



Faculty of Economics and Business

**The Effects of Macroeconomic Fundamentals on the Stock Prices
Movement in Selected Countries**

Sia Peck Ching

**Master of Science
2023**

The Effects of Macroeconomic Fundamentals on the Stock Prices Movement in Selected Countries

Sia Peck Ching

A thesis submitted

In fulfillment of the requirements for the degree of Master of Science

(Economics)

Faculty of Economics and Business
UNIVERSITI MALAYSIA SARAWAK
2023

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



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Signature

Name: Sia Peck Ching

Matric No.: 20020338

Faculty of Economics and Business

Universiti Malaysia Sarawak

Date: 26th October 2023

ACKNOWLEDGEMENT

Accomplishing a thesis demands a significant amount of effort and time to complete. A lot of people have contributed to and assisted along the way in the completion of this meaningful thesis for my Master of Degree. I would like to convey my deepest thanks and appreciation.

First and foremost, I would like to thank my supervisory committees, Professor Dr. Puah Chin Hong and Assistant Professor Dr. Leong Choi Meng, for their time and guidance. Their valuable feedback and insights had greatly improved the framework for my master thesis where thank you alone is never enough.

Next in the line, I would like to express my gratefulness to family members, friends, and seniors for their continuous supports since the beginning of my life till now. It is surely the most significant support for me to completing my master thesis in the timeframe given.

Finally, I would like to express my sincere gratitude to the Centre for Graduate Studies, for the advice and support given during my period of study in Universiti Malaysia Sarawak and the management of the Universiti Malaysia Sarawak for making it possible for me to complete my study here in Sarawak. Thank you all.

ABSTRACT

For centuries, the stock market has been the backbone of the economy serving as a crucial platform for buying and selling securities. This study contributes to investigate the symmetric and asymmetric effects of macroeconomic fundamentals on stock prices of the selected countries: Indonesia, Malaysia, and Singapore. Generally, these three countries have different stages of development where Indonesia and Malaysia are both emerging countries while Singapore is a developed country. These three ASEAN countries have various monetary policies in addition to their disparate economic condition. Previous research has thoroughly investigated the relationship between stock prices and macroeconomic issues, but it was believed that the relationship is symmetrical. There is a scarcity of empirical information on the asymmetric effect of macroeconomic fundamentals on stock prices. This study using two different approaches: autoregressive distributed lag (ARDL) approach and nonlinear autoregressive distributed lag (NARDL) to overcome the limitation of previous studies. The study used time series data based on quarterly observations from 1999 to 2021. Given the results, inflation, interest rate, and exchange rate show nonlinear effect on stock prices in Indonesia. In Malaysia, the results show nonlinear effect of interest rate and exchange rate on stock prices. However, most of the models are insignificant for Singapore. Therefore, policymakers should optimize the asymmetric effect of inflation, interest rate, and exchange rate according to the nature of each country.

Keywords: Stock market, macroeconomic fundamentals, ARDL approach, NARDL approach

Kesan Makroekonomi Terhadap Pergerakan Harga Saham di Negara Terpilih

ABSTRAK

Pasaran saham telah menjadi tulang belakang ekonomi yang berfungsi sebagai platform penting untuk membeli dan menjual sekuriti. Kajian ini menyumbang untuk penyiasatan kesan simetri dan asimetri asas makroekonomi ke atas harga saham negara terpilih: Indonesia, Malaysia dan Singapura. Secara umumnya, ketiga-tiga negara ini mempunyai tahap pembangunan yang berbeza di mana Indonesia dan Malaysia merupakan negara sedang pesat membangun manakala Singapura adalah negara maju. Ketiga-tiga negara ASEAN ini mempunyai pelbagai dasar monetari di samping keadaan ekonomi mereka yang berbeza. Penyelidikan sebelum ini telah menyiasat secara menyeluruh hubungan antara harga saham dan isu makroekonomi, tetapi dipercayai bahawa hubungan itu adalah simetri maka terdapat kekurangan maklumat empirikal mengenai kesan asimetri asas makroekonomi ke atas harga saham. Kajian ini menggunakan dua pendekatan berbeza: pendekatan autoregressive distributed lag (ARDL) dan nonlinear autoregressive distributed lag (NARDL) berdasarkan pemerhatian suku tahunan dari tahun 1999 hingga 2021. Penemuan ini, inflasi, kadar faedah, dan kadar pertukaran menunjukkan kesan tidak linear ke atas harga saham di Indonesia. Di Malaysia, keputusan menunjukkan kesan bukan linear kadar faedah dan kadar pertukaran ke atas harga saham. Di sebaliknya, kebanyakan model adalah tidak penting untuk Singapura. Oleh itu, penggubal dasar harus mengoptimumkan kesan asimetri inflasi, kadar faedah, dan kadar pertukaran mengikut sifat setiap negara.

Kata kunci: *Harga Saham, makroekonomi, pendekatan ARDL, pendekatan NARDL*

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
APT	Arbitrage Pricing Theory
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lags
ASEAN	Association of Southeast Asian Nations
CAPM	Capital Asset Pricing Model
CGS	Centre for Graduate Studies
CUSUM	Cumulative Sum of the Recursive Residuals
CUSUMSQ	Cumulative Sum of the Square Residuals
ED	Economic Development / Income Level
EMH	Efficient-Market Hypothesis
EXC	Exchange Rate
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IPI	Industrial Production Index
INF	Inflation Rate
INT	Interest Rate
ITF	Inflation Targeting Framework
JB	Jarque-Bera
LM	Lagrange Multiplier
KOSPI	Korea Composite Stock Price Index
NARDL	Non-linear Autoregressive Distributed Lag
OLS	Ordinary Least Square

OPR	Overnight Policy Rate
PP	Phillips-Perron
RESET	Ramsey Regression Specification Error Test
SBC	Schwartz Bayesian Criterion
SP	Stock Price
UECM	Unrestricted Error Correction Model
UNIMAS	Universiti Malaysia Sarawak
VAR	Vector Autoregressive

CHAPTER 1

INTRODUCTION

1.1 Introduction

The stock market is the main financial venue where investing happens. The stock market is the platform where individuals and institutions can buy and sell ownership stocks in publicly traded companies. With each fluctuation, especially during the 20th century, the resultant instability can make or break the financial market. This has long been the driver behind every economist, investor, and policymaker's pursuit for the best way to predict the market trend. Albeit its growing complexity and connection with many micro- and macroeconomics factors at the national and international level, the pursuit has never ended. Macroeconomic fundamentals, often known as economic indicators or economic variables, are important economic data that provide light on the state and functioning of an economy as a whole. These fundamentals aid in the assessment of the present status of the economy, the formulation of wise decisions, and the forecasting of future economic trends by policymakers, investors, companies, and economists.

A financial market is a platform where fund transfers from savers to investors occur. As an important component of the financial market, the stock market plays a crucial role in the growth and development of an economy. Stock markets exist with the purpose of issuing, buying, and selling over-the-counter equities. The stock market serves as a leading economic indicator and provides valuable insights into a country's or nation's economic performance. Changes in stock prices and market indices can provide signals about the overall health and direction of the economy. Stocks or equities, represent fractional ownership in a business.

The stock market facilitates the buying and selling of stocks, enabling investors to trade ownership of these investible assets because they can generate returns for investors.

The most recent global financial crisis, often referred to as the subprime mortgage crisis, originated in the United States in 2008. The root cause was the over-issuance of low-quality housing loans and over-speculation of housing prices that subsequently led to the collapse of the housing market bubble and financial institutions. As house prices fell, many borrowers defaulted on their mortgages, triggering a wave of foreclosures. This led to the collapse or near-collapse of several major banks and investment firms. A financial crisis leading to a recession like this is not new. Most often than not, the obvious warning sign is a steep drop in stock prices over a short period of time and ongoing price fluctuations in the capital market. The impact of a financial crisis is influenced by the connectivity of the affected market and economy. Through various channels such as trade, investment and financial linkages, a financial crisis in one country or market can quickly spread to other countries. The degree of interconnectedness is a key determinant of the extent to which a crisis can have spillover effects. Since the modern global economy is well-connected and intertwined, it is not surprisingly that the 2008 global financial crisis has spread well across the United States borders to other countries, including the ASEAN region.

According to Hoque and Yakob (2017), authorities are concerned about stock market performance since its impact directly affects the development of the economy. The stock market's performance can be one of the significant indicators for showing economic performance signals (Ho & Iyke, 2017). According to Demir (2019), the countries' economic administrators and policymakers closely monitor the growth of stock markets in order to take preparations in the event of unanticipated instabilities. In a nutshell, the stock market is an

indispensable component of any economy because it aids in the redistribution of financial resources among various economic entities.

For companies, stock trading allows businesses to raise funds to pay off debt and continue their expansion plans. Investors can profit from stock markets by benefiting from the rise in stock values and receiving dividend payments from companies. Stock prices have a significant impact on the confidence of consumers and businesses, which in turn has an impact on the economy as a whole. It is also crucial to note that stock markets and economic performance have a bidirectional relationship.

The Indonesian, Malaysian and Singaporean stock markets typically reflect the stage of development of the economy in terms of market capitalizations. Indonesia and Malaysia are both emerging countries while Singapore is a developed country. The Growth Triangle (IMS-GT) is a collaborative concept aimed at fostering economic development and cooperation between Indonesia, Malaysia, and Singapore. The concept was initially proposed in December 1989 with the goal of enhancing regional economic ties and leveraging the synergies between the three geographically adjacent areas. The cooperation encompasses various sectors such as trade, investment, tourism, infrastructure development, and human capital. However, question remains on whether the cooperation is indeed a triangle of growth or a triangle of inequality. Thus, this research concentrated on the effects of macroeconomic fundamentals on the stock price movement in the selected countries - Indonesia, Malaysia, and Singapore.

1.2 Stock Market and Macroeconomic Fundamentals

Stock market and macroeconomic fundamentals are intertwined, and movements in these elements can have a big influence on the stock market's performance. Macroeconomic

fundamentals are useful in describing the behaviour of stock prices. According to Ho and Lyke (2017), there are two categories into which influencing the determinants of stock market: institutional and macroeconomic variables that contribute to the stock market development. However, the relationship between macroeconomic variables and the stock market may not always be linear. During periods of extremely high or low GDP growth, the impact of on stock could be nonlinear. Moreover, the relationship between inflation and stocks can be nonlinear due to market expectations and central bank policies. In addition, the relationship between interest rates and stocks can be nonlinear due to market expectations and the speed at which interest rates change. Not to forget that nonlinear relationships with exchange rates may arise during financial crises or extreme currency fluctuations.

For corporations, pension plans, and individual investors, prolonged lower stock prices during a bear market signifies lower confidence in the business as well as less reserve for operations and growth opportunities. The impact worsens when the stock market crashes during a financial crisis. A classic example is the Black Monday or Wall Street crash that occurred 1987. The shock was preceded by a bearish week that caused a pile up of sell orders queuing up in the trading system, waiting to be executed on that very Monday. It took the stock market almost 20 months to recover. In the mid of 1996, just before the Asian financial crisis in 1997, Thailand's economy began to exhibit a downward spiral of exports, market growth rate, stock prices and etc. after massive currency devaluation and capital outflow due to the unpegging of Thai baht from the US dollar. The adverse effect then propagated to the rest of Southeast Asia and East Asia, triggered a continent-wide financial meltdown that fortunately recovered within two years. However, the global financial market was not spared from the 2008 Subprime Mortgage Crisis that first became apparent due to the fall of Lehman

Brothers Holding Inc. and stock market (Filardo, et al., 2010). This crisis also highlighted how a wavering property market could ultimately translate into financial instability.

The Covid-19 pandemic has caused a profound repercussion on global financial market, leading to another unprecedented turmoil and uncertainty. The onset of the pandemic resulted in heightened market volatility across classes. Stock markets fell by dropped 20 percent to 30 percent in the early stages of the pandemic because of investors' reaction to the ambiguity surrounding the economic effects of lockdown measures, interrupted supply chains, and decreased consumer spending. Due to lockdowns, several nations experienced an abnormally high and quick rise in unemployment during the ensuing crisis. By which, all the effect is still felt until this very day.

The second turmoil came with the 2020 Russia-Saudi Arabia oil price war which happened in March 2020 due to a disagreement between Russia and Saudi Arabia over oil production levels. This resulted to a sudden surge in excess global oil supply, exacerbating concerns of oversupply in an already weakened demand environment on the grounds that hurt by the Covid-19 pandemic. The sharp drop in oil prices had repercussions on stock markets and global financial market. The pandemic resulted in a clear decline in consumer activities in comparison to the past ten years with the collapse of the tourism, hospitality, and energy industries. When worldwide economies emerged from the early slump by Covid-19, a worldwide increase in demand, particularly in Asia, resulted in the global energy crisis of 2021–2022. This was later made worse by the global response to the Russo-Ukrainian War's intensification, which culminated in the Russian invasion of Ukraine in 2022. For these reasons, a better grasp of the behaviour of stock market is essential for authorities to take preventive measures before the impact of stock price movements leads to further

deterioration in the economy. Unexpected economic shocks, such as financial crises or natural disaster can abrupt and nonlinear movements in stock prices.

Central banks have traditionally used monetary policy to accomplish their economic goals of price stability or economic growth. In the mid-1970s, most developed and developing countries used monetary targeting as a tool to control inflation. However, by the mid-1980s, when most countries began to liberalize their financial systems, deregulation in the banking system had blurred the correlation between money supply and other macroeconomic variables. Different country uses different monetary policy that suits the nature of a country. In this study, the different macroeconomic fundamentals of Malaysia, Indonesia and Singapore were considered in understand the country's monetary policy strategy. Commodity prices are primarily stabilised by monetary policy, but stock market volatility is stabilised by other variables having a self-reinforcing calming impact (Pearce & Roley, 1985; Uwubanmwun & Eghosa, 2015).

Many macroeconomic factors and processes, according to Shin et al. (2014), have long been recognized as nonlinear. However, previous studies developed by Dickey and Fuller (1979), Engle and Granger (1987), Johansen (1988), Phillips and Hansen (1990), and Kwiatkowski et al. (1992) focused on the analyses as a symmetric linear combination of non-stationary variables. The research by Shin et al. (2014) developed a nonlinear autoregressive distributed lag (NARDL) model as a versatile framework for analysing dynamic relationships and symmetries in economic variables simultaneously and comprehensibly. The method enabling researchers to examine how these macroeconomic variables respond differently to positive and negative changes.

1.2.1 Indonesia Background

The Republic of Indonesia was previously referred to as the Dutch East Indies (or Netherlands East Indies). As the world's biggest archipelago and the 14th-largest country by land area, Indonesia is home to the world's 4th largest population (273 million people) after China, India and the United States of America in 2020 (Worldometer, 2023). In Indonesia, better living conditions, better health care, and a developing economy are the fundamentals for population growth. As the largest economy in Southeast Asia, this nation is one of the world's developing market economies with a mix of private and public businesses.

The Indonesia Stock Exchange (IDX) is authorized for all securities transactions in Indonesia with the primary purpose of establishing the infrastructure necessary for orderly, fair, and efficient trading (Murphy, 2021). The Surabaya Stock Exchange and Jakarta Stock Exchange (JSX) merged on 30 November 2007 to establish IDX. In Indonesia, the first stock exchange in Indonesia, "Vereeniging voor den Effectenhandel in Nederlandsch-Indië" (Association for Securities Trading in the Dutch East Indies) was established in 1912, before Indonesia's independence for the benefit of the Dutch East Indies (VOC) during the Dutch colonial period. Due to numerous factors such as World War I and II, the change of power from the Dutch government to the Indonesian government, and others, the capital market grew gradually and then went temporarily dormant during that period.

On 17 August 1950, Indonesia claimed its independence from Dutch. Indonesia with its abundant natural resources and a huge population has the potential to grow. However, the development expenditures were simple unaffordable. In order to finance development plans, the government had to rely on public funds and government savings. Due to extremely low economic growth and ineffective policies, Indonesia's inflation rate reached 635 percent in

1966, the highest in the country's history. The economic doctrine depleted all of Indonesia's resources, resulting in a dire economic situation. In order to avoid public panic, the Indonesian government decided to prohibit the publication of the country's economic statistics and annual reports.

President Soeharto reactivated Indonesia's capital market on 10 August 1977, and it has grown rapidly since then due to government incentives and regulations. With only 24 listed businesses in 1977, the JSX stock market was uninspiring. In fact, most investors preferred banks over the stock market. The IDX, nonetheless, succeeded in becoming a world-class stock exchange due to positive government efforts such as regulatory modifications and the implementation of an automatic trading system. All central banks use interest rate as one of the primary tools to implement monetary policy. The main purpose is to control the market's liquidity expansion, which is highly related to the performance of the stock market. Interest rates and credit availability are linked to monetary policy, which is usually influenced by short-term interest rates and bank reserves. In Indonesia, credit ceilings and interest rate controls were the most used monetary policies to control market liquidity expansion.

In the 2020 Annual Report, IDX reported 713 listed companies at the end of the year. Despite the COVID-19 outbreak, IDX managed to list 51 new firms, which is 110.87% more than the initial goal of 46. The number of listed companies has almost tripled from 252 listed companies in 1996 to 713 listed companies in 2020. The gradual increase since 1996 only decreased in 1998 due to the 1997 Asian Financial Crisis. The crisis also forced President Suharto to step down, which worsened the situation and caused a drastic devaluation of the Rupiah. The currency depreciated significantly against the US dollar, forcing the central

bank to tighten its policy by imposing high-interest rates and limiting government spending. Unfortunately, it was proven trivial. The Indonesia stock market index continued to drop from 637.4 points in 1996 to 398.0 points in 1998.

Signs of recovery became apparent in 1999. The stock market index increased rapidly to 676.9 points partly due to a better international environment that spurred export income. During the same year, the Indonesian central bank decided to use inflation targeting as the primary operational target, with base money as the primary operational target. Indonesia's interest rate declined rapidly in 1999 and eventually remained low and stable. From 2000 to 2001, Indonesia adopted an independent floating exchange rate regime while still suffering from some depreciation. From 2002 to April 2008, a managed floating regime was adopted, which finally resulted in a nominal appreciation. This was soon followed by another drastic drop due to the Global Financial Crisis. In 2007, the United States' GDP was a staggering 20 percent of the global GDP, making it the strongest country of the world (Sihono, 2008). The economic turmoil that started in the US greatly impacted Indonesia since it was the third largest export destination after Japan and China based on data from 2000 to 2015. The depreciation of Rupiah against the US dollar was devastating to both economies' exports and imports. In Indonesia, withdrawal of foreign investor funds and lack of foreign inflows were inevitable. Price of imported goods sky-rocketed. Subsequently, from May 2008 to April 2012, the floating exchange rate regime was implemented.

There was a period of economic slowdown, where GDP growth dipped below 5 percent between 2011 and 2015 due to the collapse of commodity prices (Indonesia Investment, 2023). This was brought about by the European debt crisis and the Japan Tōhoku earthquake and tsunami that affected the world's market. As the central bank, Bank

Indonesia implemented a set of policy mix as a response to the outflows of foreign funds. The key interest rates were consistently adjusted, which resulted in the appreciation of exchange rate. In May 2012, a crawl-like arrangement was adopted. Although Bank Indonesia modified its monetary policy to influence the exchange rate, the efficacy of the policy was limited due to non-economic factors (Goeltom, 2008). Interestingly, even when the Rupiah was depreciating in 2014, its GDP was the highest in the world. The capital market was still increasing against all odds, which was an intriguing phenomenon. Indonesia's stock market reached its highest in 2017 with 6,355.70 points. The highest market capitalization was recorded in 2019 with USD 522,625.20 million before the Covid-19 pandemic hit. In 2020, Indonesia had its first recession in 22 years and experienced a drop in GDP.

Bank Indonesia (BI) is the central bank of Indonesia that was formed under the New Order Act No. 13 of 1968 to replace the old central bank formed in 1953. The status and position of BI as a sovereign state institution signified a new beginning. Thus, BI is free from government and other parties' interference, unless expressly stated in applicable laws. In other words, when it comes to establishing and carrying out its tasks and responsibilities, BI is a fully autonomous state institution. With this unique status and position, BI is able to carry out its duty as the monetary authority successfully and efficiently. As a public legal body and in line with its duties and obligations, BI has the authority to enact legally obligatory rules in the application of the law.

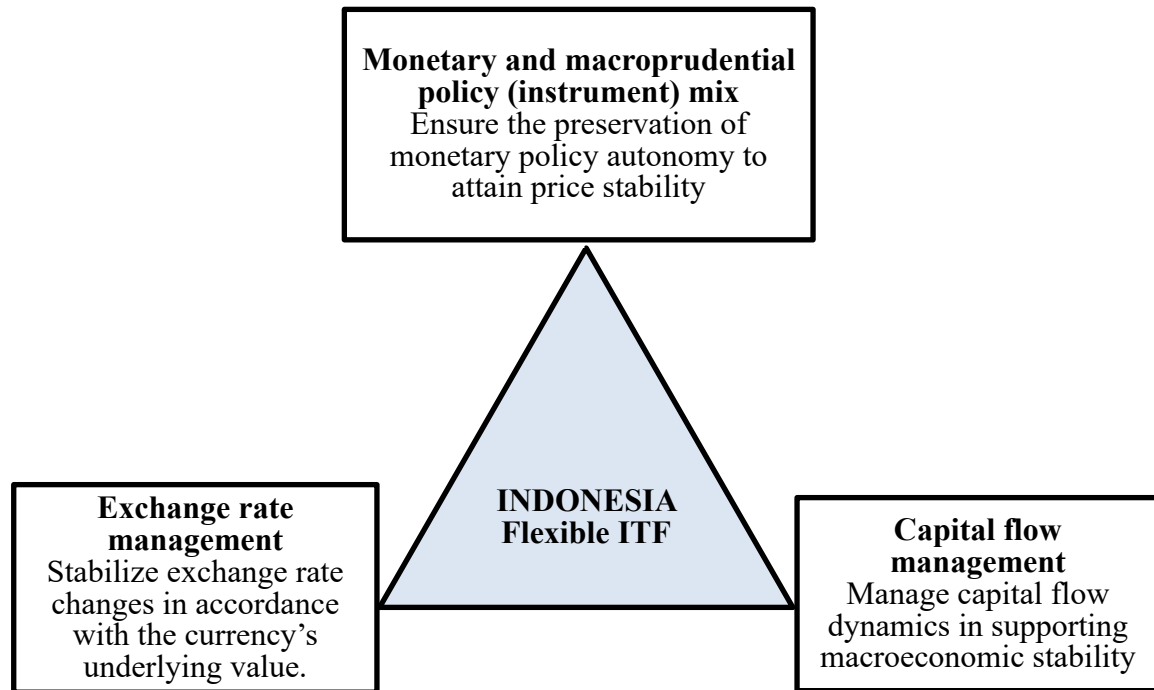
Rupiah's stability is established and maintained on two levels by BI. To begin with, inflation-measured price stability for goods and services is referred to as currency stability. The second component has to do with how stable the Rupiah's exchange rate is relative to

other currencies. A free-floating exchange rate mechanism used in Indonesia means that the value of a currency is determined by the forces of supply and demand in the market, without any fixed or predetermined exchange rate target set by the central bank or government. Maintaining exchange rate stability is essential for achieving and maintaining stability in pricing and the financial system.

Since 1 July 2005, BI has replaced base money as the monetary policy goal with the Inflation Targeting Framework (ITF). Since inflation is the primary objective, the ITF is critical to the mandate and institutional arrangements stipulated by current laws. Nonetheless, in order to improve effectiveness, BI remains committed to refining and improving its monetary policy framework in response to shifting dynamics and economic issues. BI is backed by three pillars to fulfil its objective. The first pillar is monetary policy formulation and implementation while the second is payment system regulation and availability. The third pillar is the stability of the financial system. These three pillars must work together to achieve and sustain a stable Rupiah value.

As part of the central bank's commitment and accountability, the ITF provides a framework to publicly establish an inflation goal corridor and altering monetary policy. The interbank rate serves as the operational goal of the ITF while the policy rate serves as a signal for monetary policy. One important takeaway from the Global Financial Crisis of 2008/2009 is the requirement for appropriate central bank to possess the necessary flexibility to response to intricate economic developments and the impact of a greater financial sector on macroeconomic stability. As a result, BI reinforced the ITF framework by renaming it the "Flexible ITF" since the ITF alone is no longer sufficient to maintain overall economic system stability and keep inflation within the target range. Generally, Flexible ITF has the

flexibility to merge monetary and financial system to achieve stability. This is done using a policy mix of monetary, macroprudential, exchange rate, and capital flow tools. This flexibility enhances institutional arrangements to maximise policy coordination and communication.



Source: Bank Indonesia (2023)

Figure 1.1: Bank Indonesia Monetary Policy Trilemma Management

According to Bank Indonesia (2023), low and stable inflation is essential for the effectiveness of monetary policy in achieving and preserving the stability of Rupiah. This provides a more predictable economic environment, allowing investors to make informed decisions about spending, saving, and investing. It reduces uncertainty and helps preserve the currency's purchasing power over time. The primary tool utilized by BI to influence economic activity and achieve its sole objective of controlling inflation is the BI 7-Day (Reverse) Repo Rate. This policy tool is communicated through various channels, albeit with a certain time lag. For this reason, the monetary policy transmission mechanism is known as

a form of alteration to the BI7DRR to influence inflation. This mechanism operates by adjusting monetary tools and operational targets to influence numerous economic and financial variables before the inflation is ultimately affected. This adjustment is made possible by interactions among the central bank, banking industry, and financial sector.

According to Bank Indonesia (2023), interest rates serve as a signal and are used to regulate inflation expectations to retain monetary policy autonomy. In Indonesia, macroprudential instruments have also been employed to regulate liquidity and mitigate financial sector risks. On top of these is the management of exchange rate to ensure in-line movement with the basic value. The purpose of foreign exchange intervention is to lessen short-term volatility. Simultaneously, it is critical to find the optimal equilibrium between appreciation and depreciation. A well-balanced exchange rate ensures better management of foreign exchange reserves. Macroprudential instruments are also used to manage capital flows as a form of external sector risks prevention. A well-managed capital flow encourages the financial depth of the foreign currency market and assists the management of foreign exchange serves as a type of self-insurance. Figure 1.2 to Figure 1.5 show scatter plots of the relationship between macroeconomic fundamentals and Indonesia stock indexes is nonlinear in nature.

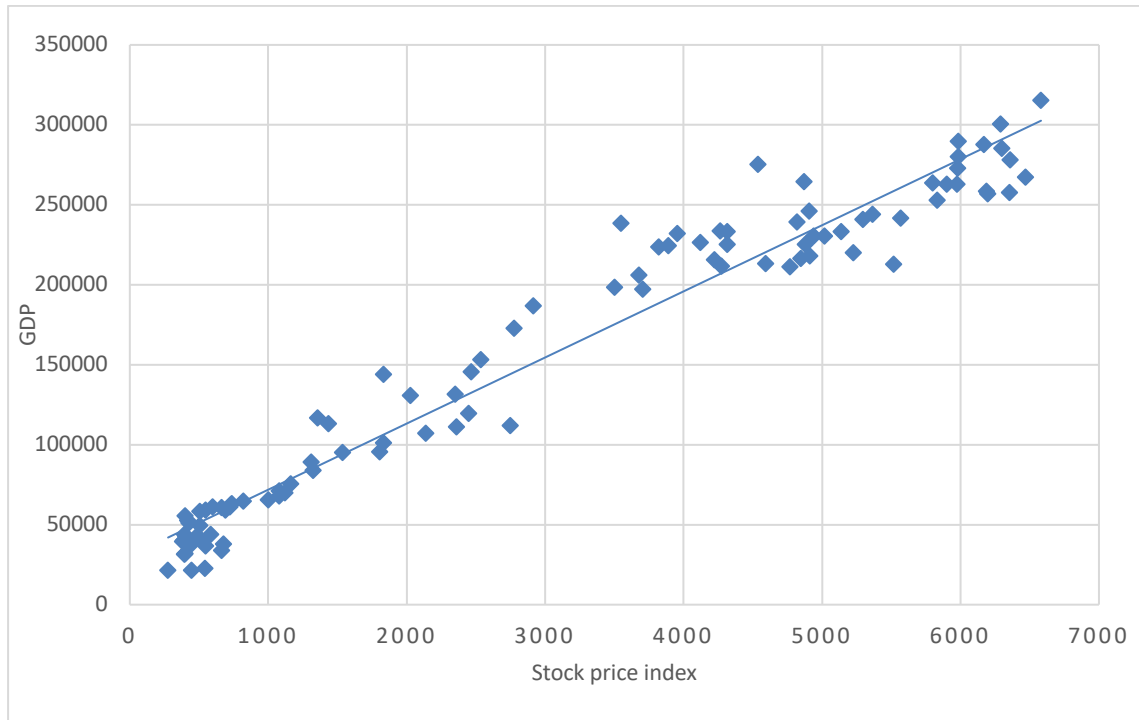


Figure 1.2: Scatter Plot of Indonesia Stock Price Index and GDP, 1999 - 2021

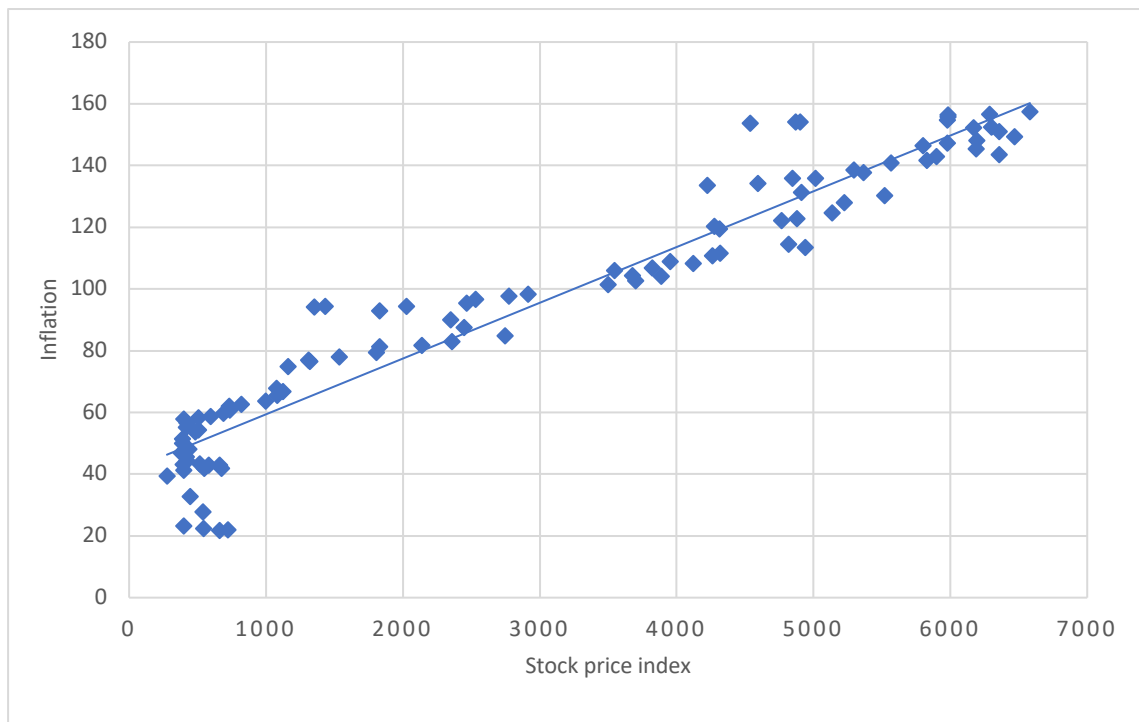


Figure 1.3: Scatter Plot of Indonesia Stock Price Index and Inflation, 1999 - 2021

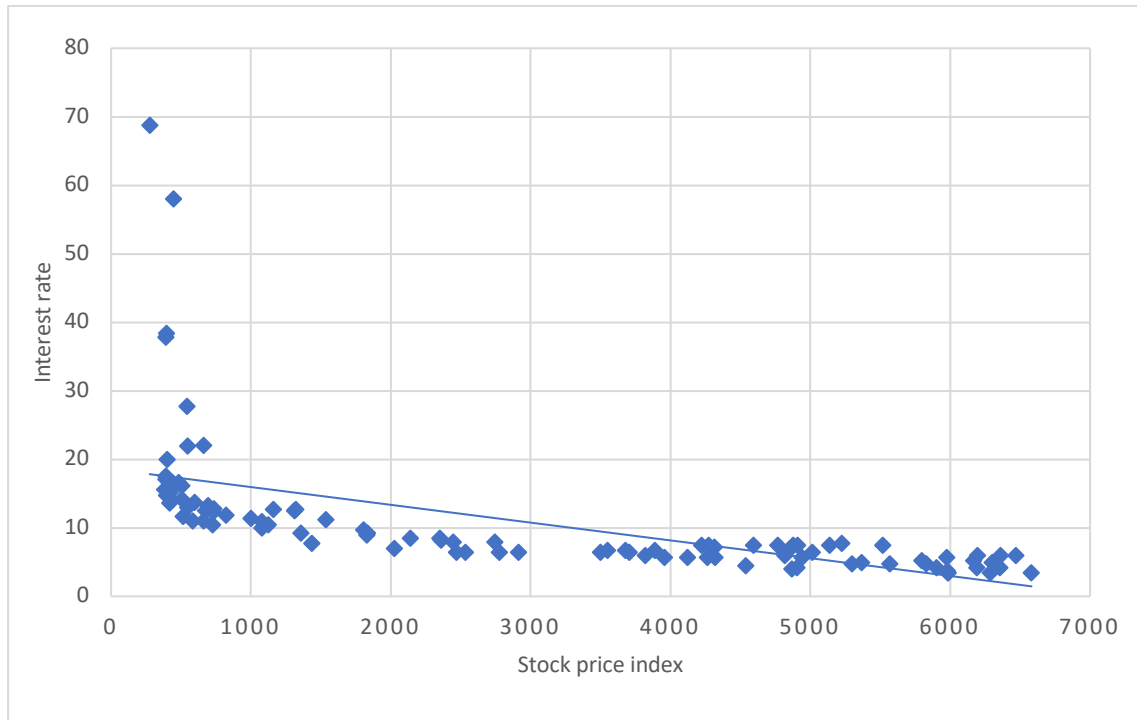


Figure 1.4: Scatter Plot of Indonesia Stock Price Index and Interest Rate, 1999 - 2021

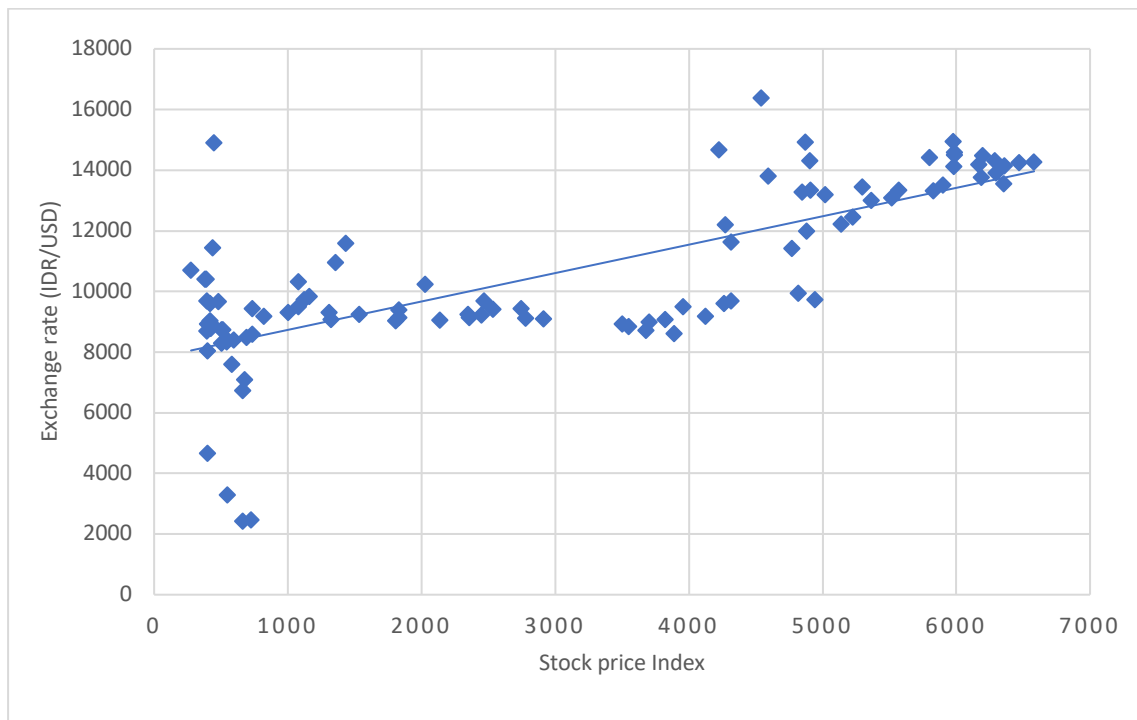


Figure 1.5: Scatter Plot of Indonesia Stock Price Index and Exchange Rate, 1999 - 2021

1.2.2 Malaysia Background

Malaysia is a newly industrialized market economy with a generally open state-oriented economy. Malaysia is a nation that is multi-ethnic and multi-religious. It is the 66th largest nation with a total land area covering 329,613 km². In 2020, Malaysia ranks 45th on the list of countries by population with an estimated total of 32,365,999 people (Worldometer, 2023). Malaysia has achieved tremendous advancements in the building of its own nation, the growth of its economy, and the enhancement of its citizens' standard of living. Since the country's independence in 1957, the development has been largely driven by the market forces. The export of basic commodities was crucial in the 1960s for economic expansion, and taxes were used to finance the government. Despite export earnings affecting the money supply, the commodity prices were maintained by conservative monetary policy. The increasing demand from manufacturing sectors in the following years, specifically Japan and the United Kingdom (UK), ensured stable export earnings. However, Malaysia suffered from an over-dependence on export earnings.

