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REVISITING TEMPORAL CAUSALITY BETWEEN ISLAMIC FINANCE INSTRUMENTS AND OUTPUT

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ABSTRACT

With the onset of the COVID-19 pandemic, financing would again be the crux of the recovery process. This paper revisits existing literature on how financial development promotes growth by focusing on the role of Islamic finance in Malaysia. Specifically, the role of sukuk and loans by Islamic banks on output is examined in Malaysia. The main objective of this paper is to investigate the causal nexus between *sukuk*, Islamic banking loan, and output using a bootstrap causality test applied to both full sample and rolling window sub-samples. Data ranges from 2000M1-2021M6 for the sukuk market and 2006M12-2021M6 for Islamic banking loans. We rely on bootstrap rolling windows which allow for time-varying causalities within time-series data. Results indicate evidence that Islamic financing instruments, in this case, *sukuk* and loans by Islamic banks Granger-cause output in the long run. Even in the long run, non-constancy in the parameters is detected for total *sukuk*, *sukuk* for finance, and *sukuk* for transport. The parameter stability tests indicate parameter non-constancy in the short run for total *sukuk*, *sukuk* for finance, sukuk for transport, and *sukuk* for utility for the output - *sukuk* equation. In the case of Islamic financing via loans, short-run parameter instability is prevalent for all loan–output equations. We take the analysis further by examining the direction of the lead variables on a multi-time scale using continuous wavelet transforms and wavelet coherence. Results show that causality runs from sukuk output for total *sukuk*, transport, and utility *sukuk* whereas construction *sukuk* seems to exhibit a mixed behaviour. In the case of *sukuk* for finance, the impact is more pronounced in the very-long run. These findings could be a guide for countries intending to use Islamic financing instruments as one of the tools for fiscal stimulus or post-pandemic economic recovery.

Keywords: Islamic financing instruments, bootstrap rolling windows, continuous wavelet transforms, output.

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1. INTRODUCTION

The recent COVID-19 pandemic has brought unprecedented damage to the economy. As vaccination progressed and countries began their recovery plan, financing this recovery becomes the central question. What type of financing options would be available and suitable for economic

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recovery? On a micro-scale, what type of financing would be best during recovery processes for businesses and households? Hence, the old-age question between financial development and economic growth comes to light as countries and individuals within a country struggle in this recovery period. The association between financial development and economic growth is one of the most researched areas in the past 30 years. The relationship between financial development and growth dates back to Schumpeter (1911), McKinnon (1973), and Shaw (1973) where financial development is a tool to attain economic growth. There is somewhat a unanimous agreement that financial development and economic growth have a strong long-run positive relationship using time series, country level, firm-level data, cross-section data, and panel data (King & Levine, 1993; Levine, 1997; Rajan & Zingales, 1998; Beck & Levine, 2004; Beck et al., 2003; Kendall, 2012; Demetriades & Law, 2006). Studies have also differentiated between high growth and low growth countries. Huang and Lin (2009) show that the positive relationship between financial development and growth is larger in low-income countries compared to high-income countries. Low-income countries tend to use financial intermediaries to gain capital access for investment purposes. On a different note, Rioja and Valev (2004) and Deidda and Fattouth (2002) show no relationship between financial development and growth in low-income economies, and a positive significant relationship only occurs in high-income economies. Studies on causality direction between financial development and growth were extensively undertaken but results remain inconclusive. Studies by Shen and Lee (2006), Ergungor (2008), Hung (2009), and Cecchetti and Kharroubi (2012) suggest the direction of causality from finance to growth or "*more finance, more growth*" or more recently "*better finance, more growth*" (Law et al., 2013). Conclusions from Levine (2003) suggest that the size of the banking sector and the liquidity of the stock market are positively linked to economic growth. In the last twenty years, Islamic finance had begun to provide alternative financing based on *shari'ah* principles but mimic the readily available conventional products for both Muslim and non-Muslim investors. This has spurred huge interest in Islamic finance-related research and development.

Islamic finance encompasses the Islamic capital market, *shari'ah-compliant* loans, and sukuk, among others. This study focuses on Malaysia since Malaysia offers several interesting scenarios in its development in Islamic banking and finance. Although Malaysia is not the first country to offer Islamic banking and finance, it kicked off Islamic banking with a strong foothold via Islamic Banking Act 1983 and successfully integrated it with the conventional system through full-fledged Islamic banking and Islamic windows. The Islamic finance development continued to expand beyond Islamic banking with the development of the Islamic money market, equity, *sukuk*, and takaful with expanding lists through the years. The total Islamic banking asset stood at more than twenty (20) percent of the total banking assets. On the other hand, Malaysia is the largest sukuk issuer in the world since 1990 and is expected to continue its momentum in issuance in both the corporate and sovereign bond space. *Sukuk* issuance increased from RM223.94 billion to RM296.84 billion between 2020-2022 which accounts for 61.08 – 68.23% of total bond and sukuk issuance (Securities Commission, 2023). *Sukuk* is the Islamic equivalent of fixed-income securities whose features are akin to bonds. *Sukuk* is derived from the word '*sakk*' which is a paper to represent financial obligation due to trade transactions or commercial activities. In practice, *sukuk* can be considered an Islamic bond in the form of a certificate with values equal to the underlying assets which can be both tangible and intangible (services, number of miles flown). Malaysia introduced the first green *sukuk* in 2017 as the Malaysian government embraces the sustainable development goals (SDGs) to develop infrastructure projects that are climate-resilient and low in carbon emission. In 2018, BIMB Investment Management Bhd., the investment hand for Bank

Islam Malaysia Berhad, launched the first ESG *sukuk* fund to further support the demand for green *sukuk.*

From the empirical perspective, the *sukuk*-economic development nexus has been tested in several countries. Echchabi and Idriss (2018) find no relationship between sukuk issuance and economic growth for GCC countries within the Toda and Yamamoto Granger Non-Causality Test. In contrast, Khoutem (2014) suggests a positive and significant contribution of the *sukuk* market and Islamic banks to economic development in Tunisia. Similarly, Al Fathan and Arundina (2019) tested the causality of three sub-sectors of Islamic finance which include the banking sector, stock market, and sukuk in Indonesia. Results suggest a unidirectional causality from the sukuk market to Islamic banking development in support of the supply-leading hypothesis. They argue that sukuk does not directly result in economic development but *sukuk* financing allows development projects to be undertaken which leads to income generation and eventually economic growth. Their results also imply that the development of the sukuk market may stimulate the development of Islamic banking. Smaoui and Nechi (2017) on the other hand, advocated that the *sukuk* market is a substitute for the banking system. In a sample of 18 *sukuk*-issuing countries, results imply that *sukuk* market development promotes financial inclusion as shown by the positive relationship between *sukuk* and economic growth.

