

The Co-Movement Between Commodity Prices and the Economic Growth of Malaysia

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Abstract

Research Originality: This research is an initial attempt to unveil the structure of the dynamic relationship between commodity prices and Malaysia's economic growth at various frequencies and moments in time.

Research Objectives: This paper investigates the co-movement and lead-lag relationship between commodity prices and the economic growth of Malaysia at different frequencies and moments in time.

Research Methods: The relationship between the variables is studied using monthly data from 2015 to 2022 and the time-frequency analysis of the Continuous Wavelet Transformation model. This method analyses the direction and lead-lag relationship between two-time series to determine which variables are leading and the direction of their co-movement.

Empirical Result: The relationships between commodity prices and economic growth are varied depending on frequency and moments in time. In the short run, most commodity prices exhibit an inverse relationship led by economic growth. Meanwhile, a positive co-movement with economic growth is indicated for most commodity prices in the medium run. These variables mostly move in unison, except for rubber and palm oil, which led to the relationship. Nevertheless, the co-movement of commodity prices and economic growth showed a diminishing magnitude in the long run.

Implications: Malaysia's policy frameworks should consider the economic dynamic responses towards commodity prices in facilitating its economic growth. In addition, efforts should be made to diversify economic activities, reducing dependence on commodities in the country's trade basket.

Keywords:

commodity price; economic growth; continuous wavelet transformation; co-movement; lead-lag relation

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INTRODUCTION

The relationship between commodity prices and economic growth has long been a subject of interest for economists, policymakers, and market analysts worldwide (Baffes et al., 2018; Goestjahjanti et al., 2023). Defined as tradable raw materials or primary agricultural products, these essential goods are indispensable components of the economies (Baffes et al., 2018; Ge & Tang, 2020) of both producing and consuming nations (Rieber, 1985; Sokhanvar & Bouri, 2023).

Table 1. Exports of Commodities of Malaysia, 2021

Products	Exports Value
Mineral products	USD 50.5 billion
Rubber and plastics	USD 27.5 billion
Vegetable and animal byproducts	USD 23.5 billion
Metals	USD 21.4 billion
Wood products	USD 2.78 billion

Source: The Observatory of Economic Complexity (2022)

As a country endowed with abundant natural resources, the movement of commodity prices is significant and profoundly impacts Malaysia’s economic trajectory (Bank Negara Malaysia, 2013). Commodities are significant exports of Malaysia, as shown in Table 1, where the primary agricultural and related products contributed around USD 130.98 billion of the country’s USD 333 billion worth of trade in 2021. The largest export of commodities in the country is mineral-related products, including refined and crude petroleum and gas, with USD 50.5 billion, followed by rubber and plastics, with USD 27.5 billion. Other notable commodities include vegetable and animal products, metals, and wood products, with exports reaching USD 47.68 billion. Referring to Table 2, the country exports most of its products to Singapore with USD 49.6 billion, China with USD 47.9 billion, the United States with USD 42.9 billion, Hong Kong with USD 19.2 billion, Japan with USD 19 billion, and Thailand with USD 12.7 billion.