In Malaysia, financial liberalization took effect in the late 1970s. As in most developing countries, interest rate deregulation was the dominant feature of the financial reforms. In 1971, interest rates with maturities of more than four years were deregulated and the ceiling of interest rates were lifted. Then, the interest rate ceiling in finance companies was removed in late 1973. The Bank Negara Malaysia (BNM) as the central bank of Malaysia, plays a crucial role in the management of Treasury Bills and government debt securities. The main role of BNM is to conduct monetary policy and manage interest rates to achieve the country's monetary objectives (Bank Negara Malaysia, 2023).

Malaysia's exchange rate system was based on a fixed rate system. Since June 1972, Malaysia's ringgit switched the peg from the pound sterling to the US dollar. Before this, the pound sterling was used. At the end of May 1973, Malaysia decided to abolish the use of the Singapore dollar and Brunei dollar as convertible currency. In June 1973, Malaysia replaced its fixed exchange rate regime with managed float system. Then, Malaysia adopted a new regime of exchange rate, where the currency was pegged with a basket of its major trading partners' currencies and major currencies used in international settlements. Bursa Malaysia Holdings Berhad is a holding company for stock exchange established in 1976 and subsequently listed on the stock exchange in 2005. The Securities Commission and the Ministry of Finance oversee Bursa Malaysia Berhad, which is made up of many subsidiaries. Trading, clearing, depository, and settlement are all available through Malaysia's publicly traded stock exchange.

In order to generate an efficient market, commercial banks were given authority to determine their own deposits and lending rate in October 1978. With a stable exchange rate in 1978, Malaysia ended the exchange rate restrictions and shifted its exchange rate system from a basket pegged currency to a trade-weighted currency. The Malaysian economy slowed down in the early 1980s due to the second oil crisis, which occurred after the commodity crisis. A quick reduction in commodity prices caused a deepening domestic and external debt. In order to address the enlarging imbalances, different type of monetary and fiscal policies have been implemented. During the early 1980s, the monetary policy was selectively restrictive with a gradual increase in the overall level of interest rates as a countermeasure to fiscal expansion. In 1984, the uncertainty of the real exchange rate and ringgit speculative attacks burdened the basket peg system. Thus, towards the end of 1984, Malaysia decided to allow the ringgit to move freely against the US dollar and Singapore

dollar. Malaysia's economy experienced a tight liquidity period in 1985, which improved in 1987.

In Malaysia, monetary targeting monetary transmission was adopted before the financial liberalization. Money supply M1 was used as the main policy target due to its strong relationship with macroeconomic fundamentals such as price level. After the financial reform, free-floating and the changes of liquidity preferences destabilised M1 for price level prediction. Thus, BNM shifted its policy target to M3 in the 1987. From 1992 to 1993, Malaysia experienced a large capital inflow, which caused monetary aggregates to become unstable. The unpredictable growth of M3 pressured BNM to rethink its monetary policy strategy. Therefore, BNM shifted its monetary targeting approach from monetary aggregates to interest rate targeting as it is more market-based and easily tracked.

The 1997 Asian Financial Crisis affected Malaysia badly. The ringgit depreciated 35 percent against the US dollar, and the increase in domestic prices raised inflation rate significantly. According to Ariff and Abubakar (1999), the KLSE composite index, which had been the third-largest stock market in the area after Tokyo and Hong Kong, collapsed on September 1st, 1997. Share prices lost nearly USD 225 billion between July 1997 and mid-January 1998. In 1998, the unemployment rate rose 0.6 percent as compared to the previous year. The interest rate spiked to its peak at 8.45 percent in 1998 and then dropped to 3.38 percent in 1999. BNM implemented selective exchange control to curb the capital outflow from Malaysia on 1st September 1998. Then, BNM decided to peg Malaysia's ringgit against the US dollar at RM 3.80 to manage the impossible trinity problem. This assisted BNM to reduce the instability of the exchange rate and influence the domestic rate through a greater monetary autonomy. With a fixed currency, Malaysia could stimulate the

economy by lowering interest rates without worrying about the currency's volatility. The stock market index raised as a result. The currency remained pegged till 2005 and then was changed to a managed-float system. In 1999, Malaysia's economy showed significant improvement with this policy. A new interest rate framework with a new policy rate was then introduced. Then, the base lending rate (BLRs) ceiling was eliminated with the introduction of the overnight policy rate (OPR) in 2004.

Malaysia was one of the countries that recovered the fastest from the 1997 Asian Financial Crisis, although the crisis nearly brought the currency, stock, and property markets to their knees (Meesook et al., 2001). The government succeeded in utilising fiscal stimulus to revive the economy when BNM reduced interest rates. A reduced interest rate is important because, when interest rate increase, it rises the cost of short-term borrowing for financial institutions as well. This has a knock-on effect on almost all other borrowing prices for businesses and consumers. Malaysia's stock price index rose steadily to 1,445 points in 2007, before it was hit again by the 2008 Global Financial Crisis (CEIC, 2022).

The unprecedented large-scale financial crisis in 2008 badly affected the global money movements, trade flows and commodity prices. This impacted Malaysia's financial and trade channels. The international rising in food and oil prices worsened the situation. The stock price index dropped to 876.8 points. However, the broad-based reforms and capacity development that were implemented in the financial industry during the Asian Financial Crisis maintained its resistance to market volatility. Earlier of the year, a fiscal policy was implemented in the form of fuel price subsidy. However, by middle of the year, the widening gap between international and domestic oil prices proved to be a great challenge to continue the fiscal policy. This drove BNM to set its BLR constant and raised

its domestic oil price by 40.4 percent in June. In general, the Global Financial Crisis had slowed down export and weakened industrial production. By November, BNM was forced to lower its OPR to 3.25 percent to stimulate the economy.

In February 2009, the OPR was further reduced to 2.00 percent to promote a greater transmission and prevent an economic downturn (BNM, 2023). Starting from July 2009, Bursa Malaysia in collaboration with its index partner, FTSE, incorporated the Kuala Lumpur Composite Index (KLCI) with globally accepted index computation methodologies to form the FTSE Bursa Malaysia KLCI that has better international recognition and marketability. To provide investors with an investable and tradable index that is representative of the underlying market, the FTSE Bursa Malaysia KLCI is free-float adjusted and liquidity-screened. The 30 largest eligible Main Board businesses by market capitalisation made up the FTSE Bursa Malaysia KLCI, as adopted the FTSE Bursa Malaysia Index calculation methodology. On 3rd August 2009, the Malaysian Exchange of Securities Dealing and Quotation (MESDAQ) market, which was created at the KLSE in 2002, was relaunched along with the Main Board and the Second Board to form the ACE Market. This new board is open to businesses of all sizes and sectors. On 9th June 2011, FTSE Bursa Malaysia KLCI was further enhanced to the liquidity screening rule to further align the index to global standards.

The OPR was then increased by a sum of 75 basis points in 2010. Since 2011, the Malaysian economy grew steadily, and inflation averaged at 3.2 percent. Monetary policy focused more on normalised interest. While keeping the OPR at 3 percent in 2012 and 2013, the monetary policy focused more on minimising negative risks to growth via moderated inflation. Malaysia reached its peak stock market index in 2013 at 1,867 points. The OPR

was raised to 3.25 percent on 10th July 2014, which was maintained throughout 2015 to ensure that the monetary conditions support the Malaysian economy's sustainable development and price stability.

In late 2015, Malaysia, being a net oil-exporting economy, experienced the negative effects of plummeting oil prices. The global market was severely affected by an oversupply of crude oil and a simultaneous decline in demand, coinciding with a period of economic weakening in Europe and some developing countries. The repercussions of China's sluggish growth, in particular, had a significant impact on emerging market economies, reducing their attractiveness for investment. Malaysia was unfortunately one of the countries affected and witnessed capital outflows from the financial market. These events weighted down the broader market and put a toll on economic growth as a whole.

Several significant external events occurred in 2016, such as the Brexit outcome, the US presidential election, and the US interest rate normalisation in December. These significant events had led to capital outflows and volatility in money market rates. On 13th July 2016, Malaysia reduced its OPR to 3.00 percent, which maintained throughout the year, based on the macroeconomic outlook. Despite a 25-basis-point increase in the OPR two years later, monetary conditions did not tighten, and economic growth continued to be supported.

In 2020, the global economy entered a deep recession due to the Covid-19 pandemic with real GDP contracting by 3.5 percent. Since then, the OPR had been reduced progressively from 2.75 percent to 2.5 percent, 2 percent and finally 1.75 percent. This was maintained until 20th January 2021. The lowering of OPR is a monetary policy tool was intended to create a domino effect of lower interest rates. By reducing the OPR, central banks

aim to stimulate economic activity through various channels, including consumer spending, borrowing, and investment. Figure 1.6 to Figure 1.9 illustrate scatter plots of the relationship between macroeconomic fundamentals and Malaysia stock indexes. Nonetheless, the relationship shows nonlinearity.

BNM, Malaysia's central bank, is a statutory entity that commenced operations on 26th January 1959. BNM is governed by the Central Bank of Malaysia Act (CBA) 2009 that replaced the CBA 1958. The BNM plays a crucial role in promoting monetary and financial stability in Malaysia. To meet monetary aims, BNM normally adjusts domestic liquidity and exchange rates to create a conducive environment for the economy. The bank has a mandate to keeping the ringgit's purchasing power stable as well as maintaining inflation low and stable. To meet the increasingly sophisticated needs of investors, BNM is also responsible for developing a progressive, well-diversified, comprehensive, and robust financial sector. As a banker and government adviser, the bank is also in charge of advising on macroeconomic policy and managing the national debt. Other essential responsibilities include money printing and managing the country's international reserves. In Malaysia, the objective of the BNM is to achieve price stability as a monetary transmission channel. However, the currency rate channel in monetary policy is weak in Malaysia.

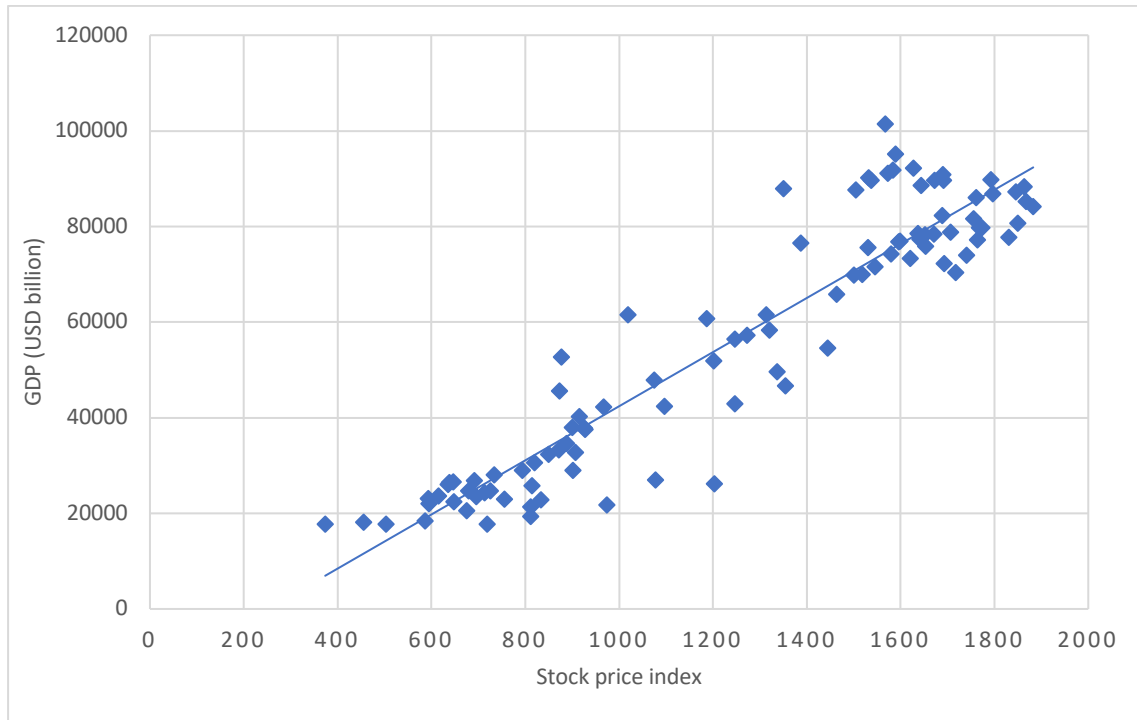


Figure 1.6: Scatter Plot of Malaysia Stock Price Index and GDP, 1999 - 2021

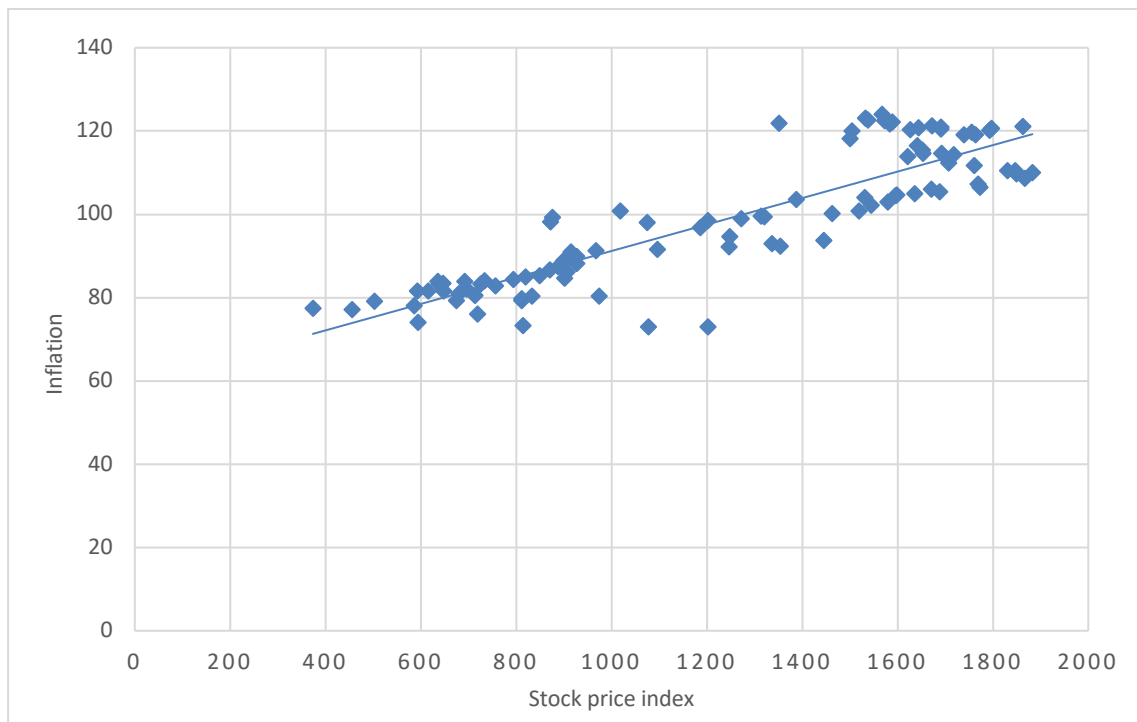


Figure 1.7: Scatter Plot of Malaysia Stock Price Index and Inflation, 1999 - 2021

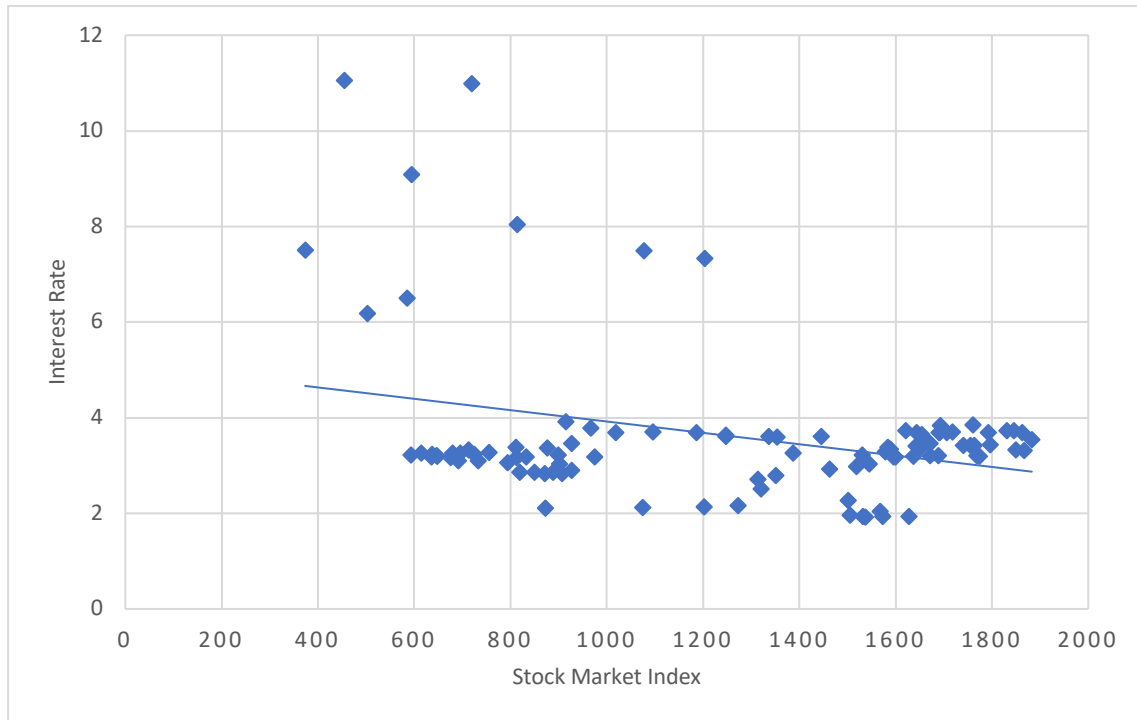


Figure 1.8: Scatter Plot of Malaysia Stock Price Index and Interest Rate, 1999 - 2021

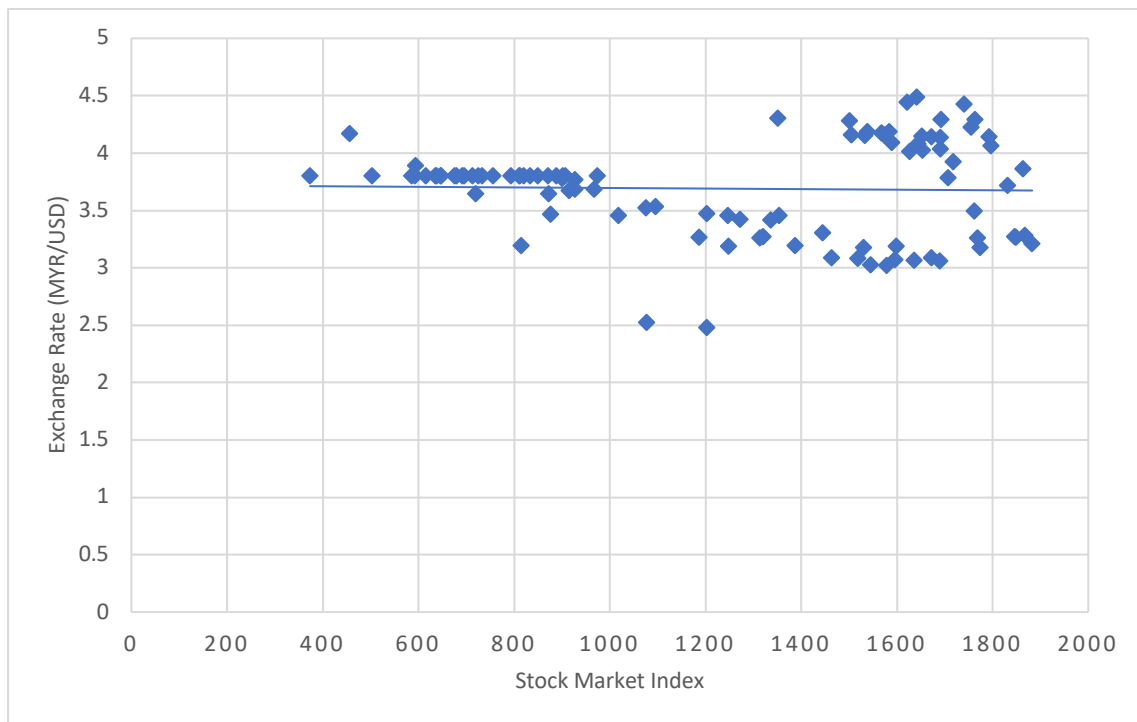


Figure 1.9: Scatter Plot of Malaysia Stock Price Index and Exchange Rate, 1999 - 2021

1.2.3 Singapore Background

Singapore, formally the Republic of Singapore, is an island country off the Malay Peninsula's southern tip. Singapore is strategically placed along the maritime routes of Southeast Asia. Singapore is a densely urbanised island city with a total land area of 724.2 km². Since gaining independence, the combined size of the territory has expanded by 25 percent through extensive land reclamation programs. Now, Singapore has the world's third most densely populated accompanied by a diverse multicultural population. The World Economic Forum has classified Singapore as the most open country on Earth.

The Republic of Singapore gained independence from Malaysia on 9th August 1965. At the beginning, the country's GDP per capita was less than USD 320. The leaders were determined to turn Singapore into a self-sufficient country and overcome national issues, including huge unemployment, housing shortages, and lack of land and natural resources. Singapore is well-aware of the importance of worldwide recognition. Singapore officially became the 117th member of the United Nations on 21st September 1965. Subsequently, it joined the Commonwealth in October of the same year. Since its establishment on 8th August 1967, Singapore played a pivotal role as one of the founding members of the Association of Southeast Asian Nations (ASEAN). Three years later, it joined the Non-Aligned Movement. Additionally, Singapore holds memberships in prominent organizations such as the Asia-Pacific Economic Cooperation (APEC) and the Trans-Pacific Partnership (TPP).

On the first day of 1971, the Monetary Authority of Singapore (MAS) was founded as Singapore's central bank and integrated financial regulator. The MAS was established with the goal of promoting long-term, non-inflationary economic growth as well as a stable and progressive financial centre. Before 1973, the Singapore dollar was pegged to pound

sterling and the US dollar through a fixed-rate regime, which was then shifted to a managed floating regime after Malaysia discarded Singapore dollars as a convertible currency. In 1975, Singapore shifted its exchange regime to basket pegging system with margin, which allowed trade-weight basket currency to be floated within a target band. In Singapore, the domestic money supply was greatly influenced by the inflow of foreign assets. In order to control interest rates and liquidity in the market, MAS focused on narrow money M1 while controlling domestic money supply quantity. However, the second oil crisis in 1979 affected the world and sparked the inflation rate in Singapore to 8.5 percent in 1980. MAS had to admit the ineffectiveness of using local money supply and interest rates to control inflation. Since 1981, MAS adopted the exchange rate management to guide its monetary policies. The exchange rate is an excellent intermediate monetary policy instrument that has been effective in achieving low and stable inflation (Loh, 2014).

In 1997, Singapore's stock market index dropped drastically from 2,216.80 to 1,529.80 due to the Asian Financial Crisis. Singapore has demonstrated a relatively strong resilience in comparison to many other Asian economies during this crisis. The economy was not directly affected and recovered with a growth rate of 5.4 percent in 1999 and then 9.9 percent in 2000 while the region's currencies suffered a sharp depreciation. In only two years, Singapore's stock price index recovered to its peak before the financial crisis. Singapore maintained its exchange rate targeting as the main monetary policy throughout this period.

Singapore operates an exchange rate-centred monetary policy framework, with the Nominal Effective Exchange Rate (NEER) of the Singapore Dollar serving as the intermediate target of monetary policy. The idea is that through the management of the

NEER, the MAS will be able to achieve a desirable balance between inflation and economic activity in Singapore. NEER was allowed to appreciate gradually over time to control inflation in Singapore. In 2005, the stock exchange reached the highest number of listed companies at 564 companies. After that, the number of listed companies remained steadily below 500. The stock market index was climbing steadily and reached its highest at 3,482.3 points in 2007. Despite the global oil and food price crises, inflation had been low and stable until 2007. In April 2007, Singapore shifted to a managed floating exchange rate regime stated in a currency composite.

Singapore was badly affected by the 2008 Global Financial Crisis. In the United States, the Dow Jones index fell 777.68 points during intraday trading after the Congress rejected a bank bailout bill. Singapore's economy experienced the worst ever recession with a drastic drop in the stock market index from 3,482.30 points in 2007 to 1,761.56 points in 2008. The inflation spiked to 7.8 percent. In September 2008, the global market panicked when oil prices dropped from USD 100 per barrel to less than USD 70 within a month. In Singapore, MAS changed its monetary policy to a zero percent appreciation of S\$NEER policy band. This means that, from May 2008 to April 2009, a more rigid regime was adopted.

In January 2009, the inflation rate in Singapore dropped to 2.4 percent. By May 2010, Singapore had implemented a crawl-like arrangement in a composite term. The road to recovery was obvious as Singapore's economy grew another 14.5 percent in 2010. There was a slight drop in stock price index to 2,646.35 points in 2011 due to the 2010 flash crash. The inflation rate rose to 5.2 percent in Q1 2011 due to the deterioration of global financial economic condition caused by the Euro debt crisis and nuclear fallout. As a response, MAS

re-centred its exchange rate policy band upwards and below the prevailing level of the S\$NEER. Since April 2012, MAS maintained the S\$NEER policy band with no slope. This has helped to restructure Singapore's economy by alleviating inflationary pressures and anchoring inflation expectations. The oil downturn is the key culprit for another decline in 2015, which then recovered in 2017. The slope of the S\$NEER policy band was decreased to 0 percent by MAS in April 2016. In addition, Singapore achieved the highest market capitalization at USD 787 billion in 2017.

In 2019, Singapore experienced an economic slowdown due to tariff hikes from the United States and China, which was then worsened by the unexpected Covid-19 pandemic in 2020, the worst full-year recession to affect Singapore since independence. Due to the effects of COVID-19 and the oil price war, the Straits Times Index declined 6.03 percent on 9th March 2020. In the medium run, MAS Core Inflation was predicted to be slightly lower than 2 percent. MAS calibrated the appreciation rate of the S\$NEER policy band to 0 percent per year, beginning in April 2020 at the then-current level of S\$NEER to help the economy weather the Covid-19 pandemic.

Exchange rate affects not just the foreign trade, but also Gross Domestic Product, production inflation and unemployment rate. Financial crises are typically accompanied by significant changes in exchange rates, which reflect changes in perceived risk of investing in particular currencies as well as increasing risk aversion. The exchange rate policy in Singapore has been designed with the key objective of securing domestic price stability coupled with supporting sustainable and non-inflationary economic growth. The MAS adopted such approach because Singapore is a small size economy that has a high reliance on the external sector. In addition, since Singapore is a small and open economy with few

natural resources and relies almost exclusively on imports to meet basic requirements such as food and electricity, the monetary policy based on exchange rate simply makes sense. Domestic consumption has a considerable import component, accounting for roughly 40 percent of total consumption. This needs to be balanced with exports to offset the cost of imports. For this reason, Singapore's economy has been extremely opened to trade. In 2011, trade accounted for over 300 percent of GDP. With such high trade volume, exchange rate is undoubtedly the right target for medium-term policies to maintain price stability. By exerting pressure on the foreign exchange markets, the government can intervene to stabilize or adjust the currency according to its desired objectives. This gives the government greater authority over macroeconomic variables.

The Singapore Exchange Limited (SGX), created on 1 December 1999, is a Singapore-based investment holding company that offers a variety of securities and derivatives trading services. Previously it was named the Stock Exchange of Singapore (SES). SGX has become the third exchange in Asia-Pacific to be listed through a public offering. SGX is dedicated to enabling sustainable economic growth by utilising its responsibilities as a significant player in the ecosystem, a business, a regulator, and a publicly traded firm. SGX aspires to be a leading sustainable and transition financing and trading hub, providing trustworthy, high-quality, end-to-end goods and solutions with climate action as a top focus.

Singapore's benchmark for the stock market is the Straits Time Index (STI). It is a free-float market capitalization-weighted index that tracks the performance of the top 30 companies listed on the SGX based on their market capitalization and liquidity. The STI serves as an important indicator of the overall performance of the Singapore stock market

and is widely followed by investors, analysts, and market participants. The composition of the STI is reviewed periodically to ensure it represents diverse industries and sectors of the Singapore economy. Overall, the STI is an important indicator of the Singapore stock market's performance and is a key reference point for market participants in the assessment of overall market trends and investor sentiment. Figure 1.10 to Figure 1.3 show scatter plots of the relationship between macroeconomic fundamentals and Singapore stock indexes is nonlinear in nature.

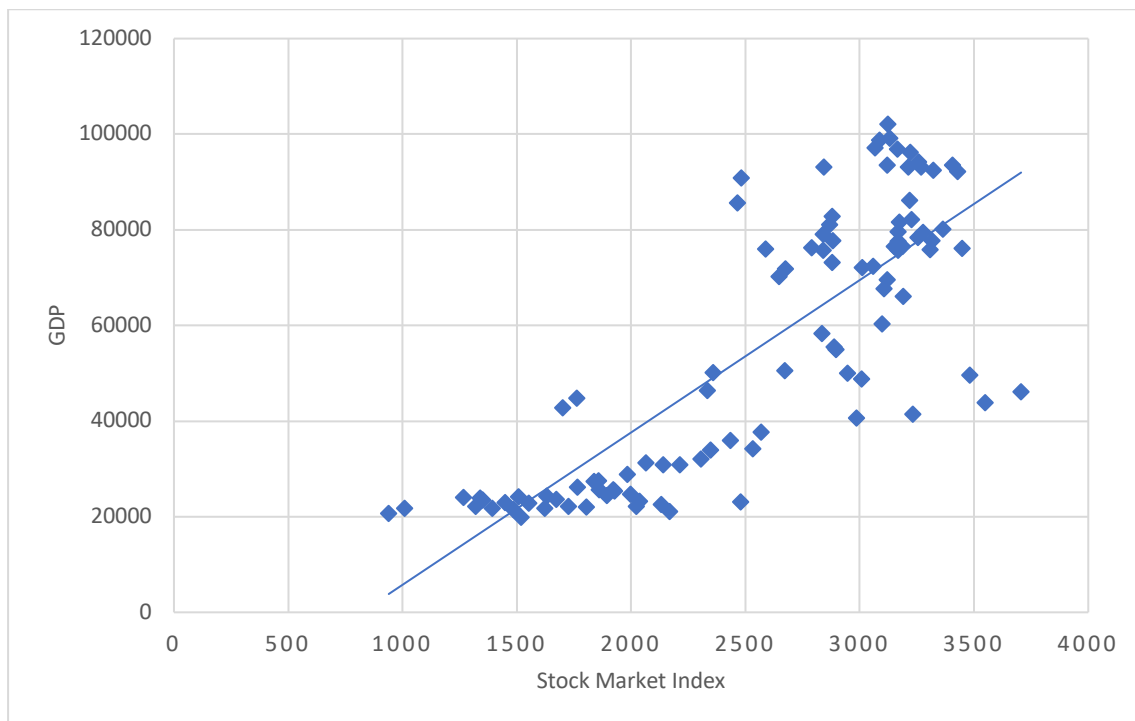


Figure 1.10: Scatter Plot of Singapore Stock Price Index and GDP, 1999 - 2021

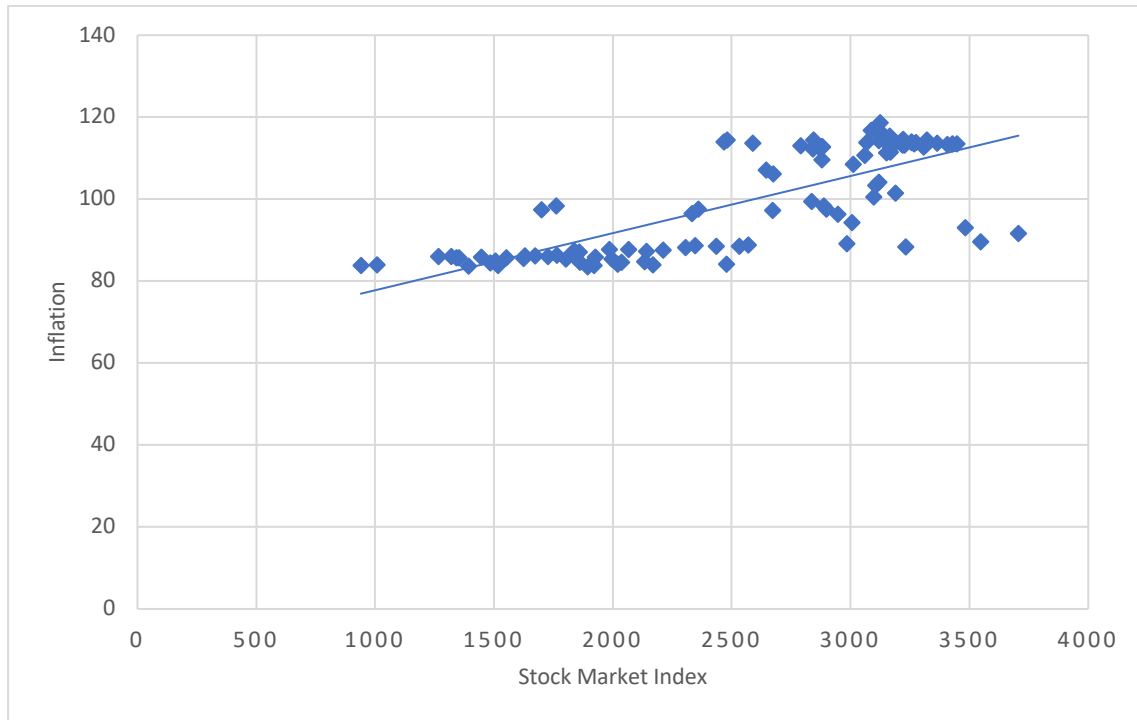


Figure 1.11: Scatter Plot of Singapore Stock Price Index and Inflation, 1999 - 2021

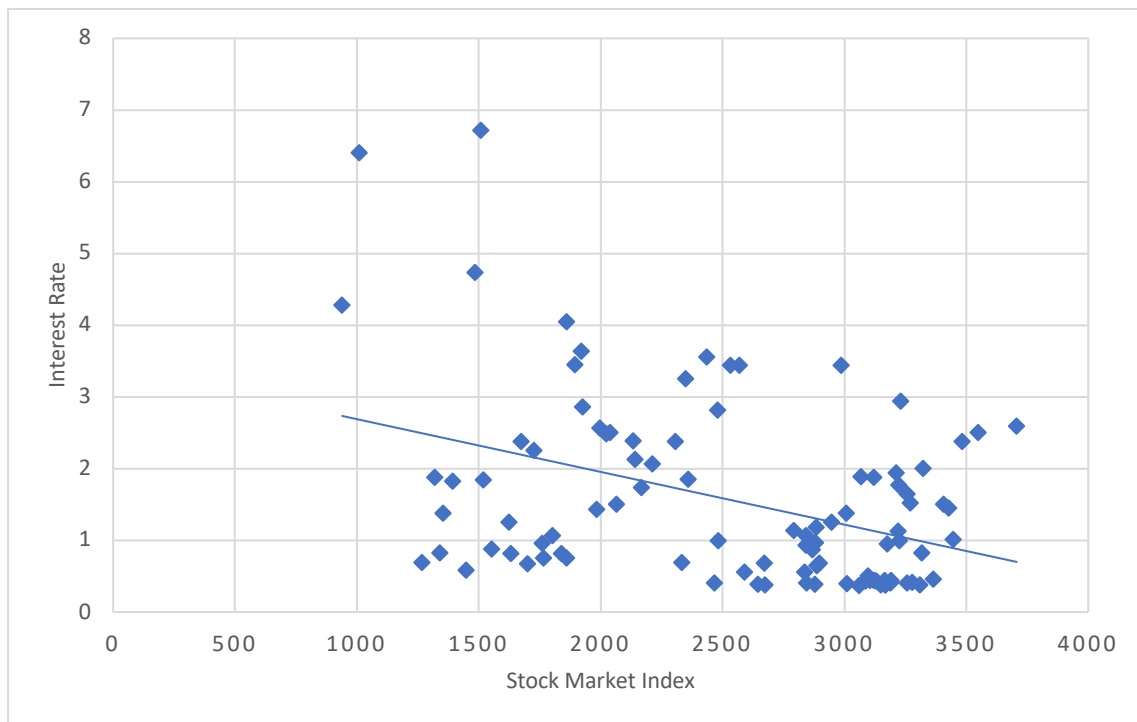


Figure 1.12: Scatter Plot of Singapore Stock Price Index and Interest Rate, 1999 - 2021

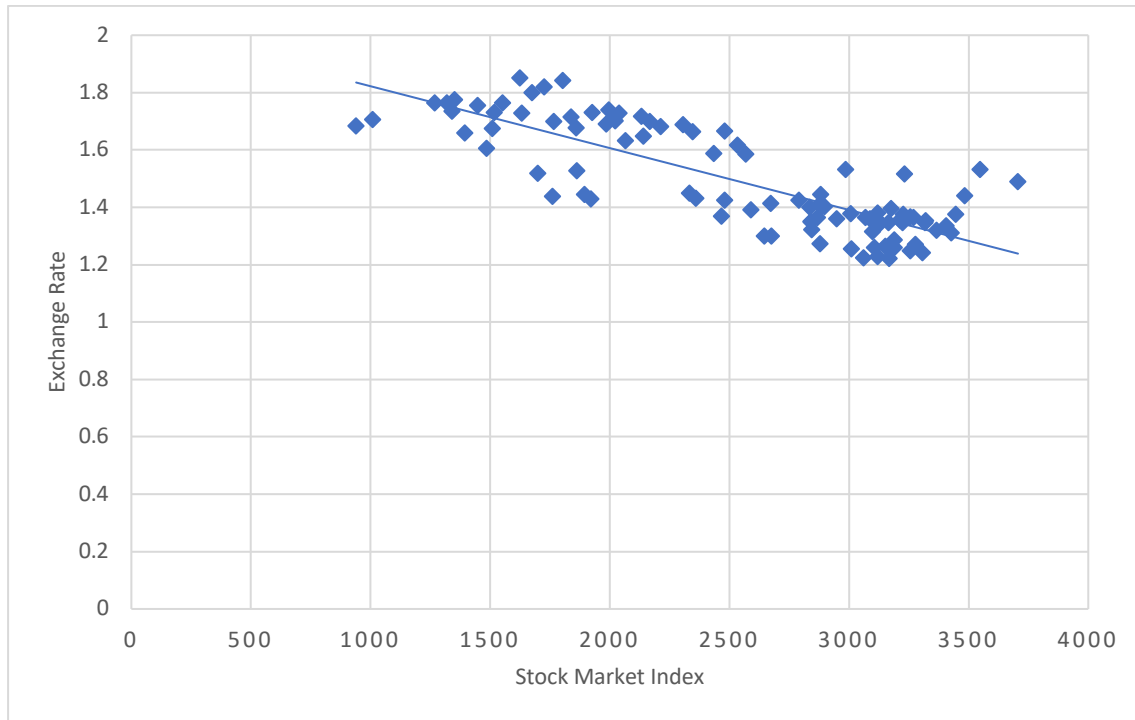


Figure 1.13: Scatter Plot of Singapore Stock Price Index and Exchange Rate, 1999 - 2021

1.3 Problem Statement

The volatile nature of stock markets should be monitored closely by the authorities for its great on the economy. Stock market volatility is due to the responses of market agents to market events. Mnif (2013) observed that the stock market exhibits a greater degree of responsiveness to information that stimulates speculative capital. Consequently, this heightened sensitivity leads to increase the stock market volatility. The most recent heightened volatility in the ASEAN stock markets is caused by the Covid-19 pandemic (Zainul, 2020). Before this, there were multiple stock market crashes due to uncontrolled volatility and weak economic performance, leading to financial crises. These include the 1929 Great Depression, the 1987 Black Monday, the 1997 Asian Financial Crisis, the 2008 Global Financial Crisis and unsurprisingly, the 2020 Covid-19 pandemic. It is thus clear that

stock market movements can serve as a signal of economic performance. Within the ASEAN region, Indonesia, Malaysia, and Singapore are located at strategic locations that have benefited their economic growth for many years. These three countries were selected for this study due to their diverse economic standing; Singapore is a developed market, while Indonesia and Malaysia are emerging markets.

