T.C.

ISTANBUL COMMERCE UNIVERSITY

GRADUATE SCHOOL OF FINANCE

MASTER OF INTERNATIONAL FINANCE

THE RELATIONSHIP BETWEEN EXCHANGE RATES AND STOCK MARKETS FOR THE FRAGILE FIVE COUNTRIES (TURKEY, BRAZIL, SOUTH AFRICA, INDIA, INDONESIA) YEAR (2010-2019)

MA Thesis

Kadra Yusuf HERSI

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	TITLE, NAME SURNAME	UNIVERSITY
THESIS ADVISOR	: Doç. Dr. Ayben Koy	Istanbul Ticaret University
JURY MEMBERS	: Doç. Dr. Serkan Cankaya	Istanbul Ticaret University
JURY MEMBERS	: Doç. Dr. Gökhan Işıl	MarMara University

ABSTRACT

This paper aims to determine the significance relation and direction of stock markets and exchange rate on Fragile five Countries (South Africa, Turkey, Indonesia, India, and Brazil) from January 2010 to December 2019. This study applied the VAR Analysis and Granger Causality Test to determine the relationship between exchange rates and stock indexes. The results show that South Africa and Turkey exchange rates and stock indexes are in bidirectional relationships, for India and Brazil, there is a one-way causality finding from the exchange rate to stock price, and the results for Indonesia show no causality.

Keywords: Exchange Rate, Stock Price, Granger causality.

ÖZET

Bu çalışma, Ocak 2010'dan Aralık 2019'a kadar kırılgan beş ülkede (Güney Afrika, Türkiye, Endonezya, Hindistan ve Brezilya) borsaların ve döviz kurunun önemini ve yönünü belirlemeyi amaçlamaktadır. Bu çalışmada, VAR Analizi ve Granger Nedensellik Testi uygulanmıştır. döviz kurları ile hisse senedi endeksleri arasındaki ilişkiyi belirlemek. Sonuçlar, Güney Afrika ve Türkiye döviz kurlarının ve hisse senedi endekslerinin iki yönlü ilişkiler içinde olduğunu göstermektedir, Hindistan ve Brezilya için, döviz kurundan hisse senedi fiyatına tek yönlü bir nedensellik bulgusu vardır ve Endonezya'nın sonuçları nedensellik göstermemektedir.

Anahtar Kelimeler: Döviz Kuru, Hisse Fiyatı, Granger nedensellik.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

USA	United States of America
U.K	United Kıngdom
JKII	Jakarta Islamic
XU100	BIST100
BVSP	BOVESPA
BSESN	BSE SENSEX 30
JTOPI	South Africa Top 40
GARCH	Generalized AutoRegressive Conditional Heteroskedasticity
VAR	Vector Autoregression
G-7	The Group of Seven
DF Test	Dickey-Fuller Test
PP Test	Phillips-Perron Test
KPSS Test	Kwiatkowski–Phillips–Schmidt–Shin

INTRODUCTION

The "Fragile Five" is a term invented in 2013 by a Morgan Stanley financial analyst to characterize emerging market economies that were dependent on unreliable foreign investment to empower their development desires. The aim of this paper is to determine the relationship for the stock markets and exchange rates on Fragile five Countries (South Africa, Turkey, Indonesia, India, and Brazil) from January 2010 – December 2019. The period of the study was characterized to be a response to the global financial crisis recovery. Developed financial markets like the U.S. and the U.K., were improving from the financial crisis that happened in 2008. Many investors started moving their investment out of the emerging countries and back into U.S. dollars and Pounds. These powerful outflows originated principally from India, Brazil, Turkey, South Africa, and Indonesia. Their currencies—the Indian rupee, the Brazilian real, the Turkish lira, the South African rand, and finally the Indonesian rupiah. These currencies encountered significant vulnerability and made it difficult to finance their account deficits. Furthermore, this results in high co-movement between the exchange markets and the stock markets. Indeed, there has never been a period in which these two vital macroeconomic variables have moved so strongly. The primary analysis investigates the broad relationship between stock prices and exchange rates in Fragile five Countries. The study of the changes in these main economic variables and the relationship between those changes is then extended.

The intense interaction between exchange rates and stock prices has been primarily investigated empirically and theoretically by researchers, academicians, investors, and regulators. Although many papers examine the relationship between the stock market and exchange rate with numerous methods, this highly controversial subject in the literature remains unsettled because of the founded different outcomes. Even though research findings vary regarding the countries under analysis and sample period, it is said that both market fundamentals and investors view mainly drive the relationship. According to economic and finance theories, there are several theoretical explanations for their relationships. Ramasamy and Yeung (2005) proposed that the reason for these inconsistent results is that the characteristics of the interaction between stock and exchange rate markets are sensitive to the stage of the corporate cycle, and broader economic aspects of these five countries decreased in value against foreign currencies.

As a result, bond yields increased, and stock exchanges suffered substantial losses in value. There are many factors that take significant roll when it comes to the relationship between these financial markets. In this research we group the relation of foreign exchange market and stock Index into four categories, bidirectional relationships, unidirectional relationships amongst stock index and foreign exchange rates, unidirectional relationships among currencies, and stock index, and no relationship. Even though there is zero agreement on either hypothetical or experimental suggestion on the relationship at a theoretical level among exchange rates and stock prices.

1. FRAGILE FIVE COUNTRIES

When it comes to emerging markets, the relation between the value of their reference stock market indices and their exchange rates is significant and negative, especially during crises (Chien-HsiuLin,2012), which are the last symptom of fragility. In this regard, "The Fragile Five" had multiple vivid examples of this crucial inverse relation. When analyzing them, we find common denominators such as twin deficits, chronic inflation, and scarce foreign reserves. However, each country has its own particular aspects, which we will review.

1.1. India

India's 1991 economic crisis can help us understand from where the particular fragilities of the country derive. In this case, the common and famous "IMF" acronym (It's Mostly Fiscal) holds true. The economic downturn is implied to have been mainly attributable to the significant and rising fiscal imbalances of the 1980s. In 1980, Indias government spending in India increase at a extraordinary pace, faster than both GDP and government revenues. High government spending, overtime, had a spill-over impact on the trade deficit causing in an external payments crisis. With weak and decreasing cost recovery levels, subsidies expanded at a faster rate than government spending. Subsidies began to rise from 8.5 percentage in 1980-1981 to 10.2 percentage in 1990-1991 as a proportion of overall expenditure (Bajpai, Nirupam, 1996).

There were two significant aspects of fiscal imbalances in India, which had assumed severe proportions since the mid-1980s. First, the outpacing of the rate of revenue growth by the growth of expenditure has dramatically decreased the funds needed to the economy for infrastructure development. The growing use of debt money to balanace current spending has caused the latter to become self-propelled. Secondly, the growing diversion of household savings to meet the requirements of public consumption has not only contributed to a rise in public debt to unsustainable levels, but has also decreased the capital available for private investment.

Through an average growth rate of $2.3 billion or 1.3 per cent of Gross domestic product throughout the first half of the 1980, the current account deficit doubled to An estimated average of $5.5 billion or 2.2% of Gross domestic product in the late 1980s and early 1990s.

In addition, as India is not a net exporter of oil & gas, The Gulf War has characterized the situation. Apart with the reduction of export profits, the most significant result of the war was the panic-stricken procurement of oil through spot prices at high prices.

The balance-of-payments came under severe strain in 1991. The government had to sell gold and seek help from the IMF to achieve stabilize its economy. Subsequently, the goverment launched an integral program of economic reforms.

As for India, we identify classic fragility variables such as twin deficits and dependancy on key imports for the economy, in this case, energy.

1.2. **Brazil**

The External financial 1998-1999 Brazilian currency crisis serves as the first example of fragility as it has the typical emerging market dynamics. After a set of liberalization reforms, there was an unexpected decrease in the rate of inflation as the local currency was pegged to the US dollar. This was followed by marked exchange rate appreciation. As a result of the differential evolution of domestic and foreign rates, the local currency appreciated in a context where the nominal exchange rate remained constant, causing the current account balance of payments to contract considerably, primarily due to an rise in the value of imports. The following deficit was complemented by a large financial account surplus, even large enough to accumulate foreign reserves.

The latter increase was due to the increase in foreign capital entering the country created by the initial success of the stabilization plan. The implementation of tight monetary policies and greater flexibility for international investors produced a sufficiently broad interest rate gap to draw capital inflows from arbitration (De Paula, L. F. R., & Alves, A. J. (2000)).

Emerging markets have a marked political dynamic. Usually, current governments tend to prefer appreciated real exchange rates so the population can feel wealthy, acquiring imported good & services or travels. This phenomenon is known as "exchange lag" (Franco, 1998). This is especially common in Latin American democracies.

In the case of Brazil, the country featured twin deficits with a currency peg system that relied on foreign reserves to be maintained. The Russian default of 1998 triggered a wave of uncertainty to all emerging markets, including Brazil, that had been selling reserves

since the South-Asian crisis of 1997. The result was a massive crisis which led to Brazil's default as they could not refinance their debt. The peg was the last resort of trust in the liberal government and had to be abandoned. The alternative was a socialist party (Worker's Party), which was seemed as anti-market and anti-institutional.

The result of the crisis was a 50% forced devaluation against the USD and a 60% fall from high to low of the Bovespa index in US dollar terms. Hence, in the case of Brazil we can identify at least three particular aspects: political risk, exchange lag and tight monetary policies with a peg system.

1.3. **Turkey**

Similarly, as has been described in the previous cases, economists of all kinds have recognized the problem of growth in Turkey, which relies on, and is driven by, foreign capital inflows. The Turkish economy's two big financial crises of 1994 and 2001 had a negative effect on the ISE. The ISE index, for example, dropped from 288.84 at the start of January 1994 to 150.97 at the end of April 1994. The Turkish Lira lost a value of 125.9% against the US Dollar. Although the ISE index at the beginning of January 2001 was 11,539.99 (Kasman, 2003: 72), it dropped at the end of February to 8344.94. In this time, the Turkish Lira lost 43.29 percent in value. The importance and relation between volatility of the currency and the economy can be found in all emerging markets, which is one of the causes of fragility. Turkey is not an exception.

As stated by the magazine "The Economist", For Turkey, this is a main problem:' Those with current account deficits are vulnerable to unexpected capital outflows if international investors become more risk-averse.' What should also be said is that Turkey's problem is not only a matter of the current account itself but also the composition of the deficit.

The import of capital goods and intermediate inputs, which were already essential components of Turkey 's development, is an important part of Turkey's current account deficit. (Tutan, M. U., & Campbell, A. (2015)) According to the International Trade Centre, as of 2019, the following product groups represent the percentage share of products in Turkey's import purchases.

- Mineral fuels including oil: 20.5% of total imports
- Machinery including computers: 10.7%

- Electrical machinery, equipment: 7.5%
- Iron, steel: 7.3%
- Gems, precious metals: 6.6%

All these products are generally used in intermediate processes for new high value added goods & services. Turkey's case of fragility is particularly relevant as the growth model itself is reliant on foreign capital. However, Turkey's "symptoms" of fragility also resemble the rest of the economies reviewed. Hot money volatility and inflation have been persistent in recent years.

When it comes to emerging markets have a marked political dynamic. Usually, current governments tend to prefer appreciated real exchange rates so the population can feel wealthy, acquiring imported good & services or travels. This phenomenon is known as "exchange lag" (Franco, 1998). This is especially common in Latin American democracies.

Inflation has spiked since 2017 and the trend seems to continue this year, with an expected inflation of 9% for year's end. Nevertheless, when looking at core inflation (not including food and energy sectors), inflation is closer to 11%. The repression of the US dollar with capital controls was partially offsetting inflation pressures until august 2020.

Hot money outflows are part of the cause of this phenomenon. Turkey entered a new phase of recession starting in the last quarter of 2018. Part of the reasons for these are political. After the unsuccessfull coup attempt in July 2016 and the yet another-quarter fall in Gross domestic product that followed, the government agreed to encourage credit growth and not let the economy go into recession.

The Government sponsored Credit Guarantee Fund was the tool to support credit growth. However, there were contradictions with the policiy as the new credit widened the gap of the current account deficit.

The government calling for early elections in 2018 was another reason for a widening of the deficit. All available tools were used to avoid a contraction in the GDP Until the polls. oThat being said, the Turkish Lira began to fall towards the elections and, in the summer of 2018, a diplomatic divide between the USA and Turkey culminated in a sudden rapid outflow of foreign and domestic capital and a strong local lcurrency weakening. (Ozgür Orhangaziand Erinç Yeldan, 2020).

Hence, in the case of Turkey, we identify all aspects of a fragile economy. First and foremost, political risk with structural dependancy on foreign goods to achieve growth. In particular, goods used in intermedaite processes such as construction, which might be the case of machinery or steel.

Hot money dependancy is also an important factor in Turkey's case, which has triggered both sharp appreciation as in the 2000s and depreciation alongside capital control as in the present. Finally, as a symptom from these aspects chronic high inflation seems to persist in the country as money demand falls even when the central bank skews its policy towards tightening.