This study extends existing literature from two new perspectives. First, the impact of finance on economic growth is specifically examined from the point of view of the Islamic financing instrument. Two types of Islamic financing instruments are selected is *sukuk* and Islamic banking loans which are predominantly used for financing consumption and investment. This study also examines sukuk and Islamic banking loans at disaggregated levels. Disaggregation allows more understanding of how different sub-sectors respond to the output. Second, this study offers a new approach to examining the impact of Islamic financing on output. We use a Granger causality model with bootstrap rolling regressions over sub-windows (BRW) and allow the estimation of the regression for both the short run and the long run. The usual Granger or Toda and Yamamoto causality tests can only capture a single long-run relationship over a period of time. We supplement the findings from BRW with continuous wavelet transforms and wavelet coherence to examine the causality direction of the variables. Both approaches allow time-varying data which means that they can accommodate structural changes, and non-stationary variables and relaxes the assumption that parameter constancy throughout the entire sample period. By allowing for non-constancy in parameters, results would be more efficient, and we were able to detect the significant areas on a multi-time scale.

This paper is organized as follows. The next section reviews the *sukuk* market and Islamic banking loans in Malaysia followed by a section on the estimation framework. The fourth section discusses the findings, and the final section concludes.

2. LITERATURE REVIEW

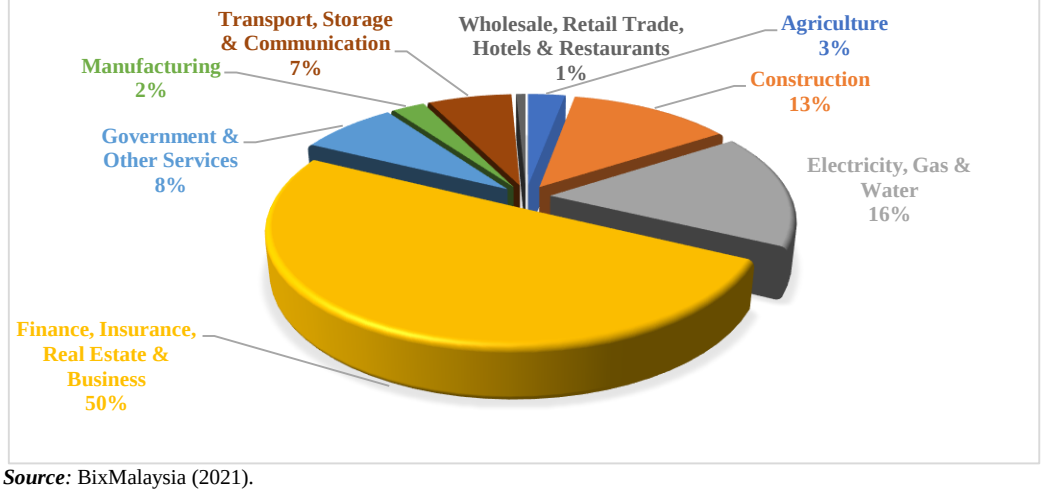
2.1. Sukuk Market and Islamic Banking Loans in Malaysia

Total global *sukuk* issuance has reached USD754.1 billion in the second quarter of 2021 (2021Q2) which is approximately a 5% increase from quarter 1 2021 (2021Q1). According to Fitch Rating,

sukuk's share in total funding mixed jumped by 36% in 2021Q2 compared to 15% in the previous quarter. *Sukuk* issuance continues to grow in the GCC region, Malaysia, Indonesia, Turkey, and Pakistan by approximately 136% in 2Q2021. In the second quarter of 2021, large *sukuk* issuance comes from Saudi Arabia, Indonesia, Turkey, and Oman. More growth in sukuk issuance is expected as countries need more financing during the recovery process and issuers are taking advantage of the low-interest rate as countries continue having fiscal deficits to fund health, vaccinations, and other recovery plans. In addition, *sukuk* default remains at a minimum at only 0.27% of total gross *sukuk*.

The *sukuk* market in Malaysia is an extension of the fixed-income market or the bond market which was originally developed in the early 1980s in Malaysia. The first *sukuk* was issued by Shell MDS Sdn. Bhd. on 22nd July 1990 at RM150 million. In the 1990s, *sukuk* issuance was rather sluggish eleven (11) issuance by Khazanah Nasional Berhad, Tenaga Nasional Berhad, Hualon Corporation (M) Sdn. Bhd, KLIA Bhd, and Segari Ventures Sdn Bhd. with a total amount of approximately RM2.4 billion (IFIS, 2015). The *sukuk* market began to pick up after the year 2000 and has since been on an upward trend. In December 2001, Kumpulan Guthrie Berhad issued the first US dollar-dominated international *sukuk*. Since then, international sukuk has proliferated significantly especially in Asia and the Middle East. The first sovereign *sukuk* was issued in June 2002 at USD600 million. Malaysia's share of *sukuk* is more than 50 percent in the years 2000-2012. Since 2010, more countries were issuing *sukuk* as a diversification strategy for financing as well as to cater to increasing demand for *shari'ah-compliant* investment and financing products. GCC countries have spearheaded the rise in *sukuk* volumes followed by Turkey since 2016. This development leads to Malaysia securing only 38.7 percent of the market share of global *sukuk* issuance as of June 2018. The first quarter of 2017 saw a decline of 12 percent (Combes, 2018) but is expected to increase especially with the rise of green *sukuk*. It is expected that *sukuk* issuance will continue to rise in volume as governments continue to have a balanced combination of Islamic and conventional financing instruments. Such rise in *sukuk* volumes will also be attributed to *sukuk* innovations such as the green *sukuk*, hybrid *sukuk*, more feasible contracts, and a stronger regulatory framework.

