8 THE RELATIONSHIP BETWEEN EXCHANGE RATES AND STOCK PRICES: COMPARATIVE EXAMPLE OF ASEAN AND BRICS COUNTRIES

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Abstract

This study examines the relationship between stock prices and exchange rates, specifically for developing countries. The reason for this focus is that financial markets in developing countries provide important reactions to global shocks. The Covid-19 pandemic, declared by the World Health Organization on 11 March 2020, is the most recent negative shock affecting the economies of these countries. This study thus investigates the relationship between stock prices and exchange rates to identify the effects of the pandemic on financial markets using weekly data for the BRICS and ASEAN (Vietnam, Malaysia, Singapore, Indonesia, the Philippines, Thailand) countries for the period 15 September 2017 and 5 September 2022. The data were employed within two different models, for the pre-pandemic and the pandemic period (measured in relation to the date of the declaration of the pandemic). Comparing the developments during the pandemic period with the pre-pandemic period is another aim of the study. A panel data method was used to examine the relationship between variables. According to the findings, while portfolio theory was valid for Malaysia, the Philippines, Thailand, Indonesia, Russia, India and South Africa in the pre-pandemic period, the traditional theory was valid for China. There was no relationship between the variables for BRICS and ASEAN countries in the post-pandemic period.

Keywords: Financial Markets, Exchange Rate, Stock Price, Panel Analysis.

JEL codes: B26, C33, F31, G15

1. Introduction

Global financial markets have become increasingly integrated in recent years (Andreou *et al*., 2013), and it is widely accepted that there is a correlation between stock prices and exchange rates. This correlation is particularly pronounced in emerging markets. The financial markets of

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emerging economies are easily affected by economic and political developments. Therefore, there are unexpected increases or decreases in exchange rates or stock markets. Financial market participants and policymakers closely monitor the volatility in exchange rates and stock markets (Malik, 2021). As a matter of fact, the gradual removal of exchange controls in developing countries has led to an increase in international investments in these countries and portfolio diversification. However, volatility in foreign exchange markets poses a risk to financial investments in developing countries (Phylaktis and Ravazzolo, 2005; Han and Zhou, 2017). Nevertheless, financial markets have been a tool for the economic growth of developing countries since the 1990s. As a result of increasing capital flows between international financial markets, a closer relationship has emerged between stock markets and exchange rates (Tian and Ma, 2010; Tang and Yao, 2018), and there have been many theoretical and empirical studies on the topic (Abdallah and Murinde, 1997; Granger *et al.* 2000; Smyth and Nandha, 2003; Phylaktis and Ravazzolo, 2005; Tian and Ma, 2010; Lin , 2012; Kodongo nad Ojah 2012; Tsai, 2012; Yang *et al*., 2014; Wong, 2017; Morales-Zumaquero and Sosvilla-Rivero, 2018; Effiong and Bassey, 2019; Malik, 2021).

There are two important theories in the literature on the relationship between stock prices and exchange rates. The first of these is the microeconomic 'flow oriented' or traditional approach (Dornbush and Fisher, 1980; Ajayi *et al*., 1998; Sui and Sun, 2016; Malik, 2021), according to which the current account has a significant effect on exchange rates. Furthermore, exchange rates have an impact on international competitiveness and trade balances. Therefore, it is thought that countries' production output and stock market will be affected (Sui and Sun, 2016). The basic principle of this theory is that a country's exchange rates are an important tool for global competition (Narayan *et al*., 2020; Nusair and Olson, 2022). According to the theory, the appreciation of the national currency negatively affects the country's global competitiveness, and its depreciation positively affects this competitiveness and, in this case, there is a negative relationship between the national currency and stocks (Nusair and Olsun, 2022) and a positive relationship between the exchange rate and stocks (Liang *et al*., 2013). The main reason for this is that the volatility in the exchange rate affects the level of output in the economy. This is thought to affect company profits and thus company stock prices through the foreign competitiveness of import and export companies (Ajayi *et al*., 1998; Andreou *et al*., 2013; Liang *et al*., 2013; Sui and Sun, 2016; Narayan *et al*., 2020). For example, assuming that the exchange rate in a country is predominantly determined by its foreign trade balance, the appreciation (depreciation) of the local currency affects the incomes of exporting companies or multinational companies negatively (positively), thereby decreasing (increasing) the share prices of exporting companies (Chkili and Nguyen, 2014; Mollicka and Sakaki, 2019).

