Volume 14 (1), 2025

SIGNIFIKAN
Jurnal Ilmu Ekonomi

Signifikan is published by the Faculty of Economics and Business UIN Syarif Hidayatullah Jakarta. Focused on Economics studies and published twice a year. Being accredited in the second tier (Sinta-S2) by Ministry of Education, Culture, Research and Technology No. 177/E/KPT/2024 renewal of the certificate number No. 85/M/KPT/2020 (Valid from Vol. 12(2), 2023 until Vol. 17(1), 2028). Currently, this journal is indexed by Dimensions, Crossref, Google Scholar, Sinta, ISJD, LIPI, Garuda, and Moraref, etc.

Editorial Office:
Faculty Economics and Business Building 2, 3rd Floor
Universitas Islam Negeri (UIN) Syarif Hidayatullah Jakarta

Jl. Ibnu Sina IV, Ciputat, South Tangerang, Banten 15412

(021) 22744610

signifikan@uinjkt.ac.id

http://journal.uinjkt.ac.id/index.php/signifikan

Contents

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 1 - 16
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.41334

The Impact of Central Bank Policy Mix on Banking Risk Behavior

Miryam B. L. Wijaya[1], Gema Adi Wibisana[2], Chandra Utama[3*]
[1,2,3]Center for Economic Studies, Faculty of Economics, Universitas Katolik Parahyangan, Indonesia
E-mail: [1]mlwijaya@unpar.ac.id, [2]gemaadi47@gmail.com, [3]chandradst@unpar.ac.id
[*]**Corresponding author**

JEL Classification:
E52
E580
E510

Received: 16 September 2024

Revised: 10 February 2025

Accepted: 15 February 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: The study investigates the impact of a coordinated policy mix on Banking Risk Behavior in creating credit.

Research Objectives: This research aims to determine the effect of the policy mix on lending and the role of risk behavior in Indonesia.

Research Methods: We use the Structural Vector Autoregression (SVAR) estimation technique for data 2012Q1-2021Q3.

Empirical Results: The study found that monetary policy does not affect credit directly through credit interest rates. Monetary policy affects credit indirectly through its ability to influence an internal variable of banks and strengthen it through interaction with macroprudential policies. The study found that deposit and capital determine the amount of credit disbursed. The study results found that the policy mix of monetary and macroprudential policies effectively influenced recognition in Indonesia. Mixed policies reinforce one another.

Implications: To manage bank risk behavior in distributing credit, a mix of monetary and macroprudential policies is needed. When coordinated, both policies reinforce each other and are more effective than when done separately.

Keywords:
monetary policy; macroprudential policy; credit; risk

How to Cite:
Wijaya, M. B. L., Wibisana, G. A. & Utama, C. (2025). The Impact of Central Bank Policy Mix on Banking Risk Behavior. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 1-16. https://doi.org/10.15408/sjie.v14i1.41334

INTRODUCTION

Economic development cannot be separated from the existence of lending activities by banks, both credit for individuals and companies (Freixas & Rochet, 2008). Credit has a pro-cyclic nature. When the economy is experiencing expansion, the behavior of investors and banks tends to be optimistic and willing to take more significant risks. Increased credit and asset prices will accompany the courage to take more significant risks. On the other hand, when the economy experiences contraction, the behavior of investors and banks tends to be less optimistic. It tends to avoid risks that result in a reduction in credit. The pro-cyclical nature of credit provides reasons why credit distribution must be managed to deepen the economic cycle.

Previous studies found a relationship between credit and business cycles (Jeong & Jung, 2013; Saini et al., 2021; Yi et al., 2022), and it has become a central bank concern. Central Bank uses interest rates to influence the cycle and financial markets (Taylor, 2009; Mishkin, 2009; Jung, 2015). However, monetary policy with interest rate instruments can only be directed at "leaning" against accumulated risks from financial procyclicality, especially credit expansion. Consequently, even though interest rates can control credit growth, a single monetary policy still cannot overcome the possibility of systemic risks arising from procyclicality. The 2008 Global Financial Crisis, the biggest global crisis after the great depression in 1929-1930 (Shala et al., 2013), provided valuable lessons and made the world agree that using monetary policy alone to maintain economic stability is insufficient. This situation has caused the Central Bank to carry out a policy mix of monetary and macroprudential policies. The policy set influences risk-taking behavior by banks in offering credit that is influenced by internal or external factors. Aiyar et al. (2016) and Robstad (2020) show that internal factors can be in the form of savings and capital, and external factors can be in the form of implemented policies and macro factors such as output gaps, inflation, and exchange rates.

Banks maximize profits by setting higher lending rates than deposit rates. Over a long period, low interest rates increase bank credit and profits but increase bank risk (Rajan, 2005; Paligorova & Jimenez, 2012; Hussain et al., 2021). Furthermore, banks also face risks as financial intermediaries since they collect funds for individuals with excess funds and distribute them back as credit to individuals who need funds. Matthew and Thompson (2008) state that the risks that have the most significant effect from the activities carried out by banks are credit risk and liquidity risk. Furthermore, Kasri and Azzahra (2020) find the positive influence of banking stability and credit growth. There are several ways to find out how interest rate policy affects risk-taking by banks (Bikker & Vervliet, 2018; Hussain et al., 2021; Amalia & Suriani, 2023). First, through the search for yield, where interest rates are set, they tend to be low, which can encourage banks to switch to riskier investments because investments with lower risks tend to have low returns and are not attractive (Rajan, 2005). Second, through the valuation effect, low interest rates affect the value of income, assets, cash flow, and risk measurement. A low-interest rate policy creates a gap between the required return target and the actual yield, which banks try to overcome by taking on excessive risk (Rajan, 2005).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

Banks' behavior in distributing excessive credit can cause instability in the financial system. Matysek-Jedrych (2018) and Sui et al. (2022) state that macroprudential policy is recognized as an essential contributor to maintaining financial system stability. Referring to the IMF survey (2010), Hidayati and Sugiyanto (2019) state that the problems faced by macroprudential policies will be grouped based on problems that might affect financial system stability. One of these problems is credit problems. In dealing with credit problems, several instruments can be used, namely the Loan Value (LTV) Ratio, the Debt to Income (DTI) Ratio, Foreign Currency Lending, and the Ceiling on Credit Growth.

The policy mix implemented by a country's central bank is primarily needed to overcome credit procyclicality and ensure financial system stability is maintained. The policy mix implemented is interpreted as optimal integration between monetary policy and macroprudential policy implemented by the central bank to maintain price stability and Financial System Stability (FSS). In order to support the maintenance of financial system stability, apart from monetary policy, macroprudential policies are needed through the regulation and supervision of financial institutions and focusing on systemic risk mitigation.

Lim et al. (2013), with reference data from 49 countries, found that the macroprudential policies used by the Central Bank have a negative correlation related to the policy response implemented by the Central Bank. Furthermore, the studies conducted by Aiyar et al. (2016) and Chen et al. (2016) found that macroprudential policy can reduce risk behavior from an increase in demand for credit. On the other hand, research by Aiyar et al. (2016) provides an overview of monetary policy, which has a more enormous and significant influence primarily related to bank loan supply. In this case, the influence of monetary policy is found through changes in Capital Requirements that can affect bank loan supply. Research by Chen et al. (2016) using the DSGE framework, which focuses on Sweden, describes how the mix of macroprudential and monetary policies has contributed to maintaining credit distribution, risk behavior, and reducing household debt. Research by Chen et al. (2016) emphasizes that macroprudential policy is better at reducing risk behavior by banks than monetary policy. The study results then show that household debt increases when monetary policy experiences shocks. However, a mix of monetary and macroprudential policies is still needed to maintain bank lending. Several studies have stated that monetary policy is more likely to influence risk-taking decisions by banks (Dajcman, 2016; Hussain et al., 2021).

Subsequent research was put forward by Robstad (2018), who looked for the effect of monetary policy shocks on credit in Norway with reference variables in research using interest rates, inflation, GDP, credit, house prices, and exchange rates. Robstad (2018) found that when there is a shock to monetary policy, banks respond by first increasing lending to individuals or companies, increasing the risks that banks take. Shocks, in this case, will then affect monetary policy easing by the Central Bank as the policy maker. The result aligns with research by Aydinbas et al. (2015) found that when monetary policy experiences shocks, other policies are needed, including macroprudential policy, since macroprudential policy aims to maintain credit distribution and banking risk-taking (Chen & Columba, 2016; De Schryder & Opitz, 2021).

Bank risk-taking can increase in line with customers' increased demand for credit (debtors). The behavior mainly applies to banks that emphasize forward-looking, which tends to increase risk-taking. In addition, a mix of monetary and macroprudential policies has proven to help reduce the possibility of losses due to excessive banking risks (Triandhari et al., 2017). The effectiveness of the policy mix between monetary and macroprudential in reducing the possibility of taking credit risk is reflected when there is the use of LTV or CRR and not only focusing or fixating on interest rates alone (Pan & Zhang, 2020). Pan and Zhang (2020) found effectiveness in reducing risk-taking and lending, assuming a policy mix was needed and not just focusing on a single policy. The policy intended in this research is not to focus on a single monetary policy but to use macroprudential policy to help reduce this risk-taking.

This research has similarities with previous studies because the variables and policy instruments used are the same. Like previous studies, this research uses interest rates as a monetary policy instrument and Loan Value Ratio (LTV) as a macroprudential policy instrument. The difference compared to previous research lies in the specific end goal of the policy on lending through the influence of the policy mix on the role of banking risk-taking behavior. Using the two instruments complements the shortcomings of previous research, which did not explicitly explain how the policy mix influences credit distribution.

Previous studies have found that the use of a mix of monetary and macroprudential policies can influence credit distribution (Lim et al., 2013; Aiyar et al., 2016; Chen et al., 2016; Triandhari et al., 2017; Robstad, 2018; Pan et al., 2020; Sui et al., 2022; Kim & Mehrotra, 2022; Malovaná et al., 2023) more effectively than monetary policy alone. In this study, the policy mix influences credit through its influence on banking risk behavior. Another novelty is that this study uses individual bank data.

This study aims to find the effect of the policy mix of monetary and macroprudential policy on credit. Monetary policy is measured using the Bank Indonesia Interest Rate, and risk-taking behavior is calculated using the Capital Adequacy Ratio (CAR); macroprudential policy is measured using loan-to-value (LTV) and bank internal instruments, including Credit Interest, Capital, Deposit Interest rates, and Savings. Furthermore, macroeconomic factors are measured by Output Gap, inflation, and Exchange Rate. Finally, credit scores are calculated using individual bank credit.

METHODS

This study will use time series data consisting of 59 conventional commercial banks, both government and national private banks in Indonesia, with the period 2012-2021 with quarterly data. The selection of 59 banks as research samples was based on the availability of financial reports. The initial period of the study was in 2012, when Indonesia began to establish macroprudential policies. The final period was completed with the latest LTV regulation with Bank Indonesia Regulation (PBI) Number 23/2/PBI/2021 concerning the Third Amendment to Bank Indonesia Regulation Number 20/8/PBI/2018 concerning

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

the Loan to Value Ratio for Property Credit, Financing to Value Ratio for Property Financing, and Down Payment for Motor Vehicle Credit or Financing which was valid from March to December 2021.

This study uses one dependent variable, namely changes in credit (ΔCr), and ten independent variables, which are entirely divided into; two policy instruments, namely Changes in Policy Interest Rates (Δr) and LTV; five bank internal instruments consisting of Capital Adequacy Ratio (CAR), changes in lending rates (Δrc), changes in capital (ΔK), changes in deposit rates (Δrd), changes in total deposits (ΔD), and three variables control (macroeconomic variable) namely output gap ($\hat{y}$), inflation fluctuation ($\hat{\pi}$), and Exchange Rate fluctuation ($\widehat{er}$).

Table 1. Description of Variable

Variable	Sign	Unit	Sources
Inflation fluctuation[a]	$\hat{\pi}$	Percent	BI
Exchange Rate fluctuation[a]	$\widehat{er}$	Billion Rupiah	FX Sauder
Output Gap[a]	$\hat{y}$	Billion Rupiah	Worldbank
Change of policy interest rate[b]	Δr	Percent	BI
Change of deposit interest rate[b]	Δrd	Percent	SPI OJK
Change of Credit interest rate[b]	Δrc	Percent	SPI OJK
Loan to Value	LTV	Index	BI
Capital Adequacy Ratio (CAR)	CAR	Percent	SPI OJK
Change of Capital[b]	ΔK	Billion Rupiah	SPI OJK
Change of Deposit[b]	ΔD	Billion Rupiah	SPI OJK
Change of credit[b]	ΔCr	Billion Rupiah	SPI OJK

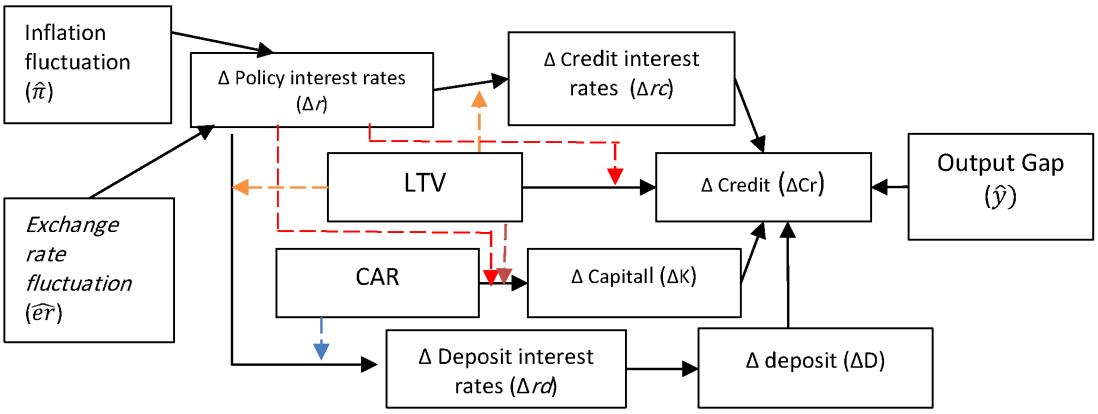
Note: [a] $\frac{x-x^*}{x^*} \times 100\%$, where x is inflation, exchange rate, or real GDP. x^* is the equilibrium value of x that is estimated using the Hodrick Prescott Filter (see Utama et al. 2022: p 100). [b] $x_t - x_{t-1}$, where x is policy interest rate, deposit interest rate, credit interest rate, capital, deposit, or credit.

This study will measure the LTV for macroprudential policy instruments using an index. This macroprudential index refers to research by Altunbas et al. (2018), who used a discrete value of -1 for policies when they were relaxed, a discrete value of 1 when they were tightened, and 0 when there was no change. The higher index indicates a tighter policy. Conversely, when the index value is lower, it suggests that the policy is being loosened. The model used in this study refers to research by Aiyar et al. (2016) and Robstar (2018), who generally examine the response of credit to easing monetary and macroprudential policies. We use the Structural Vector Autoregressive (SVAR), where the number of commercial bank loans is the dependent variable. We divide independent variables into policy, bank characteristics, and macroeconomic variables. The Loan Value Ratio (LTV) is used as a macroprudential variable, and policy interest rates as a monetary variable. We use Capital Adequacy Ratio (CAR), lending rates, bank capital, deposit rates,

and total deposits as bank characteristic variables. Finally, the output gap, inflation, and exchange rate are macroeconomic and control variables. Figure 1 shows the framework of the model.

The value of w is the lag length determined from the optimum lag test. In the conceptual framework, Δr is the change in policy interest rates, LTV is Loan to Value, CAR is the Capital Adequacy Ratio, Δrc is the change in individual bank lending rates, ΔK is the change in bank capital, Δrd is the change in interest rates individual bank deposits, ΔD is the change in individual bank deposits, $\hat{y}$ is the output gap, $\hat{\pi}$ is inflation fluctuation, $\widehat{er}$ is exchange rate fluctuation, and Cr is the change in individual bank credit.

Figure 1. The Model Framework



In the policy interest rate model, monetary instruments and LTV as macroprudential policy instruments affect bank internal factors, reflected in lending rates, capital, deposit rates, and total deposits. Other external factors besides bank policies and internal factors include the output gap, inflation fluctuations, and exchange rate fluctuations. The CAR of the bank also affects its capital. Finally, there is the influence of policy interaction on bank behavior in extending credit.

Rajan (2005) and Borio and Zhu (2008) state that using an easing monetary policy can increase interest on deposits, bank deposits, and credit interest, and then demand for credit will increase. The model also shows the effect of the interaction of monetary and macroprudential policies on bank decisions to extend credit. The monetary and macroprudential policies in this study show how the two policies' processes are simultaneously used to influence bank decisions in extending credit. In addition, there is an output gap as a macro variable that can directly influence banks' decision to extend credit. Meanwhile, inflation and the exchange rate affect the determination of the policy interest rate as stated by the Taylor Rule. However, the bank previously considered some risks when extending more or less credit. The use of this variable is in line with research by Aiyar et al. (2016) and Robstad (2018), which show that monetary, macroprudential policies and bank characteristics influence bank lending decisions.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

SVAR imposes restrictions indicating how certain variables will behave. This restriction in the SVAR model is then developed using an economic theoretical framework and empirical assumptions and can be tested using the Granger Causality Test (Insukindro & Pritadrajati, 2019). Lütkepohl & Krätzig (2004) stated that VAR innovation is orthogonalized using the Cholesky decomposition of the covariance matrix, a recursive structure that can be imposed on the relationship between variables. The order in which the variables in the model are arranged can be seen in how the variables are placed in the time series vector Y_t.

We need to carry out several steps to find effective SVAR. The steps start with the stationarity test, determining the lag length, establishing the SVAR model, model stability testing, innovation accounting (Impulse Response Function), and Forecast Error Variance Decomposition. (FEVD). In addition, determining the optimal lag is also one of the essential procedures that must be carried out in model building (Lütkepohl & Krätzig, 2004). After carrying out the lag test, the White Noise Residual test was carried out as a suitability test of the estimated VAR model. The next step is to conduct a VAR stability test. The model is stable if all roots are in the unit circle or can be interpreted as an absolute unit root value of less than 1.

RESULTS AND DISCUSSION

The first step before processing is to test the stationarity of the data using the Levin, Lin & Chu (LLC), Breitung (B), Im, Pesaran and Shin (IPS), Augmented Dickey Fuller-Fisher (ADFF) and Phillips Perron- Fisher (PPF) tests. The stationarity test results are shown in Table 2. Table 2 shows that all variables are stationary. The test statistical value is greater than the critical value and the P-Value is smaller than alpha (α) 5 percent.

Furthermore, the optimum lag length was determined before the researchers estimated the SVAR model. If the optimum lag length is too short, the model can only partially explain the model's dynamics. However, if the lag is too long, it will prevent efficient estimation due to reduced degrees of freedom. Table 5 shows that the optimum lag is at lag 3, indicated by the values on the Likelihood Ratio (LR), Final Predictor Error (FPE), Akaike Information Criterion (AIC), Schwartz Criterion (SC), and Hannan-Quinn Information Criterion (HQ)) so that in the estimation step the next stage uses lag three as the optimum lag.

The next test is the stability test of the VAR system, which is needed to ensure that the estimation results have high validity. This stability test uses a stability condition check known as the inverse roots of AR polynomial characteristic. This condition shows when each variable is multiplied by the number of lags of each variable. The VAR system is said to have high stability if the roots of characteristic polynomials have a modulus of not more than one and all are inside the unit circle. In this case, if most of the modulus is inside the circle, then the model is stable. Figure 2. shows that all inverse roots are inside the unit circle, so it can be concluded that the SVAR model is stable. All values below one.

Table 2. Stationarity Test

		LLC t*.	Breitung t-stat	IPS W-stat	ADF -Fisher Chi-square	PP - Fisher Chi-square
$\hat{\pi}$	Stat.	5.757	-6.430***	-5.586***	183.292***	395.436***
	(P-Value)	(1.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\widehat{er}$		-11.084***	-13.697***	-5.361***	178.562***	284.216***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\hat{y}$		-30.268***	-31.056***	-22.115***	651.457***	1302.450***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δr		-13.545***	-18.156***	-6.208***	196.872***	558.516***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δrd		-11.963***	-20.832***	-13.523***	382.852***	472.249***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δrc		-9.388***	-9.175***	-0.545***	92.436***	466.562***
		(0.000)	(0.000)	(0.293)	(0.961)	(0.000)
LTV		-24.916***	-16.087***	-23.470***	697.213***	1508.630***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CAR		-27.897***	-30.384***	-19.076***	551.776***	1146.120***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔK		-20.996***	-20.688***	-14.918***	363.608***	769.005***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔD		-13.471***	-7.095***	-19.405***	586.759***	3505.690***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔCr		-6.877***	-3.598***	-12.635***	408.275***	2209.410***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: ***stationer at α=0.01; Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Table 2. Lag optimum test

Lag	Log	LR	FPE	AIC	SC	HQ
0	-82938,14	NA	1,07e+34	95,3798	95,6621	95,4842
1	-81951,62	1949,241	3,58e+33	94,2879	94,6832	94,4340
2	-81267,58	1346,866	1,70e+33	93,5434	94,0517	94,7313
3	-80723,87	1066,806*	9,49e+32*	92,9602*	94,5814*	93,1899*

Note: *lag optimum

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

Figure 2. Stability Test of Vector Autoregression (VAR) System

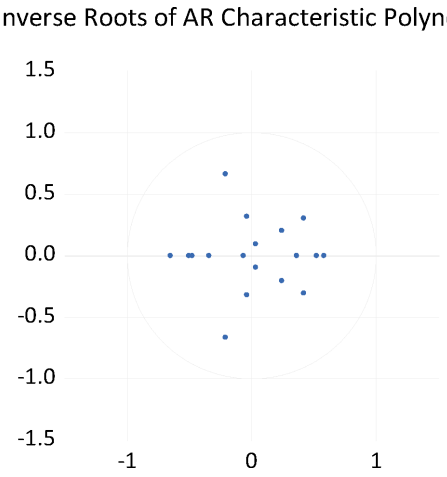


Table 6. shows the results of the SVAR estimation of the equations used in this study. The SVAR estimation results summarized in Figure 3 show that the monetary authority reacts to inflation and the exchange rate. If inflation is higher than expectations (inflation trend or inflation expectations), then interest rates are raised. Likewise, if the exchange rate, Rp/USD, is higher than expected or the Rupiah depreciates, the monetary authority will raise the policy interest rate. These estimated results confirm the central bank's objective of maintaining the currency's value internally and externally, its value against goods and services, and its value against foreign currencies.

Table 3. Estimation Result of SVAR

	Dependent Variable					
Independent variable	Δr_{it}	Δrc_{it}	Δrd_{it}	$\Delta \mathrm{K}_{it}$	$\Delta \mathrm{D}_{it}$	$\Delta \mathrm{Cr}_{it}$
Δr_{it-1}	0.3312***	0.6139***	6.9273***			
	[13.2375]	[4.8986]	[13.5382]			
Δr_{it-2}	.154678***	-1.1952***	0.3733			
	[5.9691]	[-7.2932]	[0.6214]			
Δr_{it-3}	-0.1347***	-1.6498***	-1.5809***			
	[-6.7517]	[-12.4878]	[-3.1695]			
Δrc_{it-1}		0.2888***				-1116197
		[13.2537]				[-0.3283]
Δrc_{it-2}		0.4052***				23480.85
		[24.3354]				[0.0099]
Δrc_{it-3}		-0.1370***				411261.1
		[-8.7671]				[0.1472]
Δrd_{it-1}			0.0988***		684138***	
			[3.8592]		[3.0119]	

	Dependent Variable					
Independent variable	Δr_{it}	Δrc_{it}	Δrd_{it}	$\Delta \mathrm{K}_{it}$	$\Delta \mathrm{D}_{it}$	$\Delta \mathrm{Cr}_{it}$
Δrd_{it-2}			-0.2659***		-402957	
			[-9.5812]		[-1.5815]	
Δrd_{it-3}			0.2525***		411074.4	
			[8.4934]		[1.6688]	
$\Delta \mathrm{K}_{it-1}$				-0.0048		0.8697*
				[-0.2718]		[1.6827]
$\Delta \mathrm{K}_{it-2}$				-0.0055		0.4114
				[-0.3088]		[0.7820]
$\Delta \mathrm{K}_{it-3}$				-0.0006		-0.1236
				[-0.0363]		[-0.2316]
$\Delta \mathrm{D}_{it-1}$					0.0033	0.2972***
					[0.1427]	[3.8724]
$\Delta \mathrm{D}_{it-2}$					0.1313***	0.3721***
					[5.4865]	[4.7403]
$\Delta \mathrm{D}_{it-3}$					-0.0478*	0.2970***
					[-1.9405]	[3.6775]
LTV_{it}						-1743313.
						[-1,5561]
CAR_{it}				1721,6***		
				[3,0393]		
$\hat{\pi}_{it}$	0,0025***					
	[8,5798]					
$\widehat{er}_{it}$	0,006***					
	[4,1752]					
$\hat{y}_{it}$						-136,87***
						[-2,1384]
$\Delta r_{it-1} LTV_{it-1}$		-0,7264***	-5,0845***			27813688
		[-3,734]	[-6,5977]			[1,5707]
$\Delta r_{it-2} LTV_{it-2}$		2,8434***	-4,7385***			46585495***
		[11,2433]	[-5,2227]			[2,9169]
$\Delta r_{it-3} LTV_{it-3}$		0,9532***	-2,2444***			-1489648.
		[5,2501]	[-3,6989]			[-0,14612]

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

Independent variable	Dependent Variable					
	Δr_{it}	Δrc_{it}	Δrd_{it}	$\Delta \mathrm{K}_{it}$	$\Delta \mathrm{D}_{it}$	$\Delta \mathrm{Cr}_{it}$
$\Delta r_{it-1} CAR_{it-1}$		-0,0204***	-0,2831***	3308,813*		
		[-3,6788]	[-12,3951]	[1,8490]		
$\Delta r_{it-2} CAR_{it-2}$		0,0475***	-0,0005	-4834,1***		
		[6,5927]	[-0,0205]	[-2,3424]		
$\Delta r_{it-3} CAR_{it-3}$		0,0791***	0,0879***	1203,830		
		[13,3894]	[3,9351]	[0,8273]		
$\Delta r_{it-1} LTV_{it-1}$		0,0436***	0,2243***	-4907,9		-1400798.
CAR_{it-1}		[4,5531]	[6,0644]	[-1,6699]		[-1,5415]
$\Delta r_{it-2} LTV_{it-2}$		-0,1363***	0,2809***	4572,612		-2645152***
CAR_{it-3}		[-11,1626]	[6,5109]	[1,5779]		[-3,1920]
$\Delta r_{it-3} LTV_{it-3}$		-0,0336***	0,1189***	-1041,82		93713,64
CAR_{it-3}		[-3,9760]	[4,2619]	[-0,6259]		[0,1935]

Note: *** significant at α = 1%; ** significant at α = 5%; * significant at α = 10%

Banks responded to the increase in policy interest rates by raising deposit and credit rates in the first quarter. However, the bank will adjust in the second and third quarters by lowering lending and deposit rates. The interaction between monetary policy and LTV produces interesting results; in the first quarter, the interaction has a negative effect, and the next is positive. The estimation results show that LTV is beneficial in extending the impact of monetary policy on lending rates. In contrast, the interaction policy of monetary policy and LTV has a negative sign. These results weaken the effect of monetary policy on deposit rates. The result confirm that LTV can be used to control credit.

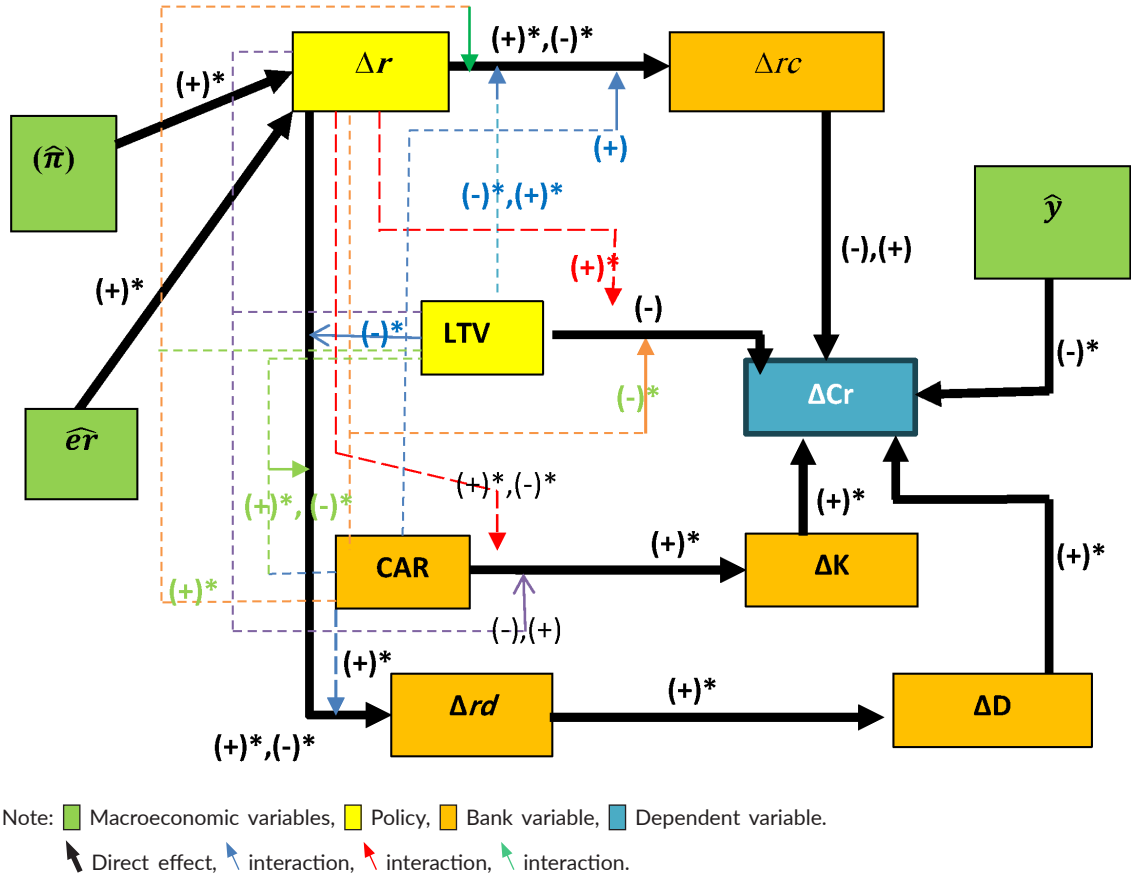
Furthermore, the policy interest rate and CAR interaction show a significant positive direction. These results indicate that the interaction of monetary policy and CAR strengthens the policy interest rate's influence on banks' determination of deposit and lending rates. Furthermore, exchanging the three policy variables strengthens monetary policy's influence on deposit and lending rates. This finding is in line with Robstad (2018), who found that changes in policy interest rates affect changes in lending and deposit rates.

The estimation results show that LTV directly affects changes in credit negatively, although not significant. However, the interaction of LTV and monetary policy reduces the effect of LTV on credit. Meanwhile, the interaction between monetary policy and CAR increases the effectiveness of LTV in influencing recognition. The results show that tightening macroprudential policy instruments reduces credit growth after interacting with monetary policy and CAR. The results align with the research of Zhang and

Tressel (2017), who found that tightening macroprudential policies will reduce credit growth.

The results showed that CAR has a positive effect on capital. When there is a movement in the CAR value, it can affect movements in the capital value. The result aligns with the theory whereby the capital adequacy ratio can indicate the extent of a bank's readiness to take risks. When the CAR value is higher (reference > 8%), the bank can face the risks arising from the loans distributed. In addition, capital is one of the investments provided by bank owners as operational costs; when there is a change in the value of the capital adequacy ratio, it is difficult for the bank to finance operational activities and contribute to profit through credit. Therefore, when the value of the capital adequacy ratio is higher, it is more likely that the bank is ready to face risks, allowing it to finance operations and contribute to providing a profit. The estimation results also show that monetary policy strengthens the effect of CAR on bank capital in the short term (one quarter) but not in the longer term.

Figure 3. Estimation Result



Note: Macroeconomic variables, Policy, Bank variable, Dependent variable.
Direct effect, interaction, interaction, interaction.

Furthermore, the estimation results show that an increase in interest rates on savings causes an increase in savings. The estimation results show that the amount

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

of savings and bank capital significantly influences the amount of credit. Meanwhile, credit interest rates do not significantly affect the amount of credit. The results of this study show that it is difficult for monetary policy to influence credit through the credit interest rate channel directly but must interact with other policies, especially macroprudential policies. The results confirm the findings of previous studies (Lim et al., 2013; Aiyar et al., 2016; Chen et al., 2016; Triandhari et al., 2017; Robstad, 2018; Pan et al., 2020; Sui et al., 2022; Kim & Mehrotra, 2022; Malovaná et al., 2023) which state that a mix of macroprudential and monetary policies is needed in controlling credit.

CONCLUSION

The results of this study indicate the importance of a policy mix and monetary and macroprudential policies in influencing banking behavior in distributing credit. Monetary and macroprudential policies have been shown to reinforce each other in controlling credit. Monetary policy has been shown to indirectly influence credit through efforts to influence credit interest rates. However, monetary policy plays a significant role in influencing credit through its influence on capital and savings and its interaction with macroprudential policies. This study also found that monetary and macroprudential policies can influence banking risk behavior. With the influence of the policy mix on banking risk behavior, credit can be controlled.

This study provides additional contributions by finding that monetary and macroprudential policies can reinforce each other. Policies' impact on bank behavior also determines the amount of credit disbursed. Furthermore, this study recommends that Bank Indonesia use both policies to strengthen its ability to control credit. In addition, macroprudential policies have more instruments, other than LTV, that can be used so that the mix of monetary and macroprudential policies can be more diverse and applied as needed.

REFERENCES

Aiyar, S., Calomiris, C. W., & Wieladek, T. (2016). How Does Credit Supply Respond to Monetary Policy and Bank. *Bank for International Settlement (BIS)*, 1-51. https://doi.org/10.1016/j.euroecorev.2015.07.021.

Amalia, S. Q., & Suriani, S. (2023). Do Interest Rate Policy and Liquidity Affect Banking Credit Risk in Indonesia?. *Signifikan: Jurnal Ilmu Ekonomi, 12*(1), 145-160. https://doi.org/10.15408/sjie.v12i1.27119.

Aydinbas, Y., Hardt, C., Rzayev, J., Soker, M., Taylor, T., Walker, D., & Zhao, P. (2015). *Conceptual Foundations of Macroprudential Policy.* New York: The Federal Reserve Bank.

Bikker, J. A., & Vervliet, T. M. (2018). Bank Profitability and Risk-Taking under Low Interest Rates. *International Journal of Finance & Economics*, *23*(1), 3-18.

Borio, C., & Zhu, H. (2008). Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism? *Bank for International Settlement*, 1-39. https://doi.org/10.1016/j.jfs.2011.12.003.

Chen, J., & Columba, F. (2016). Macroprudential and Monetary Policy Interactions in a DSGE Model for Sweden. *IMF Working Paper 16/74*, 5-58.

Dajcman, S. (2017). Bank Risk Aversion and The Risk-Taking Channel of Monetary Policy in the Euro Area. *Panoeconomicus, 64*(5), 607-621. https://doi.org/10.2298/PAN150601016D.

De Schryder, S., & Opitz, F. (2021). Macroprudential Policy and Its Impact on the Credit Cycle. *Journal of Financial Stability*, *53*, 100818. https://doi.org/10.1016/j.jfs.2020.100818.

Freixas, X., & Rochet, J.-C. (2008). *Microeconomics of Banking* (2nd ed.). London: MIT Press.

Hidayati, N., & Sugiyanto, F. (2019). Analisis Dampak Bauran Kebijakan Moneter dan Makroprudensial Terhadap Stabilitas Harga dan Stabilitas Sistem Keuangan di Indonesia. *Jurnal Dinamika Ekonomi Pembangunan, 2*(3), 31-52.

Hussain, M., Bashir, U., & Bilal, A. R. (2021). Effect of Monetary Policy on Bank Risk: Does Market Structure Matter? *International Journal of Emerging Market*, *16*(4), 696-725. https://doi.org/10.1108/IJOEM-09-2019-0674.

Insukindro, & Pritadrajati, D. S. (2019). The Effects of the United States Monetary Stimulus (Quantitative Easing) Towards the Indonesian Economic Fluctuations. *Journal of Applied Economics Sciences*, *14*(2), 440-453. https://doi.org/10.14505/jaes.v14.2(64).14.

Jeong, S., & Jung, H. (2013). Bank Wholesale Funding and Credit Procyclicality: Evidence from Korea. *Panoeconomicus, 60(5)*, 615-631. https://doi.org/10.2298/PAN1305615J.

Jimenez, G., & Saurina, J. (2006). Credit Cycles, Credit Risk, and Prudential Regulation. *International Journal of Central Banking, 2*(2), 65-98.

Jung, Y. (2015). Macroprudential and Monetary Policies: Implications for House Prices and Household Debt. *Seoul Journal of Economics, 28*(2), 143-169.

Kasri, R. A., & Azzahra, C. (2020). Determinants of Bank Stability in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *9*(2), 153-166. doi: http://doi.org/10.15408/sjie.v9i2.15598.

Kim, S., & Mehrotra, A. (2022). Examining Macroprudential Policy and Its Macroeconomic Effects–Some New Evidence. *Journal of International Money and Finance*, *128*, 102697. https://doi.org/10.1016/j.jimonfin.2022.102697.

Lim, C. H., Krznar, I., Lipinsky, F., Otani, A., & Wu, X. (2013). The Macroprudential Framework: Policy Responsiveness and Institutional Arrangements. *IMF Working Paper No. 2013/166*, 2-39.

Lütkepohl, H., & Krätzig, M. (2004). *Applied Time Series Econometrics.* London: Cambridge University Press.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

Malovaná, S., Hodula, M., Gric, Z., & Bajzík, J. (2023). Macroprudential Policy in Central Banks: Integrated or Separate? Survey Among Academics and Central Bankers. *Journal of Financial Stability*, *65*, 101107. https://doi.org/10.1016/j.jfs.2023.101107.

Matthew, K., & Thompson, J. (2008). *Risk Management.* Chichester: John Wiley & Son.

Matysek-Jedrych, A. (2018). Institutional Arrangement for Macroproprudential Policy - On Differences Across the EU Countries. *Comparative Economic Research, 21(2)*, 37-50.

Mishkin, F. S. (2009). Globalization, Macroeconomic Performance, and Monetary Policy. *Journal of Money, Credit and Banking, 41*(1), 187-195. https://doi.org/10.1111/j.1538-4616.2008.00204.x.

Paligorova, T., & Jimenez, J. S. (2012). Monetary Policy and The Risk-Taking Channel: Insights from The Lending Behaviour of Banks. *Bank of Canada Review*, 23-30.

Pan, H., & Zhang, D. (2020). Coordination Effects and Optimal Policy Choices of Macroprudential Policy and Monetary Policy. *Complexity*, *2020,* 9798063. doi:https://doi.org/10.1155/2020/9798063.

Rajan, R. G. (2005). Has Financial Development Made the World Riskier? *National Bureau of Economic Research No. 11728*, 1-42.

Robstad, O. (2018). House Prices, Credit and the Effect of Monetary Policy in Norway: Evidence from Structural VAR Models. *Empirical Economics, 54*, 461-483. https://doi.org/10.1007/s00181-016-1222-1.

Saini, S., Ahmad, W., & Bekiros, S. (2021). Understanding the Credit Cycle and Business Cycle Dynamics in India. *International Review of Economics & Finance*, *76*, 988-1006. https://doi.org/10.1016/j.iref.2021.08.006.

Shala, A., Livoreka, B., Berisha, V., & Merovci, S. (2013). The Current Global Financial Crisis 2008-2012. *Acta Universitatis Danubius. Œconomica*, *9*(6), 106-125.

Sui, J., Liu, B., Li, Z., & Zhang, C. (2022). Monetary and Macroprudential Policies, Output, Prices, and Financial Stability. *International Review of Economics & Finance*, *78*, 212-233. https://doi.org/10.1016/j.iref.2021.11.010.

Taylor, J. B. (2009). The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong. *National Bureau of Economic Research No. 14631*, 341-364.

Triandhari, R., Safuan, S., Syamsudin, M., & Alamsyah, H. (2017). Optimal Monetary and Macroprudential Policies Under Risk Taking Environment. *European Research Studies Journal, XX*(4B), 211-226.

Utama, C., Insukindro, I., & Fitrady, A. (2022). Fiscal and Monetary Policy Interactions in Indonesia during Periods of Economic Turmoil in the Us: 2001q1-2014q4. *Buletin Ekonomi Moneter dan Perbankan*, *25*(1), 97-126. https://doi.org/10.21098/bemp.v25i1.1619.

Yi, X., Liu, S., & Wu, Z. (2022). What Drives Credit Expansion Worldwide? An Empirical Investigation with Long-Term Cross-Country Panel Data. *International Review of Economics & Finance*, *80*, 225-242. https://doi.org/10.1016/j.iref.2022.02.066.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.41334

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 17 - 36
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.42955

Road Infrastructure and Local Economic Activity: Insight from Mobility Data

Raditya Yudhan Kustanto[1*], Benedictus Raksaka Mahi[2]
[1]Directorate General of Treasury, Ministry of Finance
[2]Faculty of Economics and Business, Universitas Indonesia
E-mail: [1]raditya.kustanto@kemenkeu.go.id, [2]benedictus.raksaka@ui.ac.id
[*]**Corresponding author**

JEL Classification:
H54
R11
R42

Received: 10 December 2024

Revised: 10 February 2025

Accepted: 18 February 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research measures local economic activity through a mobility approach, using Google Mobility Report (GMR) data across all provinces in Indonesia. Measuring economic activity using conventional macro indicators, such as GDP, has limitations due to lengthy collection processes.

Research Objectives: This study aims to determine the impact of road infrastructure on local economic activity using data from the GMR in categories such as Retail and recreation, Grocery and pharmacy, Parks, and Workplaces.

Research Methods: This study uses panel data on the GMR, Ministry of Public Works and Public Housing, Ministry of Finance, and Central Bureau of Statistics from 2019–2022, which is analyzed using fixed-effect methods.

Empirical Results: The results show a positive effect of road infrastructure on Retail and recreation and Grocery and pharmacy but a negative impact on Workplaces, likely due to the shift to remote work during COVID-19.

Implications: These findings suggest that the government should prioritize road construction in areas that enhance economic activity. However, road construction in the Workplaces area still needs to be considered in line with the recovery of activities after the pandemic ends.

Keywords:

road infrastructure; mobility; economic activity; google mobility report

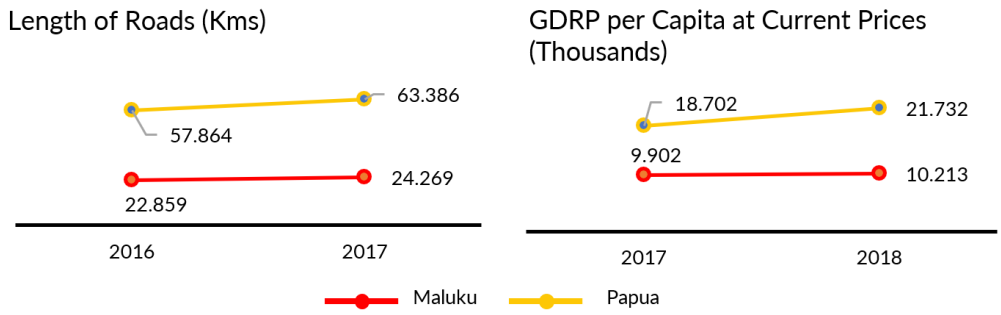
How to Cite:

Kustanto, R.Y., & Mahi, B.R. (2025). Road Infrastructure and Local Economic Activity: Insight from Mobility Data. *Signifikan: Jurnal Ilmu Ekonomi*, 14(1), 17-36. htttps://doi.org/10.15408/sjie.v14i1.42955.

INTRODUCTION

Indonesia ranked 52nd in the World Competitiveness Center's infrastructure ranking in 2022, an improvement from 57th in 2021 (Institute for Management Development [IMD], 2023). This ranking is an improvement above 2021's 57th place. Despite this progress, Indonesia continues to lag behind other Asian nations, highlighting the persistent challenge of infrastructure development. Economic performance is intricately linked to the quality of infrastructure, which has led the government to enhance its investment in this sector, amounting to Rp 213.8 trillion from 2014 to 2023. A considerable share of this funding has been directed towards the construction of non-toll roads, establishing 17,653 kilometers of new roadways from 2015 to 2022. These developments significantly enhance connectivity, facilitating the transportation of goods and services and fostering economic growth. As demonstrated in Figure 1, the relationship between the length of roads and the Gross Regional Domestic Product (GRDP) per Capita in Maluku and Papua indicates a connection between infrastructure advancement and economic activity.

Figure 1. Length of Roads and GDRP per Capita at Current Prices



Source: Ministry of PUPR (2024c, 2024a, 2024b) and BPS (2024)

Gross Domestic Product (GDP) and its regional counterpart, GRDP, serve as a metric for assessing a nation's economic performance by depicting total economic activities. However, However, economists argue that these indicators fail to capture economic variations and real-time activity (Stiglitz et al., 2018; Todaro & Smith, 2015). Furthermore, GDP and GDRP are published quarterly or annually, making them less responsive to short-term economic fluctuations. Given these limitations, alternative indicators, such as mobility data, have emerged as proxies for economic activity (Güell et al., 2018; Monika, 2021) because they reflect job mobilization (Brynjolfsson & McAfee, 2014), consumer activity (Landais et al., 2020), and the movement of goods and services (Rodrigue, 2020). Studies have shown that mobility data can effectively indicate economic dynamics, particularly during periods of economic disruption such as the COVID-19 pandemic (Khoirunurrofik et al., 2022; Spelta & Pagnottoni, 2021). Researchers have tested the use of economic activity indicators using various proxies, including Damuri et al. (2021), Gamtkitsulashvili & Plekhanov (2023), Putra & Arini (2020), and Sampi

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

Bravo & Jooste (2020). These studies examined the relationships between mobility data and GDP and other macroeconomic indicators. The results indicated a strong correlation among them.

The Google Mobility Report (GMR) provides valuable mobility data that can serve as a real-time indicator of economic activity (Caselli et al., 2020; Sampi Bravo & Jooste, 2020). In line with this statement, Campos-Vazquez and Esquivel (2021) used GMR data linked to consumption, finding that a decrease in mobility is associated with a decrease in consumption. According to Google LLC documentation, GMR data is anonymously retrieved from users' location captures shared via smartphones. The aggregated location captures data, which can be either the number of visitors or the duration of a visit, and then compares it to a baseline number at that location. The baseline is the median value of a location's activity level from corresponding days between January 3 and February 6, 2020. The activity levels of the locations were divided into several groups, namely: (a) Retail and Recreation, describing activity levels at museums, libraries, cafes, shopping malls, playgrounds, movie theaters, and other indoor recreation; (b) Grocery and Pharmacy, describing activity levels at markets, food stalls, food warehouses, and pharmacies; (c) Parks, describing activity levels at public parks, national parks, beaches, and outdoor recreation areas; (d) Workplaces, describing the level of activity in offices; (e) Residential, describing the level of activity in residential areas or villages; and (f) Transit Stations, describing the level of activity in public transportation centers, such as terminals, stations, and bus stops. With the availability of GMR data, it is possible to see the level of activity based on these locations.

The GMR indexes used in this study consist of Retail and Recreation, Grocery and Pharmacy, Parks, and Workplaces. We select the indexes based on the consideration that they reflect various aspects of economic activity. Cepparulo (2023) used the Retail and Recreation index to represent mobility linked to community consumption. Almgren & Holmberg (2021) excluded the Parks and Residential index when measuring GMR as economic activity. In this research, we still analyze the Parks index, considering the economic potential arising from activities conducted in these public places—such as trade and tourism—as Nagy et al. (2023) stated.

New approaches to measuring economic activity allow for a better understanding of the economic impacts of policies, such as road infrastructure development. If economic activity increases in locations where road infrastructure is constructed, it may indicate a positive impact of infrastructure development on economic activity.

The role of local governments in road management has increased due to decentralization following the issuance of Law No. 32/2004 on Regional Government. In Indonesia, based on their status and authority at various levels of government, roads are categorized as follows: (a) national roads, which connect provincial capitals, national strategic roads, and toll roads; (b) provincial roads, which connect district/city capitals to provincial capitals; and (c) district/city roads, which connect residential centers, activity centers, and public service centers within the district/city.

In multi-level government, where governments share tasks in implementing infrastructure policies, failed coordination will fail to maximize resource management (Gamper & Charbit, 2014). Marra (2014) states that decentralization will not be effective without an increase in regional government capacity. Higher-level government guidance is often needed to ensure the effectiveness of a program. Road construction in Indonesia requires government-level coordination to ensure integrated regional development. The Provincial Government, overseeing district/city authorities, coordinates local road projects. The provincial government's commitment to road development is measured by the share of Public Works Expenditure in total Provincial Government Expenditure. Previous studies, including those by Giammanco & Gitto (2019) and W. Zhao & Xu (2022), have used this kind of proxy, which clearly indicates government priorities.

Ji and Huang (2023) analyzed panel data from 800 Chinese counties between 2000-2019 to study the impact of road infrastructure on mobility, which is proxied by the non-permanent population ratio. Their findings reveal that increased road density significantly attracts residents. Economically developed areas further enhance this mobility. The study also explored how education interacts with road density, indicating that a higher average education level strengthens the influence of road infrastructure on mobility. Khoirunurrofik et al. (2022) identified education as a key socio-economic factor affecting mobility. Similarly, Yulianita et al. (2023) emphasize that for inclusive economic growth, the government should enhance human resource capacity and inclusive infrastructure.

Researchers have examined the impact of road infrastructure on economic activity in Indonesia, especially on a regional scale limited to a certain regency/municipality or province (Ambarita et al., 2024; Maqin, 2011; Runtunuwu, 2024; Suswita et al., 2020; Tarigan et al., 2021). Only a few studies have examined its impact on a national scale, including Khurriah & Istifadah (2019), Owusu-Manu et al. (2019), Nugraha et al. (2020), Khoirunurrofik et al. (2022), Gertler et al. (2022) and Timilsina et al. (2024). Despite these advancements, gaps remain in the literature. First, previous studies have not fully integrated mobility data to assess the local economic impact of road infrastructure. Traditional economic indicators such as GDP and GRDP fail to capture localized economic changes from infrastructure development. Second, earlier research on Indonesia's road infrastructure has primarily focused on national and provincial roads, neglecting district/city roads that directly impact local economies. Third, studies such as Gertler et al. (2022) were constrained by data limitations, as they lacked district/city-level road data.

This study addresses these gaps by introducing a novel perspective on road infrastructure and economic activity using mobility data as a proxy. Specifically, this research examines the correlation between district/city road infrastructure and local economic activity, as measured by GMR data. Road infrastructure is a proxy for infrastructure development because, first, highways ensure access to resources, labor, and markets (Queiroz & Gautam, 1992). Second, road data is more straightforward to measure and consistently recorded across Indonesia. Third, mobility data from GMR

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

needs physical infrastructure data to establish causality. This study focuses on district/city roads that link activity centers and local services. The construction or maintenance of these roads directly impacts the local economy. While national and provincial roads are important, their effects on local economies are less direct and more challenging to discern.

GMR data is available from February 15, 2020, to October 15, 2022, longer than Apple Mobility Trend (up to April 14, 2022) and Facebook Mobility Report (March 1, 2020, to May 22, 2022). However, GMR is limited to sub-national or provincial levels, whereas Facebook Mobility provides district/city levels. Additionally, GMR may introduce sample bias as it depends on Google service users and internet access, possibly excluding portions of the population, particularly in areas with low-tech infrastructure.

Controlling factors affecting the results is important when using the GMR index. Previous research used Base Transceiver Station data to control the mobility index (Ridhwan et al., 2025). Based on smartphone user location capture, the GMR index relies heavily on telecommunications infrastructure for internet availability. The roads and locations in the GMR index are predominantly in the tertiary sector, which is related to the services sector. Ji and Huang (2023) examine economic structure to assess road infrastructure's impact on mobility but use a different tertiary economic structure due to the difference in mobility data proxies. Attiah (2019) notes that the service sector in developed countries provides over two-thirds of GDP and fuels growth in developing countries.

The study offers three key contributions: First, it provides empirical evidence on the impact of road infrastructure on localized economic activity, and second, it utilizes real-time mobility data as an economic indicator. Third, it emphasizes district/city roads' role in fostering local economic development. This research enhances the understanding of infrastructure's role in economic growth and informs policy decisions regarding road development and urban planning in Indonesia.

METHODS

This study employs panel data from the Ministry of Public Works and Housing, the Ministry of Finance, the Ministry of Communication and Information Technology, and the Central Statistics Agency (BPS). The road data includes the length of district/city roads aggregated at the provincial level during 2019-2021. GMR data informs about daily community activity levels in specific location categories identifiable up to the provincial level. DKI Jakarta was excluded from the analysis because it does not have district/city roads. After data cleansing, 99 observations remain over three years.

In this study, a fixed-effects panel data model is used to assess the impact of road infrastructure on economic activity, with the GMR activity index as the dependent variable. This model is ideal for controlling unobserved, time-invariant factors at the provincial level (e.g., geographic and demographic characteristics) that may affect infrastructure development and economic performance. By isolating the effect of road infrastructure, it

accounts for potential confounders. The fixed-effects model is widely used in infrastructure studies for its ability to control for unobserved heterogeneity and analyze cross-sectional and time-series data efficiently. (Khoirunurrofik et al., 2022; Khurriah & Istifadah, 2019; Ng et al., 2019; Nugraha et al., 2020)

The daily GMR index is calculated as an annual average, using data from 7 February to 15 October each year to avoid bias from the holiday season. The analysis excludes the transit station index data because information on the train station index related to Gorontalo Province for 2022 is unavailable. Therefore, this analysis uses the GMR indexes: Retail & Recreation, Grocery & Pharmacy, Park, and Workplaces. The interest variables are the length of district/city roads and the interaction between the length of district/city roads and the provincial government's commitment to public works. The use of district/city road data is because public activities measured by the GMR index fall within the range of that road network. The length of district/city roads is proportioned to the area of the respective province, referred to as road density. The use of road density is also consistent with previous research conducted by Aschauer (1990) and Nugraha et al. (2020).

Additionally, the provincial government's commitment to public works is included as an interaction term to capture the role of governance in enhancing the impact of infrastructure on economic activity. The share of public works expenditure in the provincial government's total expenditure is a proxy for the government's dedication to infrastructure development (Giammanco & Gitto, 2019). This variable is crucial because coordination between different levels of government (national, provincial, and district/city) plays a significant role in the effectiveness of infrastructure policies.

To ensure the robustness of the results, the model controls for several additional variables. Domestic Investment in the Secondary and Tertiary Sectors represents economic development (Ji & Huang, 2023). The selection of Domestic Investment in the secondary and tertiary sectors is due to the industries in these sectors being directly related to the GMR economic activity index. The School Participation Rate (SPR) represents the education level variable. The Tertiary Economic Structure is measured using the share of gross value added in the tertiary sector to the GDP in the respective region. The variable number of BTS represents the number of BTS in each province proportionate to the population. The COVID Year and the Recovery Year are used to control the temporal effects on the model, as it is necessary to determine whether the increase in economic activity is due to the recovery of post-pandemic activities or purely from the increase in road length. Specific control variables in the model according to the GMR index as follows: (i) Online Shopping Rates in the Retail and Recreation index and the Grocery and Pharmacy index, (ii) Number of Rainy Days in the Parks index, and (iii) Labor Force Participation Rate in the Workplaces index.

Based on the description above, we develop the following regression model to measure the impact of road infrastructure on local economic activity:

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

$$EconomicActivity_{it} = \beta_0 + \beta_1 \ln DistrictRoad_{it-1} + \beta_2\, PWCommitmentProv_{it-1} + \beta_3\, RoadInteraction_{it-1} + \beta_4 \ln DomesticInvestment_{it-1} + \beta_5 SPR_{it} + \beta_6 TertiaryEcoStructure_{it} + \beta_7 BTS_{it} + \beta_8\, SpecificVariable_{it} + \beta_9\, DCovid_{it} + \beta_{10} DRecoveryInteraction_{it} + c_i + \mu_{it}$$

RESULTS AND DISCUSSION

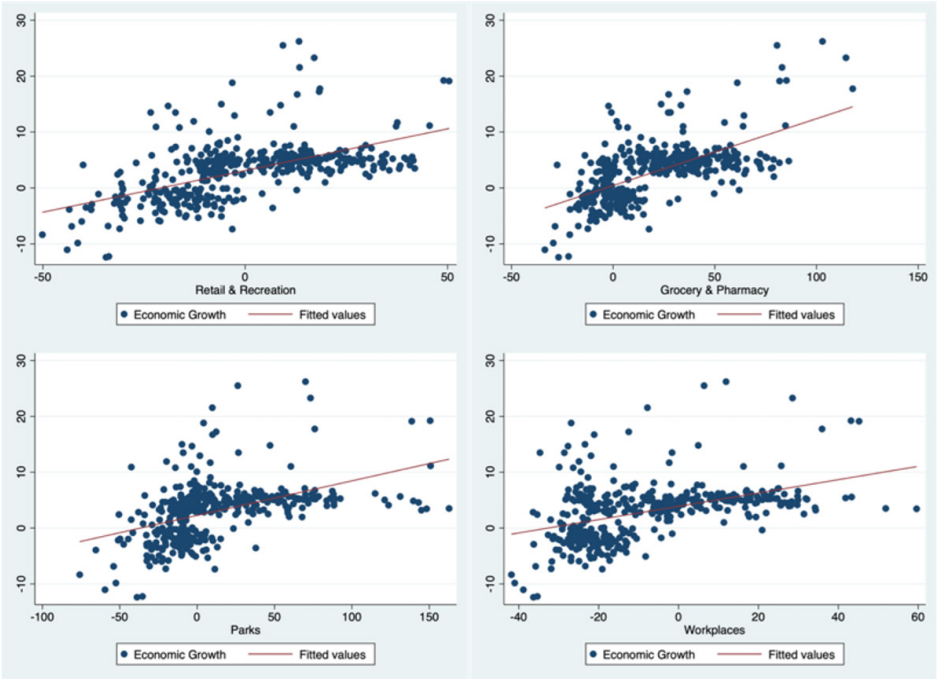
Table 1 presents the descriptive statistics of the key variables used in this study. Among the GMR Indexes, the Grocery & Pharmacy index shows the highest mean value, at 19.225%, reflecting the importance of essential services during the pandemic, when people's activities were predominantly focused on health-related locations and acquiring essential goods. Conversely, the Workplaces index has the lowest mean value at 9.42%, which can be attributed to the shift to work-from-home policies and mobility restrictions during the COVID-19 pandemic. These findings align with global mobility patterns observed during the pandemic, which saw a sharp decline in workplace-related activities compared to essential services (Caselli et al., 2020). The Parks index has the most significant standard deviation value and a wider range of values, indicating a significant variation in the various units of analysis. Meanwhile, the retail & recreation and workplace indices have lower standard deviations, indicating more consistent mobility patterns within these categories across regions.

Table 1. Descriptive Statistics

Variable	Unit	Obs	Mean	Std. Dev.	Min	Max
Retail & Recreation	%	99	-3,01	18,13	-36,16	44,35
Grocery & Pharmacy	%	99	19,22	26,03	-25,77	100,42
Parks	%	99	10,11	36,62	-45,35	126,7
Workplaces	%	99	-9,42	16,89	-37,41	36,58
DistrictRoad	km/km^2	99	0,38	0,29	0,04	1,29
PWCommitmentProv	%	99	10,535	5,19	1,94	31,87
DomesticInvestment	Billion/1.000 population	99	1183,79	1.003,14	19,84	5.514,69
School Participation Rate (SPR)	%	99	75,05	6,02	63,5	89,63
TertiaryEcoStructure	%	99	28,17	8,30	11,89	46,92
BTS	Unit/1.000 population	99	2,363	0,71	0,95	3,94
SpecificVariable–Household Online Shopping Rate	%	99	8,48	2,57	4,01	16,56
SpecificVariable–Rainy Days	Days	99	216,40	33,37	113	286
SpecificVariable–Labor Force Participation Rate	%	99	68,43	3,26	62,15	78,29

Figure 2 displays a scatter plot showing the relationship between each GMR index and provincial economic growth from 2020-2022 every quarter. Based on the scatter plot and trend line analysis, economic growth and GMR mobility data have a relatively strong positive correlation across all indices. The Grocery & Pharmacy index shows the strongest positive correlation, while the Workplaces index exhibits the weakest. These patterns can be evidence to add confidence in GMR mobility data as an indicator of local economic activity, which is also in line with previous studies (Caselli et al., 2020; Putra & Arini, 2020; Sampi Bravo & Jooste, 2020; Spelta & Pagnottoni, 2021).

Figure 2. Scatter Plot GMR index and Economic Growth 2020-2022



Source: Google LLC and BPS (2024)

Table 2 shows the estimation results for the Retail & Recreation index. The models indicate a significant positive relationship between district road infrastructure and Retail and recreation activities. Specifically, a 1% increase in district road density (measured as road length per km²) leads to a 3.60 percent increase in Retail and recreation activity in the basic model (RR-1). This effect decreases in magnitude in the controlled models (RR-2 and RR-3), which control for other variables, including the temporal effect of COVID-19. However, the reduction in effect size does not diminish the overall significance of road infrastructure in driving economic activity in Retail and recreation. This finding aligns with previous studies emphasizing the importance of transportation accessibility in promoting economic activities (Queiroz & Gautam, 1992; Rodrigue, 2016).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

Table 2. Estimation Result of the Effect of Road Infrastructure on Economic Activity in Retail & Recreation

Variables	Retail & Recreation		
	Model RR-1	Model RR-2	Model RR-3
LnDistrictRoad	360.6***	126.8**	94.52**
PWCommitmentProv	-0.520	-0.917**	-0.374**
RoadInteraction	0.280	-0.575*	0.0222
SPR		19.60***	3.186
LnDomesticInvestment		3.687	0.450
TertiaryEcoStructure		4.942**	-1.111
BTS		79.13***	35.16***
SpecificVariable–Household Online Shopping Rate		0.906	2.884***
DCovid			-30.89***
DRecoveryInteraction			4.052***
Constant	457.5***	-1,550***	-122.2
Observations	99	99	99
R-squared	0.157	0.669	0.930
Number of prov	33	33	33
Robust Standard Error	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

RoadInteraction variable—the interaction between LnDistrictRoad and PWCommitmentProv, proxy of Coordination Function—shows a significant negative relationship (10%) in the RR-2 model. In addition, the PWCommitmentProv variable also has a significant negative effect (5%). This result suggests that increased public works expenditure at the provincial level may not enhance the relationship between road infrastructure and mobility in Retail and recreation. The direction of the negative coefficient on the interaction variable means that the higher the increase in the Provincial Government's commitment to public works weakens the relationship between road infrastructure and mobility in Retail and recreation, which is consistent with findings from previous studies that suggest coordination challenges in multi-level governance systems (Gamper & Charbit, 2014).

The School Participation Rate (SPR) in the RR-2 model has a positive effect with a significance level of 1%, which means that more people accessing education services will increase economic activity in Retail and recreation. However, adding the COVID recovery temporal effect control renders the SPR variable insignificant. The TertiaryEcoStructure variable also shows similar findings. This result supports findings from Ng et al. (2019), suggesting that education levels are a key factor in driving consumption and economic activities. Areas with higher education likely benefit from better access to retail centers and increased disposable income for leisure.

The Household Online Shopping Rate variable has a positive and significant relationship of 5% in the RR-3 model with a coefficient of 2.884. This positive relationship

may result from increased delivery courier activities, such as online motorcycle taxis or package delivery services, which continue to visit Retail and recreation locations despite declining physical shopping activities. The BTS variable also supports this statement by showing a positive and significant effect. The GMR index measures activity based on the locations of smartphone users. Meanwhile, goods or food delivery services must activate the location on the cellphone, so the increase in activity also depends on the internet availability in the area. According to Mouratidis and Papagiannakis (2021), digital activities such as online shopping have increased significantly since the pandemic.

Table 3. Estimation Result of the Effect of Road Infrastructure on Economic Activity in Grocery & Pharmacy

Variables	Grocery & Pharmacy		
	Model GP-1	Model GP-2	Model GP-3
LnDistrictRoad	566.8***	290.1***	255.5***
PWCommitmentProv	-0.424	-1.149**	-0.565*
RoadInteraction	0.668	-0.595	0.0467
SPR		27.14***	9.501***
LnDomesticInvestment		6.959**	3.482
TertiaryEcoStructure		1.859	-4.646**
BTS		126.6***	79.33***
SpecificVariable–Household Online Shopping Rate		0.637	2.762*
DCovid			-33.20***
DRecoveryInteraction			4.362
Constant	742.2***	-1,859***	-324.4
Observations	99	99	99
R-squared	0.191	0.761	0.910
Number of prov	33	33	33
Robust Standard Error	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

The analysis of the Grocery & Pharmacy (Table 3) shows a positive and significant relationship at the 1% level. The interpretation of the DistrictRoad variable in the GP-3 model is that every 1% increase in district roads per km2 will increase activity in Grocery & Pharmacy by 2.55 percentage points. Although the coefficient of the DistrictRoad variable in the GP-3 model is lower than in the GP-1 and GP-2 models, the coefficient figure is still quite prominent, where the R-squared value also increases significantly. The positive relationship reinforces the idea that better access to grocery stores and pharmacies is linked to better road networks, particularly in rural and underserved areas. The coordination function represented by the RoadInteraction variable does not show a significant relationship. The analysis indicates that the coordination function does not strengthen the relationship between district roads and activities in Grocery & Pharmacy.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

The SPR variable shows a significant positive effect at the 1% level in all Grocery & Pharmacy estimation models, which indicates that more people attending school at the appropriate age will increase activity in Grocery & Pharmacy. The DomesticInvestment variable has a positive and significant effect (5%) in the GP-1 and GP-2 models. However, in the GP-3 model, the coefficient becomes insignificant. This finding suggests that the previous significant effect is more due to the variation in the temporal effect of COVID-19. The TertiaryEcoStructure has a negative relationship with activity in Grocery & Pharmacy in the GP-3 model. It means that the higher the tertiary economic structure, the lower the activity in Grocery and pharmacy. This finding is different from previous research by Attiah (2019). It is due to the shift in production factors and capital in other service sectors. The Household Online Shopping Rate shows a significant positive relationship (10%) in the GP-3 model. This result means that online shopping increases grocery and pharmacy activity. It is due to the online delivery courier activity that keeps the location enabled on the cellphone so that it is detected as a visit to the Grocery and pharmacy location.

Table 4. Estimation Result of the Effect of Road Infrastructure on Economic Activity in Parks

Variables	Parks		
	Model P-1	Model P-2	Model P-3
LnDistrictRoad	640.4***	201.0	78.83
PWCommitmentProv	-1.026	-1.905**	-0.349
RoadInteraction	-0.0256	-1.876**	-0.248
SPR		37.64***	5.191
LnDomesticInvestment		6.883	-0.123
TertiaryEcoStructure		6.065	-2.123
BTS		96.60**	19.36
SpecificVariable–Rainy Days		-0.480**	0.0918
DCovid			-57.72***
DRecoveryInteraction			-3.658
Constant	821.8***	-2,762***	-218.7
Observations	99	99	99
R-squared	0.109	0.577	0.877
Number of prov	33	33	33
Robust Standard Error	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

The results in Table 4 show that DistrictRoad variable has a significant positive relationship (1%), but only in the P-1 model. However, the model does not show a significant relationship after adding control variables and the temporal effect of COVID-19. The level of community activity in Parks is not necessarily dependent on road construction. Other factors, such as weather, have a more significant influence. The number of rainy days had a negative and significant impact of 1% in the P-2 model. This

negative relationship between weather and activity in Parks is consistent with previous studies by Hewer et al. (2016) and Paudyal et al. (2019).

The RoadInteraction variable showed no significant relationship in all the Parks estimation models. The SPR has a positive and significant effect on mobility in Parks in the P-2 model, which means that more people attending school at school age will increase visits to Parks. This finding aligns with the study of Gu et al. (2020), which states that higher education levels will increase park visits, but it contradicts the study of Gong et al. (2023). However, after adjusting for COVID-19 temporal effects, no control variables show a significant relationship with park mobility. This further supports the idea that the pandemic's disruption of normal activities outweighs the impact on road infrastructure.

Table 5. Estimation Result of the Effect of Road Infrastructure on Economic Activity in Workplaces

Variables	Workplaces		
	Model W-1	Model W-2	Model W-3
LnDistrictRoad	254.6***	43.25	-61.48**
PWCommitmentProv	-0.559	-1.039**	-0.000310
RoadInteraction	-0.240	-1.031**	-0.218
SPR		12.93***	0.257
LnDomesticInvestment		1.930	-1.767
TertiaryEcoStructure		7.516**	-0.276
BTS		67.14***	-10.44*
SpecificVariable–Labor Force Participation Rate		2.322	-0.786
DCovid			-31.65***
DRecoveryInteraction			-2.902*
Constant	311.6***	-1,367***	-6.834
Observations	99	99	99
R-squared	0.070	0.468	0.937
Number of prov	33	33	33
Robust Standard Error	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1

The results of the effect of road infrastructure in workplaces are presented in Table 5. The DistrictRoad variable in model W-1 has a positive effect with a significance level of 1% for model W-1. The interpretation is that every 1% increase in district road length per km2 will increase activity in Workplaces by 2.54 percentage points. Meanwhile, adding control variables to the W-2 model makes the DistrictRoad variable insignificant. The coordination function, proxied by the RoadInteraction variable, shows a negative and significant result in model W-2. This finding means that an increase in the coordination function of the provincial government will

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

weaken the relationship between district roads and workplace activities. The SPR, TertiaryEcoStructure, and BTS variables in model W-2 show a positive and significant relationship, indicating that these three variables increase activity in Workplaces. The DomesticInvestment and Labor Force Participation Rate variables do not show a significant effect.

When the model uses the temporal effect of COVID in Model W-3, the DistrictRoad variable shows a negative relationship. Changes in people's behavior regarding how to work affect the relationship. Many offices implemented Work From Home (WFH) and Work From Anywhere (WFA) policies during the COVID pandemic. The construction of district roads shifted activities from workplaces to other locations, such as housing, cafes, or coworking spaces, which are more easily accessible through new roads. It can also be seen that the BTS variable has a negative relationship (significant at 10%), which means that an increase in BTS will decrease workplace activity. Improved telecommunications infrastructure supports and facilitates remote working, replacing the physical functions of the office with virtual solutions, allowing workers to work without the need to be physically present in the office.

The results of this study show that road infrastructure has a significant and positive impact on activities in the Retail and recreation and Grocery and pharmacy indices, with coefficient values of 94.52 (0.94%) for Retail and recreation and 255.5 (2.55%) for Grocery & Pharmacy, respectively. The coefficient values obtained for these two indices are large compared to previous studies measuring the impact of roads on mobility, such as those reported by Yu and Zhao (2021) at 0.83% and Ji and Huang (2023) at 0.828%. When compared to studies analyzing the impact of road infrastructure on economic activities, these coefficient values are still more significant, such as by Aschauer (1990) at 0.22%–0.30%, Prasetyo and Firdaus (2009) at 0.13%, Kalan (2017) at -1.33%, and Ng et al. (2019) at 0.2%.

The more significant coefficients shown in the study above suggest that the road infrastructure in Indonesia impacts the economy of the Retail & Recreation and Grocery & Pharmacy sectors more than what has been found in previous studies in other parts of the world. The conditions may be due to several reasons specific to Indonesia, such as (1) the increased demand for basic health services that came with the COVID-19 pandemic, especially in the Grocery and pharmacy. New and better roads enabled people to procure these essential services. Such development would result in greater economic activity and mobility within these sectors. (2) the geographical constraints that Indonesia faces will, for example, benefit significantly from road improvements for rural and underdeveloped areas as they have a lack of accessibility. On the other hand, more developed countries tend to have lower coefficient values. This is because the value added from extra road construction is less in infrastructure-rich countries. (3) the active response of mobility in these sectors to new roads is significant. Mobility increases as people living in places with poor road infrastructure and are economically inactive become economically active, which causes improved road access.

If the GMR indices are compared using the district road coefficient values after controlling for the temporal effects of COVID, the lowest district road coefficient value is found in the Workplaces index at -61.48 (-0.6148 percentage points), and the highest coefficient value is found in the Grocery & Pharmacy index at 255.5 (2.55 percentage points). This finding is consistent with the descriptive analysis, in which the Workplaces index has the lowest mean, while the Grocery & Pharmacy index has the highest value. Related to the research data that uses the period of the COVID pandemic, population activities were more concentrated in areas selling food and health supplies. In addition, implementing social restrictions and new work patterns also affected the negative coefficient value of road infrastructure at Workplaces. The statement is also in line with what was conveyed by Gauvin et al. (2021), that there was a significant decrease in mobility in the industrial sector during the lockdown, as well as in the service sector during the late lockdown period and the reopening. The significant coefficient value for Grocery & Pharmacy indicates that activities at those locations are sensitive to the development of district roads. People tend to need better accessibility to reach Grocery and pharmacy areas.

When the model controls for the temporal effects of COVID, the Coordination Function—proxied by the interaction variable between the Provincial Government's Public Works Commitment variable and the district road infrastructure variable—does not have a significant relationship with all GMR indices. A significant negative relationship between the Provincial Government's Public Works Commitment variable and the Retail and Recreation and Grocery and Pharmacy indices was found, with coefficients of -0.374 and -0.565, respectively. The findings indicate that the Provincial Government is not optimally carrying out the road development coordination function. According to Freeman and Rossi (2012), the challenge of coordination is the presence of overlapping policies, where each government has different agendas, which can lead to a decrease in the effectiveness of coordination. Furthermore, Rodrigue (2016) states that developing countries often exhibit low managerial capacity and a lack of coordination in managing transportation infrastructure. Ideally, with the coordination role held by the Provincial Government, it can align and integrate various district/city road developments in its region, thereby strengthening connectivity and accessibility.

The School Participation Rate shows a positive and significant relationship in all GMR index models when the model does not control for the temporal effects of COVID-19. These findings prove that residents who receive education—regardless of a specific level of education—can enhance mobility. When the model included the temporal effects of COVID-19, a significant relationship of the SPR variable was found only in the Grocery & Pharmacy index. The results are consistent with the research by Yu and Zhao (2021) and Zhao and Yu (2021) but differ from the findings of Gauvin et al. (2021) and Khoirunurrofik et al. (2022). The difference is likely due to using different mobility data proxies and the periods used.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

CONCLUSION

The estimation results using fixed effects show that road infrastructure positively and significantly impacts mobility in Retail and recreation, Grocery and pharmacy, Parks, and Workplaces when not using temporal COVID effect controls. After applying temporal COVID effect controls, the estimation results for the road infrastructure variable vary. The road infrastructure variable consistently has a positive and significant impact for the Retail and recreation and Grocery and pharmacy models. The Parks model shows different results, which indicates insignificant results. It indicates that factors other than road infrastructure, such as weather, largely influence the increase in economic activity in Parks.

Meanwhile, in the Workplaces model, the road infrastructure variable has a significant negative impact. Due to the changing work patterns, such as the implementation of Work From Home (WFH) and Work From Anywhere (WFA) policies, employees are not required to be physically present in the office. Among all the models implemented, Grocery & Pharmacy shows the highest coefficient for the effect of road construction. During the COVID pandemic, people concentrated more on fulfilling basic needs and healthcare services, specifically in markets, supermarkets, and pharmacies. In addition, this may also indicate that the effects of road construction are more sensitive in the Grocery and pharmacy area compared to other locations, where the community tends to require better accessibility to reach these areas. The coordination function, represented by the interaction between road construction and Provincial Government Public Works Expenditure, mostly does not show significant results. These findings may indicate that the coordination carried out by the Provincial Government in road development has yet to be optimal. Coordination issues are a common occurrence in developing countries that implement multi-level governance.

Based on the analysis and findings above, the government needs to prioritize the development of better road networks, especially in areas that support local economic activities, such as Retail & Recreation and Grocery & Pharmacy. Improving accessibility will have a significantly positive impact on the local economy. Although the research results show a negative impact of road construction on mobility in workplace areas, building roads to workplace regions remains important to support long-term work mobility. Changes in work patterns during the pandemic most likely caused this negative effect. Furthermore, we need to address the suboptimal coordination function. The provincial government can enhance its coordination role by ensuring that the road development plans of the regency/municipality in the Regency/Municipality Spatial Planning and Zoning align with the Provincial Spatial Planning and Zoning. Additionally, the provincial government can initiate a joint discussion forum with the regency/municipality government to share best practices in road development.

REFERENCES

Almgren, P., & Holmberg, I. (2021). Mobility Restrictions and Macroeconomic Policymaking in the Great Covid-19 Recession A Panel Study on the Effect of Fiscal and Monetary Policy Announcements on Economic Activity in the Euro Area. *Working Paper. School of Economics and Management, Lund University.*

Ambarita, D. S., Hasyim, S., & Sari, R. L. (2024). The Influence of Infrastructure Development on the Economic Growth of North Sumatra Province. *Indonesian Interdisciplinary Journal of Sharia Economics (IIJSE)*, *7*(1), 1727–1749. https://doi.org/ 10.31538/iijse.v7i1.4763.

Aschauer, D. A. (1990). Highway Capacity and Economic Growth. *Economic Perspectives*, *14*(5), 4–24.

Attiah, E. (2019). The Role of Manufacturing and Service Sectors in Economic Growth: An Empirical Study of Developing Countries. *European Research Studies*, *22*(1), 109–124.

BPS. (2024). *Produk Domestik Regional Bruto per Kapita Atas Dasar Harga Berlaku Menurut Provinsi.* Jakarta: Badan Pusat Statistik.

Brynjolfsson, E., & McAfee, A. (2014). The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies. New Jersey: W W Norton & Co.

Campos-Vazquez, R. M., & Esquivel, G. (2021). Consumption and Geographic Mobility in Pandemic Times. Evidence from Mexico. *Review of Economics of the Household*, *19*(2), 353–371. https://doi.org/10.1007/s11150-020-09539-2.

Caselli, F., Grigoli, F., Lian, W., & Sandri, D. (2020). The Great Lockdown: Dissecting the Economic Effects. In. International Monetary Fund (Ed). *World Economic Outlook, October 2020: A Long and Difficult Ascent*. Washington DC: International Monetary Fund.

Cepparulo, B. (2023). Is Mobility a Good Proxy for Economic Activity? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4638714.

Freeman, J., & Rossi, J. (2012). Agency Coordination in Shared Regulatory Space. *Harvard Law Review*, *125*(5), 1131–1211.

Gamper, C., & Charbit, C. (2014). Coordination of Infrastructure Investment Across Levels of Coordination of Infrastructure Investment Across Levels of Government. *ICEPP Working Papers 16.*

Gauvin, L., Bajardi, P., Pepe, E., Lake, B., Privitera, F., & Tizzoni, M. (2021). Socio-Economic Determinants of Mobility Responses During the First Wave of COVID-19 in Italy: from Provinces to Neighbourhoods. *Journal of The Royal Society Interface*, *18*(181), 20210092. https://doi.org/10.1098/rsif.2021.0092.

Gertler, P., Gonzalez-Navarro, M., Gracner, T., & Rothenberg, A. D. (2022). Road Maintenance and Local Economic Development: Evidence from Indonesia's

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

Highways. *National Bureau of Economic Research Working Paper Series*, *No. 30454*. https://doi.org/10.3386/w30454.

Giammanco, M. D., & Gitto, L. (2019). Health Expenditure and FDI in Europe. *Economic Analysis and Policy*, *62*, 255–267. https://doi.org/10.1016/j.eap.2019.04.001.

Gong, Y., Mamat, Z., Shi, L., & Liu, F. (2023). Restorative Effects of Park Visiting on Physiology, Psychology, and Society and the Factors Influencing Park Visiting. *Sustainability*, *15*(1), 841. https://doi.org/10.3390/su15010841.

Gu, X., Li, Q., & Chand, S. (2020). Factors Influencing Residents' Access to and Use of Country Parks in Shanghai, China. *Cities*, *97*, 102501. https://doi.org/10.1016/j.cities.2019.102501.

Güell, M., Pellizzari, M., Pica, G., & Rodríguez Mora, J. V. (2018). Correlating Social Mobility and Economic Outcomes. *The Economic Journal*, *128*(612), F353–F403. https://doi.org/10.1111/ecoj.12599.

Hewer, M., Scott, D., & Fenech, A. (2016). Seasonal Weather Sensitivity, Temperature Thresholds, and Climate Change Impacts for Park Visitation. *Tourism Geographies*, *18*(3), 297–321. https://doi.org/10.1080/14616688.2016.1172662.

IMD. (2023). *Infrasructure Ranking - World Competitiveness Ranking*. Retrieved from: https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/

Ji, Z., & Huang, Y. (2023). The Impact of Highway Infrastructure on Population Mobility: Evidence from a Sample of 800 Counties and Districts (2000–2019) in China. *Sustainability*, *15*(20), 14834. https://doi.org/10.3390/su152014834.

Kalan, O. (2017). The Relationship Between Economix Growth and Road Infrastructure: Evidence from Turkey. *(Unpublished Dissertation).* Bogazici University.

Khoirunurrofik, K., Abdurrachman, F., & Rachmanto, U. N. (2022). Socioeconomic and Policy Determinants of Mobility During COVID-19: Evidence from Indonesian Cities. *Journal of Urban Management*, *11*(4), 424–436. https://doi.org/10.1016/j.jum.2022.07.003.

Khurriah, H., & Istifadah, N. (2019). The Role of Infrastructure in Indonesia's Economic Growth. *International Journal of Advances in Scientific Research and Engineering*, *5*(7), 215–222. https://doi.org/10.31695/IJASRE.2019.33447.

Landais, C., Bounie, D., Camara, Y., Fize, E., Galbraith, J. W., Lavest, C., Pazem, T., & Savatier, B. (2020). Consumption Dynamics in the COVID Crisis: Real Time Insights from French Transaction & Bank Data. *CEPR Discussion Paper 15474.*

Maqin, A. (2011). Pengaruh Kondisi Infrastruktur terhadap Pertumbuhan Ekonomi di Jawa Barat. *Trikonomika Journal*, *10*(1), 10–18.

Marra, M. (2014). What Coordination Mechanisms Work to Manage Regional Development Programmes? Insights from Southern Italian Regions. *European Urban and Regional Studies*, *21*(3), 254–271. https://doi.org/10.1177/0969776412442766.

Monika, A. K. (2021). The Utility of 'Covid-19 Mobility Report' and 'Google Trend' for Analysing Economic Activities. *Syntax Idea*, *3*(6), 1224. https://doi.org/10.36418/syntax-ideav3i6.1224.

Mouratidis, K., & Papagiannakis, A. (2021). COVID-19, Internet, and Mobility: The Rise of Telework, Telehealth, E-Learning, and E-Shopping. *Sustainable Cities and Society*, *74*, 103182. https://doi.org/10.1016/j.scs.2021.103182.

Nagy, B., Gabor, M. R., Bacoș, I. B., Kabil, M., Zhu, K., & Dávid, L. D. (2023). Google and Apple Mobility Data as Predictors for European Tourism During the COVID-19 Pandemic: A Neural Network Approach. *Equilibrium: Quarterly Journal of Economics and Economic Policy*, *18*(2), 419–459. https://doi.org/10.24136/eq.2023.013.

Ng, C. P., Law, T. H., Jakarni, F. M., & Kulanthayan, S. (2019). Road Infrastructure Development and Economic Growth. *IOP Conference Series: Materials Science and Engineering*, *512*, 012045. https://doi.org/10.1088/1757-899X/512/1/012045.

Nugraha, A. T., Prayitno, G., Situmorang, M. E., & Nasution, A. (2020). The Role of Infrastructure in Economic Growth and Income Inequality in Indonesia. *Economics & Sociology*, *13*(1), 102–115. https://doi.org/ 10.14254/2071-789X.2020/13-1/7.

Owusu-Manu, D. G., Jehuri, A. B., Edwards, D. J., Boateng, F., & Asumadu, G. (2019). The Impact of Infrastructure Development on Economic Growth in Sub-Saharan Africa with Special Focus on Ghana. *Journal of Financial Management of Property and Construction, 24*(3), 253-273. https://doi.org/10.1108/JFMPC-09-2018-0050.

Paudyal, R., Stein, T. V., KC, B., & Adams, D. C. (2019). Effects of Weather Factors on Recreation Participation in a Humid Subtropical Region. *International Journal of Biometeorology*, *63*(8), 1025–1038. https://doi.org/10.1007/s00484-019-01715-z.

Prasetyo, R. B., & Firdaus, D. M. (2009). Pengaruh Infrastruktur Pada Pertumbuhan Ekonomi Wilayah di Indonesia. *Jurnal Ekonomi dan Kebijakan Pembangunan, 2*(2), 222–236.

Putra, R. A. A., & Arini, S. (2020, January). Measuring the Economics of a Pandemic: How People Mobility depict Economics? An Evidence of People's Mobility Data towards Economic Activities. *8th IMF Statistical Forum: Measuring the Economics of the Pandemic*.

Queiroz, C., & Gautam, S. (1992). Road Infrastructure and Economic Development: Some Diagnostic Indicators. *Policy Research Working Paper Series 921.* Washington DC: The World Bank.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

Ridhwan, M. M., Suryahadi, A., Rezki, J. F., & Andariesta, D. T. (2025). The Impact of COVID-19 on the Labour Market and the Role of E-Commerce Development in Developing Countries: Evidence from Indonesia. *Journal of the Asia Pacific Economy*, *30*(1), 84-127. https://doi.org/10.1080/13547860.2023.2195710.

Rodrigue, J.-P. (2016). The Role of Transport and Communication Infrastructure in Realising Development Outcomes. In Grugel, J., & Hammett, D. (Eds.), *The Palgrave Handbook of International Development* (pp. 595–614). London, UK: Palgrave Macmillan UK. https://doi.org/10.1057/978-1-137-42724-3_33.

Rodrigue, J.-P. (2020). *The Geography of Transport Systems* (5th ed.). London: Routledge. https://doi.org/10.4324/9780429346323.

Runtunuwu, P. C. H. (2024). Is Economic Growth Affected by Basic Infrastructure? Study Case Ternate North Maluku. *Discourse: Journal of Social Studies and Education*, *1*, 127–141.

Sampi Bravo, J. R. E., & Jooste, C. (2020). Nowcasting Economic Activity in Times of COVID-19: An Approximation from the Google Community Mobility Report. *World Bank Policy Research Working Paper*, *9247*.

Spelta, A., & Pagnottoni, P. (2021). Mobility-Based Real-Time Economic Monitoring Amid the COVID-19 Pandemic. *Scientific Reports*, *11*(1), 13069. https://doi.org/10.1038/s41598-021-92134-x.

Stiglitz, J. E., Fitoussi, J.-P., & Durand, M. (2018). *Beyond GDP Measuring What Counts for Economic and Social Performance: Measuring What Counts for Economic and Social Performance*. Paris: OECD Publishing. https://doi.org/10.1787/9789264307292-en.

Suswita, I., Damanik, D., & Panjaitan, P. D. (2020). Pengaruh Infrastruktur Terhadap Pertumbuhan Ekonomi di Kabupaten Simalungun. *Ekuilnomi: Jurnal Ekonomi Pembangunan, 2*(1), 1-11. https://doi.org/10.36985/ekuilnomi.v12i1.346.

Tarigan, H., Matondang, A. R., Lubis, S., & Sirojuzilam, S. (2021). The Effect of Road Transportation Infrastructure on Freight Transport Mobility and Regional Economy in Indonesia. *The Journal of Asian Finance, Economics and Business*, *8*(3), 645–654. https://doi.org/ 10.13106/jafeb.2021.vol8.no3.0645.

Timilsina, G., Stern, D. I., & Das, D. K. (2024). Physical Infrastructure and Economic Growth. *Applied Economics, 56*(18), 2142-2157. https://doi.org/10.1080/00036846.2023.2184461.

Todaro, M. P., & Smith, S. C. (2015). *Economic Development* (12th ed.). New Jersey: Pearson Education.

Yu, Z., & Zhao, P. (2021). The Factors in Residents' Mobility in Rural Towns of China: Car Ownership, Road Infrastructure and Public Transport Services. *Journal of Transport Geography*, *91*, 102950. https://doi.org/10.1016/j.jtrangeo.2021.102950.

Yulianita, A., Ramadhan, D. R., & Mukhlis. (2023). Factors Affecting Economic Growth in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *12*(2), 245–262. https://doi.org/10.15408/sjie.v12i2.31186..

Zhao, P., & Yu, Z. (2021). Rural Poverty and Mobility in China: A National-Level Survey. *Journal of Transport Geography*, *93*, 103083. https://doi.org/10.1016/j.jtrangeo.2021.103083.

Zhao, W., & Xu, Y. (2022). Public Expenditure and Green Total Factor Productivity: Evidence from Chinese Prefecture-Level Cities. *International Journal of Environmental Research and Public Health*, *19*(9), 5755. https://doi.org/10.3390/ijerph19095755.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42955

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 37 - 52
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44771

GWPR Model on Indonesian Economic Growth: The Analysis of Spatially Varying Relationships

Edy Santoso[1*], Teguh Hadi Priyono[2], Nanik Istiyani[3], Aisah Jumiati[4], Duwi Yunitasari[5]
[1,2,3,4,5]Faculty of Economics and Business, University of Jember, Indonesia
E-mail: [1]edysantoso@unej.ac.id, [2]teguhhadipriyo@unej.ac.id, [3]nanik.feb@unej.ac.id,
[4]196809261994032002@mail.unej.ac.id, [5]duwiyunita@unej.ac.id
[*]**Corresponding author**

JEL Classification:
C31
O47
R11
H54

Received: 05 February 2025

Revised: 15 March 2025

Accepted: 23 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research is original in examining the spatial varying relationship on economic growth in Indonesia.

Research Objectives: This study investigates the variability of Indonesia's economic growth model determinants.

Research Methods: This study uses the Geographically Weighted Panel Regression (GWPR) approach. Panel data was analyzed with 34 provinces in Indonesia from 2016 to 2022.

Empirical Results: This study found that the Revenue Sharing Fund (DBH) variable significantly influenced economic growth in 32 provinces. Meanwhile, the influence of DBH is not significant in only two provinces, namely Papua and West Papua. The variables of Labor and Gross Fixed Capital Formation did not have a significant effect on economic growth in 34 provinces.

Implications: These results show that Indonesia's economic growth rate is still not optimal, so the government is expected to design development programs that integrate various factors, such as maximizing Revenue Sharing Fund management, improving the quality of labor, and maximizing capital efficiency, to encourage economic growth in all provinces.

Keywords:
regional economic growth; GWPR analysis; revenue sharing fund; gross fixed capital formation

How to Cite:
Santoso, E., Priyono, T. H., Istiyani, N., Jumiati, A., & Yunitasari, D. (2025). GWPR Model on Indonesian Economic Growth: The Analysis of Spatially Varying Relationships. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 37-52. https://doi.org/10.15408/sjie.v14i1.44771.