According to the Centre of Excellence in Financial Services of South Africa, the 4th Industrial Revolution will result in a faster response to real-time events in the capital market. Indonesia, in particular, has experienced steady economic growth for several decades that have made it the largest economy in Southeast Asia. However, 19 percent of its population was living below the poverty level in the 2000s due to the 1997 Asian Financial Crisis. According to World Bank (2022), Indonesia's economy is currently recovering with GDP growth estimated to be 5.1 percent in 2022. Since 2010, Malaysia has consistently maintained its position as one of the most open economies globally, with a trade-to-GDP ratio that has averaged surpassed 130. Lastly, Singapore has experienced rapid economic development, transforming from a low-income country to a high-income country in merely 50 odd years since independence.

A full understanding of the impact of economic growth and other macroeconomic fundamentals on stock market performance is a prerequisite for effective policy design and implementation. As far as the author's comprehends, policies and strategies aimed at increasing real income also boost stock market development and should so be pushed extensively. According to Ho and Iyke (2017), well-functioning financial intermediaries complement stock markets rather than going against them. Macroeconomic fundamentals and stock prices interact intricately in the fast-developing economies of Indonesia, Malaysia,

and Singapore. However, the impact of macroeconomic fundamentals on the stock prices of these countries remains debatable. The complex nature of these relationship has significant impacts on politicians, investors, and the countries' overall financial stability. Although some of the correlation has been studied in previous studies, there is still a crucial information gap about the exact nature of the relationship, particularly when considering asymmetric impacts and the significance of certain macroeconomic factors.

Financial liberalization has been taking place in Indonesia, Malaysia and Singapore since the 1970s, with the liberalization of their respective stock markets occurring between the late 1980s and early 1990s. This has boosted the trades between domestic and international markets. The adoption of flexible exchange rates and the execution of financial liberalisation policies by many emerging nations over the past three decades have spurred lively arguments regarding the correlation between the stock market and macroeconomic fundamentals. According to Dahir et al. (2018), financial liberalisation and the adoption of a free-floating exchange rate have encouraged in facilitating capital inflows, promoting financial globalisation, and encouraging cross-border investments. Undeniably, emerging countries' macroeconomic and financial fundamentals have become more susceptible to global economic factors that have caused greater fluctuations in their macroeconomic fundamentals (Yacouba & Altintas, 2019).

In addition to their diverse economic standing, these three ASEAN countries also have distinctively different monetary policy. In Indonesia, the Flexible ITF is implemented as its monetary policy since 1st July 2005. This inflation targeting policy is used to control inflation and stabilize the Rupiah. On the contrary, Malaysia's monetary policy is guided by the OPR set by the BNM. The exchange rate channel is one of the key transmission channels

under the interest rate targeting framework of Malaysia that also affects inflation. As the intermediate goal of monetary policy, the MAS employs the S\$NEER to ensure that it stays within the designated policy band. By using the exchange rate as the policy instrument, MAS has more control over interest rates and money supply.

Ioannidis and Kontonikas (2008) and Laopodis et al. (2013) suggested that monetary policy decision can significantly impact stock prices by affecting consumer and investment expenditure, which in turn affects the real economy. To put it another way, financial markets serve as a conduit through which the decisions of monetary policy are transmitted to the real economy. Consequently, stock market performance serves as both a reflection of monetary policy actions and a source of feedback for central banks in regard to the private sector expectations for key macroeconomic fundamentals. Monetary policy can have both direct and indirect impacts on investments, as it can be restrictive, expansionary, or neutral in nature. Given the different application of monetary policies in these three countries, a set of common macroeconomic fundamentals have been selected for this study. Policymakers should keep these in mind while formulating plans to enhance the stock market's performance and the banking system while keeping inflation at bay. To encourage stock market development, policymakers should aim for the establishment of quality institutions that address various considerations such as political risk, law and order, efficient bureaucracy, and democratic accountability.

On the whole, the nexus between macroeconomic fundamentals and stock market may be asymmetry. Discovering a more concise relationship between the variables provide a better tools and strategies to navigate financial markets, potentially leading to higher returns and reduced risks. Hence that is why this study determines to investigate the

existence of symmetry and asymmetry: Do the macroeconomic fundamentals impact the stock prices movement in the selected countries: Indonesia, Malaysia, and Singapore?

1.4 Research Objective

1.4.1 General Objective

The general objective of this study is to examine the relationship between stock prices and macroeconomic fundamentals in Indonesia, Malaysia, and Singapore. Specifically, it aims to investigate the long-run symmetric and asymmetric impacts of macroeconomic variables on the stock prices using two different approaches.

1.4.2 Specific Objectives

The specific objectives of the study were as follows:

- i. To examine if symmetric short-run and long-run cointegration exist among the chosen macroeconomic fundamentals and stock prices using the ARDL approach.
- ii. To empirically evaluate if asymmetric short-run and long-run cointegration exist among the selected macroeconomic fundamentals and stock prices using the NARDL approach.

1.5 Significance of the Study

The findings from this study devotes significantly to further studies related to the correlation between macroeconomic variables and stock market in Indonesia, Malaysia and Singapore. The study focused on the long-term symmetric and asymmetric impacts of these fundamentals. The study also considered the respective monetary policy instruments in these countries, namely inflation targeting in Indonesia, interest rate targeting in Malaysia, and exchange rate targeting in Singapore.

The findings are also crucial for policymakers, investors, and researchers. Fluctuation in the stock market provides valuable information on a country's economic performance. As the world becomes more connected, a better perception of the nexus between macroeconomic fundamentals and stock market can prevent uncontrolled negative impact propagating throughout the world when a financial crisis occurs in a country or region. Nonlinear relationship may require more sophisticated and data-intensive forecasting models as it introduce greater uncertainty and risk. Thus, policymakers may need to consider a broader set of indicators to adjust policies more dynamically in response to changing economic conditions. For policymakers, this means better insight into future financial market conditions to serve as an early alarm for financial vulnerability. This helps policymakers establish policies that promote economic growth, financial stability, and more effectively informed financial decisions.

For investors, the study can provide valuable information on future financial movements and help in making more accurate investment decisions. For example, financial vulnerability indicators provide information on the macroeconomic conditions. This boosts the investors' confidence in planning for future investments instead of fearing over grievous losses. For investment houses, it means a better management of portfolios through enhanced expertise in predicting market movement.

For researchers, this study contributes a better knowledge of the symmetrical and asymmetrical effect of macroeconomics fundamentals of the stock market. This fills a gap in the literature on the impacts of macroeconomic fundamentals on stock prices in ASEAN countries using latest data available up to 2021. Additionally, the application of ARDL and NARDL approaches to study the linear and nonlinear cointegration. Specifically, the

NARDL approach allows for the identification of short-term and long-term asymmetries through partial sum of positive and negative decompositions, respectively, of the changes in stock performance in relation to changes in macroeconomic fundamentals.

1.6 Organization of the Study

There are five chapters in this thesis. The study discussed the nexus between macroeconomic fundamentals and stock prices in the selected countries. The second chapter contains the literature review on the relationships between stock price and the selected macroeconomics fundamentals. Next, the third chapter explains the data and methodology, covering both ARDL and NARDL approaches. The fourth chapter provides the empirical findings of the study and justification on them. Finally, the fifth chapter summarizes the study and provide conclusion on the study, recommendations, and limitation of the study for future research in the related field.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter compose of an extensive literature review on previous literature associated with stock market and macroeconomic fundamentals. In Section 2.1, an overview of the chapter is provided. Next. Section 2.2 offers a brief background on the related literature review, while Section 2.3 focuses on the review of the macroeconomic variables and their impact on the stock market. The conceptual framework for the study is illustrated in Section 2.4. In Section 2.5 and 2.6, the Autoregressive Distributed Lag (ARDL) along with Nonlinear Autoregressive Distributed Lag (NARDL) procedure and past study results are presented. The literature gap is discussed in Section 2.7, and Section 2.8 concludes the chapter.

2.2 Background on Related Literature Review

The association between stock price and macroeconomic fundamentals is vital as macroeconomic fundamentals have a significant influence on stock market returns. The Arbitrage Pricing Theory (APT) suggests that the behaviour of macroeconomic fundamentals can affect the performance of financial companies. There have been several studies, such as Mukherjee and Naka (1995), Wongbangpo and Sharma (2002), Inci and Lee (2014), Silva (2016), Lawala et al. (2018), and Setiawan (2020) that provided empirical evidence for a linear long-run relationship between stock markets and macroeconomic fundamentals. Most early empirical investigations assumed that the link between stock market and macroeconomic factors is linear and time-invariant in nature. This assumption

suggested that the impact of macroeconomic variables on stock prices remained consistent over time and could be represented by a straightforward linear relationship.

However, subsequent research has demonstrated that the relationship is more complex and dynamic. Recent studies by Boucher (2007), Kizys and Pierdzioch (2009), Ho and Iyke (2017), Lee and Ryu (2018), Phong et al. (2019), and Sahin and Mohamed (2020) suggest that the correlation between stock markets and macroeconomic variables might be asymmetrical and changes over time. A number of research have also attempted to explain nonlinearities in financial markets, including Brock and LeBaron (1995), Shleifer and Vishny (2003), and Humpe and Macmillan (2014). All of these research point to a relationship between informed and noisy traders, implying that speculators are the primary cause of market nonlinearity. The linkage between stock market index and macroeconomic fundamentals are discussed in the following section, including whether it is symmetrical or asymmetrical.

2.3 Theoretical Background on Review of Macroeconomics Fundamental of Stock Market

The stock index reflects nearly all stocks in the market. Stock exchange offers a platform for firms to raise funds and for investors to invest in them. It also serves as a legalized marketplace to carry out transactions to buy and sell shares (Sunde & Sanderson, 2009). The correlation between stock market returns and macroeconomic variables is a popular topic in finance (Ouma & Muriu, 2014). The study of Kurihara (2006) showed GDP, exchange rates, interest rates, and inflation rate influence stock market performance. Previous literature review done by Ho and Iyke (2017) has shown that macroeconomic fundamentals determine the economic development, banking sector development, inflation rate, interest rate, currency rate, and private capital flows, all which affect the stock market.

In the study of Prowanta and Ratnawati (2017), four distinctive variables – exchange rate, GDP, inflation, and interest rate have significant influence on stock market based on results of a regression analysis of panel data. Besides, Hashmi and Chang (2023) have identified that available macroeconomic information is somewhat predictive of emerging market stock returns. They utilised key macroeconomic fundamentals: exchange rate, inflation, interest rate, industrial production, and foreign direct investment. These past studies provide some guidance to select the macroeconomic elements to be used in this study involving Indonesia, Malaysia and Singapore.

The divergence of macroeconomic fundamentals can explain stock market asymmetries. Stock prices are determined by expected cash flows and the required rate of return. According to Filis et al. (2011), changes in the macroeconomic fundamentals can impact stock prices. The most popular theories to explain the influence of macroeconomic fundamentals on stock prices include Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Law of Supply and Demand, and the Theory of Asymmetric Information in Economics.

2.3.1 Capital Asset Pricing Model (CAPM)

The CAPM was developed by Treynor (1962), Sharpe (1964), Lintner (1965a & 1965b), and Jan Mossin (1966) before the Arbitrage Pricing Theory (APT) in the 1960s. CAPM is widely used framework that explains the correlation between systematic risk and expected return in assets, including those in the stock market. It posits that not all risks in the stock market should impact asset pricing. CAPM was introduced when the theoretical frameworks of decision-making under ambiguity were still evolving and empirical evidence on risk and stock market returns was scarce (Perold, 2004). CAPM helps determine if

securities prices are appropriate, over-priced or under-priced by the market (John, 2019). For asset pricing, the expected return calculated using CAPM can be compared to the estimated rate of return over a certain period to assess investment profitability. CAPM helps investors calculate profitability with a given level of risk, risk-free return, expected market return, and portfolio beta.

However, CAPM has limitation in reality. This is because it has been built on two assumptions. Firstly, it assumes that the securities markets become progressively competitive and efficient as technology develops. Secondly, it assumes that markets are driven by rational, risk-averse investors seeking to maximise returns from their investments. CAPM also fails to accurately evaluate reasonable returns. The CAPM formula, despite its limitations and critics, remains popular in the finance industry due to its simplicity and ease of comparison for investment alternatives. It provides a standardized and straightforward approach to assessing risk and return, making it easier to compare and decide among different investment options.

The CAPM is formulated as follows:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad \text{Equation 1.1}$$

Where:

$E(R_i)$ = Expected return of investment

R_f = Risk-free factor

β_i = Beta of investment

$E(R_m)$ = Expected return of the market

$(E(R_m) - R_f)$ = Market risk premium

2.3.2 Arbitrage Pricing Theory (APT)

The APT, introduced by Stephen Ross in 1976, provides an alternative approach to asset pricing compared to the CAPM. Unlike the CAPM, which focuses on a single factor for asset pricing, APT is based on a multivariable and risk-return equilibrium model for asset valuation. APT acknowledges that financial assets can be mispriced, and thus it takes into account the fair market value to identify any misprice. Such estimate helps investors identify arbitrage opportunities.

The number of macroeconomic factors used in APT is subjective and may vary between investors. The variables used represent systematic risks that cannot be diversified in an investment portfolio. Since each investor has different risk appetite and may invest in different stock market, the choice of factors can vary widely, leading to a wide spectrum of returns. It is common that investors will look for opportunities to buy low and sell high to maximize profits, but in the event of forecasting for future returns, it becomes extremely important to consider changes in the macroeconomics scale.

In this study, APT is applied considering GDP, inflation rate, interest rate and exchange rate as the macroeconomic fundamentals. The design of the model is guided by the principle that these factors should exhibit unexpected movements, pose systemic risks, have accurate and updated information, and can be justified economically.

2.3.3 Law of Supply and Demand

The Law of Supply and Demand is a fundamental economic principle explaining how price of goods is determined in a market economy. The price is influenced by the interaction between its supply and demand. When supply is limited and demand is high, the price rises and vice versa (Jain, 2014). This phenomenon has also been seen in the stock

market for individual equities. However, beyond the law of supply and demand, the demand for individual equities can also be influenced by other factors such as interest rates, economic growth, and company performance. For example, a strong economy can increase demand for most stocks, while rising interest rates can suppress the demand due to better risk-free return rates. It is important to note that these forces often work in opposite direction, balancing each other out.

2.3.4 The Theory of Asymmetric Information in Economics

Asymmetric information, also known as “information failure”, is a major cause of market inefficiencies and affect the availability and quality of goods and services in the market as well as the effective allocation of resources. It was first analysed by economists George Akerlof, Michael Spence and Joseph Stiglitz in the 1970s and 1980s. According to Akerlof (1970), it refers to differences in the quantity and quality of information available to managers and investors, including informed and uninformed traders.

Akerlof (1970) proposed the first formal analysis of markets with the informational issue recognized as adverse selection – a condition where the buyer and seller do not have access to the same information. Examples of asymmetric information can be seen in car sales, health insurance and financial markets. In car sales, the seller may know more about the car’s condition than the buyer, leading to potential loss of value and lower satisfaction when the purchased car’s quality does not meet expectation. In health insurance, the customer has more information about their health habits than the insurer, which may lead to the insurer facing higher risk unless a medical assessment has been performed and informed. In financial markets, the 2008 financial crisis was a result of retail investors not having

access to information about the toxic assets in bundled securities that they bought, while financial professionals were aware of the risk.

Asymmetric information in financial markets occurs where one participant has more information than the other about an investment's past, present, or future performance. This creates market opportunities for those with more information while may be catastrophic to those with less information. As such, it becomes clear that asymmetric information can cause both market failure and opportunities at the same time.

2.3.5 Efficient-Market Hypothesis (EMH)

The EMH, derived from Fama (1970), posits that stock prices in financial markets reflect all available information and are always traded at their fair price, making it absurd to persistently beat the market and achieve higher returns. This means that it is unworkable to purchase cheap stocks at a bargain or sell overpriced stocks for a profit.

This theory has three different variants (weak, semi-strong, and strong) which were used to predict market efficiency. The weak form suggests that security prices reflect all publicly accessible information, but not private information that has not been disclosed. The semi-strong form posits that stock prices respond instantly to any public information regardless of whether it is technical or fundamental information. In the strong form, the market responds instantaneously to public and private information. This makes it impossible to achieve higher returns than the market average.

2.4 Conceptual Framework

The stock market value and its determinants have been extensively studied in the literature. For investors, the macroeconomic factors are the most important considerations

when making investment decisions. This is because these factors greatly affect the volatility of the market, and thus the return of their investments. Previous literature studies have established a nexus between stock prices and macroeconomic fundamentals such as economic growth, inflation, interest rate, and exchange rate. These shall be discussed extensively in the following sub-sections.

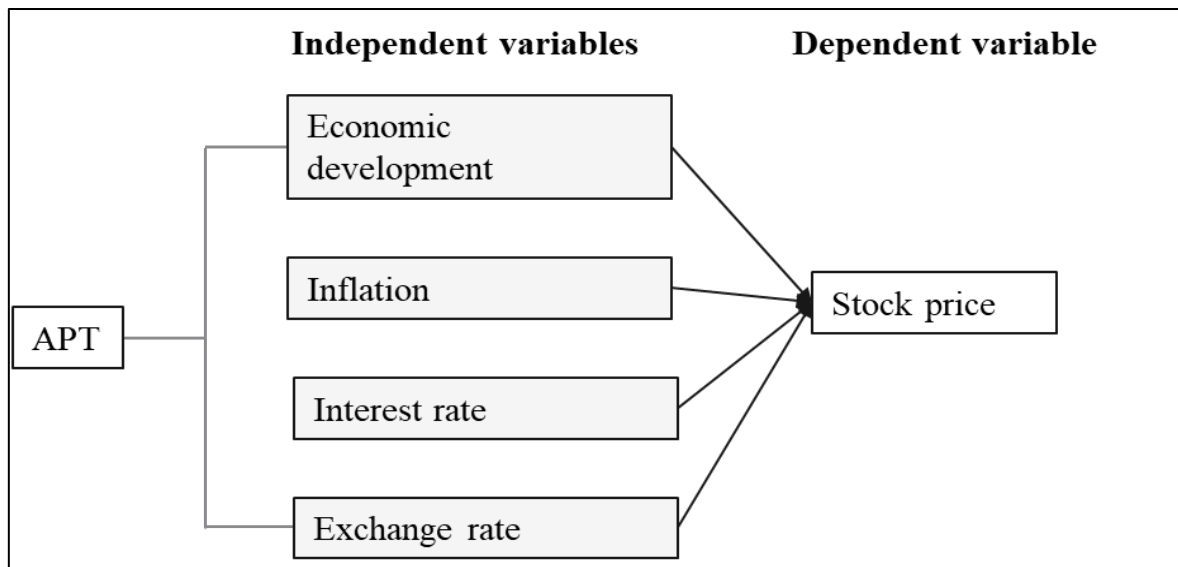


Figure 2.1: Conceptual framework

The most fundamental macroeconomics concept used frequently is the Gross Domestic Product (GDP) and economic growth. The stock market has a direct influence on GDP since it is a good gauge of public opinion. Spending and investment are the two main factors that determine GDP, which represents the output of all goods and services in an economy. Hence, GDP and stock market performance are closely related to each other.

Another two common macroeconomics variables used to describe an economy are inflation and interest rate. “Inflation” refers to the general rise in the total price of goods and services over time. Rising inflation rates are commonly associated with rising interest rate. The consumer price index (CPI), which measures the inflation rate, denotes an overall rising

price movement of goods and services (Geetha et al., 2011). Some countries' central bank target inflation by reduce the interest rate. Central banks and governments often use interest rate policy as a tool for the management of economic conditions. By adjusting interest rates, policy makers aim to control inflation, to stimulate or cool down economic growth and to stabilise the financial markets. Changes in interest rates can have an impact on the cost of borrowing, investment decisions, consumer spending and overall market sentiment. According to Alam and Uddin (2009), this is because interest rate movement exerts considerable impact on risk management techniques, financial securities valuation, and government policy toward financial markets. Interest rate is such a significant financial and economic factor that it affects the monetary policy of a country. A monetary policy, on the other hand, has both direct and indirect impact on investments. The direct impact is based on the level and direction of interest rates, whereby the indirect impact is based on predictions about where inflation is headed. Every government uses different set of monetary tools to sustain the money supply or interest rates and accomplish macroeconomic goals like inflation, consumption, growth, and liquidity.

Exchange rates act as a competitive tool in international trade and directly affect the prices of a country. When the local stock market performs well, it rises local and foreign investors' confidence in the economy that in turn rises the demand for the native currency. In addition to its impact on international trade, the exchange rate also has an influence on the GDP, production inflation, and unemployment rate of a country. Financial crises are typically accompanied by significant changes in exchange rates, reflecting shifts in perceived risk associated with investing in specific currencies and an increase in risk aversion among investors. During financial crises, investors often to become more risk-averse and seek safer investment options, consequently investors could withdraw their

investments from the countries experiencing financial turmoil, leading to depreciation of local currency.

2.4.1 Correlation between Stock Price and Economic Development

The significance of economic development on stock prices has been a topic of interest for a long time. Economic development or growth is typically measured using GDP, and changes in a country's GDP can reflect the overall health of its economy. As the economy grows, fixed costs decrease, allowing more individuals to access financial services. This boosts stock market development.

A study by Chen et al. (1986) found that the correlation among stock prices and GDP varies based on the business cycle stage. They analysed data from the US economy over a 40-year period and concluded that stock prices tend to lead GDP during the early stages of the business cycle, while GDP leads stock prices during the later stages. In some research, the industrial production index (IPI) has been used as a proxy of GDP (Demir, 2019).

GDP is the monetary sum of a country's final goods and services produced for consumption. Studies show that GDP positively affects aggregate stock price indices in Indonesia, Malaysia, Singapore and the Philippines, but negatively in Thailand (Wahyudi et al., 2017). An increase in GDP increases the income of the community, which in turn encourages businesses to expand. According to Ho and Iyke (2017), real income and growth can also promote stock market development. Jepkemei (2017) also emphasized the stock market's role in directing economic growth.

Yii et al. (2021) reported a positive relationship between economic growth and the stock market in China, while Nazir et al. (2010) documented similar finding for Pakistan.

Studies by Humpe and Macmillan (2009), Bahmani and Saha (2016), Upadhyaya et al. (2018), and Hashmi and Chang (2023) find a positive correlation between GDP, proxied by the IPI, and stock prices. These studies had utilized several econometrics techniques such as unit root tests, cointegration test, linear ARDL approach, quantile ARDL, Johansen and Juselius, and VECM Granger Causality to investigate the nexus between macroeconomic variables and stock prices.

On the other hand, Şentürk et al. (2014) found no association among economic growth and stock prices in the long run. Nevertheless, in most cases and as stated by Demir (2019), an active and developing domestic economy, regardless of its development path, boosts stock markets.

In conclusion, the NARDL model has been used to examine the nexus between stock prices and economic development in various countries. While the results are not consistent across all studies, they suggest that the stock market can indeed play an important role in the economic growth of a country. While the stock market's impact may vary determined by specific factors, essentially such as the stage of the business cycle, economic development, and the size of the economy.

2.4.2 Correlation between Stock Price and Inflation

The impact of inflation on stock market returns is complex and dependent on multiple factors such as investors' ability to hedge, monetary policy, and the economic context of the country. On one hand, high inflation can create employment growth, but it can also hurt companies' earnings, leading to decreased hiring due to higher cost. Inflation is exemplified as a rise in the typical price of goods and services expressed in monetary terms. Increase in inflation also decreases purchasing power for goods and services. While stocks can

potentially act as a hedge against inflation, it is necessary to remark that the nexus between stock prices and inflation can be complex and may not always result in a perfect correlation. Lee (2010) asserted that the nexus between stock return and inflation may change over time, depending on how economic factors interact with each other. In the study of Wahyudi et al. (2017b), inflation can have positive or negative effects on the aggregate stock price index, depending on the country of the study.

Inflation rate quantifies the percentage change in average prices from the prior year (Romer, 2012). A rapid rise in inflation is particularly damaging as it takes businesses time to pass on the increased expenses to customers. According to Lee (2010), many studies have attempted to justify the inverse link between stock market returns and inflation. Several past studies have discovered a negative nexus between stock returns and inflation (Humpe & Macmillan, 2009; Silva, 2016; Jepkemei, 2017; Wahyudi et al., 2017b; Upadhyaya et al., 2018; Eldomiaty et al., 2020; Bonelli, 2023), even in a study that used the NARDL approach (Lee & Ryu, 2018). The study by Jamaludin et al. (2017) clearly pointed out the significant impact of inflation on stock market performance at selected ASEAN countries using the panel least square analysis.

According to Phong et al. (2019), when inflation rises, the value of money decreases, causing a decline in income and reducing the appeal of the stock market to investors. Inflation exacerbates the situation when the rate of inflation exceeds the rate of return on an investment, the real rate of return decreases. This is because the purchasing power of money weakens over time due to rising prices. Furthermore, inflation increases the cost for investors with higher interest rates. Increase in inflation also rises production cost, this ultimately reduces profits and expected future cash flows (Upadhyaya et al., 2018). To mitigate the

negative impact of inflation on stock market, it is necessary to implement monetary policy measures that promote and keep inflation low.

On the contrary, Amata et al. (2016) discovered a positive association between inflation and stock volatility which implies that as inflation increases, stock market volatility also tends to increase. Issahaku et al. (2013), Ahmed et al. (2015), and Tiwari et al. (2015) also showed evidence of a positive correlation between inflation and stock prices. According to the argument put forth by Wongbangpo and Sharma (2002), equities can act as a hedge against inflation when they represent real assets. Wahyudi et al. (2017b) found that inflation has a positive and significant impact on the aggregate stock price index in Thailand. One possible reason for this link is that inflation may signify an expanding economy and greater demand for products and services, which could boost the performance and profitability of companies listed in the stock market. Ahmed et al. (2015) observed uni-directional short-run causality between inflation and stock prices, which is persistent with the Fisher effect theory on the one-to-one movement of inflation and nominal interest rate. In addition, a higher inflation increases nominal stock market returns while real stock market returns remain unchanged. This compensates the investors fully.

There were some studies which found no nexus between inflation and stock market returns. The study researched by Hasan and Javed (2009) utilized the ARDL approach, identifies that inflation rate is not significant in the long run. The research of John (2019), Mahpudin and Batu (2021), and Hashmi and Chang (2023) found similar results which reported that inflation rates had no impact on stock prices.

In conclusion, the literature on the correlation between stock prices and inflation rate has produced mixed results. Different studies have presented varying findings, including

positive, negative, or unidirectional relationships between these variables. The mixed results can be attributed to multiple factors such as market conditions, investor expectations, monetary policy, and overall economic environment.

2.4.3 Correlation between Stock Price and Interest Rate

Based on previous literature by numerous researchers, the correlation between interest rates and stock prices has shown various conclusions. Real and nominal interest rates are the two different types of measures used to assess the cost of lending or the return on investments. The nominal interest rate indicates to the stated interest rate without considering inflation, while the real interest rate adjusted for inflation on the purchasing power of money and often issued by the central bank (Mankiw, 2010). The direction of this relationship is affected by the endogenous factors such as the demand for domestic currency and the decision of foreign investors (Mikhaylov, 2018). The link between interest rate and stock market can be both positive or negative, as opined by Wahyudi et al. (2017b).

According to some studies, interest rates and stock prices have a significant positive association. In the study of Eldomiaty et al. (2018), the positive trend signified stock values' response to changes in real interest rates. This empirical outcome is also similar with that of Upadhyaya et al. (2018) and Wahyudi et al. (2017b). In the research of Wahyudi et al. (2017b), the aggregate stock price indexes of ASEAN-5 countries except Thailand are positively and significantly impacted by interest rates.

However, according to Humpe and Macmillan (2009), Amata et al. (2016), Huang et al. (2016), Wahyudi et al. (2017b), John (2019), and Setiawan (2020), a rise in interest rates will adversely affect the stock market performance. The study done by Hasan and Javed (2009) found that changes in interest rates cause stock prices have an inverse relationship.

Amata et al. (2016) also reported that stock market and interest rates have an adverse correlation because investors value shares by discounting future dividends to the present, and interest rates function as a discount rate. This conclusion is also supported by John (2019), who used Ordinary Least Square (OLS) regression, where a significant yet negative effect of interest rates on stock market performance in Nigeria is discovered. As higher interest rates increase the cost of investment and hinder the expansion of firms through the stock market, there is a pronounced adverse association among interest rates and stock market indices (Demir, 2019). In fact, when interest rate rises, investors expect greater profits. This rises the discount and causes the stock price to fall. Upadhyaya et al. (2018) suggested two primary reasons for this negative relation. Firstly, an increase in interest rate improves the appeal of interest-earning assets, prompting investors to reallocate their portfolios for more lucrative assets. However, the increase also reduces corporate profitability because of higher financing costs.

Contradicting these findings, Luwihono et al. (2021) and Mahpudin and Batu (2021) found no correlation between interest rates and share prices. The literature's contradictory findings imply that further study is necessary to properly comprehend the link between interest rates and stock prices.

2.4.4 Correlation between Stock Price and Exchange Rate

The exchange rate can affect the stock market and plays an important role in a country's economy. The currency rates are the rates for exchanging one currency for another (Amado & Choon, 2020), also represents value of one currency in terms of another currency. This would determine stock prices through appreciation and depreciation of the local currency against the target foreign currency. In addition, the flexibility of exchange rate

affects market returns. Thus, the exchange rate and stock market are important in the economic and financial development of a country (Afshan et al., 2018; Gokmenoglu et al., 2021). The portfolio balance approach posits that the health of the domestic currency can impact the market value of firms. Currency influences the costs and benefits of products, services, and securities trading (Issahaku et al., 2013). Existing studies indicate that the correlation between stock prices and exchanges rates can be positive or negative, depending on various conditions. Nevertheless, the existence of a long-run causality has been proven, for example in the study of Lee and Zhao (2014) for the China stock markets.

Studies that reported a positive nexus between exchange rates and stock prices include Upadhyaya et al. (2018), Demir (2019) and Luwihono et al. (2021). According to Upadhyaya et al (2018), when the local currency depreciates against a foreign currency, i.e., when exchange rate increases, local goods become more attractive in the global market. This stimulates exports as well as competition from similar imported goods. In essence, this should increase the local enterprises' profits and future cash flows. On the other hand, the study of Demir (2019) reported on the positive link between stock market and the Turkish currency. In another study by Wahyudi et al. (2017b), similar result has been reported for the Malaysian ringgit and Thai baht.

However, a number of studies have discovered that there is a negative link between exchange rates and stock prices such as Hasan and Javed (2009), Amado and Choon (2020). Imdadullah and Hayatabad (2012) opined that exchange rate shocks may have a negative outcome on the stock market return of a country. In their study, a rise in foreign currency has lowered the profits of investors in the stock market index and caused investors to withdraw their investment, leading to further decrease in stock market index. Wahyudi et al.

(2017b) also discovered a significant negative impact of the Philippine peso on the aggregate stock price index.

Beyond the above-mentioned studies, some have identified no nexus between exchange rate and stock market prices. Pantas et al. (2019) discovered no correlation among the exchange rate, Jakarta Islamic Index, and Composite Stock Price Index in the long term. Mahpudin and Batu (2021) reported no significant relationship in Brazil's stock market and exchange rate. Suriani et al. (2015) reported similar result for Pakistan, a conclusion supported by the work of Syahrer (2010), Fowowe (2015) and John (2019). However, Fowowe (2015) suggests that the nexus between exchange rates and stock prices might differ with structural breaks. This finding is consistent with the Asset Market approach, which proposes that exchange rates and stock markets have either no or weak interactions (Amado & Choon, 2020).

Another study from Malaysia by Asmy et al. (2010), found the relationship between exchange rates and stock prices might show different trends before and after a crisis. Prior to a crisis, exchange rates and stock prices may have a positive long-run correlation, implying that a stronger currency corresponds with higher stock prices. However, in the aftermath of a crisis, the relationship may turn negative, implying that the negative consequences of currency fluctuations outweigh any positive effects, putting downward pressure on stock prices. This could mean that fluctuations in the currency do not significantly impact the performance of stock indices in capital markets, indicating that stock market performance may not be sensitive to currency appreciation or depreciation.