The second theory (Frankel, 1983, 1987) on the relationship between stock prices and exchange rates is a macro approach known as 'portfolio balance' theory. In the portfolio balance model, developments in the stock market have an impact on exchange rates through the capital account (Frankel, 1983; Ajayi *et al*., 1998; Obben *et al*., 2006; Andreou *et al*., 2013; Tsagkanos and Siriopoulos, 2013; Caporale *et al*., 2014; Moore and Wang, 2014; Sui and Sun, 2016; Rai and Garg, 2022). This model proposes the existence of a unidirectional and inverse relationship between stock prices and exchange rates, with the effect moving from the former to the later. This model draws attention to the importance of portfolio diversification in global financial markets. When the price of national stocks increases, international funds are encouraged to buy more national assets (Koulakiotis *et al*., 2015; Ria and Garg, 2022). Accordingly, as a result of increases in stock prices, there is a sudden increase in the wealth of individuals. In this case, there is an increase in the demand for money in the market and an increase in interest rates. Thus, foreign funds will attract the attention of national assets (Mollick and Sakaki, 2019; Rai and Garg, 2022; Kumeka *et al*., 2022). While the preference of international investors for domestic assets causes the stock prices to trend upwards, it also causes a decrease in the exchange rate; there is a one-way and inverse relationship between stocks and exchange rates (Tsai, 2012; Tsagkanos &

Siriopoulos, 2013; Moore & Wang, 2014; Suriani *et al*., 2015; Sui & Sun, 2016; Erdoğan *et al*., 2020; Rai and Garg, 2022; Kumeka *et al*., 2022).

There is a substantial literature on the relationship between exchange rates and stocks, and a number of studies focus on developing countries. However, considering the increasing importance of developing countries in global economies studies specific to these countries are given importance in the literature review. In addition, while it is known that these economies were adversely affected by the Covid-19 pandemic, declared as such by the World Health Organization on 11 March 2020, there are few existing studies comparing the pre-pandemic and pandemic periods. In this context, the study will make a significant contribution to the literature by examining the relationship between variables in countries with significant economic power in the global economy – ASEAN and BRICS – through a comparison of the pre-pandemic and pandemic periods.

2. Literature Review

As a result of the rapid growth of developing economies and their increasing dependence on the global economy, an important literature has emerged on the relationship between financial markets and exchange rates. The studies in the literature show a causal relationship between exchange rates and stocks, with findings varying according to the period or the cyclical position of the economy. In these studies, there is evidence of one-way causality, but there are also studies in which there is two-way causality. For example, Bahmani-Oskooee and Sohrabian (1992) found a bidirectional causal relationship in their study on the S&P500 and US dollar effective exchange rate. Abdalla and Murinde (1997) investigated the issue for India, Korea, Pakistan and the Philippines. They determined a unidirectional causality running from the exchange rate to stock prices in all countries except the Philippines. Ajayi *et al.* (1998) examined the issue for developed and developing countries – Canada, Germany, France, Italy, Japan, the United Kingdom and the US selected as the developed countries and Taiwan, Korea, the Philippines, Malaysia, Singapore, Hong Kong, Indonesia and Thailand as the developing countries. The authors determined that there was a bidirectional causal relationship between the variables in developed countries, while a causal relationship could not be determined for developing countries.

