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Islamic Stock Price and Exchange Rate: A Wavelet Analysis for ASEAN-5

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Abstract

Purpose: The present paper aims to examine and elucidate the dynamic linkage between Islamic stock prices and exchange rates in ASEAN-5 countries. Since the economic uncertainty of exchange rate uncertainty occurred over time regardless of developed or developing countries, the risk was also borne by related parties who engaged in cross-border or international investment activities.

Design/methodology/approach: This paper employs a time series approach of the unit root test and Continuous Wavelet Transform analysis. The Continuous Wavelet Transform-based wavelet tools of the wavelet power spectrum, wavelet coherency, and wavelet phase difference use to analyze the interactions between Islamic stock prices and exchange rates at multiple time scales and frequency bands. Secondary data of Morgan Stanley Composite Index (MSCI) Islamic stock prices and exchange rates for ASEAN-5 countries of Malaysia, Singapore, Indonesia, Philippines, and Thailand were collected and covered the period 2010 to 2020. MATLAB version R12b and Stata version 16 will use to analyze the obtained data.

Findings: The wavelet analysis revealed that the relationships between Islamic stock prices and exchange rates are relatively weak in the very low-frequency scales but more correlated at the medium- and long-term scales. All ASEAN-5 Islamic stock prices negatively correlated with exchange rates, yet stock prices in Malaysia, Singapore, Indonesia, and the Philippines led the exchange rates. Meanwhile, the Thai baht leads the Thailand Islamic stock prices.

Research limitations/implications: The paper presents a quantitative study on the dynamic relations between Islamic stock prices and exchange rates in ASEAN-5. These findings should be further explored by including the recent study timeframe and comparing the interactions between the conventional stock market and exchange rates. Furthermore, since the present study has been focusing on the ASEAN-5 context, further research could explore other regions, such as OECD and BRICS, and make the comparison between regions.

Practical implications: The result of the study provides a better understanding of the financial integration phenomenon to the public and assists related parties involved in making sound decisions and policies, such as portfolio advisors and investors.

Originality/value: In terms of the context contribution, this study solely focuses on the dynamic interactions between Islamic stock prices and exchange rates in the ASEAN-5 context. In terms of methodology, this study incorporates wavelet analysis, which has lately been used in the fields of financial economics. Most existing estimation methods only capture

co-movement or causal relations between series in the time domain. Yet, the wavelet analysis examines the two series at different time scales and frequency bands.

Keywords: Islamic Stock Price, Exchange Rate, Wavelet Analysis, Wavelet Phase-Difference, ASEAN-5

Introduction

Financial liberalization and integration among countries benefited national economies in many macroeconomic perspectives, particularly for investment activities. Malaysia, Singapore, Indonesia, Thailand, and the Philippines, known as the ASEAN-5, were recognized as fast-growing emerging markets and promoted as the best investment destinations. Despite the conventional stock market, the Islamic stock market is one of the investment strategies that investors may consider. The Islamic stock market follows Shariah compliance screening processes of industrial and financial screening, Shariah (Islamic law) principles that prohibit usury (riba), deception (ghrar), alcohol (khamar), gambling (maysir) and engaging in unethical financial transactions. Meanwhile, the Islamic stock market has gained international attention due to its consistent growth and has generated funds from both Muslim and non-Muslim countries (Alam et al., 2020).

Yet, the economic uncertainty of exchange rate uncertainty is a risk borne by investors, portfolio advisors, and firm engaged in foreign trades (Masrizal & Herianingrum, 2019). Two theoretical concepts explain the connections between stock price and exchange rate, First, the flow-oriented approach advocated by Dornbusch and Fischer (1980) contends that changes in the exchange rate can influence stock market performance via international competitiveness. The theory posits that exchange rates lead the stock market prices, refer Figure 1. Second, the portfolio balance approach advocated by Barson and Frenkel (1983) asserts that stock prices are adversely associated with exchange rates due to capital flows, stock market state, and demand for a country's currency. The theory suggest that stock market prices lead the exchange rates, refer Figure 2.