2.4.5 Symmetric and Asymmetric Effects of Macroeconomics Fundamental on Stock Prices

The linkage between macroeconomic fundamentals and stock prices has long been explored by various researchers (Ahmed et al., 2015; Fowowe, 2015; Suriani et al., 2015; Silva, 2016; Afshan et al., 2017; Ho & Iyke, 2017; Jepkemei, 2017; Wahyudi et al., 2017; Demir, 2019; Amado & Choon, 2020; Setiawan, 2020; Mahpudin & Batu, 2021). However, most of these existing studies only highlighted the linear effect of macro fundamentals on stock prices, but absence of nonlinear linkage between them were absence. Thus, the existing literature is unable to provide information on what extent of the nonlinear relationship among macroeconomic fundamentals and stock prices for the selected countries.

However, the complexity of the correlation among macroeconomic variables and stock prices is complex and can be influenced by multiple factors. It is challenging to isolate the exact impact of a single macroeconomic variable on stock prices due to the interplay of various market forces, investor sentiment, company-specific factors, and external shocks. These complexities make it difficult to reach definitive conclusions about the cause-and-effect relationship between macroeconomic fundamentals and stock prices.

Asymmetries in the finance-growth relationship were first identified in the studies by Rousseau and Wachtel (2002), where it was shown that financial market efficiency impact how savings and investments are allocated due to various information asymmetries. Alagidede et al. (2011) used the Hiemstra-Jones test to demonstrate a nonlinear causal correlation among the stock price and the Japanese currency. Based on the study conducted by Chang and Rajput (2018), Dhaoui et al. (2018), Yacouba and Altintas (2019), and Yii et al. (2021), the authors discovered that the connection among macroeconomic variables and stock market prices was asymmetric, by their empirical evidence depicting both positive and

negative shocks of the variables do not influence the stock market correspondingly. According to the discussion by Bahmani-Oskooee and Saha (2016), the authors suggested that the relationship could be asymmetric to explain the insignificant relationship found in the linear ARDL model, which was later confirmed. Furthermore, Bahmani-Oskooee and Fariditavana (2015, 2016) and Bahmani-Oskooee and Saha (2016) also stated that the nexus between macro variables and stock prices can be significant if the explanatory variable is separated into positive and negative shocks to determine the asymmetric relationship. Generally, stock prices are found to be more sensitive to negative news than positive news, suggesting an asymmetric relationship.

Higher inflation rates are often accompanied by central banks implementing tighter monetary policies, which may include raising interest rates to curb inflation. In periods of high inflation, investors may become more cautious and risk-averse, which can lead to a decrease in demand for equities. According to existing research, there is an asymmetry nexus between the stock market and inflation rate (Constantinos et al., 2012; Lee & Ryu, 2018; Phong et al., 2019). Rousseau and Wachtel (2002) found that, in low-inflation contexts, financial depth changes inversely with inflation and that, at all inflation levels, disinflation is positively related to financial depth and economic growth. Constantinos et al. (2012) found that stock prices increase by 1.25 percent for each 1 percent rise in the CPI and decline by 0.77 percent for each 1 percent reduction in the CPI. Besides, Phong et al. (2019) conducted NARDL on Vietnam's stock market, empirical evidence indicated there are statistically significant asymmetric effect of money supply, interest rate, and inflation on Vietnam stock market index.

Research by Chang and Rajput (2018) highlights the presence of asymmetric effects between inflation, exchange rate, interest rate, IPI, and stock prices in both the short run and long run, with variations observed before and after the crisis. Alagidede et al. (2011) discovered that exchange rates and stock prices may be interdependent in linear or non-linear ways.

Thus, macroeconomic variables may affect stock prices differently, depending on the period being examined. The literature suggests that macroeconomic variables may have asymmetric effects on stock prices. Despite varying effects across periods, the asymmetric effect may enhance the explanation of the determinants of the stock market.

2.5 Autoregressive Distributed Lags (ARDL) Approach

2.5.1 ARDL Procedure

There are several strands of modelling in the literature on the determinant of the stock prices. Primarily, this study focused on investigating long-run relationship among selected macroeconomic fundamentals and stock market using the ARDL bounds testing approach in Indonesia, Malaysia, and Singapore. This approach can be applied to any series and is more flexible than traditional cointegration methods while accounting for the presence of both stationary and non-stationary variables (Tursoy et al., 2018).

Past literature has mostly used the Engle and Granger (1987) and Johansen and Juselius (1990) econometric technique, which are residual-based and maximum-likelihood-based cointegration. These approaches obligate the variables to be integrated in the same order, making them inapplicable to variables integrated in different orders (Samreth, 2008). Many previous research by Granger et al. (2000), Alagidede et al. (2011), Lee and Zhao (2014), and Fowowe (2015) focused on the short-run Granger causality and long-run

relationship among stock prices and exchange rates. The standard cointegration tests are not able to differentiate between the endogenous and exogenous variables in the estimated model and different order of integration can lead to increased uncertainty (Pesaran et al., 2001). These standard tests can also lead to low power of estimates and ultimately endogeneity (Ahmed et al., 2013) and autocorrelation, especially for small sample size studies (Alimi, 2014). The ARDL approach solves these issues by providing critical values of the F-statistic tabulated by Pesaran and Shin (1999) for large samples and Narayan (2005) for sample sizes scoping from 30 to 80 (Sultan, 2010).

The benefits of using the ARDL approach over standard cointegration methods are clearly stated and proven from an economic perspective. Therefore, by summing up all the advantages, this study employed the ARDL method to determine long-run relationship among macroeconomic fundamentals and stock prices for Indonesia, Malaysia, and Singapore.

2.6 Nonlinear Autoregressive Distributed Lags (NARDL) Approach

2.6.1 NARDL Procedure

The existing literature has long acknowledged the asymmetry of macroeconomic fundamentals and procedures (Shin et al. 2014). The intricate and nonlinear structure of the relationship is a key challenge to its identification. The researchers expanded the existing works in this area to further developed a non-linear ARDL model that can capture this asymmetry by splitting variables into positive and negative partial sums. This model, called the NARDL model, deduce the dynamic error correction representation (ECM) linked to the asymmetric long-run cointegrating regression, which capable for a comprehensive analysis

of the nexus between macro variables and stock market prices, considering both the long-run equilibrium and asymmetric effects.

Previous literature has used various time-series techniques to investigate the link between stock market and macro fundamentals. These techniques include the Autoregressive Conditionally Heteroscedastic (ARCH) model, the Generalized Autoregressive Conditionally Heteroskedastic (GARCH) model, the Vector Error Correction Model (VECM), the Autoregressive Integrated Moving Average (ARIMA), the Vector Autoregression (VAR) model, and the Markov switching model. However, these methods have limitations, including assumptions of symmetry and time independence of the relation (Shiller, 1993, 2005). Nonlinear models, such as the NARDL, are necessary to fully capture the asymmetry and intricacy of the nexus between stock prices and macroeconomics. In social science studies, the joint-study of behavioural finance and economics have provided an extensive impetus to the nonlinear model, confirming the existence of asymmetry to further understand its impact on macroeconomic fundamentals for the benefit of people (Shiller, 1993, 2005). Other use cases include the data-generating procedures for time-varying stock price dynamics, where individual models could only provide evidence of local predictability (Timmermann, 2008) instead of surfacing the effect of investor perception and individual investor trading (Yang & Zhou, 2016) on the dynamics.

The NARDL model is a better choice to understand the nonlinearity of correlations for various reasons. Previously, numerous research has been carried out to investigate the linear and long-run correlations among the stock market and macroeconomic fundamentals employing ARDL models. The models often failed to detect the non-linear connection (Tursoy et al., 2018). As suggested by Luqman and Kouser (2018) and Salim and Shi (2019),

it is vital to complement the ARDL model with the employment of the NARDL approach. In addition, Faisal et al. (2018) suggested that to measure the existence of asymmetries in time series analysis.

Bahmani-Oksooee and Saha (2016) conducted a study on asymmetric behaviours of stock markets using a NARDL model for the United State. The outcome demonstrated that stock market prices in the short run respond asymmetrically to exchange rate. On the other hand, Yacouba and Altintas (2019) further explored Bahmani-Oksooee and Saha (2016)'s long-run model of stock market by investigating the asymmetric effect of exchange rate, interest rate and money supply on stock returns in three different models for the case of Turkey. In this study, each model measured the effects of positive and negative variations of one independent variable with the other two independent variables acted as the control variables. The empirical findings proved the presence of asymmetric exchange rate and interest rate on stock prices. Similar research by Cheah et al. (2017), the empirical result showed there is presence of asymmetric effect of foreign currency on Malaysia's stock market.

An interesting finding by Lee and Ryu (2018) that utilized an ARDL model showed no significant response between Korea Composite Stock Price Index (KOSPI) and the real interest rate. However, a negative long-run relationship was discovered when the ARDL model was switched to a NARDL model. Using both ARDL and NARDL approaches, Yii et al. (2021) examined the correlation between hot money, GDP, oil price, inflation rate stock and market performance in China.

In this study, the NARDL approach was used to cointegrate the selected variables into a single model while simultaneously creating an asymmetric non-linear autoregressive

model. This allows the study of nonlinearity in the macro fundamentals and stock prices. Thus, both ARDL and NARDL approaches is utilised to examine the nexus of macroeconomic fundamentals on stock market prices in this study. The objective was to determine whether the relationship is symmetric or asymmetric.

2.7 The Gap in the Literature Review

The NARDL model advanced by Shin et al. (2014) is an asymmetric modification of the ARDL model that is intended to detect both long-run and short-run asymmetries in a variable of interest. This approach enabled the dynamic relationship among variables can be studied. Moreover, no published journal used this analysis in the selected countries (Indonesia, Malaysia and Singapore). This study examined the empirical gap to contribute significantly to the methodological framework understanding in the dynamic non-linear nexus among the stock market index and GDP, inflation rate, interest rate, and exchange rate.

2.8 Chapter Summary

The previous financial crises have emphasized the importance of studies on financial markets to predict future financial crises. Central banks from both developed and developing nations need to establish efficient early warning systems to prevent these crises and their impact on the real economy. This study focused on Indonesia and Malaysia as the representatives of an emerging economy and Singapore as the developed economy. The aim is to examine the suitability of different monetary policy approaches – the Inflation Targeting Framework in Indonesia, the Overnight Policy Rate policy in Malaysia, and the Exchange Rate Policy in Singapore.

To determine the repercussion of these monetary policies on the financial market, a literature review was conducted to identify significant variables in the stock market model. Some macroeconomic fundamentals and economic development have been included in such studies along with inflation rate, interest rate and exchange rate. The literature review revealed mixed outcomes on which macroeconomic fundamentals influence on stock market prices.

The ARDL approach was chosen since it allows for the study of long-run associations among the stock market and macro fundamentals, taking into account both long-run and short-run asymmetries that may exist. Asymmetric information has a dual role in that it can be the cause of failure or opportunity in the stock market. Advanced econometric techniques, such as nonlinearity analysis and the ARDL approach had been used to improve the estimates of stock market return. The NARDL model advanced by Shin et al. (2014) was employed to overcome the limitations of standard cointegration tests and examine the dual role of asymmetric information.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the methodologies applied, including data sets, theoretical framework, and tests applied to examine the influence of macroeconomic fundamentals on stock prices in the selected countries – Indonesia, Malaysia, and Singapore. Section 3.1 provides an outline, while Section 3.2 details the data. The theoretical framework is discussed in Section 3.3, the empirical modelling in Section 3.2, and the tests and methods in Section 3.5. These cover the unit root tests, ARDL and NARDL, and the diagnostic tests. The purpose is to examine long and short-term connections and detect other issues.

3.2 Data Description

In this present analysis, the impact of macroeconomic fundamentals on stock prices in Indonesia, Malaysia and Singapore was investigated using the NARDL approach. The data of the dependent variable, the stock market index is collected for Indonesia, Malaysia and Singapore. The empirical analysis is based on quarterly observations from 1999 to 2021, with a total of 92 observations in the study. There are several independent variables utilized in this present study. Therefore, it is essential to define the terms used and how it was obtained for the convenience of the readers and future research.

Table 3.1: Summary of the Variables Used

Notation	Variable	Description	Data Source
SP	Stock price index	Indonesia – Jakarta Composite Index Malaysia – FTSE Bursa Malaysia KLCI Singapore - Straits Times Index STI	Indonesia Stock Exchange, Bursa Malaysia, and Singapore Exchange
GDP	Gross Domestic Product	Nominal GDP	CEIC
INF	Inflation rate	CPI: % change over previous period.	CEIC
INT	Interest rate	Short term interest rate in % per annum	CEIC
EXC	Exchange rate	Exchange rate against USD (Selected country/USD)	CEIC

Note: The natural logarithm term for SP, GDP and EXC is denoted as LSP, LGDP and LEXC respectively.

3.2.1 Stock Market Index

The stock market index is a tool that tracks the performance of the equity market by comparing current and past stock prices. It represents the average price of all stocks listed on an exchange and serve as a gauge of market-wide price changes. The index is calculated using a weighted average of selected stock prices (Wahyudi et al., 2017b). The weights help to balance the individual impact of each stock on the index. Discrepancies may appear over time, providing insights into market trends. Stock market index is calculated using the prices

of selected stocks (typically a weighted arithmetic means). Weighting is a method of adjusting the individual impact of index items.

$$Index = \frac{\sum_{i=0}^n P_i}{n} \quad \text{Equation 3.1}$$

P_i = price of the i^{th} stock

n = number of stocks in the index

3.2.2 Gross Domestic Product (GDP)

GDP is a universally recognized metric for measuring the economic development and size of a nation's economy as it signifies the total monetary value of a country's economy. It is the sum of the total value of a country's production of goods and services over a specific period of time. According to Setiawan (2020), there are two reasons to see GDP as an economic indicator. Firstly, it measures the total income of an economy and the total expenditure on its output. Secondly, the nominal GDP represents the current market values of goods and services in an economy, which may increase when prices or quantities increase, and adjusted to inflation. The calculation of nominal GDP is as follows:

$$Nominal\ GDP = C + I + G + (E - M) \quad \text{Equation 3.2}$$

GDP is chosen as GDP growth is often seen as a proxy for corporate earnings growth, which is a key driver of stock market returns. Higher GDP growth can lead to higher earnings for companies, which can result in higher stock prices. GDP growth can impact investor sentiment and confidence. Strong GDP growth can lead to optimism about the economy and the stock market, while weak GDP growth can lead to pessimism and uncertainty, which can result in lower stock prices. Therefore, nominal GDP can provide a more direct measure of the current economy activity and potential market conditions that impact stock market prices.

3.2.3 Inflation

Inflation represents the continuous rising prices of goods and services over time, often result in decreasing in the purchasing power of money. The inflation rate measures the percentage change in the prices of commodities and services in a given time interval, usually monthly or annually. The Consumer Price Index (CPI) is a common measure of inflation, tracking changes in the costs of a basket of goods and services. CPI is widely usually used as a gauge for inflation and as a proxy for evaluating the effectiveness of the government's economic policy, typically monetary policy. Accordingly, the price changes for each item in the basket are calculated by comparing the current prices with the prices in the base period. The formula for calculating the CPI for a single item involves determining the average price change over a given period as follows:

$$CPI = \frac{\text{Cost of Market Basket in Given Year}}{\text{Cost of Market Basket in Base Year}} \times 100 \quad \text{Equation 3.3}$$

3.2.4 Interest Rate

The interest rate, which refer to the percentage charged by lender represents the cost of borrowing or lending money, is a crucial indicator of macroeconomic stability. It is calculated as a percentage of the amount borrowed or invested, calculated as a yearly rate, and can be either short-term or long-term. Interest rate frequently used as a monetary policy tool to regulate economic activity and stabilize prizes. For instance, interest rates can influence the decisions of investors by having an impact on the opportunity cost of investing in equities. In this study, we focused on short-term interest rates, expressed as a percentage per annum.

3.2.5 Exchange Rate

Foreign exchange rates are critical to international market investors because they affect the price of goods, services, and securities traded across borders. An exchange rate represents the relative price of one country's currency against another. The exchange rate can be expressed either in the domestic or foreign currency. For instance, this determines the conversion rate between currencies, which directly affects the price of imported and exported goods and services. This study used the rate of conversion between the selected countries and the US dollar as a proxy for the exchange rate.

3.3 Empirical Modelling

There are a few methods that applicable to establish the long-term correlation between macroeconomic fundamentals and stock prices. For many years, the popular methods that have been adopted to test integration of variables include the Engle and Granger (1987) method, the Phillips and Hansen (1990) total remodel procedure of OLS, the Johansen (1988) and Johansen (1991) maximum likelihood method, as well as the Johansen and Juselius (1990) tests.

The ARDL method developed by Pesaran and Shin (1999) was employed to observe the symmetric impact of macroeconomic fundamentals on stock prices in current study. Then, the NARDL model approach designed by Shin et al. (2014) was used to identify the asymmetric influence of macroeconomic fundamentals on stock prices.

To explore the symmetric and asymmetric effects of macroeconomic fundamentals on stock prices in Indonesia, Malaysia and Singapore, the following function was used:

$$SP = F(GDP, INF, INT, EXC) \quad \text{Equation 3.4}$$

where *SP* represent stock market index of the selected nation, *GDP* proxies the economic development of the country, *INF* shows inflation rate, *INT* is interest rate, and lastly *EXC* signifies the exchange rate.

This study used four NARDL models to examine for asymmetric effects of macroeconomics fundamentals on stock prices. The models allow for asymmetry in both long-run cointegration correlation and short-run ECM. The nonlinear model is constructed by adding two new variables (positive changes and negative changes) to other macroeconomics fundamentals as constants. To prevent misspecification, other macroeconomic variables are also included in each model.

Model 1 is the asymmetric gross domestic product on stock price model based on the function below:

$$SP = F(\mathbf{GDP\_POS}, \mathbf{GDP\_NEG}, INF, INT, EXC) \quad \text{Equation 3.5}$$

Model 2 is the asymmetric inflation on stock price model based on the function below:

$$SP = F(GDP, \mathbf{INF\_POS}, \mathbf{INF\_NEG}, INT, EXC) \quad \text{Equation 3.6}$$

Model 3 is the asymmetric interest rate on stock price model based on the function below:

$$SP = F(GDP, INF, \mathbf{INT\_POS}, \mathbf{INT\_NEG}, EXC) \quad \text{Equation 3.7}$$

Model 4 is the asymmetric exchange rate on stock price model based on the function below:

$$SP = F(GDP, INF, INT, \text{EXC\_POS}, \text{EXC\_NEG}) \quad \text{Equation 3.8}$$

where:

SP	=	Stock price
GDP	=	Gross domestic product
INF	=	Inflation rate
INT	=	Interest rate
EXC	=	Exchange rate

3.4 Analytical Procedure

This part outlines the methodology of this research. This includes the unit root test, bound testing procedure, techniques for establishing the validity of the long-run relationship, Wald test and diagnostic tests.

3.4.1 Unit Root Test

To ensure the accuracy of cointegration tests, a critical preliminary step involves conducting unit root tests such as the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) Unit Root Tests on all variables to confirm they are stationary, thus avoiding spurious regression (Quattara, 2004). The ARDL method employed is capable of accommodating variables with different integration orders, which may include $I(0)$, $I(1)$, or a combination of both. Akmal (2007) emphasizes the importance of the unit root test in verifying the absence of $I(2)$ variables, which is necessary to ensure the reliability of the F-

statistic derived from the critical values tabulated by Pesaran et al. (2001) and Narayan (2005).

3.4.2 Augmented Dickey-Fuller (ADF) Unit Root Test

The ADF test is an extension of the Dickey-Fuller (DF) test. The DF test was initially proposed by Dickey and Fuller (1981) as a test for the presence of a unit root for a wide range of time series models. Assuming that the variable for estimate is designated as Y , the OLS regression used to scrutinize the ADF test is formulated as follows:

$$\Delta Y_t = \varepsilon + \gamma t + \sigma Y_{t-1} + \sum_{i=1}^m p \Delta Y_{t-1} + \mu_t \quad \text{Equation 3.9}$$

where ΔY_t is the first difference of Y_t , Y_{t-1} are the lagged first differences, and σ denotes as the coefficient of Y_{t-1} . ε and t are the intercept and the time series trend. γ , σ and p are the constant parameters. The number of lagged terms, m , is used to affirm the white noise prevails in the disturbance term, μ_t .

The hypothesis of ADF unit root test is indicate as follows:

$H_0: \sigma = 0$, Unit root does exist or non- stationary.

$H_1: \sigma < 0$, Unit root does not exist or stationary.

The standard critical values at one, five, and 10 percent significance levels are used to determine the significance of the variable. The null hypothesis is rejected, and the variable is significant if the estimated t-statistic is greater than the critical value or the p-value is less than any standard significance level. Nevertheless, if the p-value is more than the standard significance level or the estimated t-statistic is less than the critical value, the variable is insignificant.

3.4.3 Phillips-Perron (PP) Unit Root Test

Phillips and Perron (1988) provided a variant (non-parametric) way of controlling serial correlation when evaluating a unit root. The PP test considers the possibility that the process generating data for Y_t might have a greater order of autocorrelation than the test equation allows, making Y_{t+1} endogenous and thus rejecting the DF t-test. This technique is incorporated in the DF t-test statistic for the null hypothesis of non-stationarity testing and to derive the Z-statistic. The tabulation of the Z-statistic follows the asymptotic distribution of the t-statistic, and its critical values can be obtained from Mackinnon (1996). The PP test is written as follows, with Y as a variable for estimation:

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \mu_t \quad (t = 1, 2, 3, \dots) \quad \text{Equation 3.10}$$

where ΔY_t is the first difference for variable Y , α_0 is the constant or drift term, t signify the number of observations in the series, δ is the parameter for estimation and μ_t is the residual for regression.

The PP test examines the non-augmented DF test equation and adjusts the t-ratio of the coefficient. The PP test adjusts the t-ratio of the coefficient by incorporating an additional lagged difference term in the test equation. This adjustment helps to address the issue of serial correlation in the errors and improve the reliability of the test results. The PP test is built on the following statistic:

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0} \right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2f_0^{1/2}s} \quad \text{Equation 3.11}$$

where $\hat{\alpha}$ is the estimate and t_α is the t-ratio of α , $se(\alpha)$ denotes the coefficients standard error, s is the standard error of the test regression, γ_0 is a consistent estimate of the error variance, and f_0 is an estimator of the residual spectrum at frequency zero.

The hypotheses of ADF and PP tests are similar, which are:

$H_0: \sigma = 0$, the variable is non- stationary.

$H_1: \sigma < 0$, the variable is stationary.

The rejection rule of null hypothesis is similar to ADF unit root test.

3.4.4 Autoregressive Distributed Lag (ARDL) Model

After the confirmation of non-existence of $I(2)$ variables, the ARDL bounds test was applied to examine the cointegration correlation between the variables. It was developed by Pesaran and Shin (1999) and advanced by Pesaran et al (2001) based on the unrestricted error correction model (UECM) estimates (Srinivasan & Kalaivani, 2013). Equations 3.12 was specified for the restricted ARDL model to study the long-run correlation among the variables:

$$\begin{aligned} \Delta SP_t = & \gamma_{1,0} + \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta INF_{t-i} \\ & + \sum_{i=0}^{q_3} \gamma_{4i} \Delta INT_{t-i} + \sum_{i=0}^{q_4} \gamma_{5i} \Delta EXC_{t-i} + \theta_1 SP_{t-1} \\ & + \theta_2 ED_{t-1} + \theta_3 INF_{t-1} + \theta_4 INT_{t-1} + \theta_5 EXC_{t-1} + \mu_{1t} \end{aligned} \quad \text{Equation 3.12}$$

where Δ , γ_0 and μ_t represent the operator of the first difference, the drift component and the white noise residual, respectively. SP_t is the stock prices. The variables GDP_{t-i} , INF_{t-i} , INT_{t-i} , and EXC_{t-i} are the GDP, inflation rate, interest rate, and exchange rate.

Based on Equations 3.12, the short-run effect is seized by the γ coefficients. The coefficients of θ are applied to capture the long-run effect. To calculate the long-run elasticities, the negative of the coefficient for one lagged independent variable is divided by the coefficient for one lagged dependent variable (Dritsakis, 2011).

Pesaran and Shin's (1999) used a two-step estimation approach, using the Schwartz Bayesian Criterion (SBC) to determine the optimal lag orders for p and q in the ARDL model. This is necessary because ARDL requires the maximum values for p and q to be specified. According to Pesaran and Smith (1998), SBC was found to be a better option than the Akaike Information Criterion through Monte Carlo simulations. After specifying the lag orders for ARDL, the short-run dynamic can be estimated through the ECM, which are expressed as follows:

$$\begin{aligned} \Delta SP_t = \gamma_{1,0} &+ \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta INF_{t-i} \\ &+ \sum_{i=0}^{q_3} \gamma_{4i} \Delta INT_{t-i} + \sum_{i=0}^{q_4} \gamma_{5i} \Delta EXC_{t-i} + \phi_1 EC_{t-1} + \mu_{1t} \end{aligned} \quad \text{Equation 3.13}$$

where EC_{t-1} is the lagged ECT, which can be calculated from the estimated cointegration model in Equation 3.12. ϕ is a parameter for evaluating the speed of adjustment of short-run deviation towards long-run equilibrium. Equation 3.13 is used to investigate the variables' short-run effects on the stock prices. In order to confirm that there are short-run dynamic adjustments towards long-run equilibrium, EC_{t-1} needs to be negative and significant. A long-run causality from explanatory variables towards the dependent variable can be confirmed if EC_{t-1} is statistically significant. The value of ϕ may range from -1 to 0. Perfect and immediate short-run adjustment to long-run equilibrium is indicated by a value of -1 and if there is no convergence after a shock, the value is 0 (Ahmed, Muzib, & Roy, 2013). The causality impact can be determined via the Wald test, by means of limiting the parameter of variables together with their lags up to zero. In testing for causality between variables, the null hypothesis typically assumes no causality or no

relationship between the variables under investigation. The rejection of the null hypothesis implies the existence of causality or a significant correlation between the variables.

3.4.5 Nonlinear Autoregressive Distributed Lag (NARDL) Model

Since long-run and short-run asymmetries may exist between macroeconomic fundamentals and stock prices, the NARDL model advanced by Shin et al. (2014) was used to permit for impending long-run and short-run asymmetries in these variables. Each of these variables were tested in vector autoregressive models (VAR). The asymmetric cointegrating equations as advanced by Shin et al. (2014) with five variables in the system are specified as follows:

$$\text{Model 1: } SP_t = \alpha_0 + \alpha_1 GDP_t^+ + \alpha_2 GDP_t^- + \alpha_3 INF_t + \alpha_4 INT_t + \alpha_5 EXC_t + e_t \quad \text{Equation 3.14}$$

$$\text{Model 2: } SP_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 INF_t^+ + \alpha_3 INF_t^- + \alpha_4 INT_t + \alpha_5 EXC_t + e_t \quad \text{Equation 3.15}$$

$$\text{Model 3: } SP_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 INF_t + \alpha_3 INT_t^+ + \alpha_4 INT_t^- + \alpha_5 EXC_t + e_t \quad \text{Equation 3.16}$$

$$\text{Model 4: } SP_t = \alpha_0 + \alpha_1 GDP_t + \alpha_2 INF_t + \alpha_3 INT_t + \alpha_4 EXC_t^+ + \alpha_5 EXC_t^- + e_t \quad \text{Equation 3.17}$$

where GDP_t , INF_t , INT_t , and EXC_t are the GDP, inflation rate, interest rate, and exchange rate, respectively. The cointegrating vector that contains long-run parameters that have to be estimated is indicated as $\alpha = (\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5)$. The dx_t^+ and dx_t^- in Equations 3.14, 3.15, 3.16, and 3.17 designate the partial sums processes of positive and negative changes in dx_t , in which x is the macroeconomic fundamentals:

$$dx_t^+ = \sum_{i=1}^t \Delta dx_i^+ = \sum_{i=1}^t \max(\Delta dx_i, 0) \quad \text{Equation 3.18}$$

and

$$dx_t^- = \sum_{i=1}^t \Delta dx_i^- = \sum_{i=1}^t \min(\Delta dx_i, 0) \quad \text{Equation 3.19}$$

The α for dx_t^+ is used to ascertain the long-run link between the regressand and an increasing dx_t . The α for dx_t^- is used to identify the long-run correlation between regressand and a decreasing dx_t .

Notwithstanding, it is further assumed that the impact of long-run alteration in the regressand due to an increasing dx_t is greater than the regressand impact of a decreasing dx_t of identical magnitude. As a result, Equations 3.14, 3.15, 3.16, and 3.17 imply the asymmetric long-run dx_t passing through to the regressands.

Equations 3.14, 3.15, 3.16, and 3.17 are then specified in an ARDL framework to derive Equations 3.20, 3.21, 3.22 and 3.23 to study the long-run association between the variables. Wald test is tested with the null hypothesis of $\sum_{i=0}^{q_1} \gamma_{2i}^+ = \sum_{i=0}^{q_1} \gamma_{2i}^-$ to measure the short-run asymmetry of macroeconomics fundamentals, while $\frac{-\theta_1^+}{\theta_n} = \frac{-\theta_2^-}{\theta_n}$ are the long-run asymmetry parameters. The rejection of null hypothesis indicating presence of asymmetry effects. According to Greenwood-Nimmo et al. (2011), compared to the existing class of regime-switching models, this approach offers a number of advantages. After developing the equations to improve the NARDL model's final form, the general to specific technique was used by reducing insignificant lags.

$$\Delta SP_t = \alpha + \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} (\gamma_{2i}^+ \Delta GDP_{t-i}^+ + \gamma_{2i}^- \Delta GDP_{t-i}^-) \quad \text{Equation 3.20}$$

$$+ \sum_{i=0}^{q_2} \gamma_{3i} \Delta INF_{t-i} + \sum_{i=0}^{q_3} \gamma_{4i} \Delta INT_{t-i} + \sum_{i=0}^{q_4} \gamma_{5i} \Delta EXC_{t-i} \\ + \theta_0 SP_{t-1} + \theta_1 GDP_{i-1}^+ + \theta_2 GDP_{i-1}^- + \theta_3 INF_{i-1} \\ + \theta_4 INT_{i-1} + \theta_5 EXC_{i-1} + \mu_t$$

$$\Delta SP_t = \alpha + \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta GDP_{t-i} \quad \text{Equation 3.21}$$

$$+ \sum_{i=0}^{q_2} (\gamma_{3i}^+ \Delta INF_{t-i}^+ + \gamma_{3i}^- \Delta INF_{t-i}^-) + \sum_{i=0}^{q_3} \gamma_{4i} \Delta INT_{t-i} \\ + \sum_{i=0}^{q_4} \gamma_{5i} \Delta EXC_{t-i} + \theta_0 SP_{t-1} + \theta_1 GDP_{i-1} + \theta_2 INF_{i-1}^+ \\ + \theta_3 INF_{i-1}^- + \theta_4 INT_{i-1} + \theta_5 EXC_{i-1} + \mu_t$$

$$\Delta SP_t = \alpha + \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta INF_{t-i} \quad \text{Equation 3.22}$$

$$+ \sum_{i=0}^{q_3} (\gamma_{4i}^+ \Delta INT_{t-i}^+ + \gamma_{4i}^- \Delta INT_{t-i}^-) + \sum_{i=0}^{q_4} \gamma_{5i} \Delta EXC_{t-i} \\ + \theta_0 SP_{t-1} + \theta_1 GDP_{i-1} + \theta_2 INF_{i-1} + \theta_3 INT_{i-1}^+ \\ + \theta_4 INT_{i-1}^- + \theta_5 EXC_{i-1} + \mu_t$$

$$\Delta SP_t = \alpha + \sum_{i=1}^p \gamma_{1i} \Delta SP_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta INF_{t-i} \quad \text{Equation 3.23}$$

$$+ \sum_{i=0}^{q_3} \gamma_{4i} \Delta INT_{t-i} + \sum_{i=0}^{q_4} (\gamma_{5i}^+ \Delta EXC_{t-i}^+ + \gamma_{5i}^- \Delta EXC_{t-i}^-) \\ + \theta_0 SP_{t-1} + \theta_1 GDP_{i-1} + \theta_2 INF_{i-1} + \theta_3 INT_{i-1} \\ + \theta_4 EXC_{i-1}^+ + \theta_5 EXC_{i-1}^- + \mu_t$$

3.4.6 Bounds Test for Cointegration

Pesaran et al. (2001) developed a bound-testing method to verify the presence of a stable long-run connection between variables. This method covers all three possible classifications ($I(0)$, $I(1)$ and mutually cointegrate) and provides a band of critical values. The method also includes asymmetric cumulative dynamic multipliers to account for asymmetric adjustment patterns in response to both positive and negative shocks to the explanatory variables. The bound test for cointegration uses F-statistic (Wald Test) to establish a long-run relationship in ARDL and NARDL approaches (Nkoro & Uko, 2016).

The null hypothesis of no cointegration among the variables was examined against the alternate hypothesis of the existence of cointegration. The null and alternative hypotheses are designated as:

$$H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$$

$$H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$$

The study by Pesaran et al. (2001) established the asymptotic distribution of the F-statistic to approximate the null hypothesis. A small sample data set was used, and the F-statistic tabulated by Narayan (2005) was also employed. Two sets of critical values are tabulated by Pesaran et al. (2001) and Narayan (2005) for variables that are all integrated at $I(0)$ and $I(1)$. The null hypothesis of no cointegration is rejected if the computed F-statistic value is greater than the upper critical value, and not rejected if it is smaller than the lower critical value, suggesting the absence of cointegration. If the F statistic falls between the upper and lower bound, the result will not be conclusive.

3.5 Diagnostic Tests

Several diagnostic tests were performed to check the statistical properties of the proposed models. These include the normality, serial correlation, heteroskedasticity, functional form and stability tests. It is important to perform diagnostic and stability tests, as these tests can determine whether the estimated model has econometric problems with the estimated model or not.

3.5.1 Jarque-Bera (JB) Test

JB test is a test statistic employed to identify if a series is normally distributed in the estimated model. The JB test is a goodness-of-fit test that compares the skewness and kurtosis for measures of the OLS residuals. This is to determine whether the residuals of the estimated model are normally distributed. The statistic is calculated using the following equation:

$$JB = \frac{N}{6} (S^2 + \frac{1}{4}(K - 3)^2) \quad \text{Equation 3.24}$$

where N is the number of observations (or degrees of freedom in general), S is the skewness, and K is the kurtosis.

N	=	Number of observations (or degrees of freedom in general)
S	=	Skewness
K	=	Kurtosis

The hypotheses for the JB test are:

H_0 : The residuals are normally distributed.

H_1 : The residuals are not normally distributed.

The JB test is distributed as χ^2 with two degrees of freedom under the null hypothesis of a normal distribution. The rejection of the null hypothesis according to the chi-square distribution at five percent significance level and critical value of 1.96. The null hypothesis cannot be rejected if the computed JB test statistic is smaller than the critical value, thus are normally distributed. Contrariwise, the residuals are not normally distributed if the computed JB test statistic is more than the JB critical value and this proof that the null hypothesis is rejected.

3.5.2 Lagrange Multiplier (LM) Test

LM test is tested to identify the autocorrelation problem of any order in the estimated model. This test falls within the category of asymptotic (big sample) tests. The LM test can be used to test for ARMA errors and is relevant regardless of whether the dependent variable is lagged. The hypotheses for LM test are:

H_0 : *There is no serial correlation up to any order.*

H_1 : *There is serial correlation up to any order.*

The rejection of the null hypothesis implies an autocorrelation problem. The null hypothesis is rejected if the computed statistic is greater than the critical chi-square value at the standard significance levels (1 percent, 5 percent, and 10 percent).

3.5.3 Autoregressive Conditional Heteroskedasticity (ARCH) Test

ARCH is a statistical model that examines volatility in time series to predict future volatility. The ARCH test is commonly used to detect a heteroskedasticity problem. The ARCH test hypotheses are:

H_0 : *There is no heteroskedasticity problem.*

H_1 : *There is a heteroskedasticity problem.*

If the computed test statistic is greater than the critical chi-square value at the 5 percent significance level or the p-value is less than the standard level of significance, the null hypothesis is rejected. The rejection indicates a heteroskedasticity problem.

3.5.4 Ramsey Reset Test

Ramsey RESET test, proposed by Ramsey (1969), is a test utilized to assess the validity of a linear regression model. The two hypotheses tested by RESET are:

H_0 : *The estimated model is correctly specified.*

H_1 : *The estimated model is misspecified.*

The rejection rule of the null hypothesis is if the p-value is smaller than the critical value at 5 percent significance level. The RESET test evaluates the residuals of the regression model to determine if any significant non-linear correlation exist between the fitted values and the response variable. This suggests that the model specification may be incorrect if significant non-linear relationship is found, and the null hypothesis is rejected.