INTRODUCTION

Economic growth is an important element in a country's economic development process because it shows its success. According to Todaro (2000), economic growth is an increase in per capita production that occurs continuously in the long term. Meanwhile, according to Sukirno (2016), economic growth is a physical development related to the production of goods and services that applies to a country consisting of additional quantities of industrial goods production, increased production of the service sector, infrastructure development, increased number of schools, and increased production of capital goods (Ng et al., 2018). Some studies have found that the economic growth of one region differs from one region to another. Dellink et al. (2017), Osiobe (2019), and Yuniarti et al. (2020) said that economic growth in the long term is influenced by population, physical capital, total factor productivity, human capital, and employment. However, in some studies, it was found that different results were found that economic growth was influenced by geographical location, variation of resources, and demographic conditions in each region (Adenola & Saibu, 2017; Raharti et al., 2021; Hadju et al., 2021). The geographical location of a region contributes significantly to its development process. The diversity of resources and demographic conditions affect each region's potential and development process (Benu & Sondakh, 2018).

Empirically, a region's economic conditions differ from those of other regions. According to Robert Solow, economic growth emphasizes the importance of production factors, such as capital accumulation, the number of workers, and technological advancements. In his perspective, capital is considered one of the main factors affecting economic growth, in addition to labor growth at the economic growth rate (Sari et al., 2016; Meiriza et al., 2023). Increasing the number of workers can increase economic output, but the impact will depend on the growth of capital and the efficiency of labor use. (Yu et al., 2024). In contrast to Samuelson's perspective, which explains the law of diminishing marginal productivity (Ellerman, 2021), where if one production input (e.g., labor or capital) is added gradually while the other input remains constant, at a certain point, the additional production resulting from one additional unit of input will decrease (Huerta, 2024; Storrie, 2020). In other words, this concept states that each additional input unit's marginal (additional) productivity will decline over time.

From 2016 until 2022, Indonesia had fluctuating economic growth that reflected the challenges and dynamics of the global and domestic economy. In 2016, Indonesia's economic growth was recorded at around 5.16%, which then increased in 2017 to 5.23%. In 2018, the Indonesian economy again showed better performance, with growth of around 5.32%. However, in 2019, there began to be an economic slowdown, where economic growth was around 5.32%, in line with the uncertainty of global economic conditions of around 5.0%. In 2020, the COVID-19 pandemic hit the global economy, causing a significant contraction, and Indonesia was no exception. Economic growth that year slowed to -2.07%, reflecting the significant challenges faced. Efforts to recover and adapt economic policies in 2021 improved performance, with economic growth reaching around 3.7% is still difficult. Until 2022 at 5.31, Indonesia's economic growth continues

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

to recover, but the exact figure for that period still requires more detailed data. These fluctuations reflect the complex dynamics of the economy and the efforts required to maintain stability and sustainable economic growth.

From 2016 to 2022, Indonesia's gross fixed capital formation (PMTB) investment sector has played a central role in boosting economic growth. Gross fixed capital formation positively affects economic growth (Amri & Aimon, 2017; Nweke et al., 2017; Meyer & Sanusi, 2019). Increasing capital formation can directly increase national production, ultimately encouraging economic growth. Increased investment in infrastructure, manufacturing, and other sectors positively impacts the productivity and competitiveness of the national economy (Aulia et al., 2024). With the condition of PMTB increasing, the development of strategic projects is also visible, including the construction of roads, ports, and industrial facilities. In the global context, the growth of PMTB investment also reflects the resilience of the Indonesian economy amid global market dynamics. This increase has contributed significantly to sustainable economic growth, created jobs, and stimulated economic activity in various sectors. According to Sunny (2016), capital formation is an important determinant for increasing economic growth. However, a different study was found by Asbiantara et al. (2016) that PMTB has a negative effect on economic growth. This is because the formation of fixed capital only focuses on specific sectors, such as government expenditure, which is still more focused on direct financing transfers from the state to the community rather than on spending for economic growth (Gajurel, 2022). It was found that in OECD countries, the composition of public spending focused on public subsidies, pensions, and family benefits will have a negative impact on decreasing economic growth (Fournier & Johansson, 2016).

One of the factors that can contribute to the emergence of economic activities and the rate of economic growth is the presence of labor (Raleva, 2014). Research by Korkmaz and Korkmaz (2017), Indana and Mulyani (2021), and Supratiyoningsih and Yuliarmi (2022) show that labor has a positive effect on economic growth. In OECD countries, labor productivity is better when countries prioritize economic development. In Indonesia, the workforce is the central pillar in driving the country's economic growth. The increase in education and skills of the workforce during this period has boosted productivity and efficiency in various sectors, from the manufacturing industry to the service industry (Supratiyoningsih & Yuliarmi, 2022). Government policies that support skills training and human resource development have created an environment in which the workforce can adapt to technological changes and global market demands. In addition, sectors such as tourism, IT, and services have benefited from the growth of the workforce. However, different studies found (Nguyen, 2021; Alvaaro, 2021; LoPalo, 2023) that the workforce has a negative effect on economic growth. In Nigeria, high temperatures negatively impact labor productivity, which affects the country's economic growth. In the short term, labor productivity has a negative impact on economic growth in Vietnam. This condition happens because domestic private investment still does not fully utilize the existing workforce (Nguyen, 2021).

The driving force of the Indonesian economy is also inseparable from the decentralization of the budget from the central government to the regions. This decentralization is in the form of revenue-sharing funds (DBHs), which are an effective instrument in boosting economic growth in each province and contributing to overall national economic growth. Research by Batubara and Gunarto (2024) said that through a fair and equitable allocation of income to local governments, DBH provides the resources needed to encourage economic development at the local level. The importance of DBH is not only limited to the local level but also positively impacts overall national economic growth. DBH creates a mechanism that strengthens synergy between the central and local governments, encouraging cooperation in achieving national development goals (Muryawan, 2014). The income received by local governments through DBH can also significantly contribute to national economic growth by creating a healthy and sustainable investment ecosystem. In this way, DBH is an instrument for wealth distribution and a catalyst for inclusive and sustainable economic growth throughout Indonesia. However, the research of Arina et al. (2019) and Iskandar et al. (2023) found that Revenue Sharing Funds have a negative effect on economic growth. The allocation of revenue-sharing funds is not optimal for government spending, such as the construction of public facilities and infrastructure that can only be guaranteed by the community in the short term. Thus, realizing the Revenue Sharing Funds received as a whole does not contribute to the development and increase of regional economic growth (Kusumawati & Wiksuana, 2018).

Although previous literature has helped inform the dynamics of economic growth, some existing studies have not considered the variation in relationships between variables in different geographic locations. Therefore, this study uses the Geographically Weighted Panel Regression (GWPR) method to understand the variation of relationships between variables that change over time and spatially. This research contributes to providing literature related to economic growth dynamics by considering the temporal and spatial dynamics in Indonesia. Each region has unique characteristics, such as the level of infrastructure development, local government policies, main economic sectors, natural resource potential, and geographical conditions. When one region experiences rapid economic growth, its positive impacts cannot always be directly spread to other regions with different challenges or potentials. In a diversified region, differences in economic growth across regions can create complex dynamics. Therefore, this study aims to determine the variability of the economic growth model of each province in Indonesia.

METHODS

This research covers 34 provinces in Indonesia from Sabang to Merauke. In this study, the data used is spatial panel data. The study used 7-year time series data in the 2016-2022 range. The type of data used in this study is secondary data obtained through official publication by the Central Statistics Agency (BPS) and other institutions related to the research topic. The dependent variable in this study is economic growth. Meanwhile, the independent variables include Revenue Sharing Fund (DBH), Number of Labor (LABOR), and Investment (PMTB). The definition of variables is as follows: (1)

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

Economic growth (GROWTH) is a change in economic conditions from time to time in percent; (2)The Revenue Sharing Fund (DBH) is the decentralization of the central government's budget for regions with a unit of billions of rupiah; (3)Labor (LABOR) is an individual who has involvement in economic activities directly or indirectly in the percentage unit; (4) Gross Fixed Capital Formation (PMTB) is an expenditure used for capital goods for the use of capital in billions of rupiah.

The analysis method in this study uses a spatial panel data model. Spatial panel data models often emphasize the coordinates of each observation location (Ananda et al., 2023). One of the spatial panel data models that uses coordinates is the Geographically Weighted Panel Regression (GWPR). The Geographically Weighted Panel Regression (GWPR) model is a statistical method that combines two concepts: Geographically Weighted Regression (GWR) and Panel Regression (Rusgiyono & Prahutama, 2021). GWR is a regression method that allows the regression coefficient to depend on the geographical location of the observation. At the same time, the Regression Panel is used to analyze panel data, including temporal and spatial observations (Bruna & Yu, 2016). The GWPR model considers spatial variation (regression coefficients vary across different geographical spaces at each observation location) and temporal variation (adjustment of the regression coefficient to changes in time) in the relationship between the dependent and independent variables. Spatial variation and temporal variation are caused by Weighted Least squares (WLS), which are given a specific weighting (Wati, 2020). Weighting is needed in the GWPR model to give different emphasis to observations that refer to geographical distance and time to capture variability that can change over time and space. Consideration of the selection of weighting can be varied to handle the assumption of heteroscedasticity (non-constant variation of the regression residuals along the values of the independent variables).

The advantages of using the GWPR method are (1) being able to take into account spatial variations. GWPR considers spatial homogeneity in the relationships between the variables analyzed; (2) combining temporal and spatial aspects. This method effectively handles data involving temporal and spatial aspects simultaneously; (3) more flexible coefficients. Through GWPR, the regression coefficient is not fixed at zero but rather varies depending on the specific spatial location so that it can provide a deeper picture of the influence of variables in a region-specific context (Ananda et al., 2023).

In this study, the variables that affect economic growth (GROWTH) include Revenue Sharing Funds (DBH), number of workers (LABOR), and investment (PMTB). From the variables used above, the design model formed in this study is:

$$GROWTH = f(\text{DBH, LABOR, PMTB}) \quad (1)$$

The spatial panel data model in this study uses the Geographically Weighted Panel Regression (GWPR) approach, the equation form of GWPR is as follows:

$$GROWTHit = \beta_0(ui_t,vi_t) + \beta_1(ui_t,vi_t)DBH_{it} + \beta_2(ui_t,vi_t)LABOR_{it} + \beta_1(ui_t,vi_t)\ PMTB_i + \varepsilon_{it} \quad (2)$$

Where (ui, vi) are the geographical coordinates (longlat) in province (i) in period (t), β0 is the intercept in province (i) in period (t), βk is the parameter in province (i) in period (t), t is the time series, i is the cross section, ε is an error term.

RESULTS AND DISCUSSION

Table 1 explains the statistical analysis of the variables used in this study. These statistics include mean, minimum, maximum, and standard deviation, which provide an overview of the data distribution of each variable. The average economic growth was 4.17, with a standard deviation of 3.6, which indicates that the data is less varied. Meanwhile, the minimum value is 15.72, and the maximum value is 22.94, which indicates that the lowest economic growth is 15.72% and the highest is 22.94%. The Revenue Sharing Fund has an average value of 600.39 with a standard deviation of 1337.88, indicating that the data varies because the average value is smaller than the standard deviation value. The minimum value is 0.03, meaning that the lowest DBH is 0.03 billion rupiah, and the highest DBH is 11759.14 billion rupiah.

Table 1. Descriptive Statistics

Variables	Observation	Mean	Min	Max	Std.Dev
Growth	238	4.179	15.72	22.940	3.604
DBH	238	600.39	0.03	11759.14	1337.88
LABOR	238	67.75	6.30	79.11	6.249
PMTB	238	713671	2679	94548206	6124668

The labor variable had an average value of 67.75, with the lowest value of 6.3% and the highest of 79.11%. The standard deviation of 6,249 indicates that the data is less varied. Meanwhile, the PMTB variable has an average value of 713671 billion rupiah. The minimum value is 2679 billion rupiah; the highest is 94548206 billion rupiah, with a standard deviation of 6124668. The next step is to test the selection of the best model in global regression, where the best model is REM compared to the CEM and FEM models. Based on Table 2, it is known that this researcher's global regression model is REM.

Table 2. Global Regression Results (REM)

Variables	Coefficient	Std.Error	t-statistic	p-value
DBH	-0.00066024	0.00017814	3.7062	0.0002104
LABOR	-0.040489	0.037192	1.0887	0.2763029
PMTB	0.000000026	0.00000003609	0.7046	0.4810575
Constants	7.611166	2.838579	2.68	0.008
R^2	6.19%			

Table 2 shows that of the three independent variables that are significant to economic growth in 34 provinces in Indonesia, only the Revenue Sharing Fund (DBH) variable has a p-value of less than 0.05. From the table above, the value of R^2 or the determination coefficient is 6.19%, which can be illustrated when there is an increase in the economic growth of one unit at the ith observation, and independent variables influence the tenth time range. Meanwhile, 93.81% of economic growth was influenced by other variables

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

not included in the model. After obtaining the best global regression model, the next step is to estimate the Geographically Weighted Panel Regression (GWPR) model by selecting the optimal bandwidth. The optimum bandwidth is obtained from the weighting function's minimum cross-validation (CV) value.

Table 3. Bandwidth and CV Values

Kernel Weighting Function	*Bandwidth*	CV Value
Bisquare	0.08890673	1218.463
Gaussian	0.06987555	1220.02
Tricube	0.08700531	1218.526

Table 3 contains each weighting function's bandwidth and cross-validation (CV) values . The bisquare weighting is considered the best because it has an optimal CV value compared to the Gaussian and Tricube weighting functions. The selection of this bisquare weighting function results in variations in bandwidth values in each province. Different bandwidth values are useful for determining parameter estimates of the GWPR model at each observation location. Although bandwidth varies between locations, these values remain consistent yearly because GWPR uses panel data. From the previous explanation, the bandwidth value of each province will be different. The difference in bandwidth applied in each province shows the variation in the GWPR model in 34 provinces of Indonesia, as shown in Table 4.

Table 4. Bandwidth Value at Each Observation Location

Province	*Bandwidth*	Province	*Bandwidth*
Aceh	248.7521	West Nusa Tenggara	141.3159
North Sumatra	234.2571	East Nusa Tenggara	166.8009
West Sumatra	223.7045	West Kalimantan	162.7522
Riau	216.8910	Central Kalimantan	148.2559
Jambi	210.1667	South Kalimantan	135.7547
South Sumatra	201.2086	East Kalimantan	132.7972
Bengkulu	211.8106	North Kalimantan	138.0734
Lampung	196.0738	North Sulawesi	161.7233
Bangka Belitung Islands	187.6025	Central Sulawesi	144.7013
Riau islands	197.1275	South Sulawesi	143.1078
Jakarta	185.7339	Southeast Sulawesi	154.3850
West Java	181.5189	Gorontalo	149.7219
Central Java	166.6021	West Sulawesi	136.3191
In Yogyakarta	165.5633	Maluku	198.7125
East Java	152.2100	North Maluku	179.8943
Banten	190.0285	West Papua	213.1245
Bali	138.8844	Papua	248.7521

The following is an example of a GWPR model used for observation locations in DKI Jakarta Province:

$$GROWTH_{11} = 0.141749539 - 0.000955472DBH_{11} - 0.025222803TK_{11} + 4680000PMTB_{11} + \varepsilon_{it}$$

The model formed for each province needs to be tested partially to determine the GWPR model's goodness of fit. Table 5 shows that the P-value is less than 0.05, thus rejecting the null hypothesis (H0) at a significance level of 5%. This result shows that the GWPR model has better goodness of fit than the global regression model.

Table 5. GWPR Model Suitability Test

F	*F*table	*P-value*	Results
5.669	2.410222	9.155e-04	Reject H0

After the model Geographically Weighted Panel Regression (GWPR) is determined as the best model, a parameter significance test is conducted to determine which predictor variables affect the response variables in 34 provinces in Indonesia. Significance is determined based on the p-value at each observation location (uit, vit), which must be less than 0.05 or 5%. The last step in the analysis is to compare the global regression model with the GWPR model to determine the most effective model in analyzing the influence of predictor variables on economic growth in 34 provinces in Indonesia.

Table 6 Comparison of Global and GWPR Regression Models

Regression Model	R^2
GWPR	0.088906
Global Regression	0.061909

As shown in Table 6, the analysis results show a comparison between the two models. The table illustrates the advantages of each model, allowing the selection of the model that best suits the characteristics of the data and the objectives of the economic growth analysis in 34 provinces in Indonesia. Table 6 shows that the GWPR model is superior in analyzing the influence of independent variables on economic growth. This result is evidenced by the higher R^2 value, which is 0,088906 or 8,89%, compared to the global regression model, which only has an R^2 value of 0,061909 or 6,19%.

Based on the analysis's results, the Revenue Sharing Fund (DBH) variable shows varying levels of significance in each province. Figure 1 visualizes the distribution of the significance of the DBH variable to facilitate understanding of the differences in significance between the provinces. The green color on the map shows that the Revenue Sharing Fund (DBH) variable significantly influences economic growth, but the effect is negative. This result means that the high DBH in the provinces in Indonesia has not yet encouraged growth. This study is in line with the research of Arina et al. (2019)

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

and Iskandar et al. (2023) that DBH shows a negative influence due to the suboptimal allocation of Revenue Sharing Funds, such as the construction of public facilities and infrastructure that can only be ensured by the community in the short term. Thus, the Revenue Sharing Fund received as a whole does not contribute to the development and increase of regional economic growth (Kusumawati & Wiksuana, 2018). The significant DBH variable was spread across 32 provinces, while the yellow color represented the provinces with insignificant DBH, namely Papua and West Papua Provinces. This condition is due to the dependence on the mining and natural resources sectors (Pasaribu, 2020).

Figure 1. Map of the Significance of Revenue Sharing Fund Variables on Economic Growth in Indonesia

The DBH variable negatively and significantly influences economic growth due to several factors. First is the high dependence of DBH on oil, mining, and natural gas. Second, some provinces have DBH dependence on plantations, agriculture, and fisheries, such as the provinces of Lampung, West Nusa Tenggara, East Nusa Tenggara, Southeast Sulawesi, West Sulawesi, Maluku, and North Maluku, which rely on the agriculture and fisheries sector for their primary income (Nugroho & Setijaningrum, 2024). This condition can limit economic diversification, making the province's economy less resilient to global economic changes, as the agriculture and fisheries sectors are highly influenced by weather conditions, global market prices, and other external factors, making DBH revenues unstable and high risk. The study's results do not match Wagner's theory, which explains that fiscal policy instruments can influence the economy through budget regulation. Revenue Sharing Funds (DBH) have a negative and significant effect on economic growth in line with research from Indriyani & Wahyudi (2021), Karampuan et al. (2023), Rusyda (2024) that the increase in Revenue Sharing Funds will have a negative impact on gross domestic product which will ultimately result in a decline in economic growth. The results of this study are also supported by research from Onifade

et al. (2020) that the Revenue Sharing Fund allocated for government spending has a negative and significant effect on economic growth.

Based on the analysis results, it was found that the workforce variable did not show significance in all provinces in Indonesia. The interpretation of these results can be visualized in the form of Figure 2. The yellow color on the map above illustrates that the labor variable is insignificant to economic growth in 34 provinces. Based on reality, Indonesia has an abundant workforce, but the contribution of the workforce to economic growth is not yet significant. Although the workforce in Indonesia continues to increase, the productivity and quality of the workforce are still major challenges. Based on data from the Central Statistics Agency (BPS), the population working in the informal sector in Indonesia in 2022 reached 59.31%. Based on their last education, elementary school graduates (SD) are in first place with a percentage of 80.32. as many as 139.85 million people. In this case, informal sector workers still dominate many economic sectors. Informal workers also have lower productivity than formal jobs, so their contribution to economic growth is also lower. In addition, low worker education levels can result in a lack of skills and knowledge and hinder productivity efficiency.

Figure 2. Map of Significance of Labor Variables on Economic Growth in Indonesia

The mismatch between the workforce's skills and the industry's needs is a serious obstacle in driving economic growth (Nguyen, 2021). As a result, even though the workforce is abundant, it has not been able to contribute significantly to sustainable and quality economic growth in Indonesia. The results of this study do not match the theory put forward by Robert Lucas that human resources are one of the key factors influencing long-term economic growth. However, this study is based on the results of research from Asrinda (2022), Nugraha and Hendrati (2023), and Azzahra (2022) that labor does not have a significant effect on economic growth.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

The analysis results also determined that the variable Gross Fixed Capital Formation (PMTB) did not show significance in all provinces in Indonesia. Figure 3 interprets and visualizes these results to provide an overview of the distribution of the PMTB variable's insignificance in each province. PMTB is often considered one of the main drivers of economic growth. However, the results of the analysis show that its impact is insignificant for several reasons. First, the distribution of investment is uneven, with most investments concentrated in several large provinces such as Java and Sumatra, while other regions receive much less allocation (Haidar, 2021). This imbalance results in minimal economic spillover in provinces with low investment levels. Second, the quality of investment also plays an important role. Suppose PMTB is more directed at less productive sectors or has low added value. In that case, its contribution to economic growth will be limited (Asbiantara, 2016), such as investment in the mining sector, which has not been integrated with the processing industry. The resulting added value is low if investment only focuses on extracting raw materials without further processing. Third, caused by the high value of the Incremental Output Ratio (ICOR). A high ICOR indicates that each additional investment unit produces a relatively small additional output, indicating low investment efficiency.

Figure 3. Map of the Significance of Gross Fixed Capital Formation to Economic Growth

The Central Statistics Agency (BPS) noted that Indonesia's Incremental Output Ratio (ICOR) has only experienced a slight decline in the last five years but has increased drastically in 2021. 2016 ICOR was recorded at 6.73% and increased in 2017 to 6.95%. Then, in 2018, it fell slightly to 6.72% but increased again in 2019 to 6.88%. 2020 recorded a drastic decline of -15.09% but increased again in the range of 8% in 2021, and in 2022 it was recorded at 6.2%. The fluctuating and relatively high ICOR value

indicates that the investment made has not been able to increase efficiency and productivity consistently. As a result, despite the increase in PMTB, its contribution to economic growth remains limited because the investment is not matched by adequate increases in productivity (Asbiantara, 2016).

The results of this study do not match Harrod Domar's theory that investment affects economic growth. However, this study follows the results of research from Asbiantara et al. (2016), Dinarjito (2020), Haidar (2021), and Hutami & Riani (2022) that investment does not have a significant effect on economic growth. This is because the formation of fixed capital only focuses on specific sectors, such as government expenditure, which is still more focused on direct financing transfers from the state to the community rather than on spending for economic growth. This finding is also supported by research from (Shabbir et al., 2021) that the gross capital formation factor in foreign investment is not significant to economic growth, especially in Pakistan.

CONCLUSION

The Revenue Sharing Fund (DBH) variable significantly influences economic growth in 32 provinces. This condition is due to the high dependence of DBH on oil, mining, and natural gas. In addition, some provinces have DBH dependence on plantations, agriculture, and fisheries, such as Lampung, West Nusa Tenggara, East Nusa Tenggara, Southeast Sulawesi, West Sulawesi, Maluku, and North Maluku, which rely on the agriculture and fisheries sectors. Meanwhile, the influence of the Revenue Sharing Fund is not significant only in 2 provinces, namely Papua and West Papua Provinces. This fact is due to the dependence on the mining sector and natural resources. The labor variable did not significantly affect economic growth in 34 provinces. The contribution of the workforce has not been optimally absorbed. In addition, despite the abundant number of workers, productivity and quality of labor are still the main problems for Indonesia. The gross total capital formation variable does not significantly affect economic growth in all provinces. The distribution of investment is uneven, and investment is directed more to less productive sectors, such as the mining sector, which has not been integrated with the processing industry.

These results show that Indonesia's economic growth rate is still not optimal. Therefore, the government is expected to design development programs that integrate various factors, such as maximizing DBH management, improving the quality of labor, and maximizing the use of capital to encourage economic growth in all provinces.

REFERENCES

Adenola, F., & Saibu, O. M. (2017). Does Population Change Matter for Long Run Economic Growth In Nigeria. *International Journal of Development And Sustainability, 12*(6), 1955-1965.

Alvaro, R. (2021). Pengaruh Investasi, Tenaga Kerja, serta Ekspor terhadap Pertumbuhan Ekonomi. *Jurnal Budget: Isu dan Masalah Keuangan Negara, 6*(1), 114-131.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

Amri, K., & Aimon, H. (2017). Pengaruh Pembentukan Modal dan Ekspor terhadap Pertumbuhan Ekonomi Indonesia. *Economac, 1*(1), 1-16.

Ananda, N. M. S., Suyitno, S., & Siringoringo, M. (2023). Geographically Weight Panel Regression Modelling of Human Development Index Data in East Kalimatan Province in 2017-2020. *Jurnal Matematika, Statistika dan Komputasi, 19*(2), 323-341. https://doi.org/10.20956/j.v19i2.23775.

Arina, M. M., Koleangan, R. A., & Engka, D. S. (2019). Pengaruh Pendapatan Asli Daerah, Dana Bagi Hasil, Dana Alokasi Umum, dan Dana Alokasi Khusus Terhadap Pertumbuhan Ekonomi Kota Manado. *Jurnal Pembangunan Ekonomi dan Pembanguanan Daerah, 20*(3). 26-35. https://doi.org/10.35794/jpekd.32796.20.3.2019.

Asbiantari, D. R., Hutagaol, M. P., & Asmara, A. (2016). Pengaruh Ekspor terhadap Pertumbuhan Ekonomi Indonesia. *Jurnal Ekonomi dan Kebijakan Pembangunan, 5*(2), 10-31.

Asrinda, D., & Setiawati, R. I. S. (2022). Pengaruh Investasi Asing, Ekspor Neto dan Tenaga Kerja terhadap Pertumbuhan Ekonomi Indonesia. *Equilibrium: Jurnal Ilmiah Ekonomi, Manajemen dan Akuntansi*, *11*(2), 50-58. http:// doi.org/10.35906/equili.v11i2.1114.

Aulia, S., Anisa, S. N., Indah, A., Dipa, M. A. K., & Panorama, M. (2024). Analisis Peran Infrastruktur dalam Pertumbuhan Ekonomi Pembangunan di Kota Palembang. *Jurnal Publikasi Ekonomi dan Akuntansi (JUPEA), 4*(1), 1-10.

Azzahra, S. (2022). Analisis Pengaruh Jumlah Unit Usaha Industri Mikro Dan Kecil (Imk), Tenaga Kerja Imk dan Pendapatan Imk terhadap Pertumbuhan Ekonomi Di Indonesia Pada Tahun 2010-2020. *IRJE: Jurnal Ilmu Pendidikan*, *3*(1), 445-456. https://doi.org/10.31004/irje.v3i1.234.

Batubara, M. N. H., & Gunarto, T. (2024). The Influence of Local Own-Source Revenue, Revenue Sharing Funds And Special Allocation Funds on GDRP In Pesisir Barat Districts of Lampung Province. *Journal of Scientific Research, Education, and Technology (JSRET), 3*(2), 630-646. https://doi.org/10.58526/jsret.v3i2.392.

Benu, N. M., & Sondakh, M. F. (2018). Disparitas Pembangunan Ekonomi Antar Wilayah di Provinsi Maluku Utara. *Agri-Sosioekonomi, 14*(1), 117-124.

Bruna, F., & Yu, D. (2016, October). Geographically Weighted Panel Regression and Development Accounting for European Regions. *Proceedings of the 6th seminar Jean Paelinck in Spatial Econometrics,* 1-20.

Dellink, R., Chateau, J., Lanzi, E., & Magné, B. (2017). Long-term Economic Growth Projections in The Shared Socioeconomic Pathways. *Global Environmental Change, 42*, 200-214. https://doi.org/10.1016/j.gloenvcha.2015.06.004.

Dinarjito, A. (2020). Pengaruh Desentralisasi Fiskal, Investasi, dan Indeks Pembangunan Manusia terhadap Pertumbuhan Ekonomi Regional di Provinsi Kalimantan Timur. *Jurnal Pajak dan Keuangan Negara*, *2*(1), 57-72.

Ellerman, D. (2021). *In Putting Jurisprudence Back Into Economics: What is Really Wrong With Today's Neoclassical Theory*. Cham: Springer International Publishing.

Fournier, J. M., & Johansson, Å. (2016). The Effect of The Size And The Mix of Public Spending on Growth And Inequality. *OECD Economic Department Working Papers No. 1344*.

Gajurel, R. P. (2022). Trade Off Between Military Expenditure and Fixed Capital Formation on Economic Growth: Panel Study of Some SAARC and ASEAN Countries. *Journal of Nepalese Management and Research*, *4*(1), 23-35. https://doi.org/10.3126/jnmr.v4i1.52778.

Hadju, I. I, Masinambow, V. A., & Maramis, M. T. (2021). Analisis Ketimpangan Pembangunan Wilayah di Provinsi Sumatera Utara. *Berkala Ilmiah Efisiensi*, *21*(1), 110-120.

Haidar, M. (2021). Analisis Pertumbuhan Ekonomi Negara-Negara ASEAN. *Forum Ekonomi: Jurnal Ekonomi, Manajemen dan Akuntansi* , *23*(3), 593-605.

Huerta de Soto, J. (2024). *The Law of Diminishing Marginal Returns or Productivity. In Lectures in Austrian Economics, Volume I: Human Action, Competition Theory, Entrepreneurship, and Price Theory*, 193-198. Cham: Springer Nature.

Hutami, R. Y., & Riani, N. Z. (2022). Peran Investasi Modal Manusia dan Modal Fisik dalam Meningkatkan Pertumbuhan Produktivitas Tenaga Kerja di Indonesia. *Ecosains: Jurnal Ilmiah Ekonomi dan Pembangunan*, *11*(1), 30-40.

Indana, Z., & Mulyani, E. (2021). The Effect of Labor, Export, and Government Expenditure on Economic Growth. *Economics and Business Quarterly Reviews, 4*(3), 311-320.

Indriyani, N. D., & Wahyudi, E. (2021). Pengaruh Pendapatan Daerah Terhadap Pertumbuhan Ekonomi di Wilayah Surabaya Raya (Surabaya, Sidoarjo, Gresik). *Yos Soedarso Economic Journal (YEJ)*, *3*(2), 1-18.

Iskandar., Safarida, N., Hisan, K., & Farucha, P. S. (2023). The Influence of Genuine Revenue, General Allocation Funds, Special Allocation Funds and Oil And Gas Product Sharing Funds On The Economic Growth of Aceh Province. *International Journal of Educational Review, Law And Social Sciences (IJERLAS), 3*(2), 554–571. https://doi.org/10.54443/ijerlas.v3i2.713.

Karampuan, A., Suharto, R. B., & Lestari, D. (2023). Pengaruh Pendapatan Asli Daerah dan Dana Bagi Hasil terhadap Pertumbuhan Ekonomi dan Indeks Pembangunan Manusia di Kabupaten Kutai Timur. *Jurnal Riset Ekonomi dan Akuntansi*, *1*(3), 66-76. https://doi.org/10.54066/jrea-itb.v1i3.610.

Korkmaz, S., & Korkmaz, O. (2017). The Relationship between Labor Productivity and Economic Growth in OECD Countries. *International Journal of Economics and Finance, 9*(5), 71-76. https://doi.org/10.5539/ijef.v9n5p71.

Kusumawati, L., & Wiksuana, I. G. B. (2018). Pengaruh Pendapatan Daerah Terhadap Pertumbuhan Ekonomi di Wilayah Sarbagita Provinsi Bali. *E-Jurnal Manajemen Universitas Udayana, 7*(5), 2592.

LoPalo, M. (2023). Temperature, Worker Productivity, and Adaptation: Evidence from Survey Data Production. *American Economic Journal: Applied Economics, 15*(1), 192-229. https://doi.org/10.1257/app.20200547.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

Lucas Jr., R. E. (1988). On The Mechanic of Economy Development. *Journal of Monetary Economics*, *22*(1), 3-42. https://doi.org/10.1016/0304-3932(88)90168-7.

Meiriza, M. S., Marpaung, D. T., Limbong, N., & Tarigan, S. W. B. (2023). Analisis Ekonomi Neo Klasik Terhadap Perkembangan Ekonomi Menurut Robert Solow dan Trevor Swan. *Ekonodinamika: Jurnal Ekonomi Dinamis, 5*(4), 1-12.

Meyer, D. F., & Sanusi, K. A. (2019). A Causality Analysis of the Relationships between Gross Fixed Capital Formation, Economic Growth and Employment in South Africa. *Studia Universitatis Babes-Bolyai Oeconomica, 64*(1), 33-44.

Muryawan, S. M., & Sukarsa, M. (2014). Pengaruh Desentralisasi Fiskal, Fiscal Stress, dan Kinerja Keuangan Daerah terhadap Pertumbuhan Ekonomi di Kabupaten/Kota Provinsi Bali. *E-Jurnal Ekonomi Pembangunan Universitas Udayana*, *3*(10), 44480.

Ng, C. P., Law, T. H., Jakarni, F. M., & Kulanthayan, S. (2019). Road Infrastructure Development and Economic Growth. *IOP conference series: materials science and engineering, 512*(1*),* 012045.

Nugraha, D. M., & Hendrati, I. M. (2023). Analisis Pengaruh Tenaga Kerja UKM, Investasi UKM, dan Ekspor UKM Terhadap Pertumbuhan Ekonomi di Indonesia. *EKOMBIS Review: Jurnal Ilmiah Ekonomi dan Bisnis*, *11*(1), 777-786. https://doi.org/10.37676/ekombis.v11i1.3420.

Nugroho, R., & Setijaningrum, E. (2024). Policy Analysis of Tobacco Excise Sharing Fund (Roccipi Method). *Indonesian Treasury Review: Jurnal Perbendaharaan, Keuangan Negara dan Kebijakan Publik, 9*(3), 169-185. https://doi.org/ 10.33105/itrev.v9i3.993.

Nweke, G. O., Odo, S. I., & Anoke, C. I. (2017). Effect of Capital Formation on Economic Growth in Nigeria. *Asian Journal of Economics, Business and Accounting, 5*(1), 1-16. https://doi.org/10.9734/AJEBA/2017/36075.

Onifade, S. T., Çevik, S., Erdoğan, S., Asongu, S., & Bekun, F. V. (2020). An Empirical Retrospect of the Impacts of Government Expenditures on Economic Growth: New Evidence from the Nigerian Economy. *Journal of Economic Structures*, *9*(1), 6. https://doi.org/10.1186/s40008-020-0186-7.

Osiobe, E. U. (2019). A literature Review of Human Capital and Economic Growth. *Business and Economic Research, 9*(4), 179-196.

Pasaribu, S. H. (2020). Pengaruh Pendapatan Asli Daerah dan Dana Perimbangan Terhadap Kinerja Keuangan Pemerintah Daerah Kabupaten/Kota di Provinsi Papua Barat. *Bilancia: Jurnal Ilmiah Akuntansi, 4*(2), 191-201.

Raharti, R., Laras, T., & Oktavianti, O. (2021). Model Ketimpangan Pembangunan Ekonomi di Indonesia. *Jurnal Samudra Ekonomi dan Bisnis*, *12*(2), 257–270. https://doi.org/10.33059/jseb.v12i2.2422.

Raleva, S. (2014). Impact of Labour on Economic Growth in Bulgaria (1991-2013). *Economic Alternatives*, *3*(2), 5-14.

Rusgiyono, A., & Prahutama, A. (2021). Regresi Panel Tertimbang Secara Geografis dengan

Efek Tetap Untuk Pemodelan Jumlah Kematian Bayi di Jawa Tengah, Indonesia. *Statistik Media*, *14*(1), 10–20. https://doi.org/10.14710/medstat.14.1.10-20.

Rusyda, M. (2024). Pengaruh PAD, Dana Bagi Hasil SDA, dan Jumlah Penduduk terhadap Belanja Daerah dan Pertumbuhan Ekonomi di Kabupaten Kutai Timur. *Indonesian Journal of Humanities and Social Sciences, 5*(2), 625-642. https://doi.org/10.33367/ijhass.v5i2.5441.

Sari, M., Syechalad, M. N., & Majid, S. A. (2016). Pengaruh Investasi, Tenaga Kerja dan Pengeluaran Pemerintah terhadap Pertumbuhan Ekonomi di Indonesia. *Jurnal Ekonomi dan Kebijakan Publik Indonesia, 3*(2), 109-115.

Shabbir, M. S., Bashir, M., Abbasi, H. M., Yahya, G., & Abbasi, B. A. (2021). Effect of Domestic and Foreign Private Investment on Economic Growth of Pakistan. *Transnational Corporations Review*, *13*(4), 437-449. https://doi.org/10.1080/19186444.2020.1858676.

Storrie, C. L. (2020). The Economics of Cupcakes: A Class Activity on the Law of Diminishing Marginal Product. *Journal for Economic Educators, 20*(2), 46-51.

Sukirno. S. (2016). *Makro Ekonomi Teori Pengantar*. Jakarta: PT. Rajawali Pers

Sunny, I. O., & Osuagwo, C. N. (2016) Impact of Capital Formation on the Economic Development of Nigeria. *Proceeding of the Fifth International Conference on Global Business, Economics, Finance and Social Sciences*.

Todaro P. M. (2000). *Pembangunan Ekonomi Dunia Ketiga*. Jakarta: Penerbit: Erlangga.

Wati, D. C. (2020). Model Geographycally Weighted Panel Regression (GWPR) dengan Fungsi Kernel Fixed Gaussian Pada Indeks Pembangunan Manusia di Jawa Timur. *Jurnal Matematika Thales (TMT)*, *2*(1), 78-97. https://doi.org/10.22146/jmt.49230.

Yu, X., Dilanchiev, A., & Bibi, S. (2024). Enhancing Labor Productivity as a Key Strategy for Fostering Green Economic Growth and Resource Efficiency. *Heliyon, 10*(3), e24640. https://doi.org/10.1016/j.heliyon.2024.e24640.

Yuniarti, P., Wianti, W., & Nurgaheni, N. E. (2020). Analisis Faktor-faktor yang Mempengaruhi Tingkat Pertumbuhan Ekonomi di Indonesia. *SERAMBI: Jurnal Ekonomi Manajemen dan Bisnis Islam, 2*(3), 169-176.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44771

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 53 - 64
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44453

Impacts of Rural Development on Human Development in Indonesia

Yuniarto Hadiwibowo[1*], Tanda Setiya[2], Taufik Raharjo[3]
[1,2,3]Polytechnic of State Finance STAN, Indonesia
E-mail: [1]yhadiwibowo@pknstan.ac.id, [2]tanda.setiya@pknstan.ac.id, [3]taufik.raharjo@pknstan.ac.id
[*]**Corresponding author**

JEL Classification:
E62
H75
I38
O15

Received: 18 Januari 2025

Revised: 02 March 2025

Accepted: 10 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study presents a new analysis of the determinants of human development to implement the government's vision of building Indonesia from the village and grassroots.

Research Objectives: This study aims to determine the effects of rural development and fiscal policy on human development in Indonesia.

Research Methods: This study uses data from 434 municipalities for the 2017-2023 period. The study employs panel data analysis with the Common Effect Model, Fixed Effect Model, Random Effect Model, and Generalized Estimating Equation.

Empirical Results: The findings suggest that rural development, economic development, and expenditures on goods and services contribute to human development. In contrast, the COVID-19 pandemic and capital expenditures negatively affect human development. The negative effects of capital expenditures become positive after they become assets.

Implications: The finding implies the important role of rural development in fostering human development. Goods and services expenditures might achieve short-run objectives, while capital expenditures should be directed toward long-run objectives. The central government may accelerate human development by transferring assets to the local government.

Keywords:
human development; panel data; rural development; sustainable development goals; fiscal policy

How to Cite:
Hadiwibowo, Y., Setiya, T., & Raharjo, T. (2025). Impacts of Rural Development on Human Development in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 53-64. https://doi.org/10.15408/sjie.v14i1.44453.

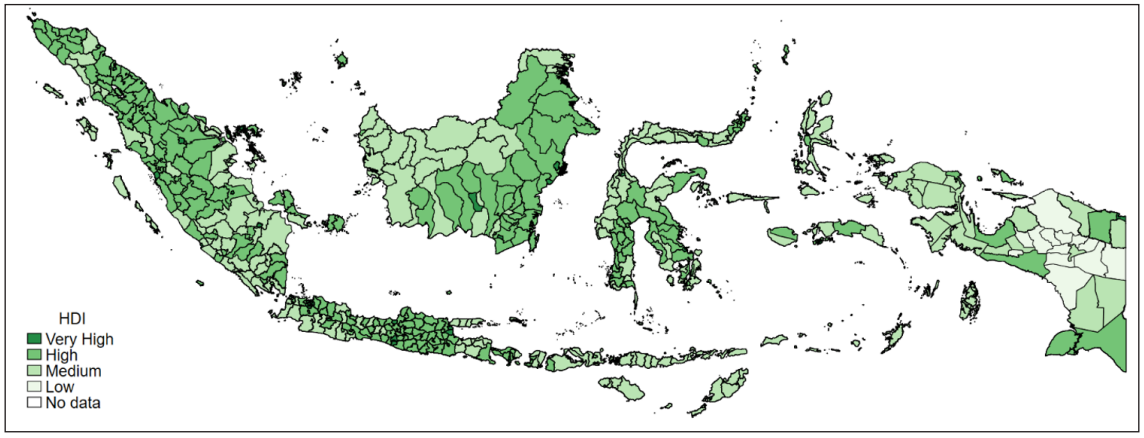
INTRODUCTION

Development is a multidimensional concept (Artelaris, 2022). The United Nations introduced a more sustainable concept of development. The 17 Sustainable Development Goals aim to tackle economic, social, and environmental issues (Halkos & Gkampoura, 2021; Biermann, 2022). Economic growth measured by per capita income as an indicator of development might not be sufficient (Panth, 2021). Development should improve not only the material status of the population as measured by per capita income but also the human status of the population.

It is important to analyze human development in all dimensions as measured by the Human Development Index (HDI). HDI provides information on development, especially the well-being of the people. It includes three dimensions: health, education access, and living standards. HDI is a good indicator of social welfare because it emphasizes the people and their capabilities as the center of development focus (Picatoste et al., 2021; Hartanto et al., 2019; Machado et al., 2020). Mohanty (2021) provides the concepts and discourse on human development. Human development and sustainability are inseparable, closely intertwined, and reinforce each other.

With sustained improvement in human development over the last four decades (Stewart, 2019), Indonesia is classified as a high human development country with an HDI value of 74 in 2023. Based on the UNDP criteria for the Human Development Index (HDI), low development is for an HDI lower than 55, medium development for an HDI between 55 and 70, high for an HDI between 70 and 80, and very high for an HDI of 80 and above (UNDP, 2022). Out of 514 municipalities in Indonesia, there are still many (193 municipalities) at the medium level of human development, and several others (13 municipalities) are at the low level. Figure 1 shows the level of human development in municipalities in Indonesia. There are 257 municipalities which have a high level of human development. Although it seems unnoticeable in Figure 1, 51 municipalities have very high human development. Figure 1 also suggests that the eastern part of Indonesia needs to catch up with other regions (Khairina & Wijaya, 2023).

Figure 1. Human Development Index in Indonesia



Source: Statistics Indonesia, data processed using Stata 18

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

To improve social welfare in all regions, the government of Indonesia has spent a large amount of funds on rural development with the new paradigm of building Indonesia from the periphery (Hadiwibowo et al., 2023). The focus of this study is the rural area because the rural area may lag behind the urban area (Wang et al., 2020).

There is a body of literature about human development. Researchers propose many different factors from various aspects that contribute to human development. It is because of the nature of HDI that human development is indicated (Picatoste et al., 2021; Mohanty, 2021). The factors vary from economic growth (Putri et al., 2022; Kaewnern et al., 2023; Zheng & Wang, 2022), government spending (Ranjan & Panda, 2021), globalization (Kiani et al., 2021), and poverty (Al-Nasser & Al Hallaq, 2019). Putri et al. (2022) mention that HDI is affected positively by economic growth and education spending and negatively by poverty, while the impacts of capital and health expenditure are insignificant. Ruzima and Veerachamy (2023) suggest that expenditure on health has positive impacts, while expenditure on education negatively impacts human development.

Capital accumulation and human resources are the main economic development factors in the Solow Growth Model (Mankiw, 2016). For rural areas, development is a complex and dynamic phenomenon (Demchenko et al., 2023). Rural development might be measured from various aspects. Village development may represent the development quality in rural areas (Suchaini et al., 2020). The level of rural infrastructure may affect human development (Zhao & Wu, 2024). The Ministry of Village, Development of Disadvantaged Regions and Transmigration of the Republic of Indonesia composed an index to measure rural areas' development process (2015). The Developing Village Index (DVI) is a comprehensive indicator for rural development that combines social, economic, and ecological approaches.

Prior studies about development in Indonesia are usually conducted only for one region in Indonesia (Khairina & Wijaya, 2023; Hartanto et al., 2019). Studies suggest that economic development contributes to the increase in human development (Kaewnern et al., 2023; Zheng & Wang, 2022). However, rural development as a determinant of human development is yet to be explored in the literature. In addition, previous studies do not have a consensus on the effects of government spending on human development; several studies suggest positive effects, while others suggest insignificant or negative effects (Putri et al., 2022; Ranjan & Panda, 2021).

This study has contributed to assessing the impacts of rural development and local government fiscal policy on human development in all regions of Indonesia. Its study compares the most developed regions with other regions to assess whether the regions in Indonesia are converging. This study aims to fill gaps in the literature and provide insights for the government, assisting the implementation of the government's vision of Indonesia from the village and grassroots to achieve the Sustainable Development Goals.

METHODS

This study analyzes the determinants of human development in all regions of Indonesia. We use the Human Development Index to represent human development as the dependent

variable. The explanatory variables are economic development, rural development, goods and services expenditure, capital expenditure, assets, and the COVID-19 pandemic. Economic development is represented by income and per capita Gross Regional Domestic Product. Rural development is represented by the Developing Village Index published by the Ministry of Village, Development of Disadvantaged Regions, and Transmigration. Goods and services expenditure and capital expenditure are used to depict fiscal policy. The asset represents the resources available for the region's development. Per capita expenditures and assets are from the Ministry of Finance. The COVID-19 pandemic is defined as a dummy variable with a value of 1 during 2020-2021 and 0 for the period before and after 2020-2021.

We estimate the relationships among human development, income, rural development, government expenditure (goods & services and capital), and assets. All variables are stated in log form. The basic model is:

$$hdi_{it} = b_0 + b_1 inc_{it} + b_2 dvi_{it} + b_3 gs_{it} + b_4 cap_{it} + b_5 ast_{it} + b_6 covid \quad (1)$$

hdi_{it} = Human Development Index
inc_{it} = income
dvi_{it} = rural development
gs_{it} = goods & services expenditure
cap_{it} = capital expenditure
ast_{it} = asset
$covid_{it}$ = COVID-19 pandemic

There are 514 municipalities in Indonesia, and only 434 municipalities have rural areas in their region. We include in the analysis only regions which have rural areas. We analyze the period of 2017 - 2023 for 434 municipalities. We employ panel data analysis to estimate the relationships, using the Common Effect Model, Fixed Effect Model, Random Effect Model, and Generalized Estimating Equation.

To analyze the different characteristics of the economy, we distinguish regions that have the highest human development from other regions. These regions are Java and Bali. By separating these two regions from the others, we can estimate different behavior between the highest and other regions. Therefore, we extend the basic model by employing a dummy variable (jb) for the regions of Java and Bali. The extended model is:

$$hd_{it} = b_0 + b_1 inc_{it} + b_2 dvi_{it} + b_3 gs_{it} + b_4 cap_{it} + b_5 ast_{it} + b_6 covid + b_7\, jb{\cdot}dvi_{it} + b_8\, jb{\cdot}gs_{it} + b_8 jb{\cdot}cap_{it} \quad (2)$$

RESULTS AND DISCUSSION

Table 1 presents data for the analysis. The data consists of 434 municipalities within 7 years. HDI and DVI are index numbers; all other variables are stated as per capita in thousands of Rupiah. It seems that there are wide disparities of value for some variables. The standard deviations are larger than mean values in income, goods and services expenditure, capital expenditure, and assets (see Table 1).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

Table 1. Descriptive Statistics

Variable		Mean	Std. dev.	Min	Max	Observations		
HDI	overall	68.24	5.50	27.87	86.69	N	=	3,005
	between		5.59	32.05	85.35	n	=	434
	within		0.99	64.06	71.38	T	=	6.92
INC	overall	52,819.29	68,711.13	5,630.00	1,392,358.00	N	=	3,004
	between		53,790.51	6,611.04	509,925.40	n	=	434
	within		42,863.28	-311,906.10	1,166,741.00	T	=	6.92
DVI	overall	0.64	0.09	0.23	0.94	N	=	3,005
	between		0.07	0.38	0.85	n	=	434
	within		0.05	0.38	0.79	T	=	6.92
GS	overall	1,677.54	2,318.99	87.75	36,307.51	N	=	3,004
	between		2,112.12	348.82	21,363.56	n	=	434
	within		1,014.94	-14,501.46	16,621.48	T	=	6.92
CAP	overall	1,245.63	1,731.11	38.49	26,465.16	N	=	3,004
	between		1,520.05	196.24	13,995.88	n	=	434
	within		844.82	-10,199.25	13,714.92	T	=	6.92
AST	overall	13,279.86	24,545.32	242.57	1,003,366.00	N	=	2,947
	between		18,454.91	1,677.14	244,327.20	n	=	434
	within		16,850.76	-166,842.50	772,318.50	T	=	6.79

Source: Data processing results of Stata 18.0

Most of the Indonesian population live in Java. The next most populated region is Bali. The population in Java and Bali is much larger than in other regions. Maluku and Papua have the lowest population. Figure 2 presents the population in the regions. HDI in municipalities by their locations is shown in Figure 3. Municipalities in Java and Bali regions have the highest HDI compared to other regions. Municipalities in Nusa Tenggara and Papua have the lowest HDI value.

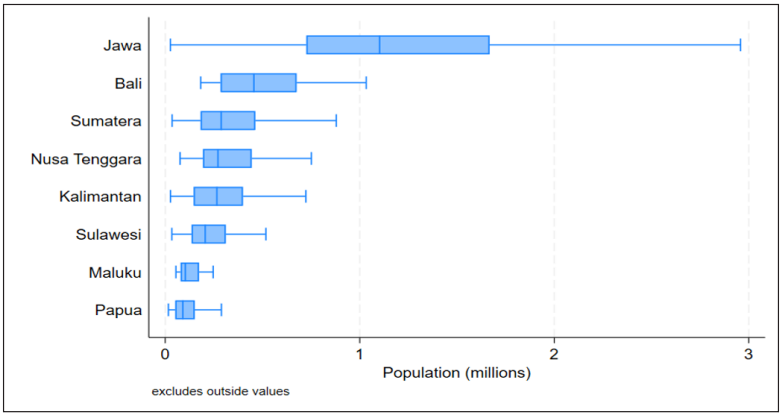
Figure 4 shows the DVI for the regions. We can see that municipalities in Java and Bali have the largest DVI compared to other regions. The rural development in Java and Bali is higher than in other regions, and the DVI in Bali is much larger than in other regions. With these different characteristics of Java and Bali, we distinguish the analysis for Java and Bali using moderating variables.

In the first regression, we estimate Equation 1 using the Common Effect Model, Fixed Effect Model, Random Effect Model, and Generalized Estimating Equation. The results are presented in Table 2. The Chow test indicates that FEM is better than CEM. The Breusch and Pagan Lagrangian's multiplier test for random effects indicates that REM is better than CEM. The value of χ^2 is higher for REM than GEE. The Hausman test shows that FEM is preferable. Therefore the preferred model is FEM.

Income has a coefficient of 0.0120 and is significant at a 1% level. A 1% increase in income will increase human development by 0.0120%. Income has positive effects on human development. The higher the income in a region, the higher human development

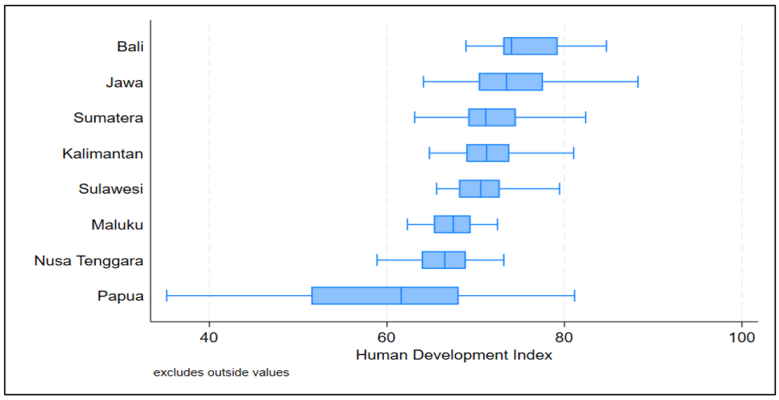
in that region. Higher-income means a higher quality of life. This result is similar to that of Putri et al. (2022). The government may integrate economic development programs with human development programs.

Figure 2. Population in 2023



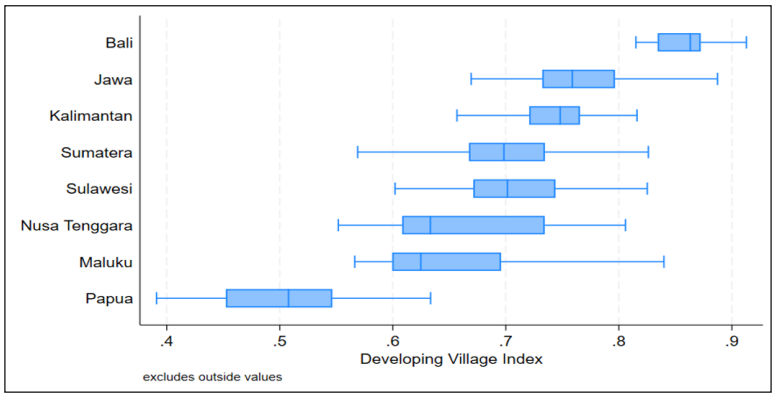
Source: Data processing results of Stata 18.0

Figure 3. Human Development Index in 2023



Source: Data processing results of Stata 18.0

Figure 4. Developing Village Index in 2023



Source: Data processing results of Stata 18.0

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

Table 2. Results of Basic Models

	CEM		FEM		REM		GEE	
inc	0.0513	***	0.0120	***	0.014	***	0.0196	***
	(0.002)		(0.001)		(0.001)		(0.002)	
dvi	0.2931	***	0.1242	***	0.1273	***	0.1359	***
	(0.010)		(0.003)		(0.003)		(0.007)	
gs	-0.0388	***	0.0045	***	0.0024	**	-0.0034	
	(0.003)		(0.001)		(0.001)		(0.002)	
cap	0.0019		-0.0065	***	-0.0062	***	-0.0053	***
	(0.003)		(0.001)		(0.001)		(0.002)	
ast	0.0121	***	0.0041	***	0.004	***	0.0038	**
	(0.003)		(0.001)		(0.001)		(0.002)	
covid	-0.0108	***	-0.0035	***	-0.0036	***	-0.004	***
	(0.003)		(0.000)		(0.000)		(0.001)	
intercept	3.966	***	4.1252	***	4.1175	***	4.0996	***
	(0.020)		(0.014)		(0.015)		(0.030)	
Number of observations	2,947		2,947		2,947		2,947	
R^2	0.564		0.673					
Adjusted R^2	0.563		0.616					
F statistic	632.97		861.20					
Log-likelihood	4,181.85		9,863.47					
AIC	-8,349.69		-19,712.94					
BIC	-8,307.77		-19,671.02					
χ^2					4,858.92		1,107.64	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * 0.1

Source: Data processing results of Stata 18.0

Rural development also has positive significant effects on human development, with a 1% significance level. The coefficient value of rural development is 0.1242. An increase in the region's rural development will improve human development. To improve human development, the government might use this channel by developing rural areas. Rural development will increase human development, as mentioned by Baldanov et al. (2019) and Edeme et al. (2017). Therefore, the government may utilize the development of rural areas as a policy option to improve human development.

Goods and services expenditures have positive and significant effects on human development. The direct positive effects of government spending on human development align with previous studies (Sharma et al., 2024; Masduki et al., 2022; Kousar et al., 2023). Government should increase the public expenditure on productive sectors of the economy (Oluwabonmi & Vasilev, 2023). However, the government should stay cautious because capital expenditures negatively affect human development. These different effects of spending confirm the findings of Ruzima and Veerachamy (2023). Capital expenditures remove the local government's limited funds from programs with direct impacts on

human development. This absence of positive impacts of capital expenditure on human development is similar to the findings of Ranjan and Panda (2022).

Furthermore, capital expenditure will be transformed into assets after the completion of the development projects. The results show that government assets positively and significantly impact human development. Increasing assets will improve human development. These positive effects of assets will offset the negative effects of the capital expenditure. The important role of the assets is also suggested by Djokoto (2022) and Acheampong et al. (2022). The coefficient of capital expenditure is -0.0065, while the coefficient of assets is 0.0041. Therefore, the positive impacts of the capital expenditure will be seen in the long run. Local governments should increase their assets for long-term growth. The central government may also accelerate human development in the regions by establishing assets using central government funds and then transferring the assets to the local government.

The results also show that the COVID-19 pandemic negatively affects human development. The global crisis caused by the COVID-19 pandemic hampers the achievement of sustainable development goals in general (Wang & Huang, 2021) and also health and well-being (Shulla et al., 2021). The government should prepare for the crisis and provide safety nets during a crisis period.

Table 3 shows the results when we distinguish between municipalities in Java and Bali with other regions. Regions in Java and Bali have the highest levels of rural and human development. These regions also have the largest populations. The preferred model is also FEM. The adjusted r^2 is 0.623, meaning the model explains 62.3% of the variations in human development. Income, rural development, expenditures on goods and services, and assets positively affect human development. On the other hand, capital expenditures and the COVID-19 pandemic decrease human development. This result is consistent with the basic model.

Furthermore, the result shows that capital expenditures in the Java and Bali regions are similar to those in other regions. The coefficient of the interaction of Java-Bali and capital expenditures is very small (0.0006) and is not significant. Regions in Java and Bali have higher positive effects for two variables, i.e., rural development and expenditures on goods and services. The coefficient of the interaction of Java-Bali and rural development is 0.0187, with a 1% significance level. This result means that a 1% increase in rural development will increase human development in the Java and Bali regions by 0.0187% compared to other regions. Similarly, a 1% increase in goods and services expenditures will increase human development in the Java and Bali regions by 0.0108% compared to other regions.

The differences reflect the gap between the Java and Bali regions and other regions. The gap between regions is also seen in other countries as China (Wang et al., 2020) and India (Sharma et al., 2024; Raj et al., 2024). The higher values imply that Java and Bali regions are more efficient in using their resources. Rural development and income levels are already higher in Java and Bali regions. Therefore, higher expenditures on goods and services are necessary for other regions to catch up with Java and Bali regions.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

Table 3. Results of Extended Models

	CEM		FEM		REM		GEE	
inc	0.0517	***	0.0122	***	0.0145	***	0.0208	***
	(0.002)		(0.001)		(0.001)		(0.002)	
dvi	0.2837	***	0.1199	***	0.1216	***	0.1277	***
	(0.010)		(0.003)		(0.003)		(0.007)	
gs	-0.0417	***	0.0031	***	0.0013		-0.0044	*
	(0.004)		(0.001)		(0.001)		(0.002)	
cap	0.0037		-0.0059	***	-0.0055	***	-0.0043	**
	(0.003)		(0.001)		(0.001)		(0.002)	
ast	0.0112	***	0.0038	***	0.004	***	0.0045	***
	(0.003)		(0.001)		(0.001)		(0.002)	
covid	-0.0108	***	-0.0033	***	-0.0034	***	-0.0037	***
	(0.003)		(0.000)		(0.000)		(0.001)	
jb # dvi	0.0679	**	0.0187	**	0.0238	***	0.0232	
	(0.027)		(0.009)		(0.007)		(0.017)	
jb # gs	0.007		0.0108	***	0.0077	***	0.008	**
	(0.006)		(0.003)		(0.002)		(0.003)	
jb # cap	-0.0038		0.0006		0.0001		-0.001	
	(0.007)		(0.002)		(0.002)		(0.004)	
intercept	3.9741	***	4.1155	***	4.1035	***	4.0681	***
	(0.022)		(0.015)		(0.015)		(0.031)	
Number of observations	2,947		2,947		2,947		2,947	
R^2	0.565		0.679					
Adjusted R^2	0.564		0.623					
F statistic	424.04		589.38					
Log-likelihood	4,186.75		9,890.78					
AIC	-8,353.50		-19,761.56					
BIC	-8,293.61		-19,701.68					
χ^2					5,059.93		1,166.23	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * 0.1
Source: Data processing results of Stata 18.0

Convergence may also be achieved if regions other than Java and Bali have lower capital expenditures and higher assets. The central government's role is important. The central government can build assets in these regions and then transfer them to the local government. Less capital expenditure and more assets may increase human development more rapidly.

However, this study does have limitations. The analysis is based on municipal data because several data on the village level are not readily available. When the data becomes available, future research should analyze data at the village level to more accurately understand the impacts of rural development. Secondly, we use only two classifications of government expenditure. Future research should consider using more detailed classifications to estimate the effects of each classification of expenditure.

CONCLUSION

The study's findings show that rural development and fiscal policy affect human development. Income, rural development, expenditures on goods and services, and assets have positive, significant effects on human development, while capital expenditures and the COVID-19 pandemic have negative effects. Moreover, rural development and goods and services expenditures in the Java and Bali regions have greater impacts than in other regions.

The findings have several implications. The government should focus on rural development to implement the vision of building Indonesia from the village and grassroots. Local government should emphasize the quality of spending and its impacts on development. In addition, the central government may accelerate human development by building and transferring assets to the local government.

REFERENCES

Aban-Perez, R. (2022). Human Development Index: A Theory. *Journal of Positive School Psychology*, *6*(3), 175-187.

Acheampong, A. O., Opoku, E. E. O., Dzator, J., & Kufuor, N. K. (2022). Enhancing Human Development in Developing Regions: Do ICT and Transport Infrastructure Matter?. *Technological Forecasting and Social Change*, *180*, 121725. https://doi.org/10.1016/j.techfore.2022.121725.

Al-Nasser, A., & Al Hallaq, S. S. (2019). Impact of Human Poverty on the Human Development Index in Jordan within the Period 2003-2016. *International Journal of Business and Society*, *20*(2), 552-562.

Artelaris, P. (2022). A development Index for the Greek Regions. *Quality & Quantity*, *56*(3), 1261-1281. https://doi.org/10.1007/s11135-021-01175-x.

Baldanov, A., Kiminami, L., & Furuzawa, S. (2019). Study on the Relationships between Rural and Agricultural Development and Human Resource Development in Russian Federation Since 2000s. *Letters in spatial and resource sciences*, *12*, 87-100. https://doi.org/10.1007/s12076-019-00228-y.

Biermann, F., Hickmann, T., Sénit, C. A., Beisheim, M., Bernstein, S., Chasek, P., Grob, L., Kim, R. E., Kotze, L. J., Nilsson, M., Llanos, A. O., Okereke, C., Pradhan, P., Raven, R., Sun, Y., Vijge, M. J., van Vuuren, D., & Wicke, B. (2022). Scientific Evidence on the Political Impact of the Sustainable Development Goals. *Nature Sustainability*, *5*(9), 795-800. https://doi.org/10.1038/s41893-022-00909-5.

Demchenko, O., Basiurkina, N., Popadynets, N., Minenko, S., & Sokoliuk, K. (2023). Factors and Determinants of the Development of Human Capital in Rural Areas in the Conditions of Global Challenges. *Economics-Innovative and Economics Research Journal*, *11*(Special issue 1), 93-108. https://doi.org/10.2478/eoik-2023-0026.

Djokoto, J. G. (2022). The Investment Development Path and Human Development: Is There a Nexus?. *Research in Globalization*, *4*, 100079. https://doi.org/10.1016/j.resglo.2021.100079.

Edeme, R. K., Nkalu, C. N., & Ifelunini, I. A. (2017). Distributional Impact of Public Expenditure on Human Development in Nigeria. *International Journal of Social Economics*, *44*(12), 1683-1693. https://doi.org/10.1108/IJSE-05-2016-0152.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

Hadiwibowo, Y., Dokhi, M., Hidayat, R. T., & Johantri, B. (2023). Sustainable Regional Economic Development by Developing Villages. *European Journal of Development Studies*, *3*(1), 22-28. https://doi.org/10.24018/ejdevelop.2023.3.1.201.

Halkos, G., & Gkampoura, E. C. (2021). Where Do We Stand on the 17 Sustainable Development Goals? An Overview on Progress. *Economic Analysis and Policy*, *70*, 94-122. https://doi.org/10.1016/j.eap.2021.02.001.

Hartanto, W., Islami, N. N., Mardiyana, L. O., Ikhsan, F. A., & Rizal, A. (2019). Analysis of Human Development Index in East Java Province Indonesia. *IOP Conference Series: Earth and Environmental Science, 243*(1), 012061. https://doi.org/10.1088/1755-1315/243/1/012061.

Kaewnern, H., Wangkumharn, S., Deeyaonarn, W., Yousaf, A. U., & Kongbuamai, N. (2023). Investigating the Role of Research Development and Renewable Energy on Human Development: An Insight from the Top Ten Human Development Index Countries. *Energy*, *262*, 125540. https://doi.org/10.1016/j.energy.2022.125540.

Khairina, N., & Wijaya, A. (2023). The Determinant of Human Development in Eastern Part of Indonesia during 2012-2020. *Signifikan: Jurnal Ilmu Ekonomi*, *12*(1), 83-96. https://doi.org/10.15408/sjie.v12i1.29496.

Kiani, A., Mohammad, N., & Soomro, R. B. (2021). The Impact of Globalization on Human Development Index: a Case of Pakistan. *Studies of Applied Economics*, *39*(2), 1-22. https://doi.org/10.25115/eea.v39i2.3710.

Kousar, S., Ahmed, F., Afzal, M., & Segovia, J. E. (2023). Is Government Spending in the Education and Health Sector Necessary for Human Capital Development?. *Humanities and Social Sciences Communications*, *10*(1), 1-11. https://doi.org/10.1057/s41599-023-01514-3.

Machado, N. G., dos Santos, G. T., Biudes, M. S., da Silva, J. L., Bacarji, A. G., da Costa, M. E. L., & de Souza Bilio, R. (2020). Sustainable Development Index of Municipalities in Mato Grosso. *Revista Brasileira de Gestão e Desenvolvimento Regional*, *16*(1), 5358.

Mankiw, G. (2016). *Macroeconomics*. New Jersey: Worth Publishers.

Masduki, U., Rindayati, W., & Mulatsih, S. (2022). How Can Quality Regional Spending Reduce Poverty and Improve Human Development Index?. *Journal of Asian Economics*, *82*, 101515. https://doi.org/10.1016/j.asieco.2022.101515.

Ministry of Village, Development of Disadvantaged Regions and Transmigration of Republic of Indonesia. (2015). *Indeks Desa Membangun*. Jakarta Selatan: Kementerian Desa, Pembangunan Daerah Tertinggal dan Transmigrasi.

Mohanty, M. (2021). Human Development and Sustainability. In. Filfo, W. L., Azul, A. M., Brandli, L., Salvia, A. L., Ozuyar, P. G., & Wall, T. (Eds). *No Poverty*, 449-459. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-69625-6_6-1.

Oluwabonmi, Y., & Vasilev, A. (2023). Linking Public Expenditure, Economic Growth, and Human Development: Focus on South Africa. *IUP Journal of Applied Finance*, 29(4), 5-32.

Panth, P. (2021). Economic Development: Definition, Scope, and Measurement. In. Filfo, W. L., Azul, A. M., Brandli, L., Salvia, A. L., Ozuyar, P. G., & Wall, T. (Eds). *No Poverty*, 231-243. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-95714-2_38.

Picatoste, X., Novo-Corti, I., & Tirca, D. M. (2021). Human Development Index as an Indicator of Social Welfare. In. Filfo, W. L., Azul, A. M., Brandli, L., Salvia, A. L., Ozuyar, P. G., & Wall, T. (Eds). *No Poverty*, 449-459. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-95714-2_42.

Putri, F. D. A., Suhendro, S., & Nauli, P. (2022). Analysis of Factors Affecting the Level of the Human Development Index. *Asian Journal of Economics and Business Management*, *1*(3), 218–228. https://doi.org/10.53402/ajebm.v1i3.229.

Raj, J., Gupta, V., & Shrawan, A. (2024). Economic Growth and Human Development in India–Are States Converging. *Indian Public Policy Review*, *5*(3), 94-137. https://doi.org/10.55763/ippr.2024.05.03.004.

Ranjan, P., & Panda, P. K. (2022). Pattern of Development Spending and Its Impact on Human Development Index and Gross State Domestic Product in Low-Income States in India. *Journal of Development Policy and Practice*, 7(1), 71-95. https://doi.org/10.1177/24551333211047358.

Ruzima, M., & Veerachamy, P. (2023). The Impact of Public Spending in Education and Health on Human Development in India. *Journal of the Asia Pacific Economy*, 28(2), 390-403. https://doi.org/10.1080/13547860.2021.1952920.

Sharma, N., Khanna, S., & Srivastava, A. (2024). Threshold Impacts of Public Expenditure on Economic Growth Insights from India Utilizing Panel Threshold Regression Model. *Asian Journal of Applied Economics*, *31*(1), 37-57. https://doi.org/10.22004/ag.econ.344198.

Shulla, K., Voigt, B. F., Cibian, S., Scandone, G., Martinez, E., Nelkovski, F., & Salehi, P. (2021). Effects of COVID-19 on the Sustainable Development Goals (SDGs). *Discover sustainability*, *2*, 1-19. https://doi.org/10.1007/s43621-021-00026-x.

Stewart, F. (2019). The Human Development Approach: An Overview. *Oxford Development Studies*, *47*(2), 135-153. https://doi.org/10.1080/13600818.2019.1585793.

Suchaini, U., Harmadi, S.H.B. & Adji, A. (2020). Indonesia's Village Development Indicator: In Terms of Mismatch of Village Development Measurement Indicator. *TNP2K Working Paper 51-e/2020*.

UNDP (United Nations Development Programme). (2022). *Human Development Report 2021-22: Uncertain Times, Unsettled Lives: Shaping our Future in a Transforming World*. New York: UNDP.

Wang, Q., & Huang, R. (2021). The Impact of COVID-19 Pandemic on Sustainable Development Goals –A Survey. *Environmental Research*, *202*, 111637. https://doi.org/10.1016/j.envres.2021.111637.

Wang, M., Kang, W., & Zhang, R. (2020). The Gap between Urban and Rural Development Levels Narrowed. *Complexity*, *2020*(1), 4615760. https://doi.org/10.1155/2020/4615760.

Zhao, C., & Wu, Q. (2024). The Wall between Urban and Rural: How Does the Urban-Rural Electricity Gap Inhibit the Human Development Index. *Structural Change and Economic Dynamics*, *71*, 289-301. https://doi.org/10.1016/j.strueco.2024.08.002.

Zheng, J., & Wang, X. (2022). Impacts on Human Development Index Due to Combinations of Renewables and ICTs--New Evidence from 26 Countries. *Renewable Energy*, *191*, 330-344. https://doi.org/10.1016/j.renene.2022.04.033.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44453

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 65 - 76
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.43926

Household Food Consumption and Poverty Reduction After Earthquakes: Evidence from Lombok

Amy Wardian Pratama[1*], Dyah Wulan Sari[2], Ilmiawan Auwalin[3]
[1,2,3]Faculty of Economics and Business, Universitas Airlangga, Indonesia
E-mail: [1]amy.wardian.pratama.384572-2022@feb.unair.ac.id,
[2]dyah-wulansari@feb.unair.ac.id, [3]auwalin@feb.unair.ac.id
[*]**Corresponding author**

JEL Classification:
C33
I32
Q54

Received: 31 December 2024

Revised: 15 March 2025

Accepted: 20 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study contributes to the literature by examining how household food consumption mitigates the poverty impact of earthquakes, an area that remains underexplored in post-disaster economic studies.

Research Objectives: The study aims to analyze the role of per capita household food consumption in poverty reduction after the Lombok earthquake and to highlight its importance for economic recovery.

Research Methods: This study uses panel data from 10 districts/cities in West Nusa Tenggara (2011-2019) to employ the First-Difference Generalised Method of Moments (FDGMM) to address potential endogeneity and estimate the causal relationship between food consumption and poverty.

Empirical Results: The results show that per capita food consumption significantly reduces poverty under normal conditions and after a disaster. Meanwhile, economic growth positively impacts poverty, suggesting that the observed growth is not inclusive. The study also finds that the direct effect of the earthquake on food consumption is statistically insignificant, suggesting that other factors, such as relief programs, may have played a role in stabilizing consumption.

Implications: These findings underscore the importance of policies that enhance food security and equitable distribution, particularly in post-disaster contexts. Strengthening social protection programs and ensuring inclusive economic growth is essential for long-term poverty reduction in disaster-prone areas.

Keywords:
poverty; food consumption; disaster; household resilience

How to Cite:
Pratama, A. W., Sari, D. W., & Awwalin, I. (2025). Household Food Consumption and Poverty Reduction After Earthquakes: Evidence from Lombok. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 65-76. https://doi.org/10.15408/sjie.v14i1.43926.

INTRODUCTION

The Central Statistics Agency (BPS, Badan Pusat Statistik) has revealed that the poverty rate in NTB has continued to decline. From 2011 to 2019, the poverty rate fell from 19.73% to 14.56% (Badan Pusat Statistik, 2020). This decline has been sustained since 2018, despite the region experiencing a substantial earthquake that significantly impacted its socio-economic landscape (Agustawijaya et al., 2020; Ang et al., 2024; Isnaeni et al., 2022; Roslinawati, 2021). The seismic event was experienced across most Lombok and Sumbawa Islands, indicating the presence of factors contributing to the region's social and economic resilience. A salient factor that must be considered is household consumption capacity, with a particular emphasis on the food sector.

The role of food consumption in post-disaster recovery is of pivotal significance, primarily in addressing food insecurity and enhancing community resilience. Access to nutritious food has been demonstrated to have a significant impact on mental health, with studies indicating a reduction in stress and depression among disaster survivors (Sioen et al., 2017). Nevertheless, studies have also indicated the compromise of food security in the aftermath of disasters. Research findings demonstrate that food access is worsened in marginalized communities following events such as Hurricane Katrina (Singleton et al., 2022). Providing emergency food and utilizing local food resources are considered essential strategies for mitigating food insecurity and supporting recovery efforts (Durry et al., 2024; Lassa et al., 2018). Community feeding initiatives have been demonstrated to engender social support, which is imperative for coping with the psychological effects of disasters (Clay et al., 2022). In conclusion, the effective distribution of food and the provision of access to nutritious options are integral to the reconstruction of communities and the enhancement of their resilience against future disasters (Clay & Ross, 2020).

In the study of the impact of disasters on the economy, most previous studies have focused more on macroeconomic recovery and infrastructure reconstruction as the main strategies for reducing the long-term impact of disasters. Examples of relevant studies include Li et al. (2022), Nugroho et al. (2022), Sseruyange & Klomp (2021), Duqi et al. (2021), Blagojević et al. (2022) and Duan (2022), who discuss how post-disaster economic recovery strategies focus more on GDP growth and infrastructure development. However, these studies do not adequately address the role of household consumption in this context. A macroeconomic approach often overlooks the socio-economic dynamics at the micro level, particularly about household consumption and food security in the context of disaster impacts.

In contrast, recent studies, including those by Chen et al. (2024), Barakat et al. (2023), Dailey et al. (2022), and Fraser et al. (2022) have begun to emphasize the significance of food security in crisis response, particularly in the context of pandemics and natural disasters. While these studies address the role of food consumption in emergencies, their research does not explicitly examine how household food consumption contributes to post-disaster poverty reduction. Furthermore, many studies have emphasized the role

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

of social assistance and government intervention in mitigating the impact of disasters. Significant contributions in this area have been made by Kuntjorowati et al. (2022), Emrich et al. (2022), Karnaji et al. (2023), and Drakes et al. (2021). These studies have demonstrated the pivotal role that social assistance programs, such as cash transfers and food subsidies, play in ensuring the economic stability of households in the aftermath of a disaster. However, these studies have not explicitly linked how household food consumption patterns can mitigate poverty after a disaster.

This study addresses a significant gap in the extant literature by examining food consumption's direct impact on poverty reduction in post-disaster settings. This area has not been thoroughly explored in previous research. Although the Lombok earthquake occurred several years ago, the findings of this study are still important for informing future disaster preparedness and long-term socio-economic recovery strategies, especially in areas prone to recurring natural disasters. The present study employs the FDGMM method to establish causal relationships rigorously and provide policy recommendations to enhance food security and household well-being in disaster-stricken areas.

METHODS

This study employs a panel data approach, encompassing 10 districts/cities in NTB from 2011 to 2019, to examine the impact of household food consumption on poverty reduction in post-disaster environments. The selection of the study period is of particular significance to ensure that the analysis captures the impact of the 2018 Lombok earthquake while minimizing extraneous influences. The decision to restrict the analysis to the 2019 dataset is based on the principle of minimizing confounding while recognizing that the economic disruptions associated with the onset of the pandemic in early 2020 could potentially introduce bias. Akita and Alisjahbana (2023) asserted that the Indonesian economy underwent a substantial contraction in the wake of the pandemic, underscoring the imperative to exclude 2020 data from the analysis to preserve the model's validity. This methodological decision ensured that the observed relationship between household consumption and poverty was predominantly driven by disaster-related factors rather than economic shocks caused by the pandemic.

To address potential endogeneity issues and ensure robust estimations, this study employs the First-Difference Generalised Method of Moments (FDGMM) estimator. This method is particularly well-suited for dynamic panel data analysis, as it effectively controls for unobserved heterogeneity, simultaneity bias, and measurement errors in explanatory variables. The validity of the FDGMM hinges on the condition that the number of units (N) exceeds the number of periods (T), ensuring reliable instrument selection and averting overfitting. In this study, with N = 10 (districts/cities) and T = 9 (years), the condition N > T is satisfied, thereby validating the utilization of this estimation technique. The analysis incorporates control variables, namely gross domestic income and the open unemployment rate (Anwar et al., 2024; Langi, 2023). The regression equation is as follows:

$$P0_{i,t} = \alpha_{i,t} + \beta_1 GRDP_{i,t} + \beta_2 UNE_{i,t} + \beta_3 EQ_t + \varepsilon_{i,t} \quad (1)$$

$$P_{0i,t} = \alpha_{i,t} + \beta_1 GRDP_{i,t} + \beta_2 UNE_{i,t} + \beta_3 EQ_t + \beta_4 FC_{i,t} + \beta_5 EQ.FC_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$FC_{i,t} = \alpha_{i,t} + \beta_1 GRDP_{i,t} + \beta_2 UNE_{i,t} + \beta_3 EQ_t + \varepsilon_{i,t} \quad (3)$$

where $P0_{i,t}$ represents the poverty rate in district i at time t, measured as the percentage of the poor population in the province. $GRDP_{i,t}$denotes the Gross Regional Domestic Product (GRDP), expressed in million rupiahs, reflecting the economic output of each region. $UNE_{i,t}$ is the unemployment rate, measured as the percentage of unemployed individuals within the workforce in each province. EQ_t is a dummy variable that assumes the value 1 if the observation falls within the designated earthquake period (2018–2019) and 0 in all other instances. The model has also been enhanced by the incorporation of an error term $\varepsilon_{i,t}$ which is essential in accounting for unobserved influences on the dependent variable.

The initial regression formula was developed for the purpose of evaluating poverty rates in areas affected by the earthquake, both prior to and following the disaster. The objective of this comparison is to facilitate a more nuanced comprehension of the poverty conditions that prevailed in the aforementioned areas during the periods preceding and succeeding the earthquake. The second regression formula is employed to analyse the effect of household food consumption on poverty levels and to explore whether there is a difference in its effect between the pre- and post-earthquake periods. $FC_{i,t}$is employed to denote household food consumption per capita, measured in rupiahs. This indicates the average food expenditure per individual. The interaction term $EQ.FC_{i,t}$ has been incorporated into the model in order to analyse whether the effect of food consumption on poverty varies between normal and disaster periods. The addition will provide a clearer picture of the fact that the second regression not only looks at the relationship between food consumption and poverty, but also compares its effect in two different periods.

The third regression formula is employed to verify the stability of the findings of the second regression. Suppose the second model finds insignificant household food consumption and the earthquake's interaction effects. In that case, the third model is expected to conclude that the earthquake does not affect the level of consumption. The estimation process employs a two-step General Method of Moments (GMM) approach, encompassing the Arellano-Bond test for serial correlation and the Sargan test for over-identifying restrictions, to validate the model's instrument specification. These tests ensure that the selected instruments are appropriate and that the model assumptions are correct. This methodological framework facilitates a more precise identification of causal relationships between food consumption and poverty reduction, accounting for disaster-related shocks and economic trends in NTB before the pandemic.

RESULTS AND DISCUSSION

The primary conclusions of this study suggest that household food consumption plays a substantial role in reducing poverty levels in NTB Province, both in normal and

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

post-disaster contexts. The analysis utilizing the FDGMM reveals that per capita food consumption exerts a negative and significant influence on poverty levels, indicating that an increase in household food consumption is associated with a decline in poverty. Furthermore, the findings suggest that economic growth in NTB is not yet inclusive, indicating that the increase in GRDP has not positively impacted the poor.

In addition to confirming that poverty decreased significantly after the earthquake, the findings of the first regression model demonstrate a positive and significant correlation between economic growth and poverty levels (see Table 1). This result indicates that the economic growth experienced during 2011–2019 was not inclusive and led to an escalation in inequality. This finding is consistent with the conclusions of previous studies by Adeleye et al. (2020), Škare and Družeta (2016), and Timiryanova et al. (2021), who also found that uneven economic growth can worsen the conditions of vulnerable groups (Altamirano, 2019; Narain, 2022). The underlying reason for this phenomenon is the limited access that vulnerable groups have to existing economic resources.

Table 1. The Effect of Earthquakes on Poverty

Explanatory variables	Dependent variables: LnP0			
	Coef.	Std. error	z	P > [z]
LnP0 (-1)	0,7959103***	0,0272333	29,23	0,000
LnGRDP	0,06397***	0,0205973	3,11	0,002
LnUNE	0,0246816***	0,0090975	2,71	0,007
EQ	-0,033512***	0,0038262	-8,76	0,000
CONSTANTA	-0,5240401	0,3963511	-1,32	0,186
Number of groups	10			
Number of instruments	41			
Wald chi2	10.593,57			
Prob. > chi2	0,0000			
Arellano-Bond test for AR(1)	0,1217			
Arellano-Bond test for AR(2)	0,8237			
Sargan test	1,0000			
Number of Obs.	67			

Note:*** significant at 1%, ** significant at 5%, * significant at 10%

Incorporating the per capita food consumption variable in the second regression model reveals a negative and significant relationship between food consumption and poverty (see Table 2). This finding suggests that maintaining stable food consumption is crucial for poor households to withstand challenging economic conditions. This finding is consistent with the conclusions of research conducted by Davis and Geiger (2017), Gorzycka-Sikora et al. (2023), and Hermans et al. (2024), which demonstrates that food consumption plays a pivotal role in safeguarding the economic well-being of disadvantaged populations, particularly during periods of crisis. The present study also

demonstrated that the interaction variable between the earthquake and per capita food consumption did not significantly affect poverty levels. This finding suggests that per capita food consumption in the second model remained constant between the pre-and post-earthquake periods.

The present study explores the significance of stable food consumption for impoverished households in challenging economic conditions, offering profound insights into household economic resilience during crises and in normal circumstances. The analysis posits that food consumption is not solely a means of fulfilling fundamental needs but also an indicator of broader well-being (Verba et al., 2023). In ordinary conditions, impoverished households frequently encounter constrained access to economic resources, including low-income and job instability. Consequently, maintaining stable food consumption emerges as a pivotal strategy for sustaining quality of life and averting a more precipitous decline in well-being. When food consumption remains stable, even at a lower level, impoverished households can mitigate the risk of health complications and hunger that frequently ensue due to constrained resources (Ghalibaf et al., 2022).

Table 2. The Effect of Earthquakes and Per Capita Food Consumption on Poverty

Explanatory variables	Dependent variables: LnP0			
	Coef.	Std. error	z	P > [z]
LnP0 (-1)	0,6192719***	0,0884735	7,00	0,000
LnGRDP	0,0605877**	0,0271719	2,23	0,026
LnUNE	0,0210639*	0,0119575	1,76	0,078
EQ	-1,444897	1,857391	-0,78	0,437
LnFC	-0,106169***	0,0412896	-2,57	0,010
LnEQ.FC	0,1070018	0,1405605	0,76	0,447
CONSTANTA	1,390898*	0,726503	1,91	0,056
Number of groups	10			
Number of instruments	42			
Wald chi2	1810,29			
Prob. > chi2	0,0000			
Arellano-Bond test for AR(1)	0,1405			
Arellano-Bond test for AR(2)	0,8352			
Sargan test	1,0000			
Number of Obs.	67			

Note:*** significant at 1%, ** significant at 5%, * significant at 10%

In situations of crisis, such as natural disasters or economic shocks, there is an increase in the challenges to household food consumption (Orjiakor et al., 2023). Crises caused by natural disasters, such as earthquakes, damage local infrastructure and economies and disrupt social stability and food distribution. Poor households already in a

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

vulnerable position are more easily affected by the direct and indirect impacts of the crisis. In such circumstances, food consumption is pivotal in determining households' resilience. Food security is critical in post-crisis recovery (Yang & Tian, 2024). Households with greater access to food consumption, facilitated by social support or food assistance policies, are better equipped to withstand and recuperate from the repercussions of the crisis. It is imperative to implement policies that facilitate easier and more equitable access to healthy and nutritious food consumption, as this is instrumental in preventing an escalation in poverty levels and reducing vulnerability to economic shocks. Social assistance programs, food subsidies, and enhancements in food distribution infrastructure are pivotal aspects that demand significant consideration. These measures act as a stabilizing factor, thereby mitigating the impact of uncertainty on food consumption among economically disadvantaged households (Amrullah et al., 2023; Dinda Pramisita et al., 2023; Susantyo, 2023).

The findings of the third regression model demonstrate that the 2018 Lombok earthquake did not substantially influence the level of food consumption per capita (see Table 3). This outcome is consistent with the results of the preceding second model, which indicated no significant variation in the impact of consumption on poverty between the periods before and after the earthquake disaster. Consequently, food consumption per capita during the disaster period remained consistent. This stability is likely influenced by government intervention, community concern, and private corporations providing social assistance, food subsidies, and logistics distribution to affected areas.

Table 3. The Effect of Earthquakes on Per Capita Food Consumption

Explanatory variables	Dependent variables: LnFC			
	Coef.	Std. error	z	P > [z]
LnFC (-1)	0,7156724***	0,0636269	11,25	0,000
LnGRDP	0,1602103***	0,059029	2,71	0,007
LnUNE	-0,1491802	0,1232053	-1,21	0,226
EQ	0,0201478	0,0274421	0,73	0,463
CONSTANTA	1,392241***	0,3775068	3,69	0,000
Number of groups	10			
Number of instruments	41			
Wald chi2	1.739,73			
Prob. > chi2	0,0000			
Arellano-Bond test for AR(1)	0,0278			
Arellano-Bond test for AR(2)	0,9452			
Sargan test	1,0000			
Number of Obs.	67			

Note:*** significant at 1%, ** significant at 5%, * significant at 10%

CONCLUSION

The findings of the research indicate that household food consumption plays a pivotal role in alleviating poverty levels in NTB, both in normal and post-disaster conditions. Stable food consumption assists impoverished households in preserving their economic well-being in challenging circumstances, constituting a pivotal factor in poverty reduction strategies. The study further reveals that economic growth in NTB during 2011–2019 was not inclusive. This result suggests that the benefits of economic growth have not been universally experienced, particularly among the economically disadvantaged. Furthermore, the study revealed that the 2018 Lombok earthquake did not substantially influence per capita food consumption levels, underscoring the significance of social interventions such as food aid and logistical support in maintaining the stability of consumption among affected communities.

The results of the present study indicate several policy implications for government and stakeholders to consider. Primarily, the government must ensure that ongoing economic growth is more inclusive. This condition can be achieved by creating more opportunities for economically disadvantaged groups to participate in economic activities. Programs such as labor-intensive programs, skills training, and access to capital for micro-enterprises can be alternative policies to help reduce economic disparities. Secondly, the study emphasizes the necessity of ensuring food consumption stability as a priority in policies aimed at poverty alleviation. Achieving this objective can be facilitated by consolidating food-based social assistance programs, implementing staple food subsidies, and providing support to local food production. The study contends that these measures ensure that vulnerable populations can access their basic needs, particularly during crises. Thirdly, the study calls for increased social interventions in the form of rapid and targeted aid distribution, emphasizing the importance of enhancing the effectiveness of such measures in reducing the negative impacts of disasters on vulnerable groups.

REFERENCES

Adeleye, B. N., Gershon, O., Ogundipe, A., Owolabi, O., Ogunrinola, I., & Adediran, O. (2020). Comparative Investigation of the Growth-Poverty-Inequality Trilemma in Sub-Saharan Africa and Latin American and Caribbean Countries. *Heliyon*, *6*(12), e05631.

Agustawijaya, D. S., Taruna, R. M., & Agustawijaya, A. R. (2020). An Update To Seismic Hazard Levels And PSHA For Lombok And Surrounding Islands After Earthquakes In 2018. *Bulletin of the New Zealand Society for Earthquake Engineering, 53*(4), 215-226.

Akita, T., & Alisjahbana, A. S. (2023). The Initial Impacts of the COVID-19 Pandemic on Regional Economies in Indonesia: Structural Changes and Regional Income Inequality. *Sustainability*, *15*(18), 13709. https://doi.org/10.3390/su151813709.

Altamirano, M. (2019). Economic vulnerability and partisanship in Latin America. *Latin American Politics and Society*, *61*(3), 80–103. https://doi.org/10.1017/lap.2019.7.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

Amrullah, E. R., Susilawati, P. N., Hidayah, I., Rusyiana, A., & Ishida, A. (2023). Do Food Price Subsidies Increase Nutritional Intake of Indonesian Households? *Agraris*, *9*(2), 258–277. https://doi.org/10.18196/agraris.v9i2.172.

Ang, M., Anggraini, J. D., Khairunnisa, S., Aniqusyita, M., Syihab, K. H., Varera, R. P., Hudaya, M. K., & Septiana, A. R. (2024). Improving Tourism Village Quality through the Development of the Geotrail in Genggelang Village, Rinjani-Lombok UGGp. Area. *IOP Conference Series: Earth and Environmental Science*, *1424*.

Anwar, S., Yudaruddin, R., Naprida, D., Wibowo, B. R., & Lesmana, D. (2024). Aids Social Expenditures, Poverty And Inequality In Time Of Covid-19 Pandemic In Indonesia. *Journal of the Malaysian Institute of Planners, 22*(4), 243–257.

Barakat, S., Cochrane, L., & Vasekha, I. (2023). The Humanitarian-Development-Peace Nexus for Global Food Security: Responding to the Climate Crisis, Conflict, and Supply Chain Disruptions. *International Journal of Disaster Risk Reduction*, *98,* 104106.

Blagojević, N., Stojadinović, B., & Didier, M. (2022). Simulating the Role of Transportation Infrastructure for Community Disaster Recovery. *Proceedings of the Institution of Civil Engineers: Bridge Engineering*, *175*(3), 150–159.

Chen, Z., Zhang, M., Dong, R. K., & Wang, S. (2024). Building Resilient Food Security Against Global Crisis: New Evidence From China. *Food and Energy Security*, *13*(5), e70008. https://doi.org/10.1002/fes3.70008.

Clay, L., Greer, A., Slotter, R., & King, D. (2022). The Social Supportive Role of Food and Meals Following Hurricane Florence. *Journal of Homeland Security and Emergency Management*, *19*(3), 323–345. https://doi.org/10.1515/jhsem-2021-0027

Clay, L., & Ross, A. D. (2020). Factors Associated With Food Insecurity Following Hurricane Harvey in Texas. *International Journal of Environmental Research and Public Health*, *17*(3), 762.