Yang and Doong (2004) found a bidirectional relation between the variables for the G-7 countries. However, they emphasized that the relationship between stocks and exchange rates was stronger. Andreou *et al.* (2013) reached a similar conclusion for twelve developing countries. Lean *et al.* (2011) examined eight Asian countries and found a weak one-way causal relationship only for Korea. Liang *et al.* (2013), in their study on the ASEAN-5 countries, found a causal effect from exchange rates to stocks. Caporale *et al.* (2014) found a causal relationship between the variables for the US, UK, Canada, Japan and Switzerland. Khan and Ali (2015) found a bidirectional relationship between the variable for Pakistan. Xie *et al.* (2020) investigated the issue for a group of developed and developing countries in their study and identified causality running from stock prices to exchange rates. Nusair and Olson (2022) researched the issue for G7 countries. They determined that there was a causal relation that runs from stock prices to exchange rates in countries other than Italy.

The literature includes research within the scope of the two important theories and considers the causality relationship between stocks and exchange rates: the 'flow oriented' or traditional approach and the portfolio balance approach (Dornbush and Fisher, 1980; Frankel, 1983; Ajayi *et al*., 1998; Obben *et al*., 2006; Andreou *et al*., 2013; Tsagkanos and Siriopoulos, 2013; Caporale *et al*., 2014; Moore and Wang, 2014; Sui and Sun, 2016; Malik, 2021; Rai and Garg, 2022). The studies supporting the traditional theory include that by Wongbangpo and Sharma (2002), who determined that there was a positive relationship between the variables for Singapore and Thailand in their study on the ASEAN-5. Phylaktis and Ravazzolo (2005) investigated the issue

for Pacific Basin countries and found a positive relationship between stocks and exchange rates. Yau and Nieh (2006) researched the issue in Taiwan and Japan. They determined that the traditional approach was valid in the short and long run for Japan and in the long run for Taiwan. Katechos (2011) found a positive relationship between high-interest-rate currencies and the returns of global stocks. Cho *et al.* (2012) determined that there was a positive relationship between exchange rate returns and stock returns for twelve developing countries. Mitra (2017) found a positive relationship between the variables in their study of South Africa. Nusair and Olson (2022) researched the issue for G7 countries and found that the traditional approach was valid in the short run.

In the literature, several studies conclude that the portfolio theory is valid. For example, Wongbangpo and Sharma (2002) mention the existence of a negative relationship between the variables for Indonesia, Malaysia and the Philippines in their study on the ASEAN-5. Yau and Nieh (2006) found that the portfolio approach was valid for Taiwan in the short run. Katechos (2011) found a negative relationship between low-interest-rate currencies and the returns of global stocks. Tsai (2012), in a study on Singapore, Thailand, Malaysia, the Philippines, South Korea and Taiwan, found a negative relationship between exchange rates and stocks. In other words, portfolio theory is supported for these countries.

Liang *et al.* (2013) examined the issue for ASEAN-5 countries, also concluding that portfolio theory is valid. Yang *et al.* (2014) observed a negative correlation between stocks and exchange rates for India, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand. Wong (2017) researched the subject for Asian and European countries, finding support for the portfolio approach for the Philippines and Singapore. Salisu and Ndako (2018) examined OECD countries and concluded that portfolio balance was valid for all OECD countries in the Euro and non-Euro areas. Nusair and Olson (2022), in their study of G7 countries, obtained evidence supporting the portfolio balance approach in the long run. Ria and Garg (2022) examined the pandemic period for BRICS countries, concluding that the increase in stock returns negatively affected exchange rates.

Finally, there are studies suggesting that there is no relationship between the variables (Nieh and Lee 2001; Lee 2001; Pan *et al.* 2007; Suriani *et al.* 2015). Hung (2017) examined Romania, Hungary, Poland and Czechia, finding that there was no causality between exchange rates and stocks. Suriani *et al.* (2015) came to a similar conclusion in their study for Pakistan, as did Nieh & Lee (2001) for G-7 countries. In their study, Pan *et al.* (2007) concluded that during the Asian crisis, there was no evidence of a causal relationship between exchange rates and stock prices in countries other than Malaysia. Granger *et al.* (2000) reached a similar conclusion for Indonesia and Japan after the Asian crisis.

When the literature is examined, it is clear that the relationship between exchange rates and stocks is the subject of many studies. In this study, the subject is discussed within the scope of the pre-pandemic and post-pandemic periods. For this reason, it is assumed that the research topic will be evaluated in different periods and will make a significant contribution to the literature.