Table 2. Export Partners of Malaysia, 2021

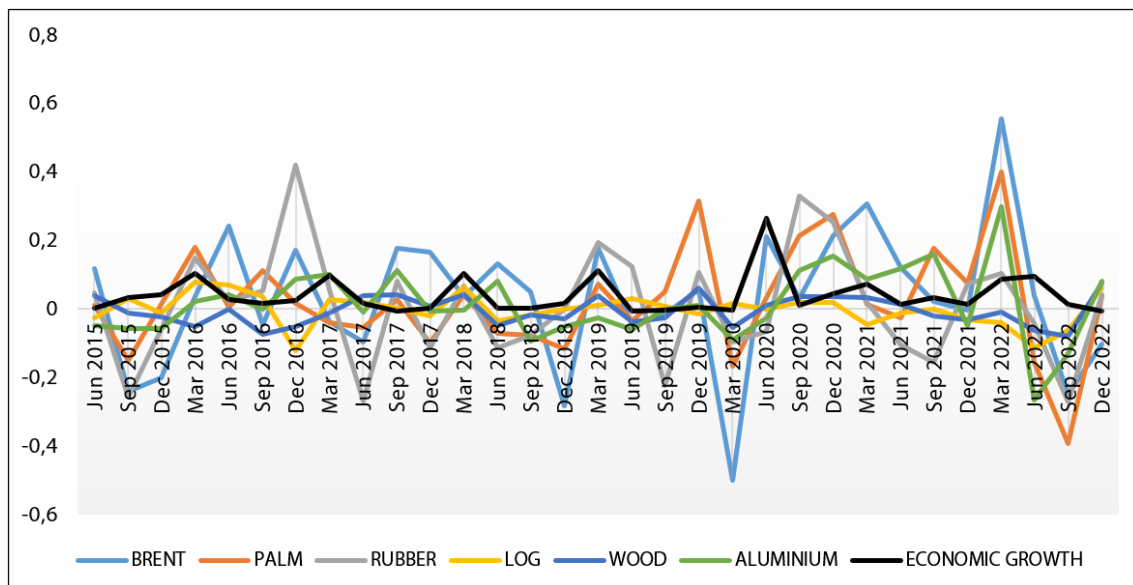
Countries	Exports Value
Singapore	USD 49.6 billion
China	USD 47.9 billion
United States	USD 42.9 billion
Hong Kong	USD 19.2 billion
Japan	USD 19.0 billion
Thailand	USD 12.7 billion

Source: The Observatory of Economic Complexity (2022)

Figure 1 shows the price changes of selected commodities, namely crude oil, palm oil, rubber, log, sawn wood, and aluminium. As displayed, prices are precarious throughout

time, as described by Chaudhuri (2001) and Jacks et al. (2011), with the lowest point exhibited during the peak of the COVID-19 pandemic, while the highest level was in the year 2022, as the world markets are recovering. The movement of commodity prices depends on various factors, including changes in demand factors and the real interest rate (Arango et al., 2012; Arbatli & Vasishtha, 2012), the exchange rate (Ghoshray & Pundit, 2021), consumption growth (Cheung & Morin, 2007), sociopolitical issues (Jiang et al., 2022), and competitiveness (Wright & Williams, 1982; Prasetyani et al., 2020).

Figure 1. The Prices of Selected Commodities, 2015 - 2022



Source: Bloomberg Terminal

The substantial dependence of the country's economy on commodity exports (Bank Negara Malaysia, 2013; Department of Statistics Malaysia, 2021) and the inherent volatility in commodity prices raises an essential question: Is there a significant relationship between commodity prices and Malaysia's economic growth? The commodity prices are said to influence economic growth through various channels, including the direct increase in export revenue (Goestjahjanti et al., 2023) and the indirect influence of exchange rate appreciation due to the demand for commodities on the domestic currency (Chen & Rogoff, 2003), the stock market (Iscan, 2015), and household consumption (Gohar et al., 2023). As shown in Figure 1, the commodity prices seem to move along with Malaysia's economic growth, showing a consistent pattern of fluctuations throughout the observation period. Nonetheless, there are instances where the movements of the two variables conflict during specific periods.

Two competing theories relate commodities to economic growth: neo-classical economics and the resource curse theory. Neo-classical economics describes the contribution of natural resources to the economy through the concept of production function. According to Davis & Tilton (2004), the more capital a country possesses, the greater its output and the higher its per capita income. This capital includes mineral

reserves, agricultural land, forests, and other natural resources. However, the resource curse theory suggests that there needs to be more evidence of economic growth in many mineral-intensive countries. Davis & Tilton (2004) describe that this is caused by several factors, including the Dutch disease, where an increase in commodity exports would reduce the competitiveness of other industries on the global market. This condition might lead to a downturn in these industries and an overreliance on the export of raw materials, which would stifle economic growth in general. Gylfason (2001) adds that natural capital tends to crowd out foreign, social, human, and physical capital, thereby impeding economic growth across countries and over time. A study by the International Monetary Fund (IMF) found that resource-rich countries such as Bolivia, Sierra Leone, and Venezuela have fared much worse than resource-poor countries regarding growth performance (Arezki & van der Ploeg, 2007).