Dailey, A., Davidson, K., Gaskin, K., Cooper, L., Schell, B., Gagliardi, Y., & Glahn, K. (2022). Responding to Food Insecurity and Community Crises through Food Policy Council Partnerships in a Rural Setting. *Progress in Community Health Partnerships : Research, Education, and Action*, *16*(2), 39–44. https://doi.org/10.1353/cpr.2022.0037

Davis, O., & Geiger, B. B. (2017). Did Food Insecurity Rise Across Europe After the 2008 Crisis? An Analysis Across Welfare Regimes. *Social Policy and Society*, *16*(3), 343–360.

Dinda Pramisita, A. A., Nyoman Saskara, I. A., Marhaeni, A. A. I. N., & Wiwin Setyari, N. P. (2023). Analysis of the Effectiveness and Impact of Cash Social Assistance of the Covid-19 Pandemic on Consumption Expenditures of Poor Households (Muslim Majority) in Indonesia. *IQTISHODUNA: Jurnal Ekonomi Islam*, *12*(2), 527–546.

Drakes, O., Tate, E., Rainey, J., & Brody, S. (2021). Social Vulnerability and Short-Term Disaster Assistance in the United States. *International Journal of Disaster Risk Reduction*, *53,* 102010. https://doi.org/10.1016/j.ijdrr.2020.102010.

Duan, C. (2022). The Macroeconomic Impact of Infrastructure Investment-or lack thereof-in the US. *BCP Business & Management GEBM*, *23,* 661-670.

Duqi, A., McGowan, D., Onali, E., & Torluccio, G. (2021). Natural Disasters and Economic Growth: The Role of Banking Market Structure. *Journal of Corporate Finance*, *71,* 102101.

Durry, F. D., Prasetya, J. D., Sahadewa, S., Windyantini, H., Winata, L. S., & Putri, A. D. R. A. (2024). The Utilization of Local Food Materials in Food Bars for Disaster Resilience Amidst Modern Transformation. *Eduvest - Journal of Universal Studies*, *4*(6), 4884–4896.

Emrich, C. T., Aksha, S. K., & Zhou, Y. (2022). Assessing Distributive Inequities in FEMA's Disaster Recovery Assistance Fund Allocation. *International Journal of Disaster Risk Reduction*, *74,* 102855. https://doi.org/10.1016/j.ijdrr.2022.102855.

Fraser, K. T., Shapiro, S., Willingham, C., Tavarez, E., Berg, J., & Freudenberg, N. (2022). What We Can Learn from U.S. Food Policy Response to Crises of the Last 20 Years – Lessons for the Covid-19 Era: A Scoping Review. *SSM - Population Health*, *17*. https://doi.org/10.1016/j.ssmph.2021.100952.

Ghalibaf, M. B., Gholami, M., & Mohammadian, N. (2022). Stability of Food Security in Iran; Challenges and Ways Forward: A Narrative Review. *Iran Journal of Public Health, 51*(12), 2654-2663.

Gorzycka-Sikora, A., Mock, N., & Lacey, M. (2023). Multivariate Analysis of Food Consumption Profiles in Crisis Settings. *PLoS ONE*, *18*(3), 0283627.

Hermans, K., Cantillon, B., & Marchal, S. (2024). Shifts at the Margin of European Welfare States: How Important is Food Aid in Complementing Inadequate Minimum Incomes? *Journal of European Social Policy*, *34*(3), 323–337.

Isnaeni, W., Asa'ad, S., Hatta, M., Syamsuddin, S., Andiwijaya, F. R., & Agustawijaya, D. S. (2022). The Development of Health Capacity Index for a Semi-Quantitative Earthquake Hazards Risk Analysis with a Special Reference to the Lombok Earthquake Disaster 2018. *Proceedings of the 2nd Global Health and Innovation Conference*.

Karnaji, K., Susanti, E., Ariadi, S., & Saud, M. (2023). Social Impacts and Post-Disaster Management in Disaster-Prone Areas of East Java, Indonesia. *Jamba: Journal of Disaster Risk Studies*, *16*(1), 1747.

Kuntjorowati, E., Hermawati, I., Ikawati, Rusmiyati, C., Cahyono, S. A. T., & Purnama, A. (2022). Analysis of the benefits of social assistance policy for victims of natural disasters. *IOP Conference Series: Earth and Environmental Science*, *1109*.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

Langi, C. R. (2023). The Impact of Social Aid on Poverty During the COVID-19 Pandemic: Empirical Evidence From Indonesia. *Public and Municipal Finance*, *12*(2), 104–116.

Lassa, J., Teng, P., Caballero-Anthony, M., & Shrestha, M. (2018). Revisiting Emergency Food Reserve Policy and Practice Under Disaster and Extreme Climate Events. *International Journal of Disaster Risk Science*, *10*(1), 1–13.

Li, H., Xu, E., Zhang, H., & Zhong, S. (2022). A Dynamic Disastrous CGE Model to Optimize Resource Allocation in Post-Disaster Economic Recovery: Post-Typhoon in an Urban Agglomeration Area, China. *Environmental Research Letters*, *17*(7). https://doi.org/10.1088/1748-9326/ac7733.

Narain, J. (2022). India at 75: Transforming the Health of Tribal Populations Through Evidence-Based Policymaking. *Indian Journal of Medical Research, 156*(2), 174–177.

Nugroho, A., Fajri, Iqbal, R. M., Fadhiela, K., Apriyani, D., Ginting, L. N., & Nurdin, S. (2022). Impacts of Village Fund on Post Disaster Economic Recovery in Rural Aceh Indonesia. *International Journal of Disaster Risk Reduction*, *70,* 102768.

Orjiakor, E. C., Adediran, A., Ugwu, J. O., & Nwachukwu, W. (2023). Household Living Conditions and Food Insecurity in Nigeria: A Longitudinal Study During Covid-19 pandemic. *BMJ Open*, *13*(1), e066810. https://doi.org/10.1136/bmjopen-2022-066810.

Roslinawati. (2021). Changes in Society after Natural Disasters Roslinawati. *International Journal of Research and Innovation in Social Science, 7*(2), 427-436.

Singleton, C. R., Chaparro, M. P., O'Malley, K., Fuster, M., & Rose, D. (2022). Emergency Food Distribution Efforts in New Orleans, LA After Hurricane Ida. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.968552.

Sioen, G. B., Sekiyama, M., Terada, T., & Yokohari, M. (2017). Post-Disaster Food and Nutrition From Urban Agriculture: A Self-Sufficiency Analysis of Nerima Ward, Tokyo. *International Journal of Environmental Research and Public Health*, *14*(7), 748. https://doi.org/10.3390/ijerph14070748.

Škare, M., & Družeta, R. P. (2016). Poverty and Economic Growth: A Review. *Technological and Economic Development of Economy*, *22*(1), 156–175.

Sseruyange, J., & Klomp, J. (2021). Natural Disasters and Economic Growth: The Mitigating Role of Microfinance Institutions. *Sustainability*, *13*(9), 5055.

Susantyo, B. (2023). Social Cash Assistance for Food Security During a Disaster: Lesson Learned From Indonesia. *Iop Conference Series Earth and Environmental Science*, *1180*(1), 012047. https://doi.org/10.1088/1755-1315/1180/1/012047.

Timiryanova, V., Krasnoselskaya, D., Lakman, I., & Popov, D. (2021). Inter-and Intra-Regional Disparities in Russia: Factors of Uneven Economic Growth. *Sustainability*, *13*(24), 13754. https://doi.org/10.3390/su132413754.

Verba, D., Kudinova, A., Tkachenko, O., & Samiilenko, A. (2023). Plotting Engel Curves For Commodities "Food" And "Education" In The Context Of Ukrainian Households' Well-Being Evaluation. *Financial and Credit Activity: Problems of Theory and Practice*, *2*(49), 228–238. https://doi.org/10.55643/fcaptp.2.49.2023.3974.

Yang, Y., & Tian, C. (2024). *Risk Assessment and Capacity Building on Food Security in the Lancang-Mekong Countries for Post-Pandemic Recovery*. London: IntechOpen.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.43926

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 77 - 92
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44874

The Impact of Digital Technology on Environmental Quality: An Empirical Evidence from Indonesia

Fitri Kartiasih[1*], Hanifah Putri Rosanti[2], Sabrina Do Miswa[3], Arif Rahman Hakim[4]

[1]DIV Statistics Study Program, Politeknik Statistika STIS, Indonesia
[2]BPS-Statistics of North Kolaka Regency, Indonesia
[3]BPS-Statistics of Balikpapan City, Indonesia
[4]The Postgraduate School, Universitas Airlangga, Indonesia
E-mail: [1]fkartiasih@stis.ac.id, [2]hanifah.putri@bps.go.id, [3]sabrina.domiswa@bps.go.id, [4]arif.rahman@pasca.unair.ac.id

[*]**Corresponding author**

JEL Classification:
O11
O13
Q56

Received: 12 February 2025

Revised: 05 March 2025

Accepted: 11 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research investigates how digital technologies influence environmental quality in Indonesia.

Research Objectives: This study examines the impact of digital technologies and socioeconomic variables on environmental quality in Indonesia.

Research Methods: This study employs the System-Generalized Method of Moments (GMM) approach and analyzes data from 2013 to 2023. Key variables include digital technology, gross regional domestic product (GRDP), foreign direct investment (FDI), and mean years of schooling.

Empirical Results: Computer ownership negatively impacts environmental quality due to higher energy consumption and e-waste. In contrast, GRDP improves environmental quality as wealthier regions invest in green infrastructure and stricter policies. FDI has a harmful effect, supporting the 'pollution haven' hypothesis of resource exploitation and unsustainable practices. Education fosters environmental awareness, though its influence is still limited.

Implications: Digital technologies can enhance environmental quality, requiring strategic planning and continuous innovation by central and local governments.

Keywords:

digital technology; environmental quality; sustainable development

How to Cite:

Kartiasih, F., Rosanti, H.P., Miswa, S.D., & Hakim, A.R. (2025). The Impact of Digital Techonologies on Environmental Quality: Empirical Evidence from Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 77-92. https://doi.org/10.15408/sjie.v14i2.44874.

INTRODUCTION

The issue of environmental sustainability and conservation has garnered global attention (Adebayo & Kirikkaleli, 2021; Nathaniel et al., 2021). Environmental challenges persist in many countries, primarily driven by economic activities (Majeed & Luni, 2019). Since the 1972 Stockholm Conference, concerns about the environmental impact of human activities and their link to economic growth have been widely acknowledged (Shi et al., 2019). The Brundtland Report, published by the World Commission on Environment and Development (WCED) in 1987, introduced and popularized the concept of "sustainable development," which has since served as a fundamental framework for developing more practical sustainability strategies. Today, sustainable development emphasizes environmental protection for future generations and the advancement of social and economic well-being. Many nations are actively working to address the challenges posed by environmental degradation while striving for sustainable economic growth (Ali et al., 2019).

Development in Indonesia brings both positive and negative impacts, often conflicting with the principles of sustainable development (Maryunani, 2018). Economic growth is a positive outcome, while environmental degradation is a significant downside. Natural resources are crucial to a country's economic prosperity (Pribadi & Kartiasih, 2020). However, the environmental carrying capacity is often overlooked when pursuing rapid economic expansion. Consequently, such growth tends to yield short-term benefits while causing significant long-term environmental harm. Sustainable economic progress depends on the efficient, effective, and responsible utilization of natural resources (Saleh et al., 2020). Given Indonesia's abundant natural resources, its economy heavily relies on exploitation. However, unsustainable practices in mining, agriculture, industrialization, and deforestation contribute to environmental destruction (Danish et al., 2019; Miswa & Kartiasih, 2025). In 2024, Indonesia ranked 164th out of 180 countries on the Environmental Performance Index (EPI), with a score of 28.2, indicating poor environmental quality (Block et al., 2024). This ranking highlights Indonesia's significant challenge in balancing economic development with environmental sustainability.

The rapid advancement of information and communication technology (ICT) is driving a global shift towards digitalization in economic activities (Kartiasih et al., 2023, 2023a, 2023b). Technologies like the internet, big data, cloud computing, and artificial intelligence are being developed, implemented, and integrated into various sectors, giving rise to a new economic model known as the digital economy (Zhu et al., 2022). The digital economy leverages ICT to enhance productivity and optimize economic structures (Wang et al., 2022).

Over the past decade, the rise of digital technology has provided new impetus for economic growth (Li et al., 2020). Amidst the global environmental crisis, digital technology presents opportunities for more effective solutions to environmental challenges (Broo et al., 2021). Recognizing its significance, the United Nations General Assembly (UNGA) identified digital technology as a crucial factor in achieving the Sustainable Development Goals (SDGs) for 2016–2030 (Yang et al., 2022). The digital economy is viewed as a means to address economic development challenges, particularly externalities

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

associated with economic activities. Traditional products and services are increasingly being replaced by digital alternatives, such as e-banking, e-commerce, e-books, online education, and virtual meetings (Ahmed & Le, 2021). These shifts contribute to reduced resource consumption and energy use through dematerialization and decreased travel (Ahmed & Le, 2021). However, efforts to expand digital technology have also led to a surge in infrastructure demands and higher energy consumption, ultimately potentially increasing CO_2 emissions more than mitigating them (Zhou et al., 2019). Several studies, including those by Wang et al. (2022), Zhu et al. (2022), Li et al. (2021), and Sultana et al. (2022), have analyzed the impact of digital technology on environmental quality, particularly CO_2 emissions while considering geographical factors.

The debate on the environmental impact of digital technologies is divided between their potential to promote sustainability and their unintended negative consequences. On the positive side, digitalization enhances energy efficiency through smart grids, AI-driven management, and real-time monitoring, reducing waste and emissions (Zhang et al., 2021). It also supports sustainable production via Industry 4.0 technologies, optimizing resource use and promoting circular economy practices (Geissdoerfer et al., 2017). Additionally, digital tools enable environmental monitoring through satellite imaging and big data analytics, aiding conservation and disaster management (Wang et al., 2022; Rolnick et al., 2019). Furthermore, digitalization contributes to decarbonization by facilitating remote work and e-commerce, reducing transportation-related emissions (Hook et al., 2020).

However, digital technologies also pose environmental risks. The rapid growth of electronic devices has led to rising e-waste, with inadequate recycling infrastructure exacerbating pollution (Baldé et al., 2020). The high energy demand of data centers and blockchain technology significantly contributes to carbon emissions, especially in regions reliant on fossil fuels (Jones, 2018). Furthermore, the extraction of rare earth metals for digital infrastructure causes deforestation and water contamination (Ali et al., 2017). Lastly, the rebound effect, where efficiency gains lead to increased consumption, offsets environmental benefits, as evidenced by greater energy use, digital consumerism, and rising waste generation (Santarius et al., 2018; Wiedmann & Lenzen, 2018). Thus, while digitalization presents opportunities for sustainability, its ecological footprint must be carefully managed.

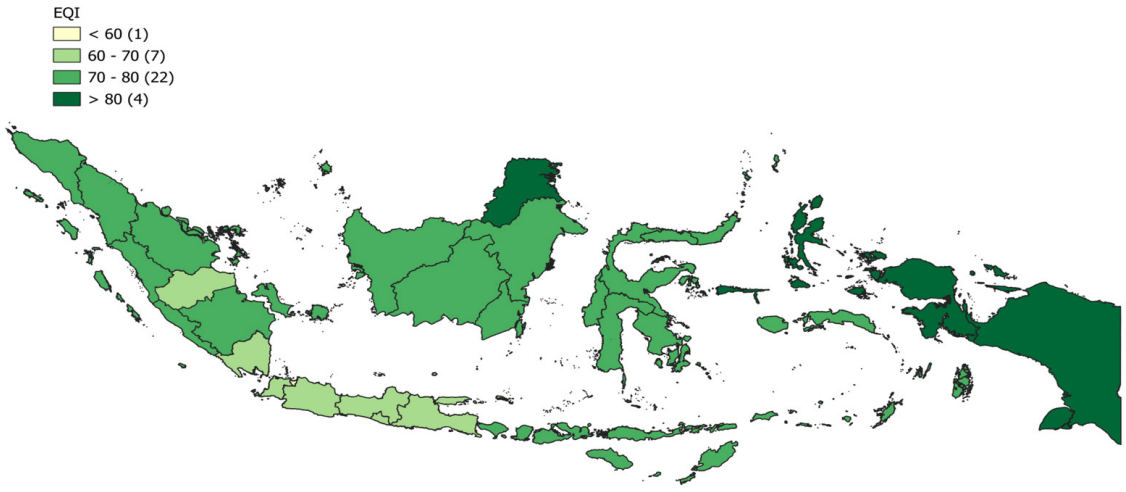
Numerous studies have examined the impact of digital technology on environmental quality in China (Huang et al., 2023; Li et al., 2021; Yang et al., 2022; Zhang et al., 2023; Zhao et al., 2023). However, such studies for the Indonesian region are still limited. Research linking digital technology to environmental quality in Indonesia is scarce. There could be unforeseen detrimental effects of digital technologies on sustainable development (Li et al., 2020). There is still a lack of research on the impact of digital technology on environmental performance and sustainability. Therefore, this study aims to analyze the impact of digital technologies and socio-economic variables on environmental quality. Even though digital technology in Indonesia has great potential to continue to grow so that it can have an impact on environmental conditions in the future, this study utilizes an empirical approach to strengthen the argument and represent one of the actively developing countries in the Asian region, using Indonesia as a case study.

This study differs from previous digital technology and environmental quality research in two key aspects. First, we apply the Generalized Method of Moments (GMM) estimation technique to analyze the impact of digital technology on environmental quality. Earlier studies have taken different approaches, including a systematic literature review (Aniqoh, 2020; Charfeddine & Umlai, 2023), a spatial regression model (Zhu et al., 2022), and static panel data analysis (Li et al., 2021). GMM is a robust method that addresses endogeneity through instrumentation (simultaneity) and considers time-invariant omitted variables. Furthermore, it mitigates over-identification issues and accounts for cross-sectional dependencies (Baltagi, 2008). Second, we incorporate three key indicators of digital technology: the percentage of internet users, mobile phone penetration, and computer ownership. The study's results demonstrate that these digital technology indicators have distinct effects on environmental quality. In contrast, prior research, such as Wang et al. (2022) and Zhu et al. (2022), primarily relied on digital economy indexes.

METHODS

This study covers 34 provinces in Indonesia from 2013 to 2023, as seen in Figure 1. Most Indonesians still live below poverty (Tohari et al., 2019). There are many areas with high poverty rates, especially in eastern Indonesia, which includes Papua, West Papua, Maluku, East Nusa Tenggara, West Nusa Tenggara, Central Sulawesi, West Sulawesi, as well as two areas in western Indonesia, namely South Sumatra, and Aceh. Meanwhile, areas with moderate poverty rates are mostly located in western Indonesia, including North Sumatra, Jambi, Riau, Lampung, North Kalimantan, West Java, Central Java, Yogyakarta, East Java, and three areas in eastern Indonesia, namely Southeast Sulawesi, North Sulawesi, and South Sulawesi. Similarly, areas with low poverty rates are mostly located in western Indonesia. The geographical condition, high diversity, population size, and many other factors pose significant challenges in alleviating poverty in Indonesia (Nugroho et al., 2021).

Figure 1. Environmental quality index in Indonesia, 2023



Source: The Ministry of Environment and Forestry, processed.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

The key dependent variable in this study is the Environmental Quality Index (EQI), which serves as a composite measure of environmental conditions. The EQI ranges from 0 to 100 and is derived from four sub-indices: the water quality index, air quality index, land quality index, and seawater quality index. The data on EQI is collected from the Ministry of Environment and Forestry.

The independent variable of interest, digital technology (DT), is represented by three key indicators: internet users, mobile phone penetration, and computer ownership. Control variables include Gross Regional Domestic Product (GRDP), Foreign Direct Investment (FDI), and Mean Years of Schooling (MYS). GRDP is measured in billions of rupiah at constant 2010 prices, while FDI is expressed in millions of USD. MYS reflects the average years of schooling among the population. These control variables are obtained from BPS-Statistics Indonesia. Since GRDP is frequently linked to environmental quality in existing literature, a natural logarithm transformation is applied to improve the accuracy of the estimates and address heteroscedasticity issues (Nosheen et al., 2020). The transformation also helps normalize the data distribution, making it more symmetrical.

FDI is included in the model as it can positively and negatively affect environmental quality. While it can stimulate economic growth through capital infusion, managerial expertise, and technology transfer, it may also lead to environmental degradation if directed toward highly polluting industries (Bekun et al., 2024). The environmental impact of FDI is influenced by the source country's policies rather than the host country's regulations (Adeel-Farooq et al., 2021). Education, represented by MYS, is another critical factor. Studies suggest that higher education levels can lead to better environmental awareness and reduced carbon emissions Zafar et al. (2020). However, in many developing countries, environmental sustainability is not emphasized in the education system, limiting its impact on environmental protection (Zhang et al., 2022).

This study employs a regression model to analyze the effects of digital technology and socioeconomic factors on environmental quality. The initial static model is formulated as follows:

$$EQI_{it} = \beta_0 + \beta_1 DT_{it} + X'_{it} + \varepsilon_{it} \quad (1)$$

where EQI_{it} is the Environmental Quality Index for province i at time t, DT_{it} is digital technology indicators, X'_{it} are vector of control variables (GRDP, FDI, and MYS), β_0 and ε_{it} are the constant and the error term, respectively.

Since static models may not fully capture the dynamics of the relationship, the model is extended to a dynamic specification by incorporating the lagged dependent variable as an explanatory variable:

$$EQI_{it} = \beta_0 + \beta_1 EQI(-1) + \beta_2 DT + \beta_3 \ln GRDP + \beta_4 FDI + \beta_5 MYS + \varepsilon_{it} \quad (2)$$

In this dynamic model, EQI_{it} accounts for persistence in environmental quality over time.

The study employs the Generalized Method of Moments (GMM) estimator to estimate this dynamic panel model, following the framework proposed by Arellano &

Bond (1991) and later refined by Arellano & Bover (1995) and Roodman (2009). GMM is chosen for three primary reasons: (1). Panel Data Suitability: The study's dataset structure (N = 34, T = 11) aligns with the GMM framework, which is well-suited for handling panel data with more cross-sectional units (N) than periods (T); (2). Endogeneity Control: GMM effectively addresses endogeneity issues by using lagged values as instruments, thereby controlling for simultaneity bias; and (3). Robustness to Unobserved Heterogeneity: The method accounts for omitted variables that do not change over time, ensuring unbiased estimation.

The study employs the "Difference GMM" approach, which transforms regressors by taking first differences to eliminate fixed effects. However, different GMMs have limitations, such as weak instrument bias in small samples. To overcome this, the "System GMM" estimator is also utilized, which incorporates both level and difference equations to improve efficiency (Blundell & Bond, 2023). For reliability, GMM estimates must meet two key diagnostic criteria: (1). Autocorrelation Test: The Arellano-Bond test for AR(1) and AR(2) is conducted to ensure the absence of second-order autocorrelation. The model may suffer from autocorrelation issues if the AR(2) test is significant. (2). Instrument Validity Test: The Hansen J-test is applied to confirm the validity of instrumental variables. A rejection of the null hypothesis indicates potential over-identification problems, questioning the reliability of the instruments. By employing the System-GMM method, this study provides a more robust understanding of the dynamic relationship between digital technology and environmental quality, accounting for both short-term and long-term effects.

RESULTS AND DISCUSSION

Initial insights into the relationship between environmental quality, digital technology, and socioeconomic variables are presented in Tables 1 and 2, which include descriptive statistics and the correlation matrix. The estimation results indicate that the System-GMM approach is more effective than FD-GMM in enhancing parameter estimation accuracy. The findings suggest that environmental quality (EQI) exhibits persistence, while economic growth (GRDP) contributes to its improvement, though emissions and energy consumption challenges remain. Additionally, foreign direct investment (FDI) negatively affects the environment, whereas education and digital technology factors have varying influences on environmental quality.

Table 1. Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
EQI	374	68.98	9.87	35.66	99.27
GRDP	374	302425.06	431159.85	18208	2050465
FDI	374	964.64	1431.531	2	8283.7
MYS	374	8.38	0.99	5.74	11.45
Internet	374	38.96	20.66	5.25	86.71
Mobile phone	374	60.18	10.49	26.05	82.47
Computer	374	15.66	5.34	6.08	34.51

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

The descriptive statistics in Table 2 summarize data from 374 observations for seven variables. The Environmental Quality Index (EQI) has a mean of 68.98 with a standard deviation of 9.87, indicating moderate variability in environmental quality. Internet usage has a mean of 38.96 with a standard deviation of 20.66, reflecting a relatively high degree of dispersion in access. Mobile phone (MP) and computer ownership have averages of 60.18 and 15.66, respectively, with standard deviations of 10.49 and 5.34, indicating that mobile phone is more evenly distributed than computer ownership. Gross regional domestic product (GRDP) has a mean of 302425.06 with high variability (431159.85). In contrast, mean years of schooling (MYS) have a mean of 8.38 with a standard deviation of 0.99, indicating a reasonably uniform distribution in mean years of schooling. Foreign direct investment (FDI) shows a very high degree of dispersion with a standard deviation of 1431.531 and a wide range from 2 to 8283.7, indicating that foreign investment varies significantly between regions.

The correlation matrix is utilized to identify relationships between variables, with matrix elements representing correlation coefficients ranging from -1 to 1. This matrix provides insight into the associations among variables within the dataset. As shown in Table 2, EQI has a negative correlation with GRDP (-0.52), FDI (-0.35), and computer ownership (-0.33). These negative correlations suggest that environmental quality tends to decline as these economic indicators increase. GRDP is strongly positively correlated with FDI (0.71), indicating that regions with higher GRDP tend to attract more foreign investment. MYS has a positive relationship with the Internet (0.57), MP (0.71), and computer ownership (0.44), indicating that higher education levels are associated with better access to technology. Meanwhile, MP and Internet have a high correlation (0.79), indicating that Internet access is closely related to mobile phones. However, computer ownership has low or even negative correlations with other variables, except with MYS (0.44) and MP (0.37), which could indicate that computer ownership is unevenly distributed and less related to key economic indicators.

Table 2. Correlation Matrix

Variables	EQI	GRDP	FDI	MYS	Internet	MP	Computer
EQI	1						
GRDP	-0.52	1					
FDI	-0.35	0.71	1				
MYS	-0.14	0.23	0.19	1			
Internet	0.02	0.28	0.21	0.57	1		
Mobile phone	-0.09	0.28	0.18	0.71	0.79	1	
Computer	-0.33	0.22	0.11	0.44	-0.08	0.37	1

Table 3 presents the estimation results using the First-Difference Generalized Method of Moments (FD-GMM) to analyze the factors affecting the environmental quality index (EQI) with the independent variables internet, mobile phone, and computer. AR(1) is significant in all models, indicating the presence of first-order autocorrelation, which

is common in dynamic models. AR(2) is significant in all models, indicating second-order autocorrelation, which means the GMM model cannot be considered valid. The Sargan test value is high but only insignificant in models (1) and (4), indicating that the instruments used are valid in these models. However, in the model (2), the Sargan test is significant, indicating that the instruments in this model may be less valid. The overall model significance test (Wald test) is significant in all models, indicating that the independent variables jointly have a significant effect on the dependent variable (EQI).

In Table 3, columns 2-4, the use of digital technology represented by the internet, mobile phones, and computers has a significant positive effect on environmental quality at a significance level of 5 percent. The internet coefficient is 0.1618, meaning that every 1 percent increase in internet users will increase environmental quality by 0.1618 points, assuming other variables are constant. Mobile phone users have a positive and significant effect on environmental quality in Indonesia at a significance level of 5 percent with a coefficient value of 0.5961, meaning that an increase in mobile phone users by 1 percent will increase EQI by 0.5961 points, assuming other variables are constant.

Table 3. FD-GMM estimation findings

Explanatory variables	Dependent variable: EQI		
	Model 1 (Internet)	Model 2 (MP)	Model 3 (Computer)
EQI (−1)	0.1278**	0.0475	0.0588
	(0.0621)	(0.0563)	(0.0547)
lnGRDP	0.6466	-3.0181	0.9099
	(2.2014)	(3.4326)	(2.3781)
FDI	0.0005	0.0007	0.0005
	(0.0006)	(0.0006)	(0.0005)
MYS	-3.8930	-2.9708*	6.2737***
	(3.1382)	(1.7721)	(1.3153)
Internet	0.1618***	-	-
	(0.0560)		
MP	-	0.5961***	-
		(0.1362)	
Computer	-		0.2535**
			(0.1101)
AR(1)	-3.8695	-3.4594	-3.5672
	[0.0001]	[0.0005]	[0.0003]
AR(2)	-3.3529	-3.0455	-3.9725
	[0.0004]	[0.0023]	[0.0000]
Sargan	34	33.4302	33.8282
	[0.8615]	[0.0023]	[0.8662]
Wald Test	40.1006	32.4323	43.2203
	[0.0000]	[0.0000]	[0.0000]

Notes: The value in the brackets are the t statistics and the value in the square brackets are the p-value ***p<0.1, **p<0.5, *p<0.1

These results align with research by Haseeb et al. (2019), which states that using a mobile phone increases energy savings and contributes positively to air quality. A study by Asongu et al. (2019) also found that mobile phones as a communication medium

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

can contribute to reducing direct (physical) meetings that require motorized vehicles or transportation so that, in the end, they can reduce CO2 emissions. In addition, research by Wathuge and Sedera (2021) indicates that increased individual awareness of the environmental impact of internet use may contribute to reducing carbon emissions related to online activities.

Table 4 presents the estimation results using System-GMM, which is more efficient than FD-GMM as it considers additional moments to improve parameter estimates. The results show that EQI in the previous period had a significant positive effect in all models, indicating a persistent effect on environmental quality, where previous conditions strongly influenced current conditions. This result aligns with the research of Zhang et al. (2020), which found that environmental quality has a strong, persistent effect in developing countries. GRDP also has a significant positive impact in all models, indicating that regions with higher income tend to have better environmental quality, possibly due to the allocation of funds for green infrastructure and better environmental policies. While an increase in the quality of life, marked by an increase in GRDP, will increase the demand for goods and services, requiring producers to expand production activities, this can lead to an increase in resource consumption and pollution (Ilham, 2021). The economy in Indonesia still relies on energy sources that are not environmentally friendly, so economic growth will still be accompanied by an increase in CO2 emissions (Sasana & Aminata, 2019). The study by Wang et al. (2019) also demonstrates that economic growth frequently leads to environmental degradation in countries with high fossil energy dependence.

Table 4. System-GMM estimation findings

Explanatory variables	Dependent variable: EQI		
	Model 4 (Internet)	Model 5 (MP)	Model 6 (Computer)
EQI (−1)	0.0828*** (0.0352)	0.7965*** (0.0382)	0.8004*** (0.0349)
lnGRDP	0.5852*** (0.0352)	0.6609*** (0.1635)	0.6461*** (0.1544)
FDI	-0.0006*** (0.0002)	-0.0007*** (0.0002)	-0.0007*** (0.0002)
MYS	0.2194 (0.3432)	0.3045 (0.4435)	0.5372* (0.2908)
Internet	0.0076 (0.0086)	-	-
MP	-	0.0072 (0.3363)	-
Computer	-	-	-0.0993* (0.0569)
AR(1)	-3.7452 [0.0001]	-3.9436 [0.0000]	-4.5853 [0.0000]
AR(2)	-2.4040 [0.0162]	-2.4137 [0.0158]	-2.4262 [0.0152]
Sargan	33.7194 [0.9940]	33.7246 [0.9939]	33.7205 [0.994]
Wald Test	172567.8 [0.0000]	98424.49 [0.0000]	151082.5 [0.0000]

Notes: The value in the brackets are the t statistics and the value in the square brackets are the p-value ***p<0.1, **p<0.5, *p<0.1

Our findings indicate a negative and significant impact of foreign direct investment (FDI) across all models, suggesting that increased foreign investment may lead to a decline in environmental quality. This study supports the 'pollution haven' hypothesis, which posits that foreign investment can lead to the exploitation of natural resources or adopting more lenient environmental policies in the host country. FDI contributes to higher environmental emissions in developing nations by facilitating industrial migration from developed countries, with stricter pollution controls, to regions with weaker regulations (Gill et al., 2018). Countries with less stringent environmental policies become attractive destinations for foreign investors seeking to lower pollution-related costs and maximize economic gains (Fang et al., 2018). Consequently, foreign investment tends to exacerbate pollution in the recipient nation.

Furthermore, mean years of schooling (MYS) are statistically significant only in model (3), exhibiting a positive effect ($p<0.1$). Higher education levels may contribute to greater environmental awareness and adoption of sustainable practices. As education improves, environmental quality tends to follow suit. The interaction between humans and the environment plays a crucial role in sustainable development, particularly in efforts to achieve clean and affordable energy (Scharlemann et al., 2020). This finding aligns with the study by Koçak & Çelik (2022), which indicates that human development, as measured by the human development index, reduces PM 2.5 levels, ultimately benefiting environmental quality. This result is also supported by the research of Liu et al. (2021), which found that an increase in education correlates with broader adoption of green policies.

The impact of digital technologies yielded mixed results. Internet and mobile phone usage were insignificant, differing from previous FD-GMM findings, suggesting that their influence on environmental quality (EQI) may be indirect. However, computer use exhibited a negative effect in model (4), potentially indicating that increased computer usage contributes to higher energy consumption or e-waste, negatively affecting the environment. Diagnostic tests confirm the model's validity, as there is no evidence of second-order autocorrelation (AR(2) is insignificant), and the Sargan test supports the instrument's validity. Additionally, the Wald test was significant ($p<0.01$), verifying that the independent variables collectively impact EQI.

The System-GMM estimation results (Table 4) allow for a comparison of the effects of digital technology. The Internet, mobile phones, and computers on environmental quality represent it. In this dynamic model, the Internet and mobile phones do not significantly impact environmental quality. While the Internet may contribute to increased environmental awareness and energy efficiency, its overall effect depends on how it is utilized (Zhao et al., 2022). Unlike the findings from the FD-GMM estimation, mobile phone usage in the System-GMM model does not show a clear impact on environmental quality, potentially due to more complex long-term effects, such as energy consumption and environmental costs associated with device production offsetting any benefits (Shahbaz et al., 2020). Conversely, an increase in computer ownership or usage is linked to a decline in environmental quality, possibly due to higher electricity consumption, increased e-waste, and carbon emissions from the manufacturing of computer devices (Wang et

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

al., 2023). This finding aligns with research by Sinha et al. (2020), which found that the use of digital technology devices, especially computers, correlates with increased electricity consumption and carbon emissions in developing economies. The findings are also consistent with the study by Liu et al. (2021), which highlights that increasing reliance on information technology can increase the carbon footprint, particularly if not supported by adequate renewable energy use.

Moreover, computer usage significantly impacts environmental quality, but negatively. This result suggests that increased computer use is associated with decreased environmental quality. Conversely, internet and mobile phone usage do not exhibit a strong influence in the long run. These results align with research by Sinha et al. (2020), who found that the use of digital technology devices, especially computers, correlates with increased electricity consumption and carbon emissions in developing economies. This finding is also consistent with the study by Liu et al. (2021), which highlights that increasing reliance on information technology can increase the carbon footprint, primarily if not supported by adequate renewable energy use.

The main findings show that economic growth (GRDP) contributes to improved environmental quality, while foreign investment (FDI) has a negative impact, supporting the 'pollution haven' hypothesis (Gill et al., 2018; Fang et al., 2018). Educational factors also play a role in increasing environmental awareness, although the effect is not consistently significant (Koçak & Çelik, 2022; Scharlemann et al., 2020). Conversely, the impact of digital technologies on environmental quality varies, with computer use showing significant negative effects, likely due to increased energy consumption and e-waste (Wang et al., 2023; Sinha et al., 2020; Liu et al., 2021). Meanwhile, Internet and mobile phone use do not have significant direct impacts in the long term, indicating that the environmental benefits of digital technologies depend primarily on their usage patterns (Zhao et al., 2022; Shahbaz et al., 2020). Therefore, policies that encourage the sustainable use of digital technologies and stricter regulation of foreign investment are needed to ensure that economic growth and technological development do not come at the expense of environmental quality.

CONCLUSION

Therefore, by analyzing the impact of digital technology on environmental quality in 34 provinces in Indonesia from 2013 to 2023 using the System-GMM approach, our results indicate that, of the three digital technology indicators analyzed—internet usage, mobile phone (MP) penetration, and computer ownership—only computer ownership has a significant impact on environmental quality (EQI), and this impact is negative. This condition is likely due to higher energy consumption and e-waste. Meanwhile, the internet and mobile phones do not show significant effects in the long run, which could be due to more complex impact mechanisms or suboptimal energy and digital waste management policies. From an economic perspective, GRDP contributes positively to EQI, suggesting that regions with higher incomes tend to have better environmental quality, possibly due to investments in green infrastructure and stricter environmental policies. In contrast, foreign direct investment (FDI) has a negative impact on EQI, supporting the 'pollution

haven' hypothesis, which suggests that foreign investment may encourage the exploitation of natural resources and less environmentally friendly industrial practices.

Both central and local governments must develop sustainability-focused digital strategies and actively promote green technology innovation. Internet and mobile phone technologies should be utilized more effectively to raise environmental awareness through digital campaigns, eco-friendly applications, and data-driven emission monitoring systems. Conversely, the negative impacts of computer use can be reduced through policies that encourage energy-efficient devices and strengthen regulations and incentives for effective e-waste management. In addition, the government should ensure that foreign investments meet strict sustainability standards to prevent environmental degradation. Financial support and subsidies for developing green technologies such as smart grids are also indispensable to ensure that digitalization improves environmental quality in the long run. With the right policies, the utilization of digital technology in Indonesia can be optimized as a tool to improve environmental sustainability, not just as a driver of economic growth.

REFERENCES

Adebayo, T. S., & Kirikkaleli, D. (2021). Impact of Renewable Energy Consumption, Globalization, and Technological Innovation on Environmental Degradation in Japan: Application of Wavelet Tools. *Environment, Development and Sustainability*, *23*(11), 16057–16082. https://doi.org/10.1007/s10668-021-01322-2.

Adeel-Farooq, R. M., Riaz, M. F., & Ali, T. (2021). Improving the Environment Begins at Home: Revisiting the Links between FDI and Environment. *Energy*, *215*, 119150. https://doi.org/10.1016/j.energy.2020.119150.

Ahmed, Z., & Le, H. P. (2021). Linking Information Communication Technology, Trade Globalization Index, and CO2 Emissions: Evidence from Advanced Panel Techniques. *Environmental Science and Pollution Research*, *28*(7), 8770–8781. https://doi.org/10.1007/s11356-020-11205-0.

Ali, R., Bakhsh, K., & Yasin, M. A. (2019). Impact of Urbanization on CO2 Emissions in Emerging Economy: Evidence from Pakistan. *Sustainable Cities and Society*, *48*, 101553. https://doi.org/10.1016/j.scs.2019.101553.

Ali, S. H., Giurco, D., Arndt, N., Nickless, E., Brown, G., Demetriades, A., Durrheim, R., Enriquez, M. A., Kinnaird, J., Littleboy, A. Meinert, L. D., Oberhansli, R., Salem, J., Schodde, R., Schneider, G., Vidal, O., & Yakovleva, N. (2017). Mineral Supply for Sustainable Development Requires Resource Governance. *Nature*, 543(7645), 367-372. https://doi.org/10.1038/nature21359.

Aniqoh, N. A. F. A. (2020). The Role of Digital Economy to Enhancing Sustainable Economic Development. *International Journal of Social Science and Business*, *4*(4), 519-530. https://doi.org/10.23887/ijssb.v4i4.28881.

Arellano, M., & Bond, S. (1991). Some Test of Spesification for Data Panel: Monte Carlo Evidence and an Aplication of Employment Equations. *Source: The Review of Economic Studies*, *58*(2), 277–297. https://doi.org/10.2307/2297968.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

Arellano, M., & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Components Models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D.

Asongu, S. A., Nwachukwu, J. C., & Pyke, C. (2019). The Comparative Economics of ICT, Environmental Degradation and Inclusive Human Development in Sub-Saharan Africa. *Social Indicators Research*, *143*(3), 1271–1297. https://doi.org/10.1007/s11205-018-2009-x.

Baldé, C. P., Forti, V., Gray, V., Kuehr, R., & Stegmann, P. (2020). The Global E-Waste Monitor 2020: Quantities, Flows, and the Circular Economy Potential. *United Nations University (UNU), International Telecommunication Union (ITU), and International Solid Waste Association (ISWA)*.

Baltagi, B. H. (2008). Forecasting with Panel Data. *Journal of Forecasting*, *27*(2), 153–173.

Bekun, F. V., Gyamfi, B. A., Olasehinde-Williams, G., & Yadav, A. (2024). Revisiting the Foreign Direct Investment-CO2 Emissions Nexus within the N-EKC Framework: Evidence from South Asian Countries. *Sustainable Futures*, *8*, 100357. https://doi.org/10.1016/j.sftr.2024.100357.

Block, S., Emerson, J. W., Esty, D. C., de Sherbinin, A., & Wendling, Z. A. (2024). *2024 Environmental Performance Index.* New Haven: Yale Center for Environmental Law and Policy.

Blundell, R., & Bond, S. (2023). Reprint of: Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics*, *234*, 38–55. https://doi.org/10.1016/j.jeconom.2023.03.001.

Brambor, T., Clark, W. R., & Golder, M. (2006). Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis*, *14*(1), 63–82. https://doi.org/10.1093/pan/mpi014.

Charfeddine, L., & Umlai, M. (2023). ICT Sector, Digitization and Environmental Sustainability: A Systematic Review of the Literature from 2000 to 2022. *Renewable and Sustainable Energy Reviews*, *184*, 113482. https://doi.org/10.1016/j.rser.2023.113482.

Danish, Baloch, M. A., Mahmood, N., & Zhang, J. W. (2019). Effect of Natural Resources, Renewable Energy and Economic Development on CO 2 Emissions in BRICS Countries. *Science of the Total Environment*, *678*, 632–638. https://doi.org/10.1016/j.scitotenv.2019.05.028.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy–A New Sustainability Paradigm? *Journal of Cleaner Production*, *143*, 757-768.

Gürdür Broo, D., Lamb, K., Ehwi, R. J., Pärn, E., Koronaki, A., Makri, C., & Zomer, T. (2021). Built environment of Britain in 2040: Scenarios and strategies. *Sustainable Cities and Society*, *65,* 102645. https://doi.org/10.1016/j.scs.2020.102645.

Haseeb, A., Xia, E., Saud, S., Ahmad, A., & Khurshid, H. (2019). Does Information and Communication Technologies Improve Environmental Quality in the Era of Globalization? An Empirical Analysis. *Environmental Science and Pollution Research*, *26*(9), 8594–8608. https://doi.org/10.1007/s11356-019-04296-x.

Hook, A., Court, V., Sovacool, B. K., & Sorrell, S. (2020). A Systematic Review of the Energy and Climate Impacts of Teleworking. *Environmental Research Letters*, 15(9), 093003.

Huang, S., Han, F., & Chen, L. (2023). Can the Digital Economy Promote the Upgrading of Urban Environmental Quality? *International Journal of Environmental Research and Public Health*, *20*(3), 2243. https://doi.org/10.3390/ijerph20032243.

Ilham, M. I. (2021). Economic Development and Environmental Degradation in Indonesia: Panel Data Analysis. *Jurnal Ekonomi & Studi Pembangunan*, *22*(2), 185-200. https://doi.org/10.18196/jesp.v22i2.7629.

Jones, N. (2018). How to Stop Data Centres from Gobbling Up the World's Electricity. *Nature*, 561(7722), 163-166.

Kartiasih, F., Djalal Nachrowi, N., Wisana, I. D. G. K., & Handayani, D. (2023). Inequalities of Indonesia's Regional Digital Development and Its Association with Socioeconomic Characteristics: A Spatial and Multivariate Analysis. *Information Technology for Development*, *29*(2–3), 299–328. https://doi.org/10.1080/02681102.2022.2110556.

Kartiasih, F., Nachrowi, N. D., Wisana, I. D. G. K., & Handayani, D. (2023a). *Potret Ketimpangan Digital dan Distribusi Pendapatan di Indonesia: Pendekatan Regional Digital Development Index* (1st ed.). Jakarta: UI Publishing.

Kartiasih, F., Nachrowi, N. D., Wisana, I. D. G. K., & Handayani, D. (2023b). Towards the Quest to Reduce Income Inequality in Indonesia: Is There a Synergy between ICT and the Informal Sector? *Cogent Economics and Finance*, *11*(2). https://doi.org/10.1080/23322039.2023.2241771.

Li, K., Kim, D. J., Lang, K. R., Kauffman, R. J., & Naldi, M. (2020). How Should We Understand the Digital Economy in Asia? Critical Assessment and Research Agenda. *Electronic Commerce Research and Applications*, *44*, 101004. https://doi.org/10.1016/j.elerap.2020.101004.

Li, Y., Yang, X., Ran, Q., Wu, H., Irfan, M., & Ahmad, M. (2021). Energy Structure, Digital Economy, and Carbon Emissions: Evidence from China. *Environmental Science and Pollution Research, 28.* 64606–64629. https://doi.org/10.1007/s11356-021-15304-4.

Li, Z., Li, N., & Wen, H. (2021). Digital Economy and Environmental Quality: Evidence from 217 Cities in China. *Sustainability*, *13*(14), 8058. https://doi.org/10.3390/su13148058.

Liu, Y., Zhang, S., Zhang, C., & Wang, Y. (2021). The Impact of Digital Economy on Carbon Emissions: Evidence from China. *Sustainability, 13*(13), 7274. https://doi.org/10.3390/su13137274.

Majeed, M. T., & Luni, T. (2019). Renewable Energy, Water, and Environmental Degradation: A Global Panel Data Approach. *Pakistan Journal of Commerce and Social Science*, *13*(3), 749–778.

Maryunani. (2018). *Pengelolaan Sumberdaya Alam dan Pembangunan Ekonomi Secara Berkelanjutan*. Malang: UB Press.

Miswa, S. Do, & Kartiasih, F. (2025). Nexus between Rural Poverty and Environmental quality: empirical evidence from Indonesia. *Asia-Pacific Journal of Regional Science*, *9,* 57-81. https://doi.org/10.1007/s41685-024-00370-6.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44874

Nathaniel, S. P., Nwulu, N., & Bekun, F. (2021). Natural Resource, Globalization, Urbanization, Human Capital, and Environmental Degradation in Latin American and Caribbean Countries. *Environmental Science and Pollution Research*, *28*(5), 6207–6221. https://doi.org/10.1007/s11356-020-10850-9.

Pribadi, W., & Kartiasih, F. (2020). Environmental Quality and Poverty Assessment in Indonesia. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)*, *10*(1), 89–97. https://doi.org/10.29244/jpsl.10.1.89-97.

Rolnick, D., Veit, A., Krause, A., & Bengio, Y. (2019). Tackling Climate Change with Machine Learning. *ACM Computing Surveys (CSUR)*, *55*(5), 1-36.

Roodman, D. (2009). How to Do Xtabond2: An Introduction to Difference and System GMM in Stata. *Stata Journal*, *9*(1), 86–136. https://doi.org/10.1177/1536867x0900900106.

Saleh, H., Surya, B., Ahmad, D. N. A., & Manda, D. (2020). The Role of Natural and Human Resources on Economic Growth and Regional Development: With Discussion of Open Innovation Dynamics. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(4), 1–23. https://doi.org/10.3390/joitmc6040103.

Santarius, T., Walnum, H. J., & Aall, C. (2018). Digitalization and the Anthropocene: Harnessing the Potential and Mitigating the Rebound Effects. *Sustainability Science*, *13*(6), 1535-1547.

Sasana, H., & Aminata, J. (2019). Energy Subsidy, Energy Consumption, Economic Growth, and Carbon Dioxide Emission: Indonesian Case Studies. *International Journal of Energy Economics and Policy*, *9*(2), 117–122. https://doi.org/10.32479/ijeep.7479.

Scharlemann, J. P. W., Brock, R. C., Balfour, N., Brown, C., Burgess, N. D., Guth, M. K., & Kapos, V. (2020). Towards Understanding Interactions between Sustainable Development Goals: The Role of Environment–Human Linkages. *Sustainability Science, 15*, 1573–1584. https://doi.org/10.1007/s11625-020-00799-6.

Shahbaz, M., Balsalobre-Lorente, D., & Sinha, A. (2020). Foreign Direct Investment–CO2 Emissions Nexus in Middle East and North African Countries: What Role of Renewable Energy and Natural Resources? *Energy Economics, 91*, 104632. https://doi.org/10.1016/j.eneco.2020.104632.

Shi, L., Han, L., Yang, F., & Gao, L. (2019). The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects. *Sustainability*, *11*(24), 1–16. https://doi.org/10.3390/su11247158.

Sinha, A., Shahbaz, M., & Sengupta, T. (2020). Renewable Energy Policies and Contradictions in Causality: A Case Study of Next 11 Countries. *Journal of Cleaner Production, 277*, 123492. https://doi.org/10.1016/j.jclepro.2020.123492.

Sultana, N., Mafizur, M., & Rasheda, R. (2022). Environmental Kuznets Curve and Causal Links between Environmental Degradation and Selected Socioeconomic Indicators in Bangladesh. *Environment, Development and Sustainability*, *24*(4), 5426–5450. https://doi.org/10.1007/s10668-021-01665-w.

Wang, J., Luo, X., & Zhu, J. (2022). Does the Digital Economy Contribute to Carbon Emissions Reduction? A City-Level Spatial Analysis in China. *Chinese Journal of Population Resources and Environment*, *20*(2), 105–114. https://doi.org/10.1016/j.cjpre.2022.06.001.

Wang, Y., Huang, J., & Sun, M. (2023). Digital Economy, Energy Consumption, and Carbon Emissions: Evidence from China. *Journal of Environmental Management, 327*, 116857. https://doi.org/10.1016/j.jenvman.2022.116857.

Wang, S., Li, X., Liu, Q., Zhang, C., & Li, J. (2022). AI-Driven Environmental Monitoring: Applications, Challenges, and Future Directions. *Environmental Research Letters*, *17*(3), 035001.

Wiedmann, T., & Lenzen, M. (2018). Environmental and Social Footprints of International Trade. *Nature Geoscience*, *11*(5), 314-321.

Yang, Q., Ma, H., Wang, Y., & Lin, L. (2022). Research on the Influence Mechanism of the Digital Economy on Regional Sustainable Development. *Procedia Computer Science*, *202*, 178–183. https://doi.org/10.1016/j.procs.2022.04.025.

Zafar, M. W., Shahbaz, M., Sinha, A., Sengupta, T., & Qin, Q. (2020). How Renewable Energy Consumption Contribute to Environmental Quality? The Role of Education in OECD Countries. *Journal of Cleaner Production*, *268*, 122149. https://doi.org/10.1016/j.jclepro.2020.122149.

Zhang, C., Khan, I., Dagar, V., Saeed, A., & Zafar, M. W. (2022). Environmental Impact of Information and Communication Technology: Unveiling the Role of Education in Developing Countries. *Technological Forecasting and Social Change*, *178*, 121570. https://doi.org/10.1016/j.techfore.2022.121570.

Zhang, Z., Ding, Z., Geng, Y., Pan, L., & Wang, C. (2023). The Impact of Digital Economy on Environmental Quality: Evidence from China. *Frontiers in Environmental Science*, *11*, 1–12. https://doi.org/10.3389/fenvs.2023.1120953.

Zhao, Y., Kong, X., Ahmad, M., & Ahmed, Z. (2023). Digital Economy, Industrial Structure, and Environmental Quality: Assessing the Roles of Educational Investment, Green Innovation, and Economic Globalization. *Sustainability*, *15*(3), 2377. https://doi.org/10.3390/su15032377.

Zhao, X., Ma, X., & Yuan, X. (2022). Does Digital Economy Development Improve Environmental Quality? Empirical Evidence from China. *Sustainable Production and Consumption, 31*, 98–108. https://doi.org/10.1016/j.spc.2022.01.002

Zhou, X., Zhou, D., Wang, Q., & Su, B. (2019). How Information and Communication Technology Drives Carbon Emissions: A Sector-Level Analysis for China. *Energy Economics*, *81*, 380–392. https://doi.org/10.1016/j.eneco.2019.04.014.

Zhu, Z., Liu, B., Yu, Z., & Cao, J. (2022). Effects of the Digital Economy on Carbon Emissions: Evidence from China. *International Journal of Environmental Research and Public Health*, *19*(15), 9450. https://doi.org/10.3390/ijerph19159450.

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 93 - 110
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44779

Shaping a Sustainable Future: How Energy Consumption and Carbon Emissions Drive Low-Carbon Development

Enni Sari Siregar
Sharia of Economy Department, STAIN Mandailing Natal, Indonesia
E-mail: ennisari056@gmail.com

JEL Classification:
F21
F43
G18
H21
R23

Received: 06 February 2025

Revised: 15 March 2025

Accepted: 23 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: The study examines the impact of deforestation, energy use, transportation, and industrialization in North Sumatra from 1991 to 2021 on low-carbon development. It aims to understand environmental change drivers and propose strategies to mitigate their negative effects on development.

Research Objectives: This research aims to explore the relationship between deforestation, energy consumption, land transportation, and industrialization as factors influencing low-carbon development.

Research Methods: The study examines factors influencing low-carbon development in North Sumatra from 1991 to 2021, including energy consumption, land transportation, industrialization, and deforestation, influenced by population density and property rights.

Empirical Results: The study reveals that deforestation, energy consumption, land transportation, and industrialization significantly impact low-carbon development in North Sumatra, with population density positively influencing deforestation.

Implications: The research suggests that the government should implement policies to reduce deforestation, increase public transportation usage, and promote electric vehicles to achieve low-carbon development, promote efficient energy consumption, and encourage environmentally friendly technological innovation.

Keywords:

carbon emissions; deforestation; energy consumption; low-carbon development

How to Cite:

Siregar, E. S. (2025). Shaping a Sustainable Future: How Energy Consumption and Carbon Emission Drive Low-Carbon Development. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 93-110. https://doi.org/10.15408/sjie.v14i1.44779.

INTRODUCTION

The pursuit of welfare is a fundamental goal for individuals, encompassing income and satisfaction derived from the benefits of economic activities. To achieve this, governments promote economic development to enhance social wealth and community welfare. However, it is essential that this economic growth is pursued sustainably, considering environmental impacts. Sustainable economic development requires balancing capital, human, and natural resources while integrating social, institutional, and political aspects (Jie & Lan, 2024). Low-carbon development is one such approach that seeks to reduce emissions, promote economic growth, and mitigate poverty. Cutting emissions can increase economic growth while improving air quality and living standards and reducing mortality rates (Mahalik et al., 2022).

Natural resources, which should be an asset for governments, can sometimes hinder low-carbon development if their utilization leads to environmental degradation. Deforestation, for instance, is a significant issue that can arise from excessive resource exploitation and land conversion (Qamruzzaman, 2024). Clearing forests produces carbon emissions, primarily through burning, contributing to climate change. North Sumatra, with a population of over 15 million, faces challenges in achieving low-carbon development due to its dense population and the environmental impacts of economic activities.

Under regional autonomy, local governments in North Sumatra work to improve community welfare and alleviate poverty through economic development that supports sustainable goals. However, such development, mainly through natural resource use, can negatively impact the environment and hinder low-carbon objectives (Hariram et al., 2023). Deforestation is one such environmental issue, as shown by the trends in carbon emissions and deforestation between 2016 and 2021. Key factors contributing to carbon emissions include energy consumption, transportation, industrialization, and deforestation (Hoa et al., 2024).

The relationship between carbon emissions and deforestation in North Sumatra is complex. Energy consumption, mainly from fossil fuels, contributes significantly to carbon emissions. Similarly, land transportation and industrialization also play a role, with the transportation sector crucial for economic activities and contributing to emissions. Deforestation, however, is the most direct environmental issue, with its impacts including climate change, biodiversity loss, and the risk of natural disasters such as floods and landslides. Studies from various regions, such as China, Brazil, and Russia, highlight the interplay between economic growth, deforestation, and environmental sustainability, emphasizing policies that promote balanced growth while protecting forest resources (Li et al., 2022). Several key factors drive deforestation in North Sumatra. Agricultural expansion for commodities like palm oil, rubber, and food crops leads to forest clearance. Illegal logging and unsustainable timber extraction also contribute significantly. The growing population demands more land for housing and agriculture, further encroaching on forests. Infrastructure development, like roads, increases forest access, promoting exploitation. Weak government policies and inconsistent enforcement allow for continued deforestation. Climate change stresses ecosystems, making forests more vulnerable, while land tenure

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

conflicts between local communities, the government, and businesses further exacerbate the problem. These factors combine to create a complex issue that requires comprehensive solutions. Table 1 shows the variable influence of deforestation in North Sumatra.

Table 1. Variables Suspected to Influence Deforestation in North Sumatra

Year	Population density (%)	Property rights (%)	Industrialization (%)
2016	1,05	2,68	5,05
2017	1,55	4,94	2,31
2018	1,02	10,68	3,66
2019	1,01	7,35	1,23
2020	1,50	6,38	-0,84
2021	0,49	6,32	1,43

Sources: Badan Pusat Statistik (BPS)

The increasing population from year to year can also cause deforestation, especially in rural areas where people without fixed livelihoods tend to utilize forests to earn a living. Property rights also play a crucial role, as land ownership rights must be established to prevent loopholes for deforestation actors. This condition is also related to the formation of capital and the extent of forests, and these are large-scale economic factors that can impact the extent of deforestation.

Najicha et al. (2023) explain the transition to sustainable energy management and its importance in mitigating the impact of fossil fuel consumption, which currently accounts for 73% of greenhouse gas (GHG) emissions in the energy sector. The focus is on policy changes and implementing renewable energy solutions supported by legal and regulatory frameworks. It emphasizes the global significance of green investments in renewable energy and the need for harmonizing legislation and technical standards to achieve sustainable development effectively. The study points out that while the energy management model has become more dynamic and adaptable through intelligent monitoring and control, there is still a gap in its optimal implementation (Najicha et al., 2023).

According to Androniceanu et al. (2024) technological advancements and the evolution of public policies supporting energy transitions drive the growing importance of sustainable energy. It uses bibliometric analysis to track trends in research from 1991 to 2024, focusing on the intersections of sustainable energy, renewable energy, and sustainable development. The study underscores the increasing collaboration in research, the significance of high-impact journals in shaping sustainability policies, and the growing emphasis on renewable energy and CO2 emissions. By analyzing these themes, the paper highlights emerging trends in environmental policy and calls for formulating coherent sustainability strategies.

Both studies emphasize the importance of sustainable energy transitions but with a focus on policy, research, and technological advancements. This study comprehensively analyzes the relationship between deforestation, energy consumption, transportation, and industrialization in North Sumatra from 1991 to 2021. It stands out from previous

research by examining how these factors interact over time in a specific regional context rather than in isolation. Previous studies have focused on global or national levels, whereas this research provides a localized understanding of North Sumatra's unique challenges (Stacey et al., 2021). The study fills a gap in the literature by exploring the combined impacts of these factors on low-carbon development, with particular attention to local governance and policy initiatives aimed at mitigating deforestation.

The study's contribution lies in its integrated model for low-carbon development in North Sumatra, which incorporates factors such as energy use, land transportation, industrialization, and deforestation. It emphasizes the need for policies addressing the complex interactions between these variables to achieve environmental and economic sustainability. The research provides valuable insights for local governments and policymakers, offering actionable recommendations for promoting sustainable growth while minimizing environmental degradation. Ultimately, the study aims to help achieve low-carbon development goals in North Sumatra and offers potential applications for other regions facing similar challenges. Unlike previous studies focusing on global or national scales and isolated factors, this study offers a localized analysis, highlighting the interactions between these factors in a specific region. Its novelty lies in developing an integrated model for low-carbon development, which provides actionable insights for local governments and policymakers to achieve sustainable growth while minimizing environmental degradation.

METHODS

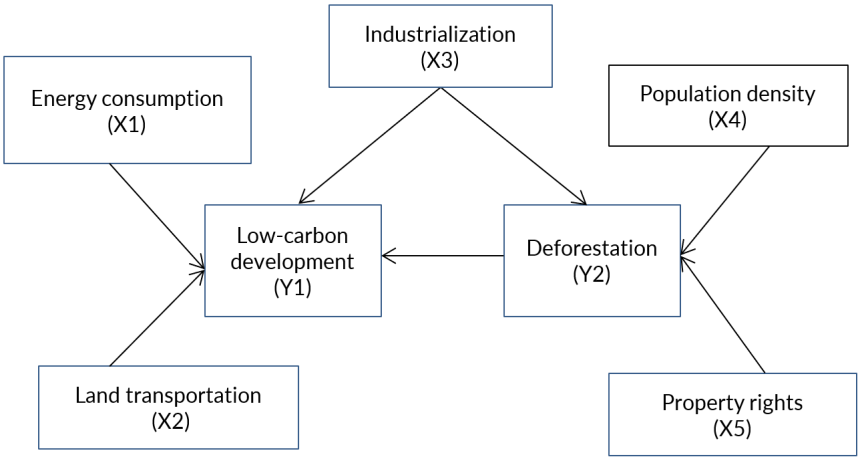
The data used in this research is secondary data collected from the Central Statistics Agency of North Sumatra, covering a period of 31 years. This extensive time frame allows for a thorough analysis of the long-term trends and relationships between various factors that influence low-carbon development in the region. Figure 1 shows the conceptual framework from this research. The key variables studied in this research include:

1. Low-carbon development (Y1): Represented by the low-carbon development index, which tracks the region's progress in reducing carbon emissions while promoting sustainable economic growth.
2. Deforestation (Y2): Measured by the deforestation area in hectares, reflecting the extent of land-use changes and the impact of deforestation activities.
3. Energy consumption (X1): Represented by the fuel consumption volume in kiloliters, which indicates the demand for fossil fuels, a major contributor to carbon emissions.
4. Land transportation (X2): Measured by the number of registered land vehicles, indicating the transportation sector's role in carbon emissions.
5. Industrialization (X3): Represented by the GDP value of the industrial sector in Rupiah, reflecting the level of industrial activity and its contribution to carbon emissions.
6. Population density (X4): Represented by the population density figure, which is a demographic factor influencing land use and resource consumption.
7. Property rights (X5): Measured by the number of land ownership certificates, which can affect land management and contribute to deforestation.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

The secondary data from these indicators provide a comprehensive set of variables to examine how various socio-economic and environmental factors interact to influence low-carbon development in North Sumatra.

Figure 1. Conceptual framework



The analysis in this research employs quantitative methods, using both descriptive and associative techniques to understand the relationships between the variables (Kotronoulas et al., 2023).

1. Descriptive Analysis: This approach helps in summarizing the data and providing an overview of the trends in each of the variables over the 31-year period. It will present the general patterns and provide context for understanding how each factor has evolved.
2. Associative Analysis: This method is used to analyze the relationships between the variables and understand how they affect each other. The key to this analysis lies in the regression models that are mathematically represented by the equations:
   - Equation 1:

     $$Y_{1t} = \alpha_0 + \alpha_1 \hat{Y}_{2t} + \alpha_2 X_{1t} + \alpha_3 X_{2t} + \alpha_4 X_{3t} + \varepsilon_{1t}$$

     This equation examines the relationship between low-carbon development (Y1) and the independent variables: deforestation area (Y2), energy consumption (X1), land transportation (X2), and industrialization (X3), with ε_{1t} representing the error term.
   - Equation 2:

     $$Y_{2t} = \alpha_5 + \alpha_6 X_{3t} + \alpha_7 X_{4t} + \alpha_8 X_{5t} + \varepsilon_{2t}$$

     This equation investigates the influence of industrialization (X3), population density (X4), and property rights (X5) on deforestation area (Y2), with ε_{2t} as the error term.
3. The regression models aim to quantify how the various factors influence the dependent variables (low-carbon development and deforestation), allowing for a deeper understanding of their causal relationships.

Table 2. Research variable indicators

No	Variables	Indicators	Unit
1	Low-carbon development (Y1)	Low-carbon development index	Index
2	Deforestation (Y_2)	Deforestation area	Hectares
3	Energy consumption (X1)	Fuel consumption volume	Kiloliter
4	Land transportation(X2)	The number of registered land vehicles	Unit
5	Industrialization (X3)	GDRP value of the industrial sector	Rupiah
6	Population density (X4)	Population density figure	People
7	Property rights (X5)	The number of land ownership certificates	Unit

Statistical analysis tools such as multiple regression analysis will likely be used to test the significance of these relationships and evaluate the strength of the influence each factor has on the outcome variables. These tools provide a way to measure and validate the hypotheses that different factors, such as energy consumption or deforestation, are related to developing a low-carbon economy in North Sumatra (Gunawan et al., 2024). The research combines descriptive methods to summarize data trends and associative methods, specifically regression analysis, to explore the relationships between energy consumption, industrialization, land transportation, deforestation, and low-carbon development. These analytical tools will help provide insights into the complex dynamics in North Sumatra's pursuit of sustainable, low-carbon growth.

RESULTS AND DISCUSSION

It is important to understand that this equation models the relationship between energy consumption, carbon emissions, and economic growth. It aims to assess how different strategies, such as energy efficiency improvements and the adoption of renewable energy, contribute to reducing carbon emissions while supporting economic development. The results, obtained using Eviews software, help analyze these relationships and guide policies for achieving sustainable, low-carbon growth. Now, let us look at the estimated results. The estimated results of the low-carbon development equation process are displayed in Table 3.

Table 3. Estimated Results of the Low-Carbon Development

Variabel	Coefficient	Std. Error
C	2,378527	2,018432
$\hat{Y}_2$	-0,217227	0,051796
$Log(X_1)$	-0,023216	0,030400
$Log(X_2)$	-0,363617	0,107216
$Log(X_3)$	-0,352933	0,213409

Note: Significant at 5%
Sources: Data processing results with Eviews

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

From the estimation conducted, the model of the low-carbon development equation in this study is as follows:

$$Y = 2{,}378 - 0{,}217\ \hat{Y}_2 - 0{,}023\log(X1) - 0{,}363\log(X2) - 0{,}352\log(X3)$$

The results of the processed data indicate that deforestation, energy consumption, land transportation, and industrialization significantly impact low-carbon development in North Sumatra. Partially, deforestation has a significant influence on low-carbon development in North Sumatra. Deforestation is an activity that results in the reduction of forest or tree cover, which is expected to produce oxygen needed by humans and absorb carbon dioxide. With the expansion of deforestation, the number of plants acting as carbon emission absorbers will decrease, thus increasing the amount of carbon emissions released.

The low-carbon development equation estimated reveals that all these factors collectively explain about 51% of the variation in low-carbon development, as indicated by the R-squared value of 0.5107. The F-statistic of 6.7853, shows that the model is statistically significant, confirming the relevance of the independent variables in shaping the trajectory of low-carbon development in the region. Among the factors examined, deforestation emerged as a particularly influential variable. The negative coefficient of deforestation demonstrates that deforestation has a substantial adverse effect on low-carbon development. This finding aligns with the work of Raihan and Tuspekova, who argued that deforestation leads to a decrease in the number of carbon-absorbing plants, thereby exacerbating carbon emissions (Raihan & Tuspekova, 2022). The results are also consistent with those of Duchelle et al. (2018), who identified reducing deforestation as one of the key strategies for achieving low-carbon development by mitigating carbon emissions from forest degradation. In the case of North Sumatra, deforestation continues to contribute significantly to carbon emission levels, and this study underscores the need for stricter enforcement of forest protection policies and the promotion of reforestation initiatives to reduce environmental degradation and enhance carbon sequestration.

Energy consumption also plays a crucial role in low-carbon development. The negative coefficient suggests that higher energy consumption is linked to more significant carbon emissions by hindering low-carbon development. This result is consistent with the findings of Yang et al. (2024), who highlighted the environmental consequences of increased energy consumption, mainly from fossil fuels like coal. Raihan et al. also emphasized that the growing demand for energy-intensive products and services contributes to increased carbon emissions (Raihan et al., 2023). In North Sumatra, where energy consumption is closely tied to fossil fuel use, this presents a significant challenge to achieving a low-carbon economy. The study suggests a transition toward cleaner energy sources, such as solar, wind, and hydroelectric power, as well as improvements in energy efficiency through the adoption of energy-saving technologies.

Land transportation is another significant factor influencing low-carbon development. The estimated coefficient indicates that land transportation contributes substantially to carbon emissions, thus obstructing low-carbon development efforts. This result is in line with the study by Wang et al. (2024), which suggested that reducing transportation

frequency and improving transportation efficiency could help reduce carbon emissions. The increasing number of vehicles and reliance on gasoline-powered transportation in North Sumatra contribute to higher carbon emissions, which hinder the region's transition to a low-carbon economy. This study proposes enhancing public transportation infrastructure, promoting the use of electric vehicles, and adopting fuel-efficient technologies. Encouraging shared mobility and transitioning from conventional gasoline-powered vehicles to electric vehicles could significantly reduce emissions from the transportation sector, aligning with global efforts to promote low-carbon development (Choudhari et al., 2024).

Finally, industrialization has a negative effect on low-carbon development in North Sumatra. Industrialization, which often relies on fossil fuels for energy, results in increased greenhouse gas emissions, primarily carbon dioxide. This issue is particularly pressing in North Sumatra, where industrialization is accelerating. The study emphasizes the need for policies that encourage cleaner industrial technologies, greater energy efficiency, and adoption of green technologies. Additionally, carbon pricing mechanisms, such as carbon taxes or emission trading schemes, could provide the necessary economic incentives for industries to reduce emissions and transition toward sustainable practices (Mehmood et al., 2024).

The results of hypothesis testing for the deforestation equation typically assess whether the independent variables (e.g., economic factors, government policies, or land use) significantly impact deforestation rates. A p-value lower than the chosen significance level indicates that the independent variables statistically affect deforestation. If the null hypothesis (suggesting no effect) is rejected, it suggests that the factors studied are indeed influencing deforestation. Conversely, if the p-value is higher than 0.05, the evidence is insufficient to conclude a significant impact, implying that the variables may not be driving deforestation in the analyzed context. The estimated results of the deforestation in the equation analyzed are displayed in Table. 4.

Table 4. Estimation results of the deforestation equation

Variabel	Coefficient	Std. Error	R-squared	F-Statistic
C	57.95469	31.25364	0.6574	17.2712
$Log(X_3)$	3.376397	3.986480		
X_4	0.977409	0.421839		
$Log(X_5)$	-0.016146	0.085224		

Note: Significant at 5%
Sources: Data processing results with Eviews

The estimation results from the deforestation equation analyzed offer valuable insights into the factors influencing deforestation in North Sumatra. The estimated equation from the study is as follows:

$$Y = 57{,}954 + 3{,}376\log(X3) + 0{,}977X4 - 0{,}016\log(X5)$$

Where Y represents the rate of deforestation, X3 stands for industrialization, X4 indicates population density, and X5 represents land ownership rights. The model reveals that industrialization, population density, and land ownership collectively influence deforestation

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

in North Sumatra. The F-statistic yielded a probability value of 0.000, indicating that the overall model is statistically significant. However, when examining the individual variables, industrialization was found to have no significant impact on deforestation, with a p-value of 0.4045. The test result on the R-squared value shows the value of 0.6574, which means the estimation results of the deforestation equation are considered good. This result suggests that industrialization is not currently a primary driver of deforestation in the region, possibly due to the growing adoption of efficient technologies and sustainable practices within industries. As industries begin implementing more eco-friendly methods, such as prioritizing recycling and improving waste management, the demand for natural resources, including wood, is reduced, thereby mitigating the pressure on forests (Mehmood et al., 2024). This finding aligns with Sunny et al. (2025), who pointed out that while industrial economic rent might increase deforestation in the short term, sustainable industrial practices can counterbalance this effect. Furthermore, Ehigiamusoe et al. (2023) support the view that industrialization can reduce deforestation with proper industrial location selection, adherence to environmental regulations, and effective waste management strategies.

On the other hand, population density was found to significantly influence deforestation. The value suggests that the pressure on forest resources increases as population density increases. This result is primarily due to the increased demand for wood for construction and fuel, as well as the need for agricultural land and settlement expansion. Population growth leads to higher demand for forest products, increasing deforestation rates. The increased demand for forest products and land use often results in more trees being cut down to meet the expanding needs of the population. While population pressure initially leads to higher deforestation rates, long-term efforts to improve agricultural practices, increase land-use efficiency, and enhance productivity could slow down these rates and allow for the sustainable management of forest resources.

In contrast, land ownership rights were found to have no significant effect on deforestation. Despite expectations that straightforward and secure property rights would encourage better land management and forest conservation, the findings suggest that landowners in North Sumatra are often motivated by economic pressures to exploit forest resources. In many cases, landowners do not comply with regulations prohibiting deforestation, driven by the immediate economic gains from exploiting forest resources (Cozma et al., 2023). The power and influence of landowners also complicate the enforcement of conservation laws. The ambiguity in land ownership, particularly with joint ownership systems, can further exacerbate the problem, as unclear ownership rights can lead to conflicts and inadequate forest management (Lawasi, 2024).

The results of this study underscore the complex dynamics driving deforestation in North Sumatra. While industrialization does not significantly contribute to deforestation, population density is crucial in increasing deforestation rates, primarily due to the rising demand for wood, land, and forest products. On the other hand, land ownership does not have a significant impact, mainly due to landowners' non-compliance with conservation regulations and the political and economic influence they wield. These findings provide valuable insights into the factors contributing to deforestation in North Sumatra and

highlight the need for more effective policies that address the root causes, particularly population growth and land use pressures, while also encouraging the adoption of sustainable industrial practices and strengthening the enforcement of land management regulations (Lieke et al., 2023).

The findings of this study provide valuable insights into the key factors influencing low-carbon development in North Sumatra, explicitly focusing on deforestation, energy consumption, land transportation, and industrialization. The statistical significance of these variables, as evidenced by their respective p-values and t-statistics, confirms their critical role in shaping the region's carbon emissions and environmental sustainability. This discussion compares the results with recent studies to highlight similarities and differences, offering a comprehensive understanding of the challenges and opportunities for achieving low-carbon development in the region.

The key factors influencing low-carbon development in North Sumatra, mainly deforestation, energy consumption, land transportation, and industrialization, align with previous research that highlights the complex interplay of these variables in shaping regional carbon emissions. For instance, Androniceanu et al. (2024) emphasize the critical role of renewable energy and policy initiatives in mitigating environmental impacts. This resonates on the importance of local governance and energy consumption patterns (Androniceanu et al., 2024). Additionally, Najicha et al. (2023) have demonstrated that sustainable energy management and reducing deforestation and industrialization are essential for low-carbon transitions. Compared to these global and national-level studies, the unique contribution of this research lies in its localized focus on North Sumatra, revealing how the integration of regional factors such as land transportation and industrialization requires tailored, context-specific solutions to reduce carbon emissions effectively. This study supports the findings of global literature and highlights the regional dynamics that must be considered to achieve low-carbon development.

Deforestation significantly hinders low-carbon development in North Sumatra, with a strong negative relationship between deforestation and the low-carbon development index. The negative coefficient for deforestation highlights how deforestation exacerbates carbon emissions by reducing the number of trees that absorb carbon dioxide. Deforestation is one of the leading causes of climate change, and reducing deforestation is a key strategy to mitigate global warming and promote sustainable low-carbon development. In line with these studies, the results in North Sumatra underline the urgent need for stricter forest protection policies, reforestation efforts, and sustainable land-use practices to reduce the environmental impact of deforestation. Furthermore, addressing illegal logging and encroachment on protected forest areas is essential to reversing the trend of deforestation and improving the region's low-carbon development trajectory.

This approach aligns with Wang et al. (2025), which explores the relationship between renewable energy utilization and circular economy strategies in 30 Chinese provinces from 2000 to 2023. Results show that both strategies significantly reduce CO2 emissions, with renewable energy having a negative association. The circular economy strategy enhances resource efficiency and minimizes waste, demonstrating the effectiveness of China's Circular

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

Economy Promotion Law. The study emphasizes the need for region-specific policy measures to achieve environmental sustainability (Wang et al., 2025). It also complements studies like Najicha et al. (2023), emphasizing the importance of sustainable land-use practices and reforestation for mitigating climate change. It reinforces the study's call for more stringent policies to reduce deforestation and promote low-carbon development.

Energy consumption, mainly from fossil fuels, has long been recognized as a significant driver of carbon emissions. The results of this study confirm that increased energy consumption negatively impacts low-carbon development in North Sumatra. Energy consumption from fossil fuels, such as coal and oil, directly contributes to carbon dioxide emissions, exacerbating climate change and hindering low-carbon initiatives. The growing demand for energy-intensive services and products in industrialized economies leads to higher carbon emissions. In the context of North Sumatra, energy consumption, primarily derived from non-renewable sources, remains a significant challenge for achieving low-carbon development. The results indicate the necessity of transitioning to cleaner energy sources, such as solar, wind, and hydropower, to mitigate the carbon emissions associated with energy production. Policies encouraging the adoption of energy-efficient technologies and renewable energy initiatives are critical to reducing the region's carbon footprint of energy consumption.

Najicha et al. (2023) confirm that increased energy consumption, mainly from fossil fuels, significantly hampers low-carbon development in North Sumatra, reinforcing existing literature on the relationship between energy use and carbon emissions. Najicha et al. highlighted how fossil fuel consumption is a major contributor to greenhouse gas emissions, emphasizing the need to shift toward renewable energy sources to mitigate environmental impacts. This study underscores the necessity of transitioning from non-renewable energy sources, such as coal and oil, to cleaner alternatives like solar, wind, and hydropower in North Sumatra. Moreover, Androniceanu et al. (2024) further support this perspective by examining the role of renewable energy adoption and energy-efficient technologies in reducing carbon emissions globally. Their analysis suggests that the shift to renewables is essential for carbon reduction and fostering long-term sustainable development. This study builds upon these previous works by emphasizing the regional importance of energy transition policies in North Sumatra, reinforcing the need for local efforts to promote clean energy initiatives and energy-efficient technologies as part of a broader low-carbon development strategy.

Land transportation has been identified as another significant contributor to carbon emissions in North Sumatra, with the study's results indicating a substantial negative relationship between land transportation and low-carbon development. The coefficient for land transportation underscores the impact of vehicle emissions on the region's carbon output. Transportation is a significant source of carbon emissions, mainly through vehicle exhaust. In North Sumatra, the rapid increase in vehicles and their reliance on fossil fuels has exacerbated the region's carbon footprint. Reducing transportation frequency and improving the transportation system's efficiency are vital strategies for reducing carbon emissions. In this study, the findings support the need for policies that promote public

transportation, encourage the use of electric vehicles (EVs), and improve fuel efficiency standards to decrease the reliance on fossil-fuel-powered vehicles. This shift toward more sustainable transportation options, including expanding the infrastructure for EVs and improving urban mobility systems, could significantly reduce emissions from the transportation sector, facilitating the region's transition toward low-carbon development.

The study on low-carbon development in North Sumatra identified land transportation as a significant barrier to emission reduction efforts (Siregar et al., 2024). This condition aligns with broader Southeast Asian patterns observed in Malaysia, where transport accounts for 28.8% of fossil fuel emissions, and urbanization drives 2.67% long-term CO_2 increases per 1% urban growth (Solaymani, 2022). The North Sumatra findings mirror Malaysia's challenges with energy intensity - where short-term efficiency gains paradoxically increase emissions due to rebound effects in vehicle utilization patterns.

Globally, these transportation-emission dynamics reflect patterns in China's Wuhan metropolitan area, where commuting carbon emissions exhibit nonlinear relationships with urban density and infrastructure development (Guo et al., 2023). However, North Sumatra's agricultural context introduces unique complexities, as expanded road networks facilitate deforestation and mechanized farming practices that compound emissions from transport and land-use changes (Harahap et al., 2023). This dual pressure contrasts with Malaysia's more urban-focused transportation emissions profile. However, both regions show transportation GDP per worker as a key emissions driver (0.57-0.63% emission increases per 1% productivity growth) (Solaymani, 2022).

The study recommends multi-pronged solutions combining Malaysia's successful adoption of compressed natural gas vehicles with China's innovative urban mobility strategies (Guo et al., 2023). For North Sumatra specifically, researchers emphasize electrifying agricultural transport fleets while implementing congestion pricing in Medan's urban core. These targeted approaches address the region's distinct emission drivers while incorporating lessons from international best practices in sustainable transportation planning.

Industrialization has long been associated with increased carbon emissions due to the energy-intensive nature of industrial processes. The results of this study reveal that industrialization in North Sumatra negatively impacts low-carbon development. Industrial activities are a significant source of carbon dioxide emissions. In North Sumatra, the rapid pace of industrialization has been linked to increased demand for fossil energy, particularly in manufacturing and energy-heavy sectors. The negative impact of industrialization on low-carbon development is that industrial waste, greenhouse gas emissions, and outdated, inefficient technologies contribute significantly to environmental degradation. This study's findings suggest that to mitigate the environmental impact of industrialization, North Sumatra must focus on promoting sustainable industrial practices. This condition could include adopting cleaner technologies, improving energy efficiency, and shifting towards green industries. Moreover, carbon pricing mechanisms, such as carbon taxes and emissions trading schemes, could incentivize industries to reduce their carbon emissions and transition towards low-carbon operations.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

The study on industrialization in North Sumatra highlights the negative impact of industrial activities on low-carbon development, indicating that industrialization is a major driver of carbon dioxide emissions due to energy-intensive processes and inefficient technologies. This result aligns with findings from Li et al. (2022), which demonstrated that industrialization generally exacerbates CO_2 emissions, particularly in middle- and low-income countries where outdated technologies and fossil fuel dependency dominate (Ehigiamusoe et al., 2023). Similarly, research in East Africa revealed that industrialization spurred significant increases in CO_2 emissions due to reliance on carbon-intensive industries and inefficient energy utilization models (Yu et al., 2024). However, studies suggest that upgrading industrial structures and adopting cleaner technologies can mitigate these effects. For instance, a study using data from 41 countries found that linking manufacturing with service sectors reduced CO_2 emissions by 0.94 metric tons per capita for every 0.1 unit increase in structural integration (Dong et al., 2020).

These findings collectively emphasize the need for North Sumatra to adopt sustainable industrial practices, such as cleaner technologies, energy efficiency improvements, and green industry transitions. Additionally, implementing carbon pricing mechanisms like taxes or emissions trading schemes could incentivize industries to reduce emissions, mirroring global strategies to balance economic growth with environmental sustainability.

The findings of this study provide several important implications for policymakers in North Sumatra. The significant influence of deforestation, energy consumption, land transportation, and industrialization on low-carbon development highlights the need for an integrated policy approach that addresses these key drivers of carbon emissions. Policies aimed at reducing deforestation, promoting renewable energy, enhancing public transportation, and encouraging green industrial practices are essential to advancing low-carbon development. Specifically, enforcing stricter forest protection laws, promoting reforestation, and encouraging alternative energy sources could mitigate carbon emissions and foster a more sustainable economy. Additionally, incentivizing the adoption of energy-efficient technologies, increasing the use of public transportation, and supporting the transition to electric vehicles would contribute to reducing emissions from energy consumption and transportation. Furthermore, using cleaner technologies and carbon pricing and fostering a green industrial revolution can help North Sumatra reduce its industrial carbon footprint.

The study's findings on low-carbon development in North Sumatra highlight significant influences from deforestation, energy consumption, land transportation, and industrialization, emphasizing the need for integrated policy approaches to address these carbon emission drivers. This result aligns with previous research in Malaysia, which demonstrated that economic growth and deforestation adversely impact carbon emissions, suggesting that afforestation, reforestation, and sustainable forest management are critical to reducing emissions while maintaining economic growth (Begum et al., 2020). Similarly, studies on rainforest conversion in Indonesia have shown that land-use intensification for plantations leads to significant carbon losses and environmental degradation, reinforcing the importance of policies to preserve forest ecosystems and promote sustainable agricultural practices (Guillaume et al., 2018).

The study's emphasis on deforestation as a key factor resonates with findings from spatial-temporal analyses of deforestation hotspots in Sumatra, which identified human activities such as oil palm plantations and wood fiber production as major contributors to forest loss (Singh & Yan, 2021). These insights suggest that stricter forest protection laws and reforestation initiatives could mitigate emissions effectively. Furthermore, promoting renewable energy and green industrial practices aligns with Indonesia's broader low-carbon development models, which advocate multi-sectoral approaches to reduce emissions while fostering sustainable growth. Together, these studies underscore the necessity of coordinated efforts across sectors to achieve low-carbon development goals in North Sumatra.

The article sheds light on the various factors influencing deforestation in North Sumatra and provides important insights into the region's forest resource management dynamics. The analysis reveals that industrialization, population density, and land ownership are key variables that affect deforestation. However, the complexity of these relationships and how different factors can either exacerbate or mitigate the pressures on forests. The discussion will focus on comparing the findings of this study with previous research, particularly recent studies within the last decade, to deepen the understanding of the regional deforestation dynamics and to suggest potential solutions for sustainable forest management.

A notable finding is the lack of a significant impact of industrialization on deforestation. The coefficient for industrialization was found to be statistically insignificant, indicating that, at present, industrialization does not directly contribute to deforestation in North Sumatra. This study contrasts with earlier studies, such as Kinda and Thiombiano (2021), who suggested that industrial economic rent could drive deforestation. However, it is important to consider that, in the context of North Sumatra, industries might have begun adopting more sustainable practices, such as using more efficient technologies, increased recycling efforts, and better waste management practices. These efforts can help reduce the demand for natural resources, including timber, thus mitigating the negative environmental impact associated with industrial growth. This study aligns with the findings of Voumik and Ridwan (2023), who also argued that industrialization's impact on deforestation could be minimized with the right policies and industrial practices. Therefore, while industrialization may have historically contributed to deforestation, the ongoing shift toward more sustainable industry practices may reduce this influence. As the population grows, the expansion of agricultural land, settlements, and the need for fuelwood intensify, driving the encroachment on forested areas. The results from this study align with these findings, underscoring that population density remains a significant factor influencing deforestation in North Sumatra. The increase in the population leads to a higher demand for forest products and exacerbates the competition for land, further accelerating the destruction of forest ecosystems.

However, the finding that land ownership rights do not significantly affect deforestation is more complex and warrants further exploration. In North Sumatra, the situation is different. This study suggest that despite property rights, many landowners do not comply with forest conservation regulations. The economic pressures they face, and their political and economic power make it challenging to enforce conservation laws effectively. Furthermore, joint land ownership can create ambiguities in land management, leading

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

to deforestation when ownership rights are not clearly defined. This result is consistent with Liu et al. (2024), who also pointed out that land ownership, when combined with economic pressures and unclear property rights, can often lead to increased deforestation rather than its reduction. This study suggest that more stringent regulations and better enforcement mechanisms are needed to ensure landowners comply with conservation efforts.

In light of these findings, it is clear that a multi-faceted approach is required to tackle deforestation in North Sumatra. While industrialization may not be a significant driver of deforestation, population density continues to exert significant pressure on forest resources. Additionally, land ownership issues must be addressed through improved legal frameworks and more effective enforcement of conservation laws. Moreover, the findings suggest the need for policies that focus on increasing land use efficiency, promoting sustainable agricultural practices, and encouraging reforestation efforts. The private sector, communities, and government must also emphasize fostering sustainable land management practices.

Policies encouraging industrial innovations, such as using renewable resources and cleaner technologies, could further reduce industrialization's impact on deforestation (Raihan, 2023). Compared with other recent studies, it underlines the importance of addressing both direct and indirect drivers of deforestation. While some factors, such as industrialization, may show reduced impacts due to technological advancements, other factors, such as population growth, pose significant challenges. Addressing deforestation requires a comprehensive strategy that includes population control measures, sustainable industrial practices, and robust forest conservation policies. Additionally, the role of local governance and land tenure systems must be strengthened to ensure that conservation regulations are effectively enforced and that landowners have clear incentives to protect forests. By drawing from local experiences and global best practices, developing a more sustainable approach to forest management in North Sumatra and beyond is possible.

CONCLUSION

Achieving low-carbon development in North Sumatra requires a multi-faceted approach that focuses on reducing deforestation, improving energy efficiency, promoting sustainable transportation, and addressing industrial emissions. Local governments play a crucial role in this process by implementing policies to protect forests, regulate land use, and encourage the use of renewable energy. Additionally, efforts to improve public transportation, support low-emission vehicles, and introduce carbon pricing can help reduce carbon emissions from the transportation and industrial sectors.

Preserving forest areas, particularly protected forests, is essential for carbon absorption and maintaining biodiversity. Moreover, managing population density through better urban planning can help reduce pressure on natural resources. North Sumatra can move toward a low-carbon future by enhancing institutional quality, enforcing environmental laws, and fostering public awareness. This condition will require coordinated action from government, industry, and the community, ensuring that development is environmentally sustainable and beneficial for future generations.

REFERENCES

Androniceanu, A., Veith, C., Ionescu, Ștefan A., Marinescu, P., Sima, A. G., & Paru, A. (2024). Shaping Sustainable Futures: Public Policies and Renewable Energy Insights Based on Global Bibliometric Analysis. *Sustainability*, *16*(12), 4957.

Begum, R. A., Raihan, A., & Said, M. N. M. (2020). Dynamic Impacts of Economic Growth and Forested Area on Carbon Dioxide Emissions in Malaysia. *Sustainability*, *12*(22), 9375. https://doi.org/10.3390/su12229375

Choudhari, T. P., Illahi, U., Al-Hosni, M., Caulfield, B., & O'Mahony, M. (2024). Decarbonising Shared Mobility: The Potential of Shared Electric Vehicles. *Transportation Research Part D: Transport and Environment*, *133*, 104313.

Cozma, A. C., Coroș, M. M., Pop, A. M., Gavrilescu, I., & Dinucă, N. C. (2023). Corruption, Deforestation, and Tourism – Europe Case Study. *Heliyon*, *9*(8), e19075.

Dong, J., He, J., Li, X., Mou, X., & Dong, Z. (2020). The Effect of Industrial Structure Change on Carbon Dioxide Emissions: A Cross-Country Panel Analysis. *Journal of Systems Science and Information*, *8*(1), 1–16. h

Duchelle, A. E., Simonet, G., Sunderlin, W. D., & Wunder, S. (2018). What is REDD+ Achieving on the Ground? *Current Opinion in Environmental Sustainability*, *32*, 134-140.

Ehigiamusoe, K. U., Lean, H. H., Mustapha, M., & Ramakrishnan, S. (2023). Industrialization, Globalization, ICT, and Environmental Degradation in Malaysia: A Frequency Domain Analysis. *Heliyon*, *9*(10), e20699.

Guillaume, T., Kotowska, M. M., Hertel, D., Knohl, A., Krashevska, V., Murtilaksono, K., Scheu, S., & Kuzyakov, Y. (2018). Carbon Costs and Benefits of Indonesian Rainforest Conversion to Plantations. *Nature Communications*, *9*(1). https://doi.org/10.1038/s41467-018-04755-y.

Gunawan, H., Setyawati, T., Atmoko, T., Subarudi, Kwatrina, R. T., Yeny, I., Yuwati, T. W., Effendy, R., Abdullah, L., Mukhlisi, Lastini, T., Arini, D. I. D., Sari, U. K., Sitepu, B. S., Pattiselanno, F., & Kuswanda, W. (2024). A Review of Forest Fragmentation in Indonesia under the DPSIR Framework for Biodiversity Conservation Strategies. *Global Ecology and Conservation*, *51*, e02918.

Guo, L., Yang, S., Zhang, Q., Zhou, L., & He, H. (2023). Examining the Nonlinear and Synergistic Effects of Multidimensional Elements on Commuting Carbon Emissions: A Case Study in Wuhan, China. *International Journal of Environmental Research and Public Health*, *20*(2). https://doi.org/10.3390/ijerph20021616.