3. Data and Methodology

The relationship between stock markets (stock) and exchange rates (exchange) for the BRICS and ASEAN countries – Vietnam, Malaysia, Singapore, Indonesia, the Phillippines and Thailand – are examined using weekly data for the period 15 September 2017 and 5 September 2022. Covid-19 was declared a pandemic by the World Health Organization on 11 March 2020. The study is divided into two separate periods to compare the pre-pandemic and pandemic periods. For the purposes of this study the pandemic period covers 130 weeks of data for each country; to ensure the same number of observations, the pre-pandemic period begins on 15 September

2017. The first period is included in the comments as Model 1 (pre-pandemic period) and the second period (pandemic period) as Model 2. The data used in the study are obtained from the investing.com database. Stock market prices and the exchange rates have been converted to US dollars. The natural logarithms of all the series are included in the analysis.

3.1. Cross Sectional Dependence

First, in panel data analysis, cross-sectional independence of the series should be examined. The presence of shocks in series or correlations in units may indicate cross-sectional dependence. (Peng, Tan, Li and Hu, 2016, p.4–5). Different tests can be used to examine the cross-sectional independence of the series. The Breusch-Pagan approach applies the Lagrange Multiplier (LM) in testing the cross-sectional independence of the series.

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \quad (1)$$

$\hat{\rho}_{ij}$ is expressed as the correlation coefficient between the error terms obtained from the ordinary least squares estimation of the model in Equation (1). Under the null hypothesis, that there is cross-sectional independence, the LM statistics has a distribution of N(N−1)/2 degrees of freedom χ^2. This test applies to panel data approaches where the number of units (N) is small, and the time dimension (T) is slightly larger. Pesaran (2004) proposed an approach based on LM test statistics where $T \to \infty$ and $N \to \infty$ are valid:

$$CD = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\rho}_{ij}^2 - 1) \quad (2)$$

The test statistic shown in Equation (2) is normally distributed. Pesaran *et al.* (2008) proposed a test based on mean and variance calculations:

$$LM_{adj} = \sqrt{\frac{2T}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{v_{Tij}^2}}, \quad (3)$$

where the average of the expression $(T\text{-}k)\hat{\rho}_{ij}^2$ is shown as μ_{Tij} and its variance as v_{Tij}^2. This test statistic has a standard normal distribution.

3.2. Panel Homogeneity Test

In the causality analysis for panel data, the method used depends on whether the units display homogeneous or heterogeneous characteristics. The homogeneity of the slope coefficients can be tested. Swamy (1970) proposes a test to determine whether panel data models are homogeneous or heterogeneous. This approach requires that N is smaller than T. Pesaran and Yamagata (2008) suggest the standard form ($\tilde{\Delta}$) of the Swamy approach to test the homogeneity of the slope in panel data models where N is larger than T. If the error terms are normally distributed and (N,T) → ∞, the $\tilde{\Delta}$ test will be valid (Hsueh *et al*., 2013, s.297). The first step in this approach is as follows:

$$\tilde{S} = \sum_{i=1}^{N}(\hat{\beta}_i - \tilde{\beta}_{WFE})'\frac{x_i' M_T x_i}{\tilde{\sigma}_i^2}(\hat{\beta}_i - \tilde{\beta}_{WFE}) \quad (4)$$

$\hat{\beta}_i$ is the OLS estimator, $\tilde{\beta}_{WFE}$ is the weighted fixed effects estimator and M_T is the unit matrix in Equation (4). The $\tilde{\Delta}$ test statistic suggested by Pesaran and Yamagata (2008) is as in Equation (5).

$$\tilde{\Delta}= \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \quad (5)$$

Under the null hypothesis with the (N,T) → ∞ condition, error terms are normally distributed when $(\sqrt{N}/T) \to \infty$ is valid. The following test statistic is used in panel data analysis with small samples.

$$\tilde{\Delta}_{adj}= \sqrt{N}\left(\frac{N^{-1}\tilde{S}-E(\tilde{z}_{it})}{\sqrt{var(\tilde{z}_{it})}}\right) \quad (6)$$

In Equation (6), the mean is $E(\tilde{z}_{it}) = k$ and the variance is expressed as $var(\tilde{z}_{it}) = 2k(T\text{-}k\text{-}1)/T + 1$ (Chang, Cheng, Pan and Wu, 2013, p.257–258).