Empirically, the relationship between commodity prices and economic growth has been studied before, with researchers such as Ge & Tang (2020) exploring using commodity prices as a leading indicator of economic growth for developed and developing countries. Ge & Tang (2020) believe that commodity prices are significant in predicting GDP growth for both markets. However, higher coefficients are exhibited for the developing markets compared to the developed ones, which indicates the significance of commodity prices for the economic growth of developing countries. According to Baffes et al. (2018), commodities are essential for developing markets due to the need for commodities to fuel their economies, and these needs boost global commodity demands. Moreover, some of these developing countries are significant exporters of world commodities (Anyanwu, 2014; Bond, 1987), and a significant proportion of the trade basket of many developing countries is comprised of primary commodities (Harvey et al., 2017).

It is also demonstrated that the relationship between commodity prices and economic growth varies depending on the period of the relationship (Ge & Tang, 2020). In the long run, Harvey et al. (2017) said that relative price movements in commodities may significantly affect economic growth. According to Tahar et al. (2021), commodity price increases have a long-term positive effect on the economy due to increased income. Moreover, the impact is also found to be asymmetric, where positive changes in commodity prices have a more significant impact than negative changes (Tahar et al., 2021). Nevertheless, Dehn (2000) found that negative shocks on commodity prices remain highly significant for economic growth, while positive shocks' impact is impermanent.

Other studies are paying attention to the short-term relations, with Tiwari et al. (2016) claiming that the co-movements between economic growth and commodity prices became weaker in the short run when controlling certain economic factors. Similar to the long run, the relationship between commodity prices and economic growth is also found to be heterogeneous in the short run across various commodities, as demonstrated by Ghoshray & Pundit (2021). Cavalcanti et al. (2014) postulated that the impact of commodities on growth varies across cross-section units and depends on country-specific factors, macroeconomic fundamentals, and institutions. Moreover, Collier & Goderis (2012) believe that price increases have positive short-term effects on growth. However,

increasing prices for non-agricultural commodities in countries with poor governance has negative long-term effects that outweigh short-term gains.

Considering the varied relationship between commodity prices and economic growth across different time horizons, several attempts were made based on wavelet analysis to thoroughly assess the relationship (Tiwari et al., 2016). The wavelet analysis provides more insight since it enables a more in-depth understanding of the variations in the series at different time scales for different subperiods. Wavelet analyses demonstrated that a co-movement exists between commodity prices and economic performance at different frequencies and specific moments in time (Ma et al., 2021; Tiwari et al., 2016).

Despite the importance of assessing the relationship between commodity prices and economic growth (Collier & Goderis, 2012; Ghoshray & Pundit, 2021) as well as the growing role of assessing such topics through wavelet analysis in economics (Connor & Rossiter, 2005), the obvious shortcoming of previous studies is that there is scarce research attempted in investigating the relationship between the variables in the context of Malaysia despite the sizeable economic scale of its commodities, as shown in Table 1 and 2. Many of the attempts conducted in the country focused on the impact of commodity prices on the stock market (Nordin et al., 2014), the exchange rate (Ramakrishnan et al., 2017), and inflation (Chuah et al., 2013). Moreover, previous studies on the topic that were conducted in Malaysia were constrained to either short-run and/or long-run linear relationships only, which limited comprehension of the relationships that vary across frequencies and moments in time. This condition is disadvantageous considering the nature of the relationship between commodity prices and economic growth, which is believed to be non-linear and asymmetric (Tahar et al., 2021) and varied across different frequencies and moments in time (Ghoshray & Pundit, 2021; Harvey et al., 2017). Tahar et al. (2021) said that estimating non-linear relationships using a linear framework may be inaccurate and lead to misleading results. Moreover, time-frequency wavelet analyses, which allow for the study of various time frequencies, are limited to a few commodities, remarkably oil price (Ma et al., 2021; Tiwari et al., 2016), while the influence of other commodities is unchecked.