1.4. **South Africa**

South Africa's economic fragilities show a mix of component from emerging and developing economies. While South Africa did not have a singular massive crisis as the other countries that we have reviewed, it should be noted that the South African Rand follows signs of fragility as any other emerging market's currencies given its volatility and net effect on inflation. There have been several flauncations in the emerging market, which mostly impact them. There have been several functions in the emerging market, which mostly impact them differently in the rest of the world. What makes the market response is that people believe, feel, and foresee where the market is going. Such a move can not be predicted, but people typically prefer to move their investment out of the developing market, into the developed countries, which do not necessarily mean more stable. That been said, as countries experience capital outflows, their local currency is once again depreciating.

Nevertheless, the repetition of depreciation fluctuates significantly in each "mini"-crisis episode. For example, while the 1996 crisis was characterized by a continuing depreciation in the rand, the 2001 crisis characterizes a very sharp adjustment in spot rate. This points to fluctuations in the South African Reserve Bank (SARB)'s policies.

The SARB participated in the forward exchange market between 1996 and 1998 in order to boost the value of the rand and, consequently, to suppress volatility. The strategy of shielding the rand from market forces had a negative effect on the accumulation by the

SARB of a very wide net open forward role. By the end of September 1998, this role amounted to USD23.2 billion.), the expense of protecting the rand during most of the 1990s can be seen as a primary reason for the shift in the government policy that took place in 2000. Subsequently, as pressure grew against the rand in the latter part of 2001, the volatility of the domestic market increased significantly (Duncan, Stuart, & Liu, 2009).

The importance and relation between volatility of the currency and the economy can be found in all emerging markets, which is one of the causes of fragility. South Africa is not an exception. In the 1990s when volatility was suppressed inflation maintained a downward trend and with SARB's regime, inflation spiked from 1999 to 2003 (IMF, 2015).

Economic data also suggests that there has been a relationship between the real mineral price and realexchange rate: the currency slumps when mineral exports are declining, as in the late 1990s (Jeffrey, 2007).

As South Africa only has suffered what we might regard as cyclical crises and not "massive" crises such as other countries, we may point out that one of the determinants of this particularity is the fact that South Africa has an important internal capital market and unlike most developing countries South Africa borrows in rand. As of 2019, South Africa's Market Capitalization accounted for 343.5 % of its Nominal GDP (CEIC, 2020).

1.5. **Indonesia**

Indonesia's structural fragilities follow a similar pattern to many emerging markets. The South-Asian crisis of 1997 featured not only an economic crisis but also a political regime change as the president Suharto, a military dictator, was forced to resign which resulted in the adoption of democracy as a system shortly after. This notes again the importance of political cycles in all Fragile Economies.

In the 1980s, due to the decline in oil and gas prices and related state revenues, the state was no longer able to act as the main agent of economic development as it had done in the 1970s. The basic financial architecture to achieve this purpose had been already installed before the 1990s through the adoption of a series of financial liberalization measures.

Indonesia’s economy boomed from 1990 to 1996. As regards to external debt, although Indonesia needed to control its growth, the government pursued a policy of creating room for private sector external borrowing by reducing public external debt. The government basically expected the private sector to raise the necessary funds through its direct access to offshore financial markets. (Matsumoto, 2006).

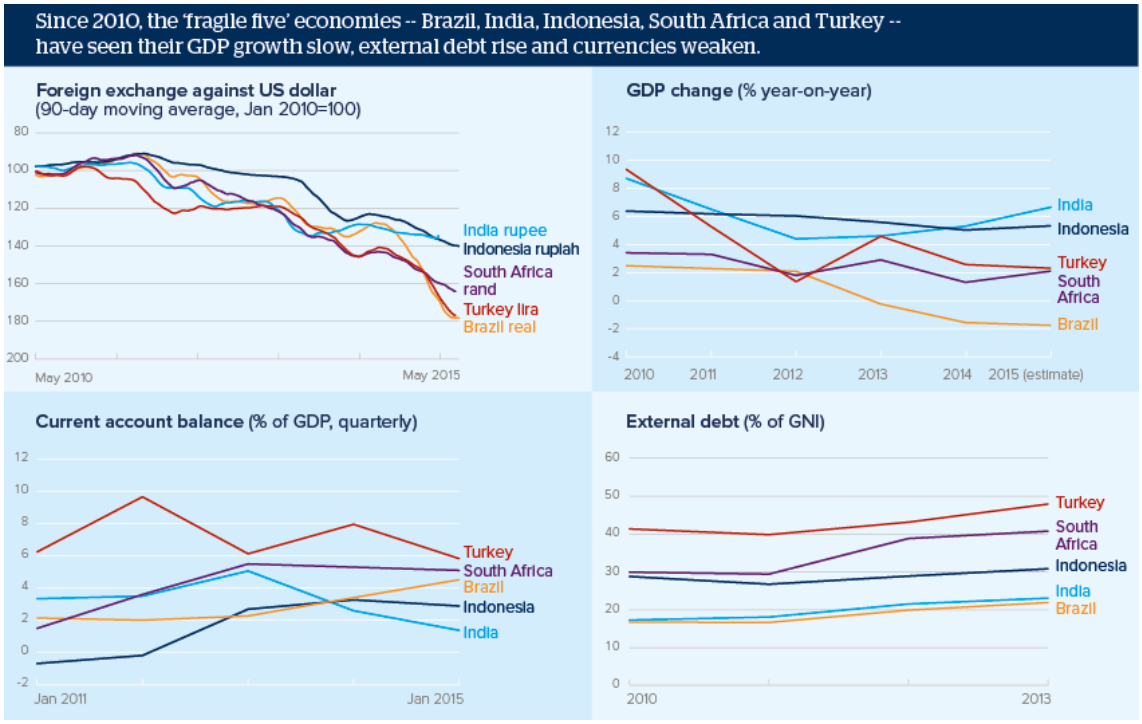
The private corporate sector rapidly expanded its balance sheet and steeply leveraged its financial structures offshore lenders were caught up in a ‘mania’as describedby Kindleberger and further accelerated lending to the sector (Kindleberger, 1978).

The sudden and large-scale retreat of offshore mobile capital from South-Asian countries such as Indonesia or Indonesia itself precipitated the collapse of cash-flow chains across the economy. The most important particularity of the Indonesian case is that it was not the public sector that was incurring in constant fiscal deficits as in other cases. The crisis was primarily private sector driven.

According to the Ministry of Finance of Indonesia and the IMF, from 1993 to 1997 the government had runned budget surpluses as high as 3% of GDP, while the current account never had a deficit greater than 2% as of the GDP.

The exchange rate between the rupiah and the dollar was about 2,600 rupiah to 1 U.S. dollar prior to the crisis. On 9 January 1998, the rate plummeted to over 11,000 rupiah to 1 U.S. dollar.

1.6. **US rate rise to separately impact 'fragile five'.**



Source: Bloomberg, World Bank, Oxford Analytica

As US rates increase, all the five fragile economies are likely to suffer massive inflation and currency depreciation, possibly before the end of 2015. This could boost manufactured exports and local currency

profits from dollar-denominated commodity exports over the longer term. That being said, despite the depressed oil prices for India, Indonesia, Turkey and South Africa, the pressure on companies of dollar-denominated debt would escalate, as would the cost of imports.

As far as sovereign risk is concerned, Brazil, South Africa and Turkey face the biggest risk from the rise. Their current account deficits are equal to, or greater than, the 'threat threshold' of 5% of GDP in the case of Turkey and hot money dependancy is also an important factor in Turkey's case, which has triggered both sharp appreciation as in the 2000s and depreciation alongside capital control as in the present. Finally, as a symptom from these aspects chronic high inflation seems to persist in the country as money demand falls even when the central bank skews its policy towards tightening.

The grim expectations for growth make the situation worse: Brazil is in recession, South Africa and Turkey are heading this year for a tepid GDP growth of about 2%. For India and Indonesia, strong, if semipar, growth and stable external accounts offer relief.

2. THEORY AND LITERATURE

2.1. Traditional Approach

There are two main hypothetical approaches background that propose the link between the stock market and the exchange market are: tradition approach and stock-oriented models. The traditional approach is about the "flow-oriented" exchange rate models (Dornbusch & Fischer 1980), recommending a Granger causality driving from exchange market to stock market, and it states that exchange rate fluctuations affect international competitiveness. Then the less favorable terms of trade may affect real income and so stock costs. Moreover, as a result of the estimated value of a stock equals the discounted add of its expected future capital flows, they react to macroeconomic events as well as the rate of exchange changes.

According to Evelyn (2010), the fluctuation in the exchange rate would influence the change in the firm's market value. Changes in market value will impact the investor's evaluation of the current and potential success of the company in the coming future, expressed in the strength of demand and supply in the company's stock exchange (Market Value). Consequently, the changes in demand and supply of stock shares would ultimately impact shifts in stock price. Local exchange depreciation would fuel export growth and rise in returns and drive its stock price up. At the same time, the company that imports more commodities in the depreciation of local the money would result in a rise in the cost of production impacting the company's earnings, which also affects the company's profits and its stock price (Yucel and Kurt, 2003).

In agreement with, Adler and Dumas (1984), the exchange rate also affects the companies which operate entirely in the domestic sphere. The impact extends in the input and output return changes of the company due to fluctuations in macroeconomic situations created by exchange rate moves. However, the difference between the local currency exchange rate facing foreign money command influence the aggressive position of the company against foreign competitors in the region.

According to Adler and Dumas (1984), the exchange rate also affects the companies which operate entirely in the domestic sphere. The impact lies in the input and output price changes of the company due to changes in macroeconomic conditions caused by exchange rate changes. However, the difference between the local currency exchange rate

and foreign currencies will also influence the competitive position of the company against foreign competitors in the region.

Hennigar (1988), Between 1980 and 1986, they placed monthly US stock prices and dollar exchange rates and noticed a clear negative correlation between stock prices and exchange rates. Besides, a dominant or deficient currency, rapid in the 1990s, can't change this outcome.

2.2. **Stock-oriented Models**

Additionally, the portfolio model is concentrated on "stock- oriented" Exchange Markets forecasts, hence proposing that the influence is on exchange rates from stock prices. The 'stock-oriented' model (Branson 1983; Frankel 1983) suggests that improvements in the stock market determine the capital of investors in demand for money. For instance, the rising stock price encourages capital inflows. It thereby increases the need for and thus appreciation of the local currency, which declares that if the local stock price increases, it resolve influence investors to buy more local goods by selling different products to obtain local currency. Expanded interest for the domestic money will lead to an appreciation of the domestic capital. On the other hand, an increase in the prices of local goods will increase wealth, which also will increase the demand for cash by investors. More foreign investment will be attracted by this situation, which will increase international demand for domestic currency, and the concluding result will be an appreciation of the local currency.

Also, the impact on the stock market can be substantial sufficient to make the foreign exchange rate appreciated as a consequence of increase in the money supply. To put in the away the stock price will substantially affect the foreign exchange rate market. Smith (1992) was in her early years, one of the proponents of the portfolio method. Smith (1992) uses quarterly data from the first quarter of 1974 until the third quarter of 1988 to research the correlation between United States exchange rates and stock prices. He used equity in the portfolio balance foreign exchange model to push an approximate equation of currency rates and discovered that stock prices in the United Kingdom would contribute to adjustments in currency exchange within the United Kingdom pound and United States dollar. He technically reexamined this relationship, using a multi-country approach. Smith (1992b) revealed a theoretical model of optimum preference over riskier investment to generate an approximate equation of the exchange rate.

Unlike past examination, the assets involve equities, government bonds, and property. This model has been calculated using quarterly data from the 1974-1988 period. Everything was found that the German-U.S. mark value the dollar and the Japanese yen-US dollar exchange rates have a significant impact on their stock prices.

In sum, the theoretical structure implies that the causality of Granger may vary of exchange rates to stock prices or from stock prices to exchange rates. There is no conclusion on a theoretical aspect of the link connecting exchange rates and stock prices.

2.3. Literature Review

The primary analysis examination narrates the short term and long term associations between combination stock values and, therefore, the rate of foreign exchange. Co-integration and granger causality techniques are practiced continuously here to analyze whether or not prolonged cooperations amongst the stock market and exchange market.

The outcomes of Several studies find insufficient proof of the relationship between foreign exchange and stock market (e.g Granger, Hüang, and Yang, 2000; Smyth and Nandha, 2003; Hatemi-J and Roca, 2005; Patra and Pöshakwale, 2006; Ehrmann Fratzscher and Rigobon, 2011; Chen and Chen, 2012;),. while others like (e.g., Tsagkanos & Siriopoulos (2013); Pan, Fok & Liu 2007; Jayasinghe & Tsui 2008; and Yau & Nieh 2009; Liang, Lin, and Hsu (2013);) discover that the relationship between exchange rates and stock prices is substantial and causal. Interestingly, Research shows that granger causality is frequently divided into four catalogs of links on various financial markets: bidirectional relationships, unidirectional relationships between stock prices and exchange rates, unidirectional relationships between currencies, and stock prices, and no relationship. Even though there is no agreement on either theoretical or empirical evidence on the relationship at a theoretical level between exchange rates and stock prices, in this sector we will examine both theoretically and empirically these two key lines of inquiry related to the interaction between stock prices and exchange rates.

2.3.1. Causality from exchange rates to stock prices

There is overabundant empirical proof relating to the flow oriented approach, which proposes that changes in the exchange price ought to lead stock price movements. Examining the relationship between US stock market indexes and the dollar's trade-weighted value for the 1974-78 period, Aggarwal (1981) finds a positive correlation

between stock prices and exchange rates. A shift in the exchange rate may directly alter multinational corporate stock prices and indirectly alter domestic corporate stock prices.