3.3. Panel Cointegration Test

Panel cointegration approaches examine the long-term relationships between variables. The variables have stationarity at the level of cointegration tests. Westerlund (2007) presents a cointegration test for panel data based on an error correction model to determine whether there are error correction models for individual units or as all. Westerlund (2007) sets out four different statistics (G_a, G_T, P_a and P_T) to test for cointegration. The error correction model is used for test statistics in Equation (7) following Kasman and Duman (2015, p.99-100). If the null hypothesis is rejected, it means that there is cointegration between variables for all panels.

$$\Delta Y_{it} = \delta' + \alpha_i(Y_{it-1} - \beta_i' X_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij}\Delta Y_{it-j} + \sum_{j=-q_i}^{p_i} \gamma_{ij}\Delta X_{it-j} + \varepsilon_{it} \quad (7)$$

3.4. Panel Causality Test

Granger (1969) developed a method to examine the causal relationship between time series. The causal relationship between two stationary variables is examined using the model below.

$$Y_t = \alpha + \sum_{k=1}^{K} \gamma_k Y_{t-k} + \sum_{k=1}^{K} \beta_k X_{t-k} + \varepsilon_t \qquad t = 1, \dots, T \quad (8)$$

The causality relationship between two variables, such as X_t and Y_t, is analyzed using Equation (8); this model analyzes whether X_t is the cause of Y_t. Dumitrescu and Hurlin (2012) present a method based on the Granger (1969) approach to examine panel data causality. The following model is applied for panel data.

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_{ik} Y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} X_{i,t-k} + \varepsilon_{i,t} \qquad t = 1, \dots, T \qquad i = 1, \dots, N \quad (9)$$

In the Dumitrescu and Hurlin (2012) approach, the units' statistical value is calculated based on the Wald test statistics. The mean of the Wald test statistic ($\overline{W}$) is obtained as in Equation (10). When Equation (9) is taken into account, the null hypothesis, that there is no homogeneous panel causality, is established as follows; the rejection of the null hypothesis means that there is heterogeneous panel causality between variables.

$H_o: \beta_{i1} = \dots = \beta_{iK} = 0 \qquad \forall \quad i = 1, \dots, N$

In the Dumitrescu and Hurlin (2012) approach, the units' statistical value is calculated based on the Wald test statistics. The mean of the Wald test statistic ($\overline{W}_{N,T}$) is obtained as in equation (10).

$$\overline{W}_{N,T} = \frac{1}{N}\sum_{i=1}^{N} W_{i,T} \quad (10)$$

$W_{i,T}$ denotes the individual Wald statistics for the i th cross-section unit. $W_{N,T}$ presents the unit specific Wald test statistic to test the null hypothesis of the unit (Dumitrescu ve Hurlin, 2012).

4. Empirical Results

In panel data analysis, whether the series have cross-sectional dependence is a factor that affects the results. If the cross-sectional dependence is ignored, it can result in the use of incorrect panel unit tests and cause the stationarity analysis of the series to be wrong. Breusch-Pagan LM, Pesaran LM, and Pesaran CD approaches are used to test the cross-sectional independence of the series. Test results for ASEAN and BRICS are given in Table 1. In these tests, the null hypothesis is that the series have cross-sectional independence. This is rejected at the 5% significance level for both series. Thus, both series have cross-sectional dependence.