For that, this paper investigates the relationship between commodity prices and Malaysia's economic growth based on time-frequency wavelet analysis. This paper fills the gap in the study, which is the need to assess the co-movement between commodity prices and economic growth at various frequencies and moments in time. It is a novel attempt to assess such relationships in the country, and the paper provides significant contributions by first extending the body of knowledge on the relationship between commodities and economic growth based on time-frequency analysis. Secondly, adequate forecasts of these prices may generate more economic information, leading to better growth predictions (Ge & Tang, 2020) and assisting the authorities in making the right decisions to sustain economic growth (Tiwari et al., 2016). By understanding how commodity prices interact with economic growth, authorities can implement appropriate policies to manage fluctuations in commodity markets and support overall economic stability and development. Moreover, this study may improve planning and investment by all

the relevant agents in the commodity supply chain, as Harvey et al. (2017) described. Understanding the relationship between commodity prices and economic growth can help relevant stakeholders make more informed decisions regarding production, distribution, and investment in commodities, thereby enhancing efficiency and profitability within the supply chain.

METHODS

The paper gathered monthly data on crucial commodity prices that are significant exports for Malaysia, including crude oil, palm oil, rubber, log, wood, and aluminium, from the World Bank Commodity Market in Bloomberg Terminal. Meanwhile, the industrial production index is used as a proxy for the country's economic growth. Based on availability, the data spanned 96 months from January 2015 to December 2022 and is sufficient for observing the co-movement between the variables across various frequencies and moments in time.

The paper utilized the time-frequency analysis of the continuous wavelet transformation model or CWT to investigate the relationship between commodity prices and economic growth across different moments in time and frequencies. The research objective cannot be attained using traditional time series analyses that typically rely on methods that involve either the time or the frequency domain and not a combination of both simultaneously (Davidson et al., 1998). The wavelet approach also addresses issues typically exhibited in price assessment, namely heteroskedasticity, outliers, and structural breaks (Davison et al., 1998). Wavelet transformation expresses how much a time series changes around certain moments in time at different frequencies or scales (Uliha & János, 2018). Ma et al. (2021) said that the advantage of wavelet analysis is that it allows for causal identification in the long, medium, and short run. Moreover, since wavelets combine the information from both time and frequency domains, an in-depth understanding of the variations in the series will be obtained (Davidson et al., 1998).

Shown below is a Morlet wavelet function (ψ):

$$\psi_{u,s}(t) = \frac{1}{\sqrt{|s|}} \psi\left(\frac{t-u}{s}\right) \quad s, u \in R, s \neq 0 \quad (1)$$

Where s is the dilation factor that determines the wavelet's width and u is the translation parameter that determines the wavelet's location. Meanwhile, the $1/\sqrt{|s|}$ component of the model determines the wave's unit variance.

From a Morlet wavelet, Continuous Wavelet Transforms is then described:

$$\psi(t) = \pi^{-\frac{1}{4}} e^{i\omega_0 t} e^{-\frac{t^2}{2}} \quad (2)$$

The unit value of the wavelet is determined by the component $\pi^{-1/4}$, and the wavelet analytics are represented by $e^{i\omega_0 t}$. The parameters denoting the frequency and time dimensions are by ω_0 and t , respectively, whereas $e^{-t^2/2}$ represents the Gaussian envelope.

Moreover, the CWT analysis determines the direction of the co-movement, whether positive or negative, and the lead-lag relationship between two time series or variables

is evaluated using the phase difference as represented by vectors or arrows (Torrence & Webster, 1999). When the phase difference is zero, it signifies that the variables exhibit synchronised motion at the given frequency (Tiwari et al., 2016).

In the context of CWT analysis, Torrence and Compo (1998) say that areas with thick edges show significant co-movement between the time series with a confidence level higher than 95%. In contrast, the shaded region denotes the cone of influence, which accounts for potential errors that may arise at the beginning and the end of the wavelet power spectrum.