As one of the first to research the effect of foreign market on stock market, Soenen &

Donnelly and Sheey (1996), suggesting the causality path from exchange rates to stock prices, showed that the entire measure of UK stock market response to exchange rate fluctuations carries many months to operate into share prices.

Nieh and Lee (2001) analyzed the complicated relationship between exchange market and stock market for the Group of seven nations and concluded that there was no significant long-run correlation between two variables, although in some G7 countries in the short-run a positive correlations was identified for single day results countries like Germany, Canada and the UK, causality is driving from Exchange market to Stock market and its particularly relevant for a day. Explicitly, the German financial market will be excited by increase in currency value even though it reduces stock market return countries like Canada and United Kingdom.

Abdalla & Murinde (1997) studied the changing in developing financial markets. The motive seems to create the causal ties between the top foreign exchange market and stock market, at same time because of a lack of data accessibility, regular data from Korea, India, the Islamic Republic of Pakistan, and the Philippines from 01/1985 to 07/1994. They discovered that the relationship between foreign exchange market and stock market reflects the flow-oriented model in Korea, India, and the Islamic Republic of Pakistan. It suggests the fluctuations in exchange market confirm stock return changes in Korea, India, and the Islamic Republic of Pakistan.

In (2004), Victor Murinde and Sunil Poshakwale investigated through 2/1/1995 – 31/12/1998, for the before Euro currency period and 1/1/1999 – 31/12/2003 for the euro period the level of interactions between European developing financial markets, especially the foreign exchange markets and also the stock markets. It has been uncovered that stock markets are unidirectionally Granger-cause exchange rates to stock prices only in Hungary for the before Euro period; similarly, reinforcing correlations between exchange rates and stock prices tend to endure within the Czech Republic and the Republic of Poland. Exchange levels unidirectionally during the euro era Granger-cause all three sample economies have stock prices. Realize even higher positive correlations

between the Hungarian, Czech, and Republic of Poland stock markets through the euro cycle than is the state during the before euro era.

Praphan Wongbangpo and Subhash C.Sharma (2002) their study investigated the role of select macroeconomic variables such as consumer price index, exchange rate, the currency supply in some of Asean countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). In courses of granger relation within stock market and foreign exchange market, it has urged that within the short-term, it has been the foreign exchange market that influence stock market in the Malaysian, Indonesian, and Thailand markets.

The Asian economic crisis started in 1997, once both the foreign exchange market and the Asian equity markets fell. Expectedly, there seems to be an ever-widening variety of research investigating the collaboration through the crisis between stock market and macroeconomic variables in many Asian countries. (The GARCH-M model was applied to regular data by Granger, Huang & Yang(2000). And then, advanced unit root and cointegration models to discover the correct granger causality relationships among stock market and exchange rates that exploit Asian crisis data, As well as impulse response definitions, are perceived to agree with this approach, And foreign exchange contribute to the strong correlation of the stock value. On the contrary, Taiwan data indicates the resulting portfolio approach forecast: inventory costs influence exchange rates with a negative relationship. Information from Indonesia, Korea, Malaysia, and the Philippines suggests close ties where there is no prevailing trend in Singapore.

Ying Wu, (2000), regularly observed Singapores dollar appreciation against the US dollar and Malaysian ringgit and depreciation against the Japanese yen and Indonesian rupiah culminated in sustained stock price rises during numerous chosen periods in the 1990s. Nevertheless, the conclusion concerning the US dollar exchange rate has a sign of reversal between the time of the 1997-98 crisis and the 1999-2000 improvement stage, the impact of exchange rates on stock prices rises in sequential order in the 1990s.

Similarly, WenShwo Fang and Stephen M. Miller (2002) often properly researched the effect of money depreciation during the Asian financial crisis on South Korea's capital markets. They used the root unit test, the test for cointegration, and the Granger test. The evidence determines that the exchange depreciation remarkably affects stock market performance. Over three separate channels: Exchange rate depreciation harms stock-market returns, decreased currency depreciation volatility decreases stock-market profits,

and currency depreciation volatility decreases stock-market fluctuations. Similarly, Russel Smyth and Monda Nandha (2003) analyzed the relationship between South Asian Currency rates and stock market prices from 1995 to 2001, using daily data. Their experimental research Suggests that Granger causality in India and Sri Lanka comes from foreign exchange to stock prices, which shows the flow-oriented model interaction between them.

Glaum et al. (2000) suggested that if correlation adjustments are attributable to consumer price index shifts, as CPI correlation model may expect, stock price might be influenced by market declines with a specific discount rate on the potential earnings streams of the businesses.

Bala Ramasamy and Matthew C.H Yeung (2005), proposed that somehow the explanation for these different outcomes is that the scenario of relationships between stock market and exchange rate markets is delicate mostly to extent of the economic recession and broader economic aspects, such as growth as well as financial sector style changes within an economy. The date when the relationship between stock and exchange markets was studied, therefore, is demeaning to anything other than the results. This reflection is indeed a crucial stage at which the existing conducted research of the engagement between stock market and foreign exchange rates in fragile Five countries and the co - integration during the study period between stock market and foreign exchange rate.

Germany is another example of the conventional approach when talking about nonlinear Granger causality. The most recent research was by Tsagkanos & Siriopoulos (2013), who, in the latest financial crisis (2008-2012), explored this causality. Using daily as well as monthly interpretations, they find that shifts in foreign exchange influence stock market returns for equally in the EU and the United State in regular periods.

In conclusion, there are comprehensive list of experiential researches that confirm that causality ranges from foreign exchange rates to stock prices unidirectionally, it is patterned with the assumptions of the conventional model. Linear or nonlinear tests of causality by Granger cannot modify these effects.

2.3.2. Causality from stock prices to exchange rates

As much as great empirical studies are supporting the traditional approach, there are the same amount of studies that show empirical proof for the portfolio approach, designating that there is unidirectional causality from stock prices to exchange rates.

Ajayi and Mougoue (1996) suggested a rise in the overall local stock price would have such a negative impact on local currency in short-term. In the longer term, nevertheless, rises in stock prices have a positive impact on local exchange rate. Investigating seven developed markets and eight emerging Asian markets, Ajayi et al. (1998) found that equity and foreign exchange markets are interconnected with established markets, leading from stock markets to currency rates to causalities.

Bala Ramasamy and Matthew C.H Yeung (2001) suggested that causality may vary depending on the study duration, and Equity markets were also found to influence exchange rates for Malaysia, Singapore, Thailand, Taiwan and Japan.

The findings show that weighted stock prices negatively affect exchange market in Canada, France, Germany, Italy, Japan, the Netherlands, the United Kingdom, and the United States. Nieh & Lee (2001) used regular data from 01/10/1993 to 15/02/1996 to investigate the dynamics of exchange rates and stock prices and determined that there is a negative causality of Granger in Italy and Japan flowing from stock prices to exchange rates. Yang & Doong (2004) further explored this relationship in respect of the G-7 countries. A quantitative model of Nelson's (1991) Empirical GARCH (EGARCH) model was used to analyze price and volatility spillovers between exchange rates and stock prices for weekly inspections over the period 01/05/1979-01/01/1999. Empirical findings affirm the portfolio strategy in terms of both return and volatilization for France, Italy, Japan, and the United States. Real, potential exchange rate fluctuations are due to shifts in stock prices. Also, stock price volatility is transmitted substantially to the exchange-rate market.

Comparably, Granger et al. (2000) observed that stock prices lead exchange rates to some degree in addition to certain countries except Japan and also for the Philippines and Hong Kong. Assimilation in these nine countries (Austria, France, Germany, UK, Czech Republic, Hungary, Poland, Slovakia, and the United States) between stock prices and exchange rates; was investigated by Stavárek (2005) studied the causalities and found that

they appeared mostly unidirectional. With the course from stock prices to currency exchanges.

The relationship between exchange rates and stock prices were studied in many emerging markets, following studies in developed economies. For example, in emerging markets, Abdalla & Murınde (1997) first suggested the Granger causality investigation between these currency and stock market and discovered that there is unidirectional causality from stock index to currency in the Philippines. Murınde & Poshakwale (2004) also examined this Granger causalities before and after the Euro period for European emerging markets, using regular measurements from two periods: 2/1/1995 – 31/12/1998, and 1/1/1999 – 31/12/2003. There is substantial support for the portfolio strategy in Hungary during the pre-Euro period. Granger et al. (2000) got similar results. In addition to the Philippines, as indicated by Granger et al. (2000), foreign exchange markets in Hong Kong, Malaysia, Singapore, Thailand, and Taiwan have discovered themselves influenced by the stock market.

In conclusion, there is also ample support for the portfolio strategy, close to the results for unidirectional causality flowing from exchange rates to stock prices. The empirical findings, in other words, suggest that stock prices can also influence exchange rates at a quantitative level.

2.3.3. Bidirectional relationship between stock prices and exchange rates

In developing markets, bidirectional causality between exchange rates and stock prices have been discovered in many kinds of research. For reference, Granger, Huang & Yang (2000) used daily data from 03-0-1986 to 16-06-1998 to investigate the shorter period relation between foreign rates and stock prices for several Asian country. throughout the Asian crisis. They conclude that there is a primary feedback relationship between the stock market and exchange rates in Hong Kong, Malaysia, Singapore, Thailand, and Taiwan. This result for Singapore and the Philippines is confirmed by Wongbangpo & Sharma (2002), Primarily focused on monthly findings from 1985 throughout 1996. As for the developing European countries

The first research to propose this feedback interaction between the two markets was Bahmani-Oskooee and Sohrabian (1992). Cointegration and the Granger test are applied from 07-1973 to 12-1988, using monthly data. The findings imply a bidirectionally-based correlation between exchange market and US stock market. Ajayi & Mougoue (1996)

present similar results for France, Germany, Italy, Japan, the United Kingdom and the United States, respectively.

This bidirectional relationship is noted by Murinde & Poshakwale (2004) Over the pre-Euro era for the Czech Republic and Poland. More sophisticated techniques can also demonstrate the result. Doong, Yang & Wang (2005), for example, use a GARCH-M models to explore the complex causality between exchange market and stock market for the emerging Asian financial markets.

Some research suggests support relationships between the foreign markets and stock markets, for instance, Incı & Lee (2014) re-examines complicated connection between the both by integrating lagged effect and causality relationships, depend on long-term yearly data from 1984 to 2009. We point out that still this connection is vulnerable to the business circle. There Is compelling proof of bidirectional-based correlations among both variables in Germany, Switzerland, France, the United Kingdom, the United States, Canada, and Japan. For India, Indonesia, and Korea, Lin (2012) confirms the result. Similarly, for the US, Canada, Japan, Italy, France, the UK, South Korea, and Hungary, Chen & Chen (2012) discover non-linear bidirectional interactions among exchange market and stock market.

2.3.4.No correlation between stock prices and exchange rates

Moreover, there are particular theoretical structures for the collaboration among trade rates and stock costs, and there are a few investigations that cannot discover whatever connection between them in specific nations. It is just plain obvious, for instance, Granger, Huang, and Yang, 2000; Hatemi-J and Roca, 2005; Smyth and Nandha, 2003; Ehrmann Fratzscher and Rigobon, 2011; Patra and Poshakwale, 2006; Chen and Chen, 2012; among numerous others. For appearance, although Granger, Huang, and Yang (2000) find proof for the flow-oriented and stock-oriented approach in individual nations, there is no indication of a connection within exchange markets and stock value in Indonesia and Japan. A comparative outcome is determined for Bangladesh and Pakistan by Smyth and Nandha (2003). Hatemi-J and Roca (2005) examined these adequate causalities in Asia emergency time frame.

The outcome reveals that stock value remained not impacted by exchange market, or lousy habit visa for Malaysia, Indonesia, the Philippines, and Thailand, throughout the Asian emergency. Around the same time, Mishra (2005) noticed that the Indian securities

exchange was not identified with its foreign trade advertising, which is following the contentions of Hatemi-J and Roca (2005). Patra and Poshakwale (2006) analyzed the modifications of stock costs, and They consider that the Athens stock trade is not recognized with its outside trade showcase, utilizing month to month information from 1990 to 1999 in their investigation. Ongoing examinations additionally affirm this sign. For instance, there’s still no proof of any momentary relations between trade rates and stock costs in the US, as proposed by Ehrmann Fratzscher and Rigobon (2011). Correspondingly, it is inconvenient.

Chen and Chen (2012) haven't to locate any direct causalities among these two factors for France, Japan, Poland, and Hungary,

In summary, several investigations have suggested no proof both of the conventional approach or the portfolio approach, implying that exchange market and stock market in the empirical literature may not be related to those countries.

3. EMPIRICAL RESEARCH

3.1. DATA AND METHODOLOGY

We used a secondary data from weekly observations of the foreign exchange markets and stock markets. WE have worked with the stock 'index' of Indonesia (JKII), South Africa(JTOPI), Turkey(XU100), Brazil(BVSP), and India(BSESN), from January 2010 - December 2019 and used each countries' currency against US Dollar. We used the Vector autoregression (VAR) model, Granger causality and impulse response tests of the VAR model. To apply the VAR model, the series should be stationary. In the first step, we used unit root tests. In the second step, VAR lag order selections are done for the stock index – exchange rate duals for each country. In the following steps, impulse response tests are done to examine the short term relationships and Granger causality tests are applied for the long term relationship for every dual.