Furthermore, measuring the interconnection of Islamic stock markets and exchange rates is increasingly recognized as it has important practical implications for finance (Gokmenoglu et al., 2021). Hence, this study aims to elucidate the dynamic linkage of the ASEAN-5 Islamic stock markets with exchange rates using wavelet analysis. The wavelet analysis approach provides time-varying correlations between series at multiple scales, the direction and degree of reliance between series, and the lead-lag relationship between series over time and frequency (Skoura, 2019). The rest of the paper is structured as follows. Section 2 reviews prior studies on the interactions of Islamic stock prices and exchange rates. The data and methodology used are presented in Section 3. Section 4 reports results and discussions. Summarize findings in Section 5.

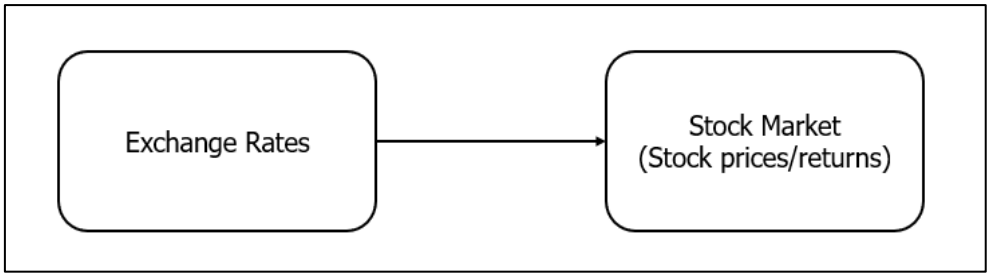

Figure 1: Theoretical Framework for Flow-Oriented Approach.
Source: Dornbusch and Fischer (1980)

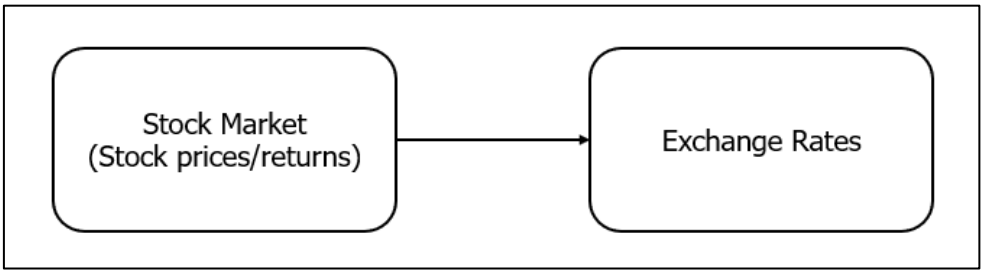

Figure 2: Portfolio Balance Approach Theoretical Framework.
Source: Barson (1983) and Frenkel (1983)

Literature Review

Due to the scarcity of studies focusing solely on Islamic stock markets and exchange rates, this study will refer to prior studies that explore the interaction between Islamic stock markets and macroeconomic factors. Yet, these existing studies yields mixed findings. These could be due to different econometric methods focusing on distinct countries, time frames, data frequencies, and variable measurements. Mustafa et al. (2017) discovered positive unidirectional causal relations of exchange rate granger cause Malaysia's Islamic stock prices using ARDL bound testing and VECM from 2007 to 2014. Masrizal & Herianingrum (2019) revealed similar findings for the Jakarta Islamic stock market using multiple linear regression model from 2011 to 2018.

In contrast, Hussin et al. (2012) showed negative bidirectional causation links for Malaysia's Islamic stock price and exchange rate using the Johansen Cointegration and VECM approach from 1999 to 2007. Further, Alam et al. (2020) revealed similar findings in both the short and long run from 2015 to 2019 using the Cointegration test and Error Correction Model. These negative relationships could be caused by the countries' respective statuses, investor viewpoints, and other related aspects. Moreover, Majid (2016) discovers an insignificant positive relationship between the Malaysian Dow Jones Islamic Index and the real effective exchange rate using the Johansen Multivariate cointegration test and the VECM approach. Karyatun et al. (2021) indicate insignificantly causal relations between stock price and exchange rate in the short run. These findings suggest that the Islamic stock market is robust to macroeconomic fluctuations due to the Shariah principles.