RESULT AND DISCUSSION

The present study examines the co-movement and lead-lag relations between commodity prices and Malaysia's economic growth across various frequencies and moments in time. Based on the CWT model, four frequency levels are established, which indicate the relationship period. The first level (1–4 months) is associated with the short run or high-frequency band, while the second and third levels (4–8 months and 8–16 months) are associated with the medium run or medium-frequency band. The fourth level (16–32 months) is intended for the long run or low-frequency band. Meanwhile, moments in time refer to observable time measured between January 2015 and December 2022.

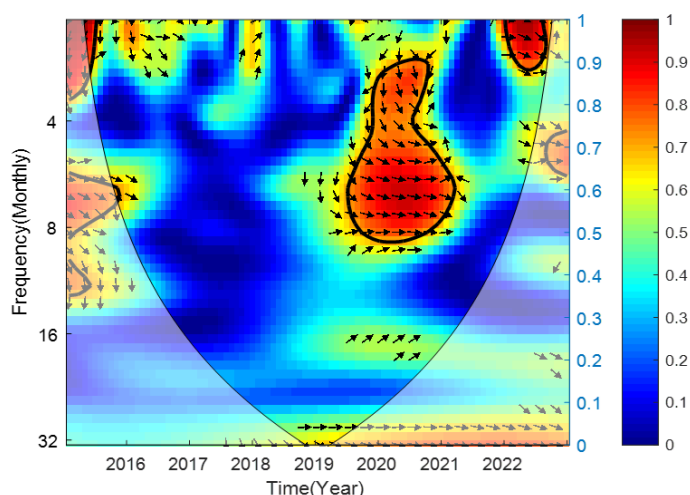
Based on the results, it is conjectured that the relationship between commodity prices and economic growth changes across different frequencies and moments in time. Most of the commodities were linked to economic growth at the first and second frequency levels, which are between 1–4 months and 4–8 months, especially during COVID-19. In line with previous evidence, as in Tiwari et al. (2016), coherence between the variables and economic growth faded at lower frequencies, particularly from 16–30 months.

Specifically, the crude oil price is demonstrated to be positively related and move together with economic growth in a similar direction at the first level of frequency (1–4 months) or short run from mid-2019 to mid-2020 and in 2022, as shown in Figure 2. As indicated by the vectors pointing right down, this relationship was led by Malaysia's economic growth. However, the lead-lag relationship changed at the second frequency level (4–8 months) or medium run, where the variables moved together in a similar direction from mid-2019 to 2020. This result coincides with Xiuzhen et al. (2022), who demonstrated a strong connection between oil prices and economic growth, especially during COVID-19. According to Moghaddam (2023), the significant relationship between oil prices and economic growth is due to the substantial size of the oil and gas industry in the economy.

Furthermore, Jiménez-Rodríguez and Sanchez (2005) said that the positive relationship is because the increase in crude oil price is considered good news for the economy in oil-exporting countries. However, there was no apparent relationship between the variables across the periods at the third and fourth levels of frequencies (8–16 months and 16–32 months). This result suggests that the co-movement between crude

oil price and economic growth eventually degrades over extended periods. This result is somewhat in line with Galayini (2011), who said that there is not a clear relationship between oil price and world economic growth, even for oil-exporting countries except for the G7 nations, due to the adjustment of consumers and producers to the oil price movement in these countries.

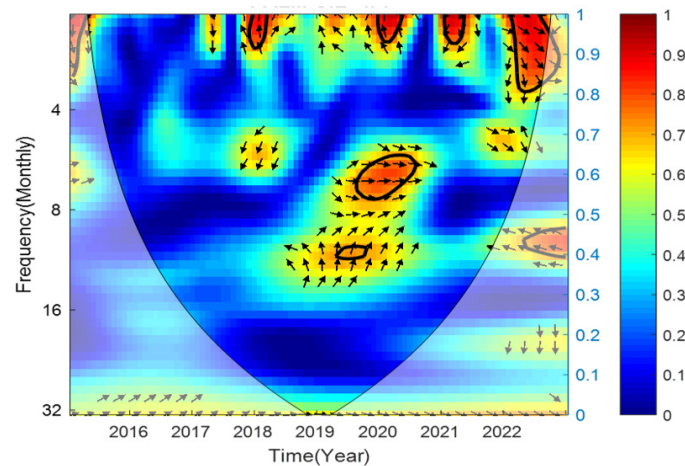
Figure 2. Crude Oil Price– Economic Growth