3.1.1. Unit Root Test

3.1.1.1. Dickey-Fuller tests (DF test and ADF test)

One of probably the most famous and most commonly used unit root tests is the Dickey-test (Dickey, Fuller, 1979). It concentrated on the autoregressive first-order process model (Box, Jenkins,1970):

$$y_t = \emptyset_1 y_{t-1} + \varepsilon_t \quad t = 1,\ldots, T \qquad (1)$$

$where\ \emptyset\_1\ \ is\ the\ autoregression\ parameter, \varepsilon\_t\ \ Is\ a\ non$
$-\ systematic\ part\ of\ a\ model\ that\ meets\ background\ noise\ system\ features.$

$The\ null\ hypothesis\ is\ H\_0\ = \emptyset\_1$
$= 1, i.e.\ the\ cycle\ has\ a\ unit\ root\ and\ is\ thus\ non-stationary,$

$and\ is\ denoted\ as\ I(1), alternative\ hypothesis\ is\ H\_(1): l\ \emptyset\_1\ l$
$< 1, i.e.\ the\ process\ does\ not\ contain\ a\ unit\ root\ and\ is\ stationary, I(0).$

Calculating the DF test numbers, we use an equation that we get if y_(t − 1) restrained from both sides of the equation (1):

$$\Delta y_t = \beta y_{t-1} + \varepsilon_t, \qquad (2)$$

where $\beta = \emptyset_1 - 1$. *The test statistic is defined as*:

$$t_{DF} = \frac{\emptyset_1 - 1}{S\phi_1} \qquad (3)$$

where $\emptyset_1$ *is a least square estimate of* $\emptyset_1$ *and* $S\phi_1$ *is its standard error estimate. Under the null hypothesis*

The whole test statistics represents the $Dickey - Fuller\ distribution$, the essential figures for the above apportionment were determined by approximation and analyzed in *Dickey* (1976) *and Fuller* (1976) respectively.

Model (1) *can be expanded by a constant or a linear trend*:

$$y_t = \beta_0 + \emptyset_1 y_{t-1} + \varepsilon_t \qquad (4)$$

$$y_t = \beta_0 + \beta_1 t + \emptyset_1 y_{t-1} + \varepsilon_t \qquad (5)$$

Mostly in case where a non-systemic variable is autocorrelated in DF models, so-called *Augmented*

Dickey − Fuller test is constructed (*Dickey, Fuller*, 1981).
Model (1) *is then transformed* as:

$$y_t = \emptyset_1 y_{t-1} + \sum_{i=1}^{p-1} y_i \ \Delta y_{t-i} + \varepsilon_t \qquad (6)$$

and the following equation is used to calculate the test statistic of the ADF test :

$$\Delta y_t = (\emptyset_1 - 1) y_{t-1} + \sum_{i=1}^{p-1} y_i \ \Delta y_{t-i} + \varepsilon_t \qquad (7)$$

The option of lags is one practical problem of this study. The first moves shall be the same as all the DF check. Schwert (1989) recommends selecting the highest lag max = 12(T/100)1/4 because it would be too small, autocorrelation will influence the test, and when it is too high the test's power will be lower. Model (6) could also be extended according to a constant or linear pattern. The underlying models are then applied to tests based on the following model:

$$y_t = d_t + \emptyset_1\, y_{t-1} + \sum_{i=1}^{p-1} y_i\ \Delta y_{t-i} + \varepsilon_t \qquad (8)$$

Where d_t=$\sum_{i=0}^{p} \beta_i\ t^i$, for p = 0,1, Includes probabilistic parts of the above model. The restrictive distribution of test statistics is the same as the distribution of DF test statistics except for

T → ∞ is tabulated in Dickey (1976) and MacKinnon (1991).

3.1.1.2. Phillips-Perron test (PP test)

Now In the Case of unit root testing of time series created by the research phase with the autocorrelated and heteroscedastic non-systematic variable, the regression model often presents a difficulty in selecting lag p. Phillips and Perron (1988) tackled this problem. Rather than explaining the autocorrelation structure of the generation process by the respective autocorrelation models, They employed the normal, non-parametrically modified Dickey-Fuller test statistics.

The whole analysis also continues to draw on the models (1), (4), and (5) Even with gap a centered time variable replaces the linear trend in the last model.

The next steps, however, are different from the $Dickey-Fuller$ studies. This examination does not use the separate equations for the estimation of test statistics but draws clear from calculations $(1), (4), and\ (5)$. The test statistics Z for a The following constant models are presented (Pesaran, 2015):

$Z_{\emptyset}$ = T ($\emptyset_t$-1) – $\frac{1}{2}\frac{T^2 S_{\emptyset}^2}{S_T^2}(S_{LT}^2 - S_T^2)$ (9)

$Z_T = \left(\frac{S_T}{S_{lT}}\right) t_{DF} - \frac{1}{2}(S_{LT}^2 - S_T^2)\frac{1}{S_{LT}}\frac{\mathrm{T}s_{\emptyset}}{S_T}$ (10)

Where:

$t_{DF} = \frac{\emptyset_r - 1}{S_{\emptyset}}$, $S_T^2 = \frac{1}{T}\sum_{i=1}^{T} \varepsilon_t^2$, $S_{LT}^2 = S_T^2 + 2\sum_{j=1}^{q} (1 - \frac{j}{q+1}) Y_{j.T}$ and $Y_{j.T} = \frac{1}{T}\sum_{t=j+1}^{T} \varepsilon_t \varepsilon_{t-j}$ (11)

t_{DF} *Is the test statistics of DF test*, S_T^2 *is the OLS estimator of the non* $-$ *systematic* Varying elements,

$Y_{j.T}$ Is indeed The full chances calculator of the *non* $-$ *systematic covariance variable*, and q is an amount of covariate lags.

If ε_t *is not autocorrelated*, then $Y_{j.T} = 0, for\ j > 0, and\ S_{LT}^2 = S_T^2$, the Constraining Test transmission.

Statistics t is consequently not Constraining Test transmission parameters of ε_t process. The *test statistics Z* are therefore lower *to* t_{DF} *test statistics*. *Dickey* $-$ *Fuller test* is therefore a unique circumstance of *non* $-$ *parametric* tests.

3.1.1.3. KPSS test

Both of the above experiments test the null hypothesis that a time series of size one, $I(1)$, is incorporated. The KPSS test explains the opposite scenario, i.e. Checking the null assumption of a time series y t *is* $I(0)$, (Kwiatkowski, Phillips, Schmidt, and Shin, 1992).

The KPSS based on the assumption that the time series through a Definitive t is stationary Pattern and estimated as a total amount of the deterministic, arbitrary and stationary pattern

random error. is created on the model:

$y_t = d_t + r_t + \varepsilon_t$ (12)

$r_t = r_{t-1} + u_t$

where $d_t = \sum_{i=0}^{p} \beta_i t^i$, for p = 0,1, $contains\ deterministic\ parts\ of\ the\ model$ (constant or deterministic

trend), $\varepsilon_t are\ iid\ N(0, \sigma_t^2)$ r_t is random walk with variance σ_u^2 and u_t are iid $N(0,\sigma_u^2)$.

The KPSS check is focused on LM assumption that the random move has a zero variance, i.e. $H_0 : \sigma_u^2 = 0_x$, That means it does r_t Is a perpetual, versus an alternative $H_1 : \sigma_u^2 > 0$

The test statistic is written as:

$$LM = \sum_{i=1}^{T} S_T^2 \ / \sigma_t^2 \quad (13)$$

where $S_t = \sum_{i=1}^{T} \varepsilon_t$, t= 1,2, $\ldots T, and\ \sigma_t^2$ Is Variance assessment σ_t^2 of Approach from ε_t the calculation. A test deduced critical values and are listed in KPSS (1992).

3.1.2. Vector Autoregressive Models (VAR) Analysis

VAR model is a blend of simultaneous equation methods and univariate time series models (Brooks 2008). VAR model is employed to get direct interdependencies among many time series. All variables used in the VAR model are viewed as endogenous, making it progressively adaptable to a more extensive cluster of factors (Brooks, 2008, p.6). The following are the purest form of the VAR model with only two equations as shown;

We may write the stationary, k-dimensional, VAR(p) process as

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + C x_t + \varepsilon_t \qquad (19)$$

Where

• $y_t = (y_{1t,} y_{2t,} \ldots., y_{kt})'$ *is a vector of endogenous variables,*

• $x_t = (x_{1t,} x_{2t,} \ldots., x_{dt})'$ *is a vector of exogenous variables,*

• $A_{1,} \ldots., A_p$ are $k \times k$ *matrices of lag coefficients to be estimated,*

• C is a $k \times d$ *matrix of exogenous variable coefficients to be estimated,*

• $\epsilon_t = (\epsilon_{1t}, \epsilon_{2t}, \ldots \epsilon_{kt})'$ is a $k \times 1$ white noise innovation process, with $E(\epsilon_t) = 0$, $E(\epsilon_t \epsilon_t') = \sum_\epsilon$, and $E(\epsilon_t \epsilon_s') = 0$ for $t \neq s$.

The last *statement implies that the vector of innovations* are contemporaneously *correlated with full rank matrix* $\sum_\epsilon$ *, but are uncorrelated with* their leads and lags *of the innovations and* (assuming the usual x_t orthogonality) *uncorrelated with all of the right − hand side variables.*

Let the $(pk + d) \times 1$ vector

$$Z_t = (y_{t-1}', \ldots, y_{t-p}', x_t')' \qquad (20)$$

represent all of the period t regressors in the VAR. Then for *observations* $t = 1, \ldots, T$ *, we* may write t*his model in compact system form as*:

$$Y = BZ + E \qquad (21)$$

where $Y = (y_1, y_2, \ldots y_T)$ and $E = (\epsilon_1, \epsilon_2, \ldots \epsilon_T)$ are $k \times T$ matrices of endogenous variables and innovations, and

$$B = (A_1, A_2, \ldots A_p, C) \qquad (22)$$

$$Z = (Z_1, Z_2, \ldots Z_T)$$

are the $k(pk+d)$ $matrix\ of\ system\ coefficients\ and\ the(pk+d)$ $\times T$ matrix of regressor data, respectively.

$Because\ only\ lagged\ values$ of the endogenous variables show up on the right side of the VAR equations equation and it is presumed that the developments are uncorrelated with lagged innovations and exogenous regressors, normal orthogonality constraints remain and appropriate estimates of OLS yield.

3.1.3. Impulse Responses

The impulse response is an essential step in econometric studies that use autoregressive vector models. Their principal aim is to explain one or more evolution of the variables of a model in reaction to a shock. The above method allows tracking the transmission of a single shock within an equation structure that is otherwise noisy and therefore makes them very useful tools in the evaluation in time series.

3.1.4. Variance Decompositions

Variance decomposition is used in econometrics. And other applications of multivariate time series analysis to assist in the clarification of a vector autoregression (VAR) model after it is equipped. The decomposition of the variance shows how much data each variable adds to the other autoregression variables. It defines how many more of each of the variables ' predicted error variance could be explained to the other variables by exogenous shocks. Campbell (1911) and Campbell and Shiller (1988) first decomposed superior revenues on stocks into cashflow variables and discounted rates, which could see as a benchmark in stock returns. Then, the debate was followed by many other researchers. Decomposition methodology will be applied before the work on variance decompositions of stock returns is checked. These models were suggested by Sims (1980) and have been used as alternatives to traditional simultaneous equations models by many economists and econometricians since. Sims questioned the ways the latter models were defined, and explicitly challenged the exogeneity assumptions common to simultaneous modeling of equations.

3.1.5. Granger Causality

Granger Causality Analysis is a scientific test for determining if a single time series can predict the other. The resulting relationship can either be unidirectional or bidirectional (Hunter et al., 2017, p.3). Granger Causality test is usually used to investigate the short term connection among variables. It is precious to anticipate the progression of one variable with the assistance of another variable. One prerequisite for using the Granger causality test is establishing the stationarity of the variables.

Granger (1969) addresses the issue on whether X triggers Y to see how much of the present Y can be clarified by Y's previous values, and then to see if adding lagging X values will boost the interpretation. Y is said to be Granger-caused by X if X aids in predicting Y, or comparably if statistically important are the coefficients on the lagged $X's$. Note that two-way causation is repeatedly the case; X Granger causes Y and Y Granger causes X.

It is significant to note that the declaration "X Granger causes Y" does not imply that Y is the influence or the outcome of X. Granger causality measures superiority and information content but does not by itself indicate causality in the more common use of the term.

$$y_t = a_0 + a_1 y_{t-1} + \cdots + a_l y_{t-1} \beta_1 x_{t-1} + \cdots + \beta_l x_{-1} + \epsilon_t$$

$$x_t = a_0 + a_1 x_{t-1} + \cdots + a_l x_{t-1} \beta_1 y_{t-1} + \cdots + \beta_l y_{-1} + u_t$$

for all possible pairs of (X, Y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = \cdots = \beta_l = 0$$

Each equation. The null hypothesis is that in the last regression, X does not Granger-cause Y, and in the subsequent regression, X does not Granger-cause.