3.5.5 Stability Tests

The cumulative sum of the recursive residuals (CUSUM) test and cumulative sum of squares residuals (CUSUM of squares) tests are developed by Brown et al. (1975) to determine whether there is any structural break during the entire study period. These two studies are employed to study the stability of the models.

The CUSUM test is according on the following statistic:

$$W_t = \sum_{r=k+1}^t \omega_r / s \quad \text{Equation 3.25}$$

where $t = k + 1, \dots, T$, ω is the recursive residual defined above, and s is the standard deviation of the recursive residuals W_t .

The CUSUM of squares test statistic is as follows:

$$S_t = \left(\sum_{r=k+1}^t \omega_r^2 \right) / \left(\sum_{r=k+1}^T \omega_r^2 \right) \quad \text{Equation 3.26}$$

The expected value of S_t under the hypothesis of parameter constancy is:

$$E(S_t) = (t - k) / (T - k) \quad \text{Equation 3.27}$$

which ranges from zero at $t = k$ to unity at $t = T$.

The estimated coefficients are considered stable if the CUSUM or CUSUMSQ statistic plots fall within the critical bounds at the 5 percent significance level. If the cumulative sum outlined the area between the two critical lines, a parameter instability has been detected.

3.6 Concluding Remarks

This aim of this study is to examine the impact of selected macroeconomic fundamentals – economic development, inflation rate, interest rate, and exchange rate on the growth of selected ASEAN stock markets. It also explored the interaction between the selected ASEAN stock markets and their respective macroeconomic fundamentals. The findings were expected to reveal a link between historical macroeconomic fundamentals and future changes in stock prices to shed light on the said relationship as well as reveal the important fundamentals affecting the stock market.

The study was also intended to determine the cointegrating vector to identify the three markets' financial integration. The results could inform further initiatives towards integrating the stock markets for enhanced efficiency. This benefits investors since it provides higher liquidity and lower trading costs, which can lead to increase in capital and resources for ASEAN companies while reducing capital costs for these companies. A regional integration also implies that currency and monetary unification may be feasible.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

Chapter 4 illustrates the empirical results on the correlation between macroeconomic fundamentals and stock prices in Indonesia, Malaysia, and Singapore. Section 4.1 introduces the chapter. Beginning Section 4.2, the results are presented and discussed. Section 4.2 provides results to the unit root test, Section 4.3 presents the ARDL model results, which is inclusive of the bound tests, ECM, estimated long-run coefficients, and diagnostic test. In Section 4.4, the outcome of the NARDL model, which is identical to that of ARDL, is presented. Section 4.5 discusses the overall findings extensively, before Section 4.6 provides the concluding remarks.

The study used EViews 12 to analyse the effects of GDP, inflation, interest rate and exchange rate on stock prices from 1999 to 2021. The study used a modified estimation model from that presented by Geetha et al. (2011) and Setiawan (2020), which were also used to study the impact of macroeconomic fundamentals on stock market performance. The choice of fundamentals was based on availability of data and previous research in other regions.

4.2 Order of Integration (ADF and PP)

Before conducting any cointegration test in the study, it is crucial to confirm that all of the variables included in the analysis are stationary time series. This is not strictly required for an ARDL model, but advisable as a precautionary step to avoid the existence of $I(2)$ variables. The ADF and PP tests were conducted to determine the properties of the variables,

and the optimal lag lengths were selected using AIC. These tests examine the existence of unit roots or trends in the time series data used in this study.

4.2.1 Indonesia

The results of the unit root tests for Indonesia are illustrated in Table 4.1. Both results are consistent, indicating that INT and LEXC are stationary with either an intercept or both trend and intercept. LSP, LGDP, and INF were integrated at order one, $I(1)$ with either an intercept or an intercept and trend. Since there is no $I(2)$ variable, the estimates using the ARDL and NARDL approaches are applicable.

Table 4.1: Indonesia Unit Root Tests Results

ADF			PP	
Panel A: Level				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-0.5202	-2.5347	-0.5727	-2.4311
LGDP	-0.2993	-2.6775	-0.4695	-2.8566
INF	-1.4840	-1.6077	-1.4840	-2.2326
INT	-2.9035**	-4.6967***	-2.9120**	-4.1175***
LEXC	-4.8059***	-5.3686***	-4.7094***	-5.3714***
Panel B: First Difference				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-10.1661***	-10.1197***	-10.1656***	-10.1191***
LGDP	-7.4046***	-7.3846***	-7.1219***	-7.1253***
INF	-7.3512***	-7.4718***	-7.3719***	-7.4631***
INT	-8.4182***	-8.3799***	-8.4352***	-8.3980***
LEXC	-7.6835***	-7.8077***	-7.6815***	-7.8135***

Notes: Asterisks (***), (**) and (*) symbolize significance levels of 1%, 5% and 10%, respectively. LSP is the logarithm of stock price index, LGDP is the logarithm of GDP, INF is the inflation, INT is the interest rate, and LEXC is the logarithm of Indonesia currency, Rupiah/USD exchange rate.

4.2.2 Malaysia

Table 4.2 shows the unit root results for Malaysia. Both tests show similar results: INT and LEXC are stationary at level when an intercept is included, while LSP and LEXC are stationary at level when both a trend and intercept are included. The remaining variables are stationary at first difference. The result showed that none of the variables are integrated of order two, but there is a mix of orders of integration for the variables. This leads to the conclusion that ARDL and NARDL approaches can be employed to estimate the long-run validity of the macro fundamentals and stock prices for Malaysia.

Table 4.2: Malaysia Unit Root Tests Results

ADF			PP	
Panel A: Level				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-1.4345	-3.9283*	-1.4783	-4.1894**
LGDP	-0.3696	-2.1285	-0.4117	-2.2711
INF	-0.4071	-2.3837	-0.3906	-2.4325
INT	-3.0624**	-3.1327	-2.6137*	-2.6666
LEXC	-3.4518**	-3.2788*	-3.5631**	-3.4449*
Panel B: First Difference				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-11.1685***	-11.1262***	-11.1076***	-11.065***
LGDP	-8.1656***	-8.1283***	-8.0609***	-8.0308***
INF	-9.5290***	-9.4838***	-9.6004***	-9.5482***
INT	-7.2085***	-7.2063***	-7.1681***	-7.1525***
LEXC	-8.8319***	-8.8582***	-8.8493***	-8.8873***

Notes: Asterisks (***) and (**) refer to significance at 1% and 5%, respectively. LSP is the logarithm of stock price index, LGDP is the logarithm of GDP, INF is the inflation, INT is the interest rate, and LEXC is the logarithm of Malaysia currency, Ringgit/USD exchange rate.

4.2.3 Singapore

Results of ADF and PP unit root tests for Singapore are reported in Table 4.3. LSP is integrated at order zero when trend and intercept are included in the estimates. The ADF unit root test also reveals that INT is stationary at level when an intercept is included in the estimates. LGDP, INF, and LEXC are stationary at first difference when either an intercept or both trend and intercept are included in the approximation.

Table 4.3: Singapore Unit Root Tests Results

ADF			PP	
Panel A: Level				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-1.8816	-3.4938*	-1.9981	-3.3580*
LGDP	-0.1844	-1.9706	-0.2123	-2.0794
INF	0.2197	-2.2673	0.0307	-1.7722
INT	-3.0050**	-3.0418	-2.5140	-2.9907
LEXC	-1.0828	-2.6067	-1.0410	-2.5698
Panel B: First Difference				
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LSP	-8.8160***	-8.7700***	-8.8468***	-8.8020***
LGDP	-8.6938***	-8.6648***	-8.6889***	-8.6613***
INF	-5.8512***	-5.8766***	-6.0682***	-6.0891***
INT	-11.3392***	-11.2918***	-11.2801***	-11.2366***
LEXC	-10.6041***	-10.6109***	-10.6041***	-10.6109***

Notes: Asterisks (***) and (**) refer to significance at 1% and 5%, respectively. LSP is the logarithm of stock price index, LGDP is the logarithm of GDP, INF is the inflation, INT is the interest rate, and LEXC is the logarithm of Singapore currency, SGD/USD exchange rate.

In the absence of $I(2)$ variable for all countries, the ARDL and NARDL approaches are ideal for estimating the symmetric and asymmetric effect of macroeconomic

fundamentals on stock prices across all the three selected countries. The ARDL and NARDL approach begin with a cointegration bound test.

4.3 Autoregressive Distributed Lag (ARDL) Model

ARDL approach was applied to identify the long-run and short-run relationship among the variables. These include (1) bounds test for cointegration; (2) estimation of ECM; and (3) estimation of long-run coefficient. The following subsections summarise the findings of this study.

4.3.1 Bounds Test for Cointegration

The bounds test identifies the preliminary long-run result. The presence of cointegration was then established using the error correction model. The F-statistic was used for the three selected countries (Indonesia, Malaysia and Singapore) to determine the presence of cointegration between macroeconomic fundamentals and stock prices. Pesaran et al. (2001) assume the existence of a single cointegration between the dependent and explanatory variables in the model. The ARDL bounds test results for cointegration are presented in Table 4.4 for Indonesia, Malaysia, and Singapore. “k” is the number of independent variables while the number of observations is showed as “n”.

Table 4.4: ARDL Bounds Test for Cointegration Results

Models	F-statistic	Lag Order
Indonesia	6.0317***	(2, 3, 0, 4, 1)
Malaysia	4.6905***	(4, 4, 4, 4, 1)
Singapore	6.1609***	(3, 3, 2, 2, 4)

Critical values bound of the F-statistic: unrestricted intercept and no trend (k=4)

Significant level	Pesaran Critical Values		Narayan Critical Values	
	<i>I</i> (0)	<i>I</i> (1)	<i>I</i> (0)	<i>I</i> (1)
90% level	2.45	3.52	2.548	3.644
95% level	2.86	4.01	3.010	4.216
99% level	3.74	5.06	4.096	5.512

Notes: Critical values are taken from Pesaran et al. (2001) and Narayan (2005), table Case III: unrestricted intercept and no trend. The choice of lag length is based on Akaike's Information Criterion (AIC). The asterisks (***) indicate significance at 1% level.

For Indonesia, a long-run relationship has been identified. The F-statistic of 6.0317 exceeds Pesaran et al.'s (2001) and Narayan's (2005) upper limits at one percent significance level. Thus, this suggests that a long run correlation exists between macroeconomic fundamentals and stock prices.

For Malaysia, the F-statistic is 4.6905, which is above the upper bound critical value from Narayan (2005) at the five percent significance level. This means there is a cointegration relationship between the independent variables and the dependent variables.

For Singapore, the F-statistic value of 6.1609 is larger than the upper bounds of Pesaran et al.'s (2001) and Narayan's (2005) critical values at the one percent significant

level. This is an indication of the presence of a cointegration relationship between the explanatory variables and stock prices.

In conclusion, the bounds test provides the preliminary evidence of cointegration for the ARDL models in all countries. All countries show the presence of a cointegration relationship. The ECM offers an additional method for examining the long-run correlation among the variables via error correction terms (ECT).

4.3.2 Error Correction Model (ECM) Estimation

The ECM was re-parameterized in the ARDL model to address the various order of variables prior to the estimation of long-run and short-run dynamics concurrently. ECT is a preferable benchmark to detect whether there is cointegration among the variables and must be less than one, significant, and negative (Kremers et al., 1992). Hence, the findings of the ECM are reported before the results of the estimation of the long-run coefficient. In this study, the ECM was utilized to identify the long-run association among the variables examined by the bounds test. AIC was employed to estimate the optimal lag length for the model's variables. Alongside the lagged ECT_{t-1} , the short-run coefficient estimates are also shown in the results.

The results of the ECM estimates for Indonesia, Malaysia, and Singapore are presented in Table 4.5. The lagged ECT_{t-1} for all three countries are all negative, less than one, and thus significant. The lagged ECT_{t-1} for Indonesia's model is statistically significant at five percent level while the lagged ECT_{t-1} for Malaysia and Singapore's models are statistically significant at one percent level. As such, all the models are verified to have long-run correlation between the macroeconomic fundamentals and stock prices due to the fulfilment of lagged ECT_{t-1} criteria.

Based on Table 4.5, the lagged ECT_{t-1} indicated that 12.70 percent, 40.65 percent and 52.33 percent of the disequilibrium in the quarterly stock prices are corrected by the short-run adjustment for Indonesia, Malaysia, and Singapore, respectively. The conclusion from the ECM therefore concludes that there is a long run correlation between the variables in all the models that have been estimated. It is apparent that the ARDL ECM is an alternative, yet equally effective method to ascertain the correlation between the variables.

Table 4.5: Error Correction Model of ARDL Results

Regressor	Indonesia	Malaysia	Singapore
Δ Constant	-0.7823 [0.834]	-1.3270 [0.273]	3.2437 [0.002]***
Δ LGDP $_{t-1}$	0.1227 [0.475]	0.4112 [0.005]***	0.1481 [0.209]
Δ INF $_{t-1}$	-0.0021 [0.536]	-0.0049 [0.285]	-0.0042 [0.366]
Δ INT $_{t-1}$	-0.0230 [0.003]***	0.0303 [0.068]*	0.0504 [0.006]***
Δ LEXC $_{t-1}$	0.0834 [0.765]	0.1029 [0.613]	-1.0393 [0.000]***
ECT_{t-1}	-0.1270 [0.050]**	-0.4006 [0.000]***	-0.5233 [0.000]***

Notes: Asterisks (***), (**) and (*) imply null hypotheses are rejected at 1%, 5% and 10% significance levels, respectively. The figures in [...] represent probabilities.

4.3.3 Estimated Long-run Coefficients

After validating the presence of a long-run association between the variables, the long-run coefficients for each model in the study are estimated. Table 4.6 shows the results of the long-run estimation for Indonesia, Malaysia, and Singapore. The long run coefficients were obtained after normalizing the coefficient of stock prices to one. Several diagnostic tests are being examined on the estimated models. These long run coefficients were estimated by considering the results of diagnostic tests to identify the parsimonious model for each country.

Table 4.6: ARDL Estimation Results

Panel (i): Estimated Long-Run Coefficients			
Regressor	Indonesia	Malaysia	Singapore
Constant	-6.1618 [0.834]	-3.3128 [0.291]	6.1990 [0.000]***
LGDP	0.9667 [0.381]	1.0265 [0.004]***	0.2830 [0.195]
INF	-0.0166 [0.531]	-0.0123 [0.311]	-0.008 [0.367]
INT	-0.1809 [0.105]	0.0757 [0.030]**	0.0962 [0.001]***
LEXC	0.6571 [0.758]	0.2569 [0.617]	-1.9861 [0.000]***
Panel (ii): Diagnostic Tests for ARDL Estimation Results			
Test	Indonesia	Malaysia	Singapore
Normality	9.4938 [0.009]***	4.8096 [0.090]*	18.6537 [0.000]***
Functional Form	0.2637 [0.793]	0.7490 [0.456]	1.3090 [0.195]
LM(1)	0.2475 [0.619]	2.2215 [0.136]	1.4677 [0.226]
LM(2)	0.2853 [0.867]	3.1984 [0.202]	4.1532 [0.125]
ARCH(1)	4.5096 [0.034]**	2.4689 [0.116]	10.9055 [0.001]***
ARCH(2)	4.3406 [0.114]	4.6740 [0.097]*	10.9175 [0.004]***
CUSUM	Stable	Stable	Stable
CUSUM of Squares	Unstable	Stable	Unstable

Notes: The regressand is LSP. Asterisks (*), (**) and (***) denote the null hypothesis is rejected at 10, 5 and 1% significance level, respectively. Normality refers to the Jarque-Bera test, which is based on the skewness and kurtosis of residuals tests. Functional form denotes Ramsey's RESET test, utilizing the square of fitted values. Serial correlation denotes the Breusch-Godfrey Serial Correlation LM test of residual serial correlation. Heteroskedasticity denotes the ARCH test, which is based on the regression of squared residuals on squared fitted values. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability.

The independent variables of the model are LGDP, INT, INF, and LEXC for all three countries. In the case of Indonesia, Table 4.6 shows that all long-run coefficients have the correct sign but are insignificant. The long-run estimated coefficient can be written as below:

$$LSP = -6.1618 + 0.9667 LGDP - 0.0166 INF - 0.1809 INT + 0.6571 LEXC \quad \text{Equation 4.1}$$

(0.834) (0.381) (0.531) (0.105) (0.758)

Equation 4.1 shows that LSP is affected by increases in LGDP and LEXC as well as decreases in INF and INT. The results can be explained through example, where a 1 percent increment in LGDP and LEXC, the LSP responds to the changes by increasing 0.97 percent and 0.66 percent respectively. A 1 percent increase in INF and INT decreases LSP by 0.02 percent and 0.18 percent, respectively. This also indicates a positive association between stock prices and EXC, which means a depreciation in local currency and increased competition in local firms cause an increase in exports, which corresponds to the research by Suriani et al. (2015). Unfortunately, this model suffered from normality and heteroskedasticity problems.

For Malaysia, the results of the analysis showed LGDP has a positive and statistically significant at one percent level. Both INF and LEXC have the correct sign, albeit the coefficients are insignificant. This means that neither INF nor LEXC have impact on stock prices in long run. The sign for INT contradicted previous reported findings, but it is significant at ten percent level. Equation 4.2 shows the nexus between macroeconomics fundamentals and stock prices for Malaysia.

$$LSP = -3.3128 + 1.0265 LGDP - 0.0123 INF + 0.0757 INT + 0.2569 LEXC \quad \text{Equation 4.2}$$

(0.291) (0.004)*** (0.311) (0.030)** (0.617)

Based on Equation 4.2, a 1 percent increase in LGDP, INT and LEXC causes 1.03 percent, 0.06 percent and 0.26 percent increase, respectively, in LSP. A 1 percent decrease in INF decreases LSP by 0.01 percent. This model also suffered from heteroskedasticity problem. However, the model is stable when CUSUM and CUSUMSQ tests were applied.

In the case of Singapore, the correlation between macroeconomic fundamentals and stock prices is shown in Equation 4.3. The model showed that LGDP and INF are insignificant variables and do not affect LSP in the long run, although both variables have the correct signs. INT and LEXC are statistically significant at the five percent level, but do not have the expected signs as shown in literature.

$$LSP = 6.1990 + 0.2830 LGDP - 0.008 INF + 0.0962 INT - 1.9861 LEXC \quad \text{Equation 4.3}$$

(0.000)*** (0.195) (0.367) (0.001)*** (0.000)***

Equation 4.3 shows that LSP is positively influenced by LGDP and INT, but negatively affected by INF and LEXC. A 1 percent rise in LGDP and INT induces 0.28 percent and 0.10 percent positive change in LSP, respectively. However, a 1 percent rise in INF and LEXC causes 0.01 percent and 1.99 percent decrease in LSP, respectively. In terms of diagnostic checking, this model also has normality and heteroskedasticity problems.

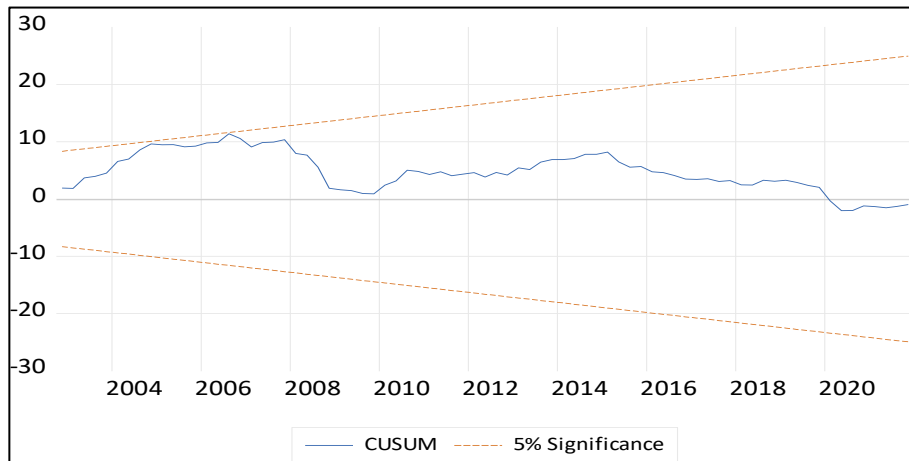


Figure 4.1: CUSUM for Indonesia

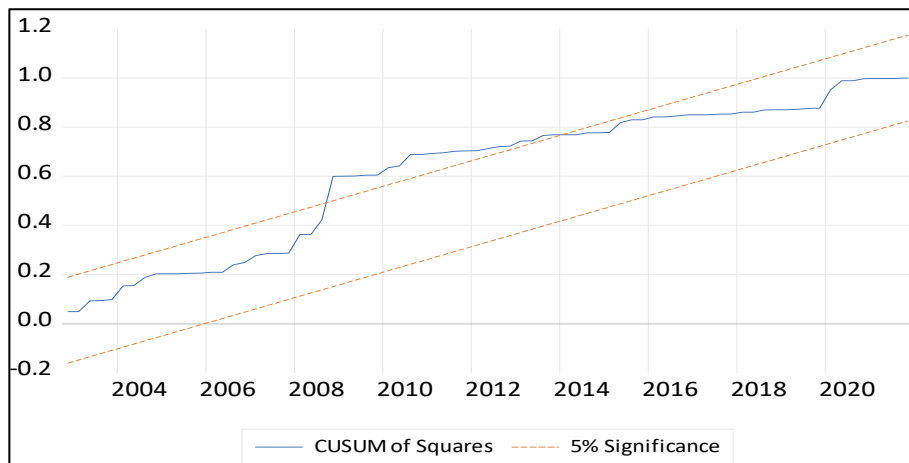


Figure 4.2: CUSUM of Squares for Indonesia

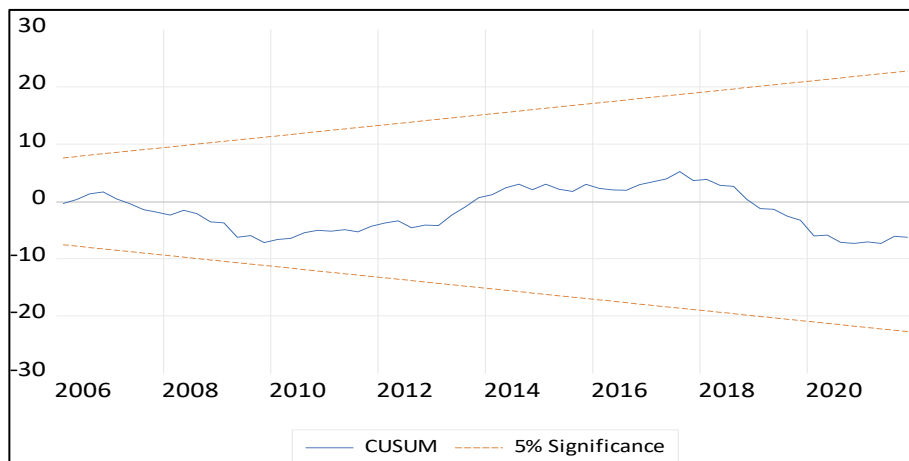


Figure 4.3: CUSUM for Malaysia

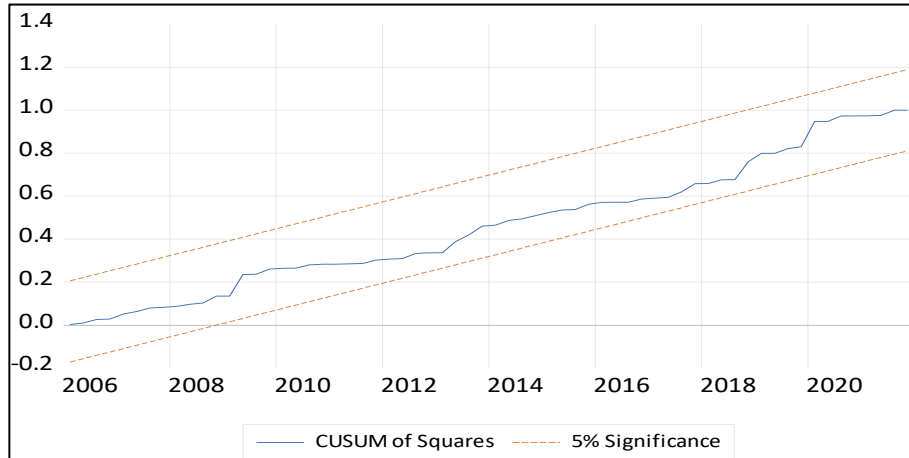


Figure 4.4: CUSUM of Squares for Malaysia

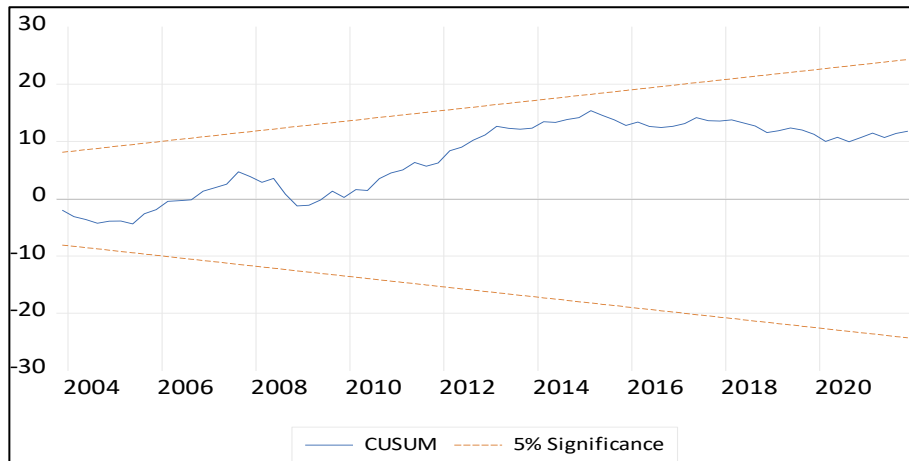


Figure 4.5: CUSUM for Singapore

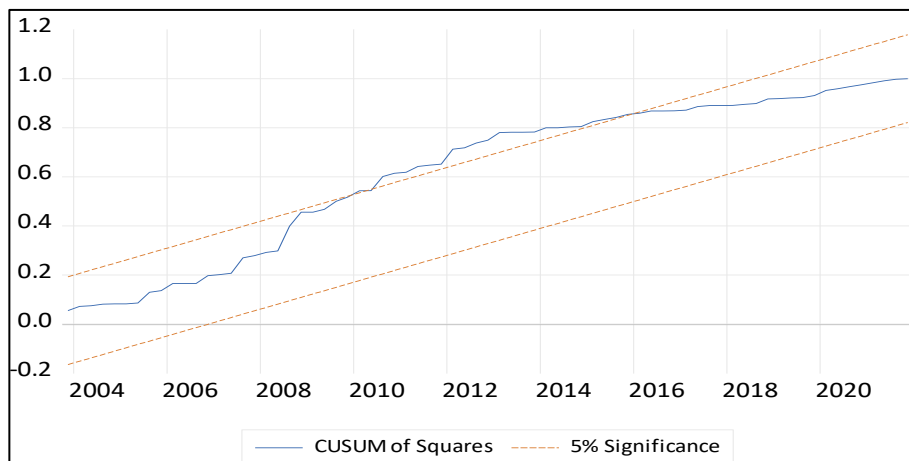


Figure 4.6: CUSUM of Squares for Singapore

4.4 Nonlinear Autoregressive Distributed Lag (NARDL) Model

Many studies had investigated the symmetric and long-run relationship among the stock market and its contributing factor using the ARDL approach, including this study based on above-mentioned findings. The NARDL model, on the other hand, uses a different approach from that proposed by Pesaran and Shin (1998) and Pesaran et al. (2001) due to its use of partial sum or decompositions to accommodate asymmetries. The NARDL model should be viewed as a complement to the ARDL model. This study separately examined the asymmetric effects of GDP (Model I), inflation (Model II), interest rate (Model III), and exchange rate (Model IV) on stock prices in Indonesia, Malaysian and Singapore.

The NARDL approach was employed in the study to identify the long-run and short-run relationship between the stock prices and macroeconomic fundamentals through (1) the standard OLS estimation method, (2) bounds test for cointegration, (3) ECM, (4) estimation of long-run coefficient, and (5) diagnostic tests. In the standard OLS model, the final specification of the NARDL model is achieved by removing insignificant lags using the general-to-specific procedure proposed by Katrakilidis and Trachanas (2012) and Ibrahim (2015). In line with the recommendations of Narayan et al. (2016), two breaks are sufficient for the detection of changes in structural movements in market efficiency.

4.4.1 Bounds Test for Cointegration

Similar to the ARDL model procedure, the bound test is used after both ADF and PP unit root tests had identify absence of $I(2)$ variable. The computed F-statistic is applied to identify whether there is a cointegration among the stock prices and the macroeconomic variables. If the F-statistic is exceeding the upper critical limit provided by Pesaran et al. (2001), the presence of a long-run association between the independent variables and the dependent variable is confirmed.

According to Pesaran et al. (2001), the concept of cointegration implies that there is only one long-run equilibrium relationship among the variables in a model. However, the Johansen and Juselius cointegration test pointed out the possibility of more than one cointegration relationship. For Indonesia, Malaysia and Singapore, the results of the bounds tests are shown in Tables 4.7, 4.8 and 4.9 respectively.

4.4.1.1 Indonesia

Table 4.7 illustrates that the F-statistic for all models for Indonesia exceeded the 95 percent upper critical bounds of Pesaran et al. (2001). From the table, the F-statistic are 7.7866, 4.5801, and 4.2279 for Models I, III, and IV, respectively, and greater than the upper critical values of Narayan (2005) at five percent level. The null hypothesis that there was no cointegration between the variables was rejected for every model.

Table 4.7: Indonesia Bounds Test for Cointegration Results

Models		F-statistic	
I: LSP, LGDP_POS, LGDP_NEG, INF, INT, and LEXC		7.7866 [0.000]***	(6, 78)
II: LSP, LGDP, INF_POS, INF_NEG, INT, and LEXC		4.0516 [0.001]***	(6, 79)
III: LSP, LGDP, INF, INT_POS, INT_NEG, and LEXC		4.5801 [0.001]***	(6, 78)
IV: LSP, LGDP, INF, INT, LEXC_POS, and LEXC_NEG		4.2279 [0.001]***	(6, 78)
Critical values bound of the F-statistic: unrestricted intercept and no trend (k=4)			
Significant level	Pesaran Critical Values		Narayan Critical Values
	<i>I</i> (0)	<i>I</i> (1)	<i>I</i> (0) <i>I</i> (1)
90% level	2.45	3.52	2.548 3.644
95% level	2.86	4.01	3.010 4.216
99% level	3.74	5.06	4.096 5.512

Notes: Critical values are from Pesaran et al. (2001) and Narayan (2005), Table Case III: unrestricted intercept and no trend. The lag length is chosen based on the information criterion AIC or general-to-specific method. The final specification of the NARDL model is obtained by trimming insignificant lags.

4.4.1.2 Malaysia

For Malaysia, the bounds test for cointegration is displayed in Table 4.8. The F-statistic are 7.9419, 5.7769, 6.8540, and 7.5663 for Models I, II, III, and IV respectively, which are greater than the upper critical value provided by Pesaran et al. (2001) and Narayan (2005) at five percent level. The results indicate that there is evidence of a long-run relationship between the variables analysed, as the null hypothesis of no cointegration is rejected in all models.

Table 4.8: Malaysia Bounds Test for Cointegration Results

Models		F-statistic	
I: LSP, LGDP_POS, LGDP_NEG, INF, INT, and LEXC		7.9419 [0.000]***	(6, 76)
II: LSP, LGDP, INF_POS, INF_NEG, INT, and LEXC		5.7769 [0.000]***	(6, 78)
III: LSP, LGDP, INF, INT_POS, INT_NEG, and LEXC		6.8540 [0.000]***	(6, 75)
IV: LSP, LGDP, INF, INT, LEXC_POS, and LEXC_NEG		7.5663 [0.000]***	(6, 78)
Critical values bound of the F-statistic: unrestricted intercept and no trend (k=4)			
Significant level	Pesaran Critical Values		Narayan Critical Values
	$I(0)$	$I(1)$	$I(0)$
90% level	2.45	3.52	2.548
95% level	2.86	4.01	3.010
99% level	3.74	5.06	4.096

Notes: Critical values are from Pesaran et al. (2001) and Narayan (2005), Table Case III: unrestricted intercept and no trend. The lag length is chosen based on the information criterion AIC or general-to-specific method to arrive at the final specification of the NARDL model by trimming insignificant lags.

4.4.1.3 Singapore

Table 4.9 shows the F-statistic results for Singapore. Since all the F-statistic values in the models are larger than the upper critical values provided by Pesaran et al. (2001) and Narayan (2005) at a five percent level of significance, this indicates that the null hypothesis of no cointegration between the variables is rejected.

Table 4.9: Singapore Bounds Test for Cointegration Results

Models		F-statistic	
I: LSP, LGDP_POS, LGDP_NEG, INF, INT, and LEXC		6.2138 [0.000]***	(6, 73)
II: LSP, LGDP, INF_POS, INF_NEG, INT, and LEXC		9.4419 [0.000]***	(6, 76)
III: LSP, LGDP, INF, INT_POS, INT_NEG, and LEXC		5.0376 [0.000]***	(6, 77)
IV: LSP, LGDP, INF, INT, LEXC_POS, and LEXC_NEG		7.7932 [0.000]***	(6, 78)
Critical values bound of the F-statistic: unrestricted intercept and no trend (k=4)			
Significant level	Pesaran Critical Values		Narayan Critical Values
	<i>I</i> (0)	<i>I</i> (1)	<i>I</i> (0) <i>I</i> (1)
90% level	2.45	3.52	2.548 3.644
95% level	2.86	4.01	3.010 4.216
99% level	3.74	5.06	4.096 5.512

Notes: Critical values are from Pesaran et al. (2001) and Narayan (2005), Table Case III: unrestricted intercept and no trend. The lag length is chosen based on the information criterion AIC or general-to-specific method to arrive at the final specification of the NARDL model by trimming insignificant lags.

The bounds test provided the preliminary results of the cointegration for all four asymmetry models for all countries. The ECM serves as another channel to examine the

long-run correlation between the stock price and the variables using ECT. This method is also suitable for the NARDL model.

4.4.2 Error Correction Model Estimation

Shin et al. (2014) stated that a well-established NARDL ECM-based test can detect asymmetric long-run relationship. This study has employed the ECM of short-run dynamics to examine the existence of a long-run link between stock prices and macroeconomic fundamentals. This was done by re-parametrizing the ARDL model. The presence of cointegration is confirmed when the ECT is negative, less than one, and significant.

The short-run coefficients and the lagged ECT (ECT_{t-1}) are tabulated in Table 4.10, 4.11 and 4.12 for Indonesia, Malaysia, and Singapore, respectively. Hosein (2007) stated that short-run coefficients indicate the dynamic adjustment of each variable, and thus are included in the estimations without explanation. According to Cheah et al. (2017), the long-run relation in each specification is a viable ECM, in which any short-run deviation in stock price is restored back to equilibrium. Hence, the discussion will be based on the ECT of all models.

4.4.2.1 Indonesia

Table 4.10 shows the short-run coefficient and the results of the ECM estimates for Indonesia. The lagged ECTs for all models are negative, less than one and significant, thus confirms that cointegration exists. For Model I, the lagged ECT is statistically significant at ten percent level. The ECTs for Models II, III, and IV are statistically significant at one percent level. The lagged ECTs showed that all models detected a long-run relationship.

Table 4.10: Indonesia Error Correction Representation of NARDL Results

Regressor	Model I	Model II	Model III	Model IV
$\Delta \text{Constant}$	3.8125 [0.015]**	-6.6615 [0.004]***	-5.6072 [0.015]**	-2.2819[0.0535]*
ΔLGDP_{t-1}	-	0.3574 [0.000]***	0.2748 [0.022]**	0.2936 [0.011]**
$\Delta \text{LGDP\_POS}_{t-1}$	0.0477 [0.684]	-	-	-
$\Delta \text{LGDP\_NEG}_{t-1}$	-0.1265[0.664]	-	-	-
ΔINF_{t-1}	0.0001 [0.981]	-	-0.0060 [0.006]**	-0.0074 [0.022]**
$\Delta \text{INF\_POS}_{t-1}$	-	-0.0062 [0.005]***	-	-
$\Delta \text{INF\_NEG}_{t-1}$	-	0.0495 [0.579]	-	-
ΔINT_{t-1}	-0.0163 [0.000]***	-0.0104 [0.029]**	-	-0.0193 [0.003]***
$\Delta \text{INT\_POS}_{t-1}$	-	-	-0.0110 [0.240]	-
$\Delta \text{INT\_NEG}_{t-1}$	-	-	-0.0225 [0.004]***	-
ΔLEXC_{t-1}	-1.3769 [0.000]***	0.4579 [0.010]**	0.3636 [0.048]**	-
$\Delta \text{LEXC\_POS}_{t-1}$	-	-	-	0.4940 [0.022]**
$\Delta \text{LEXC\_NEG}_{t-1}$	-	-	-	0.3411 [0.096]*
ECT_{t-1}	-0.1216 [0.053]*	-0.1445 [0.003]***	-0.1613 [0.003]***	-0.1611 [0.004]***
W_{LR}	0.3869 [0.5358]	0.4171 [0.5202]	1.1713 [0.2825]	0.8551 [0.3580]
W_{SR}	0.6790 [0.4125]	0.3896 [0.5343]	1.6912 [0.1972]	1.1907 [0.2785]

Notes: The regressand is LSP. Asterisks (*), (**) and (***) signify rejection of null hypothesis at 10, 5 and 1% significance level respectively. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability. W_{LR} and W_{SR} indicate the Wald test for long-run and short-run asymmetries, respectively.