Table 1. Results of Cross-Sectional Dependence

	ASEAN				BRICS			
	(1)		(2)		(1)		(2)	
Tests	exchange	stock	exchange	stock	exchange	stock	exchange	stock
Breusch – Pagan LM	473.661* (0.000)	768.866* (0.000)	750.006* (0.000)	1013.492* (0.000)	837.806* (0.000)	240.763* (0.000)	218.390* (0.000)	583.370* (0.000)
Pesaran Scaled LM	83.740* (0.000)	137.636* (0.000)	134.193* (0.000)	182.299* (0.000)	185.103* (0.000)	51.600* (0.000)	46.598* (0.000)	128.209* (0.000)
Pesaran CD	16.755* (0.000)	26.350* (0.000)	25.317* (0.000)	30.532* (0.000)	28.850* (0.000)	10.516* (0.000)	1.930* (0.043)	22.897* (0.000)

*Note: * Significance at the 5% level. The values given in the table are p-values. The natural logarithms of the series are analyzed. (1): Pre-pandemic period (2): Pandemic period*

Pesaran's (2007) CIPS test is the appropriate panel unit root test for series with cross-sectional dependence. Table 2 shows the panel unit root test results of ASEAN and BRICS for two periods; different lag lengths are used for this test. The test results show that the series have unit roots. When the first difference of the series is taken, the null hypothesis, that the series has a unit root, could not be rejected at the 1% significance level. The series are thus stationary with first differences at all lag lengths.

Table 2. Panel Unit Root Test Results

Periods	Series	ASEAN			BRICS		
		k=1	k=2	k=3	k=1	k=2	k=3
(1)	stock	0.425 (0.644)	0.269 (0.606)	0.837 (0.799)	0.204 (0.581)	-0.087 (0.466)	-0.039 (0.485)
	∆stock	-11.982*** (0.000)	-11.140*** (0.000)	-7.980*** (0.000)	-10.932*** (0.000)	-9.542*** (0.000)	-8.219*** (0.000)
	exchange	5.092 (0.955)	6.232 (0.904)	9.846 (0.629)	-1.141 (0.127)	-1.493* (0.068)	-0.971 (0.166)
	∆exchange	-11.936***	-9.079***	-7.214***	-10.938***	-10.412***	-8.176***

Periods	Series	ASEAN			BRICS		
		k=1	k=2	k=3	k=1	k=2	k=3
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(2)	stock	-1.010 (0.156)	-0.200 (0.421)	-0.325 (0.373)	-1.077 (0.141)	-1.480* (0.069)	-0.914 (0.180)
	∆stock	-11.982*** (0.000)	-11.982*** (0.000)	-11.209*** (0.000)	-10.938*** (0.000)	-10.641*** (0.000)	-9.349*** (0.000)
	exchange	-1.301 (0.100)	-1.909** (0.028)	-1.008 (0.157)	2.236 (0.989)	2.276 (0.989)	1.816 (0.965)
	∆exchange	-11.982*** (0.000)	-11.585*** (0.000)	-10.390*** (0.000)	-10.784*** (0.000)	-9.210*** (0.000)	-9.504*** (0.000)

*Note: ***,**,* signify 1%, 5%, 10% significance levels, respectively. The values given in the table are p-values. ∆ denotes the first difference of the series. (1): Pre-pandemic period (2): Pandemic period. Tests are implemented with a constant and trend.*

Heterogeneity is an important issue in panel cointegration and panel causality approaches. Testing slope heterogeneity by country is an important phase in selecting the methods to be used in other steps. The null hypothesis that the coefficients are homogeneous and the alternative hypothesis that the coefficients are heterogeneous are established. Table 3 shows Pesaran and Yamagata's (2008) test statistics for ASEAN and BRICS countries in different periods. According to the analysis, the null hypothesis of no slope homogeneity is rejected at the 1% significance level. It is concluded that the slope vary according to units that are not homogeneous.