3.2. **Empirical Results**

To accomplish our goals, there are several procedures that we used in the study following to proceed with the granger causality, and we have conducted unit root tests to ensure stationary at first and the order of VAR. Then we employed VAR Granger Causality/Block Exogeneity to find integration between the stock market and exchange rate.

3.2.1. Unit Root Test

The Results of the unit root tests of the stock price are given in the table Below

H_0: The stock series unit is rooted.

H_1: The stock series is stable.

When the stock index data by country are analyzed at the level value, H0 hypothesis is accepted since the prob>0.01 for all analyzed countries. When the first differences of the series were taken, H0 hypothesis is rejected as the prob<0.01 for all series.

3.2.1.1. Table1. Unit Root Test for Stock Price

	I(0)		I(1)	
Stocks	**Test Statistic**	**Prob**	**Test Statistic**	**prob**
Brazil	-0.53029	0.8823	-8.49828	0.00*
India	-0.29084	0.9235	-7.92183	0.00*
Indonesia	-2.33993	0.1599	-5.98321	0.00*
South Africa	-1.83556	0.3631	-6.0048	0.00*
Turkey	-1.26648	0.6464	-7.07532	0.00*

*0.01, **0.05, ***0.10

The Results of the unit root tests of the Exchange Rate are given in the table Below

H_0: Exchange rate series unit is rooted.

H_1: The exchange rate series is stable.

When the exchange rate data by country are analyzed at the level value, H0 hypothesis is accepted as the prob>0.05 for all analyzed countries. When the first differences of the

series were taken, H0 hypothesis was rejected because the prob<0.05 for all series. It is seen that exchange rate series become stable in the first difference.

3.2.1.2. Table2. Unit Root Test Results for Exchange Rate

Exchange	I(0)		I(1)	
Rate	Test Statistic	Prob	Test Statistic	prob
Brazil	-0.691986	0.8462	-5.458280	0.00
India	-1.490961	0.5376	-5.944766	0.00
Indonesia	-0.750504	0.8313	-9.960656	0.00
South Africa	-1.121601	0.7087	-6.078535	0.00
Turkey	0.441096	0.9845	-6.542150	0.00

*0.01, **0.05, ***0.10

3.2.2. VAR LAG

The lag length results for the variables discussed are shown in the next tables (Table 3-7). According to this table, it is seen that the lag length is 1 for the variables.

According to Table 3, the lag order for the model of India is taken to be two (2) as suggested by final prediction of LR, FPE, AIC, SC and finally HQ - Hannan-Quinn information criterion.

3.2.2.1. Table 3: VAR Lag Order for Indian Rupee and BSE SENSEX 30

Lag	LogL	LR	FPE	AIC	SC	HQ
0	470.7095	NA	0.000547	-1.834480	-1.817899	-1.827979
1	2908.697	4847.349	3.99e-08	-11.36085	-11.31111	-11.34135
2	2991.310	163.6081*	2.93e-08*	-11.66853*	-11.58563*	-11.63603*
3	2992.199	1.753988	2.97e-08	-11.65636	-11.54029	-11.61085
4	2993.059	1.689808	3.01e-08	-11.64407	-11.49484	-11.58556
5	2994.525	2.869825	3.04e-08	-11.63415	-11.45176	-11.56265
6	2995.665	2.221799	3.07e-08	-11.62296	-11.40741	-11.53845
7	2996.146	0.933134	3.11e-08	-11.60918	-11.36047	-11.51168
8	2998.350	4.261860	3.14e-08	-11.60215	-11.32028	-11.49165

The lag order for the model Brazil is taken to be one (1) as suggested by final prediction of LR, FPE, AIC, SC and finally HQ - Hannan-Quinn information criterion (Table 4).

3.2.2.2. Table 4: VAR lag order for Brazilian Real and Bovespa

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-71.30650	NA	0.004567	0.286914	0.303495	0.293414
1	2462.305	5037.474*	2.29e-07*	-9.613719*	-9.563976*	-9.594218*
2	2463.171	1.714416	2.32e-07	-9.601451	-9.518548	-9.568950
3	2465.691	4.970518	2.33e-07	-9.595658	-9.479593	-9.550156
4	2468.134	4.800660	2.35e-07	-9.589565	-9.440339	-9.531064
5	2471.298	6.192769	2.35e-07	-9.586295	-9.403907	-9.514793
6	2472.700	2.731914	2.38e-07	-9.576125	-9.360576	-9.491623
7	2475.057	4.575085	2.39e-07	-9.569694	-9.320983	-9.472191
8	2476.891	3.545939	2.41e-07	-9.561216	-9.279344	-9.450713

The lag order for Turkey is chosen to be (5), as suggested by the concluding estimate of LR, FPE, AIC (Table 5).

3.2.2.3. Table 5: VAR lag order for Turkish Lira and BIST100

Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.10938	NA	0.002896	-0.168726	-0.152145	-0.162225
1	2366.761	4616.043	3.33e-07	-9.239768	-9.190026*	-9.220267*
2	2371.630	9.644045	3.32e-07	-9.243172	-9.160268	-9.210671
3	2375.449	7.533045	3.32e-07	-9.242463	-9.126398	-9.196961
4	2379.931	8.806476	3.31e-07	-9.244350	-9.095123	-9.185848
5	2387.752	15.30506*	3.26e-07*	-9.259304*	-9.076917	-9.187802
6	2389.940	4.265110	3.29e-07	-9.252213	-9.036664	-9.167711
7	2390.733	1.539420	3.33e-07	-9.239661	-8.990951	-9.142159
8	2392.675	3.753047	3.36e-07	-9.231603	-8.949731	-9.121100

As shown in Table 6, for the model of South Africa, the lag order is taken to be one (1) as suggested by final prediction of LR, FPE, AIC, SC and HQ - Hannan-Quinn information criterion.

3.2.2.4. Table 6: VAR lag order for South African Rand and FTSE_JSE Top 40

Lag	LogL	LR	FPE	AIC	SC	HQ
0	436.1649	NA	0.000627	-1.699275	-1.682695	-1.692775
1	2523.949	4151.054*	1.80e-07*	-9.854986*	-9.805244*	-9.835486*
2	2524.265	0.625339	1.83e-07	-9.840566	-9.757663	-9.808065
3	2526.214	3.845890	1.84e-07	-9.832541	-9.716477	-9.787040
4	2530.073	7.580468	1.84e-07	-9.831986	-9.682760	-9.773485
5	2534.079	7.840835	1.84e-07	-9.832013	-9.649625	-9.760511
6	2537.332	6.339466	1.85e-07	-9.829087	-9.613538	-9.744584
7	2539.275	3.773057	1.86e-07	-9.821038	-9.572328	-9.723535
8	2539.943	1.290377	1.89e-07	-9.807995	-9.526123	-9.697492

According to Table 7, the lag order for the model of Indonesia is taken to be five(5), as suggested by the final prediction of FPE and AIC**.**

3.2.2.5. Table 7: VAR lag order for Indonesian rupiah and Jakarta Islamic (JKII)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	664.0365	NA	0.000257	-2.591141	-2.574560	-2.584641
1	2873.392	4392.770	4.58e-08	-11.22267	-11.17293	-11.20317
2	2887.682	28.30079	4.40e-08	-11.26294	-11.18004*	-11.23044
3	2890.767	6.085380	4.42e-08	-11.25936	-11.14330	-11.21386
4	2906.899	31.69522	4.21e-08	-11.30685	-11.15762	-11.24834*
5	2912.692	11.33701	4.18e-08*	-11.31386*	-11.13148	-11.24236
6	2916.351	7.130540	4.19e-08	-11.31253	-11.09698	-11.22802
7	2918.765	4.686029	4.21e-08	-11.30632	-11.05761	-11.20882
8	2924.528	11.14423*	4.19e-08	-11.31322	-11.03135	-11.20272

3.2.3. Impulse Tests

The impulse response function maps the effect of a one-time shock on one of the developments of the endogenous variables on current and future values. Examine the shock resoınse on one variable to another; this analysis used Cholesky decomposition. Cholesky uses the inverse of the residual covariance matrix Cholesky factor to orthogonalize the impulses.

3.2.3.1. Impulse Response of Indian Rupee and BSE SENSEX 30

The impulse-response of Indian Rupee to Indian Rupee is shown in the first figure. A positive shock on Indian Rupee and naturally lead the Indian Rupee to go up by the sum of shock-hence and the slight declines but does not go below 0.08 up to the 10th week. Indian Rupee responses to the shocks applied to BSE SENSEX shows a different path. A shock on the index does not affect the Indian Rupee. On the other hand, BSE SENSEX respond negatively to the shocks on Indian Rupee. The stock price immediately felt the shock, and it started to decline in the second week.

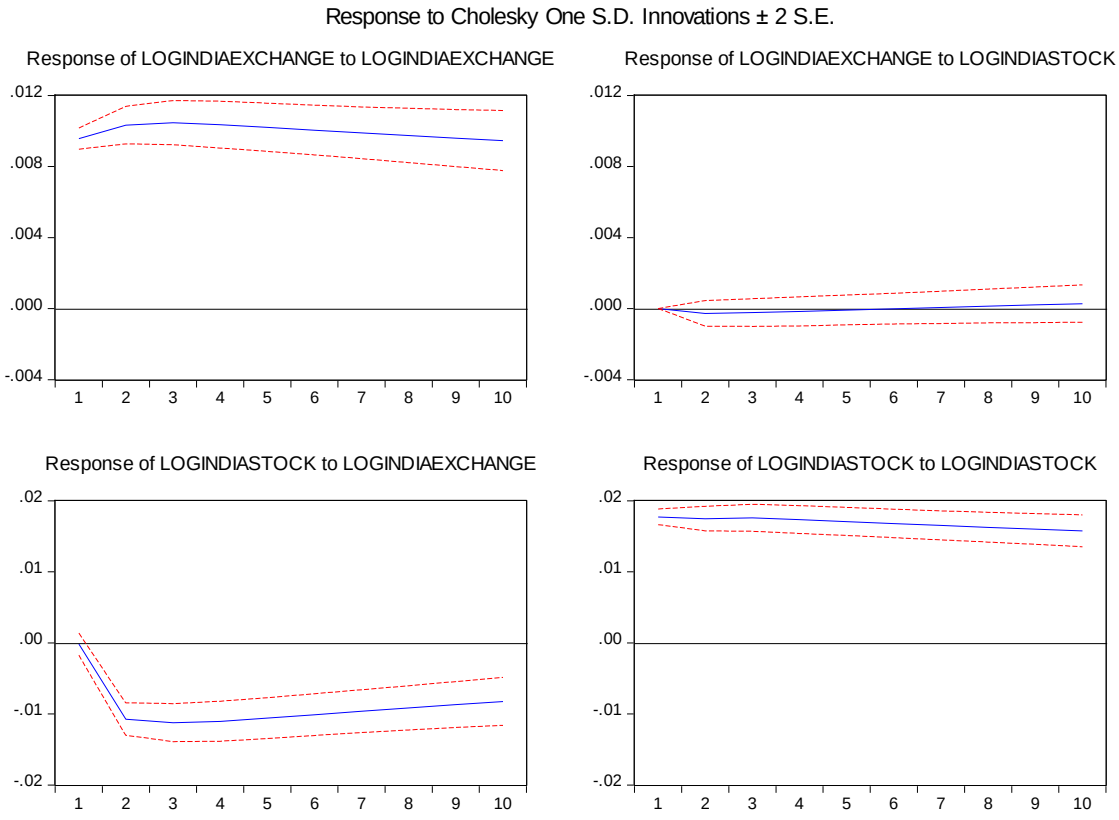


Figure 1: Impulse Response of Indian Rupee and BSE SENSEX 30

3.2.3.2. Impulse Response of Brazilian Real and Bovespa

In the figure two, the responds of Bovespa and Brazilian Rupee to the shocks applied to each other are shown. According to the results, Brazilian Real responds to the shocks on Bovespa negatively but Bovespa does not responds to the shocks on Brazilian Real, which means no effect it around 0. Moreover, the negative respond of Bovespa does not decrease significantly in the first 10 weeks.