4.4.2.2 Malaysia

For Malaysia, the lagged ECTs for Model I to Model IV are all significant at 1 percent level and have the correct signs. All lagged ECT values are negative, less than one and significant, therefore, this confirms that cointegration exists.

Table 4.11: Malaysia Error Correction Representation of NARDL Results

Regressor	Model I	Model II	Model III	Model IV
$\Delta \text{Constant}$	2.6312 [0.000]***	-3.0649 [0.026]**	-1.6782 [0.065]*	-1.4738 [0.093]*
ΔLGDP_{t-1}	-	0.4582 [0.000]***	0.5111 [0.000]***	0.3131 [0.020]**
$\Delta \text{LGDP\_POS}_{t-1}$	0.5130 [0.000]***	-	-	-
$\Delta \text{LGDP\_NEG}_{t-1}$	0.3771 [0.002]***	-	-	-
ΔINF_{t-1}	-0.0140 [0.015]**	-	-0.0191 [0.000]***	0.0040 [0.582]
$\Delta \text{INF\_POS}_{t-1}$	-	-0.0080 [0.100]	-	-
$\Delta \text{INF\_NEG}_{t-1}$	-	-0.0028 [0.816]	-	-
ΔINT_{t-1}	0.0019 [0.888]	0.0006 [0.967]	-	0.0020 [0.855]
$\Delta \text{INT\_POS}_{t-1}$	-	-	0.1184 [0.001]***	-
$\Delta \text{INT\_NEG}_{t-1}$	-	-	-0.0085 [0.514]	-
ΔLEXC_{t-1}	0.2819 [0.076]*	0.2980 [0.097]*	0.4072 [0.017]**	-
$\Delta \text{LEXC\_POS}_{t-1}$	-	-	-	0.0567 [0.777]
$\Delta \text{LEXC\_NEG}_{t-1}$	-	-	-	0.4154 [0.012]**
ECT_{t-1}	-0.2891 [0.000]***	-0.2880 [0.000]***	-0.4584 [0.000]***	-0.3055 [0.000]***
W_{LR}	5.5084 [0.0215]**	0.4294 [0.5142]	11.2855 [0.0012]***	4.3909 [0.0394]**
W_{SR}	7.6998 [0.0069]**	0.4125 [0.5226]	11.6763 [0.0010]***	4.8534 [0.0305]**

Notes: The regressand is LSP. Asterisks (*), (**) and (***) indicate the null hypothesis is rejected at 10, 5 and 1% significance level respectively. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability. W_{LR} and W_{SR} indicate the Wald test for long-run and short-run asymmetries, respectively.

4.4.2.3 Singapore

Table 4.12 reports the short-run asymmetric correlation between the macroeconomic fundamentals and stock prices in Singapore. All lagged ECTs are statistically significant at a one percent level. All the models also depicted the existence of a long-run nexus since the lagged ECTs are negative, less than one and significant.

Table 4.12: Singapore Error Correction Representation of Results

Regressor	Model I	Model II	Model III	Model IV
$\Delta \text{Constant}$	4.7230 [0.000]***	3.0456 [0.036]**	-0.1523 [0.924]	-0.2824 [0.901]
ΔLGDP_{t-1}	-	0.0806 [0.557]	0.4707 [0.039]**	0.5533 [0.039]**
$\Delta \text{LGDP\_POS}_{t-1}$	0.1617 [0.265]	-	-	-
$\Delta \text{LGDP\_NEG}_{t-1}$	0.1100 [0.669]	-	-	-
ΔINF_{t-1}	-0.0067 [0.064]*	-	-0.0123 [0.014]**	-0.0048 [0.205]
$\Delta \text{INF\_POS}_{t-1}$	-	-0.0097 [0.005]***	-	-
$\Delta \text{INF\_NEG}_{t-1}$	-	-0.0266 [0.125]	-	-
ΔINT_{t-1}	0.0433 [0.010]**	0.0377 [0.011]**	-	0.0477 [0.008]***
$\Delta \text{INT\_POS}_{t-1}$	-	-	-0.0082 [0.727]	-
$\Delta \text{INT\_NEG}_{t-1}$	-	-	0.0205 [0.250]	-
ΔLEXC_{t-1}	-0.9689[0.002] ***	-1.2096 [0.000]***	-0.5298 [0.037]**	-
$\Delta \text{LEXC\_POS}_{t-1}$	-	-	-	0.6163 [0.066]*
$\Delta \text{LEXC\_NEG}_{t-1}$	-	-	-	-0.2072 [0.728]
ECT_{t-1}	-0.4933 [0.000]***	-0.4323 [0.000]***	-0.4044 [0.000]***	-0.6449 [0.000]***
W_{LR}	0.1484 [0.7012]	1.0258 [0.3143]	2.5359 [0.1154]	1.9974 [0.1615]
W_{SR}	0.1566 [0.6934]	1.1112 [0.2952]	1.9449 [0.1671]	1.6610 [0.2013]

Notes: The regressand is LSP. Asterisks (*), (**) and (***) designate the null hypothesis is rejected at 10, 5 and 1% significance level respectively. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability. W_{LR} and W_{SR} indicate the Wald test for long-run and short-run asymmetries, respectively.

The ECMs for all countries clearly showed the presence of a long-run correlation among the variables. This proves the efficiency of the NARDL-ECM approach in determining cointegration among the variables with asymmetry properties.

4.4.3 Estimated Long-run Coefficients

The estimated long-run parameters for each model were calculated by normalizing the coefficient of the dependent variable to one. Table 4.13, 4.14 and 4.15 depict the results of the diagnostic tests and the estimated long-run coefficients of Indonesia, Malaysia, and Singapore, respectively.

4.4.3.1 Indonesia

All models measure a particular asymmetric impact of macroeconomic fundamentals on stock prices. Model I is about the non-linear effect of income level on stock price, which is comprised of asymmetric measures of GDP (LGDP_POS and LGDP_NEG), INF, INT, and LEXC as explanatory variables. The results in Table 4.13 showed that there is a no long-run asymmetric impact of GDP on the stock prices in Indonesia. The sign for INF contradicts existing literature but is insignificant. The LEXC has the correct sign according to economic theory. However, it is insignificant. The sign of the INT is correct, and it is significant at ten percent significant level.

Model II estimated the asymmetric effect of inflation on the stock price with the independent variables specified as LGDP, INF (INF_POS and INF_NEG), INT, and LEXC. The variable LGDP in the model exhibits a statistically significant relationship with the dependent variable (stock prices) at a 1 percent level of significance. The coefficient associated with LGDP also has the expected sign, indicating that a 1 percent increase in LGDP increases stock price by 2.47 percent. The results discover there is a long-run

asymmetric correlation among INF and Indonesia's stock prices. The positive partial sum of INF suggests that a 1 percent rise in INF leads to a decrease of 0.04 percent in stock prices and is statistically significant at the five percent level. INF negatively influences the stock market, but the variable is insignificant. This underlines the importance of taking the dynamics of the INF into account when analyzing stock market movements. INT and LEXC are statistically significant at the five percent level. The negative sign of INT is identical to Model I, which is consistent with existing literature while LEXC does not have the same sign as Model I.

Model III estimated the asymmetric effect of interest rate (INT_POS and INT_NEG) with LGDP, INF, and LEXC as the independent variables. Both LGDP and INF have the correct sign. LEXC does not have the correct sign, which is similar to Model II. A 1 percent rise in LGDP raises stock prices by 1.70 percent at one percent significance level. The result reveals that EXC and stock prices have a significant positive relationship. Particularly, a 1 percent increase in EXC leads to a corresponding increase of 2.25 percent in stock prices and is statistically significant at the ten percent level. A 1 percent increase in INF decreases stock prices by 0.04 percent at five percent significance level. For the asymmetric INT, the result indicates that both positive and negative changes in the INT have a negative impact on stock prices. However, only the negative shock of the INT shows statistically significant at five percent significance level. This infers that when INT decreases by 1 percent, leads to a decrease of 0.14 percent in stock prices. This finding indicates that reducing interest rates can be interpreted as a negative signal for stock market participants, thus resulting in a downtrend in stock market return. This finding of asymmetric effects of interest rate is supported by Yacouba and Altintas (2019).

In the asymmetric exchange rate model (Model IV), the independent variables are LGDP, INF, INT, and LECX (LEXC_POS and LEXC_NEG). The model captured the long-run nexus among stock prices and the fluctuation in exchange rates. The results indicated that, in the long run, stock prices are only influenced by positive exchange rate movements. A 1 percent rise in the exchange rate (appreciation of domestic currency) increases stock prices by 3.07 percent at a ten percent significance level while negative changes in exchange rate is insignificant in the long run. The results reveal that the signs of coefficients for LGDP, INF, and INT are consistent with the expected theoretical relationship. The coefficient for LGDP is discovered to be statistically significant at one percent level, when there is 1 percent increase in LGDP, the stock prices expected to rise by 1.82 percent. A five percent statistically significant negative correlation between the INT and stock prices suggests that changes in interest rates have an inverse influence on stock prices. This means the stock prices is predicted to decrease by 0.05 percent when there is a 1 percent rise in interest rate. However, the coefficient for INF is not statistically significant.

Table 4.13: Indonesia NARDL Estimation Results

Panel (i): Estimated Long-Run Coefficients				
Regressor	Model I	Model II	Model III	Model IV
Constant	31.3602 [0.108]	-46.099 [0.026]**	-34.7535 [0.029]**	-14.1694 [0.076]*
LGDP	-	2.4734 [0.001]***	1.7029 [0.005]***	1.8231 [0.005]***
LGDP_POS	0.3926 [0.642]	-	-	-
LGDP_NEG	-1.0406 [0.713]	-	-	-
INF	0.0005 [0.980]	-	-0.0374 [0.037]**	-0.0458 [0.101]
INF_POS	-	-0.0429 [0.046]**	-	-
INF_NEG	-	0.3424 [0.567]	-	-
INT	-0.134 [0.066]*	-0.0723 [0.038]**	-	-0.1200 [0.011]**
INT_POS	-	-	-0.0679 [0.182]	-
INT_NEG	-	-	-0.1393 [0.016]**	-
LEXC	-2.6622 [0.245]	3.1686 [0.046]**	2.2537 [0.069]*	-
LEXC_POS	-	-	-	3.0674 [0.086]*
LEXC_NEG	-	-	-	2.1178 [0.127]
Panel (ii): Diagnostic Tests for NARDL Estimation Results				
Tests	Model I	Model II	Model III	Model IV
Normality	3.4358 [0.179]	5.2590 [0.072]*	5.3204 [0.070]*	1.1580 [0.560]
Functional Form	0.4047 [0.687]	0.7268 [0.470]	1.7490 [0.084]*	1.3968 [0.167]
LM(1)	1.2171 [0.270]	0.1706 [0.680]	0.1001 [0.752]	0.4566 [0.499]
LM(2)	1.5604 [0.458]	1.9301 [0.381]	3.1112 [0.211]	0.8063 [0.668]
ARCH(1)	0.3680 [0.544]	0.1713 [0.679]	0.2145 [0.643]	1.2491 [0.264]
ARCH(2)	0.3911 [0.822]	0.1891 [0.910]	0.5859 [0.746]	2.2107 [0.331]
CUSUM	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable

Notes: The regressand is LSP. Asterisks (*), (**) and (***) signify the null hypothesis is rejected at 10, 5 and 1% significance level respectively. The normality denotes the Jarque-Bera test based on the skewness and kurtosis of residuals tests. Functional form denotes Ramsey's RESET test utilizing the square of fitted values. Serial correlation denotes the Breusch-Godfrey Serial Correlation LM test of residual serial correlation. Heteroskedasticity denotes the ARCH test, which is based on the regression of squared residuals on squared fitted values. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability.

For the diagnostic check, all models have passed all diagnostic tests and are stable. This also means that all models are free from normality, functional form, serial correlation, and heteroskedasticity problems. Figures 4.7 to 4.14 show the plots of CUSUM and CUSUMSQ for all models.

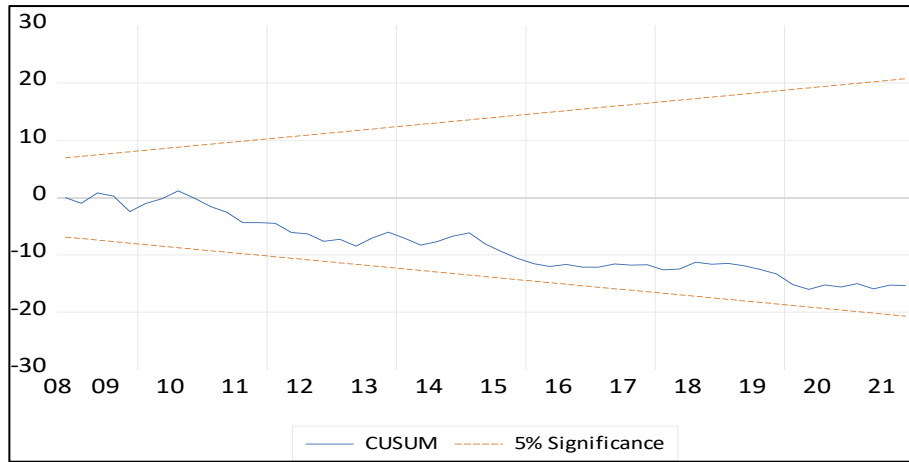


Figure 4.7: Indonesia CUSUM of Model I

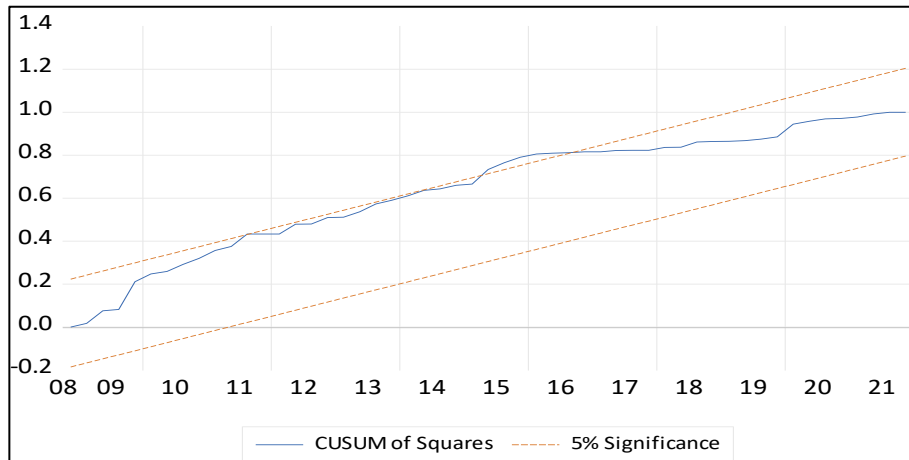


Figure 4.8: Indonesia CUSUM of Squares of Model I

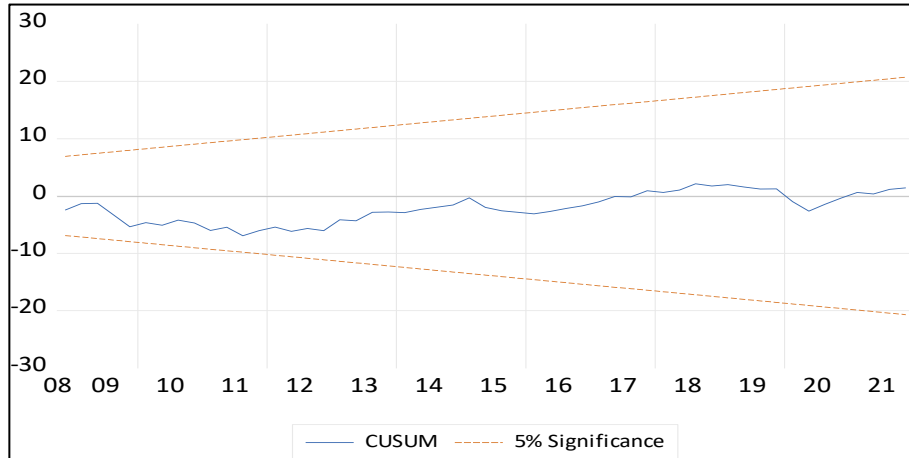


Figure 4.9: Indonesia CUSUM of Model II

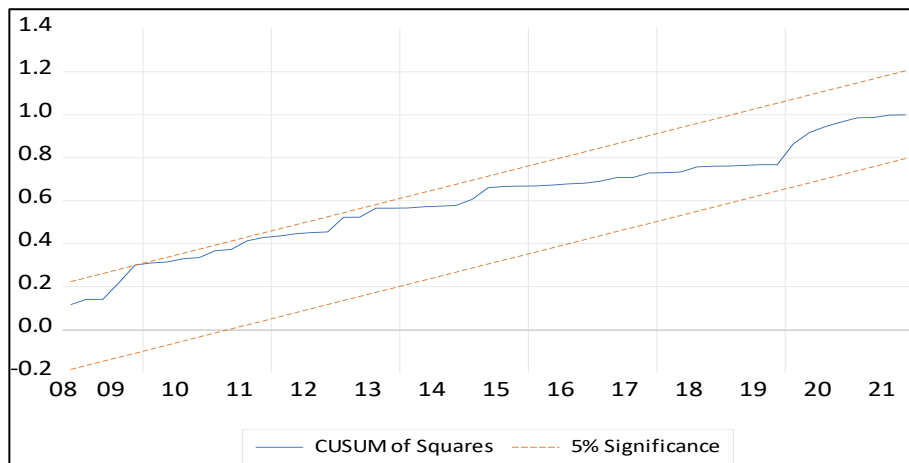


Figure 4.10: Indonesia CUSUM of Squares of Model II

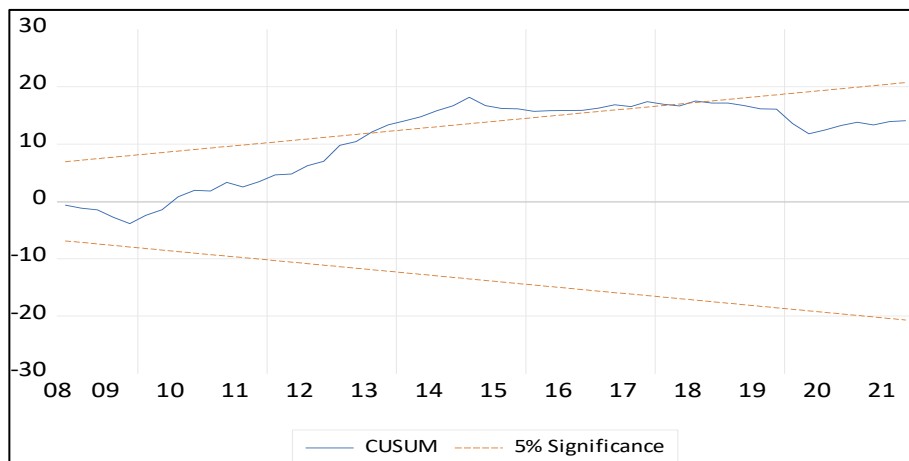


Figure 4.11: Indonesia CUSUM of Model III

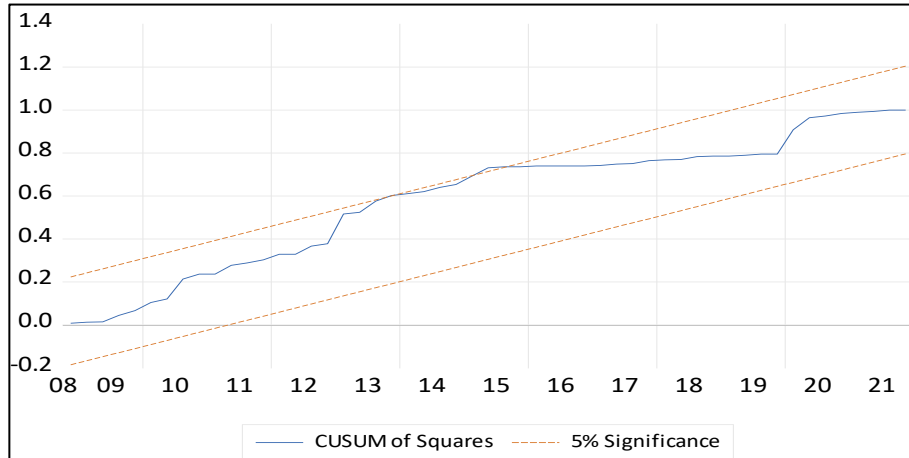


Figure 4.12: Indonesia CUSUM of Squares of Model III

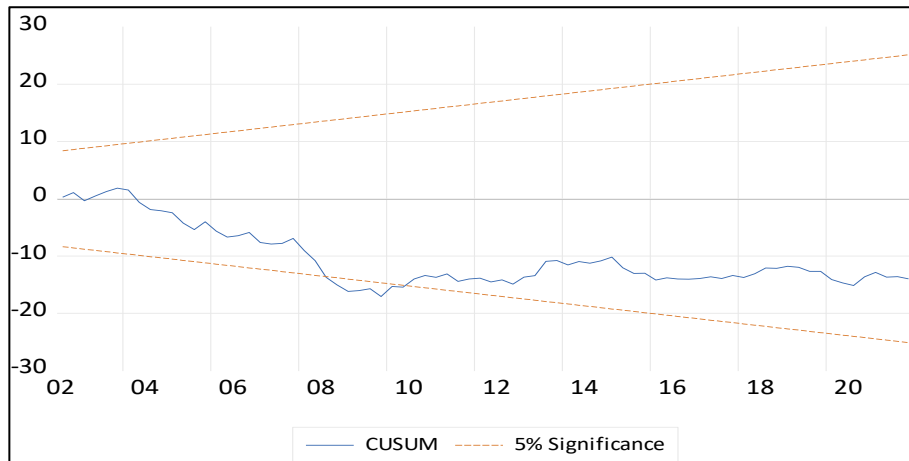


Figure 4.13: Indonesia CUSUM of Model IV

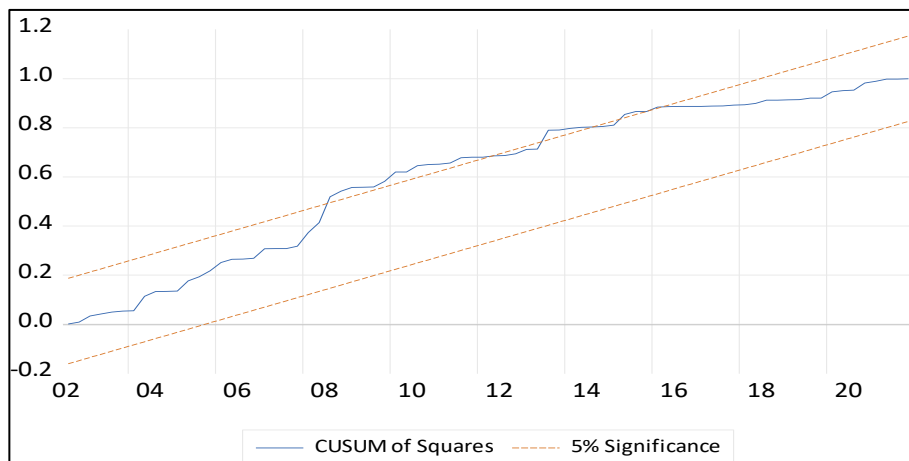


Figure 4.14: Indonesia CUSUM of Squares of Model IV

4.4.3.2 Malaysia

The results for Malaysia are tabulated in Table 4.14. Model I estimated the asymmetric influence of income level on stock prices, which depicted an utterly symmetric effect of stock prices to positive and negative shocks in LGDP at one percent significance level. Stock prices respond positively to both positive and negative shocks in LGDP. A 1 percent increase and decrease in income level positively affects the stock prices by 1.77 percent and 1.30 percent, respectively. The sign of INF is accurate and statistically significant at five percent level. The results reveal that when there is an increase in INF by 1 percent, the stock prices expected to decrease by 0.05 percent. As inflation often results in a rise in input costs and production costs, it negatively affects profit margins and ultimately the stock prices. The result of this model shows that INT and LEXC insignificantly affects the stock prices in Malaysia.

Next, Model II examined the asymmetric influence of inflation on the stock prices model, which included LGDP, INF (INF_POS and INF_NEG), INT, and LEXC. The results show that changes in inflation rates do not have a distinct impact on the behavior or movement of stock prices in an asymmetric manner. Both INF_POS (positive shock of inflation) and INF_NEG (negative shock of inflation) were discovered to be statistically insignificant in this model. From the analysis of the results, only the sign of coefficient LGDP is accurate, and it is statistically significant at the one percent level. The stock prices is predicted to increase by 1.59 percent when there is an increment in the LGDP by 1 percent. However, both INT and LEXC are insignificant.

Model III measured the asymmetric influence of interest rate on stock prices, where the independent variables of the model are LGDP, INF, INT (INT_POS and INT_NEG), and

LEXC. According to the findings presented in Table 4.14, there exists an asymmetric long-run association between interest rates and stock prices. The results suggest that a 1 percent rise in interest rate leads to a 0.26 percent rise in stock prices. However, the study did not find a significant impact of negative changes in interest rates on stock prices. This result aligns with a similar study conducted by Mohamed and Sahin (2020). All the other variables (LGDP and INF) have an accurate sign and are significant at one percent level while LEXC is statistically significant at five percent level. When there is an increase in LGDP by 1 percent, the stock prices is predicted to rise by 1.12 percent. Next, it seems that stock prices decrease by 0.04 percent when there is a 1 percent increase in INF. Lastly, the stock prices is expected to rise by 0.89 when there is a 1 percent increase in LEXC.

When analyzing the asymmetric impact of exchange rate on stock prices through model IV, an asymmetric effect was found. The model showed that LEXC_POS (positive changes) has no significant effect on stock prices in Malaysia. However, LEXC_NEG (negative changes) has a significant positive long-run effect on the stock prices. These results suggest that when Malaysia's currency depreciates by 1 percent, the stock prices is expected to rise by 1.36 percent. The results suggest that when the local currency depreciates relative to foreign currencies, therefore suggesting significant positive effect of inflation on Malaysian stock prices. This aligns with the findings of Cheah et al. (2017). In addition, the sign of LGDP is accurate, which is positive and statistically significant at five percent level, where 1 percent rise in LGDP is expected to raise stock prices by 1.03 percent. Thus, suggesting there is a positive and significant correlation between GDP and stock prices in this study. On the contrary, the coefficients of INF and INT are inconsistent with a prior theory and insignificant.

Table 4.14: Malaysia NARDL Estimation Results

Panel (i): Estimated Long-Run Coefficients				
Regressor	Model I	Model II	Model III	Model IV
Constant	9.1028 [0.000]***	-10.641 [0.054]*	-3.6613 [0.081]*	-4.8250 [0.1165]
LGDP	-	1.5909 [0.001]***	1.1150 [0.000]***	1.0251 [0.021]**
LGDP_POS	1.7749 [0.000]***	-	-	-
LGDP_NEG	1.3046 [0.001]***	-	-	-
INF	-0.0484 [0.045]**	-	-0.0416 [0.001]***	0.0131 [0.580]
INF_POS	-	-0.0279 [0.142]	-	-
INF_NEG	-	-0.0097 [0.818]	-	-
INT	0.0066 [0.888]	0.0019 [0.967]	-	0.0065 [0.854]
INT_POS	-	-	0.2583 [0.000]***	-
INT_NEG	-	-	-0.0186 [0.529]	-
LEXC	0.9752 [0.111]	1.0347 [0.135]	0.8883 [0.024]**	-
LEXC_POS	-	-	-	0.1857 [0.779]
LEXC_NEG	-	-	-	1.3600 [0.027]**
Panel (ii): Diagnostic Tests for NARDL Estimation Results				
Test	Model I	Model II	Model III	Model IV
Normality	2.0937 [0.351]	2.8969 [0.235]	3.1394 [0.208]	1.4570 [0.483]
Functional Form	0.8336 [0.407]	0.3601 [0.720]	0.5140 [0.609]	0.4795 [0.633]
LM(1)	3.1288 [0.077]	5.4646 [0.019]**	2.6897 [0.101]	2.1167 [0.146]
LM(2)	3.1578 [0.206]	6.0327 [0.049]**	2.8277 [0.243]	2.1326 [0.344]
ARCH(1)	0.0453 [0.831]	0.0005 [0.983]	2.2878 [0.130]	0.4156 [0.519]
ARCH(2)	2.0945 [0.351]	1.1576 [0.561]	2.6971 [0.260]	0.4367 [0.804]
CUSUM	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable

Notes: The regressand is LSP. Asterisks (*), (**) and (***) indicate the null hypothesis is rejected at 10, 5 and 1% significance level respectively. Normality denotes the Jarque-Bera test based on the skewness and kurtosis of residuals tests. The functional form denotes Ramsey's RESET test utilizing the square of fitted values. Serial correlation denotes the Breusch-Godfrey Serial Correlation LM test of residual serial correlation. Heteroskedasticity denotes the ARCH test, which is based on the regression of squared residuals on squared fitted values. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability.

Figure In terms of diagnostic checking, Model II suffered from serial correlation problems. Model I, Model III and Model IV passed all the diagnostic tests. The plots of CUSUM and CUSUMSQ in Figures 4.15 to 4.22 show that all models are stable.

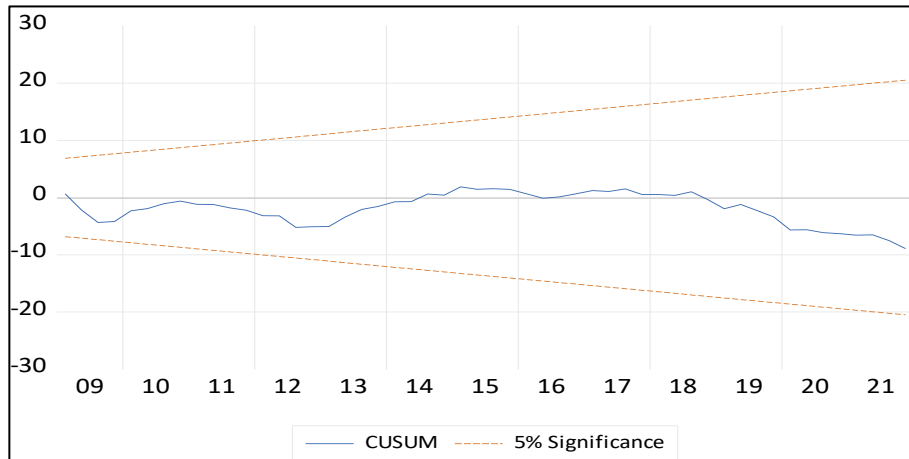


Figure 4.15: Malaysia CUSUM of Model I

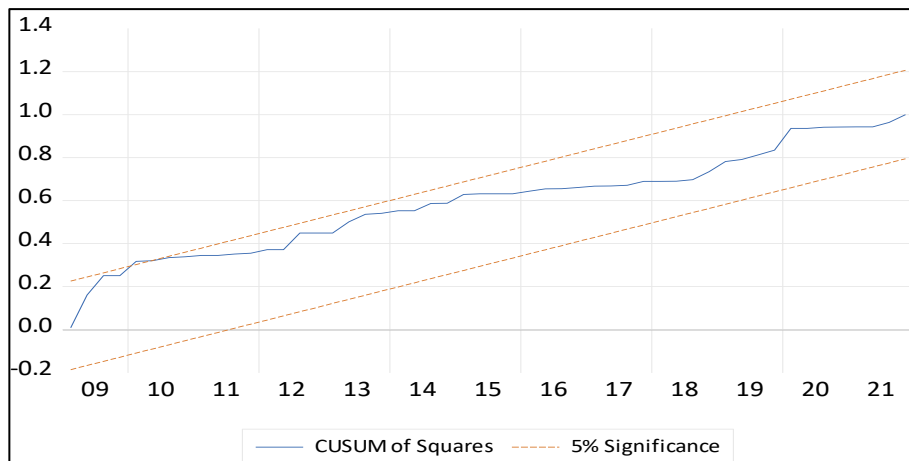


Figure 4.16: Malaysia CUSUM of Squares of Model I

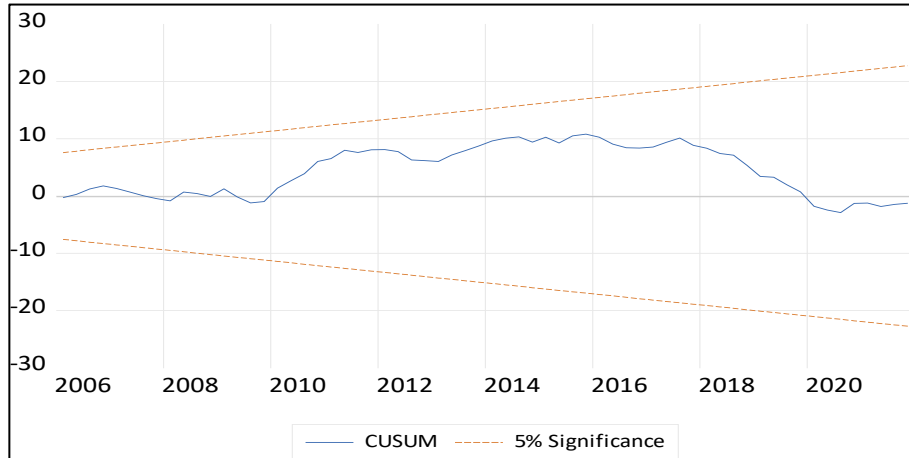


Figure 4.17: Malaysia CUSUM of Model II

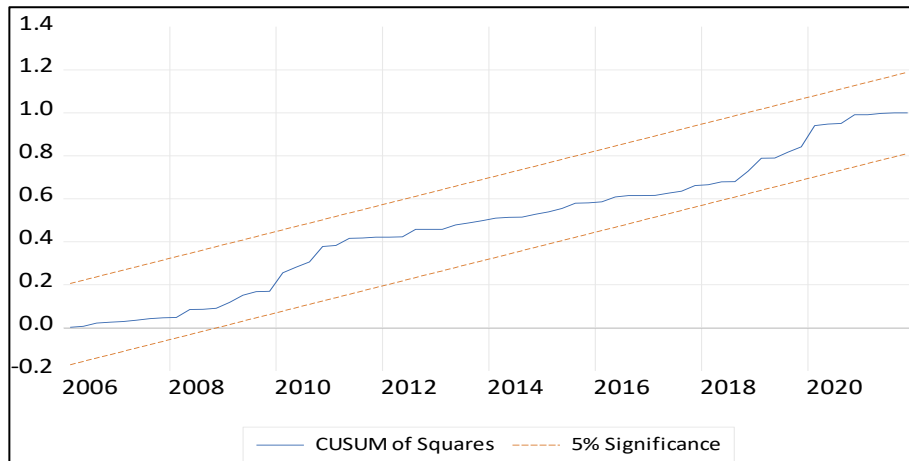


Figure 4.18: Malaysia CUSUM of Squares of Model II

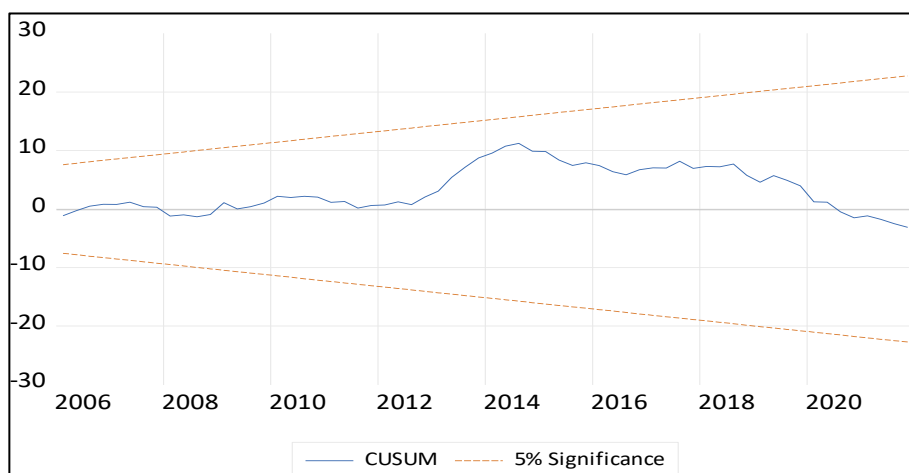


Figure 4.19: Malaysia CUSUM of Model III

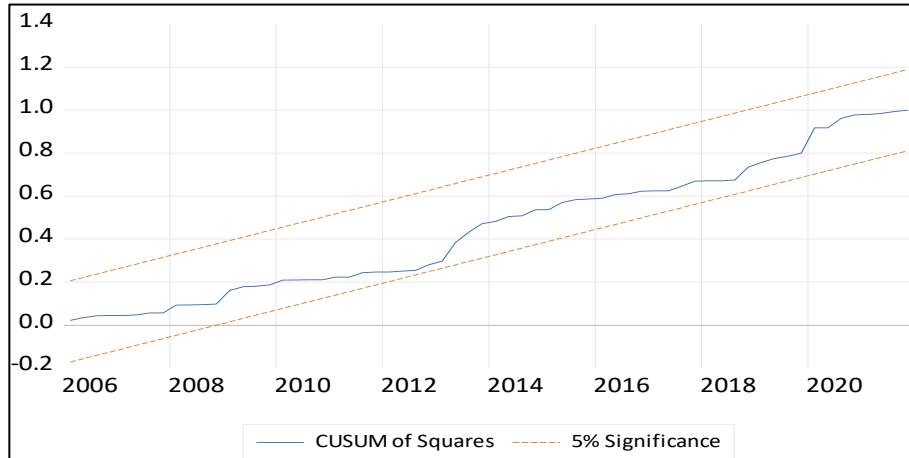


Figure 4.20: Malaysia CUSUM of Squares of Model III

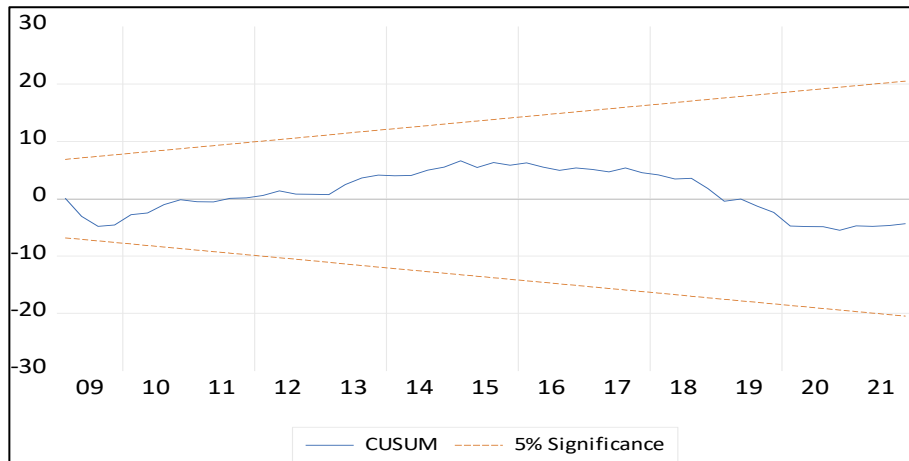


Figure 4.21: Malaysia CUSUM of Model IV

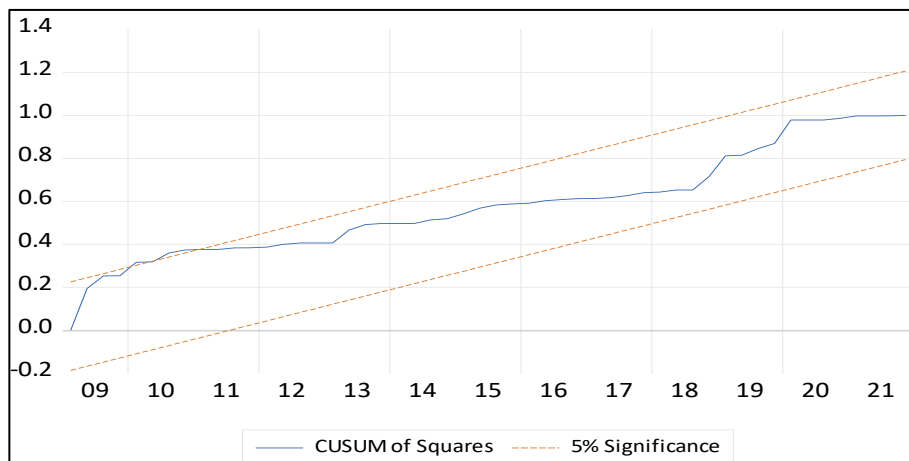


Figure 4.22: Malaysia CUSUM of Squares of Model IV

4.4.3.3 Singapore

Table 4.15 details the results for Singapore. Model I measured the asymmetric influence of income level on stock prices in Singapore. The results indicated that both LGDP_POS and LGDP_NEG are insignificant. INF has the anticipated negative impact on stock prices and is statistically significant at ten percent level. The results indicated that when 1 percent rise in INF will cause decrement of stock prices by 0.01 percent. INT and LEXC are significant at one percent level despite the signs being inconsistent with existing literature.