Harahap, M., Basyuni, M., Sulistiyono, N., Sasmito, S. D., Latifah, S., Delvian, Amelia, R., Bimantara, Y., Harahap, S. S. H., Larekeng, S. H., Sumarga, E., Al Mustaniroh, S. S., Slamet, B., Arifanti, V. B., & Ali, H. M. (2023). Carbon Stock and CO2 Fluxes in Various Land Covers in Karang Gading and Langkat Timur Laut Wildlife Reserve, North Sumatra, Indonesia. *Sustainability*, *15*(21), 15196.

Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An Integrated Socio-Economic-Environmental Model to Address Sustainable Development and Sustainability. *Sustainability*, *15*(13), 10682.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

Hoa, P. X., Xuan, V. N., & Thu, N. T. P. (2024). Factors Affecting Carbon Dioxide Emissions for Sustainable Development Goals – New Insights into Six Asian Developed Countries. *Heliyon*, *10*(21), e39943.

Jie, Y., & Lan, J. (2024). Dynamic Linkages between Human Capital, Natural Resources, and Economic Growth – Impact on Achieving Sustainable Development Goals. *Heliyon*, *10*(14), e33536. https://doi.org/10.1016/j.heliyon.2024.e33536.

Kinda, H., & Thiombiano, N. (2021). The Effects of Extractive Industries Rent on Deforestation in Developing Countries. *Resources Policy*, *73*. https://doi.org/10.1016/j.resourpol.2021.102203

Kotronoulas, G., Miguel, S., Dowling, M., Fernández-Ortega, P., Colomer-Lahiguera, S., Bağçivan, G., Pape, E., Drury, A., Semple, C., Dieperink, K. B., & Papadopoulou, C. (2023). An Overview of the Fundamentals of Data Management, Analysis, and Interpretation in Quantitative Research. *Seminars in Oncology Nursing*, *39*(2), 1–9.

Lawasi, M. A. (2024). Unveiling the Shortcomings of Social Forestry Programs in Indonesia: A Critical Analysis of Farmer Empowerment Initiatives. *Jurnal Sylva Lestari*, *12*(3), 866–889. https://doi.org/https://doi.org/10.23960/jsl.v12i3.945.

Li, B. V., Jenkins, C. N., & Xu, W. (2022). Strategic Protection of Landslide Vulnerable Mountains for Biodiversity Conservation under Land-Cover and Climate Change Impacts. *Proceedings of the National Academy of Sciences of the United States of America*, *119*(2).

Lieke, S. D., Spiller, A., & Busch, G. (2023). Can Consumers Understand that There is More to Palm Oil than Deforestation? *Sustainable Production and Consumption*, *39*, 495–505. https://doi.org/10.1016/j.spc.2023.05.037.

Liu, B., Roopsind, A., & Sohngen, B. (2024). Overlapping Extractive Land Use Rights Increases Deforestation and Forest Degradation in Managed Natural Production Forests. *World Development*, *174*, 106441.

Mahalik, M. K., Le, T. H., Le, H. C., & Mallick, H. (2022). How Do Sources of Carbon Dioxide Emissions Affect Life Expectancy? Insights from 68 Developing and Emerging Economies. *World Development Sustainability*, *1*, 100003.

Mehmood, S., Zaman, K., Khan, S., Ali, Z., & Khan, H. ur R. (2024). The Role of Green Industrial Transformation in Mitigating Carbon Emissions: Exploring the Channels of Technological Innovation and Environmental Regulation. *Energy and Built Environment*, *5*(3), 464–479. https://doi.org/10.1016/j.enbenv.2023.03.001.

Najicha, F. U., Mukhlishin, Supiandi, Saparwadi, & Sulthani, D. A. (2023). The Shaping of Future Sustainable Energy Policy in Management Areas of Indonesia's Energy Transition. *Journal of Human Rights, Culture and Legal System*, *3*(2), 361–382.

Qamruzzaman, M. (2024). Do Natural Resources Bestow or Curse the Environmental Sustainability in Cambodia? Nexus between Clean Energy, Urbanization, and Financial Deepening, Natural Resources, and Environmental Sustainability. *Energy Strategy Reviews*, *53*, 101412. https://doi.org/10.1016/j.esr.2024.101412.

Raihan, A. (2023). The Influences of Renewable Energy, Globalization, Technological Innovations, and Forests on Emission Reduction in Colombia. *Innovation and Green Development*, *2*(4), 100071. https://doi.org/10.1016/j.igd.2023.100071.

Raihan, A., Pavel, M. I., Muhtasim, D. A., Farhana, S., Faruk, O., & Paul, A. (2023). The Role of Renewable Energy Use, Technological Innovation, and Forest Cover Toward Green Development: Evidence from Indonesia. *Innovation and Green Development*, *2*(1), 100035. https://doi.org/10.1016/j.igd.2023.100035

Raihan, A., & Tuspekova, A. (2022). The Nexus between Economic Growth, Energy Use, Urbanization, Tourism, and Carbon Dioxide Emissions: New Insights from Singapore. *Sustainability Analytics and Modeling*, *2*, 100009. https://doi.org/10.1016/j.samod.2022.100009

Singh, M., & Yan, S. (2021). Spatial–Temporal Variations in Deforestation Hotspots in Sumatra and Kalimantan from 2001–2018. *Ecology and Evolution*, *11*(12), 7302–7314.

Siregar, E. S., Sentosa, S. U., & Satrianto, A. (2024). Capital Formation and Production of Carbon Emissions in Low-Carbon Development. *Global Journal of Environmental Science and Management*, *10*(2), 759–772. https://doi.org/10.22035/gjesm.2024.02.21.

Solaymani, S. (2022). CO2 Emissions and The Transport Sector in Malaysia. *Frontiers in Environmental Science*, *9*, 1–11. https://doi.org/10.3389/fenvs.2021.774164.

Stacey, N., Gibson, E., Loneragan, N. R., Warren, C., Wiryawan, B., Adhuri, D. S., Steenbergen, D. J., & Fitriana, R. (2021). Developing Sustainable Small-Scale Fisheries Livelihoods in Indonesia: Trends, Enabling and Constraining Factors, and Future Opportunities. *Marine Policy*, *132*, 104654. https://doi.org/10.1016/j.marpol.2021.104654.

Sunny, F. A., Jeronen, E., & Lan, J. (2025). Influential Theories of Economics in Shaping Sustainable Development Concepts. *Administrative Sciences*, *15*(1). https://doi.org/10.3390/admsci15010006.

Voumik, L. C., & Ridwan, M. (2023). Impact of FDI, Industrialization, and Education on the Environment in Argentina: ARDL Approach. *Heliyon*, *9*(1), e12872. https://doi.org/10.1016/j.heliyon.2023.e12872.

Wang, X., Dong, X., Zhang, Z., & Wang, Y. (2024). Transportation Carbon Reduction Technologies: A Review of Fundamentals, Application, and Performance. *Journal of Traffic and Transportation Engineering*, *11*(6), 1340–1377.

Wang, Y., He, Y., & Gao, X. (2025). Synergizing Renewable Energy and Circular Economy Strategies: Pioneering Pathways to Environmental Sustainability. *Sustainability*, *17*(5), 1801. https://doi.org/10.3390/su17051801.

Yang, Y., Xia, S., Huang, P., & Qian, J. (2024). Energy Transition: Connotations, Mechanisms and Effects. *Energy Strategy Reviews*, *52*, 101320. https://doi.org/10.1016/j.esr.2024.101320.

Yu, Y., Zhao, J., Musah, M., Owusu-Akomeah, M., Nkyi, J. A., Li, J., Appiagyei Ampong, G. O., Kumah, E. A., Cao, S., Xu, Y., Shi, Y., Wang, L., Hui, C., & Li, K. (2024). Does Industrialization Promote the Emission Mitigation Agenda of East Africa? A Pathway toward Environmental Sustainability. *Frontiers in Environmental Science*, *12*, 1–19. https://doi.org/10.3389/fenvs.2024.1305852.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44779

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 111 - 130
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.42524

Dynamic Analysis on the Determinants of Prevalence of Undernourishment in Indonesia: A System GMM Approach

Yulia Geubrina[1], Suriani Suriani[2*], Chenny Seftarita[3]
[1,2,3]Faculty of Economics and Business, Universitas Syiah Kuala, Indonesia
E-mail: [1]yuli4@mhs.usk.ac.id, [2]suriani@usk.ac.id, [3]chenny@usk.ac.id
[*]**Corresponding author**

JEL Classification:
C31
G21
I32
O18

Received: 22 November 2024

Revised: 28 February 2025

Accepted: 09 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This original study examines the determinants of undernourishment in Indonesia with mediating variables.

Research Objectives: This study examines the impact of food production, inflation, unemployment, and social food assistance on undernourishment with people's purchasing power as a mediating variable.

Research Methods: Dynamic panel analysis with the Generalized Method of Moment (GMM) and Sobel test examines direct and mediation relationships for the data period 2018-2023.

Empirical Results: The results show the direct and indirect effects of inflation, unemployment, and social food assistance on the prevalence of undernourishment in Indonesia through the mediation of people's purchasing power. Meanwhile, food production has no effect either directly or indirectly.

Implications: This study implies that the government must maintain stable inflation, create jobs, effectively target food assistance, and reduce reliance on social food assistance.

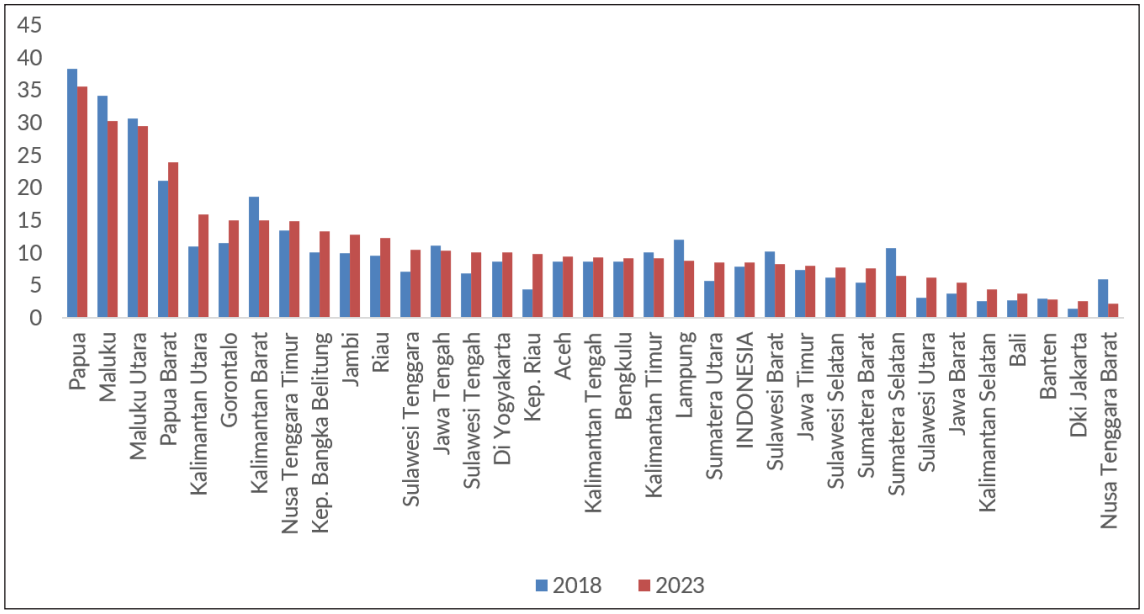
Keywords:
prevalence of undernourishment; food insecurity; people's purchasing power; dynamic panel analysis

How to Cite:
Geubrina, Y., Suriani., & Seftarita, C. (2025). Dynamic Analysis on the Determinants of Prevalence of Undernourishment in Indonesia: A System GMM Approach. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 111-130. https://doi.org/10.15408/sjie.v14i1.42524.

INTRODUCTION

Food security has become a significant issue that has received serious attention from the Indonesian government. As a country with a population of about 280 million people (BPS-Statistics Indonesia, 2023), Indonesia faces significant challenges in ensuring the availability of sufficient, safe, and nutritious food for all people, as stated in the Food Security Law No.18 of 2012. Climate change has caused various negative impacts on the agricultural sector, such as changes in growing season patterns, increased frequency and intensity of natural disasters, and decreased land productivity. These conditions have decreased domestic food production, impacting national food availability. In addition, the COVID-19 pandemic that has hit the world since early 2020 has also put additional pressure on Indonesia's food security system. Supply chain disruptions, declining purchasing power, and mobility restrictions have affected food distribution, especially in hard-to-reach areas. The crisis has exposed the vulnerability of national food security and prompted the government to strengthen a more resilient and sustainable food system (Sjahrir & Dawam, 2022).

Figure 1. Prevalence of Undernourishment in Indonesia by Province in 2018 and 2023 (Percent)



Source: BPS-Statistics Indonesia, 2024

As part of efforts to understand and address food insecurity, the National Food Agency in 2023 identified the prevalence of undernourishment as a key indicator in assessing food security conditions. This indicator represents the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels required to maintain a normal, active, and healthy life. It is included as an indicator in the second Sustainable Development Goal (SDG), namely no hunger. The prevalence of undernourishment is categorized into five very low statuses (<2.5%), low (2.5% to 4%), medium (5% to 19%), high (20% to 34%), and very high (>35%) (Ministry of

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

Agriculture, 2022). Based on data in Figure 1, most provinces in Indonesia fall within the medium category, with four provinces—West Papua, North Maluku, Maluku, and Papua—classified as having a high prevalence of undernourishment. Alarmingly, 23 out of 34 provinces have experienced an increase in undernourishment levels between 2018 and 2023. Additionally, 22 provinces have undernourishment rates exceeding the national average, emphasizing the urgency of investigating the determinants of undernourishment in Indonesia.

The ability to meet food consumption needs in a region is strongly tied to the income levels of its residents. According to Keynes's consumption theory, consumption is influenced by income levels, where disposable income directly determines people's purchasing power (Dornbusch et al., 2018; Du, 2022). Purchasing power, in turn, affects food accessibility, influencing individuals' ability to acquire sufficient and nutritious food (Hristov et al., 2022). Several studies have found that higher purchasing power reduces undernourishment prevalence (Dai & Sulila, 2020; Mazouzi & Amina, 2024; Reuveni, 2024; Hashim, 2016). Increased purchasing power will encourage changes in people's consumption patterns for the better, so that undernourishment can be resolved (Shabnam et al., 2021). Similarly, El-Laithy et al. (2023) argue that food insecurity generally results from households' low access to food due to low purchasing power.

Food availability plays a crucial role in food security. Increased food production helps ensure food supply and maintains a balanced nutritional intake, thereby reducing the prevalence of undernourishment (Marson et al., 2023). A rise in food production during harvest typically lowers food prices, improving purchasing power and food consumption levels. Various studies support the positive relationship between food production and undernourishment reduction (Njangang et al., 2024; Grewal et al., 2024; Domguia et al., 2023). However, recent research suggests that increasing agricultural production alone is insufficient to improve food security without complementary improvements in food distribution and access policies (Daccache et al., 2024; Squires & Gaur, 2020). Achieving food security requires effective public policies that focus not only on increasing agricultural production but also on aspects of demand and access through markets and supply (Fanzo, 2023; Fanzo & Davis, 2021; Rukhsana & Alam, 2021; Woodhill et al., 2022).

Another key determinant is price stability. Price fluctuations influence the level of food consumption. Inflation, especially when it leads to rising food prices without proportional wage increases, diminishes purchasing power and compels low-income households to opt for cheaper, less nutritious food, exacerbating undernourishment (El-Laithy et al., 2023; Obiora et al., 2023). High inflation rates directly impact food affordability, both as a result of rising food prices and as a result of budget constraints due to rising costs of utilities, housing, and services (Stone et al., 2024; Dhar et al., 2024; Dorward, 2012; Lieb & Schuffels, 2022). Furthermore, Johnstone and Lonnie (2023) argued that price increases, especially food prices not accompanied by wage increases, make it difficult for low-income people to buy or access healthy food. Research by Domguia et al. (2023), Arrohmah et al. (2023), and Cancino and Cancino-escalante (2023) found that inflation can increase the prevalence of undernourishment. Inflation also increases

the risk of child undernutrition, especially wasting and stunting (Headey & Ruel, 2023; Akerele et al., 2024). Despite the negative impact it creates, low and moderate levels of inflation can be beneficial. Some studies highlight the positive effects of controlled inflation; moderate inflation with appropriate policies, such as wage rate adjustments, can provide opportunities for balanced economic growth and maintained purchasing power (Chowdhury & Sundaram, 2023; Gumata & Ndou, 2017; Kar & Kar, 2024). Research by Jordà and Nechi (2023) and Raza et al. (2023) highlight that inflation can increase wages. In a tight labor market and high-inflation environment, workers tend to demand higher compensation to maintain their purchasing power. When purchasing power is maintained, food consumption needs can be met.

Unemployment is another factor that is thought to have an influence. Unemployment occurs not only because of a lack of jobs but also because of a mismatch between educational qualifications and the jobs offered, which creates educated unemployment (Albert et al., 2023; Susanto et al., 2024). Based on BPS (2023), Indonesia's unemployment rate (diploma graduates and above) reached 11 percent. High unemployment levels indicate that a substantial portion of the population lacks a stable income and thus faces difficulties in meeting food consumption (Haini et al., 2023). Unemployment heightens food insecurity risks by reducing disposable income and food accessibility (Sam et al., 2019). Several studies confirm the relationship between unemployment and undernourishment (Abebaw et al., 2020; Owens et al., 2020; Enakhe & Tamuno, 2021; Etana & Tolossa, 2017). Unemployed people generally have limited financial resources, so they prefer to consume less or less nutritious food because the price is more affordable, which will impact undernourishment.

Government intervention through social food assistance programs serves as a crucial mitigating factor. Such programs aim to reduce the financial burden on low-income households and improve their access to nutritious food. Social protection policies, including food assistance, have been shown to enhance purchasing power and food security. Sustaining the social food assistance program helps ensure the food security of beneficiary households (Sartiyah & Suriani, 2019). Studies indicate that food assistance programs effectively lower the prevalence of undernourishment; research results by Mary et al. (2018), Tranchant et al. (2019), and Treloar et al. (2024) suggest that social assistance programs such as food assistance can reduce the prevalence of undernourishment. Food assistance is a form of government transfer that can increase beneficiaries' income or real income so that people can meet their food needs. Suriani and Sartiyah (2020) further demonstrate that government food assistance enhances food security among vulnerable groups. On the other hand, Schuler (2023) and Proshin (2022) state that food social assistance can lead to community dependence on the assistance because it is consumptive and only focuses on fulfilling basic needs such as food. This will not change the people who receive assistance to become more empowered and able to develop their potential.

Several studies have examined the determinants of the prevalence of undernourishment, as explained earlier. However, previous research has not adequately explored the mediating role of purchasing power in the relationship between economic factors and

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

undernourishment. This study aims to fill that gap by investigating how purchasing power mediates the effects of food production, inflation, unemployment, and food assistance on the prevalence of undernourishment. By introducing this mediation analysis, this research provides a novel perspective on the interconnected factors influencing food security in Indonesia.

Based on the issues discussed above, this study aims to analyze the effects of food production, inflation, unemployment, social food assistance, and purchasing power on the prevalence of undernourishment in Indonesia. Besides that this study also examine the mediating role of purchasing power in the relationship between food production, inflation, unemployment, and food assistance on undernourishment.

The remainder of this article is structured as follows: Section 2 details the data, variables, and methodology. Section 3 presents and discusses the findings, including mediation test results (Sobel test). Section 4 concludes with insights and policy implications based on the results.

METHODS

This study utilizes panel data from 34 provinces in Indonesia over the 2018-2023 period (6 years), resulting in 204 observations. The data employed are secondary data entirely sourced from BPS-Statistics Indonesia. Table 1 shows this study's variable types, definitions, units, and data sources.

Table 1. Explanation of Variables

Variable	Explanation	Units	Source(s)
Prevalence of undernourishment (POU)	The proportion of the population in an area that consumes food below the standard threshold of adequate energy needed	Percent (%)	BPS-Statistics Indonesia
Food Production (FP)	Total rice production	Million tons	BPS-Statistics Indonesia
Inflation (CPI)	Inflation based on consumer price index	Indeks	BPS-Statistics Indonesia
Unemployment (UNE)	Open unemployment rate	Percent (%)	BPS-Statistics Indonesia
Social Food Assistance (FA)	Realization of social food assistance expenditure	Trillion rupiahs	BPS-Statistics Indonesia
People's purchasing power (PP)	Adjusted per capita expenditure	Million rupiahs	BPS-Statistics Indonesia

Source: author's compilation

Economic variables in reality have a dynamic relationship, which is characterized by the lag of the dependent variable between the independent variables. There are two models in this study, the first model is to see the effect of independent variables on the mediating variable, PP. The second model is to see the effect of the independent variables on the

dependent variable by including the mediating variable. Because there are differences in units between variables, some variables are converted into natural logarithms to facilitate interpretation, except for POU and UNE variables, which already have percent units. The model in this study is written as follows:

Model 1:

$$PP = f\ (FP,CPI,UNE,FA) \tag{3}$$

$$lnPP_{it} = \alpha_1 + \delta_{11} lnPP_{i,t-1} + \beta_{11} lnFP_{it} + \beta_{12} lnCPI + \beta_{13} UNE_{it} + \beta_{14} lnFA_{it} + u_{it} \tag{4}$$

with i denoting province and t denoting time. α_1 is a constant, δ_{11} is the lag coefficient of the dependent variable, $\beta_{11}\beta_{12}\beta_{13}\beta_{14}$ are regression coefficients, and u_{it} is the error term. PP stands for people's purchasing power, FP for food production, CPI for inflation, UNE for unemployment rate, and FA for social food assistance.

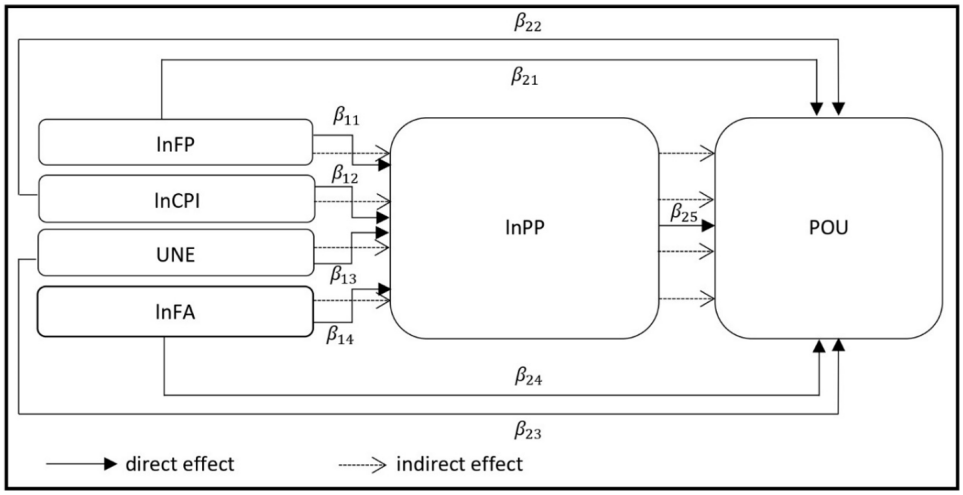
Model 2:

$$POU = f(FP,CPI,UNE,FA,PP) \tag{5}$$

$$POU_{it} = \alpha_2 + \delta_{21} POU_{i,t-1} + \beta_{21} lnFP + \beta_{22} lnCPI_{it} + \beta_{23} UNE_{it} + \beta_{24} lnFA_{it} + \beta_{25} lnPP_{it} + u_{it} \tag{6}$$

with i denoting province and t denoting time. α_2 is a constant, δ_{21} is the lag coefficient of the dependent variable, $\beta_{21}\beta_{22}\beta_{23}\beta_{24}\beta_{25}$ are regression coefficients, and u_{it} is the error term. POU is the prevalence of undernourishment, FP is food production, CPI is inflation, UNE represents the unemployment rate, FA is social food assistance, and PP is people's purchasing power.

Figure 2. Framework Analysis



Source: author's framework

The analysis method used in this research is dynamic panel analysis with the Generalized Method of Moment (GMM). The GMM dynamic panel method was chosen because it is designed for panel data situations with small T and large N that match the data conditions of this study (Igbinigie et al., 2020; Levendis, 2023; Han & Kim, 2023). The type of estimator used is the Generalized Method of Moments System (SYS-GMM)

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

or the so-called Blundell-bond estimator, which is claimed to be more efficient than the Arrellano Bond estimator (Baltagi, 2021). This is due to the use of additional level information, namely the moment of condition and matrix of instrument variable level in addition to the first difference by combining the moment of condition and matrix of instrument variable (first difference and level). Several model specification tests were carried out to ensure that the model used was valid, consistent, and unbiased, namely the Sargan test, Arrellano Bond test, and estimator unbiasedness test (Bernardelli & Carrasco-Gutierrez, 2024; Das, 2019; Levendis, 2023; Ullah et al., 2023). Furthermore, the Sobel test is used to see the mediation effect of the mediator variable. If there is a mediation effect, then there is a direct and indirect influence between the independent variable and the dependent (Kidd & Lin, 2024; Solimun & Fernandes, 2017). An illustration of the framework conducted in this study can be seen in Figure 2.

RESULTS AND DISCUSSION

The analysis started with examining the descriptive statistics for all variables and the correlation matrix among the independent variables, as presented in Table 2 and Table 3. Descriptive statistics provide insights into the variability and distribution of the variables, assist in detecting patterns or anomalies in the data, and provide preliminary information prior to more in-depth statistical analysis. Descriptive statistics show that the total data used for each variable of this study amounted to 204 observations. The average prevalence of undernourishment is 11.54 percent. The maximum value is 38.35 percent, which is the figure achieved by Papua in 2018.

Furthermore, the minimum value is 1.43 percent, which is the number achieved by DKI Jakarta in 2019. Food production has an average value of 0.93 million tons, with a maximum value of 6.01 million tons and a minimum of 0.0002 million tons. The average value of the consumer price index as an indicator of inflation is 108.19 points, with a maximum value of 120.05 points and a minimum of 99.87 points. The unemployment rate has an average value of 5.10 percent, with the highest value occurring in 2020 in DKI Jakarta, which amounted to 10.95 percent, and the lowest in 2018 in Bali, which amounted to 1.40 percent. During 2018-2023, the average realization of social food assistance issued by the government was 1.03 trillion rupiahs. The largest social food assistance was allocated to West Java in 2021, amounting to 10.30 trillion rupiahs, and the lowest was allocated to Bangka Belitung Islands in 2018, amounting to 0.02 trillion rupiahs. The average people's purchasing power of the community during the 2018-2023 period is 10.92 million rupiah, with the highest purchasing power value in DKI Jakarta amounting to 19.37 million rupiah in 2023 and the lowest in Papua amounting to 6.95 million rupiah in 2020.

The standard deviation of the prevalence of undernourishment, inflation, unemployment, and people's purchasing power is below its mean and median values, indicating that this variable has low variation. Meanwhile, the standard deviation of the food production and social food assistance is more significant than its mean and median values, indicating that the food production and variable show that the data has high variability.

Next, the correlation coefficient was calculated to assess the potential for multicollinearity in the estimated model. One of the criteria for obtaining a BLUE (Best Linear Unbiased Estimator) estimator is the absence of perfect multicollinearity among the independent variables. Perfect multicollinearity is characterized by the value of the correlation coefficient between the independent variables approaching 1 (Das, 2019; Iacobucci et al., 2017; Kalnins, 2022). The correlation matrix in Table 3 shows that the independent variables do not have perfect multicollinearity.

Table 2. Summary Statistics for The Variables

Variables	Mean	Median	Std. dev.	Min	Max	Obs
POU	11.5443	9.3600	8.5599	1.4300	38.3500	204
FP	0.9318	0.2977	1.5455	0.0002	6.0068	204
CPI	108.1869	106.2900	5.6880	99.8700	120.0500	204
UNE	5.1035	4.7000	1.7506	1.4000	10.9500	204
FA	1.0259	0.3970	1.9291	0.0156	10.3002	204
PP	10.9223	10.7730	2.2073	6.9540	19.3730	204

Source: author's computation

The estimation results in Table 4 show the validity test of the instruments used to estimate the GMM system for both models. The validity test uses the Sargan test to check for overidentifying constraints. The null hypothesis tested is that the overidentifying restriction condition in the model estimation is valid. The probability value of the Sargan test in model 1 is 0.0580, and in model 2 is 0.4398. Since the probability value for both models is greater than 0.05, it is concluded that the instrumental variables in both models are acceptable. Furthermore, checking the serial correlation for both models with the Arellano Bond Test on AR(1) and AR(2) with the expected condition for the estimator to be consistent is the AR(2) condition. The results obtained from both models are as expected. They reject H_0 in AR(1) and fail to reject H_0 in AR(2), concluding that the estimators of both models are consistent.

Table 3. Correlation Matrix of Independent Variables

Variables	lnFP	lnCPI	UNE	lnFA	lnPP
lnFP	1.0000				
lnCPI	-0.0246	1.0000			
UNE	-0.1577	-0.0658	1.0000		
lnFA	0.6849	0.2879	0.1971	1.0000	
lnPP	-0.1705	0.1231	0.3158	0.0441	1.0000

Source: author's computation

Pooled OLS and fixed effect estimates should be reported to evaluate the unbiasedness of the SYS-GMM estimates. Then a comparison of GMM independent

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

variable lag estimators with FEM (Fixed Effect Model), which is biased downward, and PLS (Pooled Least Squares), which is biased upward. The results in Table 4. show that the lag coefficients of the independent variables of FD-GMM and SYS-GMM are between the FEM and PLS models, which means that the estimators of the two models are unbiased. The testing instrument validity, consistency, and unbiased results indicate that the SYS-GMM model meets the requirements and can be further analyzed.

In the GMM model, regression coefficients are obtained for both the short and long run. The estimation results with SYS-GMM for Model 1 show that inflation, unemployment, and social food assistance significantly affect people's purchasing power in the short and long run. Meanwhile, food production is not statistically significant in the short and long run. The research results in Model 1 do not prove the hypothesis that increased food production directly affects people's purchasing power. This finding is in line with previous research (Woodhill et al., 2022; Grewal et al., 2024), which highlighted the importance of factors other than production, such as food distribution and accessibility, in determining people's purchasing power (Bonuedi et al., 2022; Waarts et al., 2021).

Table 4. Estimation Result

Variables	Model 1 lnPP		Model 2 POU	
	Short Run	Long Run	Short Run	Long Run
lnPPt-1	0.7238*** (0.0423)			
POUt-1			0.2236*** (0.0368)	
lnFP	0.00003 (0.0036)	0.0001 (0.0132)	0.7630 (0.4749)	0.9828 (0.5773)
lnCPI	0.4218*** (0.0217)	1.5273*** (0.2081)	33.0176*** (1.8842)	42.5279*** (2.1664)
UNE	-0.0069*** (0.0012)	-0.0249*** (0.0066)	0.3347*** (0.1029)	0.4312** (0.1461)
lnFA	-0.0417*** (0.0022)	-0.1555*** (0.0261)	-0.8123*** (0.2170)	-1.0463*** (0.2881)
lnPP			-27.1243*** (3.4696)	-34.9371*** (3.7563)
Number of obs	170		170	
Prob. AR(1)	0.0286**		0.0138**	
Prob. AR(2)	0.8405		0.3216	
Prob. Sargan test	0.0580		0.4398	
lnPPt-1 (FEM)	0.4510***			
lnPPt-1 (PLS)	1.0026***			
POUt-1 (FEM)			0.1089	
POUt-1 (PLS)			0.7772***	

Source: author's computation

Note: This table presents regression results using eq (4) and (5). Standard error in parentheses. Superscripts *** and ** denote statistically significant at 0.01 and 0.05.

The results of this study are related to Law No. 19/2013, which regulates various aspects of ensuring the welfare of farmers, including the protection of production prices. One of the important points is Article 15, which states that the government is obliged to protect farmers from adverse market price fluctuations through government purchase price (HPP) policies or subsidy policies. When there is a drop in the price of agricultural products, the government can take steps such as directly buying farmers' crops through state-owned enterprises (BUMN) or other agencies to maintain price stability.

Inflation positively affects people's purchasing power in the short and long term. This result shows that when there is an increase in prices or inflation, the people's purchasing power will increase. The positive relationship indicates that inflation stability can maintain people's purchasing power. In the economic mechanism of society, a price increase is necessary as it motivates individuals to engage in production activities, stimulating the economy and boosting national production (Silvia, 2021; Solaymani, 2017). When prices rise, buyers pay more for goods and services. However, simultaneously, sellers earn more from their sales. Since most people generate income by selling their services, such as labor, income inflation occurs alongside price inflation. Based on data in Table 5, during the study period (2018-2023), Indonesia's inflation was low, with an average annual value below 6 percent. In 2018, 2019, and 2023, the actual inflation was within BI's target range, which shows that inflation in that year was moderate (maintained).

The average wage has generally increased with the inflation rate, except during the COVID-19 pandemic (2020-2021). In the COVID-19 period, inflation was below BI's target, and average wages declined. In 2022, there was inflation of 5.51 percent, which is the highest inflation in the last 6 years. In line with this, the wage level increased by 12 percent, the most significant over the last 6 years. This condition aligns with research by Jordà and Nechi (2023) and Raza et al. (2023). They explained that inflation can cause wages to rise as workers demand higher compensation to maintain their purchasing power. Therefore, Wage rate adjustments can provide opportunities for balanced economic growth and maintained purchasing power (Chowdhury & Sundaram, 2023; Gumata & Ndou, 2017; Kar & Kar, 2024).

Table 5. Target and Realization of Inflation and Average Wages in Indonesia, 2018-2023

Year	Inflation Target (%)	Actual Inflation *year on year* (%)	Average Wages (Rupiahs)	% Change of Average Wages
2018	3,5±1%	3,13	2,829,130	3.15
2019	3,5±1%	2,72	2,913,897	3.00
2020	3±1%	1,68	2,756,345	-5.41
2021	3±1%	1,87	2,736,463	-0.72
2022	3±1%	5,51	3,070,756	12.22
2023	3±1%	2,61	3,178,227	3.50

Source: Bank of Indonesia dan BPS-Statistics Indonesia, 2024

One of the policies that regulates wage regulations to maintain people's purchasing power during inflation is Law No. 13/2003 on Manpower. The law stipulates that the

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

government must set a minimum wage adjusted to inflation and decent living needs. Wage adjustments that follow inflation aim to prevent workers from being trapped in economic hardship due to the ever-increasing prices of goods and services so that their purchasing power is maintained. Without regulations that consider inflation, rising prices of goods will make it difficult for workers to fulfill their basic needs, even if employed.

Furthermore, unemployment negatively affects people's purchasing power in the short and long term. This indicates that when unemployment increases, people's purchasing power will decrease. This result is in line with Halim et al. (2022), Hurd and Rohwedder (2017), Gebretsadik (2016), and Al-Yasiri and Al-Yasiri (2022). When someone loses their job, their income decreases or even disappears completely, leaving them with less money to spend. Social food assistance negatively and significantly affects people's purchasing power. Surprisingly, this result contradicts the idea that government transfers such as food aid and social assistance can increase people's purchasing power. This study's results align with Schuler (2023) and Proshin (2022), who state that food social assistance can lead to community dependence on the assistance because it is consumptive and only focuses on fulfilling basic needs, such as food. This condition will not change the people who receive assistance to become more empowered and able to develop their potential.

The estimation results using SYS-GMM for Model 2 show that the inflation, unemployment rate, social food assistance, and people's purchasing power significantly affect the prevalence of undernourishment in the short and long term. Meanwhile, food production is not statistically significant in the short and long term. This condition can occur due to unequal distribution and access gaps in some areas that can lead to food insufficiency despite sufficient food production nationally, as suggested by Daccache et al. (2024) and Squires and Gaur (2020). The tendency of farmers or rice producers to send their crops to other regions that offer higher prices can lead to inequitable food distribution, so even though rice production in the area is abundant, local people still experience difficulties in meeting their food needs because most of the rice supply is allocated to other regions, resulting in limited access to local food. Therefore, food security depends not only on food availability through agricultural production but also on physical and economic access, which requires infrastructure development, economic development, and fair wage policies (Fanzo, 2023; Fanzo & Davis, 2021; Rukhsana & Alam, 2021; Woodhill et al., 2022)

Regulations on equitable food distribution in Indonesia can be found in Law No. 18/2012 on food, emphasizing the importance of equitable food distribution to achieve food security. The government should ensure fair and equitable food distribution throughout Indonesia so everyone can access adequate and nutritious food regardless of geographical location or economic status. In addition, Law No. 7/2014 on Trade also includes provisions on food trade and distribution control. Food distribution must prioritize sustainability and equity, including reasonable prices for producers and consumers.

Inflation positively influences the prevalence of undernourishment in Indonesia in the short and long term. This is in line with what was stated in the research of Domguia et al. (2023), Arrohmah et al. (2023), Saccone (2021), and Cancino and Cancino-escalante (2023). An increase in the price of food can cause food to become more expensive and less affordable for most people, especially those on low incomes. As a result, they may

reduce the amount or quality of food consumed to save costs. High inflation directly impacts food affordability, both as a result of rising food prices and as a result of budget constraints due to rising costs of utilities, housing, and services. Rising prices can make food more expensive and less affordable for low-income people without wage adjustments. As a result, they may reduce the amount or quality of food consumed to save costs, leading to increased undernourishment (Stone et al., 2024; Dhar et al., 2024; Dorward, 2012; Lieb & Schuffels, 2022).

Unemployment positively influences the prevalence of undernourishment in Indonesia in the short and long term. This is in line with the findings by Abebaw et al. (2020), Owens et al. (2020), Enakhe and Tamuno (2021), and Etana and Tolossa (2017). A high unemployment rate diminishes individuals' ability and opportunity to access sufficient and nutritious food, thereby increasing the prevalence of undernourishment. Furthermore, social food assistance has a negative and significant influence on the prevalence of undernourishment in Indonesia in the short and long term. This finding is in line with the findings of Mary et al. (2018), Tranchant et al. (2019), and Treloar et al. (2024). The purpose of the food assistance program is to provide more balanced nutrition to beneficiary families.

People's purchasing power has a negative effect on the prevalence of undernourishment in Indonesia in the short and long term. This result is consistent with Keynes's consumption theory, which states that consumption is part of disposable income. When disposable income increases, consumption levels will also increase (Dornbusch et al., 2018). This finding aligns with a previous study (Ghosh, 2021; Herforth & Ahmed, 2015; Kaur & Kaur, 2016; Labidi et al., 2024). With sufficient purchasing power, individuals and families can choose a more varied and nutritious diet, improving their nutritional status and overall health..

Table 6. Sobel Test's Result

Variables	Short Term Coefficient			Long Term Coefficient		
	Test statistic	Direct	Indirect	Test statistic	Direct	Indirect
lnFP	-0.0075 (0.0987)	0.7630	-0.0007	-0.0075 (0.4605)	0.9828	-0.0035
lnCPI	-7.2550*** (1.5771)	33.0176***	-11.4419***	-5.7613*** (9.2614)	42.5279***	-53.3580***
UNE	4.6489*** (0.0400)	0.3347***	0.1862***	3.5052*** (0.2477)	0.4312**	0.8683***
lnFA	7.2328*** (0.1563)	-0.8123***	1.1302***	5.2030*** (1.0130)	-1.0463***	5.2705***

Source: author's computation
Note: Standard error in parentheses. Superscripts *** and ** denote statistically significant at 0.01 and 0.05.

The Sobel test was used to determine the effect of mediating variables on the relationship between the independent and dependent variables in this study. The Sobel test measures the coefficient and standard error in the short and long term. The results of the Sobel test are in Table 5. show that the mediating variable, namely people's purchasing

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

power, significantly mediates the effect of inflation, unemployment, and social food assistance on the prevalence of undernourishment. Because the three variables have direct and indirect effects, people's purchasing power is called a partial mediation variable (Carrión et al., 2017; Gaskin et al., 2023; Hair et al., 2021).

The Sobel test analysis in Table 6 shows a significant direct and indirect effect (through people's purchasing power) of the variables inflation, unemployment rate, and food assistance on the prevalence of undernourishment, which is the main finding of this research. Inflation has a complex impact on food consumption inadequacy. Directly, inflation can increase the prevalence of undernourishment because rising prices reduce people's access to basic needs, especially for low-income people. Rising food prices, in particular, make it difficult for low-income earners to buy sufficient quantity or quality food. Indirectly, inflation can have a different impact if people's purchasing power increases through increased income. In this case, an increase in income can increase people's ability to buy food despite rising prices, reducing the prevalence of undernourishment. Thus, the impact of inflation on food consumption is determined by price increases and changes in purchasing power as a mediating factor. Economic policies aimed at protecting purchasing power, such as wage adjustments, could mitigate the negative impact of inflation on the prevalence of undernourishment.

Furthermore, the coefficient of the indirect effect of unemployment on the prevalence of undernourishment is positive, indicating the same direction as the direct effect. This result indicates that an increase in unemployment can worsen the prevalence of undernourishment through a decrease in purchasing power. Therefore, the government is expected to increase employment and investment in education to improve skills, especially for the working-age population.

Food assistance's direct and indirect effects on the prevalence of undernourishment also have different effects. Directly, food assistance can reduce the prevalence of undernourishment by providing direct access to food for needy groups. Food assistance ensures that the basic needs of vulnerable people are met, especially in times of crisis or extreme poverty. Indirectly, however, food assistance also has the potential to increase the prevalence of undernourishment through reduced purchasing power. This happens when there is a dependency on food assistance. When people become overly dependent on food assistance, their purchasing power does not develop or even decline as the assistance discourages people from finding sustainable income alternatives or developing their economic capacity. Hence, sustainable food assistance policies and government support are important in independently increasing people's purchasing power. Well-designed food assistance must be accompanied by efforts to improve recipients' economic capacity and self-reliance so that they are not solely dependent on assistance to meet their food needs.

CONCLUSION

This study aims to analyze the determinants of the prevalence of undernourishment in Indonesia by addressing how economic and social factors contribute to this issue and providing policy recommendations based on empirical findings. The method used is dynamic

panel regression for the 2018-2023 data period with SYS GMM and path analysis. Several requirements were carried out, such as model specification tests, namely the Sargan, Arrellano Bond, and estimator tests. A mediation test with the Sobel test was also conducted to determine the effect of the mediating variables. The results show that food production has no significant effect, directly or indirectly, on the prevalence of undernourishment. Meanwhile, inflation, unemployment, and social food assistance play a significant role, both directly and indirectly, in influencing the prevalence of undernutrition in Indonesia through the mediation of people's purchasing power. This result highlights the need for targeted policy interventions that address food supply, economic stability, and employment opportunities.

Based on these findings, several policy recommendations can be proposed. First, strengthening food diversification policies reduces dependence on one type of food, such as rice, by promoting local and alternative food sources to enhance national food security, and second, maintaining price stability, particularly for essential food commodities, by implementing appropriate monetary and fiscal policies to control inflation. It is crucial to strike a balance, ensuring that inflation does not rise too high—causing reduced purchasing power—nor fall too low—hindering economic growth. Third, the long-term dependency on food assistance should be minimized by promoting economic self-sufficiency. This condition can be done by integrating social assistance programs with skill development and entrepreneurship training, enabling beneficiaries to generate sustainable income sources. Fourth, the accuracy and transparency of the data collection system should be improved, and the monitoring and evaluation mechanisms for food assistance distribution should be strengthened. Community participation in determining beneficiaries should be enhanced to ensure that food aid reaches those who need it. Fifth, fair labor market policies should be ensured by facilitating structured and transparent wage negotiations between workers and employers, where the minimum wage is adjusted periodically in line with inflation rates and expectations. Sixth, policies supporting labor-intensive sectors' growth and improving workforce skills through vocational training programs can encourage employment expansion and economic resilience.

ACKNOWLEDGEMENT

We would like to express our deepest gratitude to the Institute for Research and Community Service (LPPM) of Universitas Syiah Kuala for the financial support in the form of a research grant in Decree Number 434/UN11.2.1/PG.01.03/SPK/PTNBH/2024 dated May 3, 2024 for the Master Thesis Research (PTM) scheme. Funding from them is very helpful in conducting this research to increase insight into food security in Indonesia. We greatly appreciate their commitment to advancing research and supporting academic endeavors.

REFERENCES

Akerele, D., Fadare, O., Ogunniyi, A., Adeyemi, O., & Rufai, M. (2024). Effects of Food Price Changes on Child Undernutrition Among Agricultural Households in Nigeria. *World Development Sustainability*, *4*, 100158. https://doi.org/10.1016/j.wds.2024.100158.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

Al-Yasiri, A. J., & Al-Yasiri, I. J. (2022). Iraq's Unemployment Realities and Causes: An Analytical Study. *Akkad Journal Of Contemporary Economic Studies*, *1*(1), 17-28. https://doi.org/10.55202/ajces.v1i1.50.

Albert, C., Davia, M. A., & Legazpe, N. (2023). Educational Mismatch in Recent University Graduates. The Role of Labour Mobility. *Journal of Youth Studies*, *26*(1), 113–135. https://doi.org/10.1080/13676261.2021.1981840.

Arrohmah, L., Putri, A. N., Setya, I. G. N., Lestari, Z. A., Manik, R. W., & Budiasih, B. (2023). Determinants of Households Insufficient Food for the 2015 – 2022 Period. *Seminar Nasional Official Statistics*, *2023*, 569–578. https://doi.org/10.34123/semnasoff.

Baltagi, B. H. (2021). *Econometric Analysis of Panel Data* (6th Edition). New York: Springer.

Bernardelli, L. C., & Carrasco-Gutierrez, C. E. (2024). Macroeconomic, Industry-Specific and Bank-Specific Determinants of the Profitability of Brazilian Banks: Dynamic Panel Evidence. *Empirical Economics*, *67*(2), 693–726. https://doi.org/10.1007/s00181-024-02568-1.

Bonuedi, I., Kornher, L., & Gerber, N. (2022). Agricultural Seasonality, Market Access, and Food Security in Sierra Leone. *Food Security*, *14*(2), 471–494. https://doi.org/10.1007/s12571-021-01242-z.

BPS-Statistics Indonesia. (2023a). *Indonesia Population Projection 2020-2025 Based on Population Census 2020*. Jakarta:BPS-Statistics Indonesia.

BPS-Statistics Indonesia. (2023b). *Labor Force Situation in Indonesia February 2023*. Jakarta:BPS-Statistics Indonesia.

Cancino, S. E., & Cancino-escalante, G. O. (2023). An econometric study of the number of undernourished people in Colombia from 2000 to 2021. *Entramado*, *19*(2), 12–23. https://doi.org/10.18041/1900-3803/entramado.2.9631.

Carrión, G. C., Nitzl, C., & Roldán, J. L. (2017). Mediation Analyses in Partial Least Squares Structural Equation Modeling: Guidelines and Empirical Examples. In. Latan, H., Noonan, R (Eds). *Partial Least Squares Path Modeling: Basic Concepts, Methodological Issues, and Applications,* 173-195. Netherlands: Springer International Publishing.

Chowdhury, A., & Sundaram, J. K. (2023). Inflation and Development: Central Bank Stabilization Policies Revisited. *Development*, *66*, 3-14. https://doi.org/10.1057/s41301-023-00359-2.

Daccache, M. Al, Zeid, B. A., Hojeij, L., Baliki, G., Brück, T., & Ghattas, H. (2024). Systematic Review on the Impacts of Agricultural Interventions on Food Security and Nutrition in Complex Humanitarian Emergency Settings. *BMC Nutrition*, *10*(1), 1–14. https://doi.org/10.1186/s40795-024-00864-8.

Dai, S. I. S., & Sulila, I. (2020). Purchase Power and Consumption Pattern Change of Society: Analysis of 34 Panel Data in Indonesia. *Journal of Economics and Sustainable Development*, *11*(2), 66–73. https://doi.org/10.7176/jesd/11-2-07.

Das, P. (2019). *Econometrics in Theory and Practice: Analysis of Cross Section, Time Series and Panel Data with Stata 15.1.*. Singapore: Springer Singapore.

Dhar, R., Olabisi, M. A., Ogunbayo, I. E., Olutegbe, N. S., Akano, O. I., & Tschirley, D. L. (2024). Food Demand Responses to Global Price Shocks: Contrasts in Sub-National Evidence from Nigeria. *Food Security*, *16*(6), 1419–1443. https://doi.org/10.1007/s12571-024-01490-9.

Domguia, E. N., Hymette, L. F. N., Nzomo, J. T., Ngassam, S. B., & Donfouet, O. (2023). How important is ICT for reducing undernourishment in Africa? *Telematics and Informatics Reports*, *11*, 100098. https://doi.org/10.1016/j.teler.2023.100098.

Dornbusch, R., Fischer, S., & Startz, R. (2018). *Macroeconomics* (13th Edition). New Jersey: McGraw-Hill.

Dorward, A. (2012). The Short- and Medium- Term Impacts of Rises in Staple Food Prices. *Food Security*, *4*(4), 633–645. https://doi.org/10.1007/s12571-012-0210-3.

Driss, M., & Amina, B. (2024). The Impact of Agricultural Public Spending on Food Security in Algeria: An Econometric Study for the Period 2001-2021. *Journal of Economic Integration*, *11*, 455–470.

Du, J. (2022). An Empirical Study on Relationship Between Residents' Disposable Income and CPI Based on TVECM: Application of Bootstrap SupLM testing for Threshold Cointegration. *Journal of Mathematics*, *2022*. https://doi.org/10.1155/2022/1691686

El-Laithy, H., Armanious, D., & Hafez, A. (2023). The Impact of Inflation on Poverty, Food and Nutrition Security. *World Food Programme Working Paper.*

Enakhe, B., & Tamuno, S. (2021). Poverty, Unemployment and Food Insecurity: Empirical Evidence from Nigeria. *Asian Journal of Economics, Bussiness and Accounting*, *21*(6), 107–123. https://doi.org/10.9734/AJEBA/2021/v21i630395.

Etana, D., & Tolossa, D. (2017). Unemployment and Food Insecurity in Urban Ethiopia. *African Development Review*, *29*(1), 56–68.

Fanzo, J. (2023). Achieving Food Security Through a Food Systems Lens BT . In. Béné, C & Devereux, S. (Eds.). *Resilience and Food Security in a Food Systems Context*, 31–52. Berlin: Springer International Publishing.

Fanzo, J., & Davis, C. (2021). Policies Affecting Food Supply Chains. Fanzo, J., & Davis, C. (Eds.). *Global Food Systems, Diets, and Nutrition: Linking Science, Economics, and Policy* 109–130. Berlin: Springer International Publishing.

Gaskin, J., Ogbeibu, S., & Lowry, P. B. (2023). Demystifying Prediction in Mediation Research and the Use of Specific Indirect Effects and Indirect Effect Sizes. In. Latan, H., Hair, J. F., & Noonan, R. (Eds.). *Partial Least Squares Path Modeling: Basic Concepts, Methodological Issues and Applications,* 209–228. Berlin: Springer International Publishing.

Gebretsadik, T. (2016). Theories of Unemployment and Its Application in Ethiopia: A Review Introduction. *Journal of Agriculture and Research*, *2*(12), 37–55.

Ghosh, S. M. (2021). Constrained by Purchasing Power: The Story of Calorie Intake in India Post-liberalisation In. Qadeer, I., Saxena, K. B., & Arathi, P. M. (Eds.). *Universalising Healthcare in India: From Care to Coverage,* pp. 357–372. Singapore: Springer Singapore.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

Grewal, D., Guha, A., Noble, S. M., & Bentley, K. (2024). The Food Production–Consumption Chain: Fighting Food Insecurity, Loss, and Waste with Technology. *Journal of the Academy of Marketing Science*, *52,* 1412-1430. https://doi.org/10.1007/s11747-024-01040-x.

Gumata, N., & Ndou, E. (2017). The Inflation–Wage Spiral, Inflation Expectations and Monetary Policy. In. Gumata, N., & Ndou, E. (Eds.). *Labour Market and Fiscal Policy Adjustments to Shocks: The Role and Implications for Price and Financial Stability in South Africa,* pp. 373–385. Berlin: Springer International Publishing.

Haini, H., Musa, S. F. P. D., Wei Loon, P., & Basir, K. H. (2023). Does Unemployment Affect the Relationship between Income Inequality and Food Security? *International Journal of Sociology and Social Policy*, *43*(1–2), 48-66. https://doi.org/10.1108/IJSSP-12-2021-0303.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). Mediation Analysis. In. Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (Eds.). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook,* pp. 139–153. Berlin: Springer International Publishing.

Halim, H., Hubeis, M., & Astuty, P. (2022). Factors Affecting People's Purchasing Power Implications for Unemployment Levels and Poverty Levels in West Java Province. *Proceedings of the 2nd International Conference on Law, Social Science, Economics, and Education*. https://doi.org/10.4108/eai.16-4-2022.2319799.

Han, C., & Kim, H. (2023). Dynamic Panel GMM Estimators with Improved Finite Sample Properties Using Parametric Restrictions for Dimension Reduction. *Empirical Economics*, *64*, 2589-2610. https://doi.org/10.1007/s00181-023-02374-1.

Hashim, S. R. (2016). Food and Nutrition Security: Introduction to the Special Issue. *Indian Journal of Human Development*, *10*(3), 293–301. https://doi.org/10.1177/0973703017709171.

Headey, D., & Ruel, M. (2023). Food Inflation and Child Undernutrition in Low and Middle Income Countries. *Nature Communications*, *14*, 5761. https://doi.org/10.1038/s41467-023-41543-9.

Herforth, A., & Ahmed, S. (2015). The Food Environment, Its Effects on Dietary Consumption, and Potential for Measurement Within Agriculture-Nutrition Interventions. *Food Security*, *7*, 505–520. https://doi.org/10.1007/s12571-015-0455-8.

Hristov, H., Millard, J., Pravst, I., & Janssen, M. (2022). European Household Spending and Socio-Economic Impacts on Food Behavior During the First Wave of COVID-19. *Frontiers in Nutrition*, *9*, 1–20. https://doi.org/10.3389/fnut.2022.869091.

Hurd, M. D., & Rohwedder, S. (2017). Consumption Smoothing During the Financial Crisis: The Effect of Unemployment on Household Spending. *Working Paper wp 353,* University of Michigan.

Iacobucci, D., Schneider, M. J., Popovich, D. L., & Bakamitsos, G. A. (2017). Mean Centering, Multicollinearity, and Moderators in Multiple Regression: The Reconciliation Redux. *Behavior Research Methods*, *49*(1), 403–404. https://doi.org/10.3758/s13428-016-0827-9.

Igbinigie, O., Cook, M., & Zheng, L. (2020). *Strategic Motivations of Inward R & D FDI: An Empirical Analysis of the UK*. Berlin: Springer International Publishing.

Johnstone, A., & Lonnie, M. (2023). The Cost-of-Living Crisis is Feeding the Paradox of Obesity and Food Insecurities in the UK. *Obesity*, *31*(6), 1461–1462. https://doi.org/10.1002/oby.23740.

Jordà, Ò., & Nechio, F. (2023). Inflation and Wage Growth Since the Pandemic. *European Economic Review*, *156*, 104474. https://doi.org/10.1016/j.euroecorev.2023.104474.

Kalnins, A. (2022). When does multicollinearity bias coefficients and cause type 1 errors? A reconciliation of Lindner, Puck, and Verbeke (2020) with Kalnins (2018). *Journal of International Business Studies*, *53*, 1536–1548. https://doi.org/10.1057/s41267-022-00531-9.

Kar, M., & Kar, S. (2024). Inflation, Indexation and Real Wage of Non-unionised Workers. In. Marjit, S., & Mandal, B. (Eds.). *International Trade, Resource Mobility and Adjustments in a Changing World: Essays in Memory of Ronald W. Jones*, 437–452. Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-5652-0_21.

Kaur, S., & Kaur, H. (2016). Determinants of Food Security in Sub-Saharan Africa, South Asia and Latin America. In. Kathuria, R., & Nagpal, N. K. (Eds.). *Global Economic Cooperation: Views from G20 Countries* pp. 81–102. New Delhi: Springer India. https://doi.org/10.1007/978-81-322-2698-7_6.

Kidd, J., & Lin, D. Y. (2024). Improving the Power to Detect Indirect Effects in Mediation Analysis. *Statistics in Biosciences*, *16*, 129-141. https://doi.org/10.1007/s12561-023-09386-6.

Labidi, M. A., Ochi, A., & Saidi, Y. (2024). Extreme Poverty, Economic Growth, and Income Inequality Trilogy in Sub-Saharan Africa and South Asia: A GMM Panel VAR Approach. *Journal of the Knowledge Economy*, *15*(3), 10592–10612. https://doi.org/10.1007/s13132-023-01512-5.

Levendis, J. D. (2023). Dynamic Panel Data Models. In. Levendis, J. D (Ed.). *Time Series Econometrics: Learning Through Replication,* pp. 415–458). Berlin: Springer International Publishing. https://doi.org/10.1007/978-3-031-37310-7_14.

Lieb, L., & Schuffels, J. (2022). Inflation Expectations and Consumer Spending: The Role of Household Balance Sheets. *Empirical Economics*, *63*(5), 2479–2512. https://doi.org/10.1007/s00181-022-02222-8.

Marson, M., Saccone, D., & Vallino, E. (2023). Total Trade, Cereals Trade and Undernourishment: New Empirical Evidence for Developing Countries. *Review of World Economics, 159*, 299-332. https://doi.org/10.1007/s10290-022-00468-z.

Mary, S., Saravia-Matus, S., & Gomez y Paloma, S. (2018). Does Nutrition-Sensitive Aid Reduce the Prevalence of undernourishment? *Food Policy*, *74*, 100–116. https://doi.org/10.1016/j.foodpol.2017.11.008.

Matz, J. A., Kalkuhl, M., & Abegaz, G. A. (2015). The Short-Term Impact of Price Shocks on Food Security-Evidence from Urban and Rural Ethiopia. *Food Security*, *7*(3), 657–679. https://doi.org/10.1007/s12571-015-0467-4.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

Ministry of Agriculture. (2022). *Food Security Analysis 2022*. Jakarta: Ministry of Agriculture.

Njangang, H., Tadadjeu, S., & Keneck-Massil, J. (2024). Natural Resources and Undernourishment in Developing Countries: Is There a Curse. *Environmental and Resource Economics, 87*, 1887-1921. https://doi.org/10.1007/s10640-024-00877-8.

Obiora, C. U., Ezeh, M. C., George, C. I., Orjiakor, S. N., Anigbogu, C. B., Nwabude, C. G., & Omologbe, F. (2023). The Impacts of Inflation on Food Security in Nigeria: A Review. *Asian Journal of Food Research and Nutrition*, *2*(4), 476–495.

Owens, M. R., Brito-silva, F., Kirkland, T., Moore, C. E., Davis, K. E., Patterson, M. A., Miketinas, D. C., & Tucker, W. J. (2020). Prevalence and Social Determinants of Food Insecurity Among Collage Students During the COVID-19 Pandemic. *Nutrients*, *12*(9), 2515. https://doi.org/10.3390/nu12092515.

Proshin, I. (2022). Perspectives for Using Food Stamps as an Instrument of Social Support of the Poor in the Russian Federation. *Obshchestvo i Ekonomika*, *11,* article 8. https://doi.org/10.31857/s020736760021569-4.

Raza, H., Laurentjoye, T., Byrialsen, M. R., & Valdecantos, S. (2023). Inflation and the Role of Macroeconomic Policies: A Model for the Case of Denmark. *Structural Change and Economic Dynamics*, *67*, 32–43. https://doi.org/10.1016/j.strueco.2023.06.006.

Reuveni, S. (2024). A Comprehensive Analysis of the Relationship between GDP and The Global Hunger Index Over the Last 20 years. *Technium Social Sciences Journal*, *64*, 98–112. https://doi.org/10.47577/tssj.v63i1.11868.

Rukhsana, & Alam, A. (2021). Agriculture, Food, and Nutritional Security: An Overview. In. Rukhsana & Alam, A. (Eds.). *Agriculture, Food and Nutrition Security: A Study of Availability and Sustainability in India,* 3–13. Berlin: Springer International Publishing. https://doi.org/10.1007/978-3-030-69333-6_1.

Saccone, D. (2021). Can the Covid19 Pandemic Affect the Achievement of the 'Zero Hunger' Goal ? Some Preliminary Reflections. *The European Journal of Health Economics*, *22*(7), 1025-1038. https://doi.org/10.1007/s10198-021-01311-2.

Sam, A. S., Abbas, A., Surendran Padmaja, S., Kaechele, H., Kumar, R., & Müller, K. (2019). Linking Food Security with Household's Adaptive Capacity and Drought Risk: Implications for Sustainable Rural Development. *Social Indicators Research*, *142*, 363-385. https://doi.org/10.1007/s11205-018-1925-0.

Sartiyah, S., & Suriani, S. (2019). The Determinant of Household Welfare Beneficiaries of Food Social Assistance. *Proceedings of the 2nd Aceh Global Conference on Business Economic and Sustainable Development Trends (AGC-BEST)*, 55–62.

Schuler, M.-T. (2023). *Disability and Aid*. Leiden: Brill Publisher.

Shabnam, N., Ashraf, M. A., Laar, R. A., & Ashraf, R. (2021). Increased Household Income Improves Nutrient Consumption in Pakistan: A Cross-Sectional Study. *Frontiers in Nutrition*, *8*, 1–11. https://doi.org/10.3389/fnut.2021.672754.

Silvia, J. E. (2021). Profits: Rewards and Incentives in an Economic System to Allocate Capital. In. Silvia, J. E. (Ed.). *Financial Markets and Economic Performance: A Model for Effective Decision Making,* pp. 345–369. Berlin: Springer International Publishing. https://doi.org/10.1007/978-3-030-76295-7_10/

Sjahrir, B. S., & Dawam, W. I. (2022). Food Insecurity in Indonesia During the COVID-19 Pandemic: What Do We Learn from the High-Frequency Monitoring of Households? *World Bank Policy Note.* Washington DC: World Bank.

Solaymani, S. (2017). Agriculture and Poverty Responses to High Agricultural Commodity Prices. *Agricultural Research*, *6*, 195–206. https://doi.org/10.1007/s40003-017-0253-y.

Solimun, & Fernandes, A. A. R. (2017). Investigation The Mediating Variable: What Is Necessary? (Case Study in Management Research). *International Journal of Law and Management*, *59*(6), 1059-1067. https://doi.org/10.1108/IJLMA-09-2016-0077.

Squires, V. R., & Gaur, M. K. (2020). *Food Security and Land Use Change under Conditions of Climatic Variability: A Multidimensional Perspective*. Berlin: Springer.

Stone, R. A., Brown, A., Douglas, F., Green, M. A., Hunter, E., Lonnie, M., Johnstone, A. M., & Hardman, C. A. (2024). The Impact of the Cost of Living Crisis and Food Insecurity on Food Purchasing Behaviours and Food Preparation Practices in People Living with Obesity. *Appetite*, *196,* 107255. https://doi.org/10.1016/j.appet.2024.107255.

Suriani, & Sartiyah. (2020). Do Food Assistance and Welfare of Rice Farmers Affect Food Security? *DLSU Business and Economics Review*, *30*(1), 143–153.

Susanto, J., Angel, M., & Padilla, E. (2024). The Nexus between Economic Growth and Educated Unemployment. *Romanian Journal of Economics, 59*(2), 36-47.

Tefera, S. A., Tadasse, T. B., & Asmare, G. W. (2022). Prevalence of Household Food Insecurity in Ethiopia During the COVID-19 Pandemic: Evidence from Panel Data. *Scientific African*, *16*, e01141. https://doi.org/10.1016/j.sciaf.2022.e01141

Tranchant, J. P., Gelli, A., Bliznashka, L., Diallo, A. S., Sacko, M., Assima, A., Siegel, E. H., Aurino, E., & Masset, E. (2019). The Impact of Food Assistance on Food Insecure Populations During Conflict: Evidence from a Quasi-Experiment in Mali. *World Development*, *119*, 185–202. https://doi.org/10.1016/j.worlddev.2018.01.027.

Treloar, D., Taylor, D. E., & Bell, A. (2024). Understanding Food Insecurity and Participation in Food Assistance Programs among Hispanic/Latino Residents of Hialeah, Florida, Before and During the Covid-19 Pandemic. *Sustainability, 16*(17), 7612. https://doi.org/10.3390/su16177612

Ullah, S., Khan, S., Hashmi, N. I., & Alam, M. S. (2023). COVID-19 Pandemic and Financial Market Volatility: A Quantile Regression approach. *Heliyon*, *9*(10), e21131. https://doi.org/10.1016/j.heliyon.2023.e21131.

Waarts, Y. R., Janssen, V., Aryeetey, R., Onduru, D., Heriyanto, D., Aprillya, S. T., N'Guessan, A., Courbois, L., Bakker, D., & Ingram, V. J. (2021). Multiple Pathways Towards Achieving a Living Income for Different Types of Smallholder Tree-Crop Commodity Farmers. *Food Security*, *13*(6), 1467–1496. https://doi.org/10.1007/s12571-021-01220-5.

Woodhill, J., Kishore, A., Njuki, J., Jones, K., & Hasnain, S. (2022). Food Systems and Rural Wellbeing: Challenges and Opportunities. *Food Security*, *14*(5), 1099–1121. https://doi.org/10.1007/s12571-021-01217-0.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.42524

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 131 - 148
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.45142

The Impact of Household Poverty on Child Abuse in Indonesia

Nailah Rohadatul'aisy[1*], Donny Hardiawan[2], Estro Dariatno Sihaloho[3]
[1,3]Department of Economics, Faculty of Economics and Business, Universitas Padjadjaran, Indonesia
[2]Center for Economics and Development Studies, Universitas Padjadjaran, Indonesia
E-mail: [1]nailah21003@mail.unpad.ac.id, [2]donnyhardiawan@gmail.com, [3]estro.sihaloho@unpad.ac.id
[*]**Corresponding author**

JEL Classification:
D19
I31
I32
J13

Received: 16 February 2025

Revised: 05 March 2024

Accepted: 09 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study utilizes the expenditure approach as a measure of poverty and incorporates household-level factors to assess their impact on psychological and physical child abuse in Indonesia.

Research Objectives: This study aims to analyze the impact of household characteristics, especially variations in poverty status on the risk of child abuse in Indonesia.

Research Methods: This study uses Social Defense Module of the 2020 National Socio-Economic Survey (Susenas) data and the logistic regression model.

Empirical Results: The results showed that children in households living below the poverty line have the highest probability of experiencing psychological and physical abuse. Factors that also increase the likelihood of abuse are female-headed households, unemployment, low education levels, households with only boys and/or children aged 6-12 years, and living in rural areas.

Implications: These findings highlight that child protection and abuse prevention policies should focus more on economic and social interventions, with poor households as the primary target.

Keywords:

child abuse; poverty; family socioeconomic status; household expenditure

How to Cite:

Rohadatul'aisy, N., Hardiawan, D., & Sihaloho, E. D. (2025). The Impact of Household Poverty on Child Abuse in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 131-148. https://doi.org/10.15408/sjie.v14i1.45142.

INTRODUCTION

Children are the nation's next generation who play an important role in developing a country. Childhood is always a golden moment for parents in learning and character-building (Hariawan et al., 2019; Hidayati, 2018). Therefore, all parents have ways of disciplining their children, and most parents shape their children's behavior through solid disciplinary habits. Giving physical and/or psychological punishment is a method of disciplining children (Dewi et al., 2023). According to Norman et al. (2012), child abuse covers a broad spectrum of maltreatment, including physical, emotional, and sexual abuse and neglect. Abuse can often have long-term physical, mental, and health consequences for the child (Lefebvre et al., 2017).

The scope of the problem of child abuse is staggering. The World Health Organization (WHO) suggests that approximately 1 billion children experience violence of some kind every year (WHO, 2020). In Indonesia, the Central Bureau of Statistics (BPS) recorded at least 48.8% proportion of households with children aged 1-17 years who experienced physical punishment and/or psychological aggression by their caregivers in 2020 (BPS, 2019). This data means that almost half of children in Indonesia experience abuse during their lifetime. Data from the Ministry of Women's Empowerment and Child Protection in the year 2024 indicated 19,635 cases and 21,658 victims, with 70.4% of them being girls (Ministry of PPA, 2024). Unfortunately, that figure does not include unreported cases, so there is still a possibility that the number of victims is higher than that. In a cross-sectional survey, the cases are more substantial; three provinces with the highest levels of violence against children are DKI Jakarta (67.66%), Riau Islands (63.85%), and DI Yogyakarta (60.56%), and the lowest rate is Papua (30.39%) (Kemen PPPA & BPS, 2020).

The Law of The Republic of Indonesia No. 35 of 2014 provides the legal basis for child protection, including prohibiting all forms of physical, psychological, and sexual abuse and neglect of children. Unfortunately, there are still many people who are not aware of this issue. Based on studies conducted in Bandung, West Java, it is assumed that Indonesian parenting culture assumes abuse is severe if it results in injuries and necessitates hospitalization. They consider that the objective of punishment is not to abuse but to safeguard the child's life, create character, and educate the child (Dewi et al., 2023)

Of the many cases of child abuse, parents are the most common perpetrators, whereas some other family members are also abusers (Derakhshanpour et al., 2017). This condition must be a concern considering that the family is the party closest to the child, but in most cases, they are the ones who do not fulfill the child's rights and even commit child abuse. Household circumstances affect the parent's treatment of their children, and economic pressure can be the main trigger for child abuse behavior (Maguire-Jack et al., 2022). Poverty has always been a complex problem related to economic welfare and in the context of behavioral patterns in households. Poverty, which is the cause of parents' inability to meet their children's basic needs, such as regular and adequate nutrition, clothing, healthcare, and education, can create a stressful environment (Beasley et al., 2022). In addition, a lack of knowledge of suitable parenting methods for child

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

development can easily lead to patterns of behavior that are detrimental to their children and also contribute to child abuse (Geprägs et al., 2023; Jia, 2017).

Previous research on the association between poverty and child abuse (Farrell et al., 2017; Schenck-Fontaine & Gassman-Pines, 2020; Lindo et al., 2021) has measured at the country or region level. Moreover, several studies have focused explicitly on household socio-economic factors that lead to child abuse (Atteraya et al., 2018; Choi et al., 2018; Lefebvre et al., 2017; Cerna-Turoff et al., 2021; Wong et al., 2009), similar to the current study. A study by Beatriz & Salhi (2019), which focuses on child discipline practices in low- and middle-income countries, found a correlation between lower household wealth and the likelihood of practices of violent discipline to children, even when the caregiver did not think it was necessary. Another study by Martins et al. (2023) revealed that the risk of feeling stressed is four times higher in low socio-economic status (SES) parents compared to those with high SES, which enables a greater tendency for parents with low SES to commit child abuse. A study by Atteraya et al. (2018) confirmed that household heads with higher levels of education and household wealth status reduced the likelihood of physical abuse, emotional abuse, and child labor. However, some studies have shown that higher socio-economic levels do not necessarily reduce child abuse. For example, a study by Wong et al. (2009) found that high-SES families with highly educated and employed parents in China were more likely to use violence as a form of discipline.

Although previous literature has helped improve our understanding of the relationship between poverty and child abuse, most of the studies measure poverty based on household income or assets (Choi et al., 2018; Lefebvre et al., 2017; Wong et al., 2009; Beatriz & Salhi, 2019). However, this approach has limitations, as income is often volatile and biased in its reporting, while assets do not always reflect current welfare. Alternatively, this study uses household expenditure as a measure of poverty, as it is more stable and better reflects the economic pressures that households face daily, especially in developing countries. In addition, understanding the relationship between child abuse and the characteristics of perpetrators of abuse offenders in the micro-system of the family (household and beyond) is essential in developing effective interventions and support systems for vulnerable families (Okechukwu & Abraham, 2022). Hence, research needs to involve the specific surrounding environment of the household as a crucial factor. However, studies on child abuse in Indonesia are still limited to macro or perception-based approaches.

In contrast, research that combines poverty and factors at the household level as predictors of child abuse using quantitative approaches remains rare. Additionally, no study in Indonesia has classified whether different levels of poverty impact the risk of child physical and psychological abuse. One of the available data is the Indonesian National Socio-economic Survey (Susenas), which provides a more detailed overview of household expenditure and identification of specific types of abuse.

Based on these related issues, this study aims to examine the relationship of variations in poverty levels and household socio-economic and demographic characteristics to the risk of child physical and psychological abuse in Indonesia as a contribution to the literature on poverty and child abuse with a focus on household socio-economic factors in Indonesia. The

findings are expected to be taken into consideration by policymakers to develop targeted interventions to reduce child abuse, especially in vulnerable households in Indonesia.

METHODS

This study uses secondary data from the Social Defense Module of the 2020 National Socio-Economic Survey (Susenas). The Bureau of Statistics Indonesia (BPS) initiated and developed the survey after establishing the Directorate of Social Security Statistics in 2001. This survey covers a household of 75,000 samples spread across 34 provinces and 514 districts/cities in Indonesia. However, the clean data after checking the completeness is 67,280 households. This study identifies households with children aged 1-17 as admissible units of analysis. Thus, we excluded the sample of households with no children under 18 years old and households with only children under 1 year old. Based on this, the final sample size for this study was 43,406 households. The use of Susenas data for the Social Defense Module in 2020 is not only because there is information on parenting but also because during this period, BPS made several changes to the questions in the questionnaire in response to the conditions of the COVID-19 pandemic.

This study defines child abuse as a child who has been subjected to punishment in the form of physical abuse and/or psychological aggression by a parent or adult member of the household. The preparation of child abuse variables was obtained from indicators taken from Block VIIA on childcare patterns in the past year and Block IV as information on household members. The criteria for determining child abuse are several categories that include physical abuse and psychological aggression, with survey answers 0=no and 1=yes as follows: (1) Calling the child stupid, lazy, useless, saying you do not love them anymore, or other similar names; (2) yelling or scaring them; (3) locking up or leaving the child alone in a particular room/space; (4) pushing/shaking their body; (5) pinching or pulling the ear; (6) slapping, hitting, grabbing, or kicking. If a child encounters at least one of these behaviors, either physical or psychologically abusive treatment, it is categorized as child abuse (BPS, 2019). This study then categorizes psychological aggression against children by experiencing at least one treatment of categories (1), (2), and (3). Meanwhile, physical child abuse is defined as experiencing at least one treatment from categories (4), (5), and (6).

Independent variables in this study are poverty, with three different variables included in each model. This study uses the basic needs approach through household expenditure to measure consumption-based poverty. Total household expenditure itself is measured by combining two expenditure indicators from Block IX, namely total (rupiah) expenditure on food/foodstuffs, beverages/beverages, and cigarettes consumed/eaten/ drunk/cooked/ used/spent by the household during the past month and total (rupiah) expenditure on non-food items of the household during the past month.

The Logistic Regression Model is used to estimate the probability of socio-economic factors in households, especially the rate of poverty status that affects the treatment of child abuse, with standard deviations grouped at the household level. This method assumes that there is a relationship in the risk of child abuse among children from the same household, even though the individual child variable used is the oldest child from each

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

household. Average marginal effects, which represent the average change in the expected probability of the outcome for a one-unit change in the predictor, are used to interpret the effects of predictors (Wooldridge, 2014).

In this study, 6 models to see the effect of the same control variables on physical abuse and psychological abuse. Then, we consider these models with variations in poverty levels grouped into 3 variables for comparison across different models. The first model used wealth status based on quantile expenditure is used to see the likelihood of child abuse at all levels of household wealth.

$$ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 totalexp + \beta_2 age + \beta_3 agesq + \beta_4 gender + \beta_5 work + \beta_6 education + \beta_7 age\_child + \beta_8 gender\_child + \beta_9 hhsize + \beta_{10} urban + \varepsilon$$

The next model used the absolute poor as a baseline in a predictor to see how a household's per capita expenditure below the poverty line from the provincial per capita expenditure based on the area (urban or rural) where they live affects their treatment of children.

$$ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 poor + \beta_2 age + \beta_3 agesq + \beta_4 gender + \beta_5 work + \beta_6 education + \beta_7 age\_child + \beta_8 gender\_child + \beta_9 hhsize + \beta_{10} urban + \varepsilon$$

The last model illustrates the likelihood of child abuse based on indicators for determining relative poverty, we take 40% of the households with the lowest welfare or expenditure level (Adji et al., 2020)

$$ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 relpov + \beta_2 age + \beta_3 agesq + \beta_4 gender + \beta_5 work + \beta_6 education + \beta_7 age\_child + \beta_8 gender\_child + \beta_9 hhsize + \beta_{10} urban + \varepsilon$$

All models were controlled for household-level factors, including the age of the household head, gender of the household head, employment status of the household head, education level of household head (0 = uneducated/not completed senior high school; 1=educated/completed senior high school or above), age of the oldest child in the household, gender of all children in each household, number of household members, and region of residence.

RESULTS AND DISCUSSION

Table 1 shows that of the total sample, 32.19% of households have committed physical abuse, while 45.33% of them committed psychological aggression at least once. Unemployed (46.37%) and low-educated (47.19%) household heads are more often associated with psychological abuse. Child abuse also occurs more in rural households (46.58%) than in urban areas (43.47%).

In terms of children, the 6-12 age group experiences the highest psychological abuse (47.6%) and physical abuse (35.43%). Girls tend to experience less abuse than boys or households with children of both genders. In terms of economy, households in the poorest and poorer categories have higher levels of psychological abuse (47%) than the richest households (41.95%). In addition, households below the poverty line experience

the highest levels of abuse, both psychological (52.03%) and physical (40.81%). Likewise, the classification of relatively poor households (expenditure ≤40%) has a higher level of psychological abuse (47.03%).

Table 1. Descriptive Statistics

Variables		Mean	SD				
Age		46.35	11.25				
Age-squared		2275.04	1128				
Number of households		4.57	1.467				
			Total	Psychological		Physical	
			n	n	%	n	%
Gender	Male		38,962	17,698	45.42	12,618	32.39
	Female		4,444	1,979	44.53	1,354	30.47
Working status	Not working		23,599	10,944	46.37	7,804	33.07
	Working		19,807	8,733	44.09	6,168	31.14
Education level	Uneducated		27,088	12,784	47.19	9,097	33.58
	Educated		16,318	6,893	42.24	4,875	29.87
Living area	Rural		26,016	12,118	46.58	9,085	34.92
	Urban		17,390	7,559	43.47	4,887	28.10
Age of Child	1-5		5,989	2,430	40.57	1,755	29.3
	6-12		17,272	8,222	47.6	6,175	35.75
	13-17		20,145	9,025	44.8	6,042	29.99
Gender of Child	Boy		11,428	5,096	44.59	3,530	30.89
	Girl		9,822	3,994	40.66	2,593	26.4
	Both		22,156	10,587	47.78	7,849	35.43
Wealth Status	Poorest		8,682	4,083	47.03	2,849	32.82
	Poorer		8,681	4,083	47.03	2,912	33.54
	Middle		8,681	3,950	45.5	2,952	34.01
	Richer		8,681	3,919	45.14	2,764	31.84
	Richest		8,681	3,642	41.95	2,495	28.74
Household per capita expenditure	Above poverty line		38,013	16,871	44.38	11,771	30.97
	Below poverty line		5,393	2,806	52.03	2,201	40.81
Percentage of Expenditure	Middle and upper class (>40%)		26,043	11,511	44.2	5,761	33.18
	Relative poverty (≤40%)		17,363	8,166	47.03	8,211	31.53

Source: Susenas, Author's calculation

The empirical results of logit regression are presented in Tables 2, 3, and 4 with the Odds Ratio and confidence intervals of the main predictor variables presented in Table 5 to provide a comparative picture of the odds of variation in poverty status on child abuse. Our findings indicate that poverty provides a statistically significant influence on increasing the risk of child psychological and physical abuse. In addition, household characteristics, namely age, working status, education level of household head; living area, gender of child, and wealth status, negatively and significantly affect child abuse. While gender of household head and age of child have a positive and statistically significant influence on child abuse.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

Table 2. Logit Regression the Effect of Wealth Status on Child Psychological and Physical Abuse

		Psychological abuse		Physical abuse	
	Variables	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
	Age	-0.0332***	-0.0081***	-0.0634***	-0.0133***
		(0.0061)	(0.0015)	(0.0065)	(0.0014)
	Agesq	0.000202***	0.0000***	0.000416***	0.0001***
		(0.0001)	(0.0000)	(0.0001)	(0.0000)
Gender	Male				
	Female	0.114***	0.0276***	0.175***	0.0368***
		(0.0341)	(0.0083)	(0.0371)	(0.0078)
Working status	Not working				
	Working	-0.112***	-0.0272***	-0.117***	-0.0245***
		(0.020)	(0.0049)	(0.0216)	(0.0045)
Education level	Uneducated				
	Educated	-0.173***	-0.042***	-0.125***	-0.0262***
		(0.0218)	(0.0053)	(0.0235)	(0.0049)
Living area	Rural				
	Urban	-0.0363*	-0.0088*	-0.236***	-0.0495***
		(0.0208)	(0.0051)	(0.0226)	(0.0049)
Number of households		0.139***	0.0337***	0.206***	0.0432***
		(0.0081)	(0.0019)	(0.0085)	(0.0017)
Age of Child	1-5				
	6-12	0.271***	0.0656***	0.286***	0.0603***
		(0.0315)	(0.0075)	(0.034)	(0.007)
	13-17	0.160***	0.0385***	0.032	0.0065
		(0.0328)	(0.0078)	(0.0359)	(0.0072)
Gender of Child	Boy				
	Girl	-0.155***	-0.0374***	-0.212***	-0.0374***
		(0.0281)	(0.0068)	(0.031)	(0.0068)
	Both	-0.0122	-0.0025	0.0325	0.0069
		(0.0257)	(0.0063)	(0.0276)	(0.0059)
Wealth Status	Poorest				
	Poorer	-0.0453	-0.0111***	-0.021	-0.0045
		(0.0309)	(0.0076)	(0.0331)	(0.0071)
	Middle	-0.122***	-0.0299***	-0.0187	-0.004
		(0.0313)	(0.0076)	(0.0334)	(0.0072)
	Richer	-0.133***	-0.0324***	-0.111***	-0.0236***
		(0.0319)	(0.0078)	(0.0343)	(0.0072)
	Richest	-0.255***	-0.062***	-0.244***	-0.0503***
		(0.0336)	(0.0081)	(0.0365)	(0.0075)
Constant		0.342**		0.432***	
		(0.145)		(0.154)	
Observations		43,406		43,406	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: 2020 National Socioeconomic Survey & Author's calculation

Table 3. Logit Regression The Effect of Absolute Poverty on Child Psychological and Physical Abuse

		Psychological abuse		Physical abuse	
	Variables	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
	Age	-0.0349***	-0.0085***	-0.0643***	-0.0135***
		(0.0061)	(0.0015)	(0.0065)	(0.0014)
	Agesq	0.000217***	0.0000***	0.000424***	0.0001***
		(0.0001)	(0.0000)	(0.0001)	(0.0000)
Gender	Male				
	Female	0.119***	0.029***	0.175***	0.0366***
		(0.0341)	(0.0083)	(0.0371)	(0.0078)
Working status	Not working				
	Working	-0.106***	-0.0258***	-0.111***	-0.0234***
		(0.020)	(0.0049)	(0.0216)	(0.0045)
Education level	Uneducated				
	Educated	-0.207***	-0.0504***	-0.156***	-0.0328***
		(0.0211)	(0.0051)	(0.0228)	(0.0048)
Living area	Rural				
	Urban	-0.0591***	-0.0144*	-0.257***	-0.0539***
		(0.0205)	(-0.005)	(0.0223)	(0.0046)
Number of households		0.118***	0.0287***	0.184***	0.0386***
		(0.0080)	(0.0019)	(0.00845)	(0.0017)
Age of Child	1-5				
	6-12	0.276***	0.0668***	0.290***	0.0613***
		(0.0314)	(0.0075)	(0.034)	(0.007)
	13-17	0.164***	0.0394***	0.0369	0.0074
		(0.0327)	(0.0078)	(0.0359)	(0.0072)
Gender of Child	Boy				
	Girl	-0.153***	-0.0373***	-0.213***	-0.0436***
		-0.0281	-0.0068	(0.031)	(0.0063)
	Both	-0.0128	-0.0031	0.0296	0.0063
		(0.0257)	(0.0063)	(0.0275)	(0.0059)
Household per capita expenditure	Above poverty line				
	Below poverty line	0.145***	0.0352***	0.194***	0.0407***
		(0.0305)	(0.0074)	(0.0316)	(0.0066)
Constant		0.366**		0.472***	
		(0.144)		(0.154)	
Observations		43,406		43,406	
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1					

Source: 2020 National Socioeconomic Survey, Author's calculation

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

Table 2 explains the grouping of wealth status based on household expenditure quintile shows significant results in the middle, richer, and richest groups ($p < 0.01$). The marginal effect value of the richest quintile group is -0.062, which means that households in the richest quintile have a 6.2% lower probability of committing psychological child abuse. Meanwhile, in Table 5. the odds ratio value is 0.7747, which shows that the richest household has a 0.77 times smaller chance of committing child physical abuse (OR=0.77 [95% CI: 0.82, 0.93], $p<0.001$) than the poorest group. Similarly, physical child abuse was 5% less likely or 0.78 times smaller to be perpetrated by the richest group than the poorest quintile group (OR=0.78 [95% CI: 0.73, 0.84], $p<0.001$). Furthermore, the middle group had around a 3% lower probability of committing psychological abuse. However, there was no significant probability between the middle group and the tendency of child physical abuse. Likewise, the poorer group was insignificant compared to the poorest in all models.

The findings of this model indicate that the higher the economic status of a household, the less likely adult household members are to use violent punishment. This result is consistent with the study by Choi et al. (2018), which stated that children from the poorest quintile are more likely to experience physical punishment than children from the richest quintile, with the gap between households increasing over time. These observations also align with Atteraya et al. (2018), who found that children from rich and richest households protected children from physical and emotional abuse. This result suggests that economic well-being acts as a protective factor in preventing child abuse. Households with higher expenditure levels generally have better access to education, health services, and a social environment that supports positive child development.

Table 3 explains that households living below the poverty line had a 4.1% higher probability of committing child physical abuse (OR=1.21 [95% CI: 1.14, 1.29], $p<0.001$) compared to households living above the poverty line. A similar pattern was observed in child psychological abuse, where households with expenditure per capita below the poverty line had a 3.5% (OR=1.15 [95% CI: 1.09, 1.23], $p<0.001$) higher probability of committing child abuse compared to households that were not in absolute poverty. This can also be explained by the odds, which indicate that absolute poor households are 1.15 and 1.2 times more likely to commit child psychological and physical abuse, respectively.

Table 4 shows similar results in each category when households are in relative poverty; they tend to have a higher probability of committing psychological child abuse by 3.4% (OR=1.15 [95% CI: 1.10, 1.19], $p<0.001$) and 2.1% (OR=1.10 [95% CI: 1.06, 1.15], $p<0.001$) more likely to commit child physical abuse than the middle and upper class. In contrast to the previous model, where absolute poverty had a higher effect on physical abuse, but relative poverty had a higher effect on psychological abuse, the odds were 1.15 times greater for psychological abuse and 1.06 times greater for physical abuse.

Table 4. Logit Regression The Effect of Relative Poverty on Child Psychological and Physical Abuse

		Psychological abuse		Physical abuse	
	Variables	**Coefficient**	**Marginal Effect**	**Coefficient**	**Marginal Effect**
	Age	-0.0341***	-0.0083***	-0.0647***	-0.0136***
		(0.0061)	(0.0015)	(0.0065)	(0.0014)
	Agesq	0.000210***	0.0000***	0.000427***	0.0001***
		(0.0001)	(0.0000)	(0.0001)	(0.0000)
Gender	Male				
	Female	0.115***	0.0279***	0.175***	0.0367***
		(0.0341)	(0.0083)	(0.0371)	(0.0078)
Working status	Not working				
	Working	-0.109***	-0.0265***	-0.113***	-0.0238***
		(0.020)	(0.0049)	(0.0216)	(0.0045)
Education level	Uneducated				
	Educated	-0.191***	-0.0463***	-0.151***	-0.0318***
		(0.0214)	(0.0052)	(0.0231)	(0.0048)
Living area	Rural				
	Urban	-0.0490**	-0.0119*	-0.254***	-0.0533***
		(0.0206)	(0.005)	(0.0224)	(0.0046)
Number of households		0.134***	0.0327***	0.200***	0.042***
		(0.00801)	(0.0019)	(0.0084)	(0.0017)
Age of Child	1-5				
	6-12	0.274***	0.0663***	0.290***	0.0613***
		(0.0314)	(0.0075)	(0.034)	(0.007)
	13-17	0.164***	0.0394***	0.0386	0.0078
		(0.0327)	(0.0078)	(0.0359)	(0.0072)
Gender of Child	Boy				
	Girl	-0.153***	-0.0372***	-0.212***	-0.0435***
		(0.0281)	(0.0068)	(0.031)	(0.0063)
	Both	-0.00883	-0.0021	0.034	0.0073
		(0.0257)	(0.0063)	(0.0275)	(0.0059)
Percentage of Expenditure	Middle and Upper Class (>40%)				
	Relative Poverty (<40%)	0.138***	0.0336***	0.0991***	0.0208***
		(0.0211)	(0.0051)	(0.0226)	(0.0047)
Constant		0.228		0.390**	
		(0.146)		(0.156)	
Observations		43,406		43,406	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: 2020 National Socioeconomic Survey, Author's calculation

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

Table 5. Odds Ratio from Logistic Regression

	Psychological abuse			Physical abuse		
	OR	95% CI	P-Value	OR	95% CI	P-Value
Wealth Status						
Poorest						
Poorer	0.9557	0.8995-1.0155	0.143	0.9792	0.9176-1.0449	0.526
Middle	0.8849	0.8323-0.941	0.000	0.9815	0.9192-1.0479	0.576
Richer	0.8758	0.8227-0.9323	0.000	0.8946	0.8364-0.9568	0.001
Richest	0.7747	0.7253-0.8275	0.000	0.7837	0.7296-0.8419	0.000
Per capita Expenditure Below the Poverty Line	1.1557	1.0887-1.2268	0.000	1.2139	1.141-1.2914	0.000
Relative Poverty	1.1480	1.1015-1.1965	0.000	1.10412	1.0563-1.1543	0.000

Source: 2020 National Socioeconomic Survey, Author's calculation

These results show that variations in poverty measures still have a significant influence in increasing child abuse. Of particular interest in this study was that the relationship further reinforced by the model variation with absolute poor households as measured by per capita expenditure, showing that households below the poverty line in both rural and urban areas had a higher impact on increasing child physical and psychological abuse. Likewise, when using the relative poverty indicator (Walker & Lichao, 2020; Adji et al., 2020), households living in the bottom 40% quintile for food and non-food expenditure have a strong tendency to commit child abuse. This result is consistent with a study by Lefebvre et al. (2017), which found that children living in households facing economic hardship are more likely to experience abuse, 9and in some investigations, the households ran out of money for food, housing, and/or utilities.

A previous study by Isumi et al. (2018) examined the relationship between child poverty and parental maltreatment in Japan. The results showed that poverty, as measured by household income of less than 3 million yen, lack of essential goods, or inability to pay for basic utilities, were strongly associated with child physical abuse, neglect, and psychological abuse. Helton et al. (2019) also found similar findings, where poverty measured by household food insecurity levels and household income was associated with increased rates of child psychological, physical, and total aggression.