The relationship between the palm oil price and economic growth is less apparent than the crude oil price, as shown by the smaller contours within the cone of influence in Figure 3. At the first level of frequency (1–4 months) or short run, a negative co-movement led by palm oil price is presented, with small contours appearing between 2018 and 2020. However, economic growth led to the inverse co-movement with palm oil prices around 2021. This result indicates that the palm oil price and economic growth moved opposite from 2018 to 2021. However, the direction of the relationship changes to a positive co-movement led by economic growth in 2022. The horizontal vector points to the right show a positive co-movement between the variables displayed in mid-2019 to mid-2020 at the second frequency level (4–8 months) or medium run. Palm oil price is associated with economic growth through consumer demand (Purnomo et al., 2020).

Midway through 2019, a slight contour also appeared in the third frequency level (8–16 months), where the vector denotes a positive co-movement between the variables that the palm oil price led. This result indicates that commodities and economic growth move similarly in the medium run. This result coincides with Prabheesh and Laila (2020), who found a similar positive relationship in the Indonesian market. However, there was no apparent relationship or co-movement between palm oil prices and economic growth at the lower frequencies (16–32 months) or in the long run. This result reiterates the finding of Gharleghi and Chan (2015), who believe that palm oil production does not significantly impact economic growth in the long run.

Figure 3. Palm Oil Price – Economic Growth



The co-movement between rubber price and economic growth is presented in Figure 4, and corresponding to Murshidi and Aralas (2017), the relationship is found to be insignificant for most of the periods across all frequencies. According to Murshidi and Aralas (2017), the price shocks of rubber individually are not significant in explaining economic growth in both the short and long run. However, this study found an exception in 2020–2022, at the third level of frequency (8–16 months) or medium run, where a positive co-movement led by rubber is exhibited. It somewhat conjectures a more minor influence of the commodity on Malaysia's economic development in that period. This significance is explained by Hamid et al. (2019), who believe that the income of the smallholders increased with the rising price of rubber and showed a decline when the price fell sharply. The impact of the falling price of rubber on the income of rubber farmers is also shared in many countries, as reported by Nicod et al. (2020), and indicates a positive relationship between the variables.

Figure 4. Rubber Price – Economic Growth

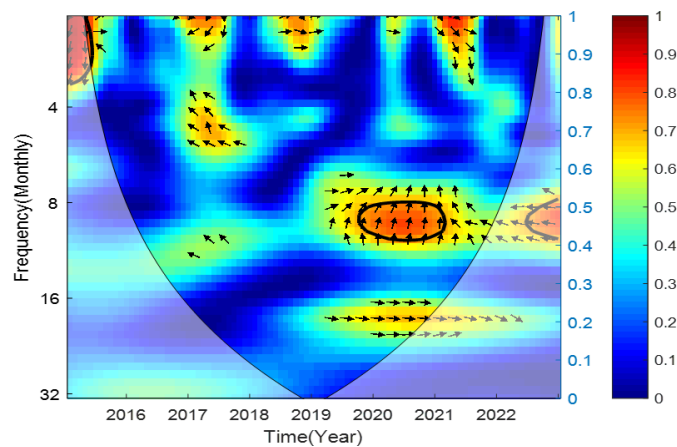
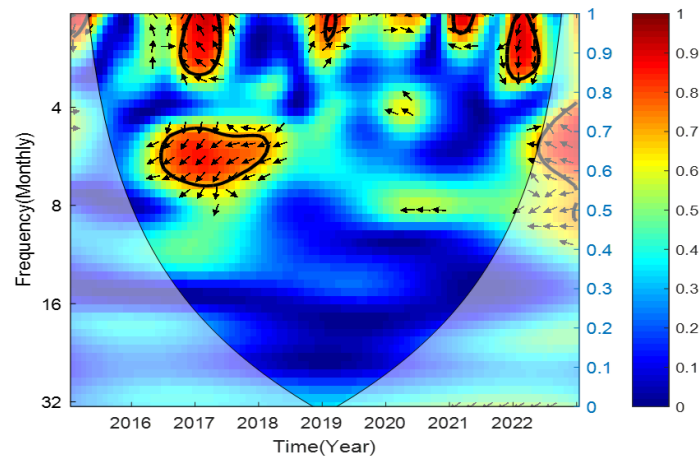