The results for Model II indicate that inflation influence stock prices asymmetrically in the long run. Similar to previous findings, only positive inflation rate affects stock prices in the long run at five percent significance level. The results indicate that when 1 percent rise in INF, the stock prices respond to the shocks by decreasing 0.02 percent. LGDP has the right sign albeit insignificant. INT and LEXC are statistically significant at 1 percent level, but do not have the anticipated signs.

In Model III, the analysis includes LGDP, INF, INT (INT_POS and INT_NEG), and LEXC as independent variables to research the asymmetric effect of interest rate on stock prices. The results from the analysis show that LGDP and INF are both statistically significant in relation to stock prices. LGDP exhibits a positive sign and is discovered to be significant at the five percent level, suggesting economic growth has a positive effect on stock prices. The results portrayed an increase of 1.16 percent in stock prices seems to respond towards the 1 percent increase of LGDP. INF, on the contrary, shows a significant negative correlation with stock prices at the one percent level, implying that higher levels of inflation tend to be associated with lower stock prices. The results of the finding can be

interpreted through, where a 1 percent increment of INF, the stock prices responds by decreasing 0.03 percent of the stock prices. Besides that, there is an absence of asymmetric impact of interest rate on stock prices in Singapore. LEXC is significant at five percent level but does not have the anticipated sign.

The results of Model IV indicate that there is an asymmetric effect of changes in the exchange rate on stock prices. This is because LEXC_POS has a significant, yet negative influence on stock prices at ten percent level while LEXC_NEG has no impact on stock prices in the long run. This asymmetric result reveals that when a 1 percent increase in LEXC_POS, the stock prices is expected to respond by decreasing by 0.96 percent. LGDP has a significant and positive long-run effect on stock prices, which is in line with economic theory. When there is a 1 percent rise in LGDP, the stock prices will respond by increasing 0.86 percent. INF has the anticipated sign albeit insignificant. INT does not have the anticipated sign but is statistically significant at one percent level.

In term of diagnostic checking, Model I has passed all the diagnostic tests. Model II suffered from serial correlation and heteroskedasticity problems, Model III suffered from normality and heteroskedasticity problems, while Model IV suffered from normality, serial correlation and heteroskedasticity problems. Models I, II and IV are stable as shown in the CUSUM and CUSUMQ plots. Figures 4.23 to 4.30 show the plots for CUSUM and CUSUMSQ for all models.

Table 4.15: Singapore NARDL Estimation Results

Panel (i): Estimated Long-Run Coefficients				
Regressor	Model I	Model II	Model III	Model IV
Constant	9.5744 [0.000]***	7.0449 [0.039]**	-0.3764 [0.924]	-0.4379 [0.901]
LGDP	-	0.1864 [0.548]	1.1637 [0.014]**	0.8579 [0.015]**
LGDP_POS	0.3277 [0.227]	-	-	-
LGDP_NEG	0.2230 [0.659]	-	-	-
INF	-0.0137 [0.073]*	-	-0.0303 [0.010]***	-0.0075 [0.216]
INF_POS	-	-0.0225 [0.013]**	-	-
INF_NEG	-	-0.0615 [0.151]	-	-
INT	0.0877 [0.004]***	0.0872 [0.003]***	-	0.0740 [0.004]***
INT_POS	-	-	-0.0203 [0.729]	-
INT_NEG	-	-	0.0506 [0.177]	-
LEXC	-1.9642 [0.005]***	-2.7980 [0.000]***	-1.3099 [0.041]**	-
LEXC_POS	-	-	-	-0.9557 [0.082]*
LEXC_NEG	-	-	-	-0.3213 [0.733]
Panel (ii): Diagnostic Tests for NARDL Estimation Results				
Tests	Model I	Model II	Model III	Model IV
Normality	2.7268 [0.256]	5.9580 [0.051]*	13.1201 [0.001]***	14.5308 [0.001]***
Functional Form	0.5544 [0.581]	0.4795 [0.633]	0.0667 [0.947]	0.4853 [0.629]
LM(1)	3.6572 [0.089]	4.5683 [0.033]**	2.6761 [0.102]	0.0001 [0.992]
LM(2)	5.0182 [0.137]	4.5955 [0.101]	2.9075 [0.234]	7.5079 [0.023]**
ARCH(1)	0.1020 [0.750]	0.4972 [0.481]	9.3210 [0.002]***	18.3757 [0.000]***
ARCH(2)	0.1074 [0.949]	8.4774 [0.014]**	9.6891 [0.008]**	18.5020 [0.000]***
CUSUM	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Unstable	Stable

Notes: The regressand is LSP. Asterisks (*), (**) and (***) indicate the null hypothesis is rejected at 10, 5 and 1% significance level respectively. The normality denotes the Jarque-Bera test based on the skewness and kurtosis of residuals tests. Functional form denotes Ramsey's RESET test utilizing the square of fitted values. Serial correlation denotes the Breusch-Godfrey Serial Correlation LM test of residual serial correlation. Heteroskedasticity denotes the ARCH test, which is based on the regression of squared residuals on squared fitted values. The figure in parentheses (...) is the lag length selection based on AIC criteria and [...] is the probability.

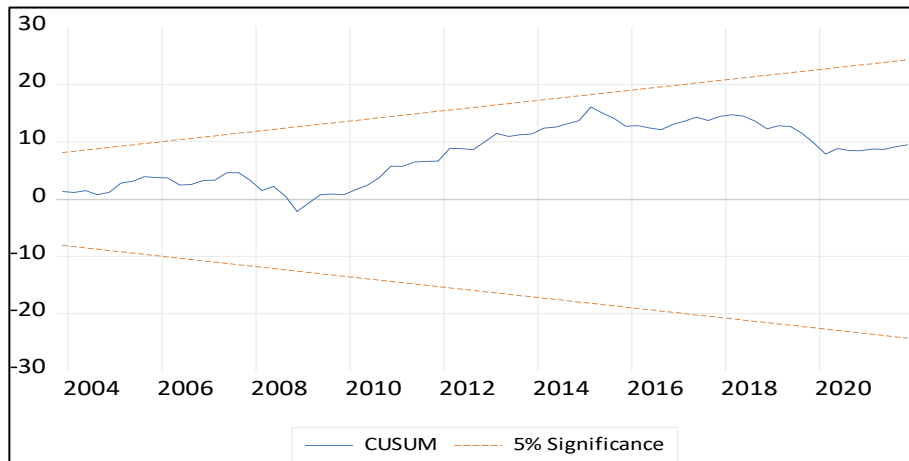


Figure 4.23: Singapore CUSUM of Model I

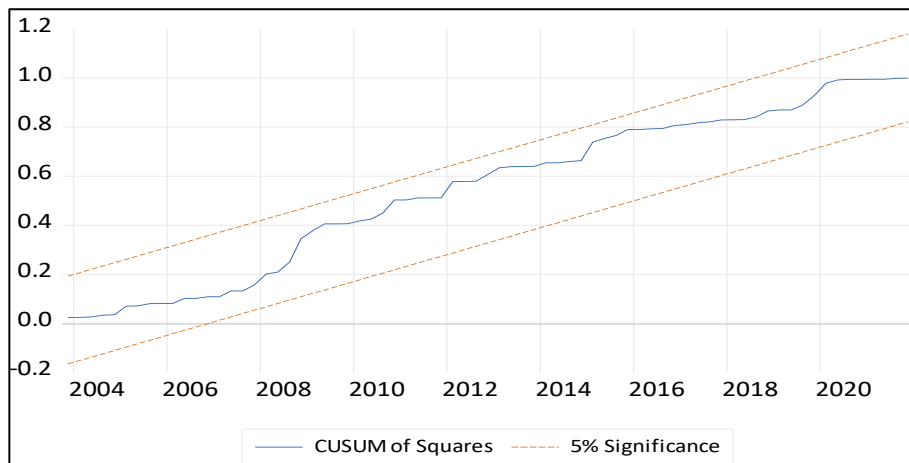


Figure 4.24: Singapore CUSUM of Squares of Model I

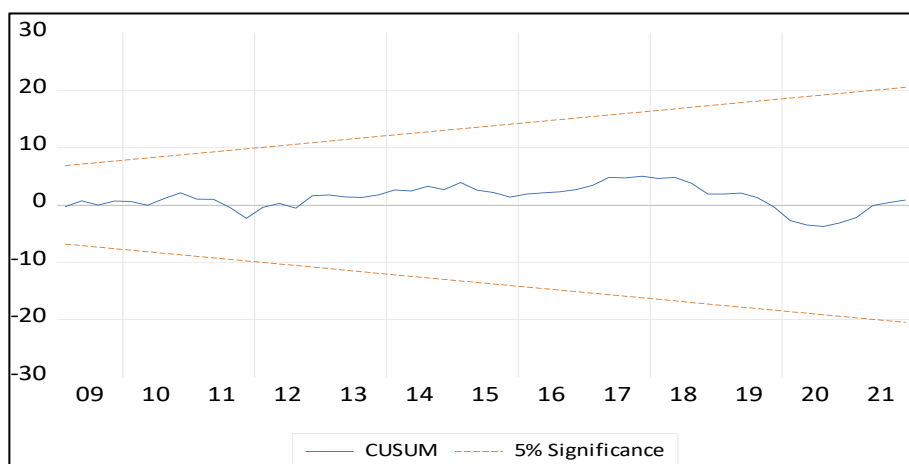


Figure 4.25: Singapore CUSUM of Model II

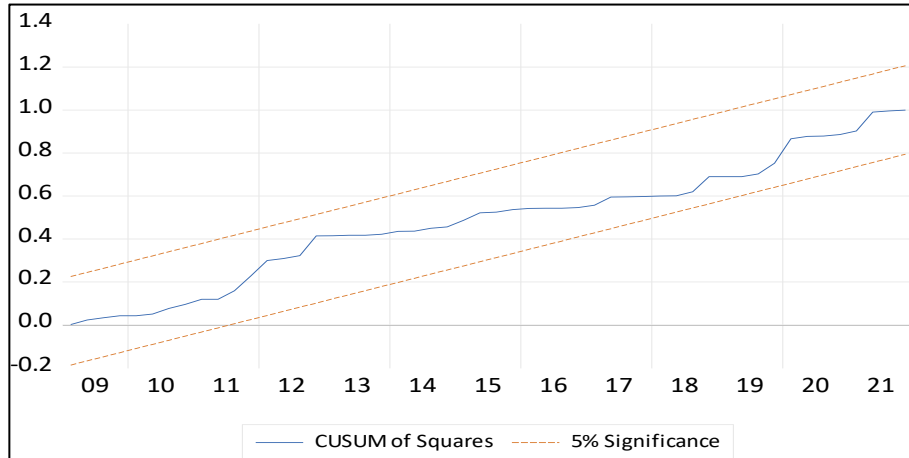


Figure 4.26: Singapore CUSUM of Squares of Model II

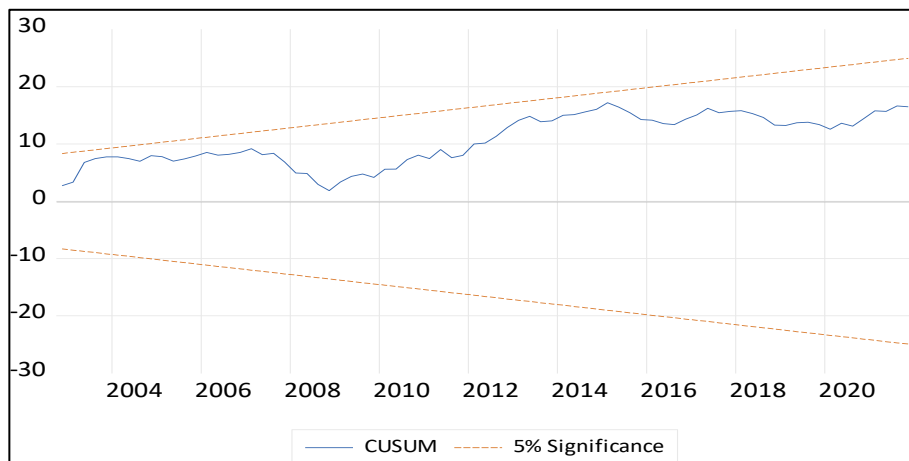


Figure 4.27: Singapore CUSUM of Model III

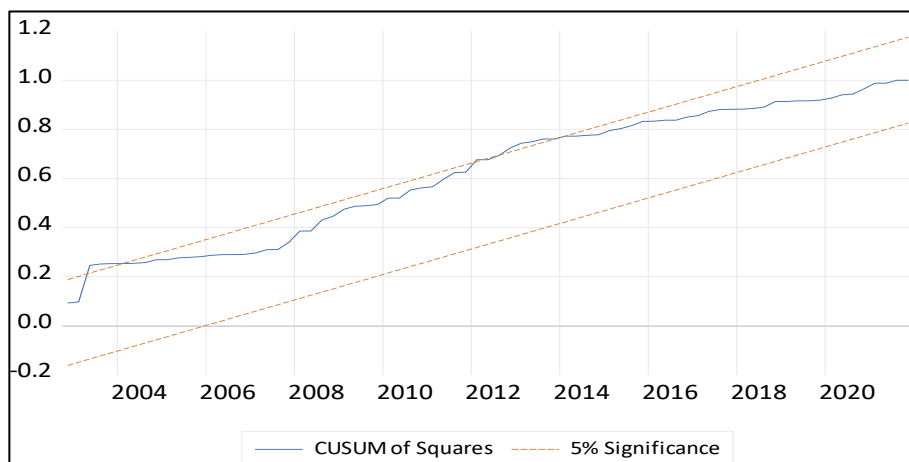


Figure 4.28: Singapore CUSUM of Squares of Model III

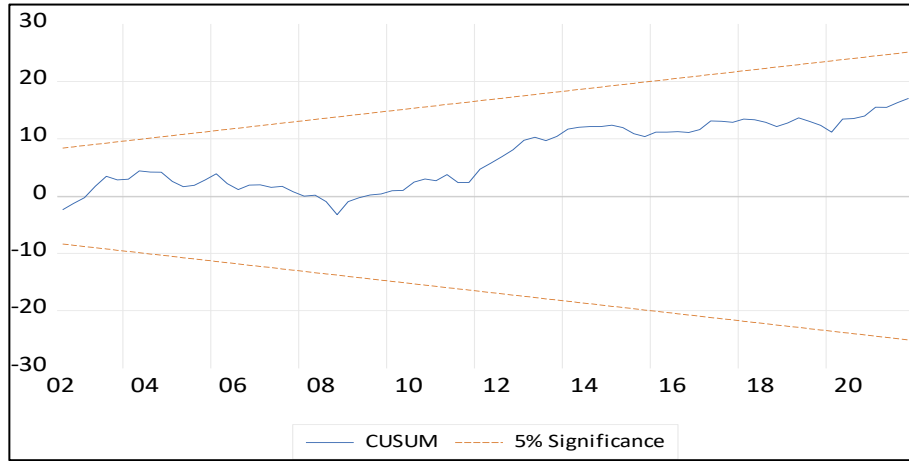


Figure 4.29: Singapore CUSUM of Model IV

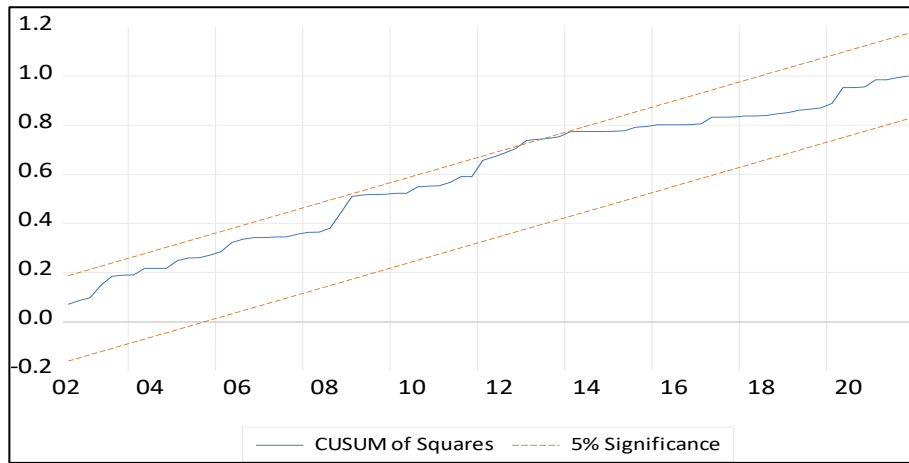


Figure 4.30: Singapore CUSUM of Squares of Model IV

4.5 Discussion

The order of integration and the stationarity properties of the variables in both the ARDL and NARDL estimated models are determined using the ADF and PP unit root tests. The utilize of ADF and PP unit root test is also suggested by Shin et al. (2014), Ibrahim (2015), Cheah et al. (2017), Dhaoui et al. (2018), Phong et al. (2019), and Yii et al. (2021). Hence, all the variables in this study were tested with the ADF and PP unit root tests. The findings of these tests indicated that there are no $I(2)$ variables, but rather a mixture of $I(0)$ and $I(1)$ variables. This satisfied the prerequisite to proceed to the bounds testing technique.

In the absence of $I(2)$ variable, the bounds testing approach of ARDL and NARDL was conducted to investigate the long-run correlation between the variables in the estimated models. Generally, the null hypothesis of “no cointegration relationship” was rejected at five percent significant level for all the models. The findings of computed F-statistic in this study are greater than the upper bound critical values provided by Pesaran et al. (2001) and Narayan (2005). Therefore, it is deduced there is presence of a long-run association between the dependent variable and explanatory variables as confirmed by Prowanta and Ratnawati (2017).

4.5.1 Macroeconomic Fundamentals and Indonesia’s Stock Prices

The result of the ARDL model for Indonesia showed the presence of a long-run correlation among the macroeconomic fundamentals and the stock prices of Indonesia. However, the model suffered from the problems of normality and heteroskedasticity. Nonetheless, the result further suggested the possibility of asymmetric impacts of macroeconomic fundamentals on stock prices. The NARDL model’s findings suggested that changes in inflation, interest rates, and exchange rates have an asymmetric influence on stock prices in both short term and long term. The adjustments in GDP have no asymmetric influence on Indonesia’s stock prices. The coefficient of the lagged ECM term for all the NARDL models are statistically significant and negative, which depicts an adjustment towards long-run equilibrium.

Based on the comparison across the five models, including both symmetry and asymmetry, the ARDL model suffered from normality and heteroskedasticity problems. Thus, the asymmetry models, especially the asymmetric inflation-stock prices model (Model II), asymmetric interest rate-stock prices model (Model III), and asymmetric exchange rate-

stock prices (Model IV) models are deemed better to explain the correlation between macroeconomic fundamentals and stock prices.

In essence, the findings of the NARDL analysis revealed that GDP has a positive and statistically significant effect on the stock prices of Indonesia. This implies that there is a positive association between GDP and stock prices in Model II, III, and IV. This indicated that both variables move parallel when there is a shock to either of the variables. The findings of Wahyudi et al. (2017) and Setiawan (2020) provide additional support to the positive and significant long-run correlation between GDP and stock prices in the case of Indonesia. This suggests that the increase in stock prices is due to the rise in GDP, as real income and its pace of growth can facilitate stock market development (Ho & Iyke, 2017). Theoretically, the growth of GDP reflects the increase in the average income of the country that spurs consumption and investment.

The result also revealed that inflation rate exhibits an asymmetric relationship with the stock prices in Indonesia (Model II). This finding shows a positive shock in inflation negatively impacts stock prices while a negative change in inflation has no significant effect on stock prices. This finding is supported by Jepkemei (2017), Wahyudi et al. (2017), Lee and Ryu (2018), Upadhyaya et al. (2018), and Eldomiaty et al. (2020). According to Erdogan and Tiriyaki (2018), there are two reasons for the negative relationship. Firstly, according to classical theory and Fama (1981), the negative relationship is induced by the negative inflation-real activity relationship, which means that the stock returns are positively correlated with the real output. Another perspective to consider is the Keynesian approach, which posits a positive correlation between economic activity and stock returns. According

to this view, there is a direct connection between economic activity and the price level, which subsequently influences stock returns.

Furthermore, in Model III, the findings also indicated the presence of an asymmetric long-run correlation between stock prices and interest rates. This finding aligns with previous studies conducted by Erdogan and Tiryaki (2018) on G7 countries and Yacouba and Altintas (2019) on Turkey. The results also suggest that positive shocks of interest rates do not have a statistically significant influence on stock prices. However, negative shocks of interest rates are discovered to have a negative and statistically significant effect on stock prices. This suggests that decreases in interest rates can exert a downward pressure on stock prices, indicating an inverse association between interest rates and stock market performance which is according to the theory. Erdogan and Tiryaki (2018) stated that a rise in interest rates hurts economic activity and eventually declining stock prices. The Keynesian theory states that a negative correlation between interest rates and stock returns exists for two reasons. Firstly, a shift in expansionary monetary policy that lowers interest rates makes bonds less appealing than shares, driving up the price of stocks. Secondly, a rise in money supply results in a decline in interest rates, which in turn boosts investment, GDP, and ultimately stock prices.

The findings from Model IV suggest the existence of a long-run asymmetric cointegration between stock prices and the exchange rate. Furthermore, the study highlights that the nature of the correlation can be influenced by a country's role as an exporter or importer in the economy. According to Mohamed and Sahin (2020), this factor can affect the sign and magnitude of the exchange rate coefficient. The US dollar serves as a commonly used benchmark in the foreign exchange market for determining the value of a nation's

currency. It is widely accepted as a reference point due to the economic strength and global significance of the United States. The use of the US dollar as a benchmark provides a standardized and easily understandable reference point for comparing and valuing different currencies. The result indicated that the rise in EXC (appreciation of the domestic currency) has a positive and significant effect on stock prices. This positive and significant influence on Indonesia's stock prices has been explained by Wahyudi et al. (2017a), who stated that an increase in the foreign exchange rate (USD) leads to negative sentiment in the domestic stock market.

Indonesia imports various goods and raw materials for its industries. When there is a depreciation in the currency rate, inflation is projected to rise, which subsequently increases the cost of imports. This is because a depreciated currency makes foreign currencies more expensive to buy, causing imports to become more expensive and exports to become cheaper. Inversely, an appreciation in the exchange rate often brings down inflation, which lowers the cost of imports. An appreciation of the exchange rate can help lower inflationary pressures by making imported goods cheaper. This can lead to lower inflation expectations, prompting the central bank to adopt accommodative monetary policies, such as lowering interest rates. Lower interest rates can stimulate economic growth, increase investment activities, and have a positive effect on stock prices. Moreover, this can lead to improved profit margins, which can positively impact on stock prices of companies operating in these sectors. A stronger exchange rate can make Indonesian assets more attractive to foreign investors. It enhances the returns on investments for foreign investors when they convert their profits back into their home currency. Increased foreign investment inflows can contribute to higher liquidity in the stock market and drive stock prices higher. This results in the foreign exchange market being perceived as more favorable by investors

and encourages capital outflow from the local stock market. However, Setiawan (2020) discovered that Indonesian share prices are not affected by the exchange rate.

All models I, II, III, and IV have passed the diagnostic test.

Table 4.16: Summary of the Results for Indonesia

Variables	ARDL	NARDL		NARDL		NARDL		NARDL	
		(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
LGDP	+	+	-	+***		+***		+***	
INF	-	+		***	+	***		-	
INT	-	***		***		-	***	-	
LEXC	+	-		***		+*		***	+

This study answers the research question by showing the existence of an asymmetric long-run correlation between stock returns and macroeconomic fundamentals in Indonesia. Specifically, there is an asymmetric long-run relationship between stock prices with inflation, interest rates, and exchange rates. The increase in interest rates leads to a decrease in stock prices is shown in Model III which is according to the theory. An appreciation of the local currency would lead to an increase in stock prices. The finding of the study also confirmed that GDP and stock prices are positively related in symmetrical way. The real activity will influence stock prices which ultimately influence the economy. Hence, the asymmetries in the relationship should be taken into consideration in the policy-making process to achieve long-run economic growth in Indonesia. as stock markets and economic growth are closely related.

4.5.2 Macroeconomic Fundamentals and Malaysia's Stock Prices

In the case of Malaysia, research on the macroeconomic stock market relationship is limited. The findings from the linear ARDL estimation of the stock market model indicated that GDP and interest rate have a positive and significant impact on the stock price. The positive nexus between GDP and stock prices indicates that economic growth, as measured by GDP, has a positive influence on investor sentiment and stock market performance. Economic growth tends to lead to higher revenues and earnings for companies, and this may lead to higher stock prices as investors anticipate future returns. A possible explanation for a positive nexus between interest rate and stock prices could be because lower interest rate can make borrowing more affordable, stimulating economic activity and potentially boosting stock prices. However, the model suffered from normality and heteroskedasticity problems despite being stable. This suggests that the influence of macroeconomic fundamentals on stock prices may be asymmetric.

In nonlinear ARDL Model I, the estimates showed that both positive and negative changes in GDP have a positive and statistically significant impact on Malaysia's stock market. This result corresponds to Chia et al. (2015), Wahyudi et al. (2017a), Kalam (2020), and Setiawan (2020). The finding of a negative and significant association between inflation and stock prices aligns with theoretical expectations. According to economic theory, an increase in inflation can have adverse effects on stock prices. When inflation rises, it erodes the purchasing power of consumers, which may reduce consumption. Reduced consumer spending can have a negative impact on corporate profits and eventually dampen stock prices. Moreover, inflation is often associated with higher interest rates, which can increase the cost of borrowing for businesses, further affecting their profitability and consequently influencing stock prices. This means that a rise in the consumer price index decreases share

prices. However, the results in this model indicate that interest rates and exchange rates have no significant impact on stock prices similar to the study of Mahpudin and Batu (2021).

The result of Model II revealed that GDP has a positive and statistically significant correlation with stock prices whereas other variables are insignificant. This is similar to the study of Mahpudin and Batu (2021) where inflation, interest rate, and exchange rate had no influence on stock prices. However, Model II suffered from serial correlation problem, and thus not further considered. In the study by Wei (2007), there is substantial evidence on the negative changes to equities returns due to unanticipated inflation that are more severe during economic crises.

The findings from Model III indicate the presence of a long-run asymmetric correlation between stock prices and interest rates, suggesting that changes in interest rates have different effects on the stock market. It's key to note that other variables in the model were also found to be significant. The positive changes of interest rate on stock price are statistically significant, but not for the negative changes. The interest rate is a significant macroeconomic indicator that is closely related to economic growth as stated by Alam and Uddin (2009). The positive finding is similar to the empirical result of Chia and Lim (2015) for the case of Malaysia but contradicts the theory of a negative relationship because stock prices are a harbinger of the economy. According to Chia and Lim (2015), the overall effect on the stock market is expected to be positive when the central bank raises interest rates in order to curb inflationary pressures resulting from robust economic growth. The rationale is that higher interest rates may help control inflation through reduced spending and borrowing, leading to a more stable economic environment. In addition to that, the GDP, interest rate

and exchange rate indicated correct and statistically significant effect on the stock prices in Malaysia.

The results also supported an asymmetric long-run influence of changes in exchange rate on stock prices which is shown in Model IV. This means that a depreciation of domestic currency increases stock prices. Theoretically, currency depreciation leads to an improvement in the competitiveness of export companies, which in turn boosts equity returns. This finding is consistent with Yacouba and Altintas (2019). In addition, the GDP reveals a positive and significant influence on stock prices which is coherent with economic theory. However, the inflation and interest rate are insignificant in this model.

For the diagnosis check, Model II was suffered by serial correlation issues. All diagnostic tests were passed by Models I, III and IV. In conclusion, the parsimonious models for Malaysia are Model I, Model III, and Model IV.

Table 4.17: Summary of the Results for Malaysia

Variables	ARDL	NARDL		NARDL		NARDL		NARDL	
		(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
LGDP	+***	+***	+***	+***		+***		+**	
INF	-	-**		-	-	-***		+	
INT	+**	+		+		+***	-	+	
LEXC	+	+		+		+**		+	+**

The results of this study demonstrate that there is an asymmetrical long-term correlation between stock returns and macroeconomic fundamentals in Malaysia, which is the research issue. Nonetheless, the long-term relationship between stock prices and interest rates and the exchange rate is nonlinear. The results indicated the consistent positive

relationship between GDP and stock prices in all models. The result also infers that the relationship between inflation and stock prices is negative in most of the models. A possible theory explanation on this is inflation erodes the purchasing power of money over time. Model III shows that the positive changes in interest rates positively affect the stock prices while negative changes in interest rates are insignificant. This might be due to increasing interest rates drive investors to stay in the stock market. The result also illustrates that depreciation of domestic currency will increase stock prices as this enhanced the export which benefits the stock markets.

4.5.3 Macroeconomic Fundamentals and Singapore's Stock Prices

The findings from the linear ARDL estimation of the stock market model indicated that GDP and inflation are found to be insignificant on the stock price. The interest rate and exchange rate were discovered to have a significant effect on the stock prices. However, the model suffered from normality and heteroskedasticity problems despite being stable. Thus, suggesting that there might be existence of nonlinear.

For Singapore, Model I depicted that both positive and negative changes of GDP have insignificant effect on stock prices. Gajdka and Pietraszewski (2016) observed that the common perception of real economic growth driving stock returns does not hold true in their research. Specifically, their findings indicated no significant correlation among stock returns and economic growth in developed nations and selected emerging markets. However, inflation, interest rates, and exchange rates were reported to be significant in this model. When inflation increases, the stock prices will decrease, which is simultaneously as the theory. When interest rate increases, the stock prices also increase. This finding is supported by Murkherjee and Naka (1995) and Panda (2008) as the positive correlation between stock

prices and short-term interest rate. In addition, the result showed that an appreciation of domestic currency decreases stock prices.

In Model II, the model that estimated the asymmetric long-run correlation between inflation and stock prices revealed positive shocks of inflation negatively affect the stock prices and is significant association while the negative shocks of inflation and stock prices relationship is insignificant. This contradicts Fama (1981) and Chen et al. (1986), who supported a negative correlation between inflation and stock prices because an increase in production costs leads to higher future profits and stock prices. However, Wahyudi et al. (2017a) opined that inflation is pushed by increase in production costs. This is because a higher cost reduces purchasing power, and thus pushes up the cost of goods and services. The results also showed that GDP positively impacted stock prices. However, it is not significant. The interest rate and exchange rate have shown a similar result as Model I.

In Model III, the asymmetric impact of interest rate on stock prices is insignificant. This indicates that both positive and negative changes of interest rates have no impact on stock prices in Singapore. However, GDP and inflation are parallel with the expected signs and are statistically significant. In this case, GDP is found to have a positive correlation with stock prices and inflation is found to have an adverse association with stock prices. In addition, when the exchange rate increases (appreciation of domestic currency), the stock prices would respond by decreasing in the prices. Appreciation of domestic currency would benefit local businesses.

For the asymmetric long-run correlation between stock prices and exchange rate in Model IV, the result showed that an increment in the exchange rate (appreciation of local currency) decreases stock prices while a decrement in the exchange rate has insignificant

effect on stock prices. If a domestic currency appreciates, exports may become more expensive and domestic companies may become less competitive internationally. As a result, the revenues and profits of export-oriented companies may be lower, which can have an adverse influence on their stock prices. The sign of coefficient GDP and inflation is accurate. However, only GDP is statistically significant. The positive correlation between stock prices and interest rates contradict the theory that the relationship should move in opposite directions. However, for the countries that are in need of foreign financing as portfolio investments, an increase in interest rates can cause the currency to appreciate in real terms and increase the stock prices. In this case, the expected sign becomes positive (Erdogan & Tiryaki, 2018).