Table 3. Results for Homogeneity Test

Tests	Test Statistics (ASEAN)		Test Statistics (BRICS)	
	(1)	(2)	(1)	(2)
$\tilde{\Delta}$	348.83* (0.000)	207.18* (0.000)	161.45* (0.000)	348.77* (0.000)
$\tilde{\Delta}_{\text{adj}}$	42.959* (0.000)	34.050* (0.000)	29.004* (0.000)	53.821* (0.000)

*Note: The values given in the table are p-values. * Significance at the 1% level. (1): Pre-pandemic period (2): Pandemic period*

Given the result of the panel unit root test, Westerlund's (2007) cointegration approach is used because the series is stationary at I(1). Westerlund (2007) uses four different statistics. The p-values obtain as a result of the bootstrap process to eliminate cross-sectional dependence are given in Table 4. According to the panel cointegration analysis results in Table 4, there was no cointegration relationship in four statistical values for ASEAN and no cointegration relationship in three statistical values for BRICS in the pandemic period. The pre-pandemic period results confirm that there is a cointegration relationship between stock markets and exchange rates for ASEAN, according to the G_a, P_T and P_a statistics. The results of the analysis for BRICS also show that there is a cointegration relationship between stock markets and exchange rates, according to all four statistics.

Table 4. Results of Westerlund (2007) Panel Cointegration Analysis

Statistics	ASEAN				BRICS			
	(1)		(2)		(1)		(2)	
	Test Statistics	p-value	Test Statistics	p-value	Test Statistics	p-value	Test Statistics	p-value
G_T	-1.097	0.143	-1.197	0.150	-3.148***	0.000	0.092	0.505
G_a	-1.405*	0.050	-1.293*	0.068	-4.390***	0.000	0.519	0.623
P_T	-2.270**	0.043	0.001	0.560	-2.015**	0.035	2.685	0.990
P_a	-2.280**	0.045	-0.519	0.333	-2.393**	0.023	2.242	0.998

*Note: ***, **, * signify 1%, 5%, 10% significance levels, respectively. (1): Pre-pandemic period (2): Pandemic period*

The results of the Westerlund (2007) panel cointegration analysis show that the long-run relationship between stock markets and exchange rates is only evident in the pre-pandemic period. Therefore, only the pre-pandemic period is investigated to obtain the long-term coefficients for each ASEAN and BRICS country. Table 5 shows the results of Pedroni's (2001) DOLS Mean Group (DOLSMG) estimation, which examines the long-term relationship between the stock market and exchange rate variables for ASEAN. The long-term coefficient is −1.311 for the entire panel. The coefficient is statistically significant at the 1% level. The exchange rate affects the stock market in the long term. When the exchange rate increases by 1 %, it decreases stock market prices by about 1.3 %. The exchange rate has a long-term negative impact on the stock market in Malaysia, the Philippines, Thailand and Indonesia. The exchange rate did not have a significant effect on the stock market for Vietnam and Singapore.

Table 5. Heterogeneous Estimators for ASEAN (Pre-pandemic period)

Countries	Coefficient	t statistics value
Vietnam	-1.067	-1.246
Malaysian	-2.242***	-8.728
Philippines	-3.293***	-9.071
Singapore	0.282	0.630
Thailand	-0.727***	-5.227
Indonesia	-0.819*	-1.822
PANEL	-1.311***	-10.400

*Note: ***, **, * signify 1%, 5%, 10% significance levels, respectively*.

The estimation results for BRICS countries with respect to the long-term relationship between the stock market and exchange rates are given in Table 6. According to the DOLSMG estimation, all coefficients were significant except for the case of Brazil. The long-run coefficient for the whole panel is found to be −0.615 for BRICS countries. In this context, a 1% increase in the exchange rate reduces the BRICS equity markets by approximately 0.6%. For Russia, India and South Africa, the exchange rate has a negative effect on the stock markets in the long run, while for China, the exchange rate has a positive effect on the stock market.

Table 6. Heterogeneous Estimators for BRICS (Pre-pandemic period)

Countries	Coefficient	t statistics value
Brazil	0.261	0.764
Russia	-2.030*	-5.100
India	-1.858*	-5.628
China	1.956*	4.074
South Africa	-1.406*	-3.405
PANEL	-0.615*	-4.157

*Note: * Significance at the 1% level.*

The approach of Dumitrescu and Hurlin (2012) is used to examine the causal relationship between stock markets ad exchange rates; Table 7 shows the results of the causality analysis using this approach. No causality is found between exchange rates and stock markets in the pre-pandemic and pre-pandemic panel causality results for ASEAN countries. For BRICS countries, it is significant that, for both lag periods, the exchange rate is the cause of changes in stock markets in the pre-pandemic period. The finding that stock markets cause changes in the exchange rate is found to be significant after only one lag. The causality results for the pandemic period indicate that there is bidirectional causality between stock markets and exchange rates.