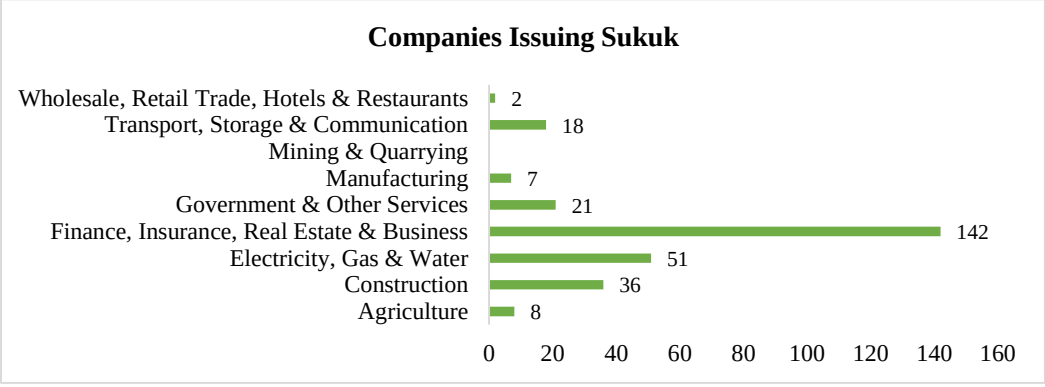
Figure 1: Percentage of Sukuk Issuance by Sectors as of July 2021



Source: BixMalaysia (2021).

Figure 1 shows the distribution of *sukuk* issuance in June 2021. Based on this figure, *sukuk* issuance is dominated by finance, insurance, real estate, and business services amounting to 50% of total issuance. Utilities stood at 16% followed by construction at 13% and government at 8%. Transport, storage and communication accounts for 7% followed by 3% from the agriculture sector and 2% from the manufacturing sector. Wholesale, retail, trade, hotels, and restaurants constitute only 1% of total sukuk issued.

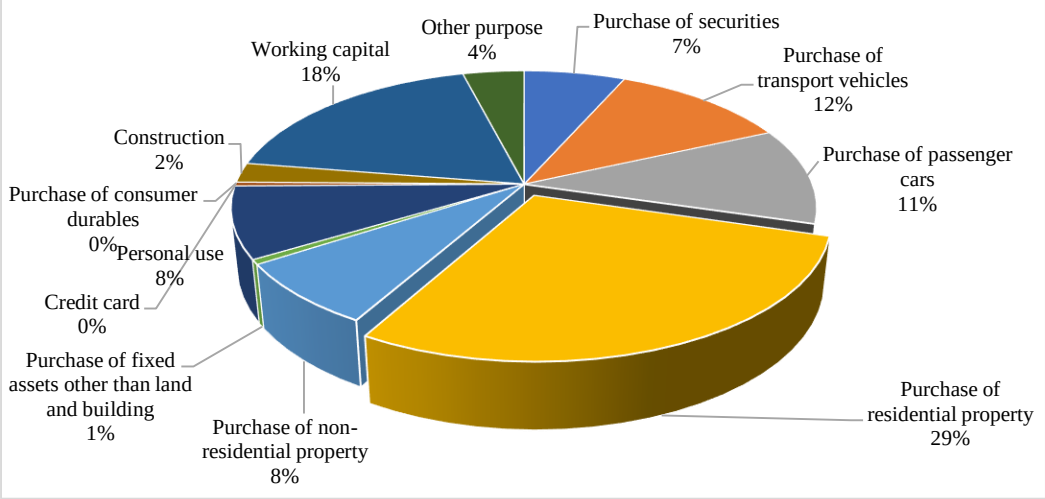
Figure 2: *Sukuk* Issuance by Number of Companies According to Sectors as of July 2021



***Source**:* BixMalaysia (2021).
Note: Some companies may issue more than one type of sukuk or multiple times. The figures above only account for the companies, not the number of times of sukuk issuance.

Figure 2 shows the *sukuk* issuance by a number of countries according to sectors as of July 2021. The majority is made up of finance, insurance, real estate, and business, followed by utility, construction, government, and other services, transport, agriculture, and manufacturing. These figures mirror the percentage of *sukuk* issuance by sector in Figure 1.

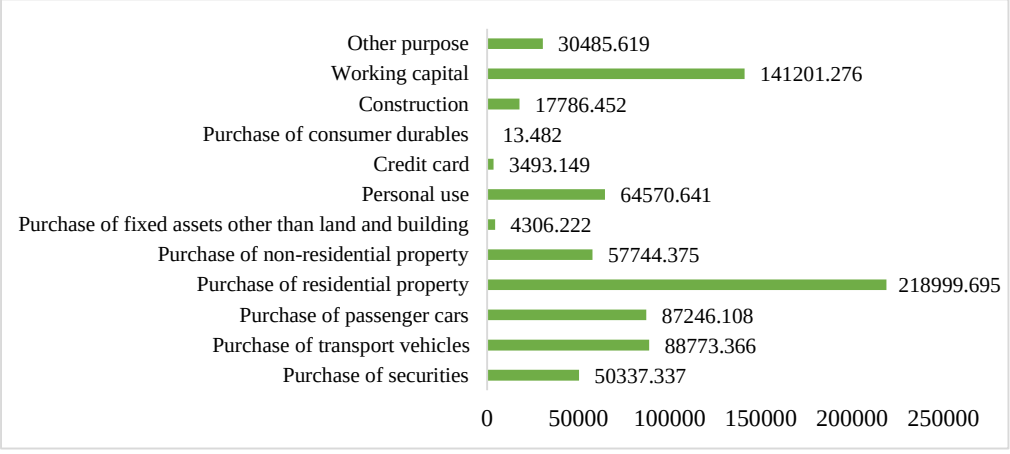
Figure 3: Percentage of Islamic Banking Loans by Type as of June 2021



Source BNM (2021).

Figure 3 shows the percentage of Islamic banking loans by type in June 2021. 29% of the total loans are used to purchase a residential property which can be viewed as a necessity. Financing purchase of passenger cars and transport vehicles stood at 11% and 12% respectively. Loans used for the purchase of securities are approximately 7%. Purchase of consumer durables and a credit card are less than 1%. The loan for working capital is 18% of the total loan whilst construction and purchase of fixed assets only account for 1% of the total loan.

Figure 1: Value (RM) of Islamic Banking Loans by Type as of June 2021 (RM million)



Source: BNM (2021).

Figure 4 shows the value of Islamic banking loans in RM million. The highest amount is dedicated for the purchase of residential property, followed by financing working capital. Purchase of passenger cars, transport vehicles, and personal use are relatively moderate. In terms of value, purchase of consumer durable, credit card and purchase of fixed assets other than land and building are also negligible. Given this scenario, it would be interesting to empirically test whether these two financing instruments promote economic growth. The output would be used as a proxy for economic growth.