Figure 5 shows a significant relationship between log price and economic growth at the first frequency level (1-4 months) or short run. The contour from 2017 to 2018

indicates that the log price leads to the co-movement. This result means an inverse relationship exists between the variables in that period. However, the direction of the co-movement momentarily changed to positive in 2019, with log price leading, and then moved back to the negative relationship in 2021 and 2022. The vectors point downward in 2022, indicating that economic growth leads the relationship. At a second level of time frequency (4–8 months) or medium run, a medium-sized contour appeared from mid-2016 to 2017, with economic growth leading to a negative co-movement. Despite the influence of economic growth as the core driver for the forest-related industry, as Caravaggio (2022) indicated, the impact is only short- to medium-term. This result is shown by the insignificant co-movement of the variables at the lower level of frequency (8–16 months and 16–32 months).

Figure 5. Log Price – Economic Growth



Meanwhile, Figure 6 displays the co-movement between sawn wood prices and economic growth. At the first level of frequency (1–4 months) or short run, there was a negative co-movement led by economic growth in 2017. However, the relationship quickly diminished in the years after, as no apparent contour was exhibited. On the other hand, a larger contour is shown at the second level (4–8 months) or medium run in 2020, with a positive co-movement between sawn wood prices and economic growth, as demonstrated by the vectors. This result means that the variables move in the same direction during that period. The less apparent contour postulates that sawn wood price and economic growth are less related, especially in the long-run relationship.

The mixed direction of the co-movement between log price, sawn wood price, and economic growth is believed to happen due to timber supply potentials, as described by Trømborg et al. (2000). In the event of increased supply potential, log and sawn wood prices will exhibit a positive relationship with economic growth. However, when the supply of logs and wood is dampened, the co-movement will be insignificant, if not inverse. Trømborg et al. (2000) said changes in the assumed timber supply potentials affected the actual prices of pulpwood and particles significantly. In explaining the supply of timber,

Banaś and Utnik-Banaś (2021) said that this supply potential is determined mainly by seasons. Sawmills are said to adjust their timber stock and reduce the acquisition of new timber in certain seasons to lessen pest damage.

Figure 6. Sawn Wood Price – Economic Growth

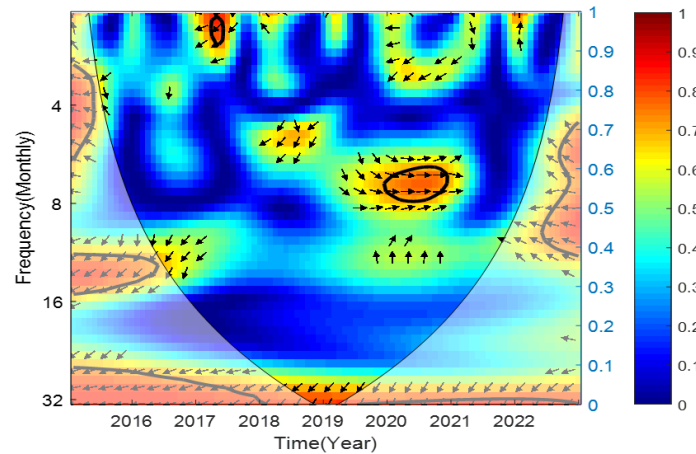
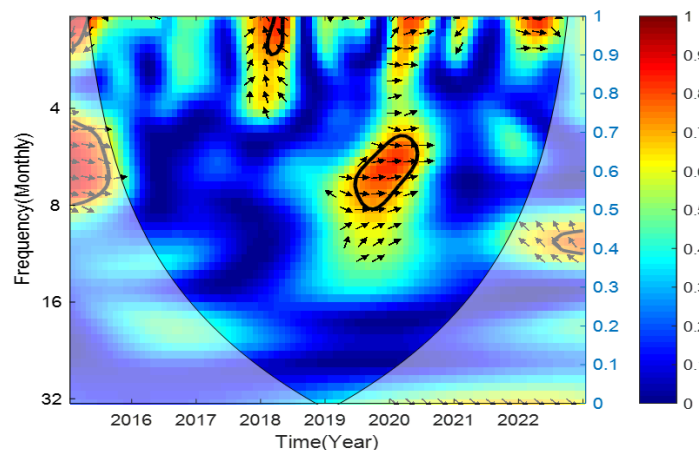