In short, it is necessary to clarify the dynamic relationship between Islamic stock price and exchange rate, particularly in different perceptions of multiscale frequency bands. Again, existing estimation methods only capture co-movement or causal relations between series in the time domain. However, there is a lack of focus on the wavelet analysis approach that analyzes the series at multiple frequencies and scales rather than just one or two. Hence, this study fill-up this gap by applying the wavelet analysis approach. Highlighting the dynamic links between Islamic stock price and exchange rate allows for a better understanding of the financial integration phenomenon and assists parties involved in making sound decisions and policies.

Method

The weekly time-series data of Morgan Stanley Composite Index (MSCI) Islamic stock prices and nominal exchange rates for ASEAN-5 countries were collected, covers from 01 January 2010 to 25 December 2020. All data are retrieved from the Bloomberg website. The Augmented Dickey-Fuller and Phillips-Perron unit root tests were used to examine the stationarity of the data. Using non-stationary data might yield spurious outputs.

Wavelet analysis is a formidable statistical tool for decomposing series in time and frequency domains and analyzing co-movement between series at multiple scales. These characteristics

provide more information about the potential interactions between series. The Continuous Wavelet Transforms (CWT) approach can deal with non-stationary financial trends, autocorrelation, and heteroscedasticity, structural breaks (Karlsson, 2019). Furthermore, the CWT method depicts the series correlation in a two-dimensional figure, which aids in identifying and interpreting the pattern or potential information of the variables. Given a time series of $x(t)$, the continuous wavelet function (w_x) is defined as equation (1). The * represent the conjugate for the complex number.

$$w_x(u,s) = \int_{-\infty}^{+\infty} x(t) \frac{1}{\sqrt{|s|}} \psi^* \left(\frac{t-u}{s}\right) dt \tag{1}$$

Moreover, there are three CWT-based wavelet tools. First, Hudgins et al. (1993) presented the Wavelet Power Spectrum to discover covariance between two time series. Second, Torrence and Compo (1998) devised Wavelet Coherency to measure the degree to which two-time series move together across time and frequencies. A value near one implies that the two series are strongly correlated, whereas a value near zero indicates a poor correlation. Wavelet coherency is defined as the absolute value of the smooth cross-wavelet power spectrum divided by the product of the smoothed individual wavelet power spectra of x and y, which is identical to the coefficient of correlation superscript two shown in equation (2). Third, Torrence and Webster (1999) developed the Wavelet Phase-Difference method for assessing positive and negative correlation and the lead-lag interaction between series. The cross-wavelet transforms ($W_{xy}(u,s)$) can be used to compute the wavelet phase-difference, as defined in equation (3). Noted that the wavelet transforms of $W_x(u,s)$ can be decomposed into the real part $R\{W_x(u,s)\}$ and the imaginary part $ב\{W_x(u,s)\}$. Meanwhile, the arrows show the statistically significant phase-difference information between series within the diagram in wavelet coherence plots. The two series are moving in opposite directions (same direction), as indicated by the arrows pointing leftward (rightward). When the arrows pointing upward, the first series (x) leads the second series (y), and vice versa. Meanwhile, the arrows point right-up (right-down) to indicate a positive correlation and x is leading (y is leading). The arrows pointing left-up (left-down) indicate a negative correlation and x is leading (y is leading).

$$R_{xy} = \frac{|S(W_{xy})|}{\left[S(|W_x|^2) \cdot S\left(|W_y|^2\right)\right]^{\frac{1}{2}}} \quad 0 \le R_{xy} \le 1 \tag{2}$$

$$\phi_{xy}(u,s) = tan^{-1}\left(\frac{ב\left(S\left(s^{-1}W_{xy}(u,s)\right)\right)}{R\left(S\left(s^{-1}W_{xy}(u,s)\right)\right)}\right) \tag{3}$$

Findings

Tables 1 shows the unit root test results of ASEAN-5 exchange rates and Islamic stock prices. Based on the outputs, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests show that all data were stationary at a different level, either at level or at first differences. These results imply that the exchange rate and the Islamic stock price are free from the unit root problem.

Table 1: Unit root test for ASEAN-5.