3. METHODOLOGY

This paper analyzes the causal relationship between Islamic financing instruments (*sukuk* and Islamic bank loans) and output using bootstrap rolling windows (Li et al., 2016; Balcilar et al., 2013; Balcilar et al., 2010; Nyakabawo et al., 2015). Unlike other existing estimation methods, bootstrap rolling windows (BRW) permits the examination of the behavior of time-varying causality in sub-periods which allows structural changes in the underlying data. As such, this estimation method permits non-linear behavior which captures instability across different sub-samples in the presence of structural changes.

With reference to Bachilar et al. (2010), the residual based bootstrap modified LR Granger causality follows a bivariate VAR(p) process,

$$y_t = \sigma_0 + \sigma_1 y_{t-1} + \cdots \ldots + \sigma_p y_{t-p} + \varepsilon_t, \quad t = 1, 2, \ldots\ldots, T \tag{1}$$

where $\varepsilon_t = (\varepsilon_{1t}\varepsilon_{2t})'$ which follows a white noise process with zero mean and covariance matrix Σ. *p* is the number of optimal lags which is determined by the Schwarz Information Criteria (SIC). When $y_{t=} (y_{1t}, y_{2t})'$ is split into two sub-vectors, y_{1t} and y_{2t}, equation (1) can be represented as:

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \sigma_{10} \\ \sigma_{20} \end{bmatrix} + \begin{bmatrix} \sigma_{11}(L) & \sigma_{12}(L) \\ \sigma_{21}(L) & \sigma_{22}(L) \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ e_{2t} \end{bmatrix} \tag{2}$$

where $y_{1t} y_{2t}$ and denote the growth rates of Islamic financial instruments and output respectively. Islamic finance instruments will be represented by sukuk and banking products.

$\varphi_{ij}(L) = \sum_{k=1}^{p+1} \sigma_{ij,k} L^k, \quad i,j = 1,2$ and L is the lag operator defined as $L^k x_t = x_{t-k}$

The null hypothesis of Islamic finance instruments do not Granger cause output is tested based on equation (2) by imposing restrictions, $\sigma_{12,k} = 0$ for $k = 1, 2, \ldots, p$. Alternatively, the null hypothesis of output does not Granger cause Islamic finance instruments are tested by imposing restrictions, $\sigma_{21,k} = 0$ for $k = 1, 2, \ldots, p$. The full sample Granger causality test relies on the residual-based *p*-values and modified LR statistics. If the null hypothesis of $\sigma_{12,k} = 0$ for $k = 1, 2, \ldots, p$ is rejected, then there is a meaningful causality between Islamic finance instruments and output where the Islamic financial instruments can predict the movements in output. If $\sigma_{12,k} = 0$ for $k = 1, 2, \ldots, p$ for is rejected, then the movement in output affects the changes in Islamic finance instruments. If causality runs from Islamic finance instruments to output, this suggests that Islamic finance promotes growth. Similarly, if causality runs from output to Islamic finance instruments, this indicates that economic development spurs the development of the Islamic financial sector. These results can be used for the assessment of policies to be implemented in Malaysia.

3.1. Parameter Stability Test

The full sample assumes that the parameters in Equation (1) and (2) of the VAR model are constant over time. Therefore, when running the full sample, we assume only a single causality persists over the whole sample period. However, the parameters may not be constant over the sample period. The data may undergo structural changes due to changes in policies or economic crises may have a permanent implication on the economy leading to structural changes. Once the assumption is violated, the full sample results will be unstable hence, invalid (Balcilar et al., 2013). To remedy this predicament, tests for short-run and long-run parameter stability are conducted on the same data. The short-run parameter stability will be tested using *Sup-F*, *Mean-F* and *Exp-F* developed by Andrews (1993) and Andrew and Ploberger (1994). The *Sup-F*, *Mean-F*, and *Exp-F* tests exhibit non-standard asymptotic distributions; therefore, the critical values are estimated via the parametric bootstrap procedure. We follow Li et al. (2016) who rely on the Monte Carlo simulations using 2,000 samples generated from VAR with constant parameters to come up with

the critical values and *p*-values. A 15 percent trimming for both ends of the sample is applied resulting in the fraction of the sample to be in (0.15, 0.85).

Prior to that, we must ensure the variables are integrated of order 1, *I(1),* and cointegration must be tested. The existence of long-run parameter stability should be established because of the variables at cointegrated at levels, then VAR models in first difference must be allowed for error corrections, otherwise, it would be misspecified. To test for cointegration and long-run relationship, we use Fully Modified ordinary least squares (FM-OLS) developed by Phillips and Hansen (1990). We employ the L_c test proposed by Nyblom (1989) and Hansen (1992) to ascertain long-run stability. The L_c test also serves as a test for cointegration given that all the variables are *I(1).* The L_c test is computed separately from *Sup-F, Mean-F,* and *Exp-F* tests. Each L_c test is estimated using VAR via FM-OLS estimator.

3.2. Sub-Sample Rolling Window Causality Test

Next, the sub-sample rolling window causality test is applied. The rolling window causality test is used to overcome the problem of parameter non-constancy and avoid pre-test bias inherent in most sample splitting techniques or the use of dummy variables. In addition, the use of rolling estimation is to capture possible instability across sub-samples arising from structural changes, given that we believe that the causal relationship between the variables changes over time. The sub-sample rolling window causality test is based on modified bootstrap estimation.

The rolling window technique enables the identification of time variations in the causal links between Islamic finance instruments and output and between output and Islamic finance instruments. It also assesses the magnitude of the effect of Islamic financial instruments on output and vice versa. The rolling window uses fixed-size sub-samples rolls running sequentially from the beginning to the end of the sample. The window size l and the increment interval of each regression will determine the performance and accuracy of the rolling windows. There is a trade-off between small and large rolling windows. Small intervals maximize the total number of rolling regressions and hence offer more detailed transitions of the causality. A small window suppresses the problem of heterogeneity and improves the representativeness of the parameter estimates. However, small windows have higher standard errors of the estimates which may reduce parameter accuracy. A larger window improves the accuracy of the estimates but reduces the detailed information on the causality and the matter is aggravated in the presence of heterogeneity. Given the trade-off in terms of the size of the window, we need to balance between representativeness and accuracy prior to choosing l. According to Balcilar et al. (2010), the optimal window size in the rolling windows method has not been established. Based on the total available data, we rely on a small window of 24 months or 2 years in the rolling window estimates. Our choice is also based on the argument by Pesaran and Timmerman (2005) and Li et al. (2016) who pointed out that the size of the window should be based on the persistence and size of the structural breaks. They argue that for frequent breaks, the size of the window should be as low as 20 based on their Monte Carlo simulations which use the root mean square errors. Other considerations that must be made when deciding the size of the window are the degree of freedom required for larger windows to ensure the precision of the causal estimates and the presence of multiple structural changes may require smaller window size to enable estimations of the multiple shifts (Li et al., 2016).