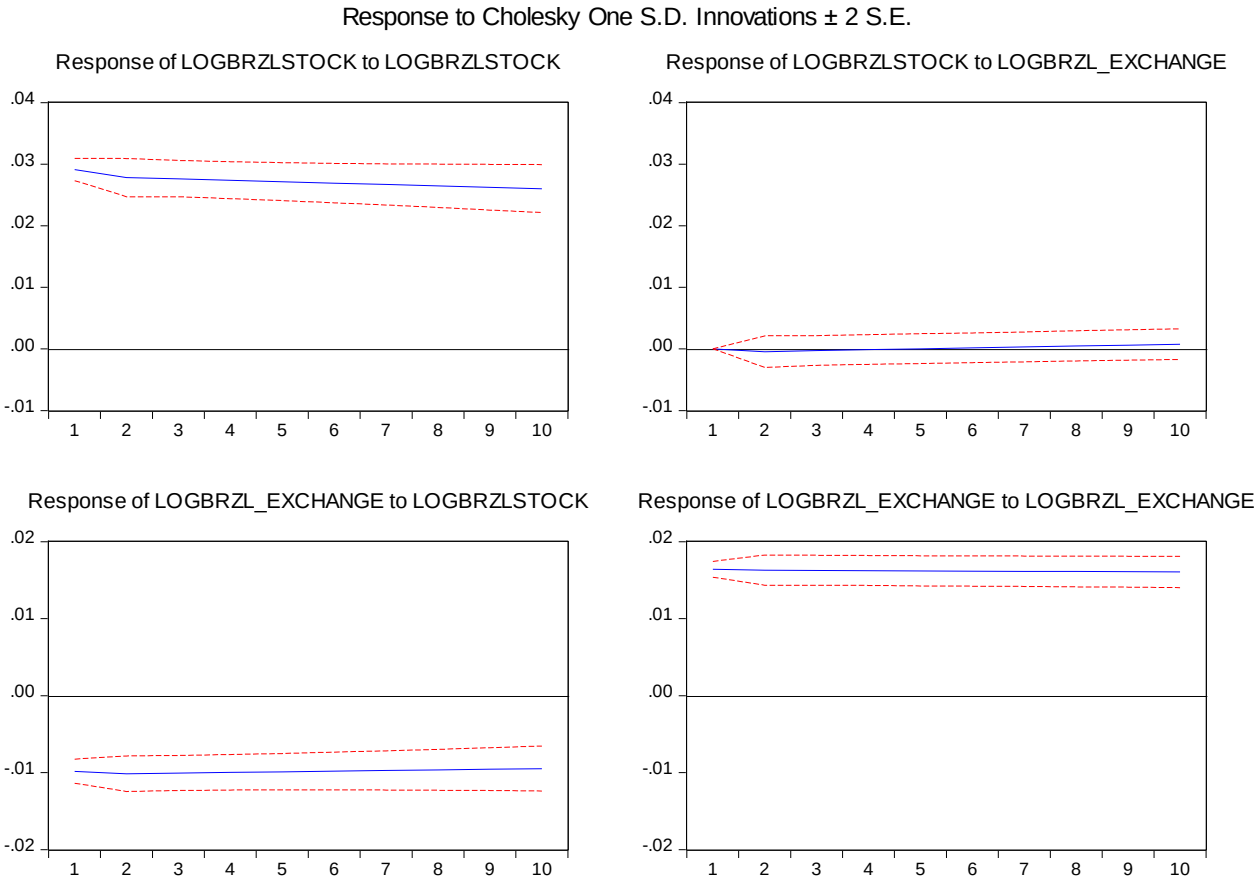


Figure 2: Impulse Response of Brazilian Real and Bovespa

3.2.3.3. Impulse Response of Turkish Lira and BIST100

The respond of Turkısh Lira to the shocks on Turkish lira shown in the first graph as a positive respond, but it slightly declines and does not go below 0.015 up to the 10th week. Turkish Lira's respond to the shocks on BIST100 shows a different path. A positive respond starts after the second week to the shocks on Turkish lira and it slightly goes up. On the other hand, BIST100 responds to Turkish lira negatively. The stock price immediately fell in the first week, and it decreases until the 10th week.

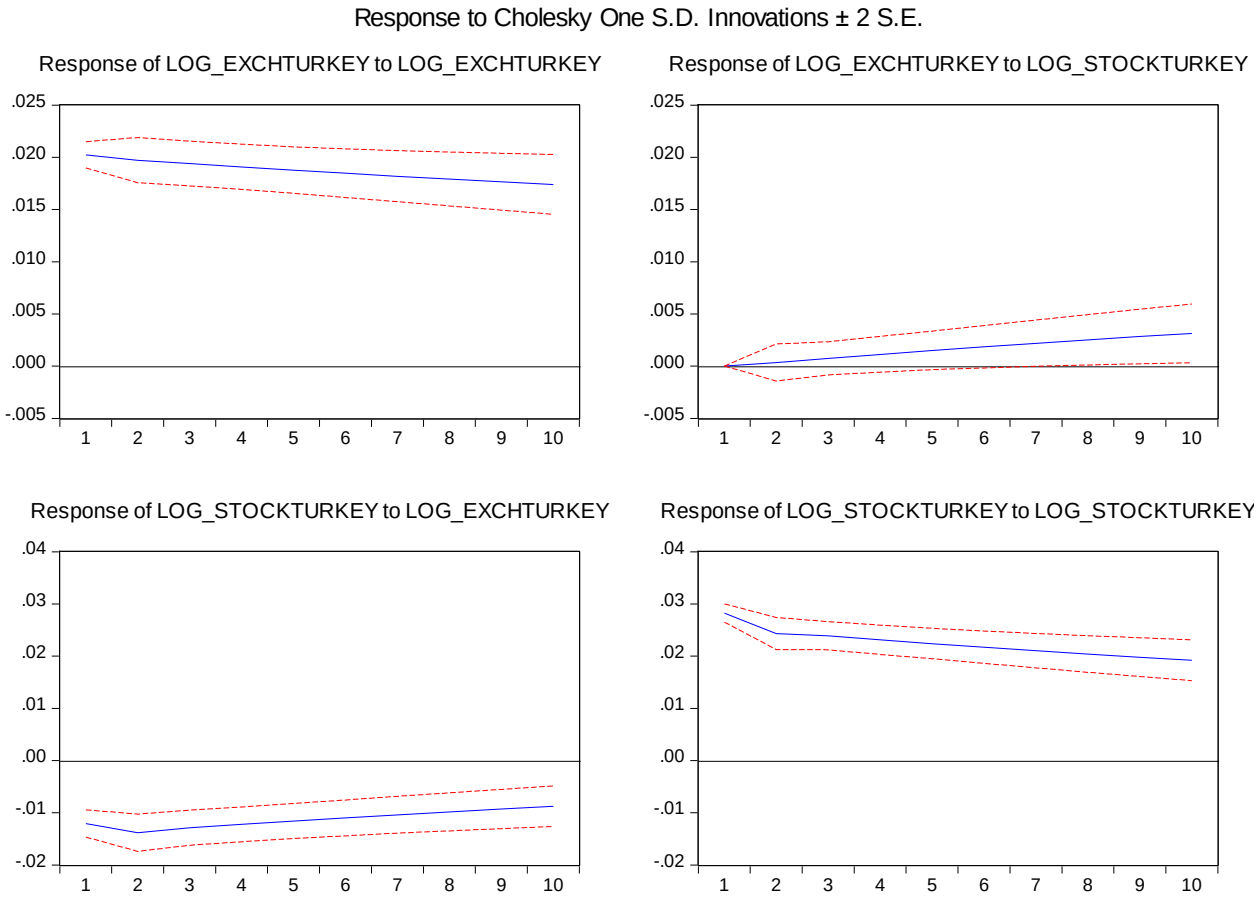


Figure 3: Impulse Response of Turkish Lira and BIST100

3.2.3.4. Impulse Response of South African Rand and FTSE_JSE Top 40

South African Rand responds to the shocks on FTSE_JSE_40 positively. The positive respond in the first week increase thought out the 10th week. On the other hand, FTSE_JSE_40 responds to the shocks on South African Rand negatively. Stock index immediately fell, and it recover until the the 10th week.

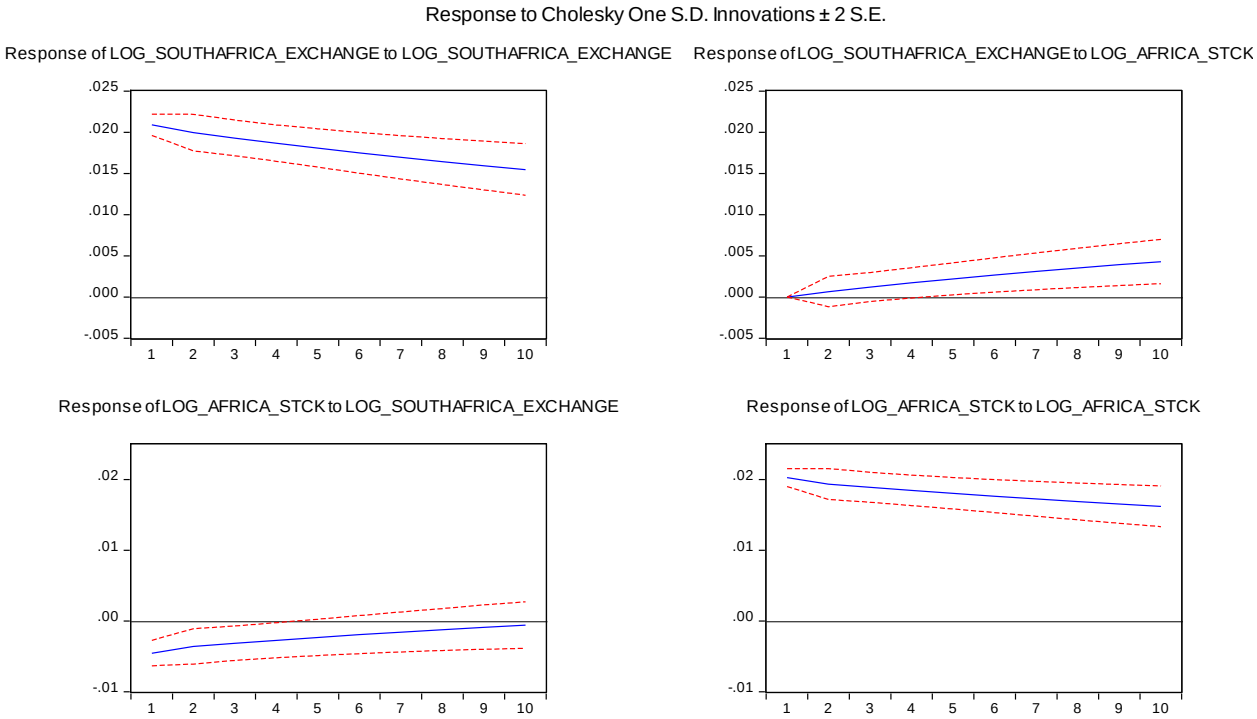


Figure 4: Impulse Response of South African Rand and FTSE_JSE Top40

3.2.3.5. Impulse Response of Indonesian rupiah and Jakarta Islamic (JKII)

Jakarta Islamic index's responds to the shocks on Indonesian Rupiah shows a small shock, above 0. The respond starts after the first week and continues until the 10th week. On the other hand, the Indonesian Rupiah responds to the shocks on Jakarta Islamic negatively. This negative respond recovers until the 10th week.

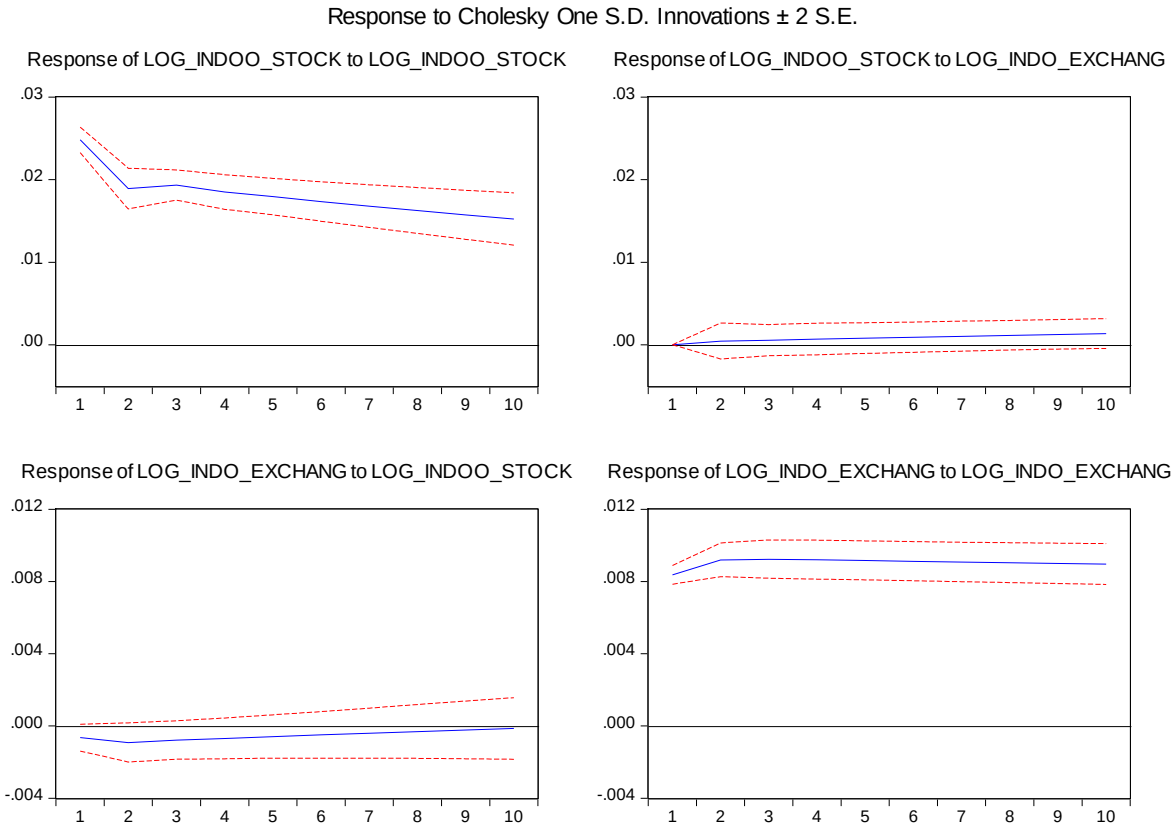


Figure 5: Impulse Response of Indonesian Rupiah and Jakarta Islamic (JKII)

3.2.4. Variance Decompositions

The decomposition of the variance shows how much data each variable adds to the other autoregression variables.