Poor households may have limited access to resources and support, and they experience dependence on social assistance due to a lack of economic resources, creating pressure and exacerbating the stress that contributes to the risk of child abuse. Difficult financial conditions can also negatively impact parents' mental health, which in turn can affect their ability to care for their children properly (Geprägs et al., 2023). These findings are also consistent with a study by Meinck et al. (2017), who showed that adolescent health is difficult to achieve in families in South Africa who face serious challenges, especially poverty, which triggers mental stress and abusive parenting patterns. This result indicates that living below the poverty line can have a profound effect on child abuse

due to the economic pressures and stress associated with these conditions (Martins et al., 2023; Maguire-Jack et al., 2022). In Indonesia itself, Wahyuni et al. (2021) found that parenting practices aimed at ensuring child welfare in poor families are still not optimal due to limited access and the stress they experience.

The impact of poverty is reinforced by specific social, economic, and demographic characteristics of the household, which can further exacerbate the risk of child abuse. The results in each model showed that the results of the age of the household head are negative and significant. However, when age-squared is added to each model, the results are positive and significant ($p < 0.01$) in forming a U-shaped relationship, suggesting that the relationship between age and the probability of committing child abuse is non-linear. There will be a point where an increase in age contributes more significantly to an increase in child abuse up to a certain point and will decrease again. These findings indicated that as household heads get older, they are less likely to commit child abuse compared to younger household heads. This result is consistent with Lakhdir et al. (2019), who found that children with young mothers were more likely to experience abuse. In line with studies that found young parents are more likely to commit child abuse because they do not have sufficient parenting skills and experience to raise children properly (Thornberry et al., 2014; Dworsky, 2015). In addition, financial pressures and uncertainty about their roles as parents at a young age may increase their risk of escalating to child abuse.

All models agreed that when the head of the household is female, the probability of committing child abuse is greater than in male-headed households ($p<0.01$). This study is aligned with Lotspeich et al. (2020), who found a higher probability of child abuse in female-headed households. Female-headed households are particularly vulnerable as they are often stressed by the multiple roles they have to fulfill, including managing family affairs, earning a living, and doing household chores (Yoosefi Lebni et al., 2020; Shadabi et al., 2021). Sadly, BPS data shows that the number of female-headed households in Indonesia is quite high; even 1 in 10 households, or around 12.3%, are headed by women in 2023. At the same time, the reality is that the female-headed phenomenon is also closely related to economic disadvantage. Extreme fatigue and stress are what drive the greater risk of child abuse when headed by a mother (Barnhart & Maguire-Jack, 2016; Schneider, 2017; Elias et al., 2018). However, this empirical evidence contradicts Merritt (2009), which found that male-headed households are more likely to be physically abusive. This condition may be because the father's physical strength usually makes them feel they have power over their children and apply corporal punishment when children do wrong (Sanchez-Rodriguez, 2021). Cases of child physical abuse perpetrated by males are more likely to result in severe injuries and are easily identifiable (Jia, 2017).

Poverty is always associated with less education and unemployment; interestingly, this study shows linear results with these statements. The work status and education level showed a significant negative probability of committing child abuse in the household. This condition means that the education level and work status of the household head play a role in reducing child psychological and physical abuse. It can also be concluded that the increased risk of child abuse occurs when the household is headed by parents

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

with low education levels and/or are unemployed. Consistent with a study by Atteraya et al. (2018) that indicated the probability of child abuse is lower when the household head has a high school education level or higher compared to those with low or no education. Parents with low levels of education tend to have limited knowledge and skills in parenting and managing stress.

Meanwhile, a study by Lindo et al. (2021) found that post-termination conditions due to economic uncertainty explained to unemployed parents that layoffs increased levels of abuse. The results of this study confirm that the data taken in this study occurred in 2020, coinciding with the COVID-19 pandemic, there were mass layoffs in Indonesia, which caused an increase in unemployment (Farida, 2022; Dartanto et al., 2023). Unemployment can worsen parents' mental health, leading to depression, which is a risk factor for child maltreatment. Household heads who are employed or have access to economic and financial assistance may be better able to provide a safe and nurturing environment for their children (Sano et al., 2021). In contrast, Wong et al. (2009) found that families with high levels of education and employment had a greater risk of child abuse. This may be because children of working mothers face the dual pressures of domestic and professional roles and high expectations of their children.

Children aged 6-12 years showed positive and significant to child abuse. This result means that households with children 6-12 years old or middle age had around 6% higher probability of committing child physical and psychological abuse than those with children 1-5 years old. However, there was a difference for children aged 13-17 years, where this category was positive and significant for psychological abuse but not for physical child abuse. This result aligned with a study by Horikawa et al. (2016), who found that children aged 9 to 13 years were more likely to experience maltreatment recurrence than younger age groups. In contrast, Wongcharoenwatana and Tarugsa (2021) found that although infants (<1 year) experienced less recurrent abuse, children aged 1–10 years showed a much higher risk of recurrence of abuse.

Child gender categorization is based on the gender of all children in the household. All models showed that when households had only one or more female children, the likelihood of experiencing psychological and physical abuse was lower than in households with only male children ($p < 0.01$). Meanwhile, there was no significant relationship when households had two or more children of mixed gender. A previous study by Sobsey et al. (1997) found that boys had higher rates of physical abuse, while girls were more likely to experience sexual and emotional abuse. This condition may be because the higher level of risk could be due to greater expectations of boys than girls, as in the case and culture of many developing countries, including Indonesia, where boys are considered the future economic backbone of the family. As a result, stricter physical treatment may be applied to boys than girls.

In addition, the number of households had positive and significant margin values, meaning that the larger the household size, the higher the likelihood of child abuse. Meanwhile, households living in urban areas had a lower probability of committing

psychological and physical abuse ($p < 0.01$) compared to households living in rural areas. This result is consistent with Atteraya et al. (2018), who found that larger household sizes and living in rural areas increased child physical and psychological abuse. Larger families face higher economic pressures, leading to parental stress. While in rural areas, the culture is permissive of corporal punishment, and there is a lack of access to knowledge about child protection, which further increases the risk of abuse.

Based on the empirical results of this study, socioeconomic factors within a household play a crucial role in childcare. Living in poverty and having disadvantaged household characteristics increase the risk of child abuse. Therefore, these findings confirm the need for child abuse prevention and protection efforts to focus on socioeconomic interventions, particularly in low-income households, to reduce violence and improve children's well-being.

CONCLUSIONS

The study's findings highlight the role of poverty with a household expenditure approach in increasing child psychological and physical abuse. The results indicate that households with per capita expenditures below the poverty line are consistently associated with a higher risk of child abuse. Similarly, relative poverty classification is linked to an increased likelihood of both physical and psychological child abuse. In line with this, the findings suggest that higher household wealth status reduces the risk of child abuse. Moreover, various household characteristics—including the age, gender, employment status, and education level of the household head; the age and gender of children; the number of family members; and the area of residence—significantly contribute to the likelihood of child abuse.

Most child protection policies in Indonesia still tend to focus on addressing cases after violence has occurred and imposing sanctions on perpetrators. Based on the research findings, policy recommendations for the government include strengthening the implementation of child protection and abuse prevention programs by ensuring greater access for low-income households. This can be achieved by enhancing coordination between social protection programs, such as the Family Hope Program (PKH), and child protection services. This way, the economic assistance provided will serve as a subsidy for basic needs to reduce financial pressure and include parenting education for vulnerable households.

Additionally, the government should consider various policies to expand access to education, employment, and skills training programs, particularly for underage and female-headed households, to reduce the risk of economic pressure as a preventive measure against child abuse. Furthermore, access to child protection education and services, especially in rural areas, should be expanded by increasing the number of social workers and strengthening the child abuse reporting system to enable faster intervention. With a more comprehensive combination of economic and social factors, poverty can be effectively minimized.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

REFERENCES

Adji, A., Hidayat, T., Tuhiman, H., Kurniawati, S., & Maulana, A. (2020). *Pengukuran Garis Kemiskinan di Indonesia: Tinjauan Teoretis dan Usulan Perbaikan*. Jakarta: TNP2K.

Atteraya, M. S., Ebrahim, N. B., & Gnawali, S. (2018). Determinants of Child Maltreatment in Nepal: Results from the 2014 Nepal Multiple Indicator Cluster Survey. *Child Abuse and Neglect*, *76*, 400–407. https://doi.org/10.1016/j.chiabu.2017.11.018.

Barnhart, S., & Maguire-Jack, K. (2016). Single Mothers in Their Communities: The Mediating Role of Parenting Stress and Depression between Social Cohesion, Social Control and Child Maltreatment. *Children and Youth Services Review*, *70*, 37–45.

Beasley, L. O., Jespersen, J. E., Morris, A. S., Farra, A., & Hays-grudo, J. (2022). Parenting Challenges and Opportunities among Families Living in Poverty. *Social Sciences*, *11*(3), 119. https://doi.org/10.3390/sosci11030119.

Beatriz, E., & Salhi, C. (2019). Child Discipline in Low- and Middle-Income Countries: Socioeconomic Disparities at the Household- and Country-Level. *Child Abuse and Neglect*, *94*, 104023. https://doi.org/10.1016/j.chiabu.2019.104023.

BPS. (2019). *Statistik Ketahanan Sosial Provinsi Papua*. Jakarta: BPS.

Cerna-Turoff, I., Fang, Z., Meierkord, A., Wu, Z., Yanguela, J., Bangirana, C. A., & Meinck, F. (2021). Factors Associated With Violence Against Children in Low- and Middle-Income Countries: A Systematic Review and Meta-Regression of Nationally Representative Data. *Trauma, Violence, and Abuse*, *22*(2), 219–232. https://doi.org/10.1177/1524838020985532.

Choi, S., Yoo, J., Park, J., Lee, H. Y., Tran, H. T. G., Lee, J. K., & Oh, J. (2018). Manifestations of Socioeconomic Status and Its Association with Physical Child Punishment– Results from the Multi-Indicators Cluster Survey in Viet Nam, 2006–2014. *Child Abuse and Neglect*, *85*, 1–8.

Dartanto, T., Susanti, H., Augustin, E., & Fitriani, K. (2023). Reemployment during the Covid-19 Pandemic in Indonesia: What Kinds of Skill Sets are Needed? *Cogent Economics and Finance*, *11*(2). https://doi.org/10.1080/23322039.2023.2210382.

Derakhshanpour, F., Shahini, N., Hajebi, A., Vakili, M. A., & Yazdi, A. S. H. (2017). Demographic Characteristics and Risk Actors of Children and Parents in Child Abuse Subtypes: Findings from a Psychosocial Support Department. *Journal of Fundamentals of Mental Health*, *19*(6), 481–490.

Dewi, R. F. K., Rusmil, V. K., Rahayuningsih, S. E., Mutyara, K., Arisanti, N., Sekarwana, N., & Dhamayanti, M. (2023). Cultural Perceptions of Child Abuse in Terms of Parents' Perspective: A Aualitative Study in Bandung-Indonesia. *Journal of Community Empowerment for Health*, *5*(3), 191–201. https://doi.org/10.22146/jcoemph.73142.

Dworsky, A. (2015). Child Welfare Services Involvement among the Children of Young Parents in Foster Care. *Child Abuse and Neglect*, *45*, 68–79.

Elias, T. I., Blais, N., Williams, K., & Burke, J. G. (2018). Shifting the Paradigm from Child Neglect to Meeting the Needs of Children: A Qualitative Exploration of

Parents' Perspectives. *Social Work in Public Health*, *33*(7–8), 407–418. https://doi.org/10.1080/19371918.2018.1543625.

Farida, I. (2022). The Social Security and Unemployment Trends during COVID-19 Pandemic in Indonesia. *Japan Labor Issues*, *6*(40), 27–36.

Farrell, C. A., Fleegler, E. W., Monuteaux, M. C., Wilson, C. R., Christian, C. W., & Lee, L. K. (2017). Community Poverty and Child Abuse Fatalities in the United States. *Pediatrics*, *139*(5), e20161616. https://doi.org/10.1542/peds.2016-1616.

Geprägs, A., Bürgin, D., Fegert, J. M., Brähler, E., & Clemens, V. (2023). Parental Stress and Physical Violence against Children during the Second Year of the COVID-19 Pandemic: Results of a Population-based Survey in Germany. *Child and Adolescent Psychiatry and Mental Health*, *17*(1), 1–14. https://doi.org/10.1186/s13034-023-00571-5.

Hariawan, R., Ulfatin, N., Huda A. Y., M., & Arifin, I. (2019). Contributions Management of Parenting and Education Program to Strengthen the Service Three Early Childhood Education Center. *International Education Studies*, *12*(2), 100. https://doi.org/10.5539/ies.v12n2p100

Hasyimzoem, Y., Neta, Y., & Agung, B. (2021). Child Neglect Protection: Policies and Strategies. *Proceedings of the 2nd International Conference on Fundamental Rights.*

Helton, J. J., Jackson, D. B., Boutwell, B. B., & Vaughn, M. G. (2019). Household Food Insecurity and Parent-to-Child Aggression. *Child Maltreatment, 24*(2), 213–221. https://doi.org/10.1177/1077559518819141.

Hidayati, A. (2018). Analysis of the Factors Affecting the Effectiveness of Character-based Instructional Video Implementation to Early Childhood Education in Padang. *Journal of Counseling and Educational Technology*, *1*(1), 14. https://doi.org/10.32698/051.

Horikawa, H., Suguimoto, S. P., & Masika, P. (2016). Child Abuse & Neglect Development of a Prediction Model for Child Maltreatment Recurrence in Japan: A Historical Cohort Study Using Data from a Child Guidance Center. *Child Abuse & Neglect*, *59*, 55–65. https://doi.org/10.1016/j.chiabu.2016.07.008.

Isumi, A., Fujiwara, T., Nawa, N., Ochi, M., & Kato, T. (2018). Child Abuse and Neglect Mediating Effects of Parental Psychological Distress and Individual- Level Social Capital on the Association between Child Poverty and Maltreatment in Japan. *Child Abuse & Neglect*, *83*, 142–150. https://doi.org/10.1016/j.chiabu.2018.07.005.

Jia, M. (2017). Parent Gender as a Moderator: The Relationships between Social Support, Collective Efficacy, and Child Physical Abuse in a Community Sample. *Physiology & Behavior*, *176*(3), 139–148. https://doi.org/10.1177/1077559514562606.Parent.

Lakhdir, M. P. A., Nathwani, A. A., Ali, N. A., Farooq, S., Azam, S. I., Khaliq, A., & Kadir, M. M. (2019). Child Abuse and Neglect Intergenerational Transmission of Child Maltreatment: Predictors of Child Emotional Maltreatment among 11 to 17 years Old Children Residing in communities of Karachi, Pakistan. *Child Abuse & Neglect*, *91*, 109–115.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

Lefebvre, R., Fallon, B., Wert, M. Van, & Filippelli, J. (2017). Examining the Relationship between Economic Hardship and Child Maltreatment using Data from the Ontario Incidence Study of Reported Child Abuse and Neglect-2013 (OIS-2013). *Behavioral Sciences*, *7*(1). https://doi.org/10.3390/bs7010006.

Lindo, J. M., Schaller, J., & Hansen, B. (2021). Economic Conditions and Child Abuse. *IZA Working Paper No. 7355.*

Lotspeich, S. C., Jarrett, R. T., Epstein, R. A., Shaffer, A. M., Gracey, K., Cull, M. J., & Raman, R. (2020). Incidence and Neighborhood-Level Determinants of Child Welfare Involvement. *Child Abuse and Neglect*, *109*, 104767. https://doi.org/10.1016/j.chiabu.2020.104767.

Maguire-Jack, K., Yoon, S., Chang, Y., & Hong, S. (2022). The Relative Influence of Family and Neighborhood Factors on Child Maltreatment at Critical Stages of Child Development. *Children*, *9*(2), 1–11. https://doi.org/10.3390/children9020163.

Martins, P. C., Matos, C. D., & Sani, A. I. (2023). Parental Stress and Risk of Child Abuse: The Role of Socioeconomic Status. *Children and Youth Services Review*, *148*, 106879. https://doi.org/10.1016/j.childyouth.2023.106879.

Meinck, F., Cluver, L. D., Orkin, F. M., Kuo, C., Sharma, A. D., Hensels, I. S., & Sherr, L. (2017). Pathways From Family Disadvantage via Abusive Parenting and Caregiver Mental Health to Adolescent Health Risks in South Africa. *Journal of Adolescent Health*, *60*(1), 57–64.

Merritt, D. H. (2009). Child Abuse Potential: Correlates with Child Maltreatment Rates and Structural Measures of Neighborhoods. *Children and Youth Services Review*, *31*(8), 927–934. https://doi.org/10.1016/j.childyouth.2009.04.009.

Negesse, A., Negesse, A., Jara, D., Jara, D., Habtamu Temesgen, Dessie, G., Getaneh, T., Mulugeta, H., Abebaw, Z., Taddege, T., Wagnew, F., & Negesse, Y. (2020). The Impact of being of the Female Gender for Household Head on the Prevalence of Food Insecurity in Ethiopia: A Systematic-Review and Meta-Analysis. *Public Health Reviews*, *41*(1), 1–14.

Norman, R. E., Byambaa, M., De, R., Butchart, A., Scott, J., & Vos, T. (2012). The Long-Term Health Consequences of Child Physical Abuse, Emotional Abuse, and Neglect: A Systematic Review and Meta-Analysis. *PLoS Medicine*, *9*(11), 1001349. https://doi.org/10.1371/journal.pmed.1001349.

Okechukwu, A., & Abraham, I. (2022). Child Maltreatment and the Ecosystem of Socioeconomic Inequities and Inequalities. *JAMA Network Open*, *5*(7), E2221516.

Sanchez-Rodriguez, M. I. (2021). Gender Differences in Child Maltreatment: Child Sexual and Physical Abuse. *Honors Projects*, *828*, 1–16.

Sano, Y., Mammen, S., & Houghten, M. (2021). Well-Being and Stability among Low-Income Families: A 10-Year Review of Research. *Journal of Family and Economic Issues*, *42*(s1), 107–117. https://doi.org/10.1007/s10834-020-09715-7.

Schenck-Fontaine, A., & Gassman-Pines, A. (2020). Income Inequality and Child Maltreatment Risk during Economic Recession. *Children and Youth Services Review*, *112*, 104926. https://doi.org/10.1016/j.childyouth.2020.104926.

Schneider, W. (2017). Single Mothers, the Role of Fathers, and the Risk for Child Maltreatment. *Children and Youth Services Review*, *81*, 81–93.

Shadabi, N., Saeieh, S. E., Qorbani, M., Babaheidari, T. B., & Mahmoodi, Z. (2021). The Relationship of Supportive Roles with Mental Health and Satisfaction with Life in Female Household Heads in Karaj, Iran: A Structural Equations Model. *BMC Public Health*, *21*(1), 1–9. https://doi.org/10.1186/s12889-021-11656-1.

Sobsey, D., Randall, W., & Parrila, R. K. (1997). Gender Differences in Abused With and Without Disabilities.*Child Abuse & Neglect, 21*(8), 707–720. https://doi.org/10.1016/S0145-2134(97)00033-1.

Thornberry, T. P., Matsuda, M., Greenman, S. J., Augustyn, M. B., Henry, K. L., Smith, C. A., & Ireland, T. O. (2014). Adolescent Risk Factors for Child Maltreatment. *Child Abuse & Neglect*, *38*(4), 706–722. https://doi.org/10.1016/j.chiabu.2013.08.009.

Wahyuni, S., Putri, A. A., & Reswita, R. (2021). Parenting Culture of Low-Income Families in Implications for the Subjective Well-being of Early Childhood Students. *AL-ISHLAH: Jurnal Pendidikan*, *13*(3), 1581–1592. https://doi.org/10.35445/alishlah.v13i3.968.

Walker, R., & Lichao, Y. (2020). Beyond the Goal of Eradicating Absolute Poverty in China: Relative Poverty Indicators and Social Security Policies. *ILO Research Brief 1*, 1–14.

WHO. (2020). *Global Status Report on Preventing Violence against Children 2020*. Switzerland: World Health Organization.

Wong, W. C. W., Chen, W. Q., Goggins, W. B., Tang, C. S., & Leung, P. W. (2009). Individual, Familial and Community Determinants of Child Physical Abuse among High-School Students in China. *Social Science and Medicine*, *68*(10), 1819–1825.

Wongcharoenwatana, J., & Tarugsa, J. (2021). Identifying Children at High Risk for Recurrence Child Abuse. *Journal of Orthopaedic Surgery*, *29*(1), 1–7. https://doi.org/10.1177/2309499021996411.

Wooldridge, J. M. (2014). *Introductory Econometrics: A Modern Approach* (7th ed.). New Jersey: Cengage Learning.

Yoosefi Lebni, J., Mohammadi Gharehghani, M. A., Soofizad, G., Khosravi, B., Ziapour, A., & Irandoost, S. F. (2020). Challenges and Opportunities Confronting Female-Headed Households in Iran: A Qualitative Study. *BMC Women's Health*, *20*(1), 1–11.

Zielinski, D. S. (2009). Child Maltreatment and Adult Socioeconomic Well-Being. *Child Abuse & Neglect*, *33*(10), 666–678. https://doi.org/10.1016/j.chiabu.2009.09.001.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45142

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 149 - 162
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44943

Dynamic Panel Data Analysis of Income Inequality in Indonesia

Allichia Errika Syafitri[1], Endang[2], Joko Hadi Susilo[3*]
[1,2,3]Faculty of Economics, Bojonegoro University
E-mail: [1]allichiarika@gmail.com, [2]endangse022@gmail.com, [3]jokohadisusilo92@gmail.com
[*]**Corresponding author**

JEL Classification:
D63
J16
O15
O32
P16

Received: 17 February 2025

Revised: 15 March 2025

Accepted: 20 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study examines the short-term and long-term relationships between macroeconomic variables and income inequality, adopting a broader approach than previous research, which has primarily focused on partial and simultaneous influences on income inequality.

Research Objectives: This study aims to analyze the dynamic variables that affect income inequality in Indonesia.

Research Methods: This study uses panel data from 34 provinces in Indonesia from 2015 to 2023 and employs the Generalized Method of Moments Arellano Bond (GMM-AB) approach. This method was selected to address endogeneity and heteroscedasticity issues commonly encountered in panel data analysis.

Empirical Results: The findings reveal that the Indonesian Democracy Index and the Gender Inequality Index significantly impact income inequality. Meanwhile, the ICT Development Index and the Human Development Index also exhibit significant influences. These results reinforce the argument that enhancing access to education and promoting gender equality are essential strategies for reducing income inequality.

Implications: The study provides valuable insights for policymakers, emphasizing the need to strengthen democratic institutions and empower women through improved access to education and economic opportunities as key measures to mitigate income inequality.

Keywords:
income inequality; ICT development index; Indonesia democracy index; human development index; gender inequality index

How to Cite:
Syafitri, A. E., Endang, E., & Susilo, J. E. (2025). Dynamic Panel Data Analysis of Income Inequality in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 149-162. https://doi.org/10.15408/sjie.v14i1.44943.

INTRODUCTION

Income inequality is one of the global issues that attracts attention from academics, the government, and the public. Indonesia is a developing Asian country that has experienced increased income inequality in recent decades. Income inequality can be measured through the Gini ratio (Sitthiyot & Holasut, 2020), reflecting the significant gap between rich and poor groups (Fahmi, 2019). Rising inequality leads to various social problems, such as increasing poverty rates, social instability, and slower economic growth (Peterson, 2017). The World Bank proves that human capital, particularly the average length of education, is one of the most important factors in reducing income inequality. In Indonesia, efforts to improve human resources are primarily focused on developing the education sector.

Data from Statistics Indonesia (BPS) for the period 2015-2023 highlights the trends in income inequality in Indonesia. The highest level of inequality was recorded in 2015, with a Gini ratio of 0.40, indicating a considerable income gap between the rich and disadvantaged groups. By 2023, the Gini ratio had declined slightly to 0.38, though it remained relatively high, reflecting persistent income inequality, as shown in Figure 1.

Figure 1. Indonesia's Income Inequality 2015-2023

Source: Data processed from the Statistics Indonesia (BPS)

High income inequality can hinder inclusive economic growth, increase the potential for social conflict, and widen the gap between the rich and the poor (Menyelim et al., 2021). Additionally, it can obstruct efforts to achieve the Sustainable Development Goals (SDGs), particularly in poverty reduction, inequality reduction, and improving community welfare. Income inequality also exacerbates gender inequality by creating barriers for women to access economic resources, education, and employment opportunities (Adeosun & Owolabi, 2021). Regions with a high Gini Ratio tend to experience greater levels of gender inequality (Fisher & Naidoo, 2016). In other words, disparities in income distribution result in inequalities in quality of life across communities.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

Income inequality not only impacts economic growth but also affects various development indicators such as the ICT Development Index, the Indonesian Democracy Index (IDI), the Human Development Index (HDI), and the Gender Inequality Index (GII). Kartiasih et al. (2023) found that ICT adoption in Indonesia can help reduce income inequality, as ICT development enhances communication and social development. Inequality in society, both in the social and economic fields, can affect the implementation of democracy; if income inequality increases, it will change the condition of democracy in society (Anyanwu et al., 2016).

Setyadi et al. (2023) analyzed the development of digital technology and its impact on income inequality in Indonesia, emphasizing that as ICT expands, individuals must develop digital competencies to utilize technology across different sectors effectively. Study Yunga et al. (2023) found that technology plays a significant role in reducing income inequality. Equitable, efficient, and innovative development can expand information at a lower cost (Wanof, 2023). This condition creates opportunities for the poor and disadvantaged. ICT development can reduce income inequality by increasing worker productivity (Cheng et al., 2021). The rapid dissemination of information reduces transaction costs. Research by Ma et al. (2023) also found that adopting ICT improves the well-being of rural communities by providing farmers with market information to increase their bargaining power and boost income generation.

Study by Lyrra et al. (2025) suggests that a strong democracy is expected to encourage a more equitable distribution of income through political participation and government accountability mechanisms. Similarly, Stoetzer et al. (2023) emphasize that income inequality is a critical issue in both global social and political contexts, especially in democratic nations. However, Ramadhan (2023) argues that good democracy will increase income inequality. On the other hand, when the country is increasingly undemocratic, income inequality will decrease (Saputro & Najicha, 2022).

Low-income communities have limited access to education and information, reducing participation in democratic processes (Willeck & Mendelberg, 2025). Efforts must focus on improving the quality of the Human Development Index (HDI) to enhance economic well-being. Prioritizing human capital development is crucial for fostering long-term economic growth and sustainable development (Agustina et al., 2023). Research Janah (2022) found a positive correlation between the Human Development Index and income inequality. This result means regions with higher HDI values tend to experience greater income inequality (Susilo et al., 2020). Conversely, a low HDI reflects a region's inability to optimize resources, resulting in income disparities (Iddrisu & Bhattacharyya, 2015).

Limited access to education and information not only affects HDI but also contributes to gender inequality, as disadvantaged groups, particularly poor women, face unequal opportunities (Kling et al., 2022). Increasing gender equality is expected to reduce income inequality (Chung et al., 2021). Ensuring equal access for women in education and economic participation so that household productivity can increase (Jabeen et al., 2020). Conversely, when women lack access to education and employment, their income potential declines, further reinforcing income inequality (Yavorsky et al., 2019).

Kuznets' theory of economic growth and income inequality explains that technology affects income inequality. According to this theory, during the early stages of industrialization, inequality in developing countries increased and then decreased after reaching a certain level of income, forming what is known as the inverted U-curve (Tabash et al., 2024). The development of ICT can have both exogenous and endogenous effects on public goods and services. Research also shows that democracy influences income inequality, as higher democratic standards can contribute to fairer income distribution (Ramadhan, 2023).

The inconsistency in the findings of previous studies on income inequality is evident. Cheng et al. (2021)found that the Information and Communication Technology (ICT) Development Index had a negative effect on income, while (Wang et al., 2021) indicated that the ICT Development Index had a significant positive effect on income inequality. Similarly, Lyrra et al. (2025) found that the democracy index had a significant negative effect. Bahamonde and Trasberg (2021) stated that the positive influence was significant on income inequality. The Human Development Index (HDI) significantly negatively affects income inequality (Ghifara et al., 2022).

Meanwhile, in Sasmita et al. (2023), the Human Development Index significantly positively affects income inequality. Study Adeosun & Owolabi (2021) demonstrated that the Gender Inequality Index (GII) has a significant negative effect on income inequality, while Ali et al. (2021) show that the gender inequality index has a significant positive effect on income inequality. These discrepancies highlight ongoing debates regarding the relationship between the ICT Development Index, the Indonesian Democracy Index, the Human Development Index, and the Gender Inequality Index about income inequality.

A research gap persists due to data selection inconsistencies such as time periods, sample sizes, and data sources. Variations in observational areas across multiple linear regression analyses lead to conflicting findings on income inequality. Specifically, prior studies have not adequately distinguished between the short-term and long-term effects of macroeconomic variables, making it difficult to understand their impact comprehensively. Previous studies have not used analytical methods that can reveal short-term and long-term effects, thus creating a gap that needs to be filled. Previous studies have not examined the short-term and long-term relationships between the ICT Development Index (Adams & Akobeng, 2021), the Indonesian Democracy Index (Al-Majali, 2024), the Human Development Index (Sarkodie & Adams, 2020), and the Gender Inequality Index (Yip et al., 2015) about income inequality. This study seeks to fill this gap by empirically analyzing the dynamic relationship between these variables and their effects on income inequality over both short-term and long-term horizons.

Several prior studies have used the ICT development index (Yunga et al., 2023), democracy index (Rau et al., 2024), human development index (Iddrisu & Bhattacharyya, 2015), gender inequality index (Kling et al., 2022). However, these studies were limited

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

to static models, which did not account for dynamic relationships over time. This study employs panel data analysis to examine the short-term and long-term dynamics using the Generalized Method of Moments Arellano-Bond (GMM-AB) approach. Furthermore, this study incorporates observational data from 34 provinces in Indonesia for 2015–2023. This study also examines the relationship between dynamic macroeconomic variables, where other variables influence one variable, both simultaneous effects and past values.

The purpose of this study was to analyze the short-term and long-term relationship of the ICT Development Index, Indonesian Democracy Index, Human Development Index, and Gender Inequality Index variables to income inequality in 34 provinces in Indonesia using the Generalized Method of Moments Arellano-Bond (GMM-AB) First Difference analysis. The findings are expected to provide new insight into the factors of income inequality and can be used as recommendations in making policies. Additionally, these findings aim to support policymakers in formulating more effective strategies to address economic challenges.

This study applies dynamic panel data regression using the Generalized Method of Moments (GMM) developed by Arellano and Bond. This dynamic panel data model includes the lagged dependent variable as an explanatory variable to capture both short-term and long-term effects. This approach ensures that the resulting estimators are unbiased, consistent, and efficient. Consequently, this study aims to comprehensively analyze the short-term and long-term relationships between these key variables and income inequality in Indonesia.

METHODS

This study employs quantitative secondary data from the Central Statistics Agency of Indonesia. The estimation method used is the Generalized Method of Moments (GMM), which is applied to evaluate the parameters of the data the model provides. The dataset consists of 34 provinces in Indonesia, covering the observation period 2015–2023, making it panel data. The total sample size in this study is 306 observations. Data collection was conducted by searching, gathering, and downloading information from the official website of the Central Statistics Agency of Indonesia for the 2015–2023 period.

The dependent variable in this study is income inequality, measured using the Gini ratio index. The independent variables include the ICT Development Index, the Indonesian Democracy Index, the Human Development Index, and the Gender Inequality Index in Indonesia. A dynamic panel data regression method is employed to analyze the relationship between these independent variables and income inequality across 34 provinces in Indonesia.

In dynamic panel data regression, the Arellano-Bond GMM estimation method is used to obtain unbiased, consistent, and efficient parameter estimates. This method effectively addresses the issues of endogeneity and heteroscedasticity, which are common in panel data analysis. The estimation process is carried out using the two-step Arellano-Bond GMM estimator, which is formulated as follows:

$$\begin{pmatrix}\hat{\hat{\delta}}\\ \hat{\hat{\beta}}\end{pmatrix} = a \times b$$

$$a = \left[(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1}\Delta x_i)'Z_i)\hat{\Lambda}^{-1}(N^{-1}\sum_{i=1}^{N}Z_i'(\Delta y_{i,t-1}\Delta x_i))\right]^{-1}$$

$$b = \left[(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1}\Delta x_i)'Z_i)\hat{\Lambda}^{-1}(N^{-1}\sum_{i=1}^{N}Z_i'\Delta y_i)\right] \quad (1)$$

Value $\left(\hat{\hat{\delta}}\right)$ and $\left(\hat{\hat{\beta}}\right)$ to estimate parameters in the dynamic panel data regression model. This parameter calculates the influence of independent variables on dependent variable variables. Simultaneous significance testing to determine the presence or absence of variable relationships in the model was carried out by Arellano-Bond: 1991, using the Wald test. The goal is to find out the significance of variables simultaneously in the equation model (1). The hypothesis of simultaneous testing is as follows.

H_0: $\delta = \beta_1 = \beta 2 = \ldots = \beta_k = 0$ (No variable coefficients have a significant effect on the model)

$$w = \hat{\hat{\beta}}'\tilde{V}^{-1}\hat{\hat{\beta}} \sim X^2_{(k)} \quad (2)$$

Reject H_0 if the value statistic test $w > X^2_{(k)}$ or p-value $< \alpha$ ($\alpha = 0.05$). To find out the coefficient of variables that have a significant effect on the model, partial testing is conducted using the Z test.

H_0 : δ *or* $\beta_j = 0$ (There are not response lag variables or independent variables that had a significant effect on the model)

H_1 : δ *or* $\beta_j \neq 0, j = 1,2,\ldots,k$ (Response lag variables or independent variables that have a significant effect on the model)

$$Z_{test} = \frac{\widehat{\beta J}}{se(\widehat{\beta J})} \text{ dan } Z_{test} = \frac{\hat{\delta}}{se(\hat{\delta})} \quad (3)$$

Reject H_0 if $|Z_{test}| > Z_{0.05/2} = 1.96$, or p-value $< \alpha$ ($\alpha = 0.05$). Furthermore, to evaluate the specification of parameters, tests were carried out using the Sargan test and the Arellano-Bond test. The sargan test is used to assess whether there is a problem with the validity of the instrument used, meaning that there is no correlation between the instrument and *the error* component. The Sargan test determines the validity of the use of variable instruments with *overidentifying restrictions*, which is more than the estimated number of parameters. The sargan test is also to determine homogeneity, i.e., the variation of *error* is constant. The hypothesis of the Sargan test is as follows

H_0: *overidentifying restrictions* in the valid model estimation (variable instrument does not correlate with error)

H_1: *overidentifying restrictions* invalid model estimates.

$$S = \hat{v}'Z\left(\sum_{i=1}^{N}Z_i'\Delta_{vi}\Delta_{vi}'Z_i\right)^{-1}Z'\hat{v} \sim X^2_{L-(k+1)} \quad (4)$$

The Arellano-Bond test is proposed as a test for the absence of first-order serial correlation of *errors* in the *first Difference* equation, used to determine the consistency of the estimation results. The Arellano-Bond test is also used to determine the correlation of observation *errors* to-t (y_t) with previous observations (y_{t-1}).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

The consistency of the method is indicated by statistical values m_1 significant $(p - value < \alpha)$ and statistical values m_2 insignificant $(p - value < \alpha)$. The statistics of the Arellano-Bond test for the serial correlation of first order components in *the first Differencing* can be written as follows.

$$m(2) = \frac{\Delta\hat{v}'_{i,t-1}\Delta\hat{v}'_{*}}{(\Delta\hat{v})^{1/2}} \sim N(0,1) \quad (5)$$

Where $\Delta\hat{v}'_{i,t-1}$ is a vector error in the 1st lag with the order $q = \sum_{i=t}^{N} T_i - 2$ and $\Delta\hat{v}'_{*}$ is a cropped error vector corresponding to $\Delta\hat{v}'_{i,t-1}$ sized $q \times 1$.

In order to analyze the influence of income distribution, this study uses the GINI index coefficient variable as a dependent variable and a number of influential variables such as ICT development index, Indonesian democracy index, human development index**,** and gender inequality index as independent variables. The econometric model used in this study to measure the influence of finance on income distribution is as follows:

$$Income\ inequality\ (Y)_{i,t} = \beta_{1i} + \beta_2 income\ inequality_{2i,t-1} - \beta_3 ICT\ development\ index_{3i,t} - \beta_4 Indonesian\ democracy\ index_{4i,t} - \beta_5 Human\ development\ index_{5i,t} - \beta_6 Gender\ inequality\ index_{6i,t} - £_{i,t}$$

The model is adapted from the model developed by Kus (2012) dan Asfar et.al (2014) which is estimated by panel data analysis. All variables used are estimated in the form of linear logs to get an overview of the elasticity.

RESULTS AND DISCUSSION

At this stage, the panel data regression model was estimated using the first-difference GMM (FD-GMM) two-step estimator approach. This model was chosen because it provides a valid instrument. Table 1 presents the intercept and slope values for each exogenous variable based on the FD-GMM approach model. The p-value indicates how much the independent variable influences the dependent variable.

Table 1. Parameter Estimation

Parameter	Coefficient	Standard Error	z	p-value
Income Inequality	.1658186	.1268791	1.31	0.191
ICT Development Index	-.0341413	.0410435	-0.83	0.406
Indonesian Democracy Index	-.4513132	.1253987	-3.60	0.000
Human Development Index	-.0628988	.2214747	-0.28	0.776
Gender Gap	-.1978232	.0376705	-5.25	0.000
cons	1.240963	.9465477	1.31	0.190

Source: data processing results using Stata application

The estimation used in this study uses the GMM Arellano-Bond two-step estimator. The signification test was conducted simultaneously using the Wald test with the following results in Table 2. From Table 2, it was decided to reject because the Wald value obtained was 46.22 or p-value (with a = 0.05), thus it can be concluded that there is at least

one independent variable that affects the dependent variable. After the Wald test is met, then a partial parameter significance test will be carried out using the Z test, the results of the Z test can be seen as follows $H_0 < \alpha$

Table 2. Wald Test

Wald value(w)	P-value
46.22	0.0000

Source: Data Processing

From Table 3, it can be decided to reject H_0 the IDI and IKG variables because the p-value of the Indonesian democracy index and the gender inequality index respectively is 0.000 with a negative coefficient. This means that the increase in the variables of Indonesia's democracy index and the gender inequality index will reduce gender inequality. Meanwhile, the ICT and HDI variables failed to be rejected because the p-values were 0.327 and 0.777 respectively so that there was no significant influence on income inequality H_0

Table 3. Partial Parameter Significance Test

Parameter	Coefficient	Standard Error	z	p-value
Income Inequality	.1658186	.140192	1.18	0.237
ICT Development Index	-.0341413	.0349875	-0.98	0.329
Indonesian Democracy Index	-.4513132	.1099028	-4.11	0.000
Human Development Index	-.0628988	.2223908	-0.28	0.777
Gender Gap	-.1978232	.0454879	-4.35	0.000
cons	1.240963	1.090683	1.14	0.255

Source: Data Processing

Furthermore, a model specification test was carried out on all variables that significantly influenced the model. The best dynamic panel data model estimation can be seen from the criteria, namely, the variables of the instrument used are valid, and the estimates obtained are consistent. The test of the variable of the instrument uses the Sargan test, and the estimation consistency test uses the Arellano-Bond test. The results of the Sargan test can be seen as follows in Table 4.

Table 4. Sargan Test Result

Test	Statistics Value (S)	P-value
Sargan Test	33.6773	0.1756

Source: Data Processing

From Table 5, it can be concluded that the p-value (0.1756) is greater than the significance level (0.05), then it fails to reject. The sargan test is also used to look at

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

residues that undergo heteroskedasticity. So, it can be H_0 decided that it fails to reject, which means that there is no heteroskedasticity or residual from the estimate of GMM Arellano-Bond homogeneous.H_0. Next, the Arellano-Bond test will be carried out, the results of the Arellano-Bond test can be seen in Table 5.

Table 5. Arellano-Bond Test

Test	Statistics Value (S)	P-value
Arellano Bond	-.58366	0.5595

Source: Data Processing

From Table 6, it can be decided that the rejection failed because the p-value is much greater than the 5% significance level; this means that there is no autocorrelation in the error of the first difference of the first order, so the estimate has been consistent. The results of the analysis in Table 6 found that the information and communication technology development index has a p-value of 0.329, and the human development index has a p-value of 0.777; this study found that the information and communication technology development index and the human development index have no significant influence on income inequality. This means that changes in the variables of the information and communication technology development index and the human development index do not provide a change in income inequality. Meanwhile, the Indonesian democracy index and the gender inequality index have a p-value of 0.000. Thus, this study found that the Indonesian democracy index and the gender inequality index have a negative effect on income inequality. This result means that changes in the quality of Indonesia's democracy index and gender inequality index have an impact on reducing income inequality.

Table 6. Short-Term and Long-Term Parameters Test

Parameter	Short-Term Elasticity Coefficient	p-value	Long-Term Elasticity Coefficient	p-value
Income Inequality	-	-	-	-
ICT Development Index	-.0341413	0.329	-.0409279	0.344
Indonesian Democracy Index	-.4513132	0.000	-.5410253	0.000
Human Development Index	-.0628988	0.777	-.0754019	0.775
Gender Gap	-.1978232	0.000	-.2371465	0.001

Source: Data processing

Table 6 evaluates the short-term and long-term effects of income inequality on the variables of the ICT Development Index, the Indonesian Democracy Index, the Human Development Index, and the Gender Inequality Index. The short-term and long-term elasticity coefficients in the Indonesian Democracy Index variables are -.4513132 and -.5410253, respectively, with a probability value of 0.000; this shows that a 1% increase in the Indonesian democracy index will cause a statistically significant decrease in the dependent variables, both in the short and long term. The probability value of the gender

inequality index is negligible from a significance level of 0.05 in the short and long term of (0.000 and 0.001) with its elasticity (-.1978232 and -.2371465). This result means that every 1% increase in the gender inequality index will cause a partially significant decrease in the dependent variables in the short and long term. The main findings in this study show a significant negative influence both in the short and long term of the Indonesian democracy index and the gender inequality index on income inequality. These findings conclude that efforts to reduce income inequality can be made by improving the quality of Indonesia's democracy index and gender inequality index both in the short and long term.

The study finds that the Indonesian Democracy Index significantly negatively affects income inequality in the short term and long term. Research (Uzar, 2023) shows that the democracy index significantly affects income inequality through increased transparency and redistribution policies. A strong democracy enables a more equitable income distribution by promoting public participation in policymaking and increased government transparency (Hue & Tung-Wen Sun, 2022). In research by Acemoglu et al. (2015), It was explained that when income inequality decreases, it will improve the quality of democracy in society; on the contrary, if income inequality increases, the quality of democracy in society will decrease. Research by Trinugroho et al. (2023) found that democracy negatively impacts economic growth, although democracy can help reduce income inequality between provinces. Fadly and Chandra (2024) argue that democracy can contribute to reducing income inequality but may simultaneously slow economic growth if not accompanied by appropriate policies. Furthermore, income inequality in Indonesia does not directly affect the implementation of democracy, as human development interventions measuring the quality of human capital play a mediating role.

Furthermore, the results of this study found that the gender inequality index has a significant negative effect on income inequality in the short term and long term. The results of this study are supported by research by Badriah and Istiqomah (2022), which found that the gender inequality index was significantly negative regarding income inequality. Rofatunnisa and Usman's (2024) research explained that areas with high income inequality tend to have greater gender inequality. High gender inequality can create barriers for women to access economic resources, education, and decent work, exacerbating overall income inequality. Gender inequality often results in women having limited access to education and skills training.

The findings of this study emphasize that improvements in democracy and reductions in gender inequality play a critical role in reducing income inequality. The implications suggest that a well-functioning democracy can contribute to a fairer income distribution by increasing public participation in economic policy decisions and ensuring equitable resource allocation. Furthermore, reducing gender inequality can help lower income inequality by providing equal access to economic resources and employment opportunities. The government should focus on enhancing the quality of democracy through inclusive economic policies while ensuring equal educational access for both men and women. Greater community participation will enable the government to understand societal needs better, leading to more inclusive policymaking.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

CONCLUSION

Based on the results of this study, the ICT Development Index and the Human Development Index do not significantly affect income inequality in the short or long term. This result indicates that, despite technological advancements and improvements in human resource quality being key focuses of various development policies, they have not directly contributed to reducing income inequality in Indonesia. Meanwhile, the Indonesian Democracy Index and the Gender Inequality Index significantly negatively impact income inequality in the short and long term. These findings highlight that governance and gender equality are crucial in determining income distribution within society. Gender inequality, for instance, can weaken economic growth by limiting access to jobs, education, and economic opportunities for women. Conversely, a stronger democracy enables fairer policy redistribution and increased public participation in decision-making.

Based on these findings, we recommend that relevant stakeholders, including both central and local governments, design effective policies grounded in factors that support income inequality reduction in Indonesia. These policies should prioritize improving democratic quality through enhanced transparency, accountability, and community empowerment in economic policymaking. Additionally, efforts to reduce gender inequality—such as expanding women's access to education, healthcare, and equal employment opportunities—should be a key priority in development strategies. For future research, we suggest expanding the scope of observational data and conducting comparative analyses to provide further insights into this issue.

ACKNOWLEDGEMENT

This research is funded by the Research Group Grant scheme by LPPM Bojonegoro University

REFERENCES

Acemoglu, D., Naidu, S., Restrepo, P., & Robinson, J. A. (2015). Democracy, Redistribution, and Inequality. In Atkinson, A. B., & Bourguignon, F. (Eds). *Handbook of Income Distribution, 2*, pp. 1885–1966. Netherlands: Elsevier B.V. https://doi.org/10.1016/B978-0-444-59429-7.00022-4.

Adams, S., & Akobeng, E. (2021). ICT, Governance and Inequality in Africa. *Telecommunications Policy*, *45*(10), 102198. https://doi.org/10.1016/j.telpol.2021.102198.

Adeosun, O. T., & Owolabi, K. E. (2021). Gender Inequality: Determinants and Outcomes in Nigeria. *Journal of Business and Socio-Economic Development*, *1*(2), 165–181. https://doi.org/10.1108/jbsed-01-2021-0007.

Agustina, M., Astuti, H., & Susilo, J. H. (2023). Unemployment in Indonesia: An Analysis of Economic Determinants from 2012-2021. *Signifikan: Jurnal Ilmu Ekonomi*, *12*(1), 69–82. https://doi.org/10.15408/sjie.v12i1.29247.

Al-Majali, A. (2024). The Effect of Democracy and Income Inequality (Gini Index). *Jordanian Journal of Law and Political Science*, *15*(4), 1-17. https://doi.org/10.35682/jjlps.v15i4.501

Anyanwu, J. C., Erhijakpor, A. E. O., & Obi, E. (2016). Empirical Analysis of the Key Drivers of Income Inequality in West Africa. *African Development Review*, *28*(1), 18–38. https://doi.org/10.1111/1467-8268.12164.

Badriah, L. S., & Istiqomah, I. (2022). Does Gender Inequality Lead to Income Inequality? Evidence from Indonesia. *Jurnal Ilmiah Bidang Ilmu Ekonomi*, *17*(1), 1–13.

Bahamonde, H., & Trasberg, M. (2021). Inclusive Institutions, Unequal Outcomes: Democracy, State Capacity, and Income Inequality. *European Journal of Political Economy*, *70,* 102048. https://doi.org/10.1016/j.ejpoleco.2021.102048.

Cheng, C. Y., Chien, M. S., & Lee, C. C. (2021). ICT Diffusion, Financial Development, and Economic Growth: An International Cross-Country Analysis. *Economic Modelling*, *94*, 662–671. https://doi.org/10.1016/j.econmod.2020.02.008.

Chung, H., Birkett, H., Forbes, S., & Seo, H. (2021). Covid-19, Flexible Working, and Implications for Gender Equality in the United Kingdom. *Gender and Society*, *35*(2), 218–232. https://doi.org/10.1177/08912432211001304.

Fadly, F., & Chandra, A. (2024). Human Development to Democracy: An Impact Analysis of Poverty and Income Inequality In Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *13*(2), 231–246. https://doi.org/10.15408/sjie.v13i2.42285.

Fahmi, A. (2019). Keterkaitan antara Penerimaan Pajak Penghasilan dan Pbb terhadap Kesenjangan Pendapatan. *Jurnal Akuntansi : Kajian Ilmiah Akuntansi (JAK)*, *6*(1), 39-50. https://doi.org/10.30656/jak.v6i1.945.

Fisher, B., & Naidoo, R. (2016). The Geography of Gender Inequality. *PLoS ONE*, *11*(3), 0145778. https://doi.org/10.1371/journal.pone.0145778.

Ghifara, A. S., Iman, A. N., Wardhana, A. K., Rusgianto, S., & Ratnasari, R. T. (2022). The Effect of Economic Growth, Government Spending, and Human Development Index toward Inequality of Income Distribution in the Metropolitan Cities in Indonesia. *Daengku: Journal of Humanities and Social Sciences Innovation*, *2*(4), 529–536. https://doi.org/10.35877/454ri.daengku1092.

Hue, T. H. H., & Tung-Wen Sun, M. (2022). Democratic Governance: Examining the Influence of Citizen Participation on Local Government Performance in Vietnam. *International Journal of Public Administration*, *45*(1), 4–22. https://doi.org/10.1080/01900692.2021.1939713.

Iddrisu, I., & Bhattacharyya, S. C. (2015). Sustainable Energy Development Index: A Multi-Dimensional Indicator for Measuring Sustainable Energy Development. *Renewable and Sustainable Energy Reviews, 50*, 513–530. https://doi.org/10.1016/j.rser.2015.05.032.

Jabeen, S., Haq, S., Jameel, A., Hussain, A., Asif, M., Hwang, J., & Jabeen, A. (2020). Impacts of Rural Women's Traditional Economic Activities on Household Economy:

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

Changing Economic Contributions through Empowered Women in Rural Pakistan. *Sustainability*, *12*(7), 2731. https://doi.org/10.3390/su12072731.

Janah, M. (2022). Analisis Pengaruh Tingkat PDRB PerKapita, Indeks Pembangunan Manusia, dan Penanaman Modal Asing terhadap Ketimpangan Pendapatan di Indonesia periode tahun 2019-2021. *Bisnis dan Akuntansi, 1* (4), 121-130.

Kartiasih, F., Nachrowi, N. D., Wisana, I. D. G. K., & Handayani, D. (2023). Towards the Quest to Reduce Income Inequality in Indonesia: Is There a Synergy between ICT and the Informal Sector? *Cogent Economics and Finance*, *11*(2), 2241771. https://doi.org/10.1080/23322039.2023.2241771.

Kling, G., Pesqué-Cela, V., Tian, L., & Luo, D. (2022). A Theory of Financial Inclusion and Income Inequality. *European Journal of Finance*, *28*(1), 137-157. https://doi.org /10.1080/1351847X.2020.1792960.

Lyrra, Putri, E., Putri, R., & Malik, A. (2025). Analisis Peran Demokrasi dan Pertumbuhan Ekonomi Terhadap Kesejahteraan Masyarakat. *Jurnal Kalikanda Halok Gagas*, *8*(1), 48–65.

Ma, W., Qiu, H., & Rahut, D. B. (2023). Rural Development in the Digital Age: Does Information and Communication Technology Adoption Contribute to Credit Access and Income Growth in Rural China? *Review of Development Economics*, *27*(3), 1421–1444. https://doi.org/10.1111/rode.12943.

Menyelim, C. M., Babajide, A. A., Omankhanlen, A. E., & Ehikioya, B. I. (2021). Financial Inclusion, Income Inequality and Sustainable Economic Growth in Sub-Saharan African Countries. *Sustainability*, *13*(4), 1780. https://doi.org/10.3390/su13041780.

Peterson, E. W. F. (2017). Is Economic Inequality Really a Problem? A Review of the Arguments. *Social Sciences, 6*(4), 147. https://doi.org/10.3390/socsci6040147.

Ramadhan, Z. (2023). Demokrasi dan Ketimpangan Pendapatan: Analisis Data Panel 9 Negara ASEAN Tahun 1973-2020. *Diponegoro Journal of Economics*, *12*(1), 45–53. https://doi.org/10.14710/djoe.36929.

Rau, E. G., Stokes, S., Bermeo, N., & Roberts, K. (2024). Income Inequality and the Erosion of Democracy in the Twenty-First Century. *Proceeding of the National Academy of Sciences, 122*(1), e2422543121. https://doi.org/10.1073/pnas.

Rofatunnisa, S., & Usman, H. (2024). Capaian Pertumbuhan Ekonomi Inklusif dan Ketimpangan Gender di Indonesia: Analisis Persamaan Simultan Data Panel. *Jurnal Ekonomi dan Kebijakan Publik*, *14*(1), 15–32. https://doi.org/10.22212/jekp.v14i1.2530.

Saputro, R., & Ulfatun Najicha, F. (2022). Penerapan Rasa Bela Negara Pada Generasi Muda Di Era Globalisasi. *Jurnal Pendidikan Ilmu Pengetahuan Sosial (JPIPS), 14*, 207–211.

Sarkodie, S. A., & Adams, S. (2020). Electricity Access, Human Development Index, Governance and Income Inequality in Sub-Saharan Africa. *Energy Reports*, *6*, 455–466. https://doi.org/10.1016/j.egyr.2020.02.009.

Sasmita, N. R., Phonna, R. A., Fikri, M. K., Khairul, M., Apriliansyah, F., Idroes, G. M., Puspitasari, A., & Saputra, F. E. (2023). Statistical Assessment of Human Development

Index Variations and Their Correlates: A Case Study of Aceh Province, Indonesia. *Grimsa Journal of Business and Economics Studies*, *1*(1), 12–24. https://doi.org/10.61975/gjbes.v1i1.14.

Sitthiyot, T., & Holasut, K. (2020). A Simple Method for Measuring Inequality. *Palgrave Communications*, *6*, 112. https://doi.org/10.1057/s41599-020-0484-6.

Stoetzer, L. F., Giesecke, J., & Klüver, H. (2023). How Does Income Inequality Affect the Support for Populist Parties? *Journal of European Public Policy*, *30*(1), 1–20. https://doi.org/10.1080/13501763.2021.1981981

Susilo J. H, Ibnu Tsani, L., Kholilurrohman, M., Surakarta, S., Slamet Riyadi, J., Sukoharjo, K., & Tengah, J. (2020). Econometrics Model of Economic Growth in East Java Province with Dynamic Panel Data through Arellano-Bond Generalized Method of Moment (GMM) Approach. *Jurnal Ilmiah Bidang Ilmu Ekonomi*, *15*(1), 38–53.

Tabash, M. I., Elsantil, Y., Hamadi, A., & Drachal, K. (2024). Globalization and Income Inequality in Developing Economies: A Comprehensive Analysis. *Economies*, *12*(1), 23. https://doi.org/10.3390/economies12010023.

Trinugroho, I., Achsanta, A. F., Pamungkas, P., Saputro, N., & Yuniarti, S. (2023). Democracy, Economic Growth, and Income Inequality: Evidence from Province Level Data. *Cogent Economics and Finance, 11*(1), 2220244. https://doi.org/10.1080/23322039.2023.2220244.

Uzar, U. (2023). Income Inequality, Institutions, and Freedom of the Press: Potential Mechanisms and Evidence. *Sustainability*, *15*(17). https://doi.org/10.3390/su151712927.

Wang, D., Zhou, T., & Wang, M. (2021). Information and Communication Technology (ICT), Digital Divide and Urbanization: Evidence from Chinese Cities. *Technology in Society*, *64,* 101516. https://doi.org/10.1016/j.techsoc.2020.101516.

Wanof, M. I. (2023). Digital Technology Innovation in Improving Financial Access for Low-Income Communities. *Technology and Society Perspectives (TACIT)*, *1*(1), 26–34. https://doi.org/10.61100/tacit.v1i1.35.

Willeck, C., & Mendelberg, T. (2025). Education and Political Participation. *Annual Review of Political Science, 25,* 89-110. https://doi.org/10.1146/annurev-polisci-051120.

Yavorsky, J. E., Keister, L. A., Qian, Y., & Nau, M. (2019). Women in the One Percent: Gender Dynamics in Top Income Positions. *American Sociological Review*, *84*(1), 54–81. https://doi.org/10.1177/0003122418820702.

Yip, P. S. F., Yousuf, S., Chan, C. H., Yung, T., & Wu, K. C. C. (2015). The Roles of Culture and Gender in the Relationship between Divorce and Suicide Risk: A Meta-Analysis. *Social Science and Medicine*, *128*, 87–94. https://doi.org/10.1016/j.socscimed.2014.12.034.

Yunga, F., Morquecho, C. A. T., Riofrío, P. Y. G., & Chamba, J. E. F. (2023). The Effect of Technology on Income Inequality. Implications of the Digital Divide: Evidence for OECD Country Members. *Contaduria y Administracion*, *68*(1), 260–288. https://doi.org/10.22201/fca.24488410e.2023.3308.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44943

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 163 - 178
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.45081

Fiscal Sustainability and Country Risk Profile: Empirical Evidence in Indonesia

Hafizh Azka Mufid[1*], Diah Widyawati[2]
[1,2]Faculty of Economics and Business, University of Indonesia, Indonesia
E-mail: [1]azkamufid@gmail.com, [2]diah.widyawati@ui.ac.id
[*]**Corresponding author**

JEL Classification:
H62
H60
H63
C32

Received: 24 February 2025

Revised: 17 March 2024

Accepted: 20 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research examines fiscal sustainability by considering the fiscal behavior of different government regimes and analyzing the correlation between fiscal sustainability and a country's risk profile using the VARX method, with the real effective exchange rate (REER) as an exogenous variable.

Research Objectives: This study aims first to determine whether Indonesia's fiscal conditions are sustainable across different government regimes. It then investigates whether a significant link exists between Indonesia's fiscal sustainability and its country's risk profile, as reflected by sovereign spreads from 2005 to 2024.

Research Methods: This study used the Vector Autoregressive Exogenous (VARX) method to capture endogeneity, exogeneity, simultaneity, direct effects, indirect effects, and shock-response of the variables used to measure the relationship between fiscal sustainability and sovereign risk.

Empirical Results: The findings indicate a significant relationship between fiscal sustainability and country risk, where an increase in the primary balance raises investor risk perception. Meanwhile, if debt management policies are implemented prudently and effectively, a rise in the debt-to-GDP ratio does not always widen the sovereign spread.

Implications: These results suggest that, despite differences in government regimes, policymakers should focus on strengthening the government's ability to manage debt prudently and either generate a primary balance surplus or reduce the deficit by sustainably enhancing revenue and spending policies to maintain fiscal sustainability and lower the country's risk profile.

Keywords:
fiscal sustainability; government debt; primary balances; sovereign spread

How to Cite:
Mufid, A.H., & Widyawati, D. (2025). Fiscal Sustainability and Country Risk Profile: Empirical Evidence in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 163-178. https://doi.org/10.15408/sjie.v14i1.45801.

INTRODUCTION

In the aftermath of the 2008–2009 global financial crisis, chronic fiscal imbalances have emerged as a major risk to the global economy. As financial and capital markets have become increasingly focused on fiscal risks, ensuring fiscal sustainability has become a key concern for policymakers across countries at all income levels (Shastri et al., 2020), particularly in economies experiencing rising government debt, including Indonesia (Widiastuti et al., 2023). Therefore, maintaining fiscal sustainability is a critical public policy priority for safeguarding economic development and the welfare state (Marín-Rodríguez et al., 2023) in developed and developing nations. In recent years, this issue has been linked to the accumulation and size of public debt and a country's risk profile. Maintaining fiscal sustainability is crucial as a necessary condition to reduce the country's risk profile as little as possible (Blanchard & Johnson, 2018).

Many empirical studies have examined fiscal sustainability and sovereign risk profiles. Research on fiscal sustainability suggests that an increase in the public debt-to-GDP ratio typically prompts an immediate fiscal policy response, involving primary balance adjustments such as reduced deficits or increased surpluses to maintain fiscal stability (Paniagua et al., 2017; Solikin & Choirunnisah, 2019; Rusdiyantoro & Simanjuntak, 2022; Leonardo & Thomas, 2024). Furthermore, Campos and Cysne (2025) analyzed fiscal sustainability across a panel of 88 countries from 2000 to 2020 using the cross-sectional panel ARDL method to estimate both short- and long-run effects, as well as the fiscal reaction function (FRF) of the government's primary surplus in response to rising public debt. Their findings indicate that fiscal sustainability was maintained in advanced and emerging economies before the pandemic. However, when incorporating the COVID-19 period, emerging economies exhibited signs of fiscal unsustainability, while low-income countries were already fiscally unsustainable before the pandemic. Several studies have also examined fiscal sustainability in Indonesia. Using a value-at-risk (VaR) approach, Sriyana and Hakim (2017) found that Indonesia's fiscal position remained sustainable between 1990 and 2014. This finding is further supported by studies from Marisa (2015), Pamungkas (2016), Basorudin (2019), Widjanarko (2020), Ikhsan and Virananda (2021), Juanda and Gladiola (2022), and Adrison (2023), which also confirm the presence of fiscal sustainability in Indonesia.

Apart from studies on fiscal sustainability, numerous other studies have separately explored the relationship between debt—as one of the key variables of fiscal sustainability—and a country's risk profile. Several studies have found that sovereign spreads serve as an indicator of investor confidence in a government's ability to meet its debt obligations (Belhocine & Dell'Erba, 2013; Presbitero et al., 2016; Mpapalika, 2019; Dachraoui et al., 2020; and Fedderke, 2021). Other studies have examined fundamental factors as determinants of sovereign spreads. Baldacci et al. (2008), Aizenman et al. (2016), as well as Kariyawasam and Jayasinghe (2022) found that country-specific factors play a more significant role than global factors in determining sovereign spreads. Similarly, Novianti and Danarsari (2013) identified key macroeconomic and global

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

determinants of sovereign spreads in Indonesia, such as the debt service ratio, real effective exchange rate, fiscal balance-to-GDP ratio, output level, the VIX index, and US interest rates, which contribute to assessing potential default risk.

Furthermore, Heimberger (2023), applying regression methods to data from 22 OECD countries from 1970–2018, found that differentials between government bond interest rates and economic growth rates are key determinants of public debt dynamics. Financial markets tend to react to changes in debt levels, with higher debt-to-GDP ratios often leading to an increase in the risk premium on government bonds. This condition suggests that investors perceive a higher risk of default as debt levels rise.

However, most existing studies do not directly explore the relationship between fiscal sustainability and country risk profiles. Furthermore, research in this area has yet to incorporate the impact of different government regimes, which can significantly influence fiscal sustainability and sovereign risk. In general, study on fiscal sustainability has emphasized three key trends: (i) the relationship between fiscal sustainability and economic growth, (ii) methodologies and models for assessing fiscal sustainability, and (iii) demographic concerns and their impact on fiscal sustainability (Marín-Rodríguez et al., 2023). Nevertheless, few studies have investigated the link between fiscal sustainability and a country's risk profile. This connection is crucial, as it can shape investor perceptions of investment risk (Baldacci et al., 2011). A high debt-to-GDP ratio tends to widen spreads, underscoring the importance of fiscal sustainability. Countries with high debt burdens are often penalized by international capital markets. Financial markets typically respond with broader credit spreads when policymakers overlook fiscal risk, particularly for countries with weak fiscal discipline or a default history.

To address this research gap, this study examines the relationship between fiscal sustainability and sovereign risk by analyzing how the fiscal behavior of different government regimes influences public debt accumulation and the primary balance—two key indicators commonly used to assess fiscal sustainability. Using quarterly data from 2005 to 2024 and the vector autoregression with exogenous variables (VARX) method, this study aims to determine whether Indonesia's fiscal conditions are sustainable or unsustainable across different government regimes. It then investigates whether a significant link exists between Indonesia's fiscal sustainability and its country's risk profile, as reflected by sovereign spreads. There are four novelties in this study: (i) examining fiscal sustainability by considering fiscal behavior of different government regimes which have influenced the dynamics of the debt-to-GDP ratio and the primary balance-to-GDP ratio differently; (ii) analyzing correlation between fiscal sustainability and country risk profile; (iii) using VARX method with the real effective exchange rate (REER) as an exogenous variable; and (iv) exploring direct effects and indirect effects of endogenous variables through the impulse response function analysis.

METHODS

This study employs the primary balance-to-GDP ratio and the government debt-to-GDP ratio as key fiscal sustainability indicators, alongside the sovereign spread (10-year government bond yield spread) as a proxy for the country's risk profile. From Q1 2005 to Q4 2024, these variables will be treated as endogenous variables. Additionally, a government regime dummy is included to capture fiscal policy behavior. At the same time, the real effective exchange rate is used as an exogenous variable in the VARX model, as it reflects the impact of exchange rates on trade with partner countries, thereby influencing fiscal policy, mainly through exports and imports (Bajo-Rubio & Berke, 2014). Consequently, it can affect government debt and the primary balance: these variables and their operational definitions are shown in Table 1.

Table 1. Operational Variables

Variables	Definition	Measurements	Data Source	References
Primary Balance	The primary balance-to-GDP ratio, which is the difference between government revenue and government expenditure excluding interest payments on debt, relative to the GDP level.	Total Primary Balance/GDP (%)	Ministry of Finance	(Pamungkas, 2016; Ikhsan & Virananda, 2021; Leonardo & Thomas, 2024)
Sovereign Spread	The difference between the yield on government bonds and the yield on risk-free bonds denominated in the same currency (USD).	10-Year Government Bond Yield – 10-Year US Treasury Yield	*Bloomberg*	(Mpapalika & Malikane, 2019; Fedderke, 2021; Kariyawasam & Jayasinghe, 2022)
Central Government Debt/GDP	The total outstanding loans of the central government at a given time, including bonds, treasury bills, and loans from international institutions or other countries, relative to the GDP level. The debt level consists of both domestic and external debt.	Total Central Government Debt/GDP (%)	Ministry of Finance	(Pamungkas, 2016; Ikhsan & Virananda, 2021; Widiastuti, Fitrady & Widodo. 2023; Leonardo & Thomas, 2024)
Real effective exchange rate (REER)	The value of a country's currency relative to multiple other countries' currencies, adjusted for the inflation rate at a given year or the consumer price index of a specific country.	Nominal Effective Exchange Rate * Price index of trading partner countries (foreign inflation)/ Domestic price index	*Bank for International Settlements*	(Novianti & Danarsari, 2013; Hofmann, Shim & Shin, 2017)
Dummy Government	A dummy variable capturing the periods of the SBY and Jokowi administrations.	Dummy Government: 1 for Jokowi period, 0 otherwise	Own calculation	-

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

To examine fiscal sustainability based on the fiscal reaction function (FRF) model and its correlation with the sovereign spread, we use the following specification of the VARX model:

$$b_t = \alpha_1 + \sum_{i=1}^{p} \beta_{11} b_{t-i} + \sum_{i=1}^{p} \beta_{12} p_{t-i} + \sum_{i=1}^{p} \beta_{13} S_{t-i} + \delta_1 e_t^* + \delta_1 DPRES_t + \varepsilon_t \quad (1)$$

$$p_t = \alpha_2 + \sum_{i=1}^{p} \beta_{21} b_{t-i} + \sum_{i=1}^{p} \beta_{22} p_{t-i} + \sum_{i=1}^{p} \beta_{23} S_{t-i} + \delta_2 e_t^* + \delta_2 DPRES_t + \varepsilon_t \quad (2)$$

$$s_t = \alpha_3 + \sum_{i=1}^{p} \beta_{31} b_{t-i} + \sum_{i=1}^{p} \beta_{32} p_{t-i} + \sum_{i=1}^{p} \beta_{33} S_{t-i} + \delta_3 e_t^* + \delta_3 DPRES_t + \varepsilon_t \quad (3)$$

Where P_t is primary balance/GDP, b_t is debt-to-GDP ratio, and s_t is sovereign spread, with two exogenous variables: e_t^* is real effective exchange rate, and $DPRES_t$ is government regime dummy.

The VARX model in this study is carried out in five (5) stages, namely: (i) the data stationarity test; (ii) determining the optimal lag length; (iii) the stability test; (iv) estimating model parameters; and (v) determining the impulse response function. The stationarity test is conducted using the Phillips-Perron (PP) test method, whereas the determination of the optimal lag length using the PP unit root test is performed through the Sequential Modified LR Test Statistic (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ). Meanwhile, the stability test in the VARX model is conducted by analyzing the inverse roots of the autoregressive (AR) characteristic polynomial.

RESULTS AND DISCUSSION

Table 2 presents descriptive statistics of all variables used in this study. The debt-to-GDP ratio averaged 31.1%, with a median of 29.3%. The highest value recorded was 47.2% in 2005: Q4, while the lowest occurred in 2013: Q1 with 21.0%. The downward trend in the debt-to-GDP ratio until the early 2010s was associated with relatively stable economic growth and tighter fiscal policy following the 1997-1998 Asian financial crisis. However, in recent years, especially after the COVID-19 pandemic, the debt-to-GDP ratio has increased again due to increased government spending on economic recovery.

Meanwhile, the primary balance-to-GDP ratio showed an average of -0.105%, indicating that the government generally experiences a primary balance deficit, where state expenditure excluding debt interest exceeds state revenue. The median primary balance/GDP ratio was recorded at -0.10%, with a high point of 1.65% in 2008: Q1 and a low point of -2.25% in 2020: Q3. The improvement in the primary balance-to-GDP surplus ratio in 2008 was related to the surge in global commodity prices that boosted state revenues, while the worsening primary balance-to-GDP deficit ratio in 2020 reflected the impact of high fiscal spending during the pandemic and the impact of the global economic slowdown.

Table 2. Summary Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Debt/GDP Ratio (b_t)	80	31,483	6,857	21,912	47,34
Primary Balance Ratio/GDP (p_t)	80	-0,105	0,705	-2,248	1,648
Sovereign Spread (s_t)	80	1,912	1,615	-1,479	9,769
Real Effective Exchange Rate (e_t^*)	80	100,94	5,71	83,18	112,58

Source: data processing

The sovereign spread over the observation period averages 1.91%, indicating that the 10-year Indonesian government bond yield is consistently higher than the 10-year US Treasury. The median sovereign spread was recorded at 1.82%, with a high point of 9.77% in 2008: Q4 and a low point of -1.47% in 2021: Q4. The sharp rise in sovereign spread in 2008 was due to the global financial crisis, which increased the risk of emerging markets, including Indonesia. Meanwhile, the significant decline in the sovereign spread in 2021 reflects the low-interest rate policy in the United States and the lower risk perception of the Indonesian economy post-pandemic. Finally, the real effective exchange rate (REER) averages 100.94, indicating that Indonesia's real exchange rate tends to appreciate compared to the base year. The median REER was recorded at 100.62, with a high point of 112.58 in 2010: Q2 and a low point of 83.18 in 2005: Q3. The REER appreciation in 2010 was related to significant foreign capital inflows and strong economic growth, while the REER depreciation in 2005 reflected the after-effects of the Asian financial crisis and exchange rate adjustments by Bank Indonesia.

Table 3. Stationarity Test Results

Phillip - Person (PP) Stationarity Test				
Variables	Level		First Difference	
	T-stat	Prob	T-stat	Prob
b_t	-2.160	0.224	**-9,663**	**0.0000**
p_t	**-6,807**	**0.000**	-	-
s_t	**-2,608**	**0,0957**	-8,596	0.0000
e_t^*	**-4,029**	**0,002**	-	-

Source: data processing

Based on the unit root test with the PP statistical test as shown in Table 3, all variables used in this study, namely the primary balance/GDP ratio (P_t), the sovereign spread (S_t) and the effective real exchange rate (e_t^*) show stationary at level, while the debt/GDP ratio (b_t) is stationary at first difference. This conclusion is based on the absolute value of PP statistics of all research variables that are greater than their critical values, both at the 99 percent, 95 percent, and 90 percent confidence levels.

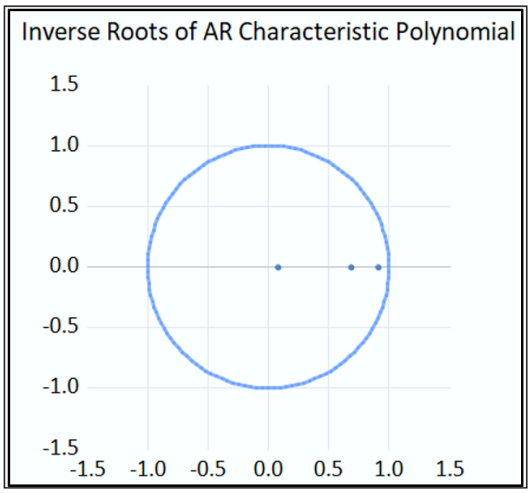
http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

Table 4. Optimal Lag Test

Lag	Log-L	LR	FPE	AIC	SC	HQ
0	-424,825	NA	13,602	11,124	11,396	11,233
1	-292,503	264,286*	0,576*	7,962*	8,505*	8,179*
2	-284,426	14,290	0,591	7,985	8,801	8,312

Source: data processing

Figure 1 Stability Test: Inverse Root of the AR Characteristic Polynomial



Source: data processing

Furthermore, the result of the stability model test, as shown in Figure 1, suggests that the characteristic roots of all variables used in this study generally have a modulus smaller than one, and the inverse roots of AR characteristic polynomial points of the model are all in the unit circle. Thus, it can be concluded that the VARX model of fiscal sustainability and risk profile used as the basis of analysis in this study is stable and valid.

The results of the VARX estimation on fiscal sustainability and risk profile are shown in Table 5. We first examine Indonesia's fiscal sustainability as an initial step in investigating the relationship between fiscal sustainability and a country's risk profile.

The results show that the coefficient of the debt-to-GDP ratio has a positive direct effect on the primary balance-to-GDP ratio and is statistically significant at the 99% confidence level over the entire observation period across all government regimes (2005–2024). This result fulfills one of the necessary conditions for achieving fiscal sustainability, namely the positive relationship between the government debt-to-GDP ratio and the primary balance-to-GDP ratio (Afonso, 2008). The findings of this study are also consistent with those of previous researchers, such as Insanu and Purwanti (2020), who found that debt has a significant positive long-term effect on fiscal sustainability, and Widiastuti et al. (2023), who found that fiscal sustainability tests—using both debt stationarity and the fiscal reaction function—produced consistent results, indicating the presence of fiscal sustainability in Indonesia.

Table 5. FRF Estimation Results of Fiscal Sustainability and Sovereign Spread

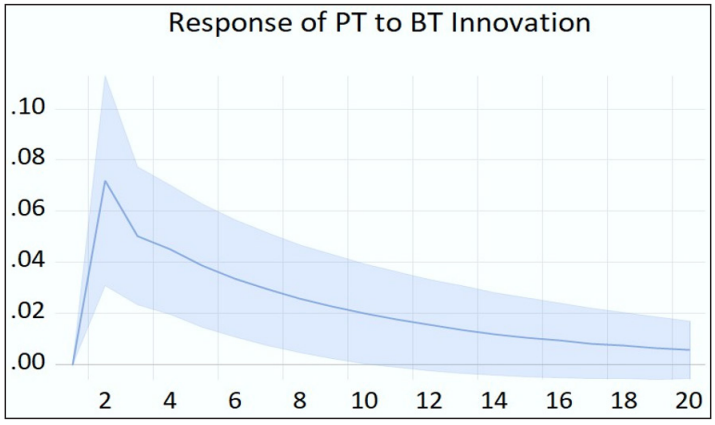
Variables	b_t (Equation (1))			p_t (Equation(2))			S_t (Equation(3))		
	Full Period	SBY period	Jokowi period	Full Period	SBY period	Jokowi period	Full Period	SBY Period	Jokowi period
b_t-1	0,871***	0,830***	0,968*	0,021**	0,035***	-0,015	-0,034*	-0,031	-0,030
p_t-1	0,403	0,748	0,563	0,112	-0,109	0,013	0,390	0,359	0,388*
S_t-1	-0,248	-0,322	0,120	0,022	0,025	-0,071	0,689***	0,665***	0,771*
c	14,134	18,320	11,336	-2,128	-2,447	-6,354	7,684	7,680	6,933
$DPRES_t$	0,964*	-	-	-0,316**	-	-	-0,292	-	-
e_t^*	-0,101**	-0,129*	-0,099	0,015	0,014	0,066*	-0,058**	-0,058	-0,056*
F-Statistic	222.673	-	-	3.795	-	-	40.579	-	-
	-	125.318	-	-	5.282	-	-	12.822	-
	-	-	118.422	-	-	1.429	-	-	49.694
R-Square	0.940	-	-	0.206	-	-	0.735	-	-
	-	0.937	-	-	0.383	-	-	0.601	-
	-	-	0.931	-	-	0.140	-	-	0.850

Note:*** significant at 1%, ** significant at 5%, * significant at 10%

Source: data processing

This finding is further supported by the Impulse Response Function (IRF) analysis, which examines how the primary balance-to-GDP ratio responds to a shock in the debt-to-GDP ratio. As illustrated in Figure 2, a shock to the debt-to-GDP ratio has a positive direct and indirect effect on the primary balance-to-GDP ratio, suggesting that Indonesia's fiscal conditions are sustainable. Specifically, when the debt-to-GDP ratio increases in the first quarter, the primary balance-to-GDP ratio rises, reaching its peak in the second quarter. Consequently, this increase in the primary balance-to-GDP ratio allows the government to either reduce new debt issuance or meet debt servicing obligations, thereby facilitating a decline in the debt-to-GDP ratio in subsequent periods. From the third quarter onward, the debt-to-GDP ratio gradually converges and stabilizes in the medium term.

Figure 2. Response of Primary Balance/GDP Ratio to Debt/GDP Ratio Shocks for the Period 2005-2024



Source: data processing

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

Although, in the long run, the overall impact of the debt-to-GDP ratio on the primary balance-to-GDP ratio supports Indonesia's fiscal sustainability, the slower response of the primary balance-to-GDP ratio to debt shocks suggests weak fiscal sustainability (Ghosh et al., 2013). This result implies that while Indonesia demonstrates long-term fiscal sustainability—where the positive adjustment speed of the primary balance-to-GDP ratio aligns with debt dynamics—the government must exercise caution when accumulating additional debt to prevent fiscal fatigue (Ghosh et al., 2013).

To test the consistency of the research results over the entire observation period (2005–2024) and simultaneously assess fiscal sustainability under the SBY and Jokowi administrations, it is necessary to analyze the estimation results of fiscal sustainability and risk profile based on each government period. As shown in Table 5, the estimation results indicate that the dummy variables representing different presidential administrations have a significant yet distinct impact on the debt-to-GDP ratio and the primary balance-to-GDP ratio, highlighting the importance of distinguishing between government periods.

Furthermore, the estimation results in Table 5 provide evidence that during the SBY administration, the debt-to-GDP ratio had a positive and significant relationship with the primary balance-to-GDP ratio. This finding suggests that fiscal sustainability was achieved during President SBY's tenure. Empirical data show that throughout SBY's administration (2005–2014), the primary balance-to-GDP ratio was in surplus for approximately 57.5% of the observation period, while it was in deficit for the remaining 42.5%. Similarly, during this period, the debt-to-GDP ratio declined significantly from 47.34% in 2005 to 24.68% in 2014. The achievement of fiscal sustainability during President SBY's tenure was also supported by government debt growth, which averaged only around 10% per year between 2005 and 2014—considerably lower than the nominal GDP growth, which averaged 28% per year over the same period.

In contrast, during the Jokowi administration (2015–2024), there was no significant relationship between the debt-to-GDP ratio and the primary balance-to-GDP ratio, indicating the absence of fiscal sustainability. President Jokowi's administration pursued expansionary fiscal policies, leading to a growing budget deficit. Empirical data show that under President Jokowi, the primary balance-to-GDP ratio was in deficit for approximately 67.5% of the observation period, while it was in surplus for only 32.5%. Consequently, as reflected in the estimation results in Table 5, during President Jokowi's tenure, the coefficient of the debt-to-GDP ratio did not exhibit a significant direct relationship with the primary balance-to-GDP ratio, meaning that the necessary conditions for achieving fiscal sustainability were not met.

Figure 3 (SBY's administration) illustrates that a shock to the debt-to-GDP ratio has both direct and indirect positive effects on the primary balance-to-GDP ratio, indicating the presence of fiscal sustainability. The positive response of the primary balance-to-GDP ratio to a debt-to-GDP ratio shock suggests that when the debt-to-GDP ratio rises in the first quarter, the primary balance-to-GDP ratio tends to

increase, reaching its peak in the second quarter. As a result, this increase in the primary balance-to-GDP ratio provides an opportunity for the government to reduce the issuance of new debt or meet debt service obligations, thereby contributing to a decline in the debt-to-GDP ratio in subsequent periods. The premature end of the positive response of the primary balance-to-GDP ratio to a rise in the debt-to-GDP ratio indicates a weak level of fiscal sustainability in Indonesia. Given this condition, the government should exercise caution when accumulating additional debt to prevent fiscal fatigue (Ghosh et al., 2013).

Figure 3. Response of Primary Balance/GDP Ratio to Debt/GDP Ratio Shocks for SBY Period, 2005- 2014

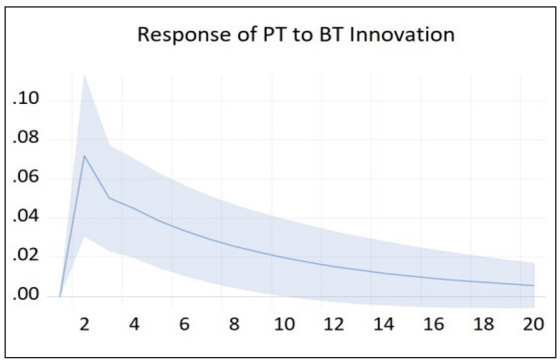
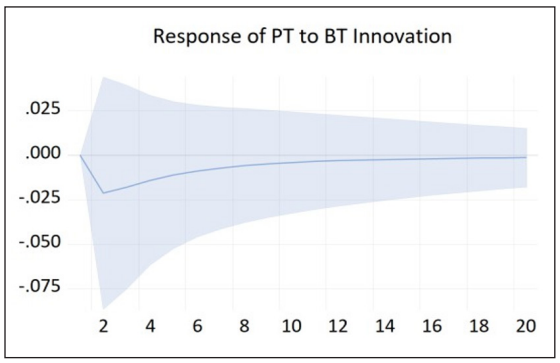


Figure 4. Response of Primary Balance/GDP Ratio to Debt/GDP Ratio Shocks for Jokowi Period, 2015- 2024



Source: data processing

In contrast, during President Jokowi's administration, as shown in Figure 4, an initial shock to the debt-to-GDP ratio was met with a negative response from the primary balance-to-GDP ratio, reaching its lowest point in the second quarter. Consequently, the primary balance-to-GDP ratio response continues to decline in the following periods. The results of the IRF analysis suggest that during President Jokowi's tenure, fiscal sustainability was not achieved, as the reduction in the primary balance deficit tends to occur at a slower pace than the increase in debt. This pattern indicates the presence of fiscal fatigue.

Having analyzed fiscal sustainability, we examine its relationship with the sovereign spread. Based on the VARX model estimation results in Table 5, the debt-to-GDP ratio has a significant direct effect in narrowing the sovereign spread. This result suggests that prudent and effective debt management supports fiscal sustainability and is crucial in reducing Indonesia's risk profile. The government's efforts to maintain the debt-to-GDP ratio below 60% and the fiscal deficit-to-GDP ratio below 3%—within the IMF's recommended limits—have been well received by investors. This perception has attracted foreign investors, mainly as Indonesia is one of the most promising emerging markets, offering high government bond yields and strong economic growth. Consequently, Indonesia has become a key destination for investors seeking high-yield opportunities in emerging markets. Additionally, new debt issuance aimed at financing productive investments—such as infrastructure development, economic transformation,

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

or expenditures that support pro-poor, pro-job, and pro-growth policies—may be perceived by the market as a strategic move to enhance economic growth and strengthen future debt servicing capacity.

Figure 5. *Sovereign Spread* Response to Debt/GDP Ratio Shocks for the Period 2005-2024

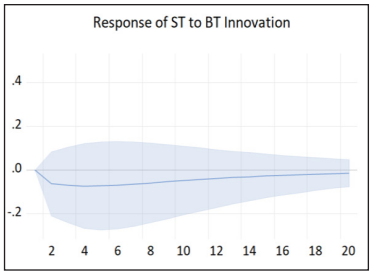


Figure 6. *Sovereign Spread* Response to Debt/GDP Ratio Shocks for SBY Period 2005-2014

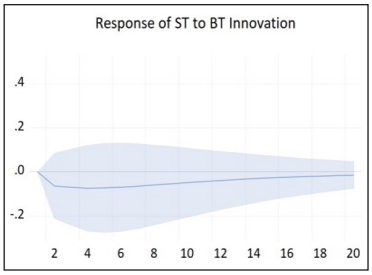
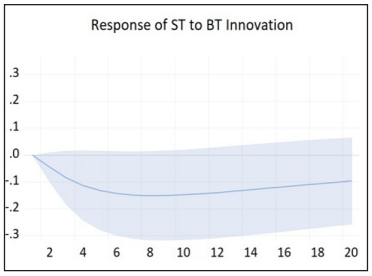


Figure 7. *Sovereign Spread* Response to Debt/GDP Ratio Shocks for Jokowi Period 2015-2024



Source: data processing

The VARX estimation results on the link between fiscal sustainability and the sovereign spread are further supported by the IRF analysis presented in Figures 5, 6, and 7 above. Figures 5 and 6 illustrate a similar response pattern of the sovereign spread on the shock of debt-to-GDP across the full observation period (2005–2024) and the SBY administration (2005–2014). Specifically, a shock to the debt-to-GDP ratio has both a direct and indirect negative effect on the sovereign spread, indicating that an increase in the debt-to-GDP ratio is met with a narrowing of the sovereign spread. During the Jokowi administration (2015–2024), the sovereign spread's response to a debt-to-GDP ratio shock generally followed the same pattern as observed in the full period and the SBY administration. However, the response is slower in magnitude and convergence. The negative response of the sovereign spread to the debt-to-GDP ratio shock persists for an extended period, peaking around the sixth quarter (1.5 years after the initial shock). This trend can be attributed to Indonesia's prudent and sound debt management policies, which align domestic interest rates with U.S. interest rate developments while maintaining a competitive debt interest rate spread. As a result, despite rising debt levels, the sovereign spread narrows due to well-maintained and competitive yields.

Furthermore, the IRF analysis in Figures 8, 9, and 10 reveals a consistent pattern in the sovereign spread's response to a positive shock in the primary balance-to-GDP ratio. This pattern is evident across the full observation period (2005–2024) and during the SBY administration (2005–2014). Similarly, under the Jokowi administration, the response follows a comparable trajectory but with a slower magnitude and convergence. According to the IRF results, shocks to changes in the primary balance-to-GDP ratio have both direct and indirect positive effects on the sovereign spread. This suggests that an increase in the primary balance-to-GDP ratio leads to a widening of the sovereign spread. However, this positive response is temporary, peaking in the second quarter before gradually weakening and converging by the sixth quarter (1.5 years after the initial shock).

Figure 8. Sovereign Spread Response to Primary Balance/GDP Ratio Shocks for the Period 2005- 2024

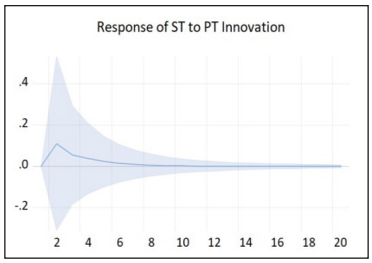


Figure 9: Sovereign Spread Response to Primary Balance/GDP Ratio Shocks for SBY Period 2005- 2014

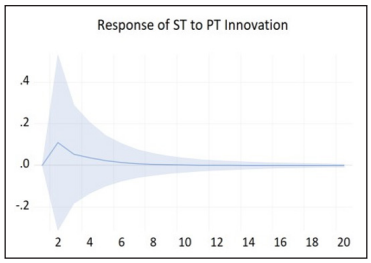
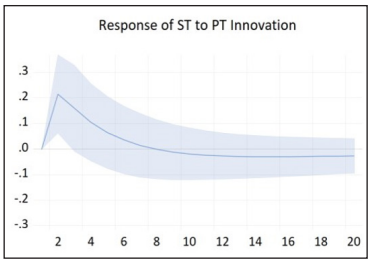


Figure 10. Sovereign Spread Response to Primary Balance/GDP Ratio Shocks for Jokowi Period 2015-2024



Source: data processing

This finding implies that while Indonesia's fiscal conditions were generally sustainable during 2005–2024, investor concerns about sovereign risk persisted due to weak fiscal sustainability. These concerns led investors to demand higher yield premiums, ultimately contributing to the widening of the sovereign spread in Indonesia. This condition also indicates the phenomenon of fiscal fatigue, where the growth of the primary balance-to-GDP ratio can no longer keep pace with the faster-growing debt-to-GDP ratio. Empirical data shows that the primary balance-to-GDP ratio has been on a declining trend—either through a reduction in surplus or an increase in the primary deficit—both in the final years of the SBY administration and throughout the Jokowi administration. Consequently, investors perceive an increase in the primary deficit negatively, impacting Indonesia's risk profile. As a result, investors tend to demand higher returns in response to the growing primary deficit. This finding is further supported by research from Basri and Sumartono (2023), which states that a persistent budget deficit—mainly since the fourth quarter of 2011—has led investors to require higher returns to compensate for increased country risk.

Another variable that affects the VARX system but is not influenced by the endogenous variables in the model is the real effective exchange rate (REER) index. Over the full observation period, the estimation results of the VARX model indicate that REER has a negative and significant effect on the government debt-to-GDP ratio at the 95% confidence level. This suggests that an appreciation of the real effective exchange rate (REER) lowers the cost of servicing external debt denominated in U.S. dollars and/or other foreign currencies, thereby decreasing the government debt-to-GDP ratio.

REER also has a negative effect on the sovereign spread, meaning that an inflow of U.S. dollars and/or other strong foreign currencies into the economy reduces Indonesia's sovereign spread. This finding is consistent with the research conducted by Hofman et al. (2017), which states that an appreciation of the domestic exchange rate signals a positive perception of the domestic economy from investors. As a result, foreign investors are more likely to allocate their funds to the domestic economy, leading to a decline in sovereign spreads (Hofman et al., 2017).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

CONCLUSION

Indonesia's fiscal condition during 2005–2024 has been sustainable but shows signs of weakening (weak fiscal sustainability). Given the importance of government regimes in fiscal sustainability, this study finds that Indonesia's fiscal condition remained sustainable during the SBY administration (2005–2014). In contrast, fiscal sustainability was absent during the Jokowi administration (2015–2024). Considering this fiscal sustainability condition, this study identifies a link between fiscal sustainability and Indonesia's risk profile. When there is a shock to the primary balance-to-GDP ratio, the sovereign spread responds positively, indicating that investors perceive higher risks, as reflected in an increase in the sovereign spread. Conversely, when there is a shock to the debt-to-GDP ratio, the sovereign spread responds negatively, suggesting that an increase in debt does not necessarily heighten risk perception.

This research suggests that, despite differences in government regimes, fiscal policymakers should focus on managing debt prudently while optimizing tax and non-tax revenues and improving spending quality to maintain fiscal sustainability and reduce the country's risk profile. Therefore, policymakers should prioritize enhancing government revenue and spending policies to strengthen the government's ability to generate a primary budget surplus or reduce the deficit, thereby narrowing the sovereign spread.

For future research, further analysis could be conducted by incorporating additional exogenous variables that influence the relationship between fiscal sustainability and risk profile, such as foreign investment flows and real exchange rates, which impact the debt-to-GDP ratio and primary balance. Additionally, future studies could expand the scope of country risk assessment beyond sovereign spreads by incorporating alternative indicators such as Credit Default Swaps, the International Country Risk Guide, credit ratings, and other relevant risk measures that influence investor perceptions.