When fixed size rolling windows has *l* observations, the full sample is transformed into a sequence of *T*- *l* sub-samples which is expressed as $\tau - l + 1, \tau - l, \ldots, T$ for $\tau = l, l + 1, \ldots, T$. The window size (*l*) has two major functions. First, it is the parameter that controls the number of observations in each sub-sample. Second, it determines the precision of the estimated causal link. The residual-based bootstrap modified-*LR* causality test is then applied to each sub-sample. The bootstrap *p*-values of the observed *LR*-statistics are calculated based on rolling through $T - l$ sub-samples which allows the identification of possible time variations in the causal link. The impact of Islamic finance instruments on output is calculated based on the average of the entire bootstrap estimations derived from $N_b^{-1} \sum_{k-1}^{p} \hat{\sigma} *_{21,k}$, where N_b represents the number of bootstrap repetitions. Similarly, the impact of output on Islamic finance instruments is calculated using $N_b^{-1} \sum_{k-1}^{p} \hat{\sigma} *_{21,k}$, where N_b is the number of bootstrap repetitions. $\hat{\sigma} *_{12,k}$ and $\hat{\sigma} *_{21,k}$ are the bootstrap estimates based on the VAR model in Equation 2. The confidence interval is calculated based on the fifth quantile for the lower limit and ninety-fifth quantiles for the upper limit of $\hat{\sigma} *_{12,k}$ and $\hat{\sigma} *_{21,k}$ for 90 per cent confidence interval.

3.3. Robustness Test

For the purpose of robustness, this paper uses another estimation approach that could capture the causality and direction of leading variables in a non-linear framework. The continuous wavelet transforms (CWT) and wavelet coherence (WC) allows the exploration of successiveness between two variables on a multi-time scale (Sharif et al., 2020). Wavelet analysis is preferable for time-series data that are non-stationary due to trends or abrupt changes (such as the COVID-19 pandemic effect). Time-varying characteristics which exist in the majority of time series data would be naturally dealt with via the wavelet filters. The CWT spectrum illustrates each variable series in different time-frequency areas which are short, medium, long, and very long term. WC analyses the causal association amongst the variables. The cyclic and anti-cyclic association between the investigated variables is identified via the cone of influence test and is displayed through the WC power spectrum.

3.4. Data Sources

All data are collected from Monthly Bulletin Statistics, Bank Negara Malaysia (various issues), and the Department of Statistics from 2000M1 to 2021M6 with 258 observations for total sukuk and categorical sukuk data. Data for loans and loans by category covers a slightly shorter period from 2006M12 to 2021M6 with 175 observations, which is partly dictated by the availability of data for Islamic banks. No separate data for loans under Islamic banking prior to this date. The choice of sample period for sukuk starts from the year 2000 since earlier data lacks regularity. In other words, prior to the year 2000 sukuk is not issued on monthly basis but issued at irregular intervals. Data for sukuk is obtained from Table 2.11 from the Monthly Statistical Bulletin, Bank Negara Malaysia (various issues). Sukuk is issued to finance at least nine (9) major sectors including (i) agriculture, forestry, and fishing (ii) construction (iii) electricity, gas, and water (utility) (iv) finance, insurance, real estates, and business services (v) government and other services (vi) manufacturing (vii) mining and quarrying (viii) transport, storage and communications, and (ix) wholesale, retail trade, hotels, and restaurants. In this study, the disaggregated analysis is estimated on only four sectors which are finance, utility, transport, and construction since sukuk issuance in other sectors lacks regularity and is small in volume over the

sample period. Output is represented by the industrial production index and data is derived from Table 3.5.1 of the Monthly Statistical Bulletin, Bank Negara Malaysia (various issues). In addition, for robustness purposes, categorical sukuk data namely construction, utility, finance, and transport are used to test whether interrelationships exist between growth and sukuk at a disaggregated level. On a similar note, the total loan is also segregated by type which includes personal loans, loans for purchasing cars, transport, credit card, buying residential property, and securities purchases. Data is extracted from Table 1.18.1.

4. RESULTS AND DISCUSSION

Table 1 reports the unit root test for all the variables used in this study. All variables are integrated of order 1, *I(1)*, or having a unit root at level, rendering the suitability of using the aforementioned estimation method in Section 3. Table 2 shows the single equation results with the assumption of parameter constancy over time. Results in Table 2 assume a permanent causal link between the two variables at every time period. In the case of *sukuk*, only total *sukuk*, and *sukuk* for transportation Granger-cause output. The null hypothesis of output does not Granger cause *sukuk* is rejected for total *sukuk*, *sukuk* for finance, and *sukuk* for construction at a 1% significant level. From the Islamic banking perspective, Islamic banking financing via loan Granger-cause output in the case of loans for the purchase of passenger cars, transport vehicles, credit cards, and securities. These results suggest that loans increase demand and promote consumption, hence increasing the production of goods and services, and eventually, economic growth. Output Granger-cause loan only in the case of credit cards which suggests as income rises, consumption via credit cards may also increase.

Table 1: Unit Root Test

	Sukuk		**Islamic Banking Loans**		
	Level	**First Difference**		**Level**	**First Difference**
Sukuk- Total	0.5380	-13.2520***	Loan - Total	1.3906	-3.6422**
Sukuk - finance	0.9218	-11.9928***	Car	0.9683	-3.5177**
Sukuk utility	-0.5162	-13.9528***	Transport Vehicles	0.9462	-3.1897**
Sukuk transport	-1.2613	-11.0811***	Credit Card	1.7161	-1.9185*
Sukuk construction	-0.6554	-11.8132***	Residential Property	2.7314	-3.5271***
IPI	-2.1399	-4.5386***	Securities	1.4986	-3.8517***

Note: The unit root test is based on ADF test statistics with no intercept and no trend. ***, ** and * denote 1%, 5% and 10% significant levels.