	ADF				PP			
	Level		First Differences		Level		First Differences	
	Intercept	Trend	Intercept	Trend	Intercept	Trend	Intercept	Trend
Exchange rates								
MYR	-0.88	-1.81	-16.63***	-16.62***	-0.91	-1.97	-23.55***	-23.50***
SGD	-2.04**	-2.76	-17.53***	-17.52***	-2.06	-2.73	-24.35***	-24.33***
IDR	-1.05	-2.46	-11.89***	-11.88***	-1.00	-2.28	-20.66***	-20.70***
PHP	-0.94	-1.79	-16.69***	-16.67***	-0.96	-1.86	-24.93***	-24.88***
THB	-1.63*	-1.57	-8.75***	-8.75***	-1.66	-1.44	-22.37***	-22.19***
Islamic Stock Price								
IM	-2.16**	-1.81	-17.66***	-17.71***	-2.18	-1.79	-24.14***	-24.15***
IS	-1.15	-2.42	-15.85***	-15.91***	-1.11	-2.36	-22.74***	-22.79***
II	-1.80**	-1.83	-15.28***	-15.30***	-1.94	-2.09	-29.02***	-29.07***
IP	-2.27**	-1.94	-17.20***	-17.24***	-2.21	-1.85	-25.04***	-24.89***
IT	-2.90***	-2.83	-11.76***	-11.77***	-2.72*	-2.72	-24.41***	-24.41***

Note: The symbols ***, **, * represent the significance levels of 1%, 5%, and 10%, respectively.

Figure 3 shows the wavelet coherence outputs of the dynamic links between ASEAN-5 Islamic stock prices and exchange rates. The continuous wavelet transforms approach decomposes data into six levels ($2^n = 1, 2, 3, \dots, n$) and covers three different holding periods: short-, medium-, and long-term. The vertical axis represents the frequency component in weekly units ranging from 4 to 128 weeks scales and divided into three holding periods: 4-8 weeks for short-term, 8-32 weeks for medium-term, and 32-128 weeks for long-term. Meanwhile, the horizontal axis represents the time component from 2010 to 2020. The color code represents the degree of series co-movement. The red regions imply a strong correlation between series, whereas the blue regions indicate a weak correlation. The thick black contour represents the statistical significance area at a 5% level, as recommended by the Monte Carlo simulation. The arrows represent the causal relationships between the series. To avoid biased outputs based on the Cone of Influence, concentrate on the area inside the cone shape.

Based on Figure 1, there is a significant correlation between ASEAN-5 Islamic stock prices and exchange rates from 2010 to 2020. The highest level of coherence between Islamic stock prices and exchange rates was recorded as follows: 4- to 32-week scales from 2012 to 2014 and 4- to 64-week scales over 2014 to 2017 and 2019 onwards for Malaysia; 8- to 64-week scales and 4- to 32-week scales, corresponding to the periods 2014-2018 and 2019 onwards for Singapore; 8- to 32-week scales over 2012-2014 and 8- to 128-week scales over 2014-2020 for Indonesia; 8- to 16-week scales from 2012 to 2014 and 64- to 128-week scales over 2014 to 2019 for the Philippines; 4- to 32-week scales from 2011 to 2013 and 64- to 128-week scales over 2013-2019 for Thailand.

Further, the Islamic stock prices for most ASEAN-5 countries are negatively correlated with exchange rates. Indonesia's Islamic stock prices are positively correlated with the exchange rate in the medium term but switch to negative interaction at long-term scales. In terms of causal links between Islamic stock prices and exchange rates, Malaysia exhibits bidirectional causal relations between series from 2012 to 2014. Yet, the Islamic stock prices granger caused the exchange rates from 2014 to 2017. The Singapore Islamic stock price leads the exchange rate from 2014 to 2018, but from 2019 onwards, the exchange rate leads the stock price. The Indonesia Islamic stock prices granger caused the exchange rate, while the exchange rate leads stock prices for the Philippines and Thailand. In short, Malaysia,

Singapore (2014-2018), and Indonesia support the portfolio balance theoretical approach where changes in stock prices may influence the exchange rate. The Philippines, Thailand, and Singapore (2019 onwards) support the flow-oriented approach in which changes in the exchange rate may affect the stock performance through international competitiveness.