Figure 7. Aluminium Price – Economic Growth



As conjectured in Figure 7, the less visible relationship is also shared by the aluminium price and economic growth, where the contours that appeared across the observation are small. Nonetheless, at the first level of frequency (1–4 months) or short run, there is a negative co-movement exhibited in early 2018, where both variables moved in a similar direction, led by the aluminium price. At the second frequency level (4–8 months) or medium run, the vectors point horizontally to the right, indicating a significant relationship between the variables from mid-2019 to mid-2020. The aluminium price and economic growth exhibited a positive co-movement at this frequency. This result is similar to Ghoshray and Pundit (2020), who found a significant relationship between aluminium prices and economic development in China. The current paper believes changes in aluminium consumption mediate the co-movement between aluminium price and

economic growth. Ezeaku et al. (2021) said that economic growth and aluminium prices had been badly affected during the COVID-19 pandemic, which may explain the positive co-movement between the variables around that period. According to Jaunky (2012), unidirectional causality from aluminium consumption to real GDP is found in the short run, while real GDP is found to Granger-cause aluminium consumption in the long run. A decline in the price of aluminium drives its consumption upward and eventually leads to economic growth, which explains the negative relationship between them in the short run. Jaunky (2012) further explains that in the medium run, aluminium price and economic growth move together in similar directions due to the influence of economic growth on aluminium consumption, which drives the price upward. Nevertheless, there is no apparent co-movement between the variables at the lower frequency level or in the long run.

CONCLUSION

Based on Continuous Wavelet Transformation analysis, this study investigated the relationship between Malaysia's economic growth and the pricing of selected significant commodities. The study shows that the relationship between commodity prices and economic growth varies across different frequencies and moments in time. In the short run, a negative co-movement is observed between the economic growth of Malaysia and most commodity prices, namely palm oil, log, sawn wood, and aluminium. Meanwhile, crude oil price demonstrates positive co-movement, unlike rubber price, which does not exhibit a significant co-movement with economic growth. In the medium run, all commodity prices demonstrate a positive co-movement with economic growth except for log, which indicates an inverse relationship. The co-movement between economic growth and commodity prices displayed a decline in magnitude over extended periods, specifically in the long run. This result posits that prolonged economic downturns cannot be attributed to commodity prices, as the co-movement between the variables is comparatively transitory.

Additionally, the wavelet analysis validates the existence of shifts in the lead-lag relationship. In the short run, the co-movement between economic growth and log, aluminium, and palm oil prices is led by commodities. Nonetheless, economic growth led to the co-movement of crude oil and sawn wood prices over multiple periods in that time-frequency. Crude oil, sawn wood, and aluminium prices fluctuate with economic growth over the medium term. In contrast, the co-movement between rubber and palm oil prices and economic growth is led by commodity prices, respectively. The only medium-run relationship led by economic growth is the log price.

In reflecting on the findings of this research, policymakers should consider the heterogeneous co-movement between commodity prices and economic growth when creating monetary and fiscal policies in the future. In addition, economic diversification should also be promoted to reduce Malaysia's commodity dependence in its trade basket and sustain growth by developing alternative industries or exploring new export

markets for non-commodity goods and services. Policymakers should also encourage value-adding operations in these commodity sectors to boost Malaysian commodities' global competitiveness and absorb adverse commodity price fluctuations. Lastly, authorities should prioritize investment in commodity infrastructure and supply chain efficiency to maximize economic advantages from commodity booms and assure sustainable expansion in the sectors.

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