Based on the results of ARDL and NARDL, Model I is the best model for Singapore as other models suffered from diagnostic test problem.

Table 4.18: Summary of the Results for Singapore

Variables	ARDL	NARDL		NARDL		NARDL		NARDL	
		(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
LGDP	+	+	+	+		***		***	
INF	-	-*		-**	-	-***		-	
INT	+***	+***		+***		-	+	+***	
LEXC	-***	-***		-***		-**		-*	-

Based on the Singapore results, both asymmetric inflation and exchange rate are asymmetric effects the stock prices while GDP and exchange rate do not affect the stock price asymmetrically. Nevertheless, the GDP has a positive relationship toward stock prices. Meanwhile, the increase in inflation will decrease stock prices. Central banks often respond

to inflation by adjusting interest rates. Higher inflation might lead to higher interest rates to curb spending which might impact on stock prices negatively. When the exchange rate increases, the stock prices decrease. Singapore is an import country, thus depreciation of local currency cause import become more expensive, which in turn influences stock market.

4.6 Concluding Remark

Taking into account potential asymmetries in the behaviour of the selected variables, the objective of this study was to examine the impact of macroeconomic fundamentals on stock prices in Indonesia, Malaysia and Singapore. The selected macroeconomic fundamentals included variables such as GDP, inflation, interest rates, and exchange rates. The ARDL and NARDL approaches have been utilized to accomplish the goals of the study. To determine the order of integration of the selected variables, the ADF and PP unit root tests were conducted. This is to ensure no $I(2)$ variables.

In order to examine the long-run symmetric relationship between macroeconomic variables and stock prices, the ARDL approach was used in this study. The ARDL bounds test for cointegration was conducted to assess whether a long-run association exists between the macroeconomic fundamentals and stock prices. The ECM was used to identify the long-run cointegration via the ECT, with long-run relationships found in most of the models. The estimated long-run coefficients were used to obtain the parsimonious models for each country. The NARDL approach has also been employed to detect the asymmetric correlation between macroeconomic fundamentals and stock prices in the long run.

There are some significant results revealed from the above procedures. Firstly, the diagnostic test statistic implied that the NARDL models are more precisely defined, have better fit, and exhibit more stability than linear ARDL models. The parsimonious models for

Indonesia are the asymmetric inflation-stock prices model, the asymmetric interest rate-stock prices model, and the asymmetric exchange rate-stock prices model. For Malaysia, the asymmetric interest rate-stock prices model and the asymmetric exchange rate-stock prices model showed non-linear effect of these two macroeconomic fundamentals on stock prices. Nevertheless, an asymmetric impact of inflation and exchange rate on stock prices has been found for Singapore. However, the models suffer from normality problem, we should interpret the results cautiously.

CHAPTER 5

CONCLUSION

5.1 Introduction

Chapter 5 concludes the study by summarizing the key findings, providing policy recommendations, discussing limitations, and suggesting areas for future research. Section 5.1 offers a comprehensive summary of the chapter, highlighting the main findings and insights derived from the analysis conducted in the study. In Section 5.2, the conclusion of the study is presented, summarizing the overall findings and their implications. Section 5.3 presents policy recommendations based on the findings of the study. Section 5.4 acknowledges the limitations of the study. It discusses any constraints, challenges, or shortcomings encountered during the research process that may have affected the reliability or generalizability of the findings. Lastly, in Section 5.5, suggestions for future research are provided.

5.2 Summary

This study aimed to examine the correlation between the stock market and macroeconomic fundamentals in Indonesia, Malaysia, and Singapore using quarterly observations from 1999 to 2021. The study looked into the nonlinear effect of macroeconomics fundamentals on the stock market using the NARDL approach. The approached was proposed by Shin et al. (2014), which decomposes the variables into positive and negative partial sums to examine short-term and long-term asymmetric effects.

GDP is an important indicator of the size and growth rate of the economy. It is a evaluate of the overall value of final goods and services. By quantifying economic output,

GDP provides an insight into the level of economic activity, productivity, and overall economic well-being. Other macroeconomic fundamentals include inflation, interest rate, and exchange rate. The selected countries practise different monetary policy, utilizing different monetary tools to achieve their objectives to control inflation, manage unemployment, and maintain long-term interest rates. Another factor included is inflation as this is closely related to the purchasing power of the people. As the general price level rises, the amount of money available for the purchase of goods and services will be less. This reduction in purchasing power can have an adverse impact on consumer spending, company profitability and company profits. In addition, the interest rate is one of the channels through which the stock market reacts to monetary policy issues. As interest rates are primarily related to economic activity through consumption and investment, lower interest rates make it cheaper to borrow for investment and finance. This would therefore affect the allocation of investors' resources. The nexus between exchange rate and stock prices is based on simple financial theory where exchange rates affect the foreign investment flows and relative prices of imports goods and services. Therefore, influence importers, exporters, or firm facing foreign competition.

Econometric procedures have been used improve model performance. Following the methodology of Shin et al. (2014) and Setiawan (2020), GDP, inflation, interest rate, and exchange rate were chosen for this study. The results are expected to enhance the current understanding on the influence of GDP, inflation, interest rate, and exchange rate on stock prices. Both ARDL approach and NARDL approach were employed to capture symmetric and asymmetric effects. In NARDL approach, the study is separated into four models to study the asymmetric impact of each selected macroeconomic fundamentals on the stock prices namely Model I (Asymmetric GDP-stock prices model), Model II (Asymmetric

inflation-stock prices model), Model III (Asymmetric interest rate-stock prices model), and Model IV (Asymmetric exchange rate-stock prices model).

The results of the ARDL approach depicted inconclusive relationship among the variables for all three countries. As such, it was postulated that the relationship could be asymmetric. To address this, the NARDL approach was used. The results support that stock prices are nonlinearly associated to macroeconomic fundamentals. This implies that the stock market is highly sensitive to changes in selected macroeconomic variables, either positively or negatively. This conclusion echoes that drawn by Dhaoui et al. (2018). Substantially, this finding can assist investors in adjusting their investment strategies, given them better understanding for long-term portfolio planning.

In general, the bounds test revealed that all estimate models exhibited the existence of a long-run correlation among the explanatory factors and the dependent variable. The validation of ECT from the ECM further supports the presence of the long-run if certain requirements are met, such as the coefficient of the ECT being negative, the value being less than one, and it being significant.

The estimates were conducted for the three countries. Based on the parsimonious model derived from the estimates, inflation, interest rate and exchange rate indicated the existence of asymmetric effect toward stock prices in Indonesia. In the long-run, an increment in inflation (positive influence in inflation) will result decrease in stock prices, while a decrease in interest rates (negative influence in interest) will result in decreasing stock prices. Finally, stock prices will fall if the exchange rate rises (the local currency appreciates). Therefore, these results suggest the correlation between inflation and interest rate with stock prices are align with the Keynesian theory where there are positive

association between economic activity (stock prices) and price level (inflation). This theory also states that lowering interest rates make bonds less appealing than shares, thus boosting the stock prices. The appreciation of domestic currency is likely to bring down inflation, thus lowering the cost of import.

In contrast, Model III and Model IV for Malaysia, the findings revealed the existence of a long-run asymmetric relationship. The positive shock of interest rate will result in rise in stock prices and is statistically significant, while the negative shock of interest rate is insignificant. However, this finding is contradicting to theory where stock prices are a harbinger of the economy (Chia & Lim, 2015). In addition, the depreciation of domestic currency increases the stock prices which is consistent with the theory. When domestic currency depreciates, local product would become cheaper for foreigner, thus increase the demand. This would raise the profits for export-oriented firms, ultimately increase stock prices.

For Singapore, the results reveal nonlinear impact of inflation and exchange rate on stock prices. Nonetheless, the models suffer from diagnostic test.

5.3 Policy Recommendation

This study revealed GDP, inflation, interest rate and exchange rate are all important macroeconomic fundamentals to stock prices estimation and should be considered in the policy-making process. These macroeconomic fundamentals can also be used as part of the economy stabilization toolkit, complementing the primary monetary policy, to achieve market stabilization and growth. On individual level, investors may monitor these economic fundamentals to predict future market trends.

In Indonesia, the monetary policy employs inflation targeting. The exchange rate can indeed serve as a transmission mechanism for monetary policy. The results show that inflation, interest rates and exchange rates are asymmetric in influencing stock prices. Thus, monetary variables are crucial to Indonesia.

Malaysia's monetary policy focuses on interest rate. Malaysia is also experiencing an outflow of fixed investment due to currency depreciation (Asian Development Bank, 2015). The exchange rate is a key transmission channel as well that affects the domestic or external demand as well as import prices and thus, prices that investors pay. These have a trickling down effect on inflation. Based on the results, interest rate has an asymmetric effect on stock prices. It is hardly unexpected that interest rate targeting has been the main transmission mechanism of the Malaysian monetary policy is not surprising. This is because researcher like Kuang (2008) has found that the interest rate channel is fourfold as efficient as the exchange rate channel in acting as the transmission mechanism of monetary policy.

Since the exchange rate is stable for Singapore, the policy challenge is to sustain durable growth by promoting export-oriented companies, investment abroad and others (Asian Development Bank, 2015). Singapore utilizes spot or forward transactions to interfere in the foreign exchange market when the exchange rate approaches the limit of the policy band. Additionally, because Singapore has long been a major international financial hub, the stock prices variable may be able to reflect the impact of financial liberalisation. The strong correlation between monetary policy and financial investments, as reported by Eldomiaty et al. (2018), suggest that stable real interest rates are necessary for stock market activity, which in turn requires the greatest feasible control over inflation rates. In the long-run, a stable

exchange rate can be achieved if monetary authorities monitor the stability in price and monetary conditions.

5.4 Limitation of the Study

This study has not considered the full spectrum of macroeconomic and microeconomic elements that may affect stock prices in all three countries. Within the existing body of literature, there is also no explicit theoretical guideline for selecting an optimal set of macroeconomic indicators and the inclusion of more variables in the model can increase its complexity and reduce its interpretability. Thus, the results should not be generalized due to country-specific differences in geography, politics and policies.

Due to the limitation of existing literature on the asymmetry effect of various macro fundamentals on stock market, there is a lack of basis for neither compare nor support the current findings. However, this also proves that there is ample room for improvement on the subject matter in future studies.

The application of secondary time series data, limited to quarterly data from 1999 to 2021 for Indonesia, Malaysia and Singapore, is also a limitation because it may be altered and influenced by the national economic climate. The approaches used, which are ARDL and NARDL, also has its limitations and may not provide accurate results. Additionally, the estimation of NARDL models can be computationally intensive and require large sample sizes to achieve reliable estimates. Following Wolpert's (1996) and Wolpert & Macready's (1997) "No Free Lunch" proposition, there is widespread recognition that no single method is superior to another in terms of accuracy in all scenarios, and that all methods are subject to limitations. Moreover, Chang and Rajput (2018) conclude that the overall results depend

on the sample time frame chosen. Without taking into account the financial crisis, all decisions made about investments or policies may not be accurately reflective of the reality.

Future research should consider the non-linear effects and employ non-linear techniques for better analysis of the correlation between macroeconomic fundamentals and stock prices. Asymmetric effects of macroeconomics fundamentals can be especially powerful during financial crises, and these effects ought to be comprehensively understood. The study can also be improved by using more complete and specific data as well as varying period to provide more precise insights on the stock market. This should ideally include periods of financial crises. There is now a growing global consensus that achieving price stability is not sufficient to ensure macroeconomic stability. Macroeconomic instability often stems from financial sector instability, even when inflation is kept low (Bean et al., 2010). As such, a wider study period, coupled with the right techniques to study both linearity and nonlinearity, is a highly recommended way forward for future studies.

In conclusion, the study has limitations in terms of the selection of macroeconomic indicators, the difficulty in generalizing results, the application of secondary time-series data, and the limitations of the chosen methods. Despite these limitations, the results provide a starting point for future study on the asymmetric influence of macroeconomic fundamentals on the stock market. Future studies can be improved by considering non-linear relationships and using more complete and specific data, and these findings can be adopted by other countries to better understand the correlation between macro fundamentals and the stock market. This understanding is crucial for creating effective and efficient policies and mitigating financial risk and crises.

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APPENDICES

Table 1 Summary of Review on ARDL

Author (Year)	Variable	Sample	Methodology	Findings
Hasan and Javed (2009)	☐ Stock market returns (Equity market) ☐ Money supply (Narrow money, M1) ☐ Treasury bill rates (Proxy for the interest rate) ☐ Foreign exchange rates ☐ Consumer price index (INF)	☐ Pakistani ☐ June 1998 – June 2009 ☐ Monthly data	☐ Multivariate cointegration analysis ☐ VECM	☐ Money supply, a positive relationship supports the liquidity hypothesis. ☐ Interest rate and exchange rate shock have a negative impact on equity market. ☐ VECM confirms the presence of a short-term relationship between monetary variables and equity returns.
Humpe and Macmillan (2009)	☐ Stock prices ☐ Industrial production index ☐ Consumer price index ☐ Money supply ☐ Long term interest rate	☐ US ☐ Japan ☐ January 1965 - June 2005 ☐ Monthly data	☐ Cointegration analysis ☐ Vector error correction model (VECM) ☐ ADF and PP tests	☐ For US, the data are consistent with a single cointegrating vector, where stock prices are positively related to industrial production and negatively related to both the consumer price index and a long-term interest rate. An insignificant (although positive) relationship between US stock prices and the money supply. ☐ However, two cointegrating vectors are found for Japan. First vector shows that stock prices are influenced positively by industrial production and negatively by the money supply. For the second cointegrating vector we find industrial production to be negatively influenced by the consumer price index and a long-term interest rate.

				These contrasting results may be due to the slump in the Japanese economy during the 1990s and consequent liquidity trap.
Lee (2010)	- Stock returns (S&P 500 Composite Index) - Dividend yields (Robert Shiller's website) - CRSP value weighted returns - Dividend yield formula (3 month T-bill rate) - Inflation	- US and international data 1927 – 2007 - Monthly data	VAR estimates	- The two-regime hypothesis that introduces positive and negative inflation shocks can be easily compatible with both pre- and post-war relations in the US. - The stock return–inflation relation can be time-varying depending on the interaction between competing economic forces.
Alagidede et al. (2011)	- Stock price - Exchange rates	- Australia, Canada, Japan, Switzerland, and UK - January 1992 – December 2005	- ADF, PP, and KPSS unit root test - Cointegration test - Granger causality (3 variations) - VECM approach	- No evidence of long-run relationship between the variables. - There is causal linkage from exchange rate to stock prices in Canada, Switzerland, and UK. - In Hsiao's version test, causal linkage from stock price to exchange rate is only found for Switzerland. - Non-linear causality through Hiemstra-Jones test show there is causal linkage from stock price to exchange rate to Japan.
Geetha et al. (2011)	- Stock returns - Inflation - Interest rate - Exchange rate - GDP	- US, Malaysia, and China - January 2000 – November 2009	- Cointegration test - Vector Error Correction Modelling	- The study revealed that there is long run relationship between expected and unexpected inflation with stock returns but there is no short run relationship between these variables for Malaysia and US but it exists for China. - The result of VEC show no short run relationship between the stock market, expected inflation, exchange

				rate, unexpected inflation, interest rate and GDP for Malaysia and US. ☐ A significant short-run relationship in between stock market and expected inflation rate of China. ☐ significant relationship between exchange rate and stock market in China. ☐ From the result, recommended that Malaysia, US and China should utilizing the information on expected inflation, unexpected inflation, exchange rate, interest rate and GDP to forecast the movement of stock market.
Issahaku et al. (2013)	☐ Stock returns (Ghana Stock Exchange) ☐ Exchange rate (cedi/USD) ☐ Inflation (CPI) ☐ Money supply ☐ Treasury-bill rate ☐ Foreign Direct Investment (FDI)	☐ Ghana ☐ January 1995 – December 2010 ☐ Monthly data	☐ VECM model ☐ ADF, PP and KPSS tests ☐ Pair-wise Granger causality test ☐ Impulse response functions ☐ Forecast error variance decomposition	☐ In the short-run, a significant relationship exists between stock returns and macroeconomic variables such as interest rate, inflation and money supply. ☐ A causal relationship running from inflation and exchange rate to stock returns has been established. ☐ Arbitrage profit opportunities exist in the Ghana stock market contrary to the dictates of the Efficient Market Hypothesis (EMH). ☐ The results indicate that all macroeconomic variables except treasury bill (LTBILL) are statistically significant. ☐ Money supply (LMS) impacts negatively on stock performance of companies listed on GSE while Consumer Price Index (LCPI), exchange rate (LEXR) and Foreign Direct Investment (LFDI) exert positive influence on stock returns. ☐ According to Fama (1981), an increase in money supply leads to an increase in both inflation and the discount rate which then lead to a fall in stock prices. ☐ This positive relationship suggests that investors are compensated for inflation and that the GSE cannot be used as a hedge against inflation since investors will

				require higher returns to compensate for high inflation (Kuwornu, 2012). □ An appreciation of the cedi leads to a decrease in price of imported inputs which constitutes a large part of factor inputs of industries in Ghana. It also leads to an increase in reserve, money supply and a fall in the interest rate. This lowers the cost of production leading to increased business activity and hence increased stock returns.
Lee and Zhao (2014)	□ Stock prices □ Exchange rates □ Macroeconomic variables (M2, inflation rate, and short-run interest rate) as the omitted variable bias	□ China □ January 2002 – December 2012 □ Monthly data	□ Unit root □ Cointegration tests □ Vector error correction estimates	□ There exists long-run causality from exchange rates to stock prices in Chinese stock markets. □ The global financial crisis of 2007-2009 has no impact on the stock price dynamics in the Chinese stock markets.
Ahmed et al. (2015)	□ Stock prices (Closing stock price indices of Dhaka Stock Exchange (DSE)) □ Inflation	□ Bangladesh □ 2004 – 2013 □ Monthly data	□ ADF and PP □ Johansen test □ VECM	□ There is a uni-directional short run causal relationship between inflation and stock price index.
Fowowe (2015)	□ Stock prices □ Exchange rates	□ South Africa & Nigeria □ January 2003 – December 2013	□ ADF, PP and KPSS unit root tests □ Johansen cointegration tests □ Multivariate block exogeneity causality tests	□ Cointegration exists between stock prices and exchange rates in Nigeria while no such relationship exists in South Africa. □ Multivariate causality tests showed that causality runs from exchange rates to domestic stock prices in Nigeria, while no evidence for South Africa. □ With structural breaks, cointegrating relationship exists in South Africa but no cointegrating relationship exists between the variables in Nigeria.

			☐ Zivot and Andrews structural break unit root test ☐ Gregory and Hansen structural break cointegration test	
Suriani et al. (2015)	☐ Stock market ☐ Exchange rate	☐ Pakistan ☐ January 2004 – December 2009 ☐ Monthly data	☐ ADF unit root test ☐ Granger causality test	☐ There is no relationship exists between exchange rate and stock price and both the variables are independent of each other.
Amata et al. (2016)	☐ Stock market volatility ☐ Interest rate ☐ Inflation rate	☐ Kenya ☐ January 2001 – December 2014 ☐ Monthly data	☐ Survey ☐ VECM ☐ Granger Causality Test	☐ Positive and significant long run relationship between inflation rate and stock market volatility. ☐ Positive and significant short run relationship between inflation and stock market volatility. ☐ The relationship between interest rate and stock market volatility was found to be negative and weakly significant.
Silva (2016)	☐ Stock price index (Colombo Stock Exchange) ☐ Stock returns ☐ Inflation rate ☐ Inflation growth rate	☐ Sri Lanka ☐ 2004 – 2014 ☐ Monthly data	☐ Linear regression model	☐ Results of the study reveal a negative relationship between inflation rate and stock prices. ☐ Percentage change approach in the study discloses a positive relationship between growth rate of inflation and stock returns.
Afshan et al. (2017)	☐ Stock prices ☐ Exchange rate	☐ Pakistan ☐ 1999 – 2016 ☐ Weekly data	☐ Wavelets approach ☐ ADF, PP and Zivot and	☐ Both stock and exchange markets are vital to bringing prosperity in a country's financial system.

			Andrew unit root tests with structural break effect. ☐ Granger and Johansen test	☐ GH threshold cointegration test to overcome the issues of structural breaks in a long time series which we faced in our study. ☐ The study evidences the strong coherence between both the series and the existence of bidirectional causality in the long timescale.
Ho and Iyke (2017)	☐ Stock market development ☐ Macroeconomic factors (Economic development, banking sector development, inflation rate, interest rate, exchange rate, private capital flows) ☐ Institutional factors (Legal origin, legal protection, corporate governance, financial market liberalisation, stock market integration, trade openness)	☐ Various	☐ Review of literature: theoretical and empirical	☐ Real income and its growth rate can foster stock market development. ☐ Banking sector can be viewed either as substitute or complement of stock market. ☐ Inflation rate is negatively related to the stock market growth in a non-linear fashion. ☐ Interest rate can have negative or positive relationship with the stock market development. ☐ Exchange rate movement is negatively associated with stock market development. In particular, currency appreciation can adversely affect stock prices. ☐ Private capital flows can have either positive or negative impact on stock market.
Jamaludin et al. (2017)	☐ Conventional and Islamic stock returns (Stock market index) ☐ Inflation ☐ Money supply (MS)	☐ Singapore, Malaysia, and Indonesia ☐ January 2005 – December 2015 ☐ Monthly data	☐ Panel Data Regression Analysis ☐ Panel least square analysis	☐ Inflation poses a greater effect and inversely related to the SR. ☐ Amendment in monetary policy to ensure that inflation rate is set at a low level to boost the capital market.

	☐ Exchange rate (ER)			
Jepkemei (2017)	☐ Stock market performance (stock market liquidity – turnover rate) ☐ Inflation (CPI) ☐ GDP growth rate	☐ Kenya ☐ 2002 – 2011 ☐ Annual data	☐ Causal research design	☐ From the findings of this study, it can be concluded that inflation rate has a negative impact on the liquidity of the Nairobi Securities Exchange. ☐ The findings from this study also emphasize on the role of the stock exchange market in directing economic growth.
Prowanta et al. (2017)	☐ Stock price index ☐ GDP ☐ Inflation ☐ Interest rates ☐ Exchange rates ☐ Foreign exchange reserves ☐ Current accounts ☐ Export-import	☐ ASEAN-5 countries ☐ 2006 – 2015 ☐ Monthly data	☐ Regression estimation of panel data ☐ Series of chow test (Hausman test and LM test)	☐ GDP, interest rates, exchange rates, and inflation showed a significant effect on stock price index. ☐ The test of common effect is used to select the variable used for data panel regression.
Wahyudi et al. (2017)	☐ Jakarta Composite Index (JCI) ☐ Money supply ☐ Gross domestic product (GDP) ☐ Inflation ☐ BI Rate ☐ Exchange rate (IDR/USD)	☐ Indonesia ☐ January 2007 – December 2016 ☐ Monthly data	☐ Multiple linear regression analysis	☐ The result showed that the Money Supply and GDP positive but not significant effect, inflation negative and not significant, BI Rate and exchange rate IDR / USD negative and significant effect on the Jakarta Composite Index.
Eldomiaty et al. (2018)	☐ Stock prices (DJIA30 and NASDAQ100) ☐ Inflation rate ☐ Interest rate	☐ Non-financial firms listed ☐ 1999 – 2016 ☐ Quarterly data	☐ Johansen cointegration test ☐ Linearity ☐ Normality tests	☐ The results of cointegration regression show that inflation rates are negatively associated with stock prices, the real interest rates and stock prices are positively associated, changes in real interest rates and inflation rates Granger cause significant changes in stock prices, significant speed of adjustment to long run equilibrium between observed stock prices and real interest rates and significant speed of adjustment to long

			☐ Cointegration regression ☐ Granger causality ☐ VECM	run equilibrium between changes in stock prices due to real interest rates and changes in inflation rates.
Mikhaylov (2018)	☐ Stock markets (NASDAQ 100 and EURUSD-benchmarks) ☐ National currencies of the four countries	☐ Russia and Brazil ☐ March 2009 – March 2017 ☐ Daily	☐ FIGARCH model ☐ DF and KPSS test	☐ The volatility spillover effect is observed in one direction: from the exchange rate to stock market. ☐ Volatility can be predicted using the FIGARCH model if the structural breaks are incorporated in the model
Upadhyaya et al. (2018)	☐ Stock price index (Bombay Stock Exchange Index) ☐ IPI ☐ M1 money supply ☐ Price level, (wholesale price index) ☐ Nominal interest rate (10-year Treasury rate) ☐ Exchange rate	☐ India ☐ January 2006 – March 2016 ☐ Monthly data	☐ ADF and PP tests ☐ Johansen and Juselius ☐ AIC criterion ☐ VECM	☐ The empirical results suggest that, in the long run, output growth and the exchange rate are positively related to stock prices, while money supply exhibits a negative relationship to stock market prices. ☐ In the short run most of the variation in the stock market is captured by its own innovation, although the exchange rate, the price level and the interest rate seem to have some effect on short-run stock prices.
Demir (2019)	☐ Turkish Stock Market index, BIST-100 (Borsa Istanbul-100) ☐ Economic growth (RGDP) ☐ Commercial loan interest rate (INT) ☐ Net portfolio investment inflows	☐ Turkey ☐ 2003Q1–2017Q4 ☐ Quarterly data	☐ ARDL Bounds Test ☐ ADF, PP, and KWSP unit root test	☐ The results of the long-run analysis imply that increases in market activity, portfolio investment inflows, FDI inflows, and real effective exchange rate raise the stock market index while increases in interest rate and crude oil prices reduce it. ☐ Increasing costs of investment and costs of operation significantly lower the market value (interest rate and crude oil prices respectively).

	(liabilities in the BOP) ☐ Real effective exchange rate (REER) ☐ Brent Crude Oil Price ☐ FDI			☐ Turkey is still in a developing country, which needs growing physical investment, lower interest rates are required to sustain the growth process. ☐ Since the REER includes price indices and reflects relative values (higher values imply a valuation of Turkish currency), this coefficient can be interpreted as the need of lower inflation and lower nominal exchange rate.
John (2019)	☐ Market capitalisation (proxy for stock market performance) ☐ Money supply ☐ Interest rate ☐ Exchange rate ☐ Inflation rate	☐ Nigeria ☐ 1981 – 2016 ☐ Annual data	☐ Ordinary Least Square (OLS) ☐ ADF test ☐ JB test ☐ Granger Causality	☐ Money supply has a significant positive effect; interest rate has a significant negative effect; whereas, exchange rate has a positive but not significant effect and inflation rate has a positive but not statistically significant effect on stock market performance. ☐ A long-run relationship between the macroeconomic indicators and stock market performance exist. ☐ The Granger Causality test results revealed that a unidirectional causality runs from money supply and exchange rate to stock market performance. ☐ Money supply and interest rate are the true factors influencing stock market performance in Nigeria because they exhibited a significant effect on stock market performance. Exchange rate and inflation rate indicated a weak (non-significant) effect on stock market performance.
Pantas et al. (2019)	☐ Stock market (IHSG & JII) ☐ Exchange rate	☐ Indonesia ☐ January 2006 – May 2016 ☐ Monthly data	☐ Quantitative descriptive approach ☐ Cointegration test (Johansen method)	☐ The fluctuation of the rupiah exchange rate in recent years did not generally affect the performance of stock indices especially after the global financial crisis of 2008. ☐ This shows the capital market in Indonesia has a good performance so that it is not so sensitive to the sentiment of the decline in the rupiah against the US dollar.

Amado and Choon (2020)	☐ Stock market ☐ Exchange rate (REER)	☐ Indonesia ☐ 1995 – 2018 ☐ Monthly data	☐ ARDL model ☐ ADF and PP	☐ The long- term relationship between rate of exchange fluctuations and share market has been established. ☐ The relationship is found to be negative which aligned with the prior findings despite they were constructed in different contexts and geographical locations.
Setiawan (2020)	☐ Stock market ☐ GDP ☐ Inflation ☐ Interest rate ☐ Exchange rate	☐ Indonesia ☐ 1999 – 2019 ☐ Annual data	☐ Multiple linear regression analysis	☐ It is found that GDP and inflation contributing to the rise of stock market value, albeit the effect of inflation is not significant. ☐ Contrary, interest rate and exchange rate bring a negative impact on the stock market performance, primarily interest rate, which has a significant effect.
Gokmenoglu et al. (2021)	☐ Stock market ☐ Exchange rates	☐ Biggest emerging market economies (China, India, Brazil, , Mexico, , Turkey, Thailand, South Africa, and Malaysia) ☐ January 1994 – March 2019 ☐ Monthly data	☐ Quantile-on-Quantile approach	☐ The exchange rate flexibility has a crucial role in determining the market returns depending on the bearish or bullish conditions. ☐ Considering the asymmetric nature of the relationship between the exchange rate and the stock market, presented results can aid governmental authorities and investors to design dynamic economic policies and investment strategies. ☐ Exchange rate shocks can affect the stock market returns when the market is bearish. The impact of exchange rate on stock market returns is minimal in most quantile combinations. ☐ Exchange rate changes affect existing firms differently.
Luwihono et al. (2021)	☐ Stock prices ☐ US dollar exchange rate ☐ Interest rate set by Bank Indonesia ☐ Inflation	☐ Indonesia ☐ 2010 – 2017 ☐ Annual data	☐ Quantitative Explanatory research	☐ Positive and significant statistical effect of rupiah's exchange rate against the US dollar at a 5 percent share price, while the BI, inflation, interest rates have nothing to do with stock prices. ☐ For investors, the BI interest rate is indeed a general forecast.
Mahpudin and Batu (2021)	☐ Stock prices (Period end closing of Bovespa Index)	☐ Brazil ☐ 2004 - 2018	☐ Quantitative descriptive analysis	☐ Inflation, interest rate, and exchange rate did not impact stock prices. ☐ The money supply had an impact on stock prices.

	☐ Interest rate ☐ Exchange rate ☐ Inflation ☐ Money supply			
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Table 2 Summary of Review on NARDL

Author (Year)	Variable	Sample	Methodology	Findings
Cheah et al. (2017)	☐ Stock prices ☐ Exchange rates (ASYMMETRIC) ☐ National production ☐ Money supply ☐ Inflation	☐ Malaysia ☐ 1993M01 -2015M12 ☐ Monthly data	☐ Nonlinear ARDL with different period	☐ Changes of KLCI are only responding to RM depreciation but not RM appreciation. ☐ Stock price–exchange rate relation is sensitive to observation periods and change in exchange rate regimes.
Aiman and Masih (2018)	☐ Shariah and conventional stocks ☐ Interest rate ☐ Inflation ☐ Crude oil price	☐ Malaysia ☐ March 2005 – April 2019 ☐ Monthly data	☐ Unit Root Test ☐ VAR ☐ Engle Granger test (1987) ☐ Johansen test (1991) ☐ ARDL ☐ NARDL ☐ Long Run Structural Modelling (LRSM) ☐ VECM	☐ There is a long-run theoretical relationship between the macroeconomic factors (interest rate, inflation, crude oil price) and the stock performance both Shariah stocks and conventional stocks. ☐ Based on NARDL analysis, Shariah stocks and conventional stocks have both short-run and long-run symmetrical relationship.

Chang and Rajput (2018)	☐ Stock prices (Karachi Stock Exchange 100 index) ☐ Exchange rate (REER) ☐ Inflation rate (CPI) ☐ IPI proxy for GDP ☐ Interest rate	☐ Pakistan ☐ June 2004 – June 2016 ☐ Pre-crisis (June 2004 – December 2007) ☐ Post-crisis (January 2009 – June 2016)	☐ Linear ARDL ☐ Nonlinear ARDL	☐ The findings suggest that the relationship between macroeconomic variables and SP is asymmetric in the short run whereas this effect is symmetric in the long run when the whole sample period is selected. However, when pre- and post-crisis periods are selected this effect becomes asymmetric in the long run as well; that is, positive and negative shocks in macroeconomic variables do not affect the SP in the same way.
Dhaoui et al. (2018)	☐ Stock markets (Real stock return) ☐ Oil prices (Real national oil prices) ☐ Real industrial production ☐ Short-term nominal interest rate	☐ January 1986 – May 2015 ☐ Monthly data	☐ Nonlinear ARDL	☐ An asymmetric long-run relation between stock market prices and macroeconomic fundamentals.
Lee and Ryu (2018)	☐ Stock market (KOSPI and KOSDAQ) ☐ Price level ☐ Real interest rate ☐ Real USD/KRW exchange rate	☐ South Korea ☐ January 1997 to December 2016 ☐ Monthly data	☐ Linear ARDL ☐ Nonlinear ARDL ☐ Conditional error-correction form of VAR model	☐ Long-run effect of macroeconomic shocks are relatively insignificant under the simple ARDL model. ☐ Long-run effect are found to be more significant under NARDL. ☐ This phenomenon, combined with stock-oriented exchange rate models, can explain why the exchange rate responds only to shocks to the KOSPI market, and not to shocks to the KOSDAQ market. ☐ Stock price shocks and macroeconomic shocks tend to amplify each other in the case of the price level and the exchange rate, whereas stock price shocks and interest rate shocks tend to dampen each other. ☐ Interest rate is the main instrument used by the government for economic intervention.

Yii et al. (2021)	☐ Stock market (Shanghai Composite Index) ☐ Price level (Producer Price Index) ☐ Oil price (Spot price of crude oil price per barrel) ☐ Economic growth (Real GDP) ☐ Hot money (Flow of speculative funds from one country to another)	☐ China ☐ 2000Q1 – 2017Q4 ☐ Quarterly data	☐ Linear ARDL ☐ Nonlinear ARDL ☐ VECM ☐ Granger Causality ☐ Impulse Response Function ☐ Variance Decomposition	☐ The results show that oil price, economic growth and hot money possess a long-run relationship towards stock market in China, whereas no effect is found from inflation. The oil price and economic growth are both positively related to stock market while there is a negative relationship from hot money. Furthermore, the study supports the existence of an asymmetric effect between hot money and stock market.
ŞENTÜRK et al. (2014)	☐ Stock returns ☐ Economic growth	☐ Turkey ☐ 1998Q2 – 2014Q2 ☐ Quarterly data	☐ ADF and PP tests ☐ NARDL	☐ The finding shows no causality between the variables by Bootstrapped Toda-Yamamoto causality test, but Frequency Domain causality test show that stock returns cause the economic growth in short term and economic growth cause stock returns in medium term.
Phong et al. (2019)	☐ Stock index (VNIndex) ☐ Exchange rate ☐ Interest rate ☐ Money supply ☐ Inflation	☐ Vietnam ☐ April 2001 – October 2017 ☐ Monthly data	☐ Error Correction Model (ECM) ☐ NARDL	☐ The findings indicate that money supply improves VNIndex in both short-run and long-run, but the magnitude of the negative cumulative sum of changes is higher than the positive one. Moreover, the positive (negative) cumulative sum of changes of interest rate has negative (positive) impact on VNIndex in both short-run and long-run, but the former's magnitude exceeds the latter. Furthermore, exchange rate demonstrates insignificant effects on VNIndex. Also, inflation hampers VNIndex almost linearly.
Yacouba and	☐ Stock returns ☐ Exchange rate ☐ Money supply	☐ Turkey ☐ January 2003 – May 2017	☐ NARDL with 3 models asymmetricall	☐ Stock prices react asymmetrically to the real effective exchange rate changes in the short-run and long-run, while the effects of the changes in interest rate on stock

Altintas (2019)	☐ Interest rate	☐ Monthly data	y on different variable	returns are asymmetrical only in the short-run. We find that money supply changes are symmetrically related to stock returns in Turkey.
Sahin and Mohamed (2020)	☐ Stock price index ☐ Exchange rate ☐ Money supply (M2) ☐ Inflation (CPI) ☐ Crude oil price ☐ Interest rate (Central Bank Policy Rate)	☐ Kuwait ☐ June 2002 – March 2018 ☐ Monthly data	☐ ARDL ☐ NARDL (Asymmetric relationship between EXC and SP, other macroeconomic variables included to avoid a misspecification problem)	☐ Appreciation of the local currency has a negative effect on stock prices in the long-run but depreciation has not a statistically significant effect so there is a case of long-run asymmetry. ☐ However, in the short-run, the exchange rate has no statistically significant effect on stock prices and there is no asymmetric causality. ☐ If the majority of firms are an exporter and benefit from the depreciation of the local currency, then we would expect α_2 to be positive. ☐ Negative relationship, increase in EXC (appreciation of the local currency) causes decrease in SP.

Appendix A: Journal Publications

1. Sia, P. C., Leong, C. M., & Puah, C. H. (2023). Asymmetric effects of inflation rate changes on the stock market index: The case of Indonesia. *Journal of International Studies*, 16(1), 128-141.