Table 2: Full Sample Bootstrap Granger Causality Tests Between *sukuk* and Output Series

Islamic finance instruments	H_0: *Sukuk* does not Granger cause output		H_0: Output does not Granger cause sukuk	
	LR-statistics	Bootstrap *p*-value	LR-statistics	Bootstrap *p*-value
Sukuk total	4.4638*	0.0990	46.2108***	0.0000
Sukuk - finance	0.2891	0.8790	40.5689***	0.0000
Sukuk utility	0.5349	0.7640	0.8822	0.6530
Sukuk transport	5.5691*	0.0630	0.5568	0.7810
Sukuk construction	0.0401	0.9850	12.5924***	0.0010

	H_0: IB financing does not Granger cause output		H_0: Output does not Granger cause IB financing	
	LR-statistics	Bootstrap *p*-value	LR-statistics	Bootstrap *p*-value
Total IB	6.0060	0.1150	2.7868	0.2600
Car	6.0648*	0.0920	2.6569	0.2740
Transport Vehicles	6.0840*	0.0960	2.4153	0.2970
Credit Card	14.3855***	0.0080	5.0296*	0.0920
Residential Property	4.3032	0.2060	4.0818	0.1420
Securities	11.5880***	00.70	0.5416	0.7710

Note: IB denote Islamic banking. ***, ** and * indicate significance level at 1%, 5% and 10%.

Table 3a: Parameter Stability Tests

	Sukuk		**Output**	
	Statistics	**Bootstrap *p*-value**	**Statistics**	**Bootstrap *p*-value**
Sukuk – total				
Sup-LR	0.8655	0.9885	5.0371**	0.0445
Exp-LR	0.1883	0.9545	1.7479***	0.0095
Mean-LR	0.3636	0.9515	3.2750***	0.0045
L_c	0.5669**	0.0275	0.4755**	0.0470
Sukuk finance				
Sup-LR	0.9043	0.9760	6.2546**	0.0155
Exp-LR	0.1170	0.9935	1.9607***	0.0045
Mean-LR	0.2300	0.9930	3.5641***	0.0025
L_c	2.1672***	0.0010	3.1380***	0.0100
Sukuk utility				
Sup-LR	2.2163	0.5590	4.5801*	0.0515
Exp-LR	0.3744	0.6615	0.8740	0.1160
Mean-LR	0.6694	0.6830	1.4981	0.1375
L_c	0.2947	0.1547	1.5531***	0.0100
Sukuk transport				
Sup-LR	2.4555	0.4455	4.1025*	0.0875
Exp-LR	0.6723	0.2815	0.8372	0.1230
Mean-LR	1.2880	0.2415	1.5516	0.1165
L_c	0.6240**	0.0187	1.3751***	0.0100
Sukuk construction				
Sup-LR	1.1503	0.9385	3.7642	0.1260
Exp-LR	0.2414	0.8975	0.7281	0.1960
Mean-LR	0.4613	0.8910	1.2283	0.2305
L_c	0.0959	0.2000	1.0328***	0.0010

Note: IB denote Islamic banking. ***, ** and * indicate significance level at 1%, 5% and 10%. *p*-values for L_c.

Table 3b: Parameter Stability Tests

	IB Financing (Loan)		Output	
	Statistics	Bootstrap *p*-value	Statistics	Bootstrap *p*-value
Total financing				
Sup-LR	14.0652**	0.0105	1.2535	0.8845
Exp-LR	3.8348***	0.0075	0.2069	0.9285
Mean-LR	4.1316***	0.0005	0.3933	0.9270
L_c	0.3263	0.1258	0.3996*	0.0000
Car				
Sup-LR	17.4973***	0.0080	0.8329	0.9795
Exp-LR	5.3884***	0.0065	0.1744	0.9595
Mean-LR	5.1197***	0.0030	0.3392	0.9550
L_c	0.1260	0.2000	0.3469	0.1098
Transport Vehicles				
Sup-LR	17.9429***	0.0020	0.6578	0.9950
Exp-LR	5.6084***	0.0015	0.1767	0.9495
Mean-LR	5.1976***	0.0005	0.3457	0.9460
L_c	0.1293	0.0200	0.3542	0.1044
Credit Card				
Sup-LR	4.8054**	0.0420	3.8631	0.1200
Exp-LR	1.4169**	0.0180	1.0704*	0.0720
Mean-LR	2.5273**	0.0185	1.8153*	0.0830
L_c	0.2189	0.0200	0.9934***	0.0100
Residential Property				
Sup-LR	12.5753**	0.0140	0.7833	0.9865
Exp-LR	3.0907**	0.0145	0.1465	0.9815
Mean-LR	3.1645**	0.0110	0.2867	0.9800
L_c	0.4802*	0.0457	0.7147***	0.0100
Securities				
Sup-LR	5.2086*	0.0820	2.0232	0.5875
Exp-LR	0.8095	0.1390	0.4021	0.6095
Mean-LR	1.2537	0.1600	0.7318	0.6240
L_c	0.1556	0.2000	0.2713	0.1797

Note: IB denote Islamic banking. ***, ** and * indicate significance level at 1%, 5% and 10%. p-values for L_c.

The sequential Sup- LR, Mean-LR, and Exp-LR are reported in Table 3a and 3b. Results in both tables account for the possible time-varying causalities within the time-series data based on sub-samples data. Therefore, in the event of structural changes or any other time-varying changes, any instability resulting from those changes could be observed, hence, results presented via the bootstrap rolling windows (BRW) should provide better estimates. Irrespective of sample size, level of cointegration, or error term processes, BRW distribution is expected to result in smaller distortions. In addition, the strict assumption of a permanent causal link between the two variables at every time period is relaxed. Sup-LR statistics are used to test a swift regime shift. Mean-LR and Exp-LR test whether there is a stable relationship over time.