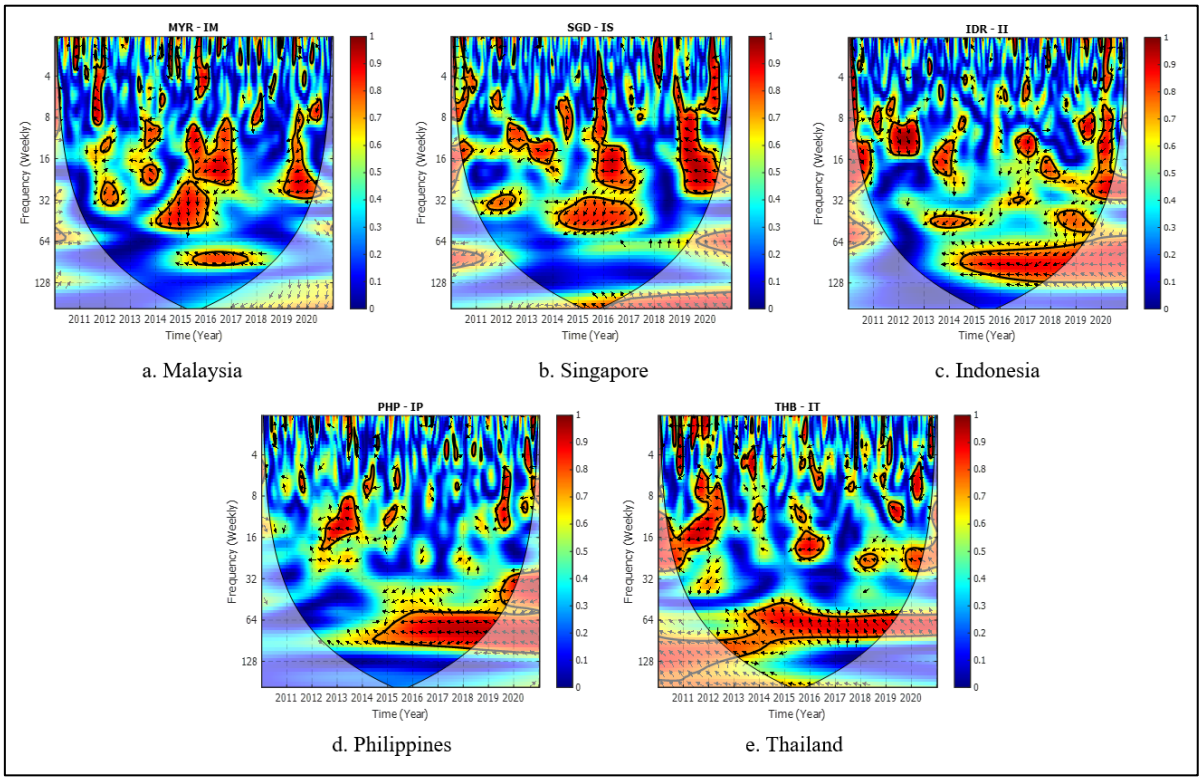

Figure 3: Wavelet Coherence Results for ASEAN-5 economies.

Conclusion

This study analyzes the dynamic correlation between Islamic stock prices and exchange rates from 2010 to 2020 using the wavelet analysis approach. The unit root test results reveal that Islamic stock price and exchange rates are stationary at a different level. Moreover, the wavelet analysis results show relatively weak coherence in the very low-frequency scales (first four weeks) but more coherence in the medium- and long-term (8-32-week scales and 32-128-week scales) in different periods. The results suggest that Islamic stock prices and exchange rates are inversely associated. Malaysia, Singapore (2014-2018), and Indonesia support the portfolio balance approach, while the Philippines, Thailand, and Singapore (2019 onwards) support the flow-oriented approach. The study's findings offer various significance for investors and portfolio advisors in making sound decisions. First, investors and portfolio managers should consider the degree of coherence between series at different frequency bands (short-, medium-, and long-term). Second, policymakers may need to study and comprehend the lead-lag correlations between series to establish sound policy measures to mitigate financial risk.

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