REFERENCES

Adrison, V. (2023). Fiscal Sustainability in Indonesia: Policies and Progress. *Asian Economic Policy Review, 19*(2), 224-247. https://doi.org/10.1111/aepr.12345.

Afonso, A., & Rault, C. (2008). What Do We Really Know About Fiscal Sustainability in the EU? A Panel Data Diagnostic. *Review of World Economics, 145*(4), 731–755. https://doi.org/10.1007/s10290-008-0017-3.

Aizenman, J., Jinjarak, Y., & Park, D. (2016). Fundamentals and Sovereign Risk of Emerging Markets. *Pacific Economic Review, 21*(2), 151–177. https://doi.org/10.1111/1468-0106.12156.

Bajo-Rubio, O., & Berke, B. (2014). Fiscal Policy and the Real Exchange Rate: Some Evidence from Spain. *Economic Modelling, 37*, 298–306. https://doi.org/10.1016/j.econmod.2013.11.023.

Baldacci, E., Gupta, S., & Mati, A. (2011). Political and Fiscal Risk Determinants of Sovereign Spreads in Emerging Markets. *Review of Development Economics, 15*(2), 251–263. https://doi.org/10.1111/j.1467-9361.2011.00606.x.

Basorudin, M. (2019). Analysis of Indonesia's Fiscal Sustainability after the Economic Crisis. *Journal of Development Economics, 17*(2), 59–70. https://doi.org/10.29259/jep.v17i2.9792.

Basri, M. C., & Sumartono, L. (2023). The Impossibility of the Impossible Trinity? The Case of Indonesia. *Oxford Review of Economic Policy, 39*(2), 341–355. https://doi.org/10.1093/oxrep/grad034.

Belhocine, N., & Dell'Erba, S. (2013). The Impact of Debt Sustainability and the Level of Debt on Emerging Markets Spreads. *IMF Working Papers, 2013*(093), 1–31.

Blanchard, O., & Johnson, D. R. (2018). *Macroeconomics: Global edition* (7th ed.). New Jersey: Pearson.

Campos, E. L., & Penha, C. R. (2025). A Cross-Sectional Panel ARDL Approach to Fiscal Sustainability Analysis. *Journal of Applied Economics, 8*(1), 45–62. https://doi.org/10.1007/s10800-025-00234-9.

Dachraoui, H., Smida, M., & Sebri, M. (2020). Role of Capital Flight as a Driver of Sovereign Bond Spreads in Latin American Countries. *International Economics, 162*, 15–33. https://doi.org/10.1016/j.inteco.2020.07.004.

Fedderke, J. (2021). The South African–United States Sovereign Bond Spread and Its Association with Macroeconomic Fundamentals. *South African Journal of Economics, 89*(4), 499–525. https://doi.org/10.1111/saje.12399.

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D., & Qureshi, M. S. (2013). Fiscal Fatigue, Fiscal Space, and Debt Sustainability in Advanced Economies. *The Economic Journal, 123*(566), F4–F30. https://doi.org/10.1111/ecoj.12010.

Heimberger, P. (2023). Public Debt and R-G Risks in Advanced Economies: Eurozone versus Stand-Alone. *Journal of International Money and Finance, 136*(C), 102573. https://doi.org/10.1016/j.jimonfin.2023.102573.

Hofmann, B., Shim, I., & Shin, H. S. (2017). Sovereign Yields and the Risk-Taking Channel of Currency Appreciation. *BIS Working Paper No. 538*.

Ikhsan, M., & Virananda, I. G. S. (2021). Fiscal Sustainability in Indonesia with Asymmetry. *Economics and Finance in Indonesia, 67*(1), 19-30. https://doi.org/10.47291/efi.v67i1.731.

Insanu, F. M. (2020). Utang Pemerintah dan Fiscal Sustainability dalam Paradigma Ricardian Fiscal Regime di Indonesia. *Jurnal Dinamika Ekonomi Pembangunan, 3*(1), 31-45. https://doi.org/10.14710/jdep.3.1.31-45.

Juanda, B., & Gladiola, S. (2022). Sustainability Analysis and the Influence of Government Securities and Other Factors on Economic Growth in Indonesia. *Indonesian Treasury Review: Journal of Treasury, State Finance, and Public Policy, 7*(3), 239–254. https://doi.org/10.33105/itrev.v7i3.529.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

Kariyawasam, N. P., & Jayasinghe, P. (2022). Determinants of Sovereign Spreads in Sri Lanka: Global Factors and Country-Specific Fundamentals. *Asian Journal of Economics and Banking, 6*(2), 236–254. https://doi.org/10.1108/AJEB-12-2021-0147.

Leonardo, D., & Thomas, F. (2024). Fiscal Sustainability Analysis in Managing State Debt. *Indonesian Treasury Review: Journal of Treasury, State Finance, and Public Policy, 9*(1), 1–11.

Marín-Rodríguez, N. J., Gonzalez-Ruiz, J. D., & Botero, S. (2023). Assessing Fiscal Sustainability in the Landscape of Economics Research. *Economies, 11*(12), 300. https://doi.org/10.3390/economies11120300.

Marisa, R. (2015). Analysis of Indonesia's Fiscal Sustainability in 2000–2012. *Bina Ekonomi, 19*(1), 1–14.

Mpapalika, J., & Malikane, C. (2019). The Determinants of Sovereign Risk Premium in African Countries. *Journal of Risk and Financial Management, 12*(1), 29. https://doi.org/10.3390/jrfm12010029.

Novianti, D. A., & Danarsari, D. N. (2013). The Impact of Indonesia's Sovereign Credit Rating Upgrades and Investment Grade Status on Sovereign Spread Changes. *Indonesian Capital Market Review, 5*(1), 67–80. https://doi.org/10.21002/icmr.v5i1.1581.

Pamungkas, R. H. (2016). Estimation of Indonesia's Fiscal Reaction Function. *Kajian Ekonomi dan Keuangan, 20*(1), 1-18.

Paniagua, J., Sapena, J., & Tamarit, C. (2017). Fiscal Sustainability in EMU Countries: A Continued Fiscal Commitment? *Journal of International Financial Markets, Institutions and Money, 50*, 85–97. https://doi.org/10.1016/j.intfin.2017.08.014.

Presbitero, A., Ghura, D., Adedeji, O., & Njie, L. (2016). Sovereign Bonds in Developing Countries: Drivers of Issuance and Spreads. *Review of Development Finance, 6*(1), 1–15. https://doi.org/10.1016/j.rdf.2016.05.002.

Rusdiyantoro, I., & Simanjuntak, R. A. (2022). Indonesia's Fiscal Sustainability During the COVID-19 Pandemic. *Journal of Taxation and Public Finance, 4*(1), 20–29. https://doi.org/10.31092/jpkn.v4i1.1706.

Shastri, S., Giri, A. K., & Mohapatra, G. (2017). An Empirical Assessment of Fiscal Sustainability for Selected South Asian Economies. *Theoretical and Applied Economics, 24*(1), 163–178.

Solikin, A., & Choirunnisah, H. (2019). Fiscal Sustainability and Estimation of Indonesia's Fiscal Reaction Function 1977-2017. *Indonesian Treasury Review: Journal of Treasury, State Finance, and Public Policy, 4*(3), 267–283. https://doi.org/10.33105/itrev.v4i3.144.

Sriyana, J., & Hakim, A. (2017). Balance Sheet approach for Fiscal Sustainability in Indonesia. *International Journal of Economics and Financial Issues, 7*(1), 68–72.

Widiastuti, N., Fitrady, A., & Widodo, T. (2023). Assessing Fiscal Sustainability in Indonesia. *Jurnal Ekonomi dan Studi Pembangunan, 15*(1), 1–12. https://doi.org/10.23917/jesp.v15i1.12345.

Widjanarko. (2020). Maintaining Debt Ratios During the COVID-19 Pandemic. *National State Finance Symposium, 2*(1), 379–401. https://doi.org/10.12345/nsfs.v2i1.6789.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45081

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 179 - 196
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44735

Empowering Loan Awareness: The Role of Sharī'ah Financial Literacy, Blockchain, and Fintech Trust

Sumar'in[1*], Pahmi Ardi[2], Sumin[3], Iwan Kusnadi[4]

[1,4]Faculty of Economics and Business, Universitas Sultan Muhammad Syafiuddin Sambas, Indonesia,
[2]Department of Informatics Management, Politeknik Negeri Sambas, Indonesia
[3]Faculty of Tarbiyah, Pontianak State Institute of Islamic Religion, Indonesia,
E-mail: [1]sumarinasmawi@gmail.com, [2]pahmiardi@gmail.com,
[3]Amien.ptk@gmail.com, [4]kawan.cell07@gmail.com

[*]**Corresponding author**

JEL Classification:
G41
G28
O33
Z12
D83

Received: 04 February 2025

Revised: 27 February 2025

Revised: 01 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study contributes original insights by examining the interplay of Sharī'ah financial literacy, blockchain understanding, and fintech trust in protecting against illegal online loans and predatory lending.

Research Objectives: It examines the effect of Sharī'ah financial literacy on illegal loan awareness, with blockchain technology understanding and Sharī'ah fintech trust as mediating variables.

Research Methods: An associative quantitative approach was employed, utilizing a survey of 519 Indonesian millennial Muslims selected through simple random sampling. Data were analyzed using structural equation modeling (SEM) to explore the variable relationships.

Empirical Results: The findings revealed that Sharī'ah financial literacy significantly influenced the studied variables. Blockchain understanding enhanced fintech trust but did not directly impact loan awareness, whereas Sharī'ah fintech trust positively affected awareness of illegal lending risks.

Implications: This study emphasizes the Sharī'ah financial literacy and blockchain understanding to strengthen consumer trust in Sharī'ah fintech and raise their awareness of illegal loans.

Keywords:

loan awareness; financial literacy; ilegal online loans; understanding blockchain; sharī'ah fintech

How to Cite:

Sumar'in, Ardi. P, Sumin, & Kusnadi, I. (2025). Empowering Loan Awareness: The Role of Sharī'ah Financial Literacy, Blockchain, and Fintech Trust. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 179-196. https://doi.org/10.15408/sjie.v14i1.44735.

INTRODUCTION

Technological advancements have profoundly transformed various aspects of life, particularly the financial industry. They introduce financial technology (fintech), revolutionizing transaction services by offering greater efficiency, flexibility, and convenience (Hakim & Irawan, 2019; Murinde et al., 2022). However, this advancement has also brought challenges, including rising consumerism and modern loan sharks with overly high interest rates (Indrianti, 2022). Consequently, digital financial service users face significant financial and legal risks, particularly from illegal online loan platforms that exploit regulatory loopholes.

In Indonesia, illegal online loans have become a critical issue. Numerous lending services operate without proper licensing from the Financial Services Authority (OJK), employing peer-to-peer (P2P) lending technologies that violate legal regulations (Subagiyo et al., 2022). These illicit practices often result in substantial financial losses, psychological distress, threats, and intimidation, categorizing them as cybercrime (Brands & Doorn, 2022). Angkasa et al. (2023) even highlight that victims of illegal loans frequently suffer substantial financial and emotional harm.

Despite existing regulations, legal protection for victims remains insufficient. Current laws do not protect users' data, which is frequently misused to harass and coerce borrowers (Rindiantika et al., 2023). Moreover, law enforcement efforts often result in soft sentences that fail to deter perpetrators (Angkasa et al., 2023). Addressing this issue is further complicated by limited resources and expertise in handling electronic evidence in cases of illegal online loans (Broadhurst, 2006; Xu et al., 2019).

In Islamic finance, a similar issue also occurs. While technological innovations have some benefits, they also pose challenges. For example, adopting QRIS digitization has shown the potential to moderate the relationship between Islamic financial literacy and interest in online transactions. These advancements directly influence consumer decisions, outlining the importance of understanding technology's role in Islamic finance (Mahrizal et al., 2023; Shaikh et al., 2020). Enhanced Islamic financial literacy enables individuals to make informed financial decisions aligned with Sharīʿah principles (Dewi & Ferdian, 2021).

On the other hand, the increasing adoption of Sharīʿah-based financial technology (fintech) in Muslim-majority countries raises several issues, for example, regarding public awareness of illegal online lending risks (Huang, 2018; Subagiyo et al., 2022). Thus, good Islamic financial literacy is essential for mitigating these risks. This condition can be achieved by increasing public understanding of blockchain technology and trust in Islamic fintech. Unfortunately, Islamic financial literacy is relatively low in many countries, including Indonesia (Apriantoro et al., 2023; Zevender et al., 2022). Consequently, individuals are not fully protected from illegal lending despite the potential of technology to offer safer financial solutions (Alaeddin et al., 2021).

This study aims to bridge the gap by examining the combined effects of Islamic financial literacy, blockchain technology understanding, and trust in Islamic fintech on raising public awareness of illegal online loans. Unlike previous research that analyzed

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

these factors independently, this study explores these variables' interplay to provide a comprehensive understanding of how financial literacy and technology adoption can empower individuals to make informed decisions and avoid illegal lending practices. This novel perspective highlights the protective role of Islamic financial literacy and fintech trust in mitigating financial risks and promoting safer financial behavior, contributing to the broader discourse on ethical financial practices in the digital era.

While many studies have investigated this topic, they are still limited in several ways. For example, previous studies primarily focused on financial literacy without adequately addressing its connection to the risks posed by the digital ecosystem (Chen et al., 2024; Kabir et al., 2021; Rahim et al., 2023). Additionally, most research relies on traditional quantitative methods that assess Islamic financial literacy independently from key factors like blockchain understanding and trust in fintech. For instance, Hassan et al. (2023) examined Islamic financial literacy without exploring its interaction with blockchain technology. Similarly, Chen et al. (2024) analyzed fintech trust without involving financial literacy or addressing illegal lending risks. Further, Javaid et al. (2021) investigated digital financial behavior but did not apply mixed methodologies or consider the combined long-term effects of financial literacy and technological trust. Consequently, there remains a critical gap in the literature regarding comprehensive methodological approaches integrating these factors to assess their collective impact on public awareness of illegal online lending.

To fill this gap, this study aims to integrate Islamic financial literacy, blockchain technology understanding, and trust in Islamic Fintech within a single analytical framework. The research seeks to analyze the effect of Islamic financial literacy on public awareness of illegal online loans, with blockchain understanding and fintech trust acting as mediating variables. In particular, the study objectives are threefold. First, it assesses the direct influence of Islamic financial literacy on awareness of illegal online loans. Second, it examines the mediating role of blockchain technology understanding. Finally, this study investigates how trust in Islamic fintech contributes to reducing the risks of illegal loans. The study contributes to the literature by providing empirical evidence on the interplay of these three factors to enhance financial awareness, offering a novel perspective that combines financial literacy and technological trust. This integrated approach is expected to inform more effective educational strategies and policy interventions to mitigate the negative impacts of illegal online lending in the digital era.

METHODS

This research used a quantitative approach with an associative design. Quantitative methods rely on collecting and analyzing numerical data to understand the relationship between variables, while the correlational design allows researchers to identify and measure the relationship between Islamic or *Sharī'ah* financial literacy, *Sharī'ah* fintech trust, illegal online loan awareness, and blockchain understanding without manipulating these variables.

This research was conducted in 2024, involving the millennial Muslim community across Indonesia as the population. The respondents were specifically chosen based on three key criteria. First, they belonged to the millennial generation, defined as individuals born between 1984 and 2004 and aged between 20 and 40 in 2024. Second, all respondents identify as members of the Muslim community in Indonesia, reflecting diverse cultural and social backgrounds from various regions across the country. Third, eligibility for participation was determined by the random sampling method. Thus, this study performed a simple random sampling technique, and 519 respondents from this population were randomly selected. This technique ensures that each member has an equal chance of being selected, thus enhancing the representativeness of the research results.

This study gathered primary data directly from respondents through online survey techniques. In so doing, an online questionnaire facilitated by Google Forms was distributed. The questionnaire was designed to measure Islamic financial literacy, trust in Islamic fintech, awareness of illegal online loans, and understanding of blockchain technology, using a 4-point Likert scale, ranging from "Disagree" to "Strongly Agree." The Likert scale in this study is based on its ability to capture respondents' degree of agreement or disagreement with the given statements, making it easier to measure attitudes, perceptions, and beliefs.

Furthermore, latent variables were used in this study. Latent variables are theoretical constructs that cannot be measured directly but are represented by several observable indicators. According to Hair et al. (2017), latent variables are often used in social research to measure abstract concepts, such as attitudes, perceptions, or beliefs, which are then operationalized through a questionnaire series of statements or questions. This study grouped these variables into three main categories: exogenous, mediating, and endogenous. The exogenous latent variable was *Sharīʿah* financial literacy, which affected other variables without being influenced by other variables in the model. *Sharīʿah* financial literacy is defined as an individual's knowledge and understanding of Islamic financial principles, including *usury*, *maysir*, and *gharar* (Alam et al., 2017). It is typically measured through a questionnaire with indicators such as the knowledge of *usury, maysir, gharar*, and Islamic financial products.

Meanwhile, blockchain understanding and trust in *Sharīʿah* fintech mediate latent variables. Blockchain understanding mediated the relationship between *Sharīʿah* financial literacy, trust in *Sharīʿah* fintech, and illegal online loan awareness. Meanwhile, trust in *Sharīʿah* fintech mediated the relationship between blockchain understanding and illegal online loan awareness. Blockchain understanding is an individual's knowledge and understanding of blockchain technology and its application in digital finance (Mahrizal et al., 2023). This variable is measured through a questionnaire that includes indicators such as basic knowledge of blockchain, its applications in finance, and perceptions of blockchain security and transparency. Trust in *Sharīʿah* Fintech, also a mediating variable, reflects individual confidence in the security, transparency, and reliability of *Sharīʿah*-based financial services (Hermantoro, 2023). The indicators include data security and privacy, transaction transparency, and the reputation and reliability of Islamic fintech service providers.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

Finally, the endogenous latent variables in this study were *Sharī'ah* fintech trust and illegal online loan awareness, which were influenced by other latent variables in the model. Illegal online loan awareness is the knowledge and ability of individuals to identify and understand the risks associated with illegal online loans (Rindiantika et al., 2023). This variable is measured through a questionnaire with indicators such as knowledge of the risks of illegal loans, the ability to identify legal vs illegal loan services, and attitudes toward illegal loans.

This study used Partial Least Squares Structural Equation Modeling (PLS-SEM) as a data analysis tool facilitated by the SmartPLS 4 software. The analysis stage began with evaluating the measurement model (outer model) to ensure indicator validity and reliability. Following that, indicator validity was assessed through the loading factor value, where indicators above 0.7 were considered valid in reflecting the latent construct being measured. Subsequently, construct reliability was tested using Composite Reliability (CR) and Cronbach's Alpha, with threshold values above 0.7 indicating good internal consistency. Convergent validity was evaluated through Average Variance Extracted (AVE), where an AVE value above 0.5 indicates that the latent construct can explain more than half of the Variance of its indicators. Lastly, discriminant validity was assessed using the Fornell-Larcker criterion, where the root AVE for each construct should be greater than the correlation between constructs to ensure that each construct is more powerful in measuring itself than other constructs.

RESULTS AND DISCUSSION

Table 1 displays respondents' characteristics, including gender, age, and educational level. The demographic characteristics of the respondents are categorized based on gender, age, and education level. Regarding gender, most respondents were male, comprising 56.64% (n = 294) of the total sample, while females accounted for 43.36% (n = 225). Interestingly, the difference is small, indicating a relatively balanced gender representation. Regarding age, respondents were divided into four age groups: 21-25, 26-30, 31-35, and 36-40 years old. The largest age group was 31-35 years, representing 29.91% (n = 155) of the total sample, followed by the 26-30 age group with 27.55% (n = 143). The 36-40 years group comprised 24.08% (n = 125), while the youngest group, 21-25 years, accounted for 18.49% (n = 96). This distribution suggests that the sample predominantly consisted of individuals in their early to mid-thirties, reflecting the age range typically associated with active workforce participation and financial decision-making.

In terms of educational attainment, respondents exhibited diverse educational backgrounds. The largest proportion held a bachelor's degree (S1), representing 44.90% (n = 233) of the sample. This data was approximately twice the proportion of diploma holders, who constituted 22.54% (n = 117), significantly higher than individuals with a senior high school education or equivalent, accounting for 17.53% (n = 91). Additionally, 13.29% (n = 69) of the respondents had obtained a master's degree (S2), while a small minority, 1.75% (n = 9), held a doctorate (S3). This distribution indicates that most

respondents possess higher education qualifications, which may contribute to a better understanding of financial literacy, technological advancements, and the implications of illegal online lending. The relatively high proportion of individuals with tertiary education highlights the relevance of this study's focus on financial awareness and technological trust within a well-educated population.

Table 1. Respondent Data

Criteria	Description	Frequency	Percent (%)
Gender	Male	294	56.64 %
	Female	225	43.36 %
Age	21-25 years old	96	18.49
	26-30 years old	143	27.55
	31-35 years old	155	29.91
	36-40 years old	125	24.08
Educational Level	Senior high school or equivalent	91	17.53
	Diploma	117	22.54
	Bachelor (S1)	233	44.90
	Master (S2)	69	13.29
	Doctorate (S3)	9	1.75

Source: Data processing

While the descriptive analysis above is significant in illustrating the demographic of the respondents in this study, further analysis is required to examine the relationship between variables. The results of the PLS-SEM analysis on the measurement model showed that most indicators had a loading factor value above 0.7, which means that these indicators are reliable in measuring latent constructs. However, several indicators have a loading factor value of less than 0.7, such as AIOL06 (the awareness of illegal online loans construct), SFL01, and SFL02 (the *Sharī'ah* financial literacy construct). These indicators have a weaker contribution in reflecting their latent constructs. Thus, indicators with a loading factor value of less than 0.7 should be removed from the measurement model to improve its validity and reliability. After removing indicators that did not meet the criteria, a re-analysis was performed by rerunning the PLS-SEM software. This step aims to ensure that the measurement model used only consists of questionnaire items that are truly strong in measuring their respective latent constructs. After this re-analysis, a loading factor of >0.7 was obtained for all items in each variable, meaning each questionnaire item contributes significantly to the latent variable it measures. Hence, the measurement model evaluation can proceed to the validity proof and construct reliability estimation stages.

Table 2 provides the results of the construct reliability estimation, with all latent variables, *awareness of illegal online loans, Sharī'ah financial literacy, trust in Sharī'ah fintech,* and *understanding of blockchain technology* having good Cronbach's Alpha (α) and Composite Reliability (ω) values, ranging from 0.850 to 0.928. These values are above the 0.7 threshold, indicating high internal consistency and reliability across all measured

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

constructs. These results support the reliability of the measurement model in the study and enable further analysis of the structural model using the Fornell-Larcker criterion and Average Variance Extracted (AVE).

Table 2. Construct Reliability Estimation

Latent Variables	*α*	*ω*
Awareness of Illegal Online Loans	.882	.885
Sharī'ah Financial Literacy	.850	.853
Trust in *Sharī'ah* Fintech	.920	.923
Understanding of Blockchain Technology	.926	.928

Table 3 presents the results of evaluating convergent and discriminant validity using the Fornell-Larcker criterion and Average Variance Extracted (AVE). The results revealed that all constructs had AVE values above 0.5, indicating good convergent validity. The AVE values ranged from 0.626 to 0.695, indicating that their respective latent constructs explain more than 50% of the Variance of the indicators. On the Fornell-Larcker criterion, each construct's diagonal value (the root of AVE) was greater than the correlation with other constructs, indicating adequate discriminant validity.

Table 3. Fornell-Larcker criterion and Average Variance Extracted (AVE)

Latent Variables	Awareness of Illegal Online Loans	*Sharī'ah* Financial Literacy	Trust in *Sharī'ah* Fintech	Understanding of Blockchain Technology
Awareness of Illegal Online Loans	.794			
Sharī'ah Financial Literacy	.479	.791		
Trust in *Sharī'ah* Fintech	.484	.606	.823	
Understanding of Blockchain Technology	.400	.547	.558	.834
AVE	**.630**	**.626**	**.677**	**.695**

Source: Processed data, 2024

Further analysis was inner model evaluation in PLS-SEM analysis. This analysis assessed the strength and quality of the relationship between hypothesized latent variables. This stage included assessing the coefficient of determination (R^2), effect size (f^2), and fit indices to evaluate the model's fit. After that, hypothesis testing was conducted to measure direct, indirect, and total effects to ensure that the model has sufficient predictive power and fits the analyzed data. The results are provided in Table 4.

The results of the inner model evaluation showed several important metrics related to predictive power and model fit. The coefficient of determination (R^2) for the latent variable *Awareness of Illegal Online Loans* was 0.296, which means about 29.6% of the Variance in awareness of illegal online loans can be explained by the independent variables in the model. The research reported the R^2 value *in Sharī'ah Fintech and Understanding of Blockchain Technology* by 0.441 and 0.299, respectively. Subsequently, the adjusted R^2 value

was slightly lower but close to the R^2 value, which indicates adjustment for the number of variables in the model. Then, the effect size (f^2) indicates the relative contribution of each independent variable to the dependent variable. The largest f^2 value was found in the *Sharīʿah Financial Literacy* path to *Understanding of Blockchain Technology* with a value of 0.427, indicating a fairly strong influence. The effect of *Understanding Blockchain Technology* on *Trust in Sharīʿah Fintech* was also significant, with an f^2 value of 0.131. The other f^2 values ranged from 0.011 to 0.231, indicating a variation in influence from weak to moderate.

Table 4. Effect Size and Coefficient of Determination

Latent Variables	R^2	R^2adjusted	f^2
Awareness of Illegal Online Loans	.296	.292	-
Trust in Sharīʿah Fintech	.441	.439	-
Understanding of Blockchain Technology	.299	.298	-
Sharīʿah Financial Literacy -> Awareness of Illegal Online Loans			.054
Sharīʿah Financial Literacy -> Trust in Sharīʿah Fintech			.231
Sharīʿah Financial Literacy -> Understanding of Blockchain Technology			.427
Trust in Sharīʿah Fintech -> Awareness of Illegal Online Loans			.056
Understanding of Blockchain Technology -> Awareness of Illegal Online Loans			.011
Understanding of Blockchain Technology -> Trust in Sharīʿah Fintech			.131

The model fit indices in Table 5 provide an overview of how well the hypothesized model fits the data. This study found that the SRMR (Standardized Root Mean Square Residual) value was 0.068, below the threshold of 0.08. This value indicates a good model fit. Other indices such as d_ULS, d_G, Chi-square, and NFI were also reported, with an NFI of 0.833 indicating a fairly good model fit. Meanwhile, the Chi-square value was 1487.168, indicating model fit based on the overall size, although Chi-square values are generally sensitive to large sample sizes.

Table 5. Fit Indices

Criteria	Indices
SRMR	.068
d_ULS	1.481
d_G	.484
Chi-square	1487.168
NFI	.838

Following the model fit results, Table 6 presents the path coefficients showing the relationships between key variables. The results revealed that six proposed hypotheses were accepted with sufficient significance values ($p < 0.05$). The first hypothesis (H1) showed that Sharīʿah Financial Literacy significantly affected Understanding Blockchain Technology with a coefficient of 0.547 and a t value of 12.783. The second (H2) and third hypotheses (H3) were also accepted, meaning that Sharīʿah Financial Literacy has a

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

significant effect on Trust in Sharīʿah Fintech (coefficient 0.430) and Awareness of Illegal Online Loans (coefficient 0.258). The effect of Understanding Blockchain Technology on Trust in Sharīʿah Fintech (H4) was also significant, with a coefficient of 0.323. Finally, the sixth hypothesis (H6) was accepted, indicating that Trust in Sharīʿah Fintech significantly affects Awareness of Illegal Online Loans with a coefficient of 0.265. The only hypothesis that was rejected was the fifth hypothesis (H5) because the t-value of 1.857 did not reach the expected significance level (p = 0.063).

Table 6. Path Coefficients

Direct Effect	Parameter	T	P	Hypothesis
Sharīʿah Financial Literacy -> Understanding of Blockchain Technology	.547	12.783	.000	H1: Accepted
Sharīʿah Financial Literacy -> Trust in Sharīʿah Fintech	.430	7.528	.000	H2. Accepted
Sharīʿah Financial Literacy -> Awareness of Illegal Online Loans	.258	4.311	.000	H3: Accepted
Understanding of Blockchain Technology -> Trust in Sharīʿah Fintech	.323	5.722	.000	H4: Accepted
Understanding of Blockchain Technology -> Awareness of Illegal Online Loans	.110	1.857	.063	H5: Rejected
Trust in Sharīʿah Fintech -> Awareness of Illegal Online Loans	.265	4.227	.000	H6: Accepted

Table 7. Total Indirect Effects

Indirect Effect	Parameter	T	P	Hypothesis
Sharīʿah Financial Literacy -> Understanding of Blockchain Technology -> Trust in Sharīʿah Fintech	.177	4.912	.000	H7: Accepted
Sharīʿah Financial Literacy -> Understanding of Blockchain Technology -> Awareness of Illegal Online Loans	.221	4.816	.000	H8: Accepted
Understanding of Blockchain Technology -> Trust in Sharīʿah Fintech -> Awareness of Illegal Online Loans	.086	3.122	.002	H9: Accepted

Following that, the evaluation results for indirect effects are presented in Table 7. Based on the findings, all hypotheses related to indirect effects were accepted with sufficient significance values (p < 0.05). The seventh hypothesis (H7) showed that Sharīʿah Financial Literacy affects Trust in Sharīʿah Fintech through Understanding of Blockchain Technology with a coefficient of 0.177 and a t-value of 4.912, which is significant. The eighth hypothesis (H8) was also accepted, showing that Sharīʿah Financial Literacy affects Awareness of Illegal Online Loans through Understanding of Blockchain Technology with a coefficient of 0.221 and a t value of 4.816. In addition, the ninth hypothesis (H9) showed the effect of Understanding Blockchain Technology on Awareness of Illegal Online Loans through Trust in Sharīʿah Fintech with a coefficient of 0.086 and a t value of 3.122. This value is also classified as significant. These results indicate that the model's proposed mediation mechanism works well, supporting the indirect effect between the hypothesized latent variables.

Table 8 reveals the results of the total effect evaluation, with all paths in the model having a significant effect. Sharīʿah Financial Literacy was reported to have the largest total effect on Trust in Sharīʿah Fintech, with a coefficient of 0.606 and a t-value of 13.834, indicating a strong and significant influence. In addition, Sharīʿah Financial Literacy also had a significant total effect on Awareness of Illegal Online Loans, with a coefficient of 0.479 and a t-value of 10.614. Similarly, Trust in Sharīʿah Fintech significantly affected Awareness of Illegal Online Loans, with a coefficient of 0.265 and a t value of 4.227, while Understanding Blockchain Technology affected this variable with a coefficient of 0.196 and a t value of 3.405. Additionally, it significantly affected Trust in Sharīʿah Fintech with a coefficient of 0.323 and a t value of 5.722. These results indicate that Sharīʿah Financial Literacy has a dominant influence in the model, directly and indirectly, on other variables such as Awareness of Illegal Online Loans and Trust in Sharīʿah Fintech. All hypothesized total effects are significant, supporting the model's strength in explaining the relationship between latent variables.

Table 8. Total Effects

Total Effect	Parameters	T	P
Sharīʿah _Financial Literacy -> Awareness of Illegal Online Loans	0.479	10.614	0.000
Sharīʿah _Financial Literacy -> Trust in _Sharīʿah Fintech	0.606	13.834	0.000
Sharīʿah _Financial Literacy -> Understanding of _Blockchain Technology	0.547	12.783	0.000
Trust in Sharīʿah Fintech -> Awareness of Illegal Online Loans	0.265	4.227	0.000
Understanding of Blockchain Technology -> Awareness of Illegal Online Loans	0.196	3.405	0.001
Understanding of Blockchain Technology -> Trust in Sharīʿah Fintech	0.323	5.722	0.000

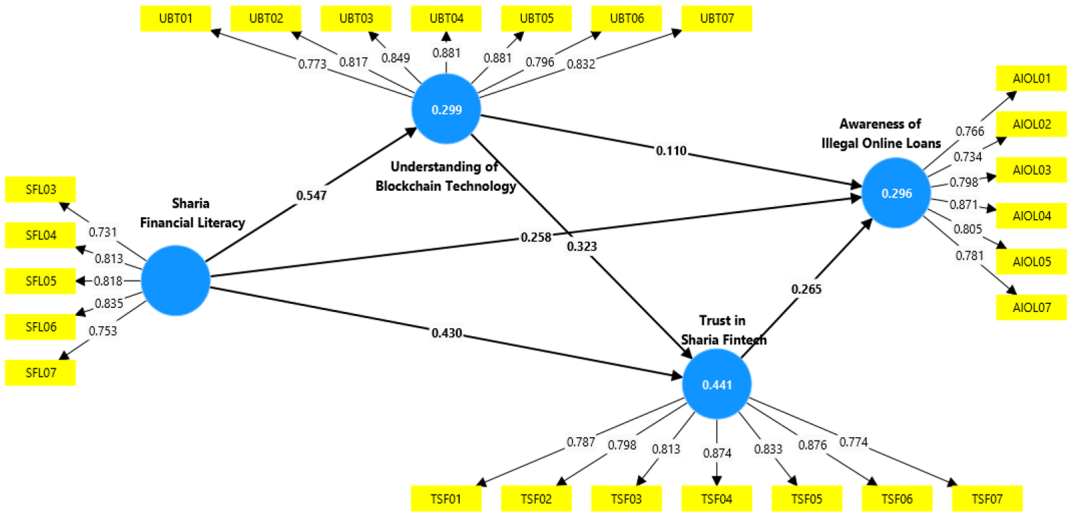
Finally, to complete the PLS-SEM model, a path diagram is presented to illustrate the measurement (outer) and structural (inner) models in the PLS-SEM analysis. The measurement model shows the relationship between latent constructs and their indicators, while the counterpart illustrates the relationship between the hypothesized latent constructs.

The results of this study provide in-depth insight into how Islamic financial literacy plays a role in influencing understanding of blockchain technology, trust in Islamic fintech, and awareness of illegal online loans. The accepted first hypothesis (H1) shows that Islamic financial literacy significantly influences understanding blockchain technology. This finding aligns with previous literature, which indicates that good financial literacy allows individuals to understand better new technologies, such as blockchain, which is often an important component in modern financial innovation. According to Andreou and Anyfantaki (2021), financial literacy is positively correlated with adopting new technologies in the financial sector, especially in emerging markets. Similarly, Alam et al. (2019) emphasized that strong financial literacy can facilitate a better understanding of blockchain technology, especially in Islamic finance supply chains. In the finance sector, a good

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

understanding of blockchain is essential, allowing individuals to have sufficient literacy to understand its benefits, such as enhancing financial transactions' security, transparency, and efficiency (Wati & Yazid, 2023).

Figure 1. Path Diagram of Final Model



Moreover, the relationship between Islamic financial literacy and blockchain comprehension aligns with broader trends observed in financial technology adoption. Islamic fintech, integrating blockchain technology, offers transparent and *Shari'ah*-compliant solutions, enhancing financial inclusion and economic development. These findings collectively indicate the importance of Islamic financial literacy in fostering an informed and resilient financial ecosystem where individuals are better equipped to navigate both opportunities and risks associated with modern financial technologies.

In the second hypothesis (H2), its acceptance demonstrates that Islamic financial literacy significantly influences trust in Islamic fintech. This study aligns with previous research that highlights the role of financial literacy in shaping users' confidence in digital financial services. For instance, Aji et al. (2020) found that individuals with higher financial literacy are more likely to trust Islamic digital financial services in Indonesia and Malaysia as they better understand the principles and mechanisms underpinning these services. Islamic fintech integrates technology with *Shari'ah* principles, offers transparent and ethical financial solutions, enhancing user trust. This correlation is particularly crucial in Islamic finance, where compliance with Shari'ah principles is paramount, and trust is a fundamental factor in the adoption of financial products and services.

The third hypothesis (H3) indicates that Islamic financial literacy significantly impacts awareness of illegal online loans. This finding is consistent with the study by Wati and Yazid (2023), which revealed that individuals with higher financial literacy are more aware of the risks associated with illegal online lending, enabling them to make more informed financial decisions. Similarly, Indrianti (2022) highlighted that Islamic financial literacy is crucial in mitigating the prevalence of illegal digital lending by promoting better financial behavior and

decision-making, particularly during the COVID-19 pandemic. This awareness is essential in protecting individuals from the financial and legal consequences of unregulated lending practices, which have become increasingly prevalent with the rise of digital financial services.

Moreover, these findings underline the broader significance of Islamic financial literacy in fostering a more resilient and informed financial ecosystem. By enhancing individuals' understanding of Islamic fintech and raising awareness of the risks associated with illegal online loans, financial literacy not only empowers individuals to make better financial decisions but also contributes to the overall stability and integrity of the financial sector. As Dinya Solihati et al. (2023) highlight, government initiatives to improve financial literacy are essential in combating illegal online lending and promoting the responsible use of digital financial services. Therefore, fostering Islamic financial literacy should be prioritized as a key strategy in enhancing both trust in Islamic fintech and awareness of financial risks, ultimately supporting the sustainable growth of the Islamic financial sector.

The acceptance of the fourth hypothesis (H4) indicates that understanding blockchain technology influences trust in Islamic fintech. This finding is supported by existing studies highlighting blockchain's transparent and secure nature, which plays a pivotal role in enhancing user trust in digital financial transactions. One study investigating this topic is Mougayar (2016), who emphasizes that blockchain fosters trust through transparency. Islamic finance highly values this principle, as it aligns with the ethical and accountability standards inherent in *Shari'ah*-compliant financial practices. Furthermore, Song et al. (2022) demonstrated that blockchain technology reduces operational risks in fintech, directly impacting user trust by ensuring the security and reliability of financial services. These findings suggest that integrating blockchain technology in Islamic fintech enhances the efficiency of financial transactions and reinforces user confidence by providing greater transparency and reducing the risk of fraud and manipulation.

One interesting finding in this study is rejecting the fifth hypothesis (H5). This rejection indicates that understanding blockchain technology does not significantly influence awareness of illegal online lending. This outcome suggests that while blockchain is crucial for enhancing trust in fintech, it may not directly improve individuals' ability to recognize and avoid illegal financial activities. Javaid et al. (2022) pointed out that blockchain technology's primary focus is improving transaction efficiency, security, and transparency rather than educating users about external risks such as illegal lending. Additionally, Wati and Yazid (2023) noted that while blockchain enhances the security and efficiency of financial transactions in Islamic banking, it does not inherently address issues related to identifying or preventing illegal online loans. This distinction requires complementary financial literacy initiatives that address the risks of illegal digital lending.

This finding suggests that blockchain's benefits should be complemented by targeted educational programs aimed at improving financial literacy, particularly in recognizing and avoiding fraudulent financial practices. By integrating technological advancements and comprehensive financial education, stakeholders can create a more resilient and informed financial ecosystem, ultimately supporting the sustainable growth of Islamic fintech. Additionally, regulatory bodies and financial institutions should collaborate to

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

develop guidelines that promote the secure use of blockchain technology and educate users on identifying and mitigating the risks associated with illegal online lending.

Finally, accepting the sixth hypothesis (H6) demonstrates that trust in Islamic fintech significantly influences awareness of illegal online loans. This finding aligns with current studies that emphasize the role of trust in financial institutions in protecting consumers from unauthorized and fraudulent financial products. For instance, Nuraini et al. (2024) found that higher trust in Islamic financial institutions enhances consumers' ability to identify and avoid unauthorized financial services, as trust often stems from institutions' commitment to ethical practices and regulatory compliance. This correlation is particularly significant in Islamic fintech, where adherence to *Shari'ah* principles reinforces consumer confidence and promotes awareness of financial risks.

Additionally, Noor et al. (2022) supported this finding by highlighting that trust in Islamic fintech can enhance consumers' awareness of illegal financial products through increased transparency and educational initiatives. By offering transparent and *Shari'ah*-compliant financial services, Islamic fintech platforms build trust and educate consumers about the risks associated with non-compliant financial products, including illegal online loans. Integrating technology within Islamic fintech enables greater access to financial information, empowering consumers to make more informed decisions and recognize potential financial threats.

Furthermore, these findings highlight the broader implications of trust in Islamic fintech for consumer protection and financial literacy. As emphasized by Dinya Solihati et al. (2023), government-led initiatives to improve financial literacy, coupled with the transparency and ethical practices of Islamic fintech, can create a more informed and financially resilient society. This synergy between trust, transparency, and consumer education is essential for mitigating the risks associated with illegal online loans, as consumers who trust and engage with Islamic fintech platforms are more likely to seek reliable financial information and avoid unauthorized financial products. Therefore, fostering trust in Islamic fintech supports the sector's growth and plays a critical role in promoting financial awareness and protecting consumers from the dangers of illegal online loans.

The results of testing the mediation hypotheses H7, H8, and H9 confirm that Islamic financial literacy through understanding blockchain technology and trust in Islamic fintech affects awareness of illegal online loans. This result indicates that the mediation approach proposed in this study successfully explains the complex relationship between these variables. Financial literacy, as expressed by Hua and Huang (2021), plays a crucial role in strengthening the adoption of new technologies and increasing trust in financial services. Similarly, Ismahani (2023) demonstrated that individuals with strong financial literacy are more likely to adopt safer Islamic fintech solutions, which helps them avoid the risks associated with illegal online loans. This result highlights the importance of integrating financial literacy into digital financial ecosystems to improve consumer awareness and decision-making.

Another key mediator in this relationship is understanding blockchain technology, as its transparent and secure nature fosters trust in Islamic fintech platforms. For

example, Zaka and Shaikh (2019) emphasized that blockchain enhances the traceability of financial transactions, ensuring compliance with *Shari'ah* principles and boosting investor confidence in Islamic financial instruments. Moreover, Supriadi et al. (2024) found that blockchain technology reduces the risks of corruption and fraud in Islamic financial systems, promoting transparency and accountability. This study aligns with the broader trend of integrating blockchain into Islamic finance to enhance trust and reduce operational risks, ultimately supporting greater consumer awareness of financial risks.

Trust in Islamic fintech also plays a critical role in raising awareness of illegal online loans. According to Unal and Aysan (2022), combining *Shari'ah*-compliant principles and advanced financial technologies in Islamic fintech fosters greater transparency and accountability, which helps consumers identify and avoid unauthorized financial products. Similarly, Indrianti (2022) found that Islamic financial literacy improves consumers' understanding of legal, and financial options and empowers them to recognize and reject illegal lending practices, thereby reducing their vulnerability to financial fraud. In other words, building consumer trust through transparent and ethical financial services is important, as trust catalyzes greater financial awareness and responsible decision-making.

These findings highlight the interconnected roles of financial literacy, blockchain technology, and trust in Islamic fintech in promoting awareness of illegal online loans. By enhancing consumers' understanding of blockchain technology and fostering trust in Islamic fintech, financial literacy empowers individuals to make informed financial decisions and avoid unauthorized financial products. As noted by Chong (2021), blockchain applications in Islamic finance increase transparency and accountability and support the delivery of *Shari'ah*-compliant products and services, reinforcing consumer trust and awareness. Therefore, developing comprehensive financial literacy programs emphasizing technological understanding and ethical financial practices is essential for promoting a more resilient and informed financial ecosystem.

The results of this study support the proposed theoretical model and provide significant practical implications for policy development and educational programs. Improving Islamic financial literacy and understanding of blockchain technology is crucial to increasing the adoption of Islamic fintech services and protecting consumers from the risks of illegal online loans. Therefore, an intensive effort is needed to educate the public on Islamic financial literacy and technology understanding to create a safer and more trusted Islamic financial ecosystem.

CONCLUSION

In conclusion, this study discovered several important findings. First, it underlines the significance of Islamic financial literacy in enhancing individuals' understanding of blockchain technology, fostering trust in Islamic fintech, and raising awareness of the risks associated with illegal online loans. While blockchain understanding positively influences trust in *Sharī'ah*-compliant fintech services, it does not directly affect awareness of illegal loans. However, trust in *Sharī'ah* fintech plays a crucial role in raising awareness of illegal

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

online lending risks, highlighting the need to strengthen financial literacy and consumer trust to mitigate such risks. These findings emphasize the importance of educational initiatives integrating Islamic financial principles with technological literacy to empower individuals to make informed financial decisions aligned with *Sharī'ah* principles.

From a policy perspective, regulators should strengthen the legal framework governing digital financial services to provide stronger protection against illegal online lending. This includes stricter enforcement of regulations related to peer-to-peer lending platforms and ensuring that consumers have access to transparent, secure, and ethical financial services. Collaborative efforts among government agencies, financial institutions, and educational organizations are essential to develop comprehensive programs addressing financial literacy and technological awareness. While this study offers valuable insights, its findings may have limited generalizability due to the specific sample and context. Future research should explore these relationships across diverse demographic and cultural settings to validate the results and provide a broader understanding of the factors influencing financial behavior in the digital age.

ACKNOWLEDGEMENT

The author sincerely appreciates *The 8th Annual Islamic Finance Call for Papers* and its reviewers for their valuable feedback, which has enhanced the quality of this research..

REFERENCES

Aji, H. M., Berakon, I., & Md Husin, M. (2020). COVID-19 and E-Wallet Usage Intention: A multigroup analysis between Indonesia and Malaysia. *Cogent Business & Management*, *7*(1), 1804181. https://doi.org/10.1080/23311975.2020.1804181.

Alaeddin, O., Al Dakash, M., & Azrak, T. (2021). Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges. *Journal of Information Technology Management*, *13*(3), 99–115. https://doi.org/10.22059/jitm.2021.83116.

Alam, N., Gupta, L., & Shanmugam, B. (2017). Prohibition of Riba and Gharar in Islamic Banking. In. Alam, N., Gupta, L., & Shanmugam, B (Eds). *Islamic Finance,* 35–53. Cham: Palgrave Macmillan.

Alam, N., Gupta, L., Zameni, A., Alam, N., Gupta, L., & Zameni, A. (2019). Application of Blockchain in Islamic Finance Landscape. In. Alam, N., Gupta, L., Zameni, A (Eds). *Fintech and Islamic Finance: Digitalization, Development and Disruption*, 81–98. Cham: Palgrave Macmillan.

Andreou, P. C., & Anyfantaki, S. (2021). Financial Literacy and Its Influence on Internet Banking Behavior. *European Management Journal*, *39*(5), 658–674. https://doi.org/10.1016/j.emj.2020.12.001.

Angkasa, A., Wamafma, F., Juanda, O., & Nunna, B. P. (2023). Illegal Online Loans in Indonesia: Between the Law Enforcement and Protection of Victim. *Lex Scientia Law Review*, *7*(1), 119–178.

Apriantoro, M. S., Herviana, J., Yayuli, Y., & Suratno, S. (2023). Sharia Financial Literacy: Research Trends and Directions for Future Inquiry. *Journal of Islamic Economic Laws*, *6*(2), 19–40. https://doi.org/10.23917/jisel.v6i2.22396.

Brands, J., & Van Doorn, J. (2022). The Measurement, Intensity and Determinants of Fear of Cybercrime: A Systematic Review. *Computers in Human Behavior*, *127*, 107082. https://doi.org/10.1016/j.chb.2021.107082.

Broadhurst, R. (2006). Developments in the Global Law Enforcement of Cyber-Crime. *Policing: An International Journal of Police Strategies & Management*, *29*(3), 408–433. https://doi.org/10.1108/13639510610684674.

Chen, Q., Yu, J., & Li, X. (2024). Research on the Reform Path of Logistics Comprehensive Practical Training Curriculum under the Background of Industry-Education Integration. *Curriculum and Teaching Methodology*, *7*(2), 7–16.

Chong, F. H. L. (2021). Enhancing Trust Through Digital Islamic Finance and Blockchain Technology. *Qualitative Research in Financial Markets*, *13*(3), 328–341. https://doi.org/10.1108/QRFM-05-2020-0076.

Dewi, M. K., & Ferdian, I. R. (2021). Enhancing Islamic Financial Literacy Through Community-based Workshops: A Transtheoretical Model. *Journal of Islamic Accounting and Business Research*, *12*(5), 729–747. https://doi.org/10.1108/JIABR-08-2020-0261.

Dinya Solihati, K., Rizki, M., & Sari, U. (2023). The Role of the Government to Improve Financial Literacy in Efforts to Prevent the Use of Illegal Online Loans. *KnE Social Sciences*, 259–276. https://doi.org/10.18502/kss.v8i11.13552.

Hair Jr, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: Updated Guidelines on Which Method to Use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123. https://doi.org/10.1504/IJMDA.2017.087624.

Hakim, R., & Irawan, M. D. (2019). Islamic Rulings and Financial Technology (Fintech): An Analysis on the Relevance and Implications. *Madania: Jurnal Kajian Keislaman*, *23*(2), 137–146.

Hassan, N. M., Khan, S. A. R., Ashraf, M. U., & Sheikh, A. A. (2023). Interconnection Between the role of blockchain technologies, supply chain integration, and circular economy: A case of small and medium-sized enterprises in Pakistan. *Science Progress*, *106*(3), 00368504231186527. https://doi.org/10.1177/00368504231186527.

Hermantoro, B. (2023). Optimizing Financial Technology Literacy in Minimizing Phishing Threats (Case Study of Indonesian Sharia Bank Customers). *Proceeding of International Conference on Islamic Philantrophy*, *1*(1), 38–52.

Huang, R. H. (2018). Online P2P Lending and Regulatory Responses in China: Opportunities and Challenges. *European Business Organization Law Review*, *19*, 63–92. https://doi.org/10.1007/s40804-018-0100-z.

Hua, X., & Huang, Y. (2021). Understanding China's Fintech Sector: Development, Impacts and Risks. *The European Journal of Finance*, *27*(4–5), 321–333. https://doi.org/10.1080/1351847X.2020.1811131.

Indrianti, L. P. (2022). Strategies to Minimize Illegal Digital Lending Practices During The Pandemic Through Islamic Financial Literacy. *Review of Islamic Economics and Finance*, *4*(2), 167–180.

Ismahani, N. (2023). Shariah Finance Transformed: Digital Literacy and Inclusion to Combat Illegal Online Loan Traps. *Proceeding of International Conference on Finance Business and Banking*, 454–465.

Javaid, M., Haleem, A., Singh, R. P., Khan, S., & Suman, R. (2021). Blockchain Technology Applications for Industry 4.0: A Literature-Based Review. *Blockchain: Research and Applications*, *2*(4), 100027. https://doi.org/10.1016/j.bcra.2021.100027.

Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Khan, S. (2022). A Review of Blockchain Technology Applications for Financial Services. *BenchCouncil Transactions on Benchmarks, Standards and Evaluations*, *2*(3), 100073.

Kabir, M. R., Islam, M. A., Marniati, & Herawati. (2021). Application of Blockchain for Supply Chain Financing: Explaining the Drivers Using SEM. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(3), 167.

Lewis, J. (2011). *Crisis in the Global Mediasphere: Desire, Displeasure and Cultural Transformation*. Cham: Palgrave Macmillan.

Mahrizal, M., Judijanto, L., Indrapraja, R., & Pujianto, D. (2023). The Influence of QRIS Digitalization, Technology and Digitalization Lifestyle, Digital Financial Literacy, and Financial Inclusion on Bank Customers Decision. *Jurnal Informasi dan Teknologi*, 124–129. https://doi.org/10.60083/jidt.v5i4.426.

Mougayar, W. (2016). *The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology*. New Jersey: John Wiley & Sons.

Murinde, V., Rizopoulos, E., & Zachariadis, M. (2022). The Impact of the FinTech Revolution on the Future of Banking: Opportunities and Risks. *International Review of Financial Analysis*, *81*, 102103. https://doi.org/10.1016/j.irfa.2022.102103.

Noor, A., Ahamat, H., Marzuki, I., Wulandari, D., Junaidi, A. A., Lisdiyono, E., & Trisnawati, B. (2022). Regulation and Consumer Protection of Fintech in Indonesia: The Case of Islamic Fintech Lending. *Linguistics and Culture Review*, *6*(S3), 49–63.

Nuraini, I., Fitri, L. E., & Lubis, P. (2024). The Influence of Knowledge, Lifestyle, and Religiosity of Jambi University FEB Students on Decisions to Use Fintech (Online Loans) from an Islamic Economics Perspective. *MONEY: Journal of Financial and Islamic Banking*, *2*(2), 120–130.

Rahim, N. F., Bakri, M. H., Fianto, B. A., Zainal, N., & Hussein Al Shami, S. A. (2023). Measurement and Structural Modelling on Factors of Islamic Fintech Adoption among Millennials in Malaysia. *Journal of Islamic Marketing*, *14*(6), 1463–1487. https://doi.org/10.1108/JIMA-09-2020-0279.

Rindiantika, W. D., Mufid, F. L., & Wahyuningtyas, Y. W. (2023). Perlindungan Hukum Terhadap Data Pribadi bagi Nasabah Pinjaman Online. *WELFARE STATE Jurnal Hukum*, *2*(2), 243–270.

Shaikh, I. M., Qureshi, M. A., Noordin, K., Shaikh, J. M., Khan, A., & Shahbaz, M. S. (2020). Acceptance of Islamic Financial Technology (FinTech) Banking Services by Malaysian Users: An Extension of Technology Acceptance Model. *Foresight*, *22*(3), 367–383. https://doi.org/10.1108/FS-12-2019-0105.

Song, Y., Sun, C., Peng, Y., Zeng, Y., & Sun, B. (2022). Research on Multidimensional Trust Evaluation Mechanism of Fintech Based on Blockchain. *IEEE Access*, *10*, 57025–57036. https://doi.org/10.1109/ACCESS.2022.3177275.

Subagiyo, D. T., Gestora, L. R., & Sulistiyo, S. (2022). Characteristic of Illegal Online Loans in Indonesia. *Indonesia Private Law Review*, *3*(1), 69–84. https://doi.org/10.25041/iplr.v3i1.2594.

Supriadi, I., Maghfiroh, R. U., & Abadi, R. (2024). Decentralized Islamic Finance: Harnessing Blockchain Technology. *EL DINAR: Jurnal Keuangan dan Perbankan Syariah*, *12*(1), 108–131. https://doi.org/10.18860/ed.v12i1.23333.

Unal, I. M., & Aysan, A. F. (2022). Fintech, Digitalization, and Blockchain in Islamic Finance: Retrospective Investigation. *FinTech*, *1*(4), 388–398. https://doi.org/10.3390/fintech1040029.

Wati, A. C. P., & Yazid, M. (2023). Blockchain Technology in Financial Transactions under Sharia Banking Practice. *EkBis: Jurnal Ekonomi dan Bisnis*, *7*(2), 81–91. https://doi.org/10.14421/EkBis.2023.7.2.2049.

Xu, D., Tang, S., & Guttman, D. (2019). China's Campaign-Style Internet Finance Governance: Causes, Effects, and Lessons Learned for New Information-Based Approaches to Governance. *Computer Law & Security Review*, *35*(1), 3–14. https://doi.org/10.1016/j.clsr.2018.11.002.

Zaka, F., & Shaikh, S. E. (2019). Blockchain for Islamic Financial Services Institutions: The Case of Sukuk Financing. In. Khosrow-Pour, M., Clarke, S., Jennex, M. E., Anttiroiko, A. V. (Eds). *FinTech as a Disruptive Technology for Financial Institutions,* 241–262. New York: IGI Global.

Zevender, P. S., Lathifahturahmah, L., Rohmawati, L., Tasiman, T., & Widayati, W. (2022). Development and Impact of Financial Technology (Fintech) on The Islamic Financial Industry Perumda BPR Majalengka. *Return: Study of Management, Economic and Bussines*, *1*(4), 169–175.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44735

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 197 - 216
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44736

Heterogeneous Effects of Islamic Finance: A Multilevel Analysis for Policy Optimization in Developing Economies

Iman Supriadi[1*], Eva Wany[2]
[1]Faculty of Economics and Business, STIE Mahardhika Surabaya, Indonesia
[2]Faculty of Economics and Business, Universitas Wijaya Kusuma Surabaya, Indonesia
E-mail: [1]iman@stiemahardhika.ac.id, [2]evawany@uwks.ac.id
[*]**Corresponding author**

JEL Classification:
C33
F43
G21
O16

Received: 31 January 2025

Revised: 03 March 2025

Accepted: 09 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study addresses a gap in the literature by examining the heterogeneous impact of Islamic financial instruments. It incorporates various contextual factors and employs panel data regression to control for cross-country and temporal heterogeneity, offering a broader perspective on Islamic finance and economic growth.

Research Objectives: This study analyzes the impact of Islamic financial instruments on economic growth in developing countries with different income levels over time.

Research Methods: A quantitative approach is applied using panel data regression with pooled data classification to account for variations in data treatment.

Empirical Results: The findings reveal that Islamic financial instruments, particularly Total Islamic Financing and Islamic Banking Assets, significantly enhance economic growth. Demographic factors, such as population size, also play a key role, while inflation has no significant impact. Additionally, Fixed Effects (Cross) values, which adjust for country- and year-specific heterogeneity, show substantial variation, with positive and negative values across countries and periods.

Implications: These findings offer policy insights to help governments and regulators develop responsive, economic policies that promote financial inclusion, strengthen regulatory frameworks, and support sustainable growth through Islamic finance.

Keywords:
Islamic financial instruments; economic development; financial institutions; macroeconomic policy; cross-country analysis.

How to Cite:
Supriadi, I., & Wany, E. (2025). Heterogenous Effect of Islamic Finance: A Multilevel Analysis for Policy Optimization in Developing Economies. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 197-216. https://doi.org/10.15408/sjie.v14i1.44736.

INTRODUCTION

The expansion of the Islamic finance industry in developing countries has become a critical topic in global economic studies (Kismawadi, 2023; Butt et al., 2023). Within this context, examining the impact of Islamic financial instruments on economic growth is of considerable significance (Saleem et al., 2021; Mensi et al., 2020; Naz & Gulzar, 2023). Previous studies have highlighted the complex relationship between Islamic financial instruments, macroeconomic factors, and economic growth; however, a more comprehensive understanding of this relationship remains necessary. While numerous studies have explored the link between Islamic financial instruments and economic growth, they often focus on specific dimensions and overlook the heterogeneity of developing countries regarding income levels, the maturity of the Islamic finance industry, and broader economic characteristics. Consequently, a significant knowledge gap persists, necessitating further research to enhance the understanding of how Islamic financial instruments influence economic growth in developing countries.

Anwar (2024) and Khattak & Khan (2023) found that Islamic financial instruments positively impact economic growth, particularly in countries with a well-established Islamic finance industry. Additionally, Ledhem and Mekidiche (2020) and Kismawadi (2023) identified macroeconomic factors—such as population and inflation—as key moderators in the relationship between Islamic financial instruments and economic growth, highlighting their significant contextual influence.

Furthermore, Naz and Gulzar (2022), Laldin and Djafri (2021), Avdukic and Asutay (2024), and Boukhatem and Ben Moussa (2018) underscored notable differences in the impact of Islamic financial instruments between developed and developing countries, emphasizing the complexity of their effects in a global context. Meanwhile, Ledhem and Mekidiche (2022) and Saleem et al. (2021) demonstrated that economic characteristics—such as the prominence of agriculture, industry, and service sectors—yield varying implications for the relationship between Islamic financial instruments and economic growth, further contributing to the diversity of findings in this field.

Moreover, Ghroubi (2023) and Amran et al. (2023) observed that differences in the level of Islamic finance development across countries lead to mixed results regarding the impact of these instruments on economic growth, reinforcing the need to account for variations in the industry's maturity. Smolo and Nagayev (2023) and Albaity et al. (2023) further emphasized the importance of considering country- and time-specific heterogeneity when analyzing the effects of Islamic financial instruments, advocating for a more contextualized and dynamic analytical approach. Finally, Khateeb et al. (2023) and Butt et al. (2023) explored temporal shifts in the Islamic finance industry. They revealed that its evolution can have varying implications for economic growth, particularly in developing economies.

These findings underscore the intricate and multifaceted impact of Islamic financial instruments across diverse economic contexts. Islamic financial instruments constitute a fundamental component of the Islamic financial system, which operates based on the

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

principles of fairness, transparency, and compliance with Shariah law (Muryanto, 2022; Ebrahim & Abdelfattah, 2021). These instruments are designed in adherence to the prohibition of usury (interest), excessive speculation, and investments in sectors deemed impermissible under Islamic law (Harahap & Risfandy, 2022; Kanwal, 2021).

Several key Islamic financial instruments are widely utilized in practice. Mudharabah is a profit-sharing partnership between investors (shahibul maal) and business managers (mudharib), where profits are distributed according to a pre-agreed ratio (Dawood, 2020; Ishak & Rahman, 2021). Musharakah involves a joint partnership between two or more parties in a business venture, with profits and risks shared based on mutual agreement (Ajmi et al., 2019; Warninda et al., 2019). Murabahah is a cost-plus financing arrangement in which the seller discloses the purchase price and markup transparently, ensuring a fair and predetermined profit margin (Abbasi & Aziz, 2023; Ahroum et al., 2020). Ijarah refers to an Islamic leasing contract that allows the lessee to use an asset in exchange for a predetermined payment. Additionally, Sukuk, often called Islamic bonds, represent ownership in tangible assets and offer profit-sharing benefits to investors while strictly avoiding interest-based returns (Mimouni et al., 2019).

A comprehensive review of the literature on Islamic financial instruments has underscored their advantages and the challenges associated with their implementation (Foglie & Keshminder, 2022; Hassan, 2020). A deeper understanding of these instruments is essential for assessing their impact on economic growth, particularly in developing countries with diverse income levels (Butt et al., 2023; Kismawadi, 2023).

Economic growth theory is a conceptual framework for understanding the factors that drive a country's economic expansion (Błażejowski et al., 2019; Rahman & Alam, 2021). Solow's economic growth theory emphasizes capital accumulation, population growth, and technological advancement as the primary drivers of long-term economic growth (Gumpert, 2019). In contrast, endogenous growth theory underscores the role of innovation, research and development, education, and institutional quality in fostering economic progress (Bucci & Prettner, 2020; Cristescu & Nerișanu, 2021). This theory highlights the significance of internal factors in generating sustainable economic growth (Tadele & Sirany, 2021).

In the context of Islamic finance, economic growth theory provides a foundation for analyzing how Shariah-compliant financial instruments influence economic development in emerging economies (Butt et al., 2023; Smolo & Nagayev, 2023). Applying economic growth theory in this study facilitates the identification of mechanisms through which Islamic financial instruments contribute to economic expansion in developing countries with diverse economic structures (Gnangnon, 2021; Rehman et al., 2019).

Beyond capital accumulation, demographic factors also play a crucial role in driving economic growth in developing countries (Cristea et al., 2020). These nations typically have large and rapidly growing populations. While a sizable population can provide an abundant labor force, it may also pose significant challenges if not accompanied by improvements in human capital through education and vocational training (Intisar et al., 2020; Matousek & Tzeremes, 2019). Without adequate investment in human capital,

developing economies risk stagnation due to low labor productivity (Dua & Garg, 2019; Makohon et al., 2020).

Another critical determinant of economic growth in developing countries is the macroeconomic policies implemented by governments (Younsi & Nafla, 2019; Petrović et al., 2021). Effective fiscal and monetary policies can foster a conducive investment climate and promote economic stability, whereas poorly designed policies may create uncertainty and hinder growth (Roncoroni et al., 2021; Makohon et al., 2020). In this regard, policymakers in developing countries often face a trade-off between stimulating short-term economic growth through increased public spending and ensuring long-term stability through prudent debt management.

Despite the growing body of research on Islamic finance and its impact on economic growth, existing studies often adopt a narrow focus—either analyzing specific financial instruments or examining macroeconomic conditions in isolation—without sufficiently addressing the heterogeneity of developing economies. Prior research has primarily investigated the relationship between Islamic finance and economic growth at an aggregate level, overlooking the variations across different income levels, stages of Islamic financial industry development, and economic structures. Furthermore, while some studies have explored the role of macroeconomic factors in shaping this relationship, there remains a gap in understanding how these factors interact across countries with varying levels of Islamic financial maturity. Additionally, limited attention has been given to the temporal dimension—how the impact of Islamic finance has evolved in response to structural economic transformations and financial sector development.

To bridge these research gaps, this study conducts a multilevel analysis to systematically assess the heterogeneous effects of Islamic financial instruments on economic growth across developing economies. Unlike previous studies that often adopt a uniform approach, this research introduces a comparative perspective by examining countries with varying levels of Islamic financial development and distinct economic structures. Additionally, it integrates a temporal dimension to analyze how the impact of Islamic finance has evolved over the past decade.

This research makes a significant contribution to the study of optimizing Islamic public finance by examining several key aspects. First, by highlighting the impact of Islamic financial instruments on economic growth in developing countries, this study deepens the understanding of how Islamic financial principles can serve as a crucial driver of inclusive and sustainable economic development. Second, by identifying macroeconomic factors and related variables that influence economic growth, this research establishes a strong foundation for formulating public finance policies based on Islamic principles. These insights can aid governments and regulators in designing more effective policies that align with Islamic financial principles to enhance overall societal welfare. Third, by exploring the heterogeneity in the impact of Islamic financial instruments across countries with varying levels of Islamic finance industry development, this study provides valuable insights into how economic characteristics, industry maturity, and demographic factors shape the effectiveness of Islamic financial instruments in driving economic growth.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

Thus, this study's findings contribute significantly to the theoretical and practical development of Islamic public finance. By offering a deeper understanding of how Islamic financial principles can be optimized, this research supports efforts to achieve inclusive and sustainable economic growth that benefits society.

The novelty of this study lies in its comprehensive approach, which combines heterogeneity analysis, macroeconomic moderation, and temporal comparisons within a multilevel panel data regression framework. Accordingly, the primary objective is to investigate how Islamic financial instruments influence economic growth in developing economies, considering variations in financial development, macroeconomic conditions, and temporal dynamics. By offering a more granular understanding of these relationships, this research aims to generate nuanced policy insights that can inform the development of targeted financial strategies in diverse economic contexts.

METHODS

This study adopts a quantitative approach utilizing panel data regression analysis, categorized by object (pooled data), to account for variations in data treatment. This method enables a comprehensive assessment of the relationship between Islamic financial instruments and economic growth, allowing for cross-country and time variability in the analysis. The dataset consists of annual data from 2013 to 2023, covering six countries with significant Islamic finance development: the United Arab Emirates, Bahrain, Indonesia, Malaysia, Pakistan, and Saudi Arabia. The data were sourced from reputable institutions, including central banks, financial regulatory authorities, and international organizations such as the Islamic Financial Services Board, the World Bank, and the International Monetary Fund. The study incorporates two primary dimensions. The first dimension comprises Islamic financial instruments, including Total Islamic Financing, Sukuk Issuance Value, Islamic Banking Assets, and Islamic Investment. The second dimension consists of macroeconomic variables, namely Population and Inflation, which serve as control variables. Economic growth is measured using Gross Domestic Product (GDP) and GDP per Capita as dependent variables.

Panel data regression models are employed to evaluate the impact of Islamic financial instruments on economic growth. These models enable the control of country-specific and time-specific heterogeneity, ensuring robust estimations. The analysis applies both Fixed Effects Model (FEM) and Random Effects Model (REM), with Hausman tests conducted to determine the most appropriate model. The regression equations for GDP and GDP per capita are specified as follows:

$$GDP_{it} = \beta_0 + \beta_1 Fin_{it} + \beta_2 Sukuk_{it} + \beta_3 Assets_{it} + \beta_4 Invst_{it} + \beta_5 Pop_{it} + \beta_6 Infl_{it} + \varepsilon_{it} \quad (1)$$

$$GDP\ Percapita_{it} = \beta_0 + \beta_1 Fin_{it} + \beta_2 Sukuk_{it} + \beta_3 Assets_{it} + \beta_4 Invst_{it} + \beta_5 Pop_{it} + \beta_6 Infl_{it} + \varepsilon_{it} \quad (2)$$

To further enhance the analysis, a heterogeneity test is conducted to examine variations in the impact of Islamic financial instruments on economic growth across different economic conditions. This model includes comparisons between countries with

varying income levels, economies with differing levels of Islamic finance development, and economic conditions across different periods within the study timeframe. The heterogeneity analysis provides deeper insights into how the effectiveness of Islamic financial instruments varies across different economic environments.

The study employs EViews ver. 13.0 for data processing and estimation, ensuring rigorous econometric analysis. Various diagnostic tests, including multicollinearity checks, heteroskedasticity tests, and robustness assessments, are performed to validate the consistency and reliability of the regression results. The findings from these analyses contribute to a better understanding of how Islamic financial instruments influence economic growth, offering valuable insights for policymakers and financial regulators in developing economies.

RESULTS AND DISCUSSION

In panel data regression analysis, selecting the optimal model is crucial to ensuring valid, accurate, and reliable results. Proper model selection is essential for minimizing bias, controlling for unobserved time effects, and enhancing the consistency and efficiency of the estimators.

Table 1. Redundant Fixed Effects Tests

Effects Test	Test cross-section fixed effects		
	Statistic	d.f.	Prob.
Cross-section F	43.74032	-5.54	0.000
Cross-section Chi-square	106.8800	5	0.000

Table 2. Pooled Least Squares output for GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.42E+11	1.42E+11	1.7032	0.0943
Total Islamic financing	4.35E+08	1.18E+08	3.6860	0.0005
Value of sukuk issuance	6.68E+08	5.01E+08	1.3341	0.1878
Islamic banking assets	3.04E+08	2.11E+08	1.4431	0.1548
Islamic investment	953,668.2	11,316,904	0.0843	0.9332
Population	647.4673	1682.107	0.3849	0.7018
Inflation	1.33E+09	2.08E+09	0.6419	0.5236

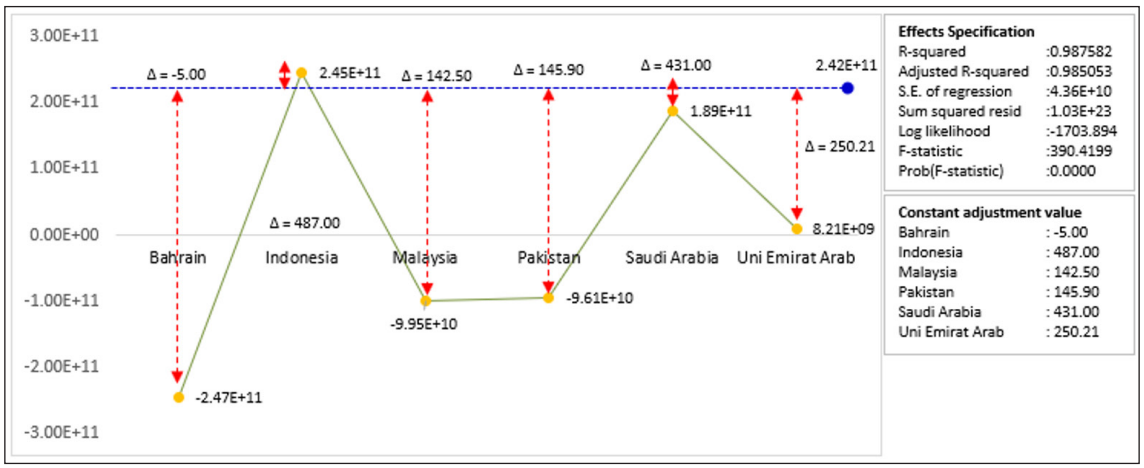
The Chow test results indicate that the Cross-Section F probability value is 0.000, suggesting that the Fixed Effects Model is the most appropriate estimation method for the analysis. Several significant findings emerge based on the regression analysis incorporating heterogeneity across countries. Total Islamic financing exhibits a positive effect on GDP. In contrast, sukuk issuance value, Islamic banking assets, Islamic investment, population, and inflation do not significantly affect GDP (see Table 2). However, when considered collectively, total Islamic financing, sukuk issuance value, Islamic banking assets, Islamic

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

investment, population, and inflation have a significant impact on GDP, as indicated by the Prob (F-statistic) value being less than 0.05. Additionally, the Fixed Effects (Cross) value for the country-specific constant adjusts the intercept for each country. Bahrain, Malaysia, and Pakistan exhibit negative values, whereas Indonesia, Saudi Arabia, and the United Arab Emirates display positive values (See Figure 1).

For the GDP per capita variable, the findings indicate that total Islamic financing, sukuk issuance value, Islamic banking assets, Islamic investment, population, and inflation do not significantly affect GDP per capita, as evidenced by the p-value of each variable being greater than 0.05 (see Table 3). However, collectively, these variables significantly impact GDP per capita, as indicated by the Prob (F-statistic) value being less than 0.05.

Figure 1. GDP Fixed Effects (Cross) Comparison Across Countries



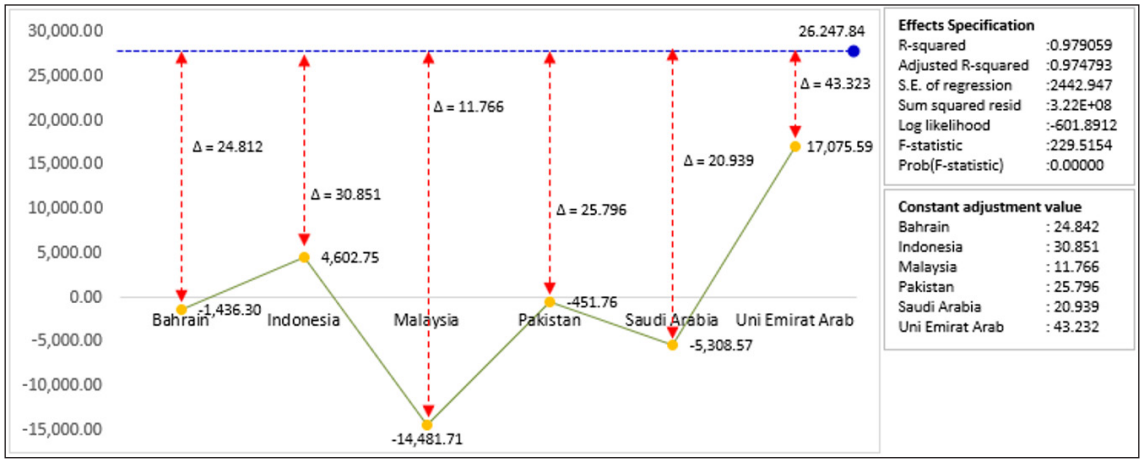
Source: Data processed (2024)

Fixed Effects (Cross) values for country constants also provide corrections to the constant values. Bahrain, Malaysia, Pakistan and Saudi Arabia show negative values, while Indonesia and United Arab Emirates show positive values (See Figure 2).

Table 3. Pooled Least Squares output for GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26,247.84	7,969.716	3.293448	0.0018
Total Islamic financing	10.45	6.617515	1.579752	0.1200
Value of sukuk issuance	-1.71	28.07465	-0.060744	0.9518
Islamic banking assets	2.34	11.81215	0.198347	0.8435
Islamic investment	-0.03	0.634315	-0.05179	0.9589
Population	-0.00012	9.43E-05	-1.276087	0.2074
Inflation	197.66	116.489	1.696778	0.0955

Figure 2. GDP per capita Fixed Effects (Cross) Comparison across countries



Source: Data processed (2024)

The Chow test results in Table 4 show that the Cross-section F probability value is 0.000, which indicates that the Fix Effect Model is the best model estimation in the analysis used. The regression analysis results, accounting for inter-temporal heterogeneity, reveal several key findings. Total Islamic financing positively impacts GDP, as indicated by a p-value of less than 0.05. In contrast, sukuk issuance does not exhibit a significant effect on GDP. Islamic banking assets positively impact GDP, while Islamic investment shows no significant effect, as reflected by a p-value greater than 0.05. Additionally, population positively impacts GDP, with a p-value of less than 0.05, whereas inflation does not show a significant effect (see Table 5).

Table 4. Redundant Fixed Effects Tests

Effects Test	Test cross-section fixed effects		
	Statistic	d.f.	Prob.
Cross-section F	2.467036	-10.49	0.0177
Cross-section Chi-square	26.9135	10	0.0027

Table 5. Pooled Least Squares Output for GDP

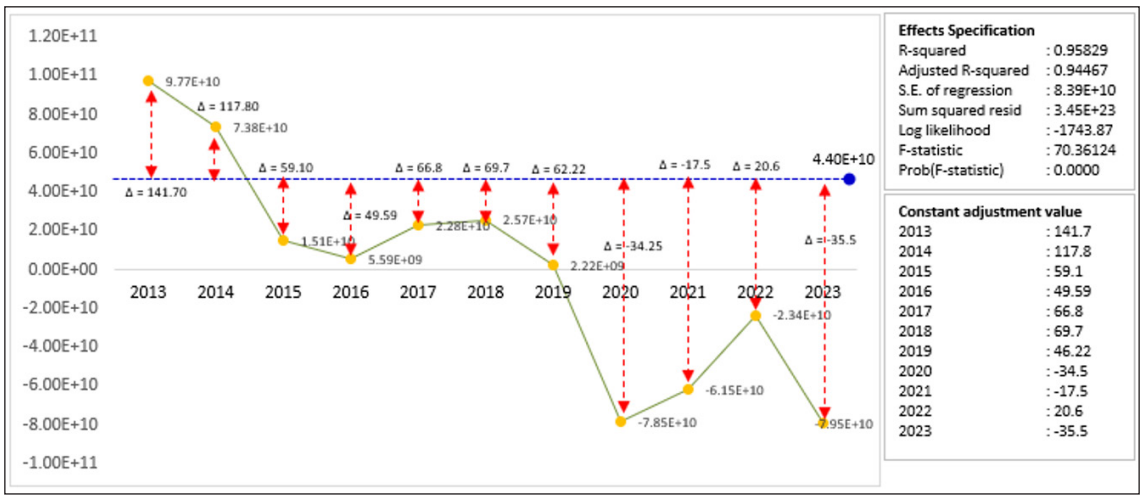
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.40E+10	2.35E+10	1.872649	0.067
Total Islamic financing	4.25E+08	1.91E+08	2.228177	0.031
Value of sukuk issuance	-1.11E+09	5.69E+08	-1.960404	0.056
Islamic banking assets	1.30E+09	2.77E+08	4.695308	0.000
Islamic investment	12,232,818	16,736,536	0.730905	0.468
Population	1133.128	190.3091	5.954144	0.000
Inflation	8.71E+08	3.44E+09	0.253183	0.801

Collectively, total Islamic financing, sukuk issuance value, Islamic banking assets, Islamic investment, population, and inflation have a significant impact on GDP,

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

as evidenced by the Prob (F-statistic) value being less than 0.05. The results of the simultaneous test further confirm that these variables jointly exert a significant influence on GDP. In addition, the Fixed Effects (Cross) value which is a correction of the constant value for each year shows variation, with positive values in some years and negative values in certain years (see Figure 3).

Figure 3. GDP Fixed Effects (Cross) Comparison across time



Source: Data processed (2024)

Meanwhile, GDP per capita, total Islamic financing, sukuk issuance value, Islamic banking assets, Islamic investment, population, and inflation do not have a significant partial impact on GDP per capita. However, the results of the simultaneous test indicate that these variables collectively have a significant impact on GDP per capita (see Table 6).

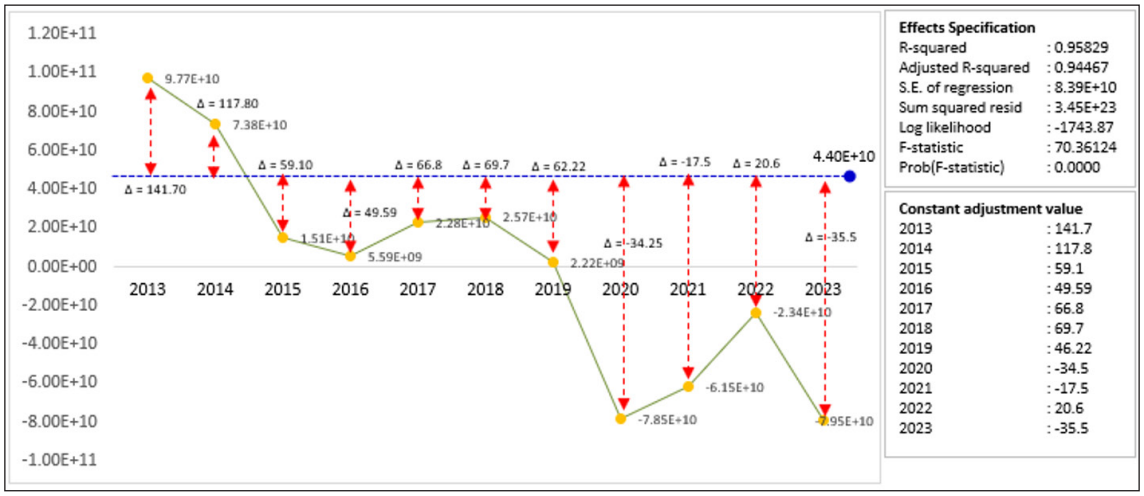
Table 6. Pooled Least Squares Output for GDP per capita

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	31,020.4			0.00000
Total Islamic financing	-53.73629			0.02100
Value of sukuk issuance	-242.0096			0.00070
Islamic banking assets	87.91301			0.00980
Islamic investment	2.974212			0.13930
Population	-0.000123			0.00000
Inflation	-198.6934			0.62750

Note: significant at 5%

Additionally, the Fixed Effects (Cross) value, which adjusts the constant for each year, exhibits significant variation, with positive values in some years and negative values in others (see Figure 4).

Figure 4. GDP per capita Fixed Effects (Cross) Comparison across time



Source: Data processed by Eviews 13, 2024

The varying levels of development in the Islamic finance industry across different countries provide valuable insights into how Islamic financial instruments influence economic growth. The regression results demonstrate that total Islamic financing positively affects GDP, reinforcing the notion that Islamic financing plays a crucial role in stimulating economic activity. However, other financial instruments, such as sukuk issuance value, Islamic banking assets, and Islamic investment, do not exhibit a statistically significant partial effect. Nevertheless, when analyzed collectively, these instruments significantly impact GDP, as indicated by the Prob (F-statistic) < 0.05, suggesting their complementary function in driving economic growth, with their effectiveness varying based on country-specific economic conditions.

These findings align with prior studies that emphasize the heterogeneous impact of Islamic financial instruments. For instance, Anwar (2024) and Khattak and Khan (2023) found that Islamic financial instruments contribute positively to economic growth, particularly in countries with well-established Islamic finance industries. Additionally, Ledhem and Mekidiche (2020) highlighted the role of macroeconomic factors in shaping the effectiveness of Islamic finance, a perspective further reinforced by the current study's findings. This result suggests that while Islamic financial instruments may not always exhibit direct effects, their combined influence can be substantial, depending on the broader financial ecosystem and macroeconomic context.

Regarding GDP per capita, the results reveal that no single Islamic financial instrument has a significant partial effect, yet their combined influence is significant. Total Islamic financing, sukuk issuance value, Islamic banking assets, and Islamic investment do not individually exhibit significance. This result suggests that the economic benefits of Islamic financial instruments may take time to translate into tangible improvements in individual income levels. This finding resonates with the work of Naz and Gulzar (2022), who highlighted the delayed impact of financial instruments on income distribution and social welfare, particularly in developing economies.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

A comparative analysis of countries with well-established Islamic finance industries, such as Malaysia, Saudi Arabia, and the United Arab Emirates (UAE), reveals important insights into the role of financial instruments in economic growth. The findings indicate that total Islamic financing significantly contributes to GDP in these countries, consistent with previous research by Boukhatem and Ben Moussa (2018) and Avdukic and Asutay (2024), who emphasized that countries with strong financial regulatory frameworks and institutional support tend to experience greater economic benefits from Islamic finance. However, the effects of Sukuk issuance value and Islamic investment remain inconsistent, suggesting that factors beyond financial instruments—such as industrial diversification and macroeconomic stability—also play critical roles in shaping economic outcomes.

For example, despite having a well-developed sukuk market, Malaysia does not show a significant partial effect of sukuk issuance on GDP. This result aligns with the argument by Laldin and Djafri (2021), who suggested that Malaysia's broader economic diversification reduces the relative impact of sukuk on overall economic performance. Similarly, Saudi Arabia and the UAE exhibit positive contributions from total Islamic financing but with varying correction values in GDP and GDP per capita, highlighting the structural differences in their economies. These variations support the findings of Smolo and Nagayev (2023), who underscored the importance of accounting for country-specific heterogeneity when evaluating the effectiveness of Islamic financial instruments.

Regarding GDP per capita, Malaysia's negative correction value suggests that despite its strong Islamic finance sector, income distribution challenges may limit the sector's impact on individual welfare. This observation is consistent with Butt et al. (2023), who noted that financial market maturity does not always translate into equitable income gains, particularly in economies where wealth concentration remains high.

A key finding of this study is the divergent impact of Islamic financial instruments on GDP and GDP per capita. While total Islamic financing significantly impacts GDP, its influence on GDP per capita remains limited. This result suggests that while Islamic financial instruments contribute to overall economic expansion, their effects on individual income distribution take longer to materialize. This finding aligns with the research of Ledhem and Mekidiche (2022), who argued that the structural transformation of an economy—such as shifts in labor markets and investment patterns—plays a crucial role in determining how financial growth translates into per capita income gains. Similarly, Saleem et al. (2021) demonstrated that Islamic financial instruments tend to have more substantial aggregate economic effects but may require supportive policies, such as financial inclusion initiatives, to translate into widespread income improvements.

The results also highlight the distinct dynamics of Islamic finance between developed and developing economies. While Malaysia and Saudi Arabia, with more mature financial

industries, show stable yet moderate contributions from Islamic finance, emerging economies such as Indonesia and Pakistan exhibit more substantial short-term effects due to their rapid financial sector growth. This echoes the findings of Ghroubi (2023) and Amran et al. (2023), who identified that financial sector maturity influences the stability and effectiveness of Islamic financial instruments.

Malaysia and Indonesia exhibit distinct economic characteristics, particularly in developing their Islamic finance sectors. Malaysia is regarded as a developed country in this sector, while Indonesia, as a developing country, is actively working to expand its Islamic finance industry. When examining the impact of Islamic financial instruments and macroeconomic factors on GDP, Malaysia's constant correction value suggests that the contribution of Islamic financial instruments to GDP is relatively lower than anticipated despite Malaysia being a pioneer in Islamic finance. This condition may be attributed to the country's greater reliance on other economic sectors, such as manufacturing and international trade. Conversely, Indonesia's constant correction value indicates a more substantial positive influence of Islamic financial instruments on GDP. Although Indonesia is still a developing country, the rapid expansion of its Islamic finance sector, supported by the world's largest Muslim population, has begun to yield significant results. The disparity in constant correction values suggests that in the short term, Islamic financial instruments may have a more pronounced impact on GDP in a developing country like Indonesia, where the sector is still in an early growth phase. In contrast, Malaysia's Islamic finance sector may have reached a level of maturity, resulting in a more stable contribution to GDP.

When analyzing the impact of Islamic financial instruments and macroeconomic factors on GDP per capita, Malaysia's correction value indicates that the sector's influence on individual welfare is more limited. Although Malaysia has a well-established Islamic finance industry, the benefits may not be equitably distributed across the population. In contrast, Indonesia's correction value suggests that, despite being a developing country, its Islamic finance instruments are beginning to contribute positively to individual welfare. This comparison highlights that while Malaysia is more advanced in Islamic finance development, its per capita impact in Indonesia is incredible due to its higher growth potential.

Saudi Arabia and Pakistan exhibit different levels of Islamic finance development. As one of the global centers of Islamic finance, Saudi Arabia has a well-established industry, whereas Pakistan remains in the developmental stage despite its long history in Islamic finance. When examining the impact of Islamic financial instruments and macroeconomic factors on GDP, the constant correction value for Saudi Arabia suggests that Islamic finance plays a significant role in driving the country's GDP growth. With strong policy support and a well-developed financial infrastructure, Saudi Arabia effectively leverages Islamic financial instruments to bolster its economy. In contrast, Pakistan's constant correction value indicates a relatively low contribution of Islamic finance instruments to GDP, highlighting challenges in integrating the sector with the broader economy. While Pakistan has substantial potential, its Islamic finance industry

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

has yet to develop sufficiently to impact overall GDP significantly. This disparity underscores the critical role of regulatory and infrastructural support in fostering the Islamic finance industry. With its robust foundation, Saudi Arabia demonstrates more positive outcomes than Pakistan, which continues to face challenges in advancing its sector.

When assessing the impact of Islamic financial instruments and macroeconomic factors on GDP per capita, the constant correction value for Saudi Arabia suggests a marginally negative impact of Islamic finance on individual welfare. Despite Saudi Arabia's advanced Islamic finance sector, the equitable distribution of its benefits remains a challenge. In contrast, Pakistan's constant correction value for GDP per capita indicates that, while the country's Islamic finance sector is still underdeveloped, its negative impact on individual welfare is relatively small. This contrast suggests that a well-developed Islamic finance sector does not necessarily guarantee a stronger positive impact on per capita welfare. Meanwhile, a developing country like Pakistan may be laying the groundwork for future growth, potentially leading to a more significant impact in the long run.

The United Arab Emirates (UAE), with its oil-based economy, and Bahrain, as a financial center in the Gulf region, illustrate how economic characteristics influence the impact of Islamic financial instruments on economic growth. When analyzing the effect of Islamic financial instruments and macroeconomic factors on GDP, the UAE's constant correction value indicates a moderate contribution of Islamic finance to GDP. Despite being a key hub for Islamic finance, the UAE's heavy reliance on the oil sector diminishes the relative significance of Islamic finance in driving GDP growth compared to other countries. In contrast, Bahrain's constant correction value suggests a substantial negative effect on GDP, indicating that although Bahrain is a center for Islamic finance, the overall size of its economy and its dependence on the financial sector limit the ability of Islamic financial instruments to stimulate GDP growth significantly. This contrast highlights how underlying economic structures shape the impact of Islamic financial instruments. With its oil-dominated economy, the UAE may not rely as heavily on Islamic finance. In contrast, Bahrain, despite its financial sector focus, faces challenges in achieving a sufficiently large economic scale to maximize the benefits of Islamic finance.

When examining the effect of Islamic financial instruments and macroeconomic factors on GDP per capita, the UAE's correction value reflects a substantial positive impact of Islamic finance on individual welfare, suggesting a more equitable distribution of its benefits compared to other countries in this study. Conversely, Bahrain's constant correction value indicates a negative impact of Islamic finance on per capita welfare despite Bahrain's status as a financial center. This contrast suggests that while both the UAE and Bahrain serve as financial hubs, the UAE has been more effective in channeling the benefits of Islamic finance to society, whereas Bahrain continues to face distributional challenges.

Several significant findings emerge based on the results of the multilevel panel data regression analysis, which accounts for period heterogeneity. First, regarding GDP as the dependent variable, the analysis reveals that Total Islamic Financing and Islamic Banking Assets exert a significant and positive influence on economic growth, as indicated by their positive regression coefficients. This result suggests that Islamic financial instruments, such as Islamic financing and banking assets, are crucial to economic expansion in the studied countries. Islamic Investment also demonstrates a positive impact, although its effect is not statistically significant.

Second, the Population variable is found to have a positive and significant effect on economic growth, highlighting the critical role of demographic factors in shaping the economic dynamics of these nations. However, Inflation does not exhibit a significant relationship with economic growth in the estimated model.

When examining the fixed effects, substantial variation is observed across different years. In 2013, a constant correction value of 9.77 suggests the presence of positive factors supporting economic growth. 2014 indicates stability, with a correction value of 7.38, while 2015 experiences a decline, reflected in a correction value of 1.51. In 2016, positive influences reemerge with a correction value of 5.59, followed by a positive impact in 2017, with a correction value of 2.28.

When considering GDP per capita as the dependent variable, the regression results indicate that Islamic financial instruments and macroeconomic factors do not significantly influence GDP per capita. However, when examined simultaneously, the tested variables demonstrate a statistically significant impact on GDP per capita. Similar to the GDP model, substantial variation is observed across years in the fixed effects. In 2014, the high constant correction value of 294.7187 reflects positive factors contributing to GDP per capita. However 2015, a sharp decline was observed, with a correction value of -2512.465, followed by another negative correction in 2016 at -1371.447. The downward trend continues in 2017 and 2018, with correction values of -1181.718 and -1036.804, respectively.