Table 3a presents the results for *sukuk* and output. There is significant evidence of parameter non-constancy in the output - total *sukuk* equation. In addition, even in the long run, there is parameter instability in both directions. Similar results are reflected in the output - *sukuk* for finance. Significant parameter non-constancy is detected for output – *sukuk* for finance and the long run exhibit similar results as total *sukuk*. Parameter stability is present in the case of construction but in the long run, output – *sukuk* for construction show evidence of parameter non-constancy. For *sukuk* for utility and *sukuk* for transport – output equation, the short run seems to be stable. In both cases, only the Sup-LR test shows some parameter non-constancy in the short run and instability occurs in the long run in the output – *sukuk* for utility and *sukuk* for transport equation. The long-run equation for *sukuk* transport – output also exhibits parameter non-constancy. The results in Table 3a echo the linear results in Table 2 in most cases. Both long-run equations for total sukuk – output and output – total sukuk, are significant in the long run with the sub-sample results providing more information on parameter instability in the short run. Similar results are echoed in the long run case of output - *sukuk* for finance. Results for long-run output – *sukuk* for construction are similar with BRW offering information on parameter instability in the long-run equation. In other words, although in the long run there is a relationship between the two estimated variables, the results may not be stable across the sample period which means that there could be a period of a significant and insignificant causal relationship.

Table 3b offers several interesting insights. Parameter instability is evident in all relationships running from loans to output. For the output–loan equation, parameter instability is detected only in credit cards. Others remain relatively stable in the sub-sample period. The long-run results are relatively stable in the case of the total loan, cars, transport vehicles, credit cards, and securities but significant short-run instabilities are present in the sub-samples for total loan and disaggregated loan – output cases. Hence, we can infer that the long-run parameter in Table 2 for loan–output causality is relatively stable in the long run despite short-run parameter instability. The significant long-run causal relationship from the output – credit card is relative may suffer from parameter instability as shown in Table 3b.

4.1. Robustness Test

The results in Table 2, Table 3a, and Table 3b show the causal relationship between Islamic financing instruments (*sukuk* and loans) and output. The results offer some insights on the possibility of parameter non-constancy in the short and long run. We take the analysis further by examining whether two variables move together (phase) or in opposite direction (anti-phase) and which variable is the lead/ or lag variable. Figure 5 and 6 shows the continuous wavelet transform (CWT) and wavelet coherence (WC) diagrams. The vertical axis shows the frequency where the lower the frequency, the higher the scale. The time period is interpreted as follows: 4-8 (short term), 8-16 (medium-term), 16-32 (long term), and more than 32 (very-long term). Time is on the horizontal axis which is interpreted as in Tables 4 and 5.

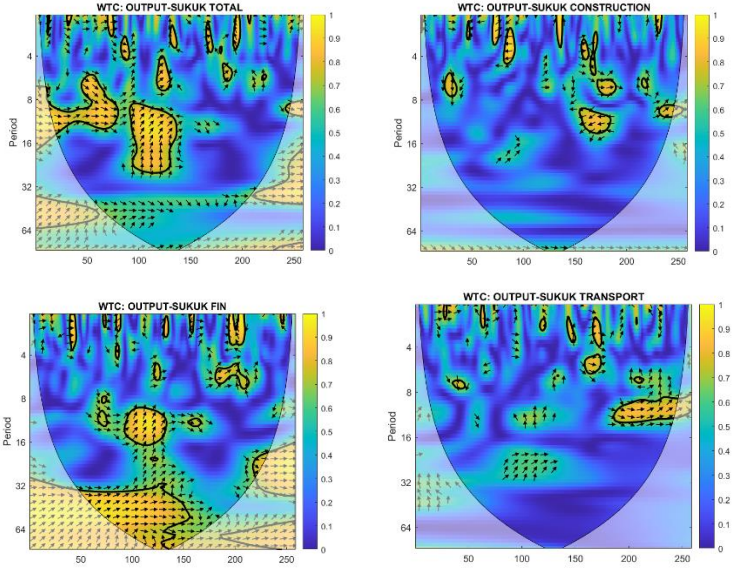
Table 4: For output – Islamic (2006M12-2021M6)

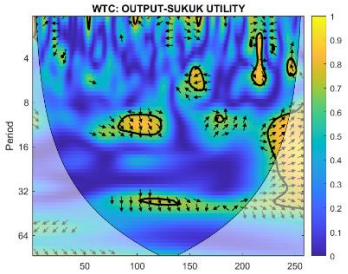
Notation		Approximate Month/Year
20	-	July 2008
40	-	March 2010
60	-	November 2011
80	-	July 2013
100	-	March 2015
120	-	November 2016
140	-	July 2018
160	-	March 2020

Table 5: For output – *sukuk* (2000M1-2021M6)

Notation		Approximate Month/Year
20	-	July 2002
40	-	February 2005
60	-	September 2007
80	-	May 2010
100	-	December 2011
120	-	July 2014
140	-	February 2017
160	-	September 2019

Figure 5: CWT Plots for Output and *Sukuk*





Note: The thick black contour indicates the 5% significance level against yellow noise. The cone of influence specifies the region affected by edge effects and is displayed outside of the black line. The colour code for power ranges from blue (low dependence) to yellow (high interrelationship). The phase difference between the two series is indicated by arrows. Arrows pointing to the right mean that the variables are in phase. Arrows pointing to the left mean that the variables are out of phase. In phase indicates that variables are having a cyclic effect and out of phase or anti-phase means that the variables are having an anti-cyclic effect.