Table 7. Results of Dumitrescu and Hurlin (2012) Panel Causality Analysis

	ASEAN				BRICS			
	(1)		(2)		(1)		(2)	
	k=1	k=2	k=1	k=2	k=1	k=2	k=1	k=2
Δexchange - Δstock	1.065 (0.935)	2.664 (0.455)	1.968 (0.109)	2.668 (0.452)	4.481* (0.000)	5.795* (0.000)	8.609* (0.000)	9.297* (0.000)
Δstock - Δexchange	0.388 (0.290)	1.826 (0.806)	1.344 (0.581)	3.046 (0.452)	2.053 (0.111)	5.002* (0.001)	4.895* (0.000)	5.519* (0.000)

*Note: * signify 1% significance levels, respectively. Δ denotes the first difference of the series. The values given in the table are p-values. (1): Pre-pandemic period (2): Pandemic period*

5. Conclusions

In this study, the relationship between stock prices and exchange rates for ASEAN and BRICS countries is considered for the pre-pandemic and pandemic periods. Researching the study as two different periods is the most important feature distinguishing this from other studies. The relationship between stock prices and the exchange rates was examined, and the effect of the pandemic on these markets was investigated.

The relationship was examined by panel data analysis. Panel cointegration analyses were conducted using the Westerlund (2007) approach to determine whether there is a long-term relationship between stock prices and exchange rates. As a result of these analyses, it was determined that there was a cointegration relationship between stock prices and exchange rate variables for ASEAN and BRICS countries in the pre-pandemic period (Narayan *et al*., 2020) and no cointegration relationship between the two variables during the pandemic period (Narayan *et al*., 2020).

Since there was a cointegration relationship between stock prices and exchange rates in the pre-pandemic period, heterogeneous estimators were obtained for this period alone, and the effect of exchange rates on stock prices for each country was examined. In the results obtained for

ASEAN, it is seen that the long-term effect of exchange rates on stock prices is negative and significant for Malaysia, the Philippines, Thailand and Indonesia. In the results obtained for BRICS, the long-term effect of the exchange rate on stock prices for Russia, India and South Africa was found to be negative and significant. Considering these results, it is understood that the portfolio theory is valid for Malaysia, the Philippines, Thailand, Indonesia, Russia, India and South Africa. This confirms the similar results of Wongbangpo and Sharma (2002) for Indonesia, Malaysia, and the Philippines; Liang *et al*., (2013) for the ASEAN-5 countries; Yau and Nieh (2006) for Taiwan; Tsai (2012) for Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan; Yang *et al.* (2014) for India, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand and, finally, Nusair and Olson (2022) for the G7 countries.

The study also determined that the traditional theory explains the results for China. Wongbangpo and Sharma (2002) found similar results for Singapore and Thailand; Phylaktis and Ravazzolo (2005) for the Pacific Basin countries, and Yau and Nieh (2006) for Taiwan and Japan. Finally, a causality analysis was conducted to examine the relationship between variables. While there was no causal relationship between stock price and exchange rates for ASEAN countries before and during the pandemic, it was concluded that there was bidirectional causality between the variables for BRICS countries both before and during the pandemic.

In the study, the relationship between stock prices and exchange rates in the pre-pandemic period in both ASEAN and BRICS countries was not evident during the pandemic period; that is, no relationship could be found between the variables during the crisis period. The reason for this is that the variables experienced significant volatility independently of each other during the crisis period. It is important for investors to diversify their portfolios to protect themselves from exchange rate risk and adverse impacts of fluctuations in the stock markets due to the significant shocks to these variables during the crisis periods. In addition, policy makers need to develop policies against volatility in exchange rates, given their impact on both the current account deficit and company profits; it is important, for developing countries in particular, to ensure stability in the exchange rate to ensure economic stability.

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