The year-by-year interpretation of these constant correction values provides a deeper insight into the factors influencing economic growth and GDP per capita in the countries studied. These fluctuations reflect the complex interplay of economic conditions and policy changes over time, underscoring the importance of understanding these dynamics when formulating effective and sustainable economic policies for the future.

The findings of this study indicate that Islamic financial instruments, such as Total Islamic Financing and Islamic Banking Assets, have a significant positive impact on economic growth in countries with varying levels of Islamic finance industry development. Additionally, demographic factors, particularly Population, play a crucial role in driving economic growth, whereas Inflation does not exhibit a significant influence. The heterogeneity between countries with well-established and emerging Islamic finance industries highlights differences in the effects of Islamic financial instruments on GDP and GDP per capita. Furthermore, another key finding is the substantial year-to-year

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

variation in the impact of Islamic financial instruments and macroeconomic factors on economic growth and per capita welfare.

Several important implications can be drawn from these findings. First, it is essential to continuously promote the development of the Islamic finance industry as a driver of economic growth in developing countries, particularly by strengthening instruments such as Islamic financing and banking assets. Second, demographic factors should be recognized as a critical element influencing national economic dynamics. Third, countries with a well-established Islamic finance industry should consider diversifying their economic sectors to enhance the contribution of Islamic finance to overall economic growth. Fourth, expanding access to and developing Islamic financial instruments in emerging economies, such as Pakistan and Bahrain, could be pivotal in increasing the sector's contribution to long-term economic growth. Finally, governments and regulators must remain attentive to shifts in economic dynamics and policy changes to formulate responsive and effective economic policies that support both economic growth and the Islamic financial sector in the future.

CONCLUSION

This study examines the impact of heterogeneous Islamic financial instruments and macroeconomic factors on economic growth in developing countries with varying income levels. The findings confirm that Islamic financial instruments, particularly total Islamic financing and banking assets, play a significant role in economic growth. This study underscores the importance of the Islamic finance industry in supporting sustainable economic expansion. Additionally, demographic factors, particularly population size, notably influence economic performance, while inflation appears to have no significant effect within the examined models. The study also reveals heterogeneity in the impact of Islamic financial instruments across countries, depending on the maturity of their Islamic finance sectors. Countries with well-established Islamic finance industries exhibit more stable positive effects on growth, whereas emerging markets demonstrate greater potential for expansion. Temporal analysis further indicates fluctuations in the effectiveness of Islamic financial instruments, influenced by evolving economic policies and external conditions.

Based on these findings, several policy recommendations are proposed. Governments and financial regulators should focus on expanding the accessibility and development of Islamic financial instruments, particularly in developing economies. Policy frameworks should include fiscal incentives, strengthened financial infrastructure, and increased public awareness of Islamic finance principles. Additionally, demographic factors should be incorporated into economic planning to promote long-term stability and productivity. Economic diversification beyond finance is crucial for countries with mature Islamic finance sectors to reduce dependency and enhance resilience. Future research should explore the intricate interactions between Islamic financial instruments, macroeconomic variables, and economic growth in various economic contexts to offer deeper insights for effective policymaking.

ACKNOWLEDGEMENT

The author sincerely appreciates **The 8th Annual Islamic Finance Call for Papers** and its reviewers for their valuable feedback, which has enhanced the quality of this research.

REFERENCES

Abbasi, H., & Aziz, K. M. (2023). Critical Study of Commodity Murabahah Practice of Islamic Banks from Shariah Perspective. *Hamdard Islamicus*, 46(2), 706.

Ahroum, R., Touri, O., & Achchab, B. (2020). Murabahaand Musharakah Moutanaquissah Pricing: An Interest-Free Approach. *Journal of Islamic Accounting and Business Research*, *11*, 201–215. https://doi.org/10.1108/JIABR-12-2016-0147.

Ajmi, H., Aziz, H. A., Kassim, S., & Mansour, W. (2019). Adverse Selection Analysis for Profit and Loss Sharing Contracts. *International Journal of Islamic and Middle Eastern Finance and Management*, *12*(4), 532-552. https://doi.org/10.1108/IMEFM-03-2018-0079.

Albaity, M., Saadaoui Mallek, R., Bakather, A., & A. Hassan Al-Tamimi, H. (2023). Heterogeneity of the MENA Region's Bank Stock Returns: Does Country Risk Matter? *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(2), 100057.

Amran, N. H., Ahmad, W., & Ho, C. S. F. (2023). Impact of Islamic Financial Markets on Economic Growth: Evidence from the Middle East and Asia. *Management and Accounting Review*, *22*(3), 271–295. https://doi.org/10.24191/MAR.V22i03-11.

Anwar, M. (2024). The Impact of Islamic Financial Deepening on Economic Growth in Indonesia. *Airlangga Journal of Innovation Management, 5*(1), 78-90.

Avdukic, A., & Asutay, M. (2024). Testing the Development Impact of Islamic Banking: Islamic Moral Economy Approach to Development. *Economic Systems*, 101229. https://doi.org/10.1016/j.ecosys.2024.101229.

Błażejowski, M., Kwiatkowski, J., & Gazda, J. (2019). Sources of Economic Growth: A Global Perspective. *Sustainability, 11*(1), 275. https://doi.org/10.3390/su11010275.

Boukhatem, J., & Ben Moussa, F. (2018). The Effect of Islamic Banks on GDP Growth: Some Evidence from Selected MENA Countries. *Borsa Istanbul Review*, *18*(3), 231–247.

Bucci, A., & Prettner, K. (2020). Endogenous Education and the Reversal in the Relationship between Fertility and Economic Growth. *Journal of Population Economics*, *33*, 1025–1068.

Butt, H. A., Sadaqat, M., & Shear, F. (2023). Does Islamic Financial Development Foster Economic Growth? International Evidence. *Journal of Islamic Accounting and Business, 14*(6), 1013-1029. https://doi.org/10.4324/9781003518617.

Cristea, M., Noja, G. G., Ștefea, P., & Sala, A. L. (2020). The Impact of Population Aging and Public Health Support on EU Labor Markets. *International Journal of Environmental Research and Public Health*, *17*(4), 1439. https://doi.org/10.3390/ijerph17041439.

Cristescu, M. P., & Nerişanu, R. A. (2021). Sustainable Development with Schumpeter Extended Endogenous Type of Innovation and Statistics in European Countries. *Sustainability, 13*(7), 3848. https://doi.org/10.3390/su13073848.

Dawood, H. A. H. (2020). The Partnership of Beneficial Owner (Rabb al-Mal) with Managing Trustee (Mudarib) in Business. *Journal of Systems and Software*, *9*, 1397.

Dua, P., & Garg, N. (2019). Determinants of Labour Productivity: Comparison between Developing and Developed Countries of Asia-Pacific. *Pacific Economic Review, 24*(5), 686-704. https://doi.org/10.1111/1468-0106.12294.

Ebrahim, A. M., & Abdelfattah, T. (2021). The Substance and Form of Islamic Finance Instruments: An Accounting Perspective. *Journal of Islamic Accounting and Business Research*, *12*(6), 872-886. https://doi.org/10.1108/JIABR-10-2019-0200.

Foglie, A. D., & Keshminder, J. S. (2022). Challenges and Opportunities of SRI Sukuk Toward Financial System Sustainability: A Bibliometric and Systematic Literature Review. *International Journal of Emerging Markets*, *19*(10), 3202-3225.

Ghroubi, M. (2023). Linkages between Capital, Bank Financing and Economic Growth: The Case of Islamic and Conventional Banks from a Panel of Muslim Countries. *Journal of Islamic Accounting and Business Research*, *16*(3), 585-607.

Gnangnon, S. K. (2021). Economic Complexity and Poverty in Developing Countries. *Economic Affairs, 41*(3), 416-429. https://doi.org/10.1111/ecaf.12485.

Gumpert, M. (2019). Regional Economic Disparities Under the Solow Model. *Quality & Quantity*, *58*, 1017-1037. https://doi.org/10.1007/s11135-019-00836-2.

Harahap, B., & Risfandy, T. (2022). Islamic Organization and the Perception of riba (Usury) and Conventional Banks Among Muslims: Evidence From Indonesia. *SAGE Open*, *12*. https://doi.org/10.1177/21582440221097931.

Hassan, M. K. (2020). Introduction: Islamic Finance and Contemporary Challenges. *Arab Law Quarterly, 35*(1/2), 1-5.

Intisar, R. A., Yaseen, M. R., Kousar, R., Usman, M., & Makhdum, M. S. A. (2020). Impact of Trade Openness and Human Capital on Economic Growth: A Comparative Investigation of Asian Countries. *Sustainability, 12*(7), 2930.

Ishak, M. S. I., & Rahman, M. H. (2021). Equity-based Islamic Crowdfunding in Malaysia: a Potential Application for Mudharabah. *Qualitative Research in Financial Markets*, *13*(2), 183-198. https://doi.org/10.1108/QRFM-03-2020-0024.

Jolo, A. M., Ari, I., & Koç, M. (2022). Driving Factors of Economic Diversification in Resource-Rich Countries via Panel Data Evidence. *Sustainability, 14*(5), 2797. https://doi.org/10.3390/su14052797.

Kanwal, A. (2021). The Prohibition of Speculation in Islamic Finance: Fairness and Framing. *International Journal of Islamic and Middle Eastern Finance and Management*, *15*(1), 146-157. https://doi.org/10.1108/IMEFM-01-2021-0034.

Khateeb, S. H., Ali, S. N., & Jumat, Z. H. (2023). Islamic Finance, FinTech and the Road to Sustainability: Reframing the Approach in the Post-Pandemic Era—An

Introduction. In. Jumat, Z. H., Khateeb, S. H., & Ali, S. N. (Eds.). *Islamic Finance, FinTech, and the Road to Sustainability: Reframing the Approach in the Post-Pandemic Era*, 1–11. Cham: Springer International Publishing.

Khattak, M. A., & Khan, N. A. (2023). Islamic Finance, Growth, and Volatility: A Fresh Evidence From 82 Countries. *Journal of Islamic Monetary Economics and Finance*, 9(1), 39-56. https://doi.org/10.21098/jimf.v9i1.1625.

Kismawadi, E. R. (2023). Contribution of Islamic Banks and Macroeconomic Variables to Economic Growth in Developing Countries: Vector Error Correction Model Approach (VECM). *Journal of Islamic Accounting and Business Research*, *15*(2), 306-326. https://doi.org/10.1108/JIABR-03-2022-0090.

Kusairi, S., Wong, Z. Y., Wahyuningtyas, R., & Sukemi, M. N. (2023). Impact of Digitalisation and Foreign Direct Investment on Economic Growth: Learning from Developed Countries. *Journal of International Studies, 16*(1), 98-111.

Laldin, M. A., & Djafri, F. (2021). The Role of Islamic Finance in Achieving Sustainable Development Goals (SDGs). In. Hassan, M. K., Saraç, M., & Khan, A (Eds.). *Islamic Finance and Sustainable Development: A Sustainable Economic Framework for Muslim and Non-Muslim Countries,* 107–126. Berlin: Springer International Publishing.

Ledhem, M. A., & Mekidiche, M. (2020). Economic Growth and Financial Performance of Islamic Banks: A CAMELS Approach. *Islamic Economic Studies*, *28*(1), 47–62. https://doi.org/10.1108/IES-05-2020-0016.

Ledhem, M. A., & Mekidiche, M. (2022). Islamic Finance and Economic Growth: The Turkish Experiment. *ISRA International Journal of Islamic Finance*, *14*(1), 4–19. https://doi.org/10.1108/IJIF-12-2020-0255.

Makohon, V., Radionov, Y., & Adamenko, I. (2020). Investment Policy of the State as a Tool for Economic Growth of the Country. *Problems and Perspectives in Management*, 18(3), 245-254. http://dx.doi.org/10.21511/ppm.18(3).2020.21.

Matousek, R., & Tzeremes, N. G. (2019). The Asymmetric Impact of Human Capital on Economic Growth. *Empirical Economics*, *60*, 1309–1334. https://doi.org/10.1007/s00181-019-01789-z.

Mensi, W., Hammoudeh, S., Tiwari, A. K., & Al-Yahyaee, K. H. (2020). Impact of Islamic Banking Development and Major Macroeconomic Variables on Economic Growth for Islamic Countries: Evidence from Panel Smooth Transition Models. *Economic Systems*, *44*, 100739. https://doi.org/10.1016/j.ecosys.2019.100739.

Mimouni, K., Smaoui, H., Temimi, A., & Al-Azzam, M. (2019). The Impact of Sukuk on the Performance of Conventional and Islamic Banks. *Pacific-Basin Finance Journal, 54*, 42-54. https://doi.org/10.1016/j.pacfin.2019.01.007.

Muryanto, Y. T. (2022). The Urgency of Sharia Compliance Regulations for Islamic Fintechs: A Comparative Study of Indonesia, Malaysia and the United Kingdom. *Journal of Financial Crime*, *30*(5), 1264-1278. https://doi.org/10.1108/JFC-05-2022-0099.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

Naz, S. A., & Gulzar, S. (2022). Impact of Islamic Finance on Economic Growth: An Empirical Analysis of Muslim Countries. *The Singapore Economic Review*, *67*(01), 245–265. https://doi.org/10.1142/S0217590819420062.

Naz, S. A., & Gulzar, S. (2023). Islamic Financial Development and Economic Growth: The Emergence of Islamic Financial Market in Pakistan. *Journal of Islamic Accounting and Business Research*, *14*(6), 989-1012. https://doi.org/10.1108/JIABR-09-2022-0222.

Paprotny, D. (2020). Convergence Between Developed and Developing Countries: A Centennial Perspective. *Social Indicators Research*, *153*, 193–225.

Petrović, P., Arsic, M., & Nojković, A. (2021). Increasing Public Investment Can be an Effective Policy in Bad Times: Evidence from Emerging EU Economies. *Economic Modelling*, *94*, 580–597. https://doi.org/10.1016/j.econmod.2020.02.004.

Rahman, M. M., & Alam, K. (2021). Exploring the Driving Factors of Economic Growth in the World's Largest Economies. *Heliyon*, *7, e07109*. https://doi.org/10.1016/j.heliyon.2021.e07109.

Rauf, A., Ali, N., Sadiq, M. N., Abid, S., Kayani, S. A., & Hussain, A. (2023). Foreign Direct Investment, Technological Innovations, Energy Use, Economic Growth, and Environmental Sustainability Nexus: New Perspectives in BRICS Economies. *Sustainability, 15*(18), 14013. https://doi.org/10.3390/su151814013.

Rehman, A., Jingdong, L., Khatoon, R., Iqbal, M. S., & Hussain, I. (2019). Effect of Agricultural Growth on Poverty Reduction, its Importance and Suggestions. *Transylvanian Review*, *24*(7), 449-454.

Roncoroni, A., Battiston, S., Farfàn, L. O. L. E., & Jaramillo, S. M. (2021). Climate Risk and Financial Stability in the Network of Banks and Investment Funds. *Journal of Financial Stability, 54,* 100870. https://doi.org/10.1016/j.jfs.2021.100870.

Saleem, A., Sági, J., & Setiawan, B. (2021). Islamic Financial Depth, Financial Intermediation, and Sustainable Economic Growth: ARDL Approach. *Economies*, *9*, 49. https://doi.org/10.3390/economies9020049.

Saleem, A., Setiawan, B., Bárczi, J., & Sági, J. (2021). Achieving Sustainable Economic Growth: Analysis of Islamic Debt and the Islamic Equity Market. *Sustainability, 13*(15), 8319. https://doi.org/10.3390/su13158319.

Sepehrdoust, H., Davarikish, R., & Setarehie, M. (2019). The Knowledge-based Products and Economic Complexity in Developing Countries. *Heliyon*, *5,* 302979. https://doi.org/10.1016/j.heliyon.2019.e02979.

Smolo, E., & Nagayev, R. (2023). Finance – Growth Nexus: Evidence from Systemically Important Islamic Finance Countries. *Journal of Islamic Accounting and Business Research*, *15*(4), 684-700. https://doi.org/10.1108/JIABR-01-2022-002

Tadele, E., & Sirany, T. (2021). The Relative Choice Over Destiny in a Country's Long-run Economic Growth and Economic Affluence. *Cogent Economics & Finance*, *9*(1), 1949133. https://doi.org/10.1080/23322039.2021.1949133.

Warninda, T. D., Ekaputra, I. A., & Rokhim, R. (2019). Do Mudarabah and Musharakah Financing Impact Islamic Bank Credit Risk Differently? *Research in International Business and Finance, 49*, 166-175. https://doi.org/10.1016/j.ribaf.2019.03.002.

Younsi, M., & Nafla, A. (2019). Financial Stability, Monetary Policy, and Economic Growth: Panel Data Evidence from Developed and Developing Countries. *Journal of the Knowledge Economy*, *10*, 238–260. https://doi.org/10.1007/s13132-017-0453-5.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44736

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 217 - 230
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44739

Women's Micro Business Performance in Islamic Perspective: Social Learning Theory Approach

Salsabila Husnul Fatimah[1*], Aas Nurasyiah[2], Rida Rosida[3]
[1,2,3]Faculty of Economics & Business Education, Universitas Pendidikan Indonesia
E-mail: [1]salsabilahusnulftmh@gmail.com, [2]asnur.fna@upi.edu, [3]rida.rosida@upi.edu
[*]**Corresponding author**

JEL Classification:
L26
J16
M10
M13
O17
Z12

Received: 04 February 2025

Revised: 06 Marchn 2025

Accepted: 09 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research examines the gender gap in the economic sector, particularly women's micro-enterprises in Indonesia, which has not been widely explored. With an Islamic approach and Albert Bandura's Social Learning Theory.

Research Objectives: This study aims to describe the performance of women micro-entrepreneurs from an Islamic perspective and empirically prove the influence of competence, Islamic work ethic, family support, and manager role actualization on women's micro-enterprises in Bandung City.

Research Methods: This study used a quantitative method with a descriptive causality research design. The survey method collected data from 236 female micro-business owners in Bandung City. The data was processed using the Partial Least Square—Structural Equation Modeling (PLS-SEM) analysis technique.

Empirical Results: The results show that, from an Islamic perspective, competence and an Islamic work ethic positively affect women's micro-enterprise performance. However, family support has a negative influence on business performance.

Implications: This research makes an important contribution to understanding the dynamics of women's micro-enterprise performance from an Islamic perspective. The results can be used as a basis for developing more effective programs and policies to support women's economic empowerment through micro-enterprises.

Keywords:
micro business; womens' entrepreneurs; family support; manager role actualization; Islamic work ethic; performance

How to Cite:
Fatimah, S. H., Nurasyiah, A., & Rosida, R. (2025). Women's Micro Business Performance in Islamic Perspective: Social Learning Theory Approach. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 217-230. https://doi.org/10.15408/sjie.v14i1.44739.

INTRODUCTION

In the context of economic development, countries worldwide strive to achieve prosperity for their citizens by following the targets listed in the Sustainable Development Goals (SDGs); all countries have agreed to this through the United Nations Development Programme (UNDP). As a developing country, Indonesia is considered to have a low level of prosperity compared to developed countries, especially in terms of the gender gap; Indonesia is ranked 87th out of 146 countries in the world (World Economic Forum, 2023). Indonesia's score remains the same as in 2022, at 0.697. This data shows that Indonesia has only achieved 69.7% gender equality and has not changed in achievement since 2022 (Indonesia Business Coalition for Women, 2023). In addition, Indonesia is responsible for improving family welfare and providing more opportunities for women to develop their ability to access social and economic resources (Hanis and Marzaman, 2019).

Currently, the number of women who are actors in Medium, Small, and Micro Enterprises is almost equal to that of men. According to the Ministry of Cooperatives and SMEs, in 2024, there were 65 million MSMEs in Indonesia, of which 64 million were micro-enterprises. Of the 64 million micro-enterprises, 60% are owned and managed by women (Ministry of Women and Child Protection, 2024). This percentage shows that micro businesses run by women have the largest share compared to the small and medium business sectors.

Although more and more women are engaging in entrepreneurship and owning businesses, the fact is that their potential has not been fully realized, which can be seen from the productivity levels that still lag behind those of male entrepreneurs (Sabrina et al., 2023). Men are perceived to outperform women in annual sales, revenue per employee, and business owner income (Jha & Alam, 2022). In addition, women entrepreneurs often face many obstacles in developing and expanding their businesses compared to men, such as a husband's death, divorce, or disability (Nurasyiah et al., 2022). Women-owned businesses grow more slowly and often fail to thrive and survive (Tundui & Tundui, 2021).

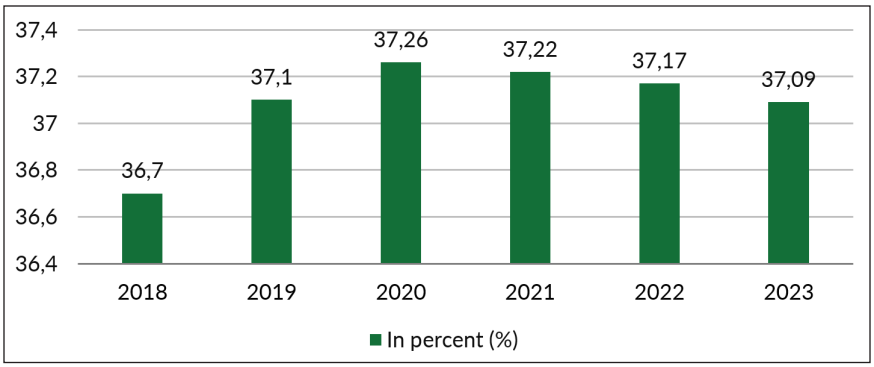
Starting a business for women is not easy, as they often face more obstacles than men. Such obstacles include cultural and political challenges, lack of mentoring, and difficulties obtaining capital (Jha & Alam, 2022). In Indonesia, the patriarchal culture requires women to prioritize tasks related to children's education, family responsibilities, and maintaining dignity (Anwar et al., 2024). Limitations can be seen in asset ownership, business experience, mobility limitations, family or household responsibilities, and greater dependence on the husband (Anwar et al., 2024).

Figure 1 shows that women in Indonesia play a role in earning income for their families. Data shows that the income contribution of women in Indonesia has fluctuated, even experiencing a significant decline in the last three years. This decline in income can be caused by various factors, including decreased sales, lack of discipline, price increases, raw materials, decreased number of buyers, and poor business performance. Poor business performance can result in decreased revenue because performance is a determining factor in achieving company goals (Nurdiyanto & Sirajuddin, 2013). On the other hand, company

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

goals will not be achieved if business actors do not perform well, which will affect the results of the work (Mangkunegara, 2017).

Figure 1. Women's Income Contribution in Indonesia



Meanwhile, in Islam's view, performance is an individual's way of self-actualization. Performance is produced according to the effort invested, and even if done well, it will get more optimal results. Performance reflects individuals' values, beliefs, and understanding, is based on solid moral principles, and can motivate the creation of quality work. Achievement in Islam focuses on achievement for the world's benefit and considers the interests of the hereafter (Romdhoni et al., 2022).

Islam emphasizes that business is not only for material gain but also for spreading mercy and seeking God's pleasure. Islamic business is based on two models of interaction: the relationship with God and the relationship with society and the environment. The ultimate goal of development in Islam is human progress through attaining spiritual and socio-economic well-being. Prosperity in this world and the hereafter is a key concept in Islam, with the principle of equality without discrimination based on race, gender, wealth, or social status. Diversity is a natural right that must be respected without supremacy or domination (Romdhoni et al., 2022).

Low performance in Indonesia is caused by a low level of quality in Human Resources (HR). Effective HR management is the key to improving performance (Sani & Ekowati, 2020). The performance of women entrepreneurs is highly dependent on various dimensions, each of which has a different role in determining their level of success in facing existing social and economic challenges. The suboptimal performance of women entrepreneurs is a matter of concern in both developed and developing countries (Jha et al., 2018).

In line with business performance issues, the theory used in this study is Social Learning Theory (SLT), Introduced by Albert Bandura (1977), who argued that learning occurs through observation, imitation, and modeling and is influenced by factors such as attention, motivation, attitudes, and emotions. Thus, Social Learning Theory (SLT) explains how interactions between environmental and cognitive elements influence individual learning (Cherry, 2022). In Islam, learning by example and a positive social environment are strongly emphasized, where a good social environment will encourage positive behavior and discourage negative behavior

Furthermore, competence is an important element of human resources that impacts business performance (Zainal et al., 2015). The results of previous studies show that the following competencies have a positive effect on business performance (Wahyuni & Sara, 2020; Sallah & Caesar, 2022; ChoudhuryKaul et al., 2023; Namagembe & Mbago, 2023; Li & Song, 2023; and Beyer et al., 2024). However, in contrast to research by Hendriani et al. (2019) which shows that competence has no significant effect on performance.

Then the results of research by Jha and Alam (2022) show that family support has an important influence on business performance especially married business owners seem to show increased profits when they receive moral support from their spouses, use household resources, and use family energy to support business operations, On the other hand, the family does not have a significant influence on business performance if the family does not support Welsh and Kaciak (2019) and Tundui and Tundui (2021).

Furthermore, not a few business actors tend to ignore the principles of Islamic business ethics in their business. Islamic business ethics are technical and applicable guidelines sourced from the Qur'an and Hadith (Juliana et al., 2019). Islamic work ethic positively influences performance (Din et al., 2019; Syarif et al., 2019; Badar et al., 2024; and Zaim et al., 2024). In contrast, research conducted by Shafissalam and Azzuhri (2017) states that the Islamic work ethic has no simultaneous effect on employee performance.

Women have great potential to support and even develop the economic sector of a region by optimally utilizing their roles. If the roles of women and men in the workforce are treated fairly, it will positively impact economic growth. This condition provides great hope for women's overall well-being, as they can create livelihoods for themselves and their families (Cabeza-García et al., 2018). In addition, microenterprises managed by women play a significant role in achieving several SDGs goals, such as poverty alleviation, gender equality, and inclusive economic growth.

This research differs from previous studies that have mainly highlighted the role of competence, family support, and Islamic work ethic separately in influencing women's business performance. In contrast, the research results have different findings. The research gap identified is the lack of studies that integrate the three factors in one comprehensive analysis model, especially from an Islamic perspective, where previous studies have mainly discussed these factors separately and have not highlighted how the three elements can interact with each other in improving women's business performance. Therefore, the novelty in this research lies in the holistic approach that combines competence, family support, and Islamic work ethic as the main determinants of improving women's micro-business performance in Indonesia, as well as providing an Islamic perspective in understanding the concept of performance as part of self-actualization and socio-economic responsibility. Thus, the main objective of this study is to analyze the influence of competence, family support, and Islamic work ethic on women's micro-enterprise performance and test the relevance of social learning theory in the context of women's business development in Indonesia so that it is expected to make academic and practical contributions in supporting women's economic empowerment policies and achieving sustainable development goals (SDGs).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

METHODS

Bandung, the largest metropolitan city in West Java and third in Indonesia plays an important role in politics, economy, and culture. However, the number of MSMEs in Bandung is only third in West Java, with 523,584 business units in 2023. In addition, women's income contribution in the city decreased by 0.47% from 2022 to 2023. The research used a quantitative method with a descriptive causality research design. Causality research focuses on the cause-and-effect relationship between various concepts or variables to find explanations that can be widely applied (Ferdinand, 2014).

Meanwhile, the sample is part of the entire population, which is this study's primary data source. In other words, the sample is a partial representation of the population that represents the entire population. The sampling method used is non-probability sampling, which means a method that does not provide equal opportunities for each element or member of the population to be selected as a sample (Ani et al., 2021).

The type of sampling used is purposive sampling. Purposive sampling is a sampling technique that deliberately selects specific individuals who are considered capable of providing relevant information, either because they have the necessary knowledge or because they meet the criteria set by the researcher (Sekaran & Bougie, 2017).

Based on the formula provided by Hair et al. (2017), the authors can determine the minimum number of samples by taking the largest number of indicators and then multiplying by ten. Most indicators are in the business performance variable with five indicators, so the minimum number of samples is formulated in the following formula:

$$(V1+V2+V3....) \times 10 = n$$

Note:

Vn = Number of indicators per variable

N = Sample Size

Form this method, the minimum sample is obtained as follows:

$$(5) \times 10 = 50$$

Based on the results of calculations using the method (Hair et al., 2017), he minimum sample size required is 50 respondents. As for calculating the maximum sample size, it can be calculated through the total indicators of each variable, namely the business performance variable has five indicators, the competency variable has three indicators, the family support variable has four indicators, the Islamic work ethic has four indicators, and the manager's role actualization variable has three indicators. So that the maximum sample acquisition is as follows:

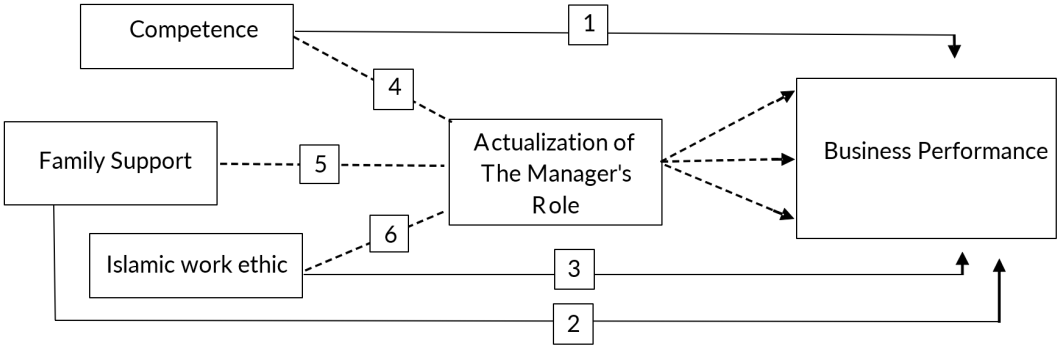
$$(5 + 3 + 4 + 4 + 3) \times 10 = 190$$

In this study, the sampling technique was carried out in 30 sub-districts in Bandung City. This method is used to ensure that each sub-district gets a balanced representation according to its population, so that the research results are more accurate and reflect the condition of the population as a whole. The calculation of the sample proportion was carried out using the following formula:

$$\text{Sub-district Proportion} = \frac{Number\ of\ sub\text{-}district\ residents}{Total\ population\ of\ Bandung\ city}\ x\ 100$$

These calculations provide a proportional sample size for each sub-district so that the sample distribution corresponds to the population in each area. Thus, this study ensures that all sub-districts are fairly represented in the data collection. Based on the calculation results, the maximum sample size required for this study was 190 respondents. However, in practice, the final sample size collected was 236 respondents, who remained proportionally distributed. This value is in line with the opinion of Hair et al. (2017), which states that the greater the number of samples used, the better the quality of the research results obtained. After determining a representative sample, this study used a conceptual model that describes the relationship between the variables studied. Figure 2 shows the research model for this study.

Figure 2. Research Model



In analyzing the relationship between variables in the research model using the Structural Equation Modeling - Partial Least Square (SEM-PLS) method. According to Ghazali (2014), PLS is one of the Structural Equation Modeling (SEM) models that uses a component-based or variant-based approach.

RESULTS AND DISCUSSION

The results of this study indicate that the model used is valid based on validity and reliability tests that have been carried out using SPSS software. The validity test is carried out by looking at the correlation value between the indicator and its variable, where all indicators have a significant correlation value above the required minimum limit. In addition, the reliability test using Cronbach's Alpha shows that all variables have values above 0.70, indicating that the research instrument has a high internal consistency. Thus, the results of this study confirm that the instruments used in this study are valid and reliable in measuring the concepts under study.

Based on the processing results in Table 1, it is known that the adjusted R-square value of the business performance variable has an adjusted R^2 value of 0.655, which is included in the medium category. This result means that the variables of competence, family support, Islamic work ethic, and actualization of the manager's role have a moderate

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

ability to explain business performance, which is 65.5%, while the remaining 34.5% is influenced by other variables not explained in this research model. The manager's role actualization variable has an adjusted R^2 value of 0.785, which is included in the substantial/strong category. This result means that the variables of competence, family support, and Islamic work ethic have a substantial/strong ability to explain the manager's role actualization variable, which is 78.5%, while 21.5% is influenced by other variables not explained in the model.

Table 1. R-Square Value (R^2)

Variables	R square	R Square Adjusted
Manager Role Actualization	0.788	0.785
Business Performance	0.661	0.655

Q^2 analysis is performed to show the model's predictive power or predictive relevance beyond the sample under study. If the Q2 value is greater than zero, it means that the predictive accuracy of the model is acceptable for model construction. In contrast, if the Q2 value is less than zero, the model has less predictive relevance.

Table 2. Q-Square Test Result (Q^2)

Variables	SSO	SSE	Q^2 (=1-SSE/SSO)
Competence	1.888.000	1.888.000	
Family Support	944.000	944.000	
Islamic Work Ethic	1.888.000	1.888.000	
Manager Role Actualization	1.652.000	764.931	0.537
Business Performance	1.652.000	965.175	0.416

Based on Table 2, the Q2 value is 0.537 and 0.416, which exceeds zero (0). This result identifies that the observation value or predictive relevance value generated by this research model can be said to be good. A positive Q2 value indicates a better prediction rate than random predictors, while a negative Q2 value indicates a worse prediction.

Furthermore, the F-Square test is performed to evaluate the ability of a particular exogenous construct to describe the variance of the endogenous construct. A high F^2 value indicates the higher ability of exogenous constructs to explain variation in endogenous constructs. The F^2 values are 0.02 (small), 0.15 (medium), 0.35 (large). Based on Table 3, it is known that the manager's role actualization variable (0.89), family support (0.03), Islamic work ethic (0.049), and competence (0.050) have little effect on business performance. Then the variables of family support (0.291), Islamic work ethic (0.062), and competence (0.284) have little effect on the actualization of the manager's role, because the value of F^2 is <0.15.

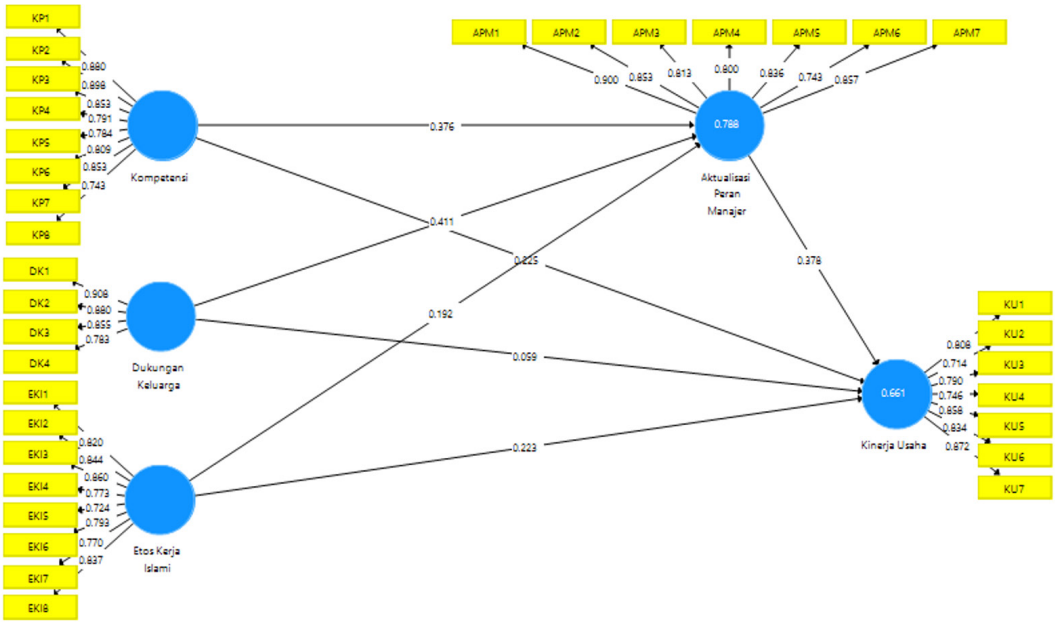
Table 3. Effect Size Value (F^2)

Variable	Manager Role Actualization	Business Performance
Competence	0.284	0.050
Family Support	0.291	0.003
Islamic Work Ethic	0.062	0.049
Manager Role Actualization		0.089

Furthermore, the Goodness of Fit test aims to assess the suitability of the overall structural and measurement models. The GoF value is obtained through manual calculation in data analysis using the PLS-SEM method. There are three categories of GoF values, namely 0.1 for the small category, 0.25 for the medium category, and 0.38 for the large category. Based on the calculations that have been carried out, the Gof value for this research model is included in the large category because it has a value of 0.700, which is more than 0.38. Therefore, the model that has been built has a good goodness of Fit value. The Goodness of Fit (GoF) value provides an overview of how well the model fits the existing empirical data.

After testing the R-Square, Q-Square, and Goodness of Fit, the resulting model is robust. Figure 3 shows the output of the PLS-SEM model after passing the testing stage and proving to be robust both in the outer and inner models.

Figure 3. Smart PLS Processing Results



After the field data is tested and produces a robust research model, the next step is to test the research hypothesis. Based on the output path coefficient in Table 4, the competency variable positively and significantly affects business performance. Islamic Sharia regulates how women carry out their role as business people; Islam provides

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

instructions for running a halal business and working hard according to their talents, energy, and abilities. The results of research conducted by (Zainal et al., 2015) state that entrepreneurial competence can improve business performance; namely, the more entrepreneurial competence increases, the more business performance also increases. This result aligns with Wahyuni and Sara (2020), Sallah and Caesar (2022), ChoudhuryKaul et al. (2023), Namagembe and Mbago (2023), Li and Song (2023), Beyer et al. (2024) that states that competence has a significant and positive impact on business performance.

The family support variable shows that the level of family support does not affect business performance. According to Bandura's social learning theory, behavior can be learned through observation and social interaction, including in business. Family support should play a role in shaping business skills. However, if family support does not affect business performance, this suggests that business owners do not apply learning from family to their business. Thus, this study does not support Bandura's social learning theory in the context of women's microenterprises.

Tabel 4. Path Coefficients

	Original Sample (O)	Sample Average (M)	Standard Deviation (STDEV)	T Statistic (|O/ STDEV|)	P-Value
Family Support -> Business Performance	0.059	0.058	0.086	0.686	0.223
Islamic Work Ethic -> Business Performance	0.223	0.225	0.077	2.892	0.003
Competencies > Business Performance	0.225	0.224	0.071	3.186	0.001
Family Support -> Manager Role Actualization -> Business Performance	0.155	0.155	0.043	3.648	0.000
Islamic Work Ethic -> Manager Role Actualization -> Business Performance	0.073	0.072	0.031	2.375	0.009
Competence -> Manager Role Actualization -> Business Performance	0.142	0.141	0.040	3.510	0.000

Source: SmartPLS Processing Results

The results of this study are in line with research conducted by Mari et al. (2016), Welsh and Kaciak (2019), and Tundui and Tundui (2021) where family support does not affect business performance. This result is possible because women have duties as housewives and business owners, so this role sometimes still lacks family support in the form of instrumental support for business and instrumental at home (Simanjuntak et al., 2023). In addition, family support is also insufficient to help women entrepreneurs who do not have access to broader business networks, which are often important for expanding markets, gaining business partners, or accessing important information (Nurasyiah et al., 2022; Jha & Alam, 2022; Anwar et al., 2024).

The Islamic work ethic variable positively influences business performance. The results of this study provide theoretical implications that support the social learning theory proposed by Bandura (1997) in Firmansyah and Saepuloh (2022), which emphasizes the importance of imitation observation and modeling in the learning process. Islamic work ethic reflects the attitudes, values, and work principles of Islamic teachings, which not only advocate seeking sustenance but also emphasize the importance of obtaining wealth in a halal and legal manner and avoiding false practices. This finding is in line with research conducted by Syarif et al. (2019), Hassi et al. (2021), Zaim et al. (2024), and Kareem et al. (2025), stating that Islamic work ethic has a positive influence on employee performance, Islamic work ethic is among the variables that have the most significant influence on employee performance.

Furthermore, the activation of the manager's role can mediate the effect of competence on performance. This result is in line with research conducted by Ssekakubo et al. (2014), showing a positive correlation between managerial competence and financial performance. This finding aligns with research conducted by Rogers et al. (2014).

Then, the actualization of the manager's role can also mediate the effect of family support on business performance. Manager role actualization includes the ability to plan, organize, direct, and control business operations. Business actors who can actualize this role well can make good use of family support through moral encouragement, financial assistance, and assistance in managing household responsibilities optimally for business development. This result is in line with research by Edelman et al. (2016), Neneh (2017), Neneh (2018), and Xu et al. (2020), which states that family support has a role in supporting their daily activities, women entrepreneurs rely heavily on support from family members to run their operations.

Based on the path coefficients output in Table 4, the manager's role actualization variable on Islamic work ethic and business performance has a positive and significant sample value. Effective leadership improves the Islamic work ethic, as stated in the research by Javed et al. (2020). In the business world, business owners who act as managers have a strategic position in bridging the relationship between work ethic and business performance. (Permana et al., 2019). Managers can create a more harmonious and productive work environment by applying a leadership style that instills Islamic values such as discipline, trust, and hard work. The manager's role as a mediator ensures that a high work ethic can be implemented in real terms to improve business performance in terms of operational efficiency, service quality, and business sustainability.

CONCLUSION

The results of this study indicate that entrepreneurial competence has a positive and significant effect on business performance. The higher the entrepreneurial competence of an entrepreneur, the better the resulting business performance. In contrast, family support does not directly influence business performance, which suggests that in the absence of mediating factors, family support alone is not enough to improve the performance

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

of women's microenterprises. However, when manager role actualization is present as a mediator, family support contributes significantly to improved business performance. In addition, Islamic work ethic was shown to have a positive and significant influence on business performance, supporting social learning theory that emphasizes the importance of observation and modeling in the learning process. In this case, effective leadership from business owners who act as managers improves Islamic work ethic and overall business performance. Mediation analysis shows that manager role actualization strengthens the influence of entrepreneurial competence and family support on business performance. With good planning, organizing, directing, and controlling, a manager can optimize the potential of available resources, including family support and Islamic work ethic values, to increase business productivity and sustainability.

Based on these findings, several suggestions can be made. The government needs to strengthen policies that support the integration of women's businesses into the more prominent industrial supply chain so that their products have a greater chance of competing in local and global markets. In addition, relevant agencies are expected to provide ongoing technical assistance and guidance to improve the competitiveness of women's micro-enterprises and their resilience to economic change. Women micro-enterprises are also advised to improve their managerial and entrepreneurial skills, apply Islamic values-based business management, and strengthen financial literacy to improve the effectiveness of business management. The use of digital technology in marketing and business operations also needs to be expanded so that business actors can reach a broader market and improve business efficiency. With a holistic approach that includes economic, social, and Islamic values aspects, it is expected that women's micro-enterprises can develop better, improve the welfare of business actors, and provide wider benefits to the regional economy.

ACKNOWLEDGEMENT

The author sincerely appreciates *The 8th Annual Islamic Finance Call for Papers* and its reviewers for their valuable feedback, which has enhanced the quality of this research..

REFERENCES

Ani, J., Lumanauw, B., & Tampenawas, J. L. A. (2021). The Influence of Brand Image, Promotion and Service Quality on Consumer Purchase Decisions on Tokopedia E-Commerce in Manado. *Jurnal EMBA*, *9*(2), 663–674.

Anwar, M. K., Ridlwan, A. A., Timur, Y. P., Dewi, T. N. L. C., Juliana, J., & Shikur, A. A. (2024). Business Success of Asnāf Women's Entrepreneur: an Islamic Law Perspective. *Al-Ihkam: Jurnal Hukum dan Pranata Sosial*, *19*(2), 1–26. https://doi.org/10.19105/al-lhkam.v19i1.8690.

Badar, K., Aboramadan, M., Alhabil, W., Dahleez, K. A., & Farao, C. (2024). Does Employee Relations Climate Mediate the Effect of Islamic Work Ethics on Organizational Performance? Evidence from Qatar. *Journal of Islamic Accounting and Business Research, 15*(8), 1205-1221. https://doi.org/10.1108/JIABR-07-2022-0164.

Beyer, A., Hohagen, S., Wilkens, U., & Langholf, V. (2024). The Impact of Team Competence on Short- and Long-term Team Performance. *Team Performance Management*, *30*(5/6), 136–153. https://doi.org/10.1108/TPM-09-2023-0067.

Cabeza-García, L., Brio, E. B. Del, & Oscanoa-Victorio, M. L. (2018). Gender Factors and Inclusive Economic Growth: The Silent Revolution. *Sustainability*, *10*(1), 121. https://doi.org/10.3390/su10010121.

Cherry, K. (2022). *How Social Learning Theory Works*. Retrieved from: https://www.verywellmind.com/social-learning-theory-2795074.

ChoudhuryKaul, S., Supriyadi, O., & Fahlevi, N. (2023). Muslim Indonesian Women Entrepreneurs: a Factor Analysis of Business Performance. *Journal of Islamic Marketing*, *14*(12), 3186–3207. https://doi.org/10.1108/JIMA-01-2022-0036.

Din, M. U., Khan, F., Khan, U., Kadarningsih, A., & Astuti, S. D. (2019). Effect of Islamic Work Ethics on Job Performance: Mediating Role of Intrinsic Motivation. *International Journal of Islamic Business Ethics*, *4*(2), 676–688. http://doi.org/10.30659/ijibe.4.2.676-688.

Edelman, L. F., Manolova, T., Shirokova, G., & Tsukanova, T. (2016). The Impact of Family Support on Young Entrepreneurs' Start-up Activities. *Journal of Business Venturing*, *31*(4), 428–448.

Ferdinand, A. (2014). *Metode Penelitian Manajemen* (5th Ed.). Semarang: Badan Penerbit Universitas Diponegoro.

Firmansyah, D., & Saepuloh, D. (2022). Social Learning Theory: Cognitive and Behavioral Approaches. *Jurnal Ilmiah Pendidikan Holistik (JIPH)*, *1*(3), 297–324. https://doi.org/10.55927/jiph.v1i3.2317.

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: Updated Guidelines on Which Method to Use. *International Journal of Multivariate Data Analysis*, *1*(2), 107. https://doi.org/10.1504/ijmda.2017.087624.

Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwiser, V. G. (2021). Partial Least Squares Structural Equation Modeling (PLS-SEM). *European Journal of Tourism Research*, *6*(2), 211–213.

Hanis, N. W., & Marzaman, A. (2019). Peran Program Pemberdayaan Kesejahteraan Keluarga dalam Pemberdayaan Perempuan di Kecamatan Telaga. *Publik: Jurnal Ilmu Administrasi, 8*(2), 123-135.

Hassi, A., Balambo, M. A., & Aboramadan, M. (2021). Impacts of Spirituality, Intrinsic Religiosity and Islamic Work Ethics on Employee Performance in Morocco: The Mediating Role of Intrinsic Motivation. *Journal of Islamic Accounting and Business Research*, *12*(3), 439–456. https://doi.org/10.1108/JIABR-05-2020-0131.

Hendriani, S., Efni, Y., & Tiyasiningsih, E. (2019). The Effect of Knowledge, Entrepreneurship Motives and The Society's Culture in Increasing The Women Micro Business Performance in Riau Province. *International Journal of Law and Management*, *61*(5–6), 563–574. https://doi.org/10.1108/IJLMA-12-2017-0297.

Javed, S., Malik, A., & Alharbi, M. M. H. (2020). The Relevance of Leadership Styles

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

and Islamic Work Ethics in Managerial Effectiveness. *PSU Research Review*, *4*(3), 189–207. https://doi.org/10.1108/PRR-03-2019-0007.

Jha, P., & Alam, M. M. (2022). Antecedents of Women Entrepreneurs' Performance: An Empirical Perspective. *Management Decision, 60*(1), 86-122. https://doi.org/10.1108/MD-07-2020-0849.

Jha, P., Makkad, M., & Mittal, S. (2018). Performance-Oriented Factors for Women Entrepreneurs – A Scale Development Perspective. *Journal of Entrepreneurship in Emerging Economies*, *10*(2), 329–360. https://doi.org/10.1108/JEEE-08-2017-0053.

Juliana, J., Sulthan, M. A., & Fathir, M. (2019). Islamic Business Ethics: Case Study of Puspa Sharia Micro Business Actors in Bank Indonesia West Java Region in Bandung 2017. *Review of Islamic Economics and Finance (RIEF)*, *2*(1), 32–40. https://doi.org/10.17509/rief.v2i1.17674.

Kareem, O., Aliyu, O. A., & Salimon, M. G. (2025). Does The Islamic Work Ethic Moderate The Relationship between Organizational Culture and Enterprise Performance? *Journal of Small Business and Enterprise Development, 32*(2), 298-324. https://doi.org/10.1108/JSBED-11-2022-0480.

Li, Y., & Song, X. (2023). Impacts of Brand Digitalization on Brand Market Performance: The Mediating Role of Brand Competence and Brand Warmth. *Journal of Research in Interactive Marketing*, *17*(3), 398–415. https://doi.org/10.1108/JRIM-03-2022-0107.

Mangkunegara, A. A. A. P. (2017). *Manajemen Sumber Daya Manusia Perusahaan*. Surakarta: PT Remaja Rosdakarya.

Mari, M., Poggesi, S., & De Vita, L. (2016). Family Embeddedness and Business Performance: Evidences from Women-Owned Firms. *Management Decision*, *54*(2), 476–500. https://doi.org/10.1108/MD-07-2014-0453.

Namagembe, S., & Mbago, M. (2023). Small and Medium Enterprise Agro-Processing Firms Supply Chain Performance: The Role of Owner-Manager's Managerial Competencies, Information Sharing and Information Quality. *Modern Supply Chain Research and Applications*, *5*(4), 265-288. https://doi.org/10.1108/MSCRA-11-2022-0033.

Neneh, B. N. (2017). Family Support and Performance of Women-owned Enterprises: The Mediating Effect of Family-to-Work Enrichment. *The Journal of Entrepreneurship*, *26*(2), 197–219. https://doi.org/10.1177/0971355717716762.

Neneh, B. N. (2018). Challenges and Performance of Women-Owned Informal Businesses in South Africa: A Family Embeddedness Perspective. *Paper Presented at the 19th Annual International Academy of African Business and Development (IAABD) Conference*.

Nurasyiah, A., Sarwath, L., Mahri, A. J. W., Hermawan, R., & Karmanto, G. D. (2022). Reducing Family Poverty through an Islamic Women's Empowerment Strategy in Indonesia: An Analytical Network Process Approach. *Al-Uqud : Journal of Islamic Economics*, *6*(2), 245–261. https://doi.org/10.26740/aluqud.v6n2.p245-261.

Permana, A., Aima, M. H., Ariyanto, E., & Nurmahdi, A. (2019). The Effect of Leadership Style, Motivation and Discipline of Employee Performance With Understanding of Islamic Work Ethics. *International Journal of Scientific and Technology Research*, *8*, 1098–1106.

Rogers, M., Sentrine, N., & Suubi, S. (2014). Corporate Governance, Managerial Competences, Accountability and Financial Performance of Commercial Banks in Uganda. *International Journal of Economics, Commerce and Management*, *2*(9), 1–15.

Romdhoni, M. F., Juliana, J., & Monoarfa, H. (2022). Business Performance of Muslim Entrepreneurs: Maslahah Scorecard Perspective. *TSARWATICA: Islamic Economic, Accounting, and Managemeng Journal, 3*, 24–34.

Sallah, C. A., & Caesar, L. D. (2022). Performance of Ghanaian Women Businesses Community: The Moderating Role of Social Competence. *Journal of Enterprising Communities*, *16*(3), 450–471. https://doi.org/10.1108/JEC-12-2020-0209.

Sani, A., & Maharani Ekowati, V. (2020). Spirituality at Work and Organizational Commitment as Moderating Variables in Relationship between Islamic Spirituality and OCB IP and Influence toward Employee Performance. *Journal of Islamic Marketing*, *11*(6), 1777–1799. https://doi.org/10.1108/JIMA-08-2018-0140.

Sekaran, U., & Bougie, R. (2017). *Metode Penelitian untuk Bisnis: Pendekatan Pengembangan-Keahlian*. Jakarta: Salemba Empat.

Simanjuntak, M., Pratiwi, I. I., Mandagi, D. W., Fitrinna, N., & Lorensius, M. (2023). *Feminist Entrepreneurship*. Jakarta: Yayasan Kita Menulis.

Ssekakubo, J., Ndiwalana, G., & Lwanga, F. (2014). Managerial Competency and the Financial Performance of Savings, Credit and Cooperative Societies in Uganda. *International Research Journal of Arts and Social Science*, *3*(3), 66–74.

Syarif, A. H., Rahmawati, A., & Fasa, M. I. (2019). The Effect of Islamic Work Ethic and Productivity on Work Quality Through The Employee Performance. *Review of Islamic Economics and Finance*, *2*(2), 40–52. https://doi.org/10.17509/rief.v2i1.22375.

Tundui, H. P., & Tundui, C. S. (2021). Marriage and Business Performance: The Case of Women-Owned Micro and Small Businesses in Tanzania. *Journal of Entrepreneurship in Emerging Economies*, *13*(5), 1287–1308. https://doi.org/10.1108/JEEE-06-2020-0202.

Wahyuni, N. M., & Sara, I. M. (2020). The Effect of Entrepreneurial Orientation Variables on Business Performance in the SME Industry Context. *Journal of Workplace Learning*, *32*(1), 35–62. https://doi.org/10.1108/JWL-03-2019-0033.

Welsh, D. H. ., & Kaciak, E. (2019). Family Enrichment and Women Entrepreneurial Success: The Mediating Effect of Family Interference. *International Entrepreneurship and Management Journal*, *15*, 1045–1075. https://doi.org/10.1007/s11365-019-00587-4.

Xu, F., Kellermanns, F. W., Jin, L., & Xi, J. (2020). Family Support as Social Exchange in Entrepreneurship: Its Moderating Impact on Entrepreneurial Stressors-Well-Being Relationships. *Journal of Business Research*, *120*, 59–73. https://doi.org/10.1016/j.jbusres.2020.07.033.

Zaim, H., Erzurum, E., Zaim, S., Uluyol, B., & Seçgin, G. (2024). The Influence of Islamic Leadership on Work Performance in Service Industry: An Empirical Analysis. *International Journal of Ethics and Systems*, *40*(1), 127–152. https://doi.org/10.1108/IJOES-12-2021-0242.

Zainal, V. R., Ramly, M., Mutis, T., & Arafah, W. (2015). *Manajemen Sumber Daya Manusia untuk Perusahaan: Dari Teori ke Praktik*. Jakarta: RajaGrafindo Persada.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44739

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 231 - 246
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44740

Sharia Supervisory Board and Islamic Banking Performance in Indonesia: Does Size Matter?

Jerry Adriaan Pessiwarisa[1*], Rahmatina Awaliah Kasri[2]
[1]Indonesian Hajj Fund Management Agency, Indonesia
[2]Faculty of Economics and Business, Universitas Indonesia, Indonesia
E-mail: [1]jpessiwarisa222@yahoo.com, [2]rahmatina@ui.ac.id
[*]**Corresponding author**

JEL Classification:
G21
G28
G34

Received: 02 February 2025

Revised: 26 February 2025

Accepted: 28 February 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This study is amongst a few studies empirically examining the impact of the Sharia Supervisory Board's (SSB) characteristics on the financial performance of Islamic banks in Indonesia. This attribute concerns regulators and market players due to its importance in Shariah governance and Islamic banks' performance. This study encompasses both full-fledged and dual-banking Islamic financial institutions.

Research Objectives: This study investigates the impact of the Sharia Supervisory Board's characteristics on the financial performance of Islamic banks in Indonesia.

Research Methods: This study utilizes random-effects GLS unbalanced panel data regression analysis with panel data from 30 Islamic banks in Indonesia (13 full-fledged Islamic banks and 17 dual-banking Islamic banks) from 2018 to 2023.

Empirical Results: The study highlights the pivotal role of SSB size in enhancing the financial performance of Islamic banks. The results suggest that the size of SSB has a significant positive influence on the financial performance of Islamic banks in Indonesia during the 2018- 2023 period.

Implications: It provides additional rationale for the newly issued regulation regarding the SSB size in Indonesia. It also offers actionable insights into the necessity of effective governance structures to ensure the sustainable growth of Islamic banking institutions.

Keywords:

financial performance; sharia supervisory board; Islamic bank; sharia governance; return on asset (ROA).

Pessiwarisa, J. A., & Kasri, R. A. (2025). Sharia Supervisory Board and Islamic Banking Performance in Indonesia: Does Size Matter?. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 231-246. https://doi.org/10.15408/sjie.v14i1.44740.

INTRODUCTION

Islamic banking has experienced significant growth over the past decade, driven by increasing demand for Sharia-compliant financial services worldwide. As of 2023, the global Islamic banking sector's total assets reached USD 3.38 trillion, reflecting a compound annual growth rate of 10.5% from 2017 to 2023 (IFSB, 2024). This expansion underscores the sector's resilience and growing appeal among diverse communities. The Islamic banking sector has also progressed notably in Indonesia, which has the world's largest Muslim population. By August 2024, its market share rose to 7.33%, with assets totaling IDR 902.39 trillion (approximately USD 57.8 billion), marking an annual growth rate of 10.37% (OJK, 2024). These figures highlight the increasing acceptance and integration of Sharia-compliant financial services globally and within Indonesia. Sharia governance and its implications are becoming interesting studies, especially in Indonesia, a country with the highest Muslim population in the world. Islamic bank financial performance, sharia governance, and supervision of Islamic banks are among the main themes in research related to Islamic bank governance (Alam et al., 2025). The governance framework within Islamic banking institutions is designed to optimize financial and operational performance metrics, with the Shariah Supervisory Board (SSB) serving as a crucial governance mechanism that potentially influences institutional performance outcomes (Minaryanti & Mihajat, 2023).

Research indicates that adherence to Shariah principles represents the primary determinant in customers' selection of Islamic banking services (Elgattani & Hussainey, 2020). The SSB is a cornerstone of Islamic banking, ensuring compliance with Islamic principles and influencing Islamic banks' overall governance and performance (Grassa et al., 2023; Jabeen & Kausar, 2022). Theoretical frameworks such as legitimacy theory (Dowling & Pfeffer, 1975), stakeholder theory (Freeman, 1984), agency theory (Jensen & Meckling, 1976), and resource dependency theory (Pfeffer & Salancik, 1978) provide valuable insights into the SSB's role. Legitimacy theory suggests that Islamic banks can continue to operate sustainably if society recognizes that the Islamic banks have been operating with a value system (sharia principles), one of which is reflected in the existence of SSB, that is the same as or equivalent to the value system held by society. Stakeholder theory positions the SSB as a key entity safeguarding the interests of diverse stakeholders, including investors, regulators, and the Muslim community, by maintaining Sharia compliance and legitimacy. Agency theory emphasizes the SSB's function in reducing conflicts between management and stakeholders, ensuring accountability and adherence to ethical principles. Additionally, resource dependency theory suggests that the SSB is vital for banks, contributing intellectual, relational, and reputational capital that enhances governance and decision-making. Larger SSBs are often better equipped to handle complex financial products and governance challenges, reinforcing their role as a critical mechanism in Islamic banking.

In the context of Indonesia, the role of SSB is also highly strategic not only because all products that Islamic banks will offer must have a basis in religious scholars' fatwas but also because they perform supervisory rule in the governance of the Islamic banks

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

(Puspitasari & Kasri, 2023). Thus, SSB not only needs to know Islamic law but must also have knowledge of accounting and/or finance, which equips them to understand the specifics of modern banking transactions and activities so that they can conduct adequate supervision, which can ultimately improve the financial performance of Islamic banks (Ghayad, 2008).

In this respect, there are several regulations in Indonesia regarding SSB. One example is the Indonesian Financial Services Authority (OJK) regulation or POJK No. 10/POJK.03/2016 on Governance for Islamic Banks, which stipulated that the SSB must be appointed based on recommendations from the National Shariah Council (DSN-MUI) and provide periodic reports to OJK regarding Shariah compliance. Regarding the size of SSB, POJK No. 16/2022 requires a full-fledged Islamic bank to have a minimum of 2 SSB members and a maximum of 50% of the number of Directors. However, POJK No. 12/2023 regulates that dual-banking Islamic banks must have a minimum of 2 SSB members and a maximum of 3 SSB members. Thus, different regulations require different numbers of SSB members. This condition suggests no uniform baseline for determining the ideal number of SSB members.

Empirical studies have examined the impact of various SSB characteristics on the financial performance of Islamic banks. The size of the SSB is a significant factor in the governance mechanisms of Islamic banks. A larger SSB, comprising members with diverse competencies and experiences, tends to understand products better and can provide more comprehensive assessments, potentially contributing to improved performance (Hamza, 2016). Studies have found a positive relationship between SSB size and the financial performance of Islamic banks (Mollah & Zaman, 2015; Almutairi & Quttainah, 2017; Baklouti, 2020; Grassa et al., 2023). From the customer's perspective, more SSB members can enhance Islamic bank's credibility by demonstrating a strong commitment to Sharia principles. Nevertheless, empirical evidence derived from a study on Islamic banking institutions in Saudi Arabia demonstrates that SSB size exhibits no statistically significant influence on the financial performance of Islamic banks (Bashir et al., 2023).

Other SSB characteristics, such as expertise, reputation, and cross-membership, have also been studied. The presence of board members with higher educational backgrounds can improve company performance (Darmadi, 2013). Sharia advisors ideally understand Sharia, legal, and economic issues (Ghayad, 2008). SSB members without a financial or accounting background may struggle to carry out their duties effectively. However, other studies found that SSB expertise does not significantly influence Islamic banks' financial performance (Hakimi et al., 2018; Baklouti, 2020). Regarding reputation, directors bring knowledge and reputation to the institution, which can be a competitive advantage. Reputation and Islamic bank industry knowledge strongly correlate with performance (Nomran et al., 2018).

In countries where the Islamic finance industry is still developing, Sharia experts become corporate elites in SSB (Gözübüyük et al., 2020). Resource dependency theory suggests that directors who hold multiple positions on boards (cross-membership) have wider access to information, enriching their knowledge and experience related to corporate

governance (Nomran et al., 2018). Cross-membership significantly positively influences Islamic banks' performance in Indonesia (Grassa et al., 2023; Rahman & Haron, 2019). However, other studies, such as Krause et al. (2014), argue that cross-membership can reduce the independence and flexibility of SSB supervision. Hamza (2013) highlights potential conflicts of interest that may arise. Gözübüyük et al. (2020) warn about the risk of negligence and information leakage, while Baklouti (2020) mentions the possibility of increased absenteeism and decreased effectiveness of SSB control if SSB members hold multiple positions.

This study addresses a research gap in Islamic banking literature by examining the impact of Shariah Supervisory Board (SSB) characteristics on financial performance within Indonesia's two Islamic banking models. While previous studies (e.g., Bashir et al., 2023; Tashkandi, 2023; Baklouti, 2020; Mukhibad, 2019; Alsartawi, 2019; Nomran et al., 2018) have predominantly focused only on full-fledged Islamic banks, they overlooked the dual-banking Islamic banks, which also exist in some countries. The novelty of this research lies in its comprehensive analysis of both full-fledged and dual-banking Islamic banks, offering a comparative perspective that has been largely absent in existing literature. The primary purpose of this study is to investigate how SSB characteristics, with specific emphasis on SSB size, influence the financial performance of Islamic banks operating within Indonesia's dual-banking framework during the period 2018-2023. This research aims to generate valuable insights for regulators and bank management in optimizing SSB roles while simultaneously contributing to the theoretical understanding of Shariah governance by providing empirical evidence on SSB effectiveness across different Islamic banking models within a unified regulatory environment.

METHODS

This study adopts a quantitative research methodology that utilizes secondary data from banks' audited financial and annual reports. Key information on SSB characteristics—such as SSB size, educational background (competence), elite group representation, and cross-membership—was extracted from the SSB profile section of the bank's annual reports. Financial metrics were collected from audited financial statements, including Return on Assets (ROA), Net Profit Margin (NPM), and total assets. The study employs ROA as the dependent variable because of limitations in Islamic bank's equity data availability, which precludes using the return on equity (ROE) ratio. Macroeconomic data, such as GDP growth and inflation rates, were obtained from the Central Bureau of Statistics. The operationalization of each variable used in this study is carried out with different calculations, as explained in Table 1.

The dataset combines cross-sectional data, including independent and control variables, with time-series data from 2018 to 2023. This integration forms a panel dataset, enabling the analysis of individual and temporal variations. Panel data methods are particularly advantageous in enhancing the efficiency of parameter estimates by addressing issues related to multicollinearity, omitted variable bias, and unobserved heterogeneity.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

A data cleansing is processed to ensure the quality and reliability of the data. This action involved removing outliers and incomplete observations. For example, some full-fledged Islamic banks that did not disclose SSB profiles or net profit data were excluded. Consequently, the final sample comprises 155 panel observations from 13 full-fledged Islamic banks and 17 dual-banking Islamic banks, covering 2018–2023. Data selection prioritizes banks with adequate information disclosure and reliable reporting standards, ensuring a robust and representative sample.

Table 1. Operational Variables

Variables	Definitions	Reference
ROA	Natural logarithm of *Return on Assets* with calculation: Net profit devided by total asset	Kusi et al. (2018)
SSB_SIZE	Number of SSB members	Baklouti (2020)
SSB_COMP	The ratio of SSB who has an education background in economics/finance/accounting with calculation: Number of SSB who have education background in economics or finance or accounting devided by total number of SSB	Baklouti (2020)
SSB_ELITE	The ratio of SSB who is also chairman or member of DSN-MUI with the calculation: Number of SSB who is also chairman or member of DSN-MUI devided by total number of SSB	Gözübüyük et al. (2020)
SSB_CMRT	The ratio of SSB's members who sit on SSBs of other Islamic Financial Institutions (IFIs), with the calculation: Number of SSB's who sit on SSBs of other IFI devided by total number of SSB	Baklouti (2020)
BANK_NPM	Net profit margin ratio with calculation: Net profit devided by revenue	Manogna and Mishra (2021)
BANK_ASSET	Natural logarithm of total Islamic bank's asset	Alsartawi (2019)
CRISIS	The dummy variable, "1" is years of the COVID-19 crisis (2020-2021), if not "0"	Susanti et al. (2023)
GDP	Indonesia's Gross domestic product growth	Romus et al. (2020)
INFLATION	Indonesia's inflation rate	Tarkom and Ujah (2023)

Descriptive statistical analysis was initially performed to summarize the data's central tendency, dispersion, and distribution characteristics. Subsequently, the study conducted a series of model specification tests to identify the most suitable panel data regression model, including the Hausman test and the Breusch-Pagan Lagrange Multiplier (LM) test. These tests are critical for selecting common, fixed, and random effects models, ensuring that the estimation results are consistent and efficient.

After determining the most appropriate model, the study applied random-effects Generalized Least Squares (GLS) panel regression for the analysis. The GLS approach is suitable for handling heteroskedasticity and autocorrelation commonly present in panel data. This method aligns with the methodologies employed in previous studies, such as Baklouti (2020), who utilized GLS for examining SSB characteristics, and Tashkandi

(2023) and Nomran et al. (2018), who applied the Generalized Method of Moments (GMM) for similar purposes. While Mukhibad (2019) employed a fixed-effects model with Ordinary Least Squares (OLS) estimation, and Alsartawi (2019) used multiple linear regression, the choice of GLS in this study is justified by its ability to account for unobserved heterogeneity across banks and reduce estimation bias in cases of random effects. GLS estimation is instrumental when dealing with heteroscedasticity and autocorrelation in panel data, as it provides more efficient estimates by accounting for the variance-covariance structure of the error terms.

The statistical analysis includes partial variable testing (t-test) to assess the significance of individual predictors, simultaneous variable testing (F-test) to evaluate the model's overall explanatory power, and determination coefficient (R-squared) analysis to measure the proportion of variance explained by the model. This study performed robustness tests using alternative measurement proxies for the variables. Robustness testing is essential to confirm that the findings remain valid under different specifications and assumptions (Neumayer & Plümper, 2017). This approach strengthens the credibility of the conclusions by demonstrating that the observed relationships are not contingent on a specific model or measurement approach. By employing a rigorous panel data regression framework and incorporating robustness testing, this study aims to provide a comprehensive and reliable analysis of the impact of SSB characteristics, particularly SSB size, on the financial performance of Islamic banks in Indonesia.

In this study, researchers conducted panel data regression analysis using the least square method. The following is the research model used to estimate based on the available panel data:

$$ROA_{i,t} = \alpha_0 + \beta_1 SSB\_SIZE_{i,t} + \beta_2 SSB\_COMP_{i,t} + \beta_3 SSB\_ELITE_{i,t} + \beta_4 SSB\_CMRT_{i,t} + \beta_5 BANK\_NPM_{i,t} + \beta_6 BANK\_ASSET_{i,t} + \beta_7 CRISIS_{i,t} + \beta_8 GDP_{i,t} + \beta_9 INFLATION_{i,t} + \varepsilon_{i,t}$$

Where: i: Islamic banks (i = 1,….,30); t: Annual period (t = 2018,….,2023); α: Constant; β: The vectors of coefficient estimates; ε: The error term.

RESULTS AND DISCUSSION

The descriptive statistical analysis of Islamic banks in Indonesia during the 2018–2023 period, as detailed in Table 2, highlights several notable findings. Islamic banks' Return on Assets (ROA) exhibits substantial variability, with an average of 0.06 and a standard deviation of 1.29. This significant variability reflects the differences in business strategies and cost structures among Islamic banks, consistent with findings from prior research (Baklouti, 2020; Miao et al., 2023).

The composition of the SSBs in Indonesia underscores the sector's limited availability of specialized human resources. Only 38.28% of SSB members possess an educational background in economics, finance, or accounting. Additionally, most (78%) of SSB members hold multiple positions in other IFIs, further indicating the constrained pool of expertise. Furthermore, 44.41% of SSB members concurrently serve as board members

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

of the National Sharia Council (DSN-MUI), highlighting DSN-MUI's pivotal role as a talent pool for SSB members. Cross-membership is prevalent, with 59.36% of SSB members holding positions in multiple Sharia financial institutions. In terms of financial performance, Islamic banks reported an average net profit ratio of 22.72%, reflecting a wide range of profitability across the sampled banks. The average ROA was 0.0557, further underscoring significant variability in operational efficiency and strategic approaches. These differences illustrate the diverse cost structures and income generation models' Islamic banks adopt.

The macroeconomic context during the observation period provides additional insights. The 2020–2021, marked as the COVID-19 crisis period, is captured by the crisis dummy variable, with an average value of 0.30. During this time, Indonesia experienced average GDP growth of 3.81%, while the inflation rate averaged 2.95%. These macroeconomic conditions add to Islamic banks' challenges, affecting their governance and financial performance during this period. This analysis offers a comprehensive overview of the operational, governance, and macroeconomic factors impacting Islamic banks in Indonesia. The variability in ROA, differences in SSB composition, and the influence of external factors such as the COVID-19 crisis highlight the complexity of managing Sharia-compliant financial institutions. These findings underscore the need for targeted policy interventions and governance reforms to enhance the resilience and efficiency of Islamic banks in Indonesia.

Table 2. Descriptive Statistics

Variables	Observation	Median	Mean	Std. Dev.
ROA	155	0.3400	0.0557	1.2963
SSB_SIZE	155	2	2.2645	0.4978
SSB_COMP	155	50	38.2792	32.0183
SSB_ELITE	155	50	44.4090	40.1243
SSB_CMRT	155	66.6700	59.3550	42.7283
BANK_NPM	155	19.7000	22.7158	18.9280
BANK_ASSET	155	8.9500	9.0434	1.1869
CRISIS	155	0	0.3032	0.4611
GDP	155	5.0500	3.8063	2.5749
INFLATION	155	2.7200	2.9531	1.2520

Source: EViews Output

Multicollinearity testing was implemented to assess the presence of correlations between predictor variables in the regression model. Correlation coefficients below 0.8 among independent variables indicate the absence of multicollinearity concerns. The results presented in Table 3 demonstrate that all correlation coefficients fall below the 0.80 threshold, thus confirming the absence of multicollinearity in the dataset.

Table 3. Multicollinearity Test

	SSB_ SIZE	SSB_ COMP	SSB_ ELITE	SSB_ CMRT	BANK_ NPM	BANK_ ASSET	CRISIS	GDP	INFLATION
SSB_SIZE	1.00								
SSB_COMP	-0.14	1.00							
SSB_ELITE	0.17	0.17	1.00						
SSB_CMRT	0.14	0.07	0.77	1.00					
BANK_NPM	0.07	0.11	-0.09	-0.12	1.00				
BANK_ASSET	0.32	-0.07	0.63	0.63	-0.16	1.00			
CRISIS	0.02	0.02	-0.01	-0.00	-0.00	0.03	1.00		
GDP	0.01	-0.01	-0.00	-0.04	0.05	-0.04	-0.78	1.00	
INFLATION	-0.03	-0.00	-0.01	-0.05	0.05	0.02	-0.62	0.54	1.00

Source: EViews Output

The results of the panel data regression estimation are presented in Table 4. The model selection process began with the Chow test, which yielded a cross-section F probability value of 0.0000. This result suggests that the fixed-effect model (FE) is more suitable than the common-effect model (CE). Subsequently, the Hausman test was conducted to determine whether the fixed-effect or random-effect model (RE) would be more appropriate. The Hausman test results showed a cross-section random probability value of 0.3171, indicating that the random-effect model is preferable. The Lagrange Multiplier (Breusch-Pagan) test was performed, producing a cross-section probability value of 0.0000. The results of both the Hausman and Lagrange Multiplier tests consistently support the adoption of the random-effect model for panel data regression analysis.

Based on the Random-Effect model estimation results in Table 4, SSB size positively influences the financial performance (ROA) of Islamic banks in Indonesia during 2018–2023. This result differs from the Bashir et al. (2023) study, which found that SSB size does not significantly influence ROA. This condition may be caused by different Islamic bank data as the object of research. Additionally, three other variables significantly influence the financial performance of Islamic banks: profitability level, bank assets, and the crisis period (marked by the COVID-19 pandemic).

The simultaneous testing of independent variables yields an F-statistic of 21.59, greater than the critical F-table value of 1.94. This result indicates that the independent variables collectively significantly affect ROA. Furthermore, the adjusted R-squared value of 0.5461, or 54.61%, demonstrates that the independent variables collectively explain 54.61% of the variation in ROA. The remaining 45.39% is attributable to other factors not included in the research model.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

Table 4. Panel Data Regression Estimation Results

Variables	CE	FE	RE
C	0.4276 0.54	2.1662 1.56	0.4902 0.50
SSB_SIZE	-0.0245 -0.15	0.2865 2.09**	**0.2557** 1.99**
SSB_COMP	-0.0020 -0.82	0.0026 0.97	0.0013 0.52
SSB_ELITE	-0.0077 -2.49**	-0.0019 -0.62	-0.0031 -1.08
SSB_CMRT	0.0071 2.50**	0.0016 0.56	0.0027 1.10
BANK_NPM	0.0469 11.70***	0.0581 12.25***	**0.0544** 13.26***
BANK_ASSET	-0.1511 -1.69*	-0.4519 -2.91***	**-0.2465** -2.27**
CRISIS	-0.1631 -0.58	-0.2399 -1.77*	**-0.2618** -1.96*
GDP	-0.0214 -0.46	-0.0239 -1.09	-0.0231 -1.06
INFLATION	0.0380 0.50	0.0225 0.61	0.0167 0.46
Observations Adjusted R-Squared	155 0.5056	155 0.8959	155 0.5461
F-Statistics	18.4995***	35.8781***	21.5882***
Chow Test (Cross-Section F) Probability cross-section F		19.7463*** 0.0000	
Hausman Test (Chi-Square Statistics) Probability cross-section random			10.4258*** 0.3171
Lagrange Multiplier (Breusch-Pagan) Probability cross-section	186.0491*** 0.0000		

Notes: * significance at 10%; ** significance at 5%; and ***significance at 1%
CE= Common-Effect; FE= Fixed-Effect; RE= Random-Effect; Coeff= Coefficient; t-stat= t-statistics
Source: EViews Output

Furthermore, to ensure the validity of the findings, a robustness test was conducted by adding two independent variables (the ratio of professors on the SSB and the SSB meeting attendance rate) and one control variable (exchange rate). Table 5 reports the result of the robustness test. Based on the regression result in Table 5, SSB size remains a variable that positively influences Islamic banks' financial performance, just as in the first model. In addition, four other variables significantly influence the financial performance of Islamic banks: Profitability level, bank assets, crisis, and currency exchange rate. The results of panel data regression estimations were found to be robust due to their consistency. However, the independent variables and control variables were added to the second model for robustness testing purposes.

Table 5. Robustness Test Results

Variables	Coefficient	t-statistic	Prob.
C	-1.1899	-0.97	0.33
SSB_SIZE	0.2511	2.00**	0.048
SSB_COMP	0.0006	0.23	0.82
SSB_PROF	0.0005	0.22	0.83
SSB_ELITE	-0.0028	-0.97	0.33
SSB_CMRT	0.0036	1.48	0.14
SSB_PRES	0.0028	0.83	0.41
BANK_NPM	0.0530	13.10***	0.00
BANK_ASSET	-0.3592	-3.04***	0.00
CRISIS	-0.2537	-1.86*	0.06
GDP	-0.0255	-1.18	0.24
INFLATION	-0.0420	-0.96	0.34
CURRENCY	0.0002	2.07**	0.04

Notes: * significance at 10%; ** significance at 5%; and ***significance at 1%
Source: EViews Output

The results of this study, as presented in Table 4 and Table 5, provide significant insights into the relationship between Sharia Supervisory Board (SSB) characteristics and the financial performance of Islamic banks in Indonesia during the 2018–2023 period. The findings of the various SSB characteristics analyzed reveal that only SSB size significantly influences Islamic banks' financial performance. This result aligns with findings from previous studies, such as Mollah and Zaman (2015), Almutairi and Quttainah (2017), Baklouti (2020), and Grassa et al. (2023), which have also established a positive relationship between SSB size and the financial performance of Islamic banks. These studies highlight that SSB size is critical in Sharia governance mechanisms, as it positively correlates with better bank performance (Bukair & Rahman, 2015; Baklouti, 2020). Specifically, a larger SSB brings together individuals with diverse skills and experiences, facilitating a better understanding of complex financial products and more effective Sharia assessments (Hamza, 2016).

The result is also consistent with the view of the Resource Dependence Theory and The Legitimacy Theory. From the perspective of Resource Dependence Theory, a larger SSB size increases the diversity of resources available to Islamic banks. This diversity includes a broader range of SSB members' educational backgrounds, expertise, and experiences. In Indonesia, where Sharia knowledge is still developing, having more SSB members enables cumulative knowledge-sharing, enhancing decision-making and improving Islamic banks' overall performance. Furthermore, under the framework of the Legitimacy Theory, a larger SSB strengthens the credibility of Islamic banks and enhances

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

public trust. Islamic banks can align their operations with the societal value system by demonstrating their commitment to upholding Sharia principles in all operational activities. This alignment is crucial for maintaining legitimacy, as organizations are more likely to operate sustainably when society recognizes them as adhering to shared values and principles. Consequently, the presence of a larger SSB not only reinforces the legitimacy of Islamic banks but also promotes sustainable operations and long-term growth.

Notably, the study's finding suggesting 3 (i.e., rounding value of 2.6) as a minimum number of SSBs aligns with the recently issued regulation regarding SSB size in Indonesia. As explained earlier, before 2024, different regulations require different numbers of SSB members. While POJK 16/2022 requires a minimum of 2 SSB members and 50% of the number of Directors, POJK 12/2023 mandates a minimum of 2 SSB members and 3 SSB members. This condition has somewhat created confusion amongst Islamic banks. However, the regulator recently issued POJK Number 2/ 2024 Concerning the Implementation of Sharia Governance for Full-Fledged Islamic Banks and Dual-Banking Islamic Banks. This regulation stipulates that each Islamic bank must have a minimum of 3 SSB members and a maximum of 50% of the number of Directors. This regulation aligns with the recommendation issued by the National Committee on Governance Policy (KNKG), which recommends a minimum of 3 Sharia Supervisory Board (SSB) members for each entity. As such, it appears that the government is beginning to standardize the provisions applicable to full-fledged Islamic banks and dual-banking Islamic banks. This alignment also suggests that this study could serve as a foundation for understanding the rationale behind increasing the minimum number of SSB members compared to previous regulations.

In addition, based on the estimation results of the random effect model presented in Table 4, three variables significantly influence the financial performance of Islamic banks: profitability level, bank assets, and the COVID-19 crisis period. First, bank profitability emerges as a critical determinant of firm performance. A higher net profit margin typically corresponds to an increase in Return on Assets (ROA), as supported by Manogna and Mishra (2021). This condition was also the case for Islamic banks in Indonesia during that period. Second, bank assets show mixed results regarding their impact on financial performance. While Alsartawi (2019) found a significant positive relationship between bank assets and ROA—where larger banks achieved higher ROA than smaller ones—studies on Islamic banks in Indonesia during 2018–2023 reveal a negative impact of bank assets on ROA. This contradictory finding may be explained by the ability of smaller Islamic banks, with relatively lower asset volumes, to manage and maximize existing funds more efficiently to generate profits.

Lastly, the global financial crisis and the COVID-19 pandemic negatively impact Islamic banks' performance. For instance, Tashkandi (2023) highlighted that the global financial crisis adversely affected ROA in Islamic banks within the Gulf Cooperation

Council (GCC) region. Similarly, studies measuring bank performance in Indonesia before and during the COVID-19 pandemic (Boshnak et al., 2023; Susanti et al., 2023) demonstrated that the pandemic caused substantial losses in the Indonesian banking industry. During the COVID-19 period, ROA significantly declined compared to pre-pandemic levels. This condition is also the case for Islamic banks in Indonesia during the 2018-2023 period.

CONCLUSION

This study investigates the impact of the Sharia Supervisory Board's characteristics on the financial performance of Islamic banks in Indonesia. The study's main findings indicate that the size of the SSB has a significant positive impact on the financial performance of Islamic banks. Larger SSB size increases the diversity of resources available to Islamic banks and promotes sustainable operations and long-term growth. This study underscores the critical role of having an adequately sized SSB in enhancing Sharia supervision and bolstering a bank's financial outcomes. However, other SSB attributes—such as competence, elite group membership, and cross-membership—did not significantly affect the banks' performance. Notably, the bank's profit, the bank size, and the COVID-19 crisis period are also found significant in this study.

The study's findings have several implications. First, Islamic bank management must proactively address the requirements of POJK 2/ 2024, which mandates a minimum of three SSB members by 1st January 2026. This action is important to enhance Islamic banks' legitimacy and customer trust and optimize resource potential for the Islamic bank. Second, to anticipate the increase of new SSB applications, the regulator and assessor (Financial Services Authority and National Sharia Council/DSN-MUI) must conduct a better fit and proper assessments for which, at the same time, must also enhance its monitoring processes to uphold the integrity and quality of SSB appointments.

REFERENCES

Alam, A., Nugroho, D. W., Isman, I., & Ahmi, A. (2025). Bibliometric Study on Corporate Governance of Islamic Banks. *International Journal of Economics and Financial Issues, 15*(2), 397–410. https://doi.org/10.32479/ijefi.18280.

Almutairi, A. R., & Quttainah, M. A. (2017). Corporate Governance: Evidence from Islamic Banks. *Social Responsibility Journal*, *13*(3), 601–624.

Alsartawi, A. M. (2019). Board Independence, Frequency of Meetings and Performance. *Journal of Islamic Marketing*, 10(1), 290–303.

Baklouti, I. (2020). Is the Sharia Supervisory Board a Friend or an Enemy of Islamic Banks? *Journal of Islamic Marketing*, 13(2), 526541. https://doi.org/10.1108/jima-04-2020-0118.

Boshnak, H. A., Alsharif, M., & Alharthi, M. (2023). Corporate Governance Mechanisms

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

and Firm Performance in Saudi Arabia Before and During the COVID-19 Outbreak. *Cogent Business & Management, 10*, Article 2195990.

Bashir, M. S., Edris, M. M. A. M., & Muslichah, M. (2023). Does Shari'ah supervisory board characteristics affect Islamic banks'financial performance? Evidence from Saudi Arabia. *Corporate Board: Role, Duties and Composition, 19*(2), 15–25.

Bukair, A. A., & Rahman, A. A. (2015). The Effect of the Board of Directors' Characteristics on Corporate Social Responsibility Disclosure by Islamic banks. *Journal of Management Research*, *7*(2), 506–519. https://doi.org/10.5296/jmr.v7i2.6989.

Darmadi, S. (2013). Board Members' Education and Firm Performance: Evidence from a Developing Economy. *International Journal of Commerce and Management*, 23(2), 113-135.

Dowling, J. & Pfeffer, J. (1975). Organizational Legitimacy: Social Values and Organizational Behavior. *Pacific Sociological Journal Review*, *18*, 122-136.

Francis, B., Hasan, I., & Wu, Q. (2015). Professors in the Boardroom and Their Impact on Corporate Governance and Firm Performance. *Financial Management*, *44*(3), 547–581.

Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach*. Cambridge: Cambridge University Press.

Ghayad, R. (2008). Corporate Governance and the Global Performance of Islamic Banks. Humanomics, *24*(3), 207-216.

Gözübüyük, R., Kock, C. J., & Ünal, M. (2020). Who Appropriates Centrality Rents? The Role of Institutions in Regulating Social Networks in the Global Islamic Finance Industry. *Journal of International Business Studies*, *51*(5), 764–787. https://doi.org/10.1057/s41267-018-0202-4.

Grassa, R., & Matoussi, H. (2014). Corporate Governance of Islamic Banks. *International Journal of Islamic and Middle Eastern Finance and Management*, *7*(3), 346–362. https://doi.org/10.1108/imefm-01-2013-0001.

Grassa, R. (2015). Corporate Governance and Credit Rating in Islamic Banks: Does Shariah Governance Matters? *Journal of Management & Governance, 20*(4), 875–906. https://doi.org/10.1007/s10997-015-9322-4.

Grassa, R., El-Halaby, S., & Khlif, H. (2023). Shariah Board Characteristics and Islamic Banks' Performance: A Meta-Analysis. *International Journal of Islamic and Middle Eastern Finance and Management*, *16*(6), 1089–1106. https://doi.org/10.1108/imefm-10-2022-0392.

Gupta, K., & Raman, T. V. (2021). Intellectual Capital: A Determinant of Firms' Operational Efficiency. *South Asian Journal of Business Studies*, *10*(1), 49-69. https://doi.org/10.1108/SAJBS-11-2019-0207.

Hamza, H. (2013). Sharia Governance in Islamic Banks: Effectiveness and Supervision

Model. *International Journal of Islamic and Middle Eastern Finance and Management*, *6*(3), 226–237. https://doi.org/10.1108/IMEFM-02-2013-0021.

Hamza, H. (2016). Does Investment Deposit Return in Islamic Banks Reflect PLS Principle? *Borsa Istanbul Review*, *16*(1), 32–42. https://doi.org/10.1016/j.bir.2015.12.001.

IFSB. (2024). *Islamic Financial Services Industry Stability Report 2024*. Retrieved from: https://www.ifsb.org/wp-content/uploads/2024/09/IFSB-Stability-Report-2024-8.pdf.

Jabeen, M. & Kausar, S. (2022). Performance Comparison between Islamic and Conventional Stocks: Evidence from Pakistan's Equity Market. *ISRA International Journal of Islamic Finance,* 14(1), 59-72.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics, 3*(4), 305–360. https://doi.org/10.1016/0304-405x(76)90026-x.

Krause, R., Semadeni, M., & Cannella, A. A. (2014). CEO Duality: A Review and Research Agenda. *Journal of Management*, *40*(1), 256–286. https://doi.org/10.1177/0149206313503013.

Kusi, B.A., Gyeke-Dako, A., Agbloyor, E.K. & Darku, A.B. (2018). Does Corporate Governance Structures Promote Shareholders or Stakeholders Value Maximization? Evidence from African Banks. *Corporate Governance*, *18*(2), 270-288.

Manogna, R. L., & Mishra, A. K. (2021). Measuring Financial Performance of Indian Manufacturing Firms: Application of Decision Tree Algorithms. *Measuring Business Excellence*, *26*(3), 288–307. https://doi.org/10.1108/mbe-05-2020-0073.

Mefteh-Wali, S., & Rigobert, M. J. (2019). The Dual Nature of Foreign Currency Debt and Its Impact on Firm Performance: Evidence from French Non-Financial Firms. *Management International*, *23*(1), 68–77. https://doi.org/10.7202/1060063ar.

Miao, M., Khan, M. I., Ghauri, S. P., & Zaman, S. I. (2023). The Effect of Corporate Governance on Firm Performance: Perspectives from an Emerging Market. *Economic Research-Ekonomska Istraživanja*, *36*(3), 2277275. https://doi.org/10.1080/1331677X.2023.2277275.

Minaryanti, A. A., & Mihajat, M. I. S. (2023). A Systematic Literature Review on the Role of Sharia Governance in Improving Fnancial Performance in Sharia Banking. *Journal of Islamic Accounting and Business Research*, *15*(4), 553-568. https://doi.org/10.1108/JIABR-08-2022-0192.

Mollah, S., & Zaman, M. (2015). Shari'ah Supervision, Corporate Governance and Performance: Conventional vs. Islamic Banks. *Journal of Banking & Finance, 58*, 418–435. https://doi.org/10.1016/j.jbankfin.2015.04.030.

Mukhibad, H. (2019). The Role of Sharia Supervisory Boards in Meeting Maqasid Syariah – Study on Islamic banks in Indonesia. *European Journal of Islamic Finance, 13,* 1-10. https://doi.org/10.13135/2421-2172/3620.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

Musibah, A. S., & Alfattani, W. S. W. Y. (2014). The Mediating Effect of Financial Performance on the Relationship between Shariah Supervisory Board Effectiveness, Intellectual Capital and Corporate Social Responsibility of Islamic Banks in Gulf Cooperation Council Countries. *Asian Social Science, 10*(17), 139-164.

Nomran, N. M., Razali, H., & Hassan, R. (2018). Shari'a Supervisory Board Characteristics Effects on Islamic Banks' Performance: Evidence from Malaysia. *International Journal of Bank Marketing*, *36*(2), 290-304.

Ntim, C. G., Soobaroyen, T., & Broad, M. (2017). Governance Structures, Voluntary Disclosures and Public Accountability: The Case of UK Higher Education Institutions. *Accounting, Auditing and Accountability Journal*, *30*(1), 65-118.

Neumayer, E., & Plümper, T. (2017). *Robustness Tests for Quantitative Research*. Cambridged: Cambridge University Press.

Pang, J., Zhang, X., & Zhou, X. (2020). From Classroom to Boardroom: The Value of Academic Independent Directors in China. *Pacific-basin Finance Journal*, *62*, 101319. https://doi.org/10.1016/j.pacfin.2020.101319.

Pfeffer, J., & Salancik, G.R. (1978). *The External Control of Organizations: A Resource Dependence Perspective*. New York: Harper and Row.

Puspitasari, N. D., & Kasri, R. A. (2023). Shariah Board Governance and Sustainability Performance: Analysis of Sharia Banking in Indonesia. *Jurnal Ekonomi & Studi Pembangunan*, *24*(2), 458-478.

Rahman, A. S. A., & Haron, R. (2019). The Effect of Corporate Governance on Islamic Banking Performance: A Maqasid Shari'ah Index Approach on Indonesian Islamic Banks. *Journal of Islamic Finance*, *8*, 1-18.

Rahman, M. (2023). The Effect of Business Intelligence on Bank Operational Efficiency and Perceptions of Profitability. *FinTech, 2*, 99–119.