3.2.4.1. Variance Decomposition of Indian Rupee and BSE SENSEX 30

The variance of the exchange rate of India (Indian Rupee) is 100% explained by it is own variance. Nearly 20% of the variance of the Indian stock market's (BSE SENSEX 30 index) variance is explained by the variance of the exchange rate of India.

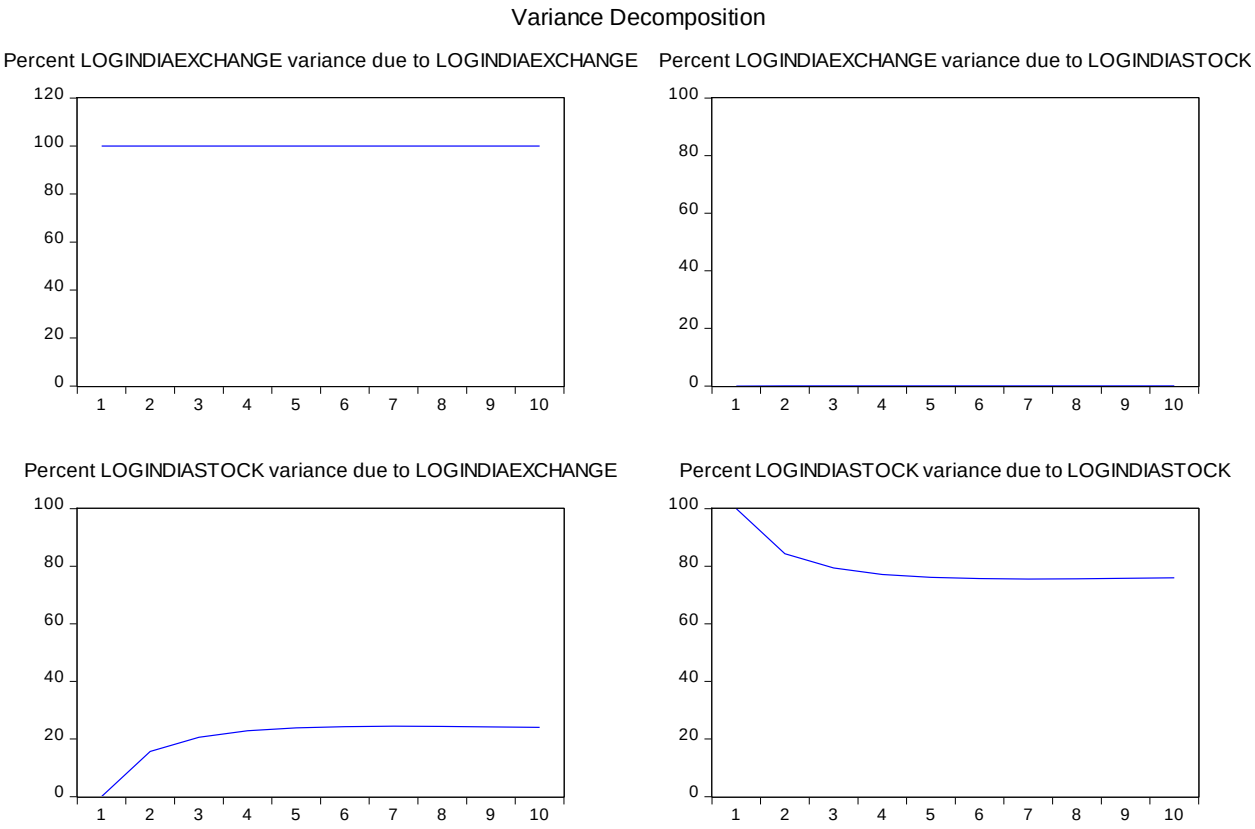


Figure 6: Variance Decomposition of Indian Rupee and BSE SENSEX 30

3.2.4.2. Variance Decomposition of Brazilian Real and Bovespa

The variance of the exchange rate of Brazil is nearly 70% explained by it is own variance and 30% explained by the variance of the stock market. Nearly 100% of the variance of the Brazilian stock market's variance is explained by its own variance.

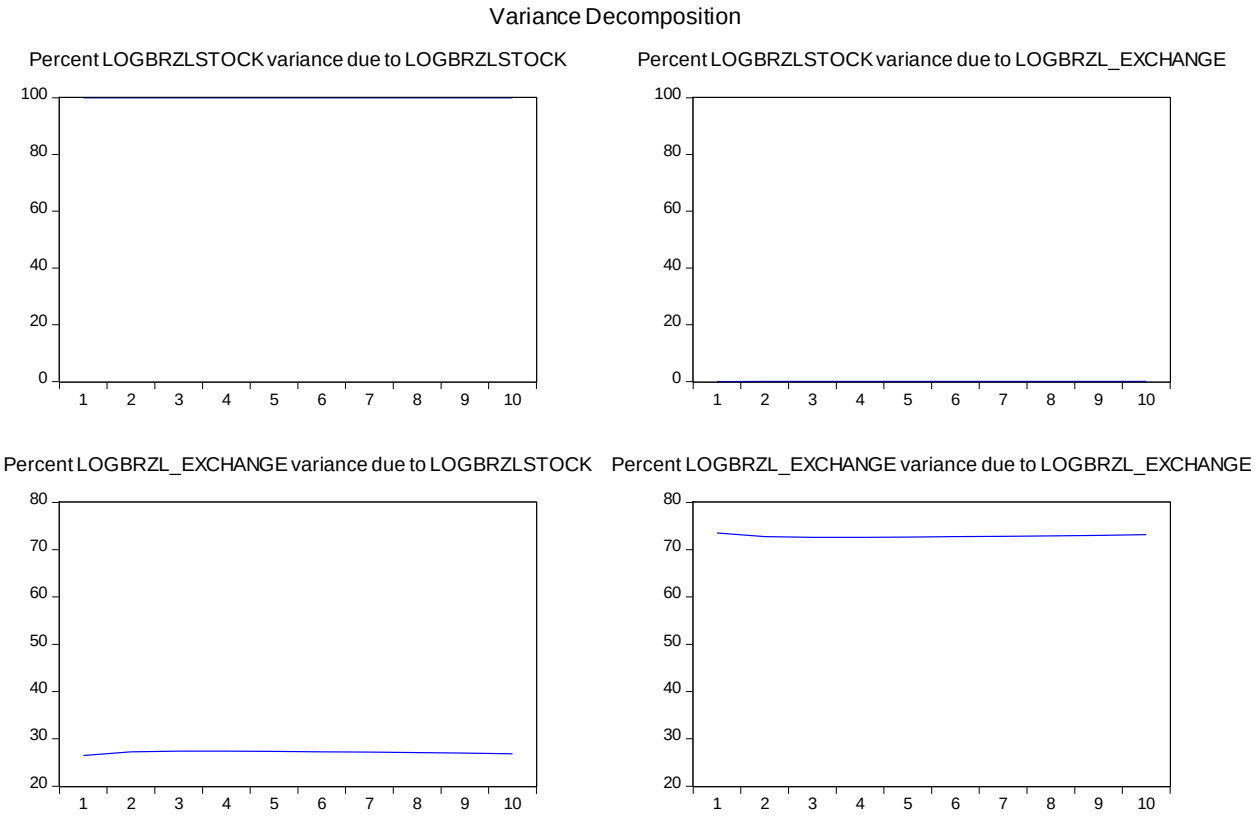


Figure 7: Variance Decomposition of Brazilian Real and Bovespa

3.2.4.3. Variance Decomposition of Turkish Lira and BIST100

The variance of the exchange rate of Turkey is 99% explained by it is own variance. Nearly 20% of the variance of the Turkey's stock market's variance is explained by the variance of the exchange rate.

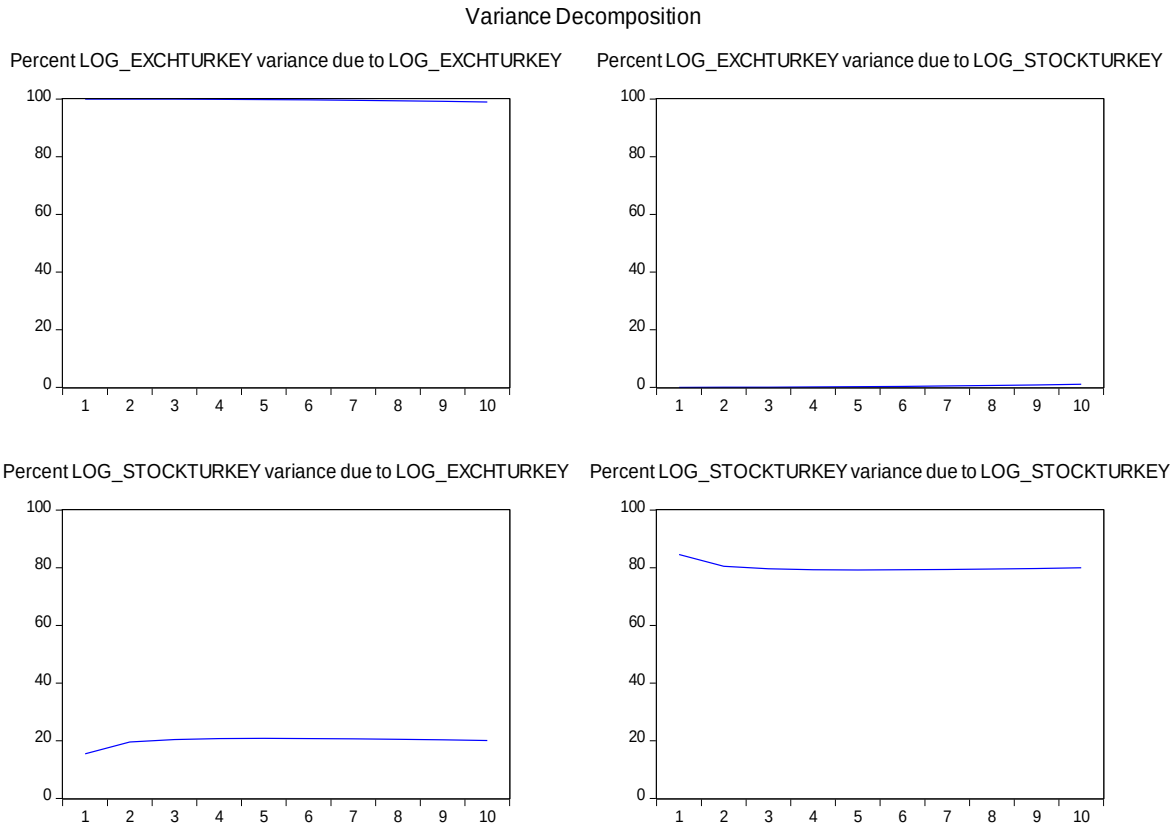


Figure 8: Variance Decomposition of Turkish Lira and BIST10

3.2.4.4. Variance Decomposition South African Rand and FTSE_JSE Top 40

Both the variance of the exchange rate of South Africa and the variance of the stock market are explained with their own variances. But variances of the stock market are 5% explained by variance of exchange rate.

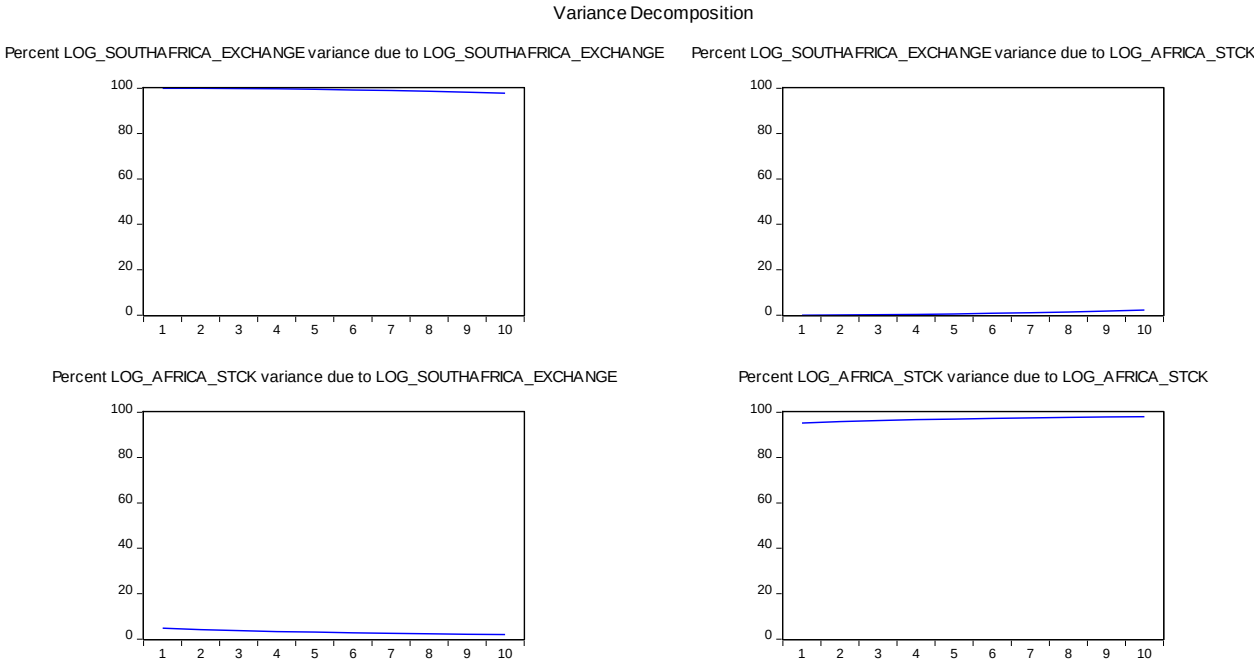


Figure 9: Variance Decomposition of South African Rand and FTSE_JSE Top40

3.2.4.5. Variance Decomposition Indonesian rupiah and Jakarta Islamic (JKII)

Both the variance of the exchange rate of Indonesia and the variance of the stock market are 100% explained with their own variances. But variance of exchange rate and stock market doesn't explain each other.