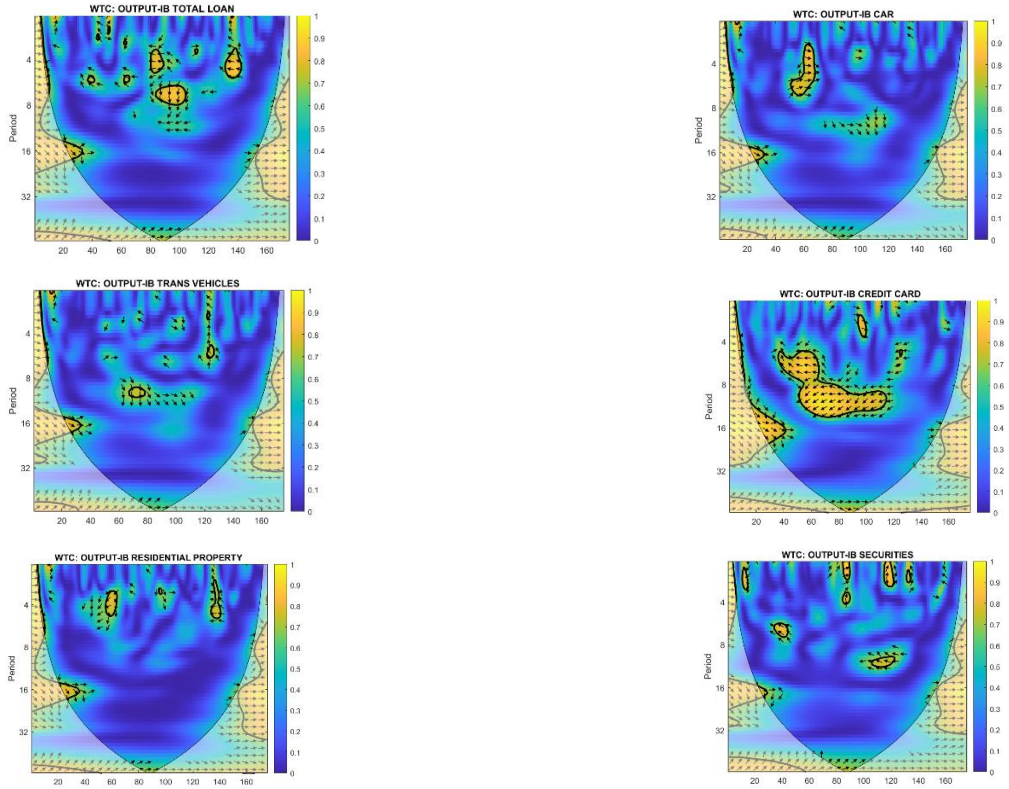
Figure 5 illustrates the results for the interrelationship between *sukuk* and output. For the total *sukuk*, there is a significant positive relationship between *sukuk* and output in the short and medium-term especially in years 2004 and 2008-2010. The arrow is pointing to the right-up indicating that the leading variable is *sukuk*. *Sukuk* for construction have less significant areas, most occurring for short term (period 4-8) and medium-term (period 8-16) from 2012 to 2015. Results are also mixed in the case of construction with significant phase (variables move in the same direction) and anti-phase period (variables move in the opposite direction) is detected in the short run. There is a significant positive relationship between s*ukuk* for finance and output. Right-up pointing arrows show that output is the leading variable that substantiates the demand-following hypothesis where economic development promotes financial development. The result is consistent with the results in Table 2. The significant areas show a strong interrelationship between *sukuk* (finance) and output in the short term (period 0-8) in the year 2008, medium-term (period 8-16) between 2008-2009, and very-long-term (period 32-64) in 2004-2011. *Sukuk* for transport provides some interesting results. The causal relationship runs from *sukuk* for transport to output which emphasizes the importance of supply chain and logistics in promoting output growth. The positive significant relationship is prevalent in the short to medium term especially between 2016 – 2019. On a similar note, *sukuk* for utility is the leading variable with a significant positive relationship in the short and medium-term. In summary, causality runs from *sukuk* output for total *sukuk*, transport, and utility *sukuk* whereas construction sukuk seems to exhibit a mixed behaviour. In the case of *sukuk* for finance, the impact is more pronounced in the very-long run. Such results are consistent with earlier findings using BRW.

Figure 6 displays the CWT plots for output and Islamic banking loans. For total Islamic loans, there is a significant negative interrelationship between the two variables in the short term (period 4-8). For all samples, the interrelationship between output and Islamic loan is very low in the long run which is in line with the results in Table 2. Car loans are positive and significant in the short and medium-term. In the short term, private car loan is the leading variable whilst in the medium term, the output is the lead variable. Loan for transport vehicles exhibits low dependence amongst the two variables. For credit card loans, the significant interrelationship is detected in the short term (period 4-8) and medium-term (period 8-16) in 2008-2010. In the short run and anti-phase, the output is the leading variable which indicates that output growth would reduce the usage of

credit cards, hence, credit card loans in the short run. In the medium term and in-phase, between 2011-2016, credit card loan is the lead variable which infers that loan on consumption expenditure leads to growth in output. As for residential property, no significant relationship is present except for a small patch in the short term, around 2010-2011 where residential property loans lead to the output. For loans to purchase securities, a significant relationship is present in the short and medium-term in years 2011, 2014, and 2016, all of which show a negative relationship between output and securities loans. This may indicate that less investment would be available for production (output) when the resources are diverted to the purchase of securities.

In general, the overall results suggest the role of Islamic financing instruments in promoting economic growth which is consistent with existing studies (Smaoui et al., 2017; Al Fathan and Arundina, 2019; Khoutem, 2014). This study further enhances previous work by incorporating the short, long-run effects, non-linear effects, direction lead/lag variable, and the duration of the significant relationship.

Figure 6: CWT Plots for Output and Islamic Banking Loans



Note: The thick black contour indicates the 5% significance level against yellow noise. The cone of influence specifies the region affected by edge effects and is displayed outside of the black line. The colour code for power ranges from blue (low dependence) to yellow (high interrelationship). The phase difference between the two series is indicated by arrows. Arrows pointing to the right mean that the variables are in phase. Arrows pointing to the left mean that the variables are out of phase. In phase indicates that variables are having a cyclic effect and out of phase or anti-phase means that the variables are having an anti-cyclic effect.

5. CONCLUSION

This paper revisits the financial development – economic growth nexus from the perspective of Islamic financing instruments namely *sukuk* and Islamic banking loans. The *sukuk* market is used as a proxy for Islamic finance since Malaysia is one of the largest *sukuk* issuers in the world and due to the availability and consistency of publication of data. The prime aim of this study is to understand the direction of causality, that is, whether the causality runs from Islamic finance to output growth or vice versa. In the static models which assume parameter constancy, the direction of causality runs from growth of output to *sukuk* which supports the demand-led hypothesis. BRW results also support the same contention with additional details. *Sukuk* can be viewed as a financing tool to support further development. As the economy grows, the demand for financing also increases to fulfil the increasing demand. In the case of Malaysia, *sukuk* is mainly used to finance development projects such as the Kuala Lumpur International Airport (KLIA) and other infrastructure-enhancing projects. Another major financing instrument is Islamic banking financing through loans. Results suggest parameter non-constancy in the sub-samples for loans – output equations. The results are supplemented with continuous wavelet transforms (CWT) and wavelet coherence (WC) which allows for causality in a multi-time scale. In addition, CWT and WC allow for a measure of successiveness of the lead/lag variable in a phase (move together in the same direction) or in an anti-phase (moving in the opposite direction) manner. In conclusion, both *sukuk* and Islamic banking loans are necessary to promote output and vice versa. Based on the results, the government should carefully balance financing via loans and *sukuk* to ensure resilience in the economy. In addition, *sukuk* is a viable option for financing the COVID-19 recovery process.

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