Romus, M., Anita, R., Abdillah, M. R., & Zakaria, N. B. (2020). Selected Firms Environmental Variables: Macroeconomic Variables, Performance and Dividend Policy Analysis. *IOP Conference Series. Earth and Environmental Science*, *469*(1), 012047. https://doi.org/10.1088/1755-1315/469/1/012047.

Sahoo, M., Srivastava, K. B., Gupta, N., Mittal, S. K., Bakhshi, P., & Agarwal, T. (2023). Board Meeting, Promoter CEO and Firm Performance: Evidence from India. *Cogent Economics & Finance*, *11*(1), 2175465. https://doi.org/10.1080/23322039.2023.2175465.

Susanti, Putra, R., & Bahtiar, M. D. (2023). Banking Performance Before and During the Covid-19 Pandemic: Perspectives from Indonesia. *Cogent Economics & Finance*, *11*(1), 2202965. https://doi.org/10.1080/23322039.2023.2202965.

Tashkandi, A. A. (2023). Shariah Supervision and Corporate Governance Effects on Islamic Banks' Performance: Evidence from the GCC Countries. *Journal of Business and Socio-Economic Development, 3*(3), 253-264. https://doi.org/10.1108/jbsed-02-2022-0024.

Tarkom, A., & Ujah, N. U. (2023). Inflation, Interest Rate, and Firm Efficiency: The Impact of Policy Uncertainty. *Journal of International Money and Finance*, *131*, 102799. https://doi.org/10.1016/j.jimonfin.2022.102799.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44740

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 247 - 264
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.44901

Examining the Model for Enhancing E-Loyalty in Digital Banks

Muhammad Ady Mahfuzh[1], Joko Setyono[2*], Alex Fahrur Riza[3]
[1]Gadjah Mada University, Indonesia
[2,3]State Islamic University of Sunan Kalijaga, Indonesia
E-mail: [1]muhammadadymahfuzh@mail.ugm.ac.id, [2]joko.setyono@uin-suka.ac.id, [3]alex.riza@uin-suka.ac.id
[*]**Corresponding author**

JEL Classification:
G21
M31
D91

Received: 14 February 2025

Revised: 04 March 2025

Accepted: 09 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: This research novelty lies in applying the Stimulus-Organism-Response (S-O-R) theory to measure e-loyalty among digital banking customers in Indonesia. This approach has not been widely explored in Indonesia's digital banks' context.

Research Objectives: This research evaluates e-loyalty among digital banks' customers in Indonesia using the SOR theory's direct and indirect measurement methodologies.

Research Methods: The sample consists of 130 participants drawn from customers of both Islamic and conventional digital banks in Indonesia. This research applies PLS-SEM through SmartPLS software for structural model analysis.

Empirical Result: The results show that e-CRM, e-trust, and e-satisfaction directly enhance e-loyalty. E-CRM and e-trust also influence e-loyalty indirectly through e-satisfaction. Moreover, e-satisfaction mediates these relationships, highlighting its crucial role in strengthening customer loyalty in Islamic and conventional digital banks.

Implications: Digital banks need to enhance e-CRM by improving application features and usability to maintain customer interaction. Additionally, e-trust is crucial to continuously strengthening security systems to reduce customer concerns. Moreover, services must consistently meet or even exceed customer expectations to achieve high satisfaction and foster customer loyalty.

Keywords:
digital banks; e-Loyalty; stimulus-organism-respons theory

How to Cite:
Mahfuzh, M. A., Setyono, J., & Riza., A. F. (2025). Examining the Model for Enhancing E-Loyalty in Digital Banks. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 247-264. https://doi.org/10.15408/sjie.v14i1.44901.

INTRODUCTION

Indonesia ranks as the fourth most populous country globally. According to the Central Statistics Agency (BPS), in 2022, the population of Indonesia reached 275 million people, while the Ministry of Communication and Information (Kominfo) reports that the number of internet users in the country has grown to 204.7 million. The widespread use of the Internet is driving a shift from traditional to digital transactions, leading many individuals to move their business activities to online platforms (Johan, 2021). Consequently, Indonesia holds significant potential for developing financial technology, particularly in the digital banking sector. The growth of Indonesia's digital financial sector has been remarkable with the COVID-19 pandemic, despite its widespread impact on all sectors, providing momentum for the expansion of digital banks.

Digital Banks are based on paragraph 1 number (22) PJOK No.12/POJK.03/2021, explaining that Digital Banks are Indonesian Legal Entity Banks (BHI) which primarily provide and carry out their business activities through electronic channels without a physical office other than the head office or use a limited physical office. Before the pandemic, from 2016 to 2019, there were only two digital banks, Jenius and Digibank. However, with the onset of the pandemic in 2020, several new digital banks emerged, including Bank Jago Sharia, Bank Aladin Sharia, Sea Bank, and Blu Bank. As a result, between 2020 and the fourth quarter of 2022, the number of digital bank customers surged rapidly, reaching 40 million.

This phenomenon should be appreciated because the average digital bank is a young industry; in less than two years, customers have touched 40 million, and active customers are more than 10 million. However, there is an anomaly phenomenon from the development of digital banks in Indonesia where there are only around 10 million monthly active customers, namely customers who have been active for the last three months or 25% of the total digital bank customers as a whole. This data indicates a notably low level of e-loyalty among digital bank customers in Indonesia.

E-loyalty is defined as an expression in the customer's attitude towards the bank, which leads to repeat transaction behavior (Huang, 2023). Loyalty is not only about involvement, but loyalty emerges from the psychological involvement of customers, starting from web pages that create attitudes and intentions to use effectively (Rezeki et al., 2023). To predict digital bank customer e-loyalty, researchers use the stimulus-organism-response (S-O-R) theory. S-O-R theory states that there is a relationship between stimulus and response through an organism; this states that a stimulus characterized by the environment impacts an organism, which, in the end, will impact specific responses (Mishra et al., 2022).

In this research, one of the antecedents of digital bank customer e-loyalty is e-CRM. E-CRM is proxied as a stimulus referring to marketing technology that stimulates consumers through internet services (Kumar et al., 2022; Mang'unyi et al., 2018; Suchitra & Merugu, 2024). Herman et al. (2021) explained that e-CRM could help increase and maintain customer loyalty for an extended period. In line with this explanation, the

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

findings of Mokha & Kumar (2022), Kumar and Mokha (2021), and Rashwan et al. (2019) state that there is a positive relationship between e-CRM and e-loyalty.

The second construct is e-trust. E-trust is proxied as a stimulus because customer trust directly impacts banks, such as bank credibility, bank integrity, bank virtue, and bank attitudes in the aspect of solving problems that occur with customers (Ashiq & Hussain, 2024). Customers are worried about privacy violations and potential loss of control over their personal information (Kalantari, 2017). Trust is essential in business-to-business and business-to-customer relationships (Kuska et al., 2024). Therefore, digital banks must be trusted by their customers. When customers trust the bank, they will continue to use its services and recommend them to others (Kuska et al., 2024; Qatawneh et al., 2024; Shankar & Jebarajakirthy, 2019). E-trust has a positive effect with e-loyalty, when trust increases, customer loyalty also increases (Almaiah et al., 2022; Dospinescu et al., 2019; Hayati et al., 2020; Jeon & Jeong, 2017; Kuska et al., 2024; Qatawneh et al., 2024; Shankar & Jebarajakirthy, 2019).

Furthermore, an additional variable utilized for assessing e-loyalty within the framework of this study is e-satisfaction, which is operationalized as the organism component in line with the Stimulus-Organism-Response (S-O-R) theoretical model. The attribution of e-satisfaction as an organism arises from its dual nature encompassing affective and cognitive dimensions, as posited by Mokha and Kumar (2022) and Kumar and Mokha (2021). The assertions of Tahir (2020), Mokha and Kumar (2022), Kumar and Mokha (2021), and Hayati et al. (2020) collectively highlight a robust and well-documented connection between customer satisfaction and loyalty. The propensity for elevated customer loyalty is notably observed when customers express contentment with the array of products and services proffered by the bank.

Inconsistency is seen in the ability of e-satisfaction to mediate e-CRM to e-loyalty, where in the studies of Kumar and Mokha (2021), Mokha and Kumar (2022), and Mulyono et al. (2018), e-satisfaction can mediate e-CRM towards e-loyalty but in the research of Rashwan et al. (2019) and Ismail and Hussin (2017) it cannot mediated. After that, the research of Gotama and Indarwati (2019) and Suariedewi (2020) found that e-satisfaction can act as a mediation between e-trust and e-loyalty, but in Dospinescu et al. (2019), Hayati et al. (2020), Jeon and Jeong (2017) it was rejected.

Despite extensive research on e-loyalty in digital banks, gaps remain in understanding the interplay between e-CRM, e-trust, and e-satisfaction within the S-O-R framework, particularly in Indonesia. Previous studies such as Kumar and Mokha (2021) and Mokha and Kumar (2022) show inconsistent findings on the mediating role of e-satisfaction, highlighting the need for further examination. Additionally, the impact of e-CRM and e-trust on e-loyalty is well-documented (Kumar et al., 2022; Kuska et al., 2024). limited research applies the S-O-R theory to capture the psychological mechanisms influencing customer behavior. This research addresses these gaps by integrating e-CRM, e-trust, and e-satisfaction into the S-O-R model, offering a more comprehensive understanding of e-loyalty dynamics in Indonesia's digital banking sector.

This research aims to analyze the direct impact of e-CRM and e-trust on e-loyalty among digital banking customers in Indonesia while also identifying the mediating role of e-satisfaction in the relationship between e-CRM, e-trust, and e-loyalty. By adopting the Stimulus-Organism-Response (S-O-R) theory, this research explores how e-CRM and e-trust function as stimuli that influence e-satisfaction as an organism, ultimately shaping e-loyalty as the final response. Furthermore, this study seeks to provide managerial implications for digital banks by offering strategic insights into optimizing e-CRM practices, fostering customer trust, and enhancing satisfaction to reinforce customer loyalty in the digital era.

The novelty of this research is that the application of the S-O-R theory in the context of e-loyalty in digital banks in Indonesia is still rarely found. By using e-CRM and e-trust as stimuli and e-satisfaction as the organism that mediates their relationship with e-loyalty, this study provides a more comprehensive approach to understanding digital banking customer behavior. This research provides a theoretical contribution by reinforcing the S-O-R theory in digital banks and expanding the literature on the role of e-CRM and e-trust in shaping e-loyalty, considering the mediating role of e-satisfaction. Practically, this research offers recommendations for digital banks to enhance e-CRM strategies, build customer trust through e-trust, and improve customer satisfaction to foster loyalty.

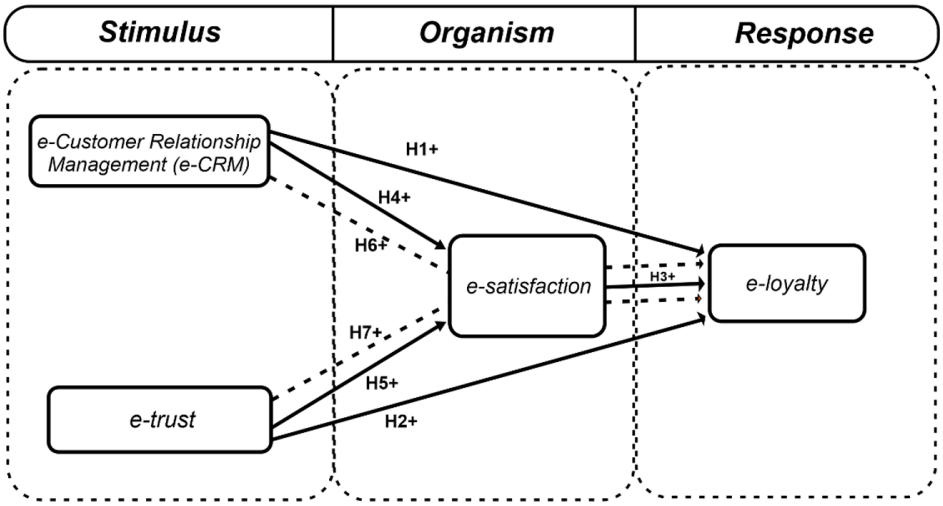
METHODS

The sampling technique employed for this study was a nonprobability approach, explicitly utilizing the purposive sampling method. The sample criteria in this research are based on several considerations. First, respondents must be customers of digital banks in Indonesia to ensure relevance to the research context. Second, they must have been digital bank customers for at least six (6) months, as this period allows them to develop sufficient experience and familiarity with the bank's services. Lastly, they must have conducted transactions more than twice, ensuring respondents have actively engaged with digital bank services rather than merely registering without regular usage. The sample size was established based on the guidelines outlined by Hair et al. (2022), which recommend a minimum of ten times the number of directed structural paths in the research model. Following this criterion, a minimum sample of 70 participants was determined. Accordingly, the researchers selected a sample of 130 respondents, exceeding the prescribed minimum threshold.

The analysis model in this study uses PLS-SEM with the help of the SmartPLS analysis tool and uses SPSS 23 for descriptive analysis. The researchers implemented a multi-stage data analysis process to achieve accurate and comprehensive results. This study used a quantitative method where the measurements used a Likert scale of 1-5 answer intervals. The variables in this study were taken by combining previous studies that measured e-CRM based on scale items from Kumar and Mokha (2021) and Mokha and Kumar (2022), then measured e-trust based on scale items from Ben Mansour (2016) to measure e-satisfaction based on scale items from Kumar and Mokha (2021) as well as to measure e-loyalty based on scale items from Kumar and Mokha (2021).

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

Figure 1. Model Development



This analytical procedure comprised two primary phases: the Outer Model assessment and the Inner Model evaluation (Hair et al., 2022). The initial phase involved assessing the measurement model (Outer Model) through validity and reliability tests. Validity was measured via convergent and discriminant validity analyses, while reliability was assessed using composite reliability metrics. In the second phase, structural evaluation of the model (Inner Model) was conducted, including tests for model fit and quality indices, R-squared (R^2), Q-squared (Q^2), f-squared (f^2), PLSpredict, and Robustness Check. Before hypothesis testing, a full collinearity variance inflation factor (VIF) test was performed to verify the absence of multicollinearity between constructs. Subsequently, hypothesis testing was conducted to determine the relationship between variable constructs. The researchers also analyzed mediation effects and identified the types of mediation established within the research.

In this framework, e-CRM and e-trust act as stimuli, while e-satisfaction is the intermediary organism. E-loyalty serves as both the response and the primary outcome under examination. Figure 1 shows the model development from this research.

RESULTS AND DISCUSSION

Based on Table 1, most digital bank customers in this study were women, comprising 89 respondents (68.5%), while men accounted for 41 respondents (31.5%). Thus, women represent the dominant demographic of digital bank users supporting their daily activities. Regarding age distribution, most users were between 20-30 years old, with 118 respondents (90.8%), followed by respondents under 20 years old with nine respondents (6.9%). The remaining respondents were aged 31-40 (2 respondents, 1.5%) and 41-50 years (1 respondent, 0.8%). These findings suggest significant growth potential for digital banks, particularly among the 20-30 age group and those under 20, representing highly productive age ranges, indicating a need for digital banks to continue providing services supporting daily activities.

Table 1. Operational Definition of Research Variables

Variables	Operation Definition	Indicator	Likert Scale	Previous Studies
E-Customer Relationship Management (E-CRM)	E-CRM refers to the utilization of digital communication technologies to enhance a company's relationships with existing customers, with the aim of increasing the usage of online services (Mokha & Kumar, 2022).	1. Digital Bank allows me to customize products or services according to my needs. 2. Customized products and services motivated me to use Digital Bank. 3. Alternative payment options are clearly stated at Digital Banks. 4. Digital Bank quickly resolved the problems I encountered when transaction. 5. Digital Bank provides the correct information when a problem occurs. 6. Online feedback feature is available on Digital Banks service channels. 7. Digital Bank has online customer service representatives. 8. Frequently asked questions (FAQ) feature helps me use Digital Banks products or services. 9. I always use the FAQ feature when browsing Digital Bank service channels. **Source:** Kumar & Mokha (2021); Mokha & Kumar (2022)	1-5	(Ismail & Hussin, 2017; Kumar & Mokha, 2021; Mokha & Kumar, 2022; Rashwan et al., 2019)
E-Trust	E-Trust is defined as the level of customer trust in direct exchanges and online exchange channels (Qatawneh et al., 2024).	1. Digital Bank's services are efficient. 2. Digital Bank will keep the promise that has been made. 3. Digital Bank's security features to protect its customers. 4. I feel safe placing personal information in Digital Banks. 5. Digital Banks has a service design that shows respect for its customers. 6. Digital Banks always pays attention to my best interests. 7. Digital Banks shows sympathy for the problems that befall its customers. 8. If there is a problem, it will be easy to make a claim. **Source:** Ben Mansour (2016)	1-5	(Kuska et al., 2024; Qatawneh et al., 2024)

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

Variables	Operation Definition	Indicator	Likert Scale	Previous Studies
E-Satisfaction	E-satisfaction refers to the level of customer satisfaction derived from their experience in utilizing digital services (Mang'unyi et al., 2018).	1. I am satisfied with my decision to become a customer at Digital Bank. 2. My decision to become a Digital Bank customer is wise. 3. Using Digital Bank is the right thing. 4. I feel happy to be a customer of Digital Bank. 5. I am satisfied with the security mechanism of Digital Bank. 6. I am satisfied with Bank Digital's services because it is easy to use. 7. I received more benefits than I expected. 8. Overall, I am satisfied with Digital Bank. **Source:** Kumar & Mokha (2021)	1-5	(Hayati et al., 2020; Kumar & Mokha, 2021; Mokha & Kumar, 2022)
E-Loyalty	E-loyalty is defined as an expression in the customer's attitude towards the bank which leads repeat transaction behaviour (Kuska et al., 2024).	1. I don't think about moving to another bank. 2. After receiving this service, I am hesitant to move to another bank. 3. I use Digital Bank whenever I need to. 4. Digital Bank is my first choice when I need to make a transaction. 5. I like using Digital Bank products and services. 6. For me, Digital Bank is the best bank. 7. Digital Bank is my favorite bank. 8. I recommend Bank Digital to the people closest to me. **Source:** Mokha & Kumar, (2022), Kumar & Mokha (2021)	1-5	Kumar & Mokha (2021), Mokha & Kumar (2022), Mulyono et al. (2018), Rashwan et al. (2019), and Ismail & Hussin (2017)

Most respondents had been digital bank customers for six months, totaling 48 respondents (36.9%). Among respondents who had been customers for more than six months, there were 38 respondents (29.2%), 27 respondents (20.8%) had been customers for more than one year, and 17 respondents (13.1%) had been customers for precisely one year. The highest number of respondents were customers of Sea Bank, with 35 respondents (26.9%), followed by 29 respondents (22.3%) using Jenius and 17 respondents (13.1%) using Allo Bank. Additionally, 14 respondents (10.8%) held accounts with two digital banks. Furthermore, 13 respondents (10%) were customers of Bank Jago Sharia, while

six respondents (4.6%) each used Bank Raya and Digibank. Customers of Aladin Sharia Bank numbered four respondents (3.1%), and three respondents (2.3%) were customers of Line Bank and BLU, respectively. Regarding transaction frequency, most respondents conducted digital banking transactions thrice daily, accounting for 52 respondents (40%). Another 44 respondents (33.8%) transacted ten times per month, and 34 (26.2%) made five weekly transactions.

Table 2. Respondent Demographics

	Characteristics	Quantity	Percentage
Gender	Male	41	31,5%
	Female	89	68,5%
Age	< 20 years old	9	6,9%
	20-30 years old	118	90,8%
	31-40 years old	2	1,5%
	41-50 years old	1	0,8%
	> 50 years old	0	0,0%
Length of Use	6 months	48	36,9%
	> 6 months	38	29,2%
	1 years	17	13,1%
	> 1 years	27	20,8%
Provider	Allo Bank	17	13,1%
	Bank Aladin Sharia	4	3,1%
	Bank Jago Sharia	13	10,0%
	Bank Raya	6	4,6%
	BLU Bank	3	2,3%
	Digibank	6	4,6%
	Jenius	29	22,3%
	Line bank	3	2,3%
	Have two Digital Bank accounts	14	10,8%
	Sea Bank	35	26,9%
Frequency of Use	10 times a month	44	33,8%
	3 times a daily	52	40,0%
	5 times a week	34	26,2%

Source: (Data processing)

Validity and reliability assessments were conducted to ensure the robustness of the measurement model. Convergent validity was evaluated using the loading factor, which is deemed valid when its value exceeds 0.5 (Hair et al., 2022). Further validity checks were performed through the Cronbach's alpha (α) value, where a threshold of α greater than 0.6 indicates adequate validity (Hair et al., 2022). Discriminant validity was confirmed if the square root of the Average Variance Extracted (AVE) exceeded 0.5, as specified by (Hair et al., 2022). Reliability was measured using composite reliability, which must exceed 0.7 to be considered reliable Based (Hair et al., 2022). On the results presented in Table 2, all variable items in this study are valid, as indicated by loading factor values

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

above 0.7(Hair et al., 2022). Than Heterotrait-Monotrait Ratio (HTMT) should ideally be no higher than 0.9 (Hair et al., 2022). The research variable is valid because all item no above than 0.9 (see Table 3).

Table 3. Outer Model Measurement

Code	Scale Item	Loading
e-CRM (AVE=0.677, CA=0.957, CR=0.962)		
EC1	Digital Bank allows me to customize products or services according to my needs.	0.678
EC2	Customized products and services motivated me to use Digital Bank.	0.644
EC3	Alternative payment options are clearly stated at Digital Bank.	0.631
EC4	The Digital Bank quickly resolved the problems I encountered when transaction.	0.741
EC5	The Digital Bank provides the correct information when a problem occurs	0.713
EC6	The online feedback feature is available on Bank Digital's service channels.	0.662
EC7	Digital Bank has online customer service representatives.	0.709
EC8	The frequently asked questions (FAQ) feature helps me use Bank Digital's products or services.	0.645
EC9	I always use the FAQ feature when browsing Digital Bank's service channels.	0.562
e-Trust (AVE=0.706, CA=0.940, CR=0.951)		
ET1	Bank Digital's services are efficient.	0.560
ET2	Bank Digital will keep the promise that has been made.	0.760
ET3	Bank Digital has security features to protect its customers.	0.597
ET4	I feel safe placing personal information in Digital Bank.	0.704
ET5	Digital Bank has a service design that shows respect for its customers.	0.596
ET6	The Bank always pays attention to my best interests.	0.707
ET7	The Bank shows sympathy for the problems that befall its customers.	0.681
ET8	If there is a problem, it will be easy to make a claim.	0.739
e-Satisfaction (AVE=0.584, CA=0.898, CR=0.918)		
ES1	I am satisfied with my decision to become a customer at Digital Bank.	0.763
ES2	My decision to become a Digital Bank customer is wise.	0.597
ES3	Using Digital Bank is the right thing.	0.701
ES4	I feel happy to be a customer of Digital Bank.	0.706
ES5	I am satisfied with the security mechanism of Digital Bank.	0.712
ES6	I am satisfied with Bank Digital's services because it is easy to use.	0.611
ES7	I received more benefits than I expected.	0.623
ES8	Overall, I am satisfied with Digital Bank.	0.746
e-Loyalty (AVE=0.637, CA=0.918, CR=0.933)		
EL1	I don't think about moving to another bank.	0.641
EL2	After receiving this service, I am hesitant to move to another bank.	0.614
EL3	I use Digital Bank whenever I need to.	0.558
EL4	Digital Bank is my first choice when I need to make a transaction.	0.740
EL5	I like using Digital Bank products and services.	0.703
EL6	For me, Digital Bank is the best bank.	0.817
EL7	Digital Bank is my favourite bank.	0.822
EL8	I recommend Bank Digital to the people closest to me.	0.761

Source: Data processing

Furthermore, Table 4 illustrates that the discriminant validity coefficients for all constructs surpass their correlations with other constructs. The diagonal elements in the table represent the square root of the respective AVE values, highlighting the relationships between each construct and its indicators. This result demonstrates that all developed items effectively capture the intended theoretical constructs. Moreover, composite reliability values exceeding 0.9 indicate that the study's instruments are reliable and consistent across measurements.

Table 4. HTMT Output

Construct	EC	EL	ES	ET
EC				
EL	0.780			
ES	0.800	0.866		
ET	0.864	0.845	0.880	

Source: Data processing

This study incorporated a comprehensive analysis of path coefficients for the hypothesized relationships, the computation of coefficients of determination (R^2) for the variables, and assessments of both effect size (f^2) and the Variance Inflation Factor (VIF). These evaluations were pivotal to the study's rigorous methodological framework (Hair et al., 2022). Then, examining the Variance Inflation Factor (VIF) remains one of the most robust methods for detecting multicollinearity among independent variables (Hair et al., 2022). The regression analysis revealed that the VIF values ranged between 2.096 and 2.732. In line with (Hair et al., 2022), these results indicate the absence of common method bias, as all VIF values remained below the threshold of 5. Moreover, (Hair et al., 2022) identify three critical thresholds for the F-square: 0.35 suggests a high effect size, 0.15 represents a moderate effect size, and 0.02 reflects a low effect size. The regression analysis in this study demonstrated that f^2 values ranged from 0.046 to 0.303, indicating varying effect sizes across the constructs under examination.

Table 5. Effect Size and Multicollinearity Output

Construct Relationship	f^2	VIF
EC -> EL	0.046	2.348
ET -> EL	0.072	2.732
ES -> EL	0.170	2.466
EC -> ES	0.120	2.096
ET -> ES	0.303	2.096

Source: Data processing

According to Hair et al. (2022), the R-Square criteria consist of three classifications: an R-Square value of 0.75 means strong, 0.50 means moderate, and 0.25 means weak (Poor). Based on this, the R Square of this study is included in the weak category. It

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

can be interpreted that the ability of the stimulus variable to influence the organism is 59.4% (moderate), and the ability of the stimulus variable and the organism in this study to influence the response is 62.3% (moderate). The suggested Q-squared value must be more significant than zero (> 0), which is further explained in Table 5. Therefore, the external latent variables in this study are relevant to the endogenous latent variables.

Table 6. R Square and Q^2 Output

Construct	R Square	R Square Adjusted	Q^2
EL	0.623	0.614	0.302
ES	0.594	0.588	0.266

Source: Data processing

A model is considered an excellent fit model if the SRMR value is less than 0.05, but if the model has an SRMR value below 0.10, the model can be fit (Hair et al., 2022). Furthermore, by looking at the NFI values, namely > 0.90 good fits, 0.80-0.90 marginal fit, and <0.80 poor fits. Based on Table 6, it can be seen that the NFI value of the model is categorized as a poor fit, and based on the SRMR value, which is 0.076 (below 0.10), this indicates that the model in this study is a fit.

Table 7. Model Fit Output

Model fit	Saturated Model	Estimated Model
SRMR	0.076	0.076
NFI	0.651	0.651

Source: Data processing

Table 7 presents the PLSpredict data. According to Hair et al. (2022), an endogenous variable (E-Loyalty and E-Satisfaction) with a PLS model with lower RMSE and MAE values compared to LM for all indicators indicates that the proposed PLS model possesses high predictive power. Therefore, it can be concluded that the PLS model in this study demonstrates a high predictive power level.

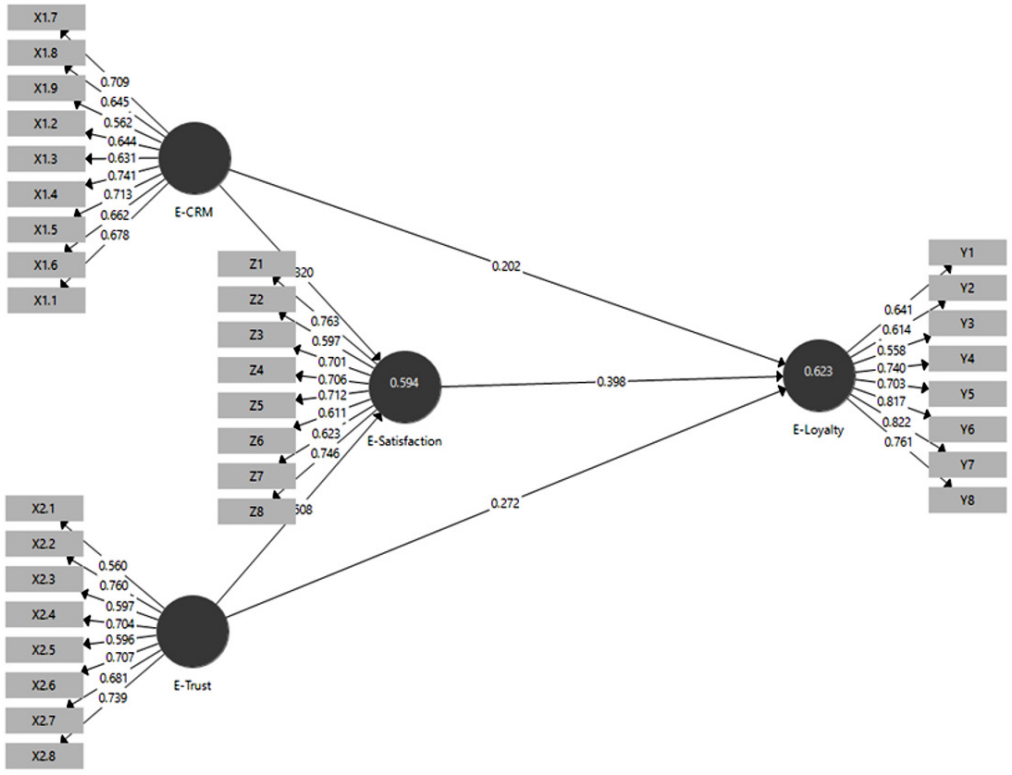
This research performed a robustness test by incorporating the non-linearity criterion, as suggested by Sarstedt et al. (2020). It acknowledged that the theoretical assumption of a linear relationship between constructs may not always be empirically valid. Statistically, when the association between two constructs is non-linear, the effect size is influenced by the magnitude of change in the exogenous construct and its specific values (Hair et al., 2022). The research utilized a polynomial model that included quadratic effects. However, the analysis revealed that none of the paths with quadratic effects were statistically significant, as shown in Table 8 and Figure 2. Thus, the findings suggest that the linear effects remain robust, as the non-linear relationships did not significantly influence the results (Sarstedt et al., 2020). This result indicates that the model in this research is considered robust and can be applied in future research.

Table 8. PLS Predict Output

Construct	PLS-SEM		Benchmark	
	RMSE	MAE	RMSE	MAE
EL1	0.742	0.594	0.768	0.613
EL2	0.775	0.597	0.865	0.670
EL3	0.523	0.448	0.552	0.442
EL4	0.618	0.489	0.711	0.552
EL5	0.537	0.428	0.573	0.453
EL6	0.633	0.499	0684	0.544
EL7	0.613	0.484	0.680	0.526
EL8	0.535	0.415	0.583	0.438
ES1	0.458	0.379	0.478	0.384
ES2	0.551	0.446	0.565	0.455
ES3	0.545	0.446	0.587	0.466
ES4	0.534	0.434	0.606	0.480
ES5	0.502	0.400	0.563	0.441
ES6	0.557	0.465	0.597	0.480
ES7	0.570	0.464	0.598	0.467
ES8	0.469	0.390	0.525	0.426

Source: Data processing

Figure 2. Full Model Output



http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

Table 9. Output of Quadratic Effect

Construct Relationship	β	p-value	f^2
EC -> EL	0.208	0.043	0.043
ET -> EL	0.221	0.009	0.039
ES -> EL	0.394	0.001	0.156
EC -> ES	0.348	0.001	0.129
ET -> ES	0.531	0.000	0.265
Quadratic Effect EC -> EL	-0.040	0.292	0.005
Quadratic Effect ET -> EL	-0.005	0.467	0.000
Quadratic Effect ES -> EL	-0.088	0.121	0.022
Quadratic Effect EC -> ES	0.092	0.101	0.027
Quadratic Effect ET -> ES	0.013	0.412	0.001

Source: Data processing

The significance and statistics influence the relationship between exogen and endogen variables. The rule of thumb is more than 1.65, 1.28, and 2.33 for one-tailed (hypothesis directional) (Hair et al., 2022). In this study, the researchers determined that the results of a significant influence would be obtained using one-tailed with a t-count > 1.65 (5% significance) and p-values less than 0.05. Based on the research results, e-CRM has a positive effect of 0.175. Furthermore, e-trust positively affects e-loyalty by 0.255. E-satisfaction on e-loyalty also has a positive effect of 0.284. The effect of e-CRM on e-loyalty is also positive at 0.324. The following hypothesis is that e-trust positively affects e-satisfaction of 0.338. Furthermore, the relationship between e-CRM and e-loyalty, mediated by e-satisfaction, was significantly positive, with a coefficient of 0.264. Similarly, the relationship between e-trust and e-loyalty, mediated by e-satisfaction, demonstrated a positive effect, with a coefficient of 0.351 (for details, see Tables 9 and 10).

Table 10. Hypothesis Testing Results

	Hypothesis	β	T-Statistics	P-Values	Results
H1	EC -> EL	0.175	1.719	0.043	Supported
H2	ET -> EL	0.255	2.620	0.004	Supported
H3	ES -> EL	0.284	2.464	0.007	Supported
H4	EC -> ES	0.324	2.929	0.002	Supported
H5	ET -> ES	0.338	2.802	0.002	Supported
H6	EC -> ES -> EL	0.264	2.061	0.020	Supported
H7	EC -> ES -> EL	0.351	3.012	0.001	Supported

Source: Data processing

Hair et al. (2022) suggest that partial mediation happens when an exogenous construct affects an endogenous construct in two ways: directly and indirectly through a mediator. As seen in Table 10, directly or indirectly, e-CRM and e-trust to e-loyalty are significant. Therefore, the type of mediation that is formed is partial mediation (Table 11).

The findings of this research underscore the paramount influence of e-satisfaction on digital bank customer e-loyalty. This phenomenon is primarily attributed to the notion that satisfied customers are more inclined to advocate for the banks' services, aligning with the assertions of Mulyono et al. (2018). The theoretical foundation of cognitive dissonance supports the argument that customer loyalty is integral to fostering satisfaction, as individuals may hold multiple bank accounts but exhibit loyalty to a single institution (Tahir, 2020). These results align with the findings of previous studies by Hayati et al. (2020), Kumar et al. (2022), and Kumar and Mokha (2021).

Moreover, the empirical evidence suggests that e-trust positively impacts digital bank customer e-loyalty. Theoretically, trust in service providers enhances customer satisfaction and loyalty (Jeon & Jeong, 2017; Tahir, 2020). Tahir (2020) further elucidates that when customers perceive a bank as credible and reliable, their service satisfaction increases, fostering long-term engagement. Customers exhibit loyalty through cooperative behaviors, reinforcing their trust in the institution (Kuska et al., 2024). To enhance customer trust, digital banks must fortify their credibility and integrity while demonstrating empathy when addressing customer concerns. This result aligns with the findings of Baabdullah et al. (2019) and Lestari and Saibil (2022).

Table 11. Type of Mediation

Hypothesis	Total Effects	Direct Effects	Indirect Effects	Type Mediation
EC -> ES -> EL	0.439	0.175 (p=0.043) (Significant)	0.264 (p=0.020) (Significant)	Partial Mediation
ET -> ES -> EL	0.606	0.255 (p=0.004) (Significant)	0.351 (p=0.001) (Significant)	Partial Mediation

Source: Data processing

Additionally, e-CRM is a pivotal determinant of digital bank customer e-loyalty. Theoretical perspectives emphasize that e-CRM is a strategic tool for acquiring new customers and retaining existing ones (Kumar et al., 2022; Mang'unyi et al., 2018; Suchitra & Merugu, 2024). Mokha and Kumar (2022) assert that e-CRM fosters long-term customer loyalty by facilitating sustained interactions between banks and customers. Investing in e-CRM enables digital banks to personalize services, enhance transactional security, and provide seamless payment alternatives, strengthening customer relationships (Mokha & Kumar, 2022). Furthermore, integrating social media for customer engagement and expanding FAQ services can improve customer experience, as supported by (Kumar et al., 2022; Suchitra & Merugu, 2024). These findings are consistent with previous research by Kumar et al. (2022), Kumar and Mokha (2021), Mang'unyi et al. (2018), and Mokha and Kumar (2022).

Furthermore, this research confirms that e-satisfaction is an essential mediating variable in bridging the relationship between e-CRM, e-trust, and e-loyalty in digital banking. As an intermediary factor, e-satisfaction transforms positive experiences from implementing e-CRM and e-trust into customer loyalty. Without satisfaction, even if customers positively perceive

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

e-CRM and e-trust, it does not necessarily lead to loyalty. E-satisfaction ensures that positive customer interactions with digital banks create strong emotional attachments and long-term preferences for the banking institution (Kumar & Mokha, 2021). Thus, although e-CRM and e-trust directly influence e-loyalty, their impact becomes more significant when mediated by e-satisfaction (Kumar & Mokha, 2021). Therefore, to increase customer loyalty, digital banks need to optimize their e-CRM strategies, build trust, and ensure that the services provided consistently meet or exceed customer expectations to create a level of satisfaction and make customers loyal. (Mokha & Kumar, 2022). These findings are aligned with Gotama and Indarwati (2019), Kumar and Mokha (2021), Mokha and Kumar (2022), Mulyono et al. (2018), and Suariedewi (2020).

CONCLUSION

This research confirms that e-CRM, e-trust, and e-satisfaction significantly influence e-loyalty among digital banking customers in Indonesia. Using the Stimulus-Organism-Response (S-O-R) theory, the findings highlight direct and indirect effects, where e-satisfaction mediates the relationship between e-CRM, e-trust, and e-loyalty. The research provides empirical evidence that improving digital customer relationship management and strengthening trust mechanisms are key drivers in enhancing customer loyalty, but also ensure that the services provided consistently meet, or even exceed, customer expectations to create the level of satisfaction and make a customer loyal.

To enhance digital banking e-loyalty, policymakers, particularly Bank Indonesia (BI) and the Financial Services Authority (OJK), should focus on regulatory frameworks that promote security, transparency, and service excellence. Strengthening consumer protection policies, enforcing strict cybersecurity measures, and ensuring fair digital banking practices will foster greater trust and satisfaction. Additionally, digital banks should invest in improving e-CRM strategies, optimizing user experience, and developing personalized engagement models to sustain long-term customer loyalty. Future research should explore comparative analyses between conventional and Islamic digital banks and examine additional variables such as e-service quality and customer experience to gain deeper insights into e-loyalty dynamics.

ACKNOWLEDGMENT

The author would like to sincerely thank The Fiscal Policy Agency of the Ministry of Finance and the Center for Islamic Economics and Business at the Faculty of Economics and Business, Universitas Indonesia, for organizing the 8th Annual Islamic Finance Conference (AIFC). This conference has provided valuable insights and constructive feedback that have significantly contributed to the improvement this article. The author also deeply appreciates the financial support provided for publication in this journal. Such support has been instrumental in facilitating the completion and dissemination of this research.

REFERENCES

Almaiah, M. A., Al-Rahmi, A., Alturise, F., Hassan, L., Lutfi, A., Alrawad, M., Alkhalaf, S., Al-Rahmi, W. M., Al-sharaieh, S., & Aldhyani, T. H. H. (2022). Investigating the Effect of Perceived Security, Perceived Trust, and Information Quality on Mobile Payment Usage through Near-Field Communication (NFC) in Saudi Arabia. *Electronics*, *11*(23), 1–22. https://doi.org/10.3390/electronics11233926.

Ashiq, R., & Hussain, A. (2024). Exploring the Effects of E-Service Quality and E-Trust on Consumers' E-Satisfaction and E-Loyalty: Insights from Online Shoppers in Pakistan. *Journal of Electronic Business & Digital Economics*, *3*(2), 117–141. https://doi.org/10.1108/jebde-09-2023-0019.

Baabdullah, A. M., Alalwan, A. A., Rana, N. P., Patil, P., & Dwivedi, Y. K. (2019). An Integrated Model for M-Banking Adoption in Saudi Arabia. *International Journal of Bank Marketing*, *37*(2), 452–478. https://doi.org/10.1108/IJBM-07-2018-0183.

Ben Mansour, K. (2016). An Analysis of Business' Acceptance of Internet Banking: An Integration of E-Trust to the TAM. *Journal of Business and Industrial Marketing*, *31*(8), 982–994. https://doi.org/10.1108/JBIM-10-2016-271.

Dospinescu, O., Anastasiei, B., & Dospinescu, N. (2019). Key Factors Determining the Expected Benefit of Customers When Using Bank Cards: An Analysis on Millennials and Generation Z in Romania. *Symmetry*, *11*(12), 1449. https://doi.org/10.3390/SYM11121449.

Gotama, F., & Indarwati, T. A. (2019). The Effects of E-Trust and E-Service Quality to E-Loyalty with E-Satisfaction as the Mediation Variable (The Study of Bebas Bayar Application User's in Indonesian). *Jurnal Minds: Manajemen Ide Dan Inspirasi*, *6*(2), 145-160. https://doi.org/10.24252/minds.v6i2.9503.

Hair, J. F., Hult, G. T., Ringle, C., & Sarstedt, M. (2022). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) Third Edition*. New York: SAGE.

Hayati, S., Suroso, A., Suliyanto, & Elfan Kaukab, M. (2020). Customer Satisfaction as a Mediation between Micro Banking Image, Customer Relationship and Customer Loyalty. *Management Science Letters*, *10*(11), 2561–2570. https://doi.org/10.5267/j.msl.2020.3.039.

Herman, L. E., Sulhaini, S., & Farida, N. (2021). Electronic Customer Relationship Management and Company Performance: Exploring the Product Innovativeness Development. *Journal of Relationship Marketing*, *20*(1), 1–19. https://doi.org/10.1080/15332667.2019.1688600.

Huang, T. (2023). Using SOR Framework to Explore the Driving Factors of Older Adults Smartphone Use Behavior. *Humanities and Social Sciences Communications*, *10*(1), 690. https://doi.org/10.1057/s41599-023-02221-9.

Ismail, N. A. B., & Hussin, H. B. (2017). The Effect of E-CRM Features on Customers Satisfaction for Airline E-ticket Services in Malaysia. *Proceedings - 6th International Conference on Information and Communication Technology for the Muslim World, ICT4M 2016*, 336–343. https://doi.org/10.1109/ICT4M.2016.67.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

Jeon, M. M., & Jeong, M. (2017). Customers' Perceived Website Service Quality and Its Effects on E-Loyalty. *International Journal of Contemporary Hospitality Management*, *29*(1), 438–457. https://doi.org/10.1108/IJCHM-02-2015-0054.

Johan, S. (2021). Peer-to-peer Lending's Customer Profile: Empirical Research on Indonesia's Financial Technology Market. *Southeast Asian Journal of Economics*, *9*(1), 103–120.

Kalantari, M. (2017). Consumers Adoption of Wearable Technologies: Literature Review, Synthesis, and Future Research Agenda. *International Journal of Technology Marketing*, *12*(1), 1. https://doi.org/10.1504/ijtmkt.2017.10008634.

Kumar, P., & Mokha, A. K. (2021). Electronic Customer Relationship Management (E-CRM) and Customer Loyalty: The Mediating Role of Customer Satisfaction in the Banking Industry. *International Journal of E-Business Research*, *18*(1), 1–22. https://doi.org/10.4018/IJEBR.293292

Kumar, P., Mokha, A. K., & Pattnaik, S. C. (2022). Electronic Customer Relationship Management (E-CRM), Customer Experience and Customer Satisfaction: Evidence from the Banking Industry. *Benchmarking*, *29*(2), 551–572. https://doi.org/10.1108/BIJ-10-2020-0528.

Kuska, D. A. R., Wijayanto, H., & Santoso, A. (2024). Improving The E-Satisfaction and E-Loyalty Based on E-Trust and E-Service Quality on Shopee Customer. *Journal of Consumer Sciences*, *9*(1), 22–39. https://doi.org/10.29244/jcs.9.1.22-39.

Lestari, H. B., & Saibil, D. I. (2022). Implication of Relationship Marketing on Loyalty With Brand Image As A Moderation Variable. *Al-Amwal: Jurnal Ekonomi dan Perbankan Ssyariah*, *14*, 183–196.

Mang'unyi, E. E., Khabala, O. T., & Govender, K. K. (2018). Bank Customer Loyalty and Satisfaction: the Influence of Virtual E-CRM. *African Journal of Economic and Management Studies*, *9*(2), 250–265. https://doi.org/10.1108/AJEMS-08-2017-0183.

Mishra, M. K., Kesharwani, A., Gautam, V., & Sinha, P. (2022). Stimulus-Organism-Response (S-O-R) Model Application in Examining the Effectiveness of Public Service Advertisements. *International Journal of Business*, *27*(2), 1–17. https://doi.org/10.55802/ijb.027(2).005.

Mokha, A. K., & Kumar, P. (2022). Examining the Interconnections Between E-CRM, Customer Experience, Customer Satisfaction and Customer Loyalty: A Mediation Approach. *Journal of Electronic Commerce in Organizations*, *20*(1), 1–21. https://doi.org/10.4018/JECO.292474

Mulyono, H., Helmi, S., & Situmorang, S. H. (2018). E-CRM and Loyalty: A Mediation Effect of Customer Experience and Satisfaction in Online Transportation of Indonesia. *Academic Journal of Economic Studies*, *4*(3), 96–105.

Qatawneh, N., Al-Okaily, M., Alkhasawneh, R., Althonayan, A., & Tarawneh, A. (2024). The Mediating Role of E-Trust and E-Satisfaction in the Relationship between E-Service Quality and E-Loyalty toward E-Government Services. *Global Knowledge, Memory and Communication, in-press*. https://doi.org/10.1108/GKMC-07-2023-0263.

Rashwan, H. H. M., M. Mansi, A. L., & Hassan, H. E. (2019). The Impact of the E-CRM (Expected Security and Convenience of Website Design) on E-Loyalty Field Study on Commercial Banks. *Journal of Business & Retail Management Research*, *14*(01), 106–122. https://doi.org/10.24052/jbrmr/v14is01/art-10.

Rezeki, M. R., Majid, M. S. A., & Kassim, S. H. (2023). The Effect of E-Service Quality on E-Loyalty of Islamic Banking customers: Does E-Satisfaction Act as Mediator? *Jurnal Ekonomi & Keuangan Islam*, *9*(2), 228–245. https://doi.org/10.20885/jeki.vol9.iss2.art6.

Sarstedt, M., Ringle, C. M., Cheah, J. H., Ting, H., Moisescu, O. I., & Radomir, L. (2020). Structural Model Robustness Checks in PLS-SEM. *Tourism Economics*, *26*(4), 531–554. https://doi.org/10.1177/1354816618823921.

Shankar, A., & Jebarajakirthy, C. (2019). The Influence of E-Banking Service Quality on Customer Loyalty: A Moderated Mediation Approach. *International Journal of Bank Marketing*, *37*(5), 1119–1142. https://doi.org/10.1108/IJBM-03-2018-0063.

Suariedewi, I. G. A. A. M. (2020). Effect of Mobile Service Quality to E-Trust to Develop E-Satisfaction and E-Loyalty Mobile Banking Services. *International Research Journal of Management, IT and Social Sciences*, *7*(1), 185–196. https://doi.org/10.21744/irjmis.v7n1.836.

Suchitra, M. S., & Merugu, P. (2024). The Role of E-CRM Systems in Strengthening Bank-Customer Relationships: Evidence from Visakhapatnam Banks. *Nanotechnology Perceptions*, *20*(S6), 669–675. https://doi.org/10.62441/nano-ntp.v20iS6.53.

Tahir, H. S. (2020). Antecedents of Customer Satisfaction in E-Service Transactions. *International Journal of Innovation, Creativity and Change*, *11*(2), 363–379.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.44901

Signifikan: Jurnal Ilmu Ekonomi
Volume 14(1), 2025: 265 - 278
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v14i1.45353

The Intention of Young Muslim Generation to Choose Muslim-Friendly Destinations in Indonesia

Nur Diana Dewi
Institut Daarul Qur'an Jakarta, Indonesia
E-mail: ndiana@idaqu.ac.id

JEL Classification:
M30
M31

Received: 15 February 2025

Revised: 25 March 2025

Accepted: 30 March 2025

Available online: April 2025

Published regularly: April 2025

ABSTRACT

Research Originality: Although much research has examined Muslim-friendly tourism, this research conducts a more comprehensive study of the intentions of the young Muslim generation to choose Muslim-friendly tourist destinations.

Research Objectives: The research objective is to analyze what factors influence the young Muslim generation's intention to choose Muslim-friendly tourist destinations in Indonesia.

Research Methods: The data analysis technique used a Structural Equation Model (SEM) with SmartPLS 3.0 software. Data was obtained by distributing questionnaires to 200 respondents.

Empirial Result: The results showed that the variables of subjective norms, behavioral control, and religiosity had a significant effect on the intentions of the young generation in choosing Muslim-friendly tourist destinations in Indonesia, while the attitude variable had no significant effect.

Implications: The results of this research imply that the government must create regulations that attract the young generation of Muslims to visit Muslim-friendly tourist destinations in Indonesia.

Keywords:

intention; young muslim generation; muslim-friendly tourism; religiousity

How to Cite:

Dewi, N. D. (2025). The Intention of Young Muslim Generation to Choose Muslim-Friendly Destinations in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *14*(1), 265-278. https://doi.org/10.15408/sjie.v14i1.45353.

INTRODUCTION

In today's era, a new trend has emerged in the world of tourism, namely halal tourism, which is in great demand by Muslim tourists around the world, so that many Muslim-majority countries, even non-Muslim-majority countries, are ready to provide Muslim-friendly tourism products and facilities to attract the Muslim tourist market (Ratnasari et al., 2020). One of the fastest-growing sectors in the global tourism industry is halal tourism (Ainin et al., 2020; Moshin et al., 2020). Aminuddin and Jamal (2020) state a similarity between Muhammads' travel chronicle during premodern times and the types of tourism of contemporary standing.

According to DSN-MUI Fatwa Number 108 of 2016 concerning Guidelines for Organizing Tourism Based on Sharia Principles, halal tourism is tourism whose implementation process is by Sharia principles. The Global Islamic Economy Report reports that the turnover of money from world halal tourism is projected to increase from 177 billion US dollars in 2017 to 274 billion dollars in 2023. This condition makes countries with a Muslim majority population and countries with a non-Muslim majority population enthusiastic about developing halal tourism in their countries, including Indonesia.

The development of Indonesia's halal tourism potential began with a victory in the "The World Halal Travel Summit & Exhibition 2015" event, where Indonesia managed to win three awards at once, namely World Best Family Friendly Hotel, World Best Halal Honeymoon Destination, and World Best Halal Tourism Destination. The Global Muslim Travel Index (GMTI) 2023 ranked Indonesia as the world's top halal tourism destination. This accomplishment surpasses 140 other countries, including those with Muslim minority populations, such as Singapore, Thailand, and the Philippines. According to data from KNEKS, several countries have begun capitalizing on the potential of the Muslim travel market, including Muslim-minority nations like Japan, Thailand, South Korea, Spain, China, Russia, and Mexico. Consequently, developing Muslim-friendly tourism in regions with Muslim minority populations—such as North Sulawesi, which is the focus of this study—is an important agenda in advancing Muslim-friendly tourism destinations in Indonesia.

According to Battour and Ismail (2016), the success of developing halal tourism destinations must be guided by adopting Islamic principles in all tourism activities. Muslim-friendly destinations refer to travel locations that provide services and facilities aligned with Islamic principles, such as halal food, prayer facilities, gender-segregated amenities, and modest entertainment options (Battour & Ismail, 2016). This concept is based on Islamic principles distinguishing between halal (permissible) and haram (prohibited), which influence multiple aspects of Muslim life, such as food, clothing, behavior, and social interactions. Muslim travelers often prioritize access to halal food at their destinations (Akyol & Kilinc, 2014). A key challenge in halal tourism is ensuring compliance with halal standards (Boğan & Sarıışık, 2019).

In the tourism industry, halal refers to activities, products, and services that align with Islamic law and ethical guidelines, ensuring they are permissible and free from

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

prohibited elements. This action includes adhering to Islamic dietary laws in food sourcing and preparation and offering environments conducive to prayer, modesty, and family-friendly experiences. Proper management of Muslim-friendly features by tourism authorities can enhance visitor engagement and satisfaction (Abror et al., 2021). These destinations offer religiously appropriate services and promote an inclusive and culturally respectful environment. The increasing demand for such destinations is closely linked to the growing awareness among Muslim travelers about their faith-based requirements while traveling abroad.

As a Muslim-majority country with numerous tourist attractions and destinations, Indonesia should strategically prepare and maximize the benefits of this advantage. Muslim travelers may find visiting a Muslim-majority country more appealing than a non-Muslim one, provided they receive the same level of hospitality (Abror et al., 2019). However, some tourists, especially non-Muslim tourists, have a negative perception of halal tourism. Non-Muslim tourists consider halal tourism rules to restrict their freedom to enjoy the tourist destination (Battour et al., 2018).

According to Battour et al. (2022), Muslim-friendly terms could be more suitable in halal tourism when non-Muslim destinations try to promote themselves as Muslim-friendliness. Before someone travels to a halal tourist destination, it is generally based on the intention to carry out the behavior. Adel et al. (2021) and Adham et al. (2025) state some remarkable results regarding the importance of some halal marketing strategies such as halal searchability and availability, halal certification and appraisal, halal at airports and halal hotels that affect Muslim tourists to travel in tourism-destination. Battour et al. (2018) suggest that countries with strong Islamic norms and values can promote as travel destinations to non-Muslim tourists interested in Islamic culture and halal hospitality.

Cupian et al. (2021) stated that knowledge, motivation to travel, accommodation, and ease of obtaining halal food and drinks have a significant influence, while WOM factors, destination image, and facilities do not have a significant influence on the intention of millennial Muslim tourists to travel halal in West Sumatra. This study differs from Cupian et al. (2021) in terms of grand theory because this study uses the Theory of Planned Behavior.

The main difference between this research and previous research is the respondents' use. This research focuses on the young generation of Muslims who will travel to Muslim-friendly destinations. Young Muslim tourists represent a particularly influential segment among the various demographic groups within the Muslim tourism market. Often characterized as digital natives with higher levels of education and global exposure, young Muslim travelers are more adventurous yet remain conscious of their religious identity. A unique interplay of religious commitment, social influences, lifestyle aspirations, and exposure to global trends via digital platforms shapes their travel behavior.

Understanding the intention of young Muslim tourists to visit Muslim-friendly destinations is vital for tourism marketers, destination managers, and policymakers aiming to attract and accommodate this growing segment. Despite the growing academic interest

in Muslim tourism, research focusing specifically on young Muslim travelers remains limited. Most existing studies tend to generalize Muslim tourists as a monolithic group, overlooking generational and behavioral diversity. Moreover, there is a lack of empirical studies examining the behavioral intentions of young Muslims using comprehensive theoretical frameworks. This gap necessitates a deeper investigation into the factors influencing their travel intentions in contemporary global tourism.

This study aims to fill that gap by analyzing the intention of young Muslim tourists to visit Muslim-friendly destinations. The findings are expected to provide practical implications for tourism providers and policy planners seeking to develop inclusive, sustainable, and faith-conscious travel experiences. This study aims to analyze what factors influence the intention of the young Muslim generation to choose Muslim-friendly tourist destinations. It is expected that this research will contribute to the development of Muslim-friendly tourism in Indonesia.

METHODS

This study will use the theory of planned behavior framework developed by Fishbein and Ajzen (1975) to analyze the intentions of the young Muslim generation to travel to Muslim-friendly destinations. Ajzen (1991) defines intention as the subjective probability that a person has to perform a behavior. Intention will remain a behavioral tendency until, at the right time, an effort is made to change the intention into a behavior. The Theory of Planned Behavior intention has three aspects: Attitude Toward Behavior, Subjective Norms, Indirect Perceived Behavioral Control, and Direct Perceived Behavioral Control (Fishbein & Ajzen, 1975). Intention is influenced by three things, namely, attitude, subjective norms, and behavioral control (Asadifard et al., 2015).

The dependent variables in this study consist of attitudes (X1), subjective norms (X2), behavioral control (X3), and religiosity (X4). The independent variable is the intention of young Muslim tourists to choose halal tourist destinations (Y). This study uses primary data in the form of a questionnaire of 200 respondents. Sampling in this study used a non-probability sampling technique with a purposive sampling method where the researcher has determined the sample criteria. There are three main criteria for respondents: being Muslim, aged between 20 - 40 years, and having an independent income.

This quantitative study uses the Structural Equation Model (SEM) data analysis technique with the SMART-PLS 3.0 tool. According to Panca et al. (2017), there are 4 (four) stages of SEM-PLS analysis, namely: formulating structural model theory, outer model analysis, inner model analysis, and hypothesis testing.

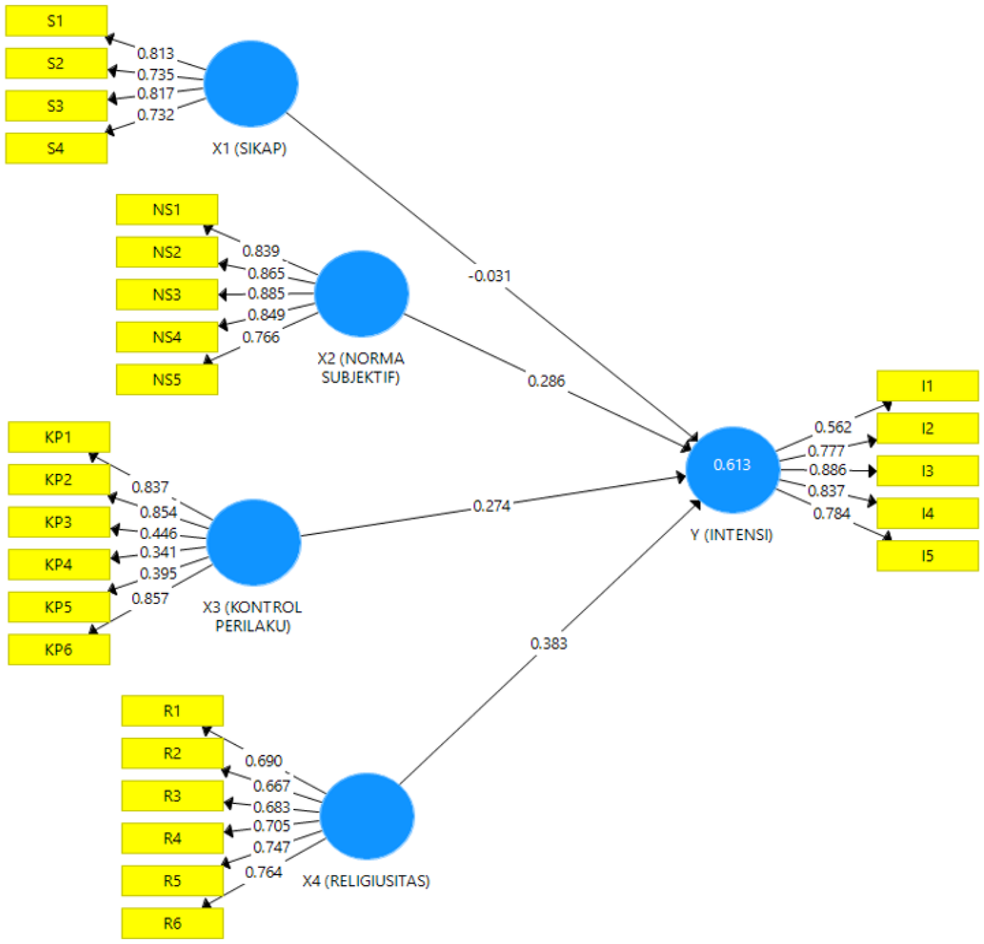
RESULTS AND DISCUSSION

The convergent validity value can be seen from the correlation between item or indicator scores and constructs. An indicator is valid if it has a correlation value above 0.70, but the loading factor value of 0.5 - 0.6 is still acceptable in the research stage

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

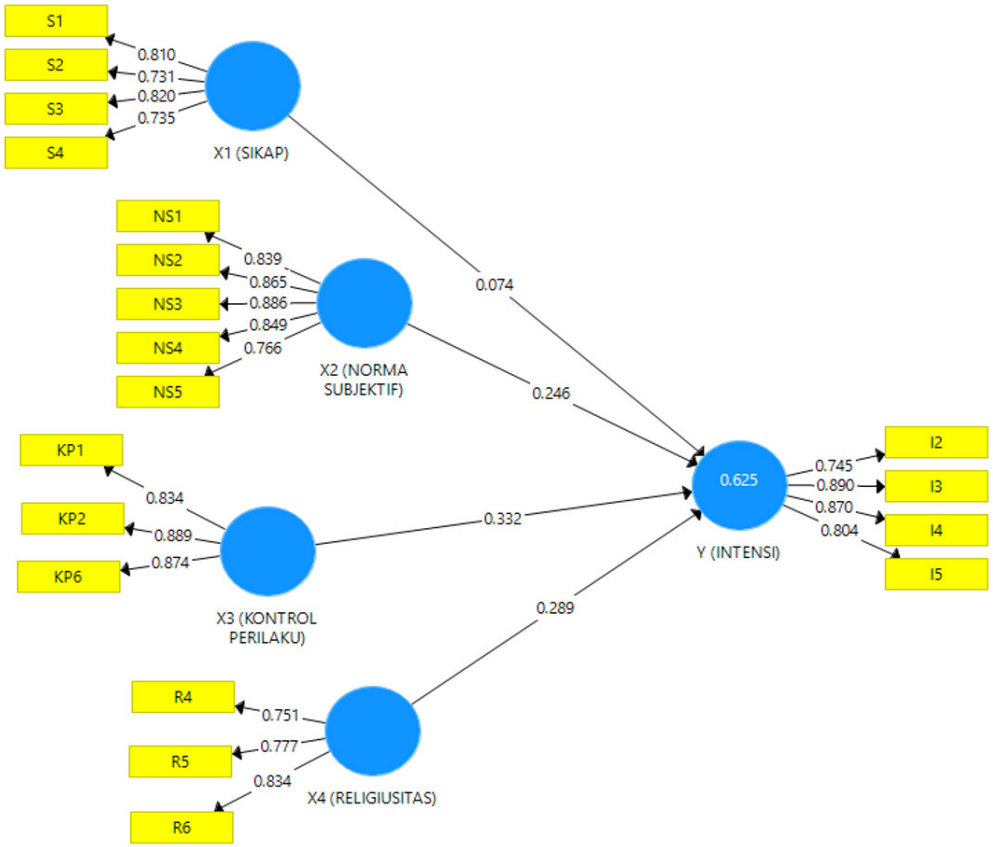
of developing the scale. If seen in Figure 1, it can be seen that in the latent variable of intention, there is one indicator (manifest variable) that must be removed from the model because the loading factor value does not meet the standard, namely more than 0.7, namely in indicator I1 which is worth 0.562. Then, in the latent variable of religiosity, three manifest variables must be removed from the model, namely in the R1 indicator, which is worth 0.690, then R2, which is worth 0.667, and finally, R3, which is worth 0.683. Furthermore, in the latent variable of behavioral control, 3 manifest variables are removed from the model, namely KP3, which is worth 0.446, KP4, which is worth 0.341, and KP5, which is worth 0.395.

Figure 1. Outer Model Algorithm (First)



Because there are several manifest variables that are removed from the first model, a second model will be created in which all manifest variables are considered to have passed the convergent validity test or have a loading factor value of more than 0.7 (see Figure 2).

Figure 2. Outer Model Algorithm (Second)



Another way to test discriminant validity is with the AVE value. If the AVE value of each construct is more than 0.5, it is said to have passed the discriminant validity test. Based on Table 1, we can see that all variables in this study have AVE values of more than 0.5. Therefore, it can be concluded that all variables in this study pass the Average Variance Extracted (AVE) test.

Reliability tests can be known by looking at the composite reliability number. A construct is reliable if it has a composite reliability number of more than 0.6. In addition to looking at the composite reliability number, it is necessary to analyze Cronbach's alpha number. A construct is reliable if it has a Cronbach's alpha above 0.7. Based on Table 2, it can be seen that the Cronbach's alpha value and composite reliability value of all variables have met the requirements. It can be concluded that all variables in this study passed the reliability test.

Table 1. The Result Test of AVE

Variable	AVE
X1 (Attitude)	0.601
X2 (Subjective Norm)	0.709
X3 (Behavior Control)	0.750
X4 (Religiosity)	0.621
Y (Intention)	0.688

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

The Q2 value can know the goodness of fit in PLS. The Q2 value has the same meaning as the coefficient of determination (R-Square) in regression analysis (P Panca et al., 2017). The results of the R-square test can be seen in Table 3. Based on table 3 shows that the R Square value for variable Y (intention) is 0.625, or the percentage level is 62.5%. This result means that variables X1 (attitude), X2 (subjective norms), X3 (behavioral control), and X4 (religiosity) influence variable Y (intention) by 62.5%, and other variables influence the remaining 37.5%.

Table 2. Reliability and Validity Constructs

Variables	Cronbanch's Alpha	Composite Reliability
X1 (Attitude)	0.779	0.857
X2 (Subjective Norm)	0.896	0.924
X3 (Behavior Control)	0.834	0.900
X4 (Religiosity)	0.702	0.831
Y (Intention)	0.848	0.898

The bootstrapping stage determines the level of significance in the structural model. Bootstrapping is a procedure or statistical technique of resampling. Resampling means that respondents are drawn randomly, with replacement, from the original sample many times until observations are obtained.

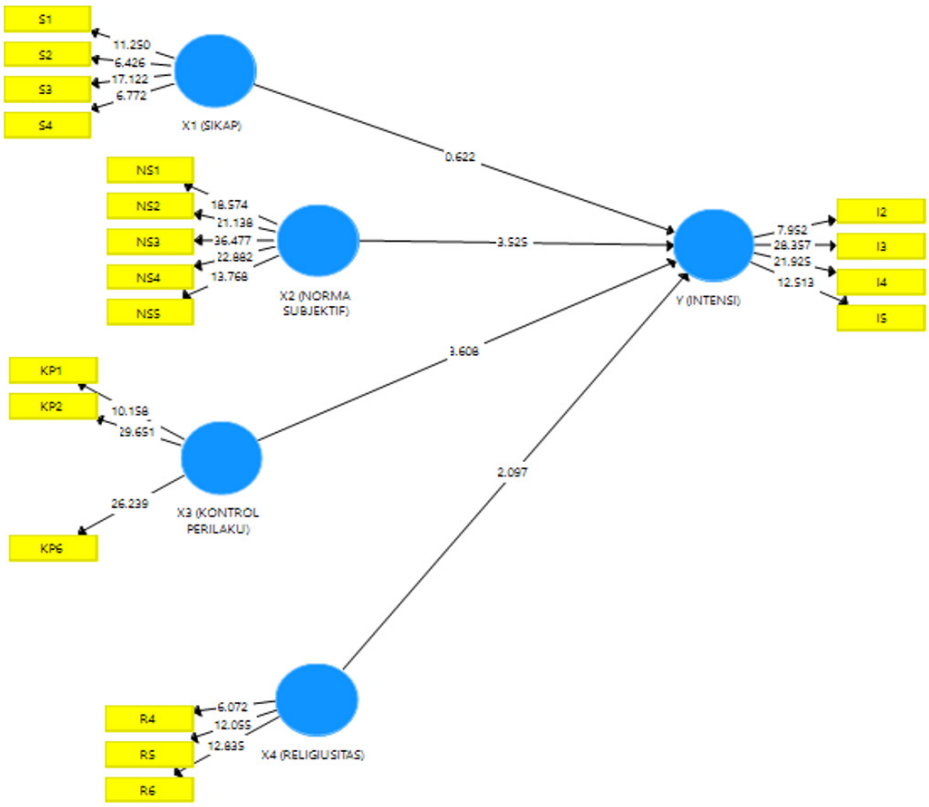
Table 4. The Result of R-Square

Variable	R Square
Y (Intention)	0.625

Based on Figure 3, it can also be seen that all paths have met the significant figures at CI 95% > (1.96). Hypothesis testing in this study was carried out by looking at the t-Statistics and P-Values. The hypothesis is accepted if the t-statistics value is > 1.96 and P-Values < 0.05. Based on Table 5, we can see that out of 4 variables, there is 1 (one) variable whose hypothesis is rejected, namely X1 (attitude) because the t-Statistics value is <1.96 and P-Values> 0.05. The hypothesis is accepted for the other three variables, namely variables X2 (subjective norms), X3 (behavioral control), and X4 (religiosity).

The attitude variable does not have a significant effect on travel intention. This study aligns with Akter and Hasan (2023), who state that attitude does not influence the intention to visit. However, this result differs from Abidin et al. (2022), who found that attitude positively relates to visit intention. In tourism, attitude refers to an individual's positive or negative evaluation of visiting a particular destination. For young Muslim tourists, this evaluation often includes considerations such as the availability of halal services, prayer facilities, safety, and cultural sensitivity. A positive attitude toward a Muslim-friendly destination that supports Islamic values and lifestyle significantly enhances the likelihood that the individual will intend to visit such a location (Han & Hyun, 2017).

Figure 3. Bootstrapping Inner Model



The role of attitude in shaping travel intention is particularly relevant for Muslim travelers because leisure motivations and faith-based considerations often influence their decision-making. Research shows that when tourists perceive a destination aligning with their personal and religious values, they develop a favorable attitude toward that destination, strengthening their travel intention (Battour et al., 2018). This relationship is especially pronounced among younger generations, who, despite being globally connected and open to new experiences, still prioritize destinations that do not compromise their religious identity (Suhartanto et al., 2020).

Table 5. Path Coefficients.

Variables	Original Sampel	t-statistics	P Value	Note
X1 (Attitude)	0.074	0.622	0.534	Rejected
X2 (Subjective Norm)	0.246	3.525	0.000	Accepted
X3 (Behavior Control)	0.332	3.608	0.000	Accepted
X4 (Religiosity)	0.289	2.097	0.037	Accepted

Moreover, empirical studies have consistently validated the significance of attitude in predicting Muslim tourists' intentions. Muslim tourists with positive perceptions of a destination's Muslim-friendly attributes were likelier to express a firm intention to visit (Mohsin et al., 2016; 2020). These findings suggest that building and promoting

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

a favorable destination image—especially one that emphasizes Islamic hospitality, halal food, and cultural inclusiveness—can enhance tourists' attitudes and, consequently, their intentions. Therefore, for destination marketers aiming to attract young Muslim tourists, fostering positive attitudes through tailored messaging, halal branding, and value-aligned experiences is essential.

The subjective norm variable significantly affects travel intention. Subjective norm reflects the influence of significant others—such as family, friends, religious leaders, and peer groups—on an individual's decision to visit a particular destination. For young Muslim tourists, travel decisions are often made not in isolation but within a social and cultural framework where religious guidance and communal expectations shape individual preferences. When important referents support or endorse Muslim-friendly travel, individuals are more likely to form a strong intention to visit such destinations.

In Muslim societies, where collectivist values are often dominant, subjective norms can particularly strongly affect behavioral intentions (Musa et al., 2012). For instance, when family members or peers perceive Muslim-friendly destinations as appropriate, safe, and in line with Islamic values, young Muslims are more likely to feel encouraged and supported to choose those destinations. This dynamic is further amplified by the role of social media influencers, halal travel communities, and Islamic scholars, who shape the discourse around acceptable and desirable travel practices. The collective approval reinforces a sense of religious compliance and social belonging, increasing the intention to travel to Muslim-friendly locations.

Empirical studies have affirmed the significance of subjective norms in influencing Muslim tourists' travel intentions. Battour et al. (2014) found that subjective norm was a significant predictor of intention among Muslim tourists, particularly in choosing destinations accommodating Islamic needs. Similarly, a study by Jalilvand et al. (2012) highlighted that social influence is critical in forming positive travel intentions in religious tourism contexts. These findings suggest that tourism marketers and destination managers aiming to attract young Muslim travelers should leverage community-based endorsements, testimonials from respected figures, and culturally appropriate promotions to strengthen the positive social influence associated with Muslim-friendly travel. This study is also in line with Jehane (2019), who concluded that, in general, it can be said that attitudes, subjective norms, and behavioral control positively influence the intention to visit a tourist attraction. In contrast, Akter and Hasan (2023) found that subjective norms do not affect halal tourism intention.

The behavioral control variable has a significant influence on the intention to travel. Perceived behavioral control (PBC) is another key construct within the theory of planned behavior (TPB), referring to an individual's perception of the ease or difficulty of performing a particular behavior based on past experiences and anticipated obstacles. In the context of Muslim-friendly tourism, PBC relates to how much control a traveler believes they have over chosen and visiting a destination that accommodates Islamic principles—such as the availability of halal food, prayer spaces, modest dress norms, and Islamic-friendly accommodations. When young Muslim tourists perceive that they can

easily access such facilities, they are more likely to develop a stronger intention to visit these destinations.

For Muslim travelers, if a destination is perceived as safe, easy to reach, and supportive of Islamic values, it reduces psychological and logistical barriers, thus increasing travel intention. For example, destinations that offer clear information about halal certifications, prayer facilities, and separate recreational areas for men and women help reduce uncertainties and empower Muslim tourists to make decisions confidently (Battour et al., 2017). Conversely, perceived difficulties—such as language barriers, limited halal options, or cultural insensitivity—can lower one's perceived control and subsequently weaken the intention to travel to such places.

Empirical evidence supports the notion that PBC is a significant predictor of travel intentions among Muslim tourists. A study by Eid and El-Gohary (2015) demonstrated that perceived behavioral control strongly impacted Muslim tourists' intentions to visit Islamic tourism destinations. Similarly, research by Rianawati and Febryano (2020) found that the more confident Muslim travelers could find Muslim-friendly facilities and services, the more likely they were to plan a visit. These findings suggest that tourism stakeholders should prioritize accessibility, clear communication, and infrastructure tailored to Muslim needs to enhance PBC and foster higher travel intentions among this growing segment. The results of this study are also in line with the research of Anggriana et al. (2022), which resulted in the behavioral control variable having a reasonably sizeable positive effect on the intention to visit a tourism destination. Akter and Hasan (2023) also found that perceived behavior control affects halal tourism intention.

The religiosity variable has a significant influence on travel intention. Religion has long been the most influential motivational factor when someone travels, considering that tourism and hospitality are industries that include socio-cultural elements—a condition within an individual that encourages him to behave according to his obedience to religion. Religiosity plays a central role in shaping the travel intentions of young Muslims. It affects their destination choices and their expectations regarding travel services and facilities (Liat et al., 2021). Studies have shown that travelers with high levels of religiosity are more likely to prioritize destinations that align with their Islamic beliefs (Battour et al., 2018). However, religiosity is not a homogenous concept and varies significantly across individuals and cultural contexts, especially among youth.

This result aligns with the research of Abror et al. (2021) that found religiosity as a significant antecedent of Muslim-friendly tourism. The same result was also found by Abror et al. (2023), highlighting the moderating roles of Islamic religiosity. Aji et al. (2021) state that religiosity affects the perceived risk of Muslim tourism when visiting the destination. Religiosity influences a person's purchase intention for a product; the stronger a person's commitment to the teachings of the religion he adheres to, the stronger his purchase intention is for products that do not conflict with the teachings of his religion. Tourism destination management should improve the facilities that can accommodate the needs of Muslim tourists. According to Battour and Ismail (2016), Shariah-compliant

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

hotels are still limited, especially in non-Muslim destinations. According to Boğan and Sarıışık (2019), one of the practical challenges in halal tourism is having a lack of halal standards, especially for hotels.

Stakeholders must also consider the socio-demographic characteristics of tourists. Aziz et al. (2018) found that differences in socio-demographic characteristics affect motivation and intention to travel. Government and destination management should increase the engagement of tourists because customer engagement will increase tourist satisfaction (Abror et al., 2019) because tourist engagement will increase tourist loyalty (Djatola et al., 2025). Tourist destination management should create tourist attractions to increase the number of visitors (Sasanti et al., 2025).

In addition, the influence of social media and online platforms cannot be overstated in this context. Young travelers rely heavily on digital content, peer reviews, and influencers to shape their perceptions and decisions. Muslim travel bloggers, halal travel communities, and user-generated content have become powerful tools in shaping destination awareness and trust. The digital sphere also amplifies the visibility of Muslim-friendly destinations and facilitates the exchange of experiences among like-minded travelers. The halal travel industry can use digital platforms to increase the experience of the entire Muslim community, especially Gen Alpha travelers (Battour et al., 2022). Berakon et al. (2023) state that the increasing number of tourists in the Muslim world encourages digital business developers to integrate halal services, including Muslim-friendly tourism, with the technologies. The management of Muslim-friendly destinations can use AI to improve the Muslim-friendly tourism experience (Battour et al., 2023).

CONCLUSION

Empirical findings show that based on subjective norms, behavioral control, and religiosity have a positive influence on the intention of young Muslim generations in choosing Muslim-friendly tourist destinations. While the attitude variable does not have a significant influence on the intention of young Muslim generations in choosing halal tourism destinations. The variable that has the greatest influence is the behavioral control variable. Based on these results, managers of Muslim-friendly tourist destinations must develop facilities and attractions that can attract more Muslim tourists to visit.

Suggestions for related parties in the management and development of Muslim-friendly tourism to pay attention to indicators that can influence tourist intentions in choosing halal tourist destinations that have been analyzed in this study. The government needs to improve the quality of service at every Muslim-friendly tourist destination in Indonesia.

REFERENCES

Abror, A., Wardi, Y., Trinanda, O., & Patrisia, D. (2019). The Impact of Halal Tourism, Customer Engagement on Satisfaction: Moderating Effect of Religiosity. *Asia Pacific Journal of Tourism Research, 24*(7), 633-643.

Abror, A., Patrisia, D., Trinanda, O., Omar, M. W., & Wardi, Y. (2021). Antecedents of Word of Mouth in Muslim Friendly Tourism Marketing: The Role of Religiosity. *Journal of Islamic Marketing, 12*(4), 882-899. https://doi.org/10.1108/JMA-01-2020-0006.

Abror, A., Patrisia, D., Engriani, Y., Wardi, Y., Hamid, R. S., Najib, M., Anuar, M. M., Battour, M., & Ratnasari, R. T. (2023). Antecedents of Muslim Tourist Loyalty: The Role of Islamic Religiosity and Tourist Value Co-Creation. *Cogent Business & Management, 10*(2), 2247871. https://doi.org/10.1080/23311975.2023.2247871.

Abidin, Z., Handayani, W., Zaky, E. A., & Faturrahman, A. D. (2022). Perceived Risk and Attituded Mediating Role Between Tourism Knowledge and Visit Intention During the Covid-19 Pandemic: Implementattion for Coastal-Ecotourism Management. *Heliyon, 8*, e10724. https://doi.org/10.1016/j.heliyon.2022.e10724.

Adel, A. M., Dai, X., Roshdy, R. S., & Yan, C. (2021). Muslims' Travel Decision-Making to Non-Islamic Destinations: Perspective from Information-Seeking Models and Theory of Planned Behavior. *Journal of Islamic Marketing, 12*(4), 918-940.

Adham, K. A., Nasir, N. M., Sinaau, A., Shaznie, A., & Munawar, A. (2025). Halal Tourism on an Island Destination: Muslim Travellers' Experiences in the Local Islands of the Maldives. *Journal of Islamic Marketing, 16*(1) 236-257.

Ainin, S., Feizollah, A., Anuar, N. B., & Abdullah, N. A. (2020). Sentiment Analysis of Multilingual Tweets on Halal Tourism. *Tourism Management Perspective, 34*, 100658.

Aji, H. M., Muslichah, I., & Seftyono, C. (2021). The Determinants of Muslim Travellers' Intention to Visit Non-Islamic Countries: A Halal Tourism Implication. *Journal of Islamic Marketing, 12*(8), 1553-1576. https://doi.org/10.1108/JMA-03-2020-0075.

Akter, N., & Hasan, S. (2023). The Moderating Role of Perceived Behavioral Control in Predicting Muslim Tourists' Halal Tourism Intention: A Developing Country Perspective. *Journal of Islamic Marketing, 14*(7), 1744-1767.

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T.

Akyol, M., & Kilinc, O. (2014). Internet and Halal Tourism Marketing. *Journal of Turkish Studies, 9*(8), 171-186.

Aminudin, N., & Jamal, S. A. (2020). Types of Tourism: The Travelogue of the Greatest Traveller. *Journal of Islamic Marketing, 11*(2), 497-506. https://doi.org/10.1108/JMA-05-2018-0089.

Asadifard, M., Rahman, A. A., Aziz, Y. A., & Hashim, H. (2015). Review on Tourist Mall Patronage Determinant in Malaysia. *International Journal of Innovation, Management and Technology, 6*(3), 229-233.

Aziz, Y. A., Hussin, S. R., Nezakati, H., Yusof, R. N. R., & Hashim, H. (2018). The Effect of Socio-Demographic Variables and Travel Characteristics on Motivation of Muslim Family Tourists in Malaysia. *Journal of Islamic Marketing, 9*(2), 222-239.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

Battour, M., Battor, M., & Bhatti, M. A. (2014). Islamic Attributes of Destination: Construct Development and Measurement Validation, and Their Impact on Tourist Satisfaction. *International Journal of Tourism Research*, *16*(6), 556–564.

Battour, M., & Ismail, M. N. (2016). Halal Tourism: Concepts, Practices, Challenges and Future. *Tourism Management Perspectives,* 19, 150-154.

Battour, M., Ismail, M. N., Battor, M., & Bhatti, M. A. (2017). Islamic Tourism: An Empirical Examination of Travel Motivation and Satisfaction in Malaysia. *Current Issues in Tourism*, *20*(1), 50-67. https://doi.org/10.1080/13683500.2014.965665.

Battour, M., Hakimian, F., Ismail, M., & Boğan, E. (2018). The Perception of Non-Muslim Tourist towards Halal Tourism: Evidence from Turkey and Malaysia. *Journal of Islamic Marketing, 9*(4), 823-840. https://doi.org/10.1108/JMA-08-2017-0072.

Battour, M., Salahelden, M., & Mady, K. (2022). Halal Tourism: Exploring Innovative Marketing Opportunities for Entrepreneurs. *Journal of Islamic Marketing, 13*(4), 887-897.

Battour, M., Mady, K., Salaheldeen, M., Elsotouhy, M., Elbendary, I., & Boğan, E. (2023). AI-Enabled Technologies to Assist Muslim Tourist in Halal-Friendly Tourism. *Journal of Islamic Marketing, 14*(5), 1291-1309. https://doi.org/10.1108/JIMA-01-2022.0001.

Boğan, E., & Sarıışık, M. (2019). Halal Tourism: Conceptual and Practical Challenges. *Journal of Islamic Marketing, 10*(1), 87-96.

Cupian., Rahmadita, A., & Noven, S. A. (2021). Analisis Faktor-Faktor yang Mempengaruhi Minat Masyarakat Mengunjungi Wisata Halal Sumatra Barat (Studi Kasus Wisatawan Muslim Milenial Indonesia). *Jurnal Ilmiah Ekonomi Islam*, *7*(03), 1318–1326.

Djatola, H. R., Hilal, N., & Sutomo, M. (2025). How Destination Value and Tourist Engagement Image Affect Tourist Loyalty? *Etikonomi, 24*(1), 97-118.

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA.: Addison-Wesley.

Han, H., & Hyun, S. S. (2017). Impact of Hotel-Restaurant Image and Quality of Physical-Environment, Service, and Food on Satisfaction and Intention. *International Journal of Hospitality Management, 63,* 82-92. https://doi.org/10.1016/j.ijhm.2017.03.006.

Jalilvand, M. R., Samiei, N., Dini, B., & Manzari, P. Y. (2012). Examining the structural relationships of electronic word of mouth, destination image, tourist attitude, and travel intention. *Journal of Internet Commerce*, 11(4), 345–367.

Jehane, P. T. (2019). Penerapan Teori Planned Behavior Dalam Memprediksi Intensi Berkunjung di Obyek Wisata Pasar Malam, Kota Kupang. *Tourism - Jurnal Pariwisata*, *2*(1), 39.

Liat, C. B., Nikhashemi, S. R., & Dent, M. M. (2021). The Chain Effects of Service Innovation Components on the Building Blocks of Tourism Destination Loyalty: the Moderating Role of Religiosity. *Journal of Islamic Marketing, 12*(), 1887-1929.

Mohsin, A., Ramli, N., & Alkhulayfi, B. A. (2016). Halal tourism: Emerging opportunities. *Tourism Management Perspectives*, 19, 137–143.

Mohsin, A., Brochado, A., & Rodrigues, H. (2020). Halal Tourism is Traveling Fast: Community Perceptions and Implications. *Journal of Destination Marketing and Management, 18*, 100503.

Musa, G., Doshi, D., Wong, K. M., & Thirumoorthi, T. (2012). Travel behaviour among Muslim tourists in Malaysia. *Asia-Pacific Journal of Tourism Research*, 17(3), 277–288.

Panca, W. A., Ariana, I. N. J., & Arismayanti, N. K. (2017). Pengaruh Kualitas Pelayanan Terhadap Loyalitas Wisatawan dan Citra Hotel Melati di Kelurahan Seminyak Kabupaten Badung Bali. *Jurnal Kepariwisataan Dan Hospitalitas*, *1*(1), 65–72.

Ratnasari, R. T., Gunawan, S., Mawardi, I., & Kirana, K. C. (2020). Emotional Experience on Behavioral Intention for Halal Tourism. *Journal of Islamic Marketing*, *12*(4), 864–881.

Sasanti, I. A., Gravitiani, E., Sartika, R. C., & Herniti, D. (2025). Assessing Sustainable Tourism in Top Selfie: A Mapping and Decision-Making Technique. *Etikonomi, 24*(1), 119-134.

Suhartanto, D., Helmi Ali, M., Tan, K. H., Sjahroeddin, F., & Kusdibyo, L. (2020). Loyalty toward Islamic banking: Service quality, emotional or religious driven? *Journal of Islamic Marketing*, 11(1), 66–80.

http://journal.uinjkt.ac.id/index.php/signifikan
https://doi.org/10.15408/sjie.v14i1.45353

INDEXING AND ABSTRACTING

Signifikan: Jurnal Ilmu Ekonomi (Journal of Economics) is accredited "Sinta S2" by Ministry of Research, Technology and BRIN Republic of Indonesia Republic of Indonesia No. 85/M/KPT/2020 renewal of the certificate number 30/E/KPT/2018 (Valid from Vol. 8(2), 2019 until Vol. 13(1), 2024). The journal indexed by Dimensions, CrossRef, Google Scholar, ISJD LIPI, IPI, Moraref, etc.

Signifikan: Jurnal Ilmu Ekonomi (Journal of Economics) has been covered (indexed and abstracted) by following indexing services:

- CrossRef
- Dimensions
- Ebsco (Open Access Directory)
- Goggle Scholar
- Garuda
- Indonesian Scientific Journal Database (ISJD)
- Moraref
- Indonesia OneSearch
- Bielefiedl Academic Search Engine (BASE)
- Open Archive Initiative (OAI)
- Open Access Library
- Ulrichs' Periodical Database

WRITING GUIDANCE FOR JOURNAL OF SIGNIFIKAN

1. The manuscripts represent academic research in economics discipline.
2. Upon the publication of the manuscript, the author should provide a letter states that the manuscripts have never been, or under consideration to be, published in other journal publications.
3. Structure of the manuscripts
   a. **Title.** The title should be short, clear, and informative, but does not exceed 12 words.
   b. **Author's names and institutions.** The author's names should be accompanied by the author's institutions and email addresses, without any academic titles and/or job title.
   c. **Abstract and keywords.** The abstract consist of 100-150 words and one paragraph only. The abstract should state briefly: (i) a clear statement of the background of the study; (ii) the purpose of the study; (iii) method; (iv) the principal result; and (v) the major conclusion. The key words should be 2 to 5 phrases.
   d. **Introduction.** This section explains the background of the study, and aims of the manuscripts. It should be written without numbers and/or pointers.
   e. **Methods.** This section describes the tools of analysis along with the data and their sources.
   f. **Result and Discussion.** This section explains the results of the study.
   g. **Conclusions.** This section concludes and provides policy implications, if any, of the study.
   h. **References.** This section lists only the papers, books, or other types of publications referred in the manuscript. This journal use APA style 6th edition. References should the last 10 years publication with a minimum of 80% of the journal (especially form international recognized journals). The author is suggested to use reference management software –such as Mendeley, Zotero, etc- to prepare citations and the list of references.
4. The authors should provide an index of subject, namely the specific term in the manuscript. The authors should also provide the index of authors, namely the key authors of papers referred in the manuscript. Please write the family name followed by the given name.
5. Estimation result from a software package is not allowed to be directly presents in the paper. They should be presented in equations with the appropriate estimation results.
6. Table format should contain only heading and contents. Please provide the top and bottom lines, along with the line(s) that separate the heading and the contents. Example:

Table 1. Quality of Life Index (Selected Countries)

Countries	2010	2020
ASEAN Countries		
Indonesia	5,814 (71)	5,54 (71)
Malaysia	6,608 (36)	6,62 (36)
Thailand	6,436 (42)	5,96 (50)
Filipina	6,403(44)	5,71 (63)
Singapura	7,719 (11)	8,00 (6)
Vietnam	6,080 (61)	5,64 (68)

Source: Economist Intelegence Unit

7. The manuscript is prepared in a quarto paper, single-sided, and single-space format. A new paragraph should start 5 characters from the left margin, using 12-size, times-new-romans font type.
8. The manuscript is written in proper English, either British or American English, but not the combination of both, except for special editions.
9. The top and bottom margins are 1 inch.
10. The title is written using capital letters of 14 font size, centre position.
11. Sub titles are written using capital letters, started from the left margin.
12. Sub of sub titles are written using capital letters only at the beginning of each word except for connecting words. They should be started from the left margin.
13. References should be those of the last ten years publication, unless they are key references.
14. Citation in the text body should be written using the family name and years of publication. Example:
    a. Hill (2001) suggests that the objective of depreciation ….
    b. According to Kotler (2010), intra industry trade can be …
    c. Wagner (in McCain, 1990) states that …
    d. The definition of flypaper effect is … (Wagner, 1976).
15. Tables and figures should be presented as follows:
    a. The name of tables and figures should follow a numbering system (Arabic numbering system). The names of the tables and figures are on the top and bottom parts of the tables, respectively.
    b. The tables and figures should provide the source of information, if any, at the bottom part of both.
16. References should be written in alphabetical order, without any number. They should be written using the following criteria:
    a. For books, the format should follow the following example:

       Al Arif, M. N. R. 2015. *Pemasaran Stratejik Pada Asuransi Syariah.* Jakarta: Gramata.
    b. For papers that are part of a book, the format should follow the following example:

       Bahl, R. 2000. *How to Design a Fiscal Decentralization.* in Sahid, Y. (eds.), Local Dynamics in an Era of Globalization, 25-26, London: Oxford University Press.
    c. For journal/magazine papers, the format should follow the following example:

       Al Arif, M. N. R. 2012. *Efek Multiplier Wakaf Uang dan Pengaruhnya Terhadap Program Pengentasan Kemiskinan.* Jurnal Asy-Syir'ah, Vol. 46 (1), Januari 2012, hlm. 10-12.
17. The manuscript in microsoft word should be sent to signifikan@uinjkt.ac.id or through online submission at: http://journal.uinjkt.ac.id/index.php/signifikan/user/register
18. A brief CV that records full name, academic title, institution, telephone, fax and mobile number should accompany the manuscript.
19. The decision of the manuscript are:
    a. Accepted, or
    b. Minor revision, or
    c. Major revision, or
    d. Rejected.
20. Further information about the journal can be seen at http://journal.uinjkt.ac.id/index.php/signifikan