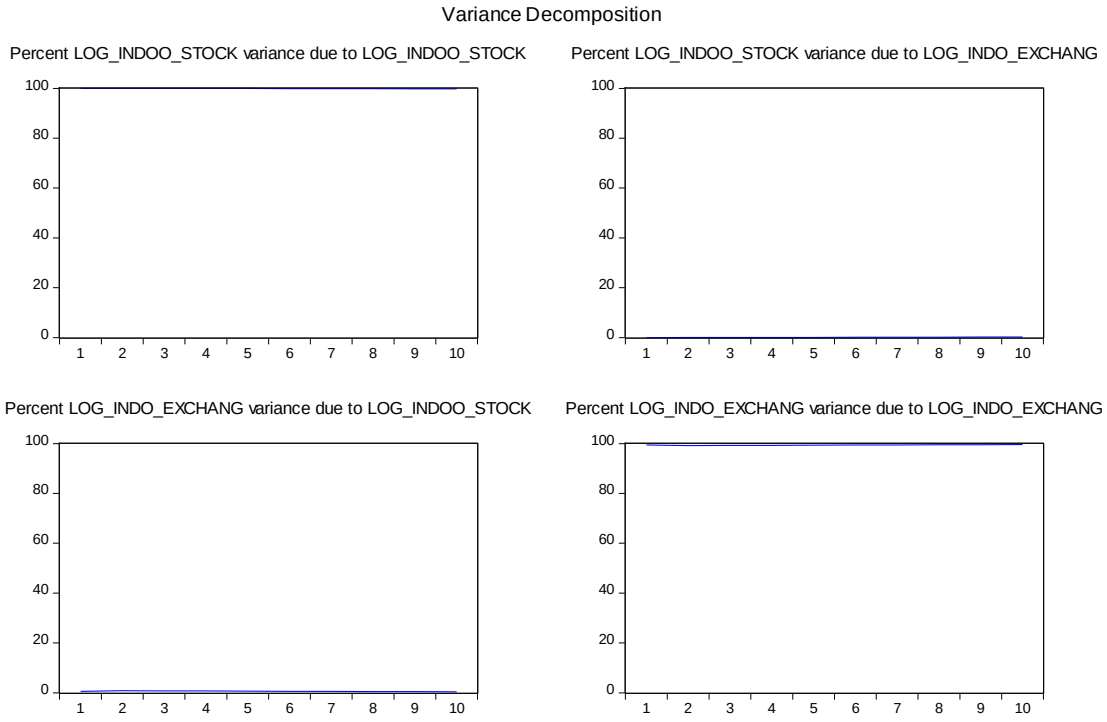


Figure 10: Variance Decomposition of Indonesian Rupiah and Jakarta Islamic (JKII)

3.2.5. GRANGER CAUSALITY TEST

The causality test was applied to the series where the stationarity findings were obtained as a result of unit root tests. Analysis of the results shows the foreign exchange and stock prices for South Africa and Turkey are in a bidirectional relationship. For India and Brazil, there is a one-way causality finding from the exchange rate to the stock market indexes. Finally, any relation could not found between the stock market and the exchange market of Indonesia.

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

3.2.5.1. Table 8. Granger Causality Test Results

Stocks → Exchange Rate	**Test Statistic**	**df**	**prob**
Brazil	0.50857	2	0.7755
India	2.746441	2	0.2864
Indonesia	3.44909	2	0.4417
South Africa	9.442639	2	0.0089*
Turkey	5.128902	2	0.0770***
Exchange Rate → Stocks	**Test Statistic**	**df**	**prob**
Brazil	5.028166	2	0.0809***
India	15.65251	2	0.0000*
Indonesia	2.305969	2	0.1127
South Africa	5.10141	2	0.0780***
Turkey	12.29221	2	0.0021*

*0.01, **0.05, ***0.10

3.2.5.2. VAR Granger Causality/Block Exogeneity Wald Tests between Indian Rupee and BSE SENSEX 30

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

With Indian Rupee as the dependent variable, the p-value is 0.2864, which is higher than the proposed value of 0.05. Thus, BSE SENSEX 30 Index does not have Granger cause Indian Rupee. Analyzing BSE SENSEX as the dependent variable, the probability value for Indian Real is 0.0000 its less than 0.05. Therefore that INDIAN RUPEE does have Granger cause to BSE SENSEX.

Table 9. Granger Causality Test Results of India

Dependent variable: **INDIAN RUPEE**

Excluded	Chi-sq	df	Prob.
BSE SENSEX 30	2.500809	2	0.2864
All	2.500809	2	0.2864

Dependent variable: **BSE SENSEX 30**

Excluded	Chi-sq	df	Prob.
INDIAN RUPEE	192.5878	2	0.0000
All	192.5878	2	0.0000

3.2.5.3. VAR Granger Causality/Block Exogeneity Wald Tests Between Brazilian Real and Bovespa

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

By Brazilian Real as the dependent variable, the p-value is 0.7755, which is higher than the suggested value of 0.05. Thus, the Bovespa Index does not have Granger cause Brazilian Real. Analyzing Bovespa as the dependent variable, the probability value for Brazilian Real is 0.0809 its less than 0.10. Hence determine that Brazilian Real does Granger cause Bovespa.

Table 10. Granger Causality Test Results of Brazil

Dependent variable: **BRAZİLİAN REAL**

Excluded	Chi-sq	df	Prob.
BOVESPA	0.508570	2	0.7755
All	0.508570	2	0.7755

Dependent variable: **BOVESPA INDEX**

Excluded	Chi-sq	df	Prob.
BRAZİLIAN REAL	5.028166	2	0.0809
All	5.028166	2	0.0809

3.2.5.4. VAR Granger Causality/Block Exogeneity Wald Tests between Turkish Lira And BIST100

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

Taking Turkish Lira as the dependent variable, the p-value is 0.0770, which is lower than the wished-for value of 0.10. Therefore, BIST100 Index does have Granger cause on Turkish Lira. Analyzing BIST100 Index as the dependent variable, the probability value for Turkish Lira is 0.0021 its less than 0.05. Therefore Turkish Lira does have Granger cause to BIST100.

Table 11. Granger Causality Test Results of Turkey

Dependent variable: **BIST100**

Excluded	Chi-sq	df	Prob.
TURKISH LIRA	12.29221	2	0.0021
All	12.29221	2	0.0021

Dependent variable: **TURKISH LIRA**

Excluded	Chi-sq	df	Prob.
BIST100	5.128902	2	0.0770
All	5.128902	2	0.0770

3.2.5.5. VAR Granger Causality/Block Exogeneity Wald Tests between South African Rand and FTSE_JSE Top 40

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

Using South African Rand as the dependent variable, the p-value is 0.0089, which is Less than the proposed value of 0.10, which means FTSE_JSE top 40 have Granger cause on South African Rand. Then, we take the FTSE JSE top40 Index as the dependent variable. The probability value for South African Rand is 0.0780 its too less than 0.10. Therefore South African Rand does have Granger cause to FTSE JSE Top 40.

Table 12. Granger Causality Test Results of South Africa

Dependent variable: **South African Rand**

Excluded	Chi-sq	df	Prob.
FTSE_JSE	9.442639	2	0.0089
All	9.442639	2	0.0089

Dependent variable: **FTSE_JSE**

Excluded	Chi-sq	df	Prob.
South African Rand	5.101410	2	0.0780
All	5.101410	2	0.0780

3.2.5.6. VAR Granger Causality/Block Exogeneity Wald Tests between Indonesian rupiah and Jakarta Islamic (JKII)

H_0: There is no causality between the variables.

H_1: There is a causal relationship between the variables.

At Indonesian Rupiah as the dependent variable, the p-value is 0.4417, which is higher than the suggested value of 0.05. Thus, JKII Index does not have Granger cause on Indonesian Rupiah. Analyzing JKII as the dependent variable, the probability value for Rupiah is 0.1127 its greater than 0.05. Hence determine that Indonesian Rupiah does not Granger cause on JKII.

Table 13. Granger Causality Test Results of Indonesia

Dependent variable: **Indonesian rupiah**

Excluded	Chi-sq	df	Prob.
JKII	1.634422	2	0.4417
All	1.634422	2	0.4417

Dependent variable: **JKII**

Excluded	Chi-sq	df	Prob.
RUPIAH	4.366083	2	0.1127
All	4.366083	2	0.1127

CONCLUSION

This research investigates the direction of causality between exchange rates and stock prices of the market. We employed the multivariate time series approach, VAR Granger Causality, and Unit root tests were applied to the trials where the stationarity findings were obtained. As an outcome of the causality analysis, in the long run, Granger causality between Indian Rupee and BSE SENSEX 30 indicates that BSE SENSEX 30 Index does not have Granger cause Indian Rupee, meanwhile that INDIAN RUPEE does have Granger cause to BSE SENSEX. In the short run, a shock in Indian Rupee Impulse Response to BSE SENSEX shows a different path. A clash of Indian Rupee impulse responds to BSE SENSEX 30 index does not affect it. On the other hand, BSE SENSEX Impulse respond to Indian Rupee has Negative shock. Variance decomposition shows the variance of the exchange rate of India (Indian Rupee) is 100% explained by it is own variance. Nearly 20% of the variance of the Indian stock market's (BSE SENSEX 30 index) variance is explained by the variance of the exchange rate of India

The analysis proposes that the Brazil direction of causality is unidirectional relation from exchange rates to stock prices that in the long-term, the Bovespa Index does not have Granger cause Brazilian Real. Hence determine that Brazilian Real does Granger cause Bovespa. In the short run, a shock Brazilian Real Impulse Response to Bovespa shows a negative shock. Bovespa Impulse responds to Brazilian Real has no shock. On Variance decomposition The variance of the exchange rate of Brazil is nearly 70% explained by it is own variance and 30% explained by the variance of the stock market. Nearly 100% of the variance of the Brazilian stock market's variance is explained by its own variance.

Turkey's Examination shows in foreign exchange and stock prices are bidirectional in the long-run. BIST100 Index does have Granger cause on Turkish Lira. Therefore Turkish Lira does also have Granger cause to BIST100 as well. But in the short-term the Turkish Lira Impulse Response to BIST100 shows a different path. A shock starts after the second period to Turkish Lira and slightly goes up. On the other hand, BIST100 Impulse responds to Turkish Lira has Negative shock. Finally, On Variance decomposition, the variance of the exchange rate of Turkey is 99% explained by it is own variance. Nearly 20% of the variance of the Turkey's stock market's variance is explained by the variance of the exchange rate.

In the long run, South Africa has, too, proposed that the direction of causality in foreign exchange and stock prices is bidirectional in the long-run. Using South African Rand as the dependent variable FTSE_JSE top 40 have Granger cause on South African Rand. Then, we take the FTSE JSE top40 Index as the dependent variable. Therefore South African Rand does have Granger cause to FTSE JSE Top 40. While the short-term shock. South African Rand Impulse Response to FTSE_JSE_40 shows a positive shock. On the other hand, FTSE_JSE_40 Impulse respond to South African Rand has started with Negative shock. Variance decomposition outcomes, Both the variance of the exchange rate of South Africa and the variance of the stock market are explained with their own variances. But variances of the stock market are 5% explained by variance of exchange rate.

There is no relation between the Stock market and the Exchange market of Indonesia; JKII Index does not have Granger cause on Indonesian Rupiah. Analyzing JKII as the dependent variable determines that Indonesian Rupiah does not Granger cause on JKII in the long-term. Jakarta Islamic Impulse Response to Indonesian Rupiah shows a small shock, On the other hand, the Indonesian Rupiah Impulse response to Jakarta Islamic has started with Negative shock.

For variance decomposition, Indonesian Rupiah, and Jakarta Islamic (JKII) does not influence each other. To conclude, the stock market of Indonesia and the exchange market has no influence on each other on the long-short run. Both the variance of the exchange rate of Indonesia and the variance of the stock market are 100% explained with their own variances. But variance of exchange rate and stock market doesn't explain each other.

In summary, As a result of the causality test, Analysis shows that South Africa and Turkey in foreign exchange and stock prices are bidirectional. India and Brazil propose that the direction of causality is unidirectional relation from exchange rates to stock prices and no relation in Indonesia.

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