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Analyzing The Impact of Macroeconomic Factors on Stock Market Performance in Asean-5 Countries

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Abstract

The research on factors affecting the stock market index has been thoroughly documented over the years. However, most of this research has primarily focused on macroeconomic aspects within industrialized countries. To address this disparity, this study aims to bridge the gap by investigating the factors influencing the stock market index in emerging countries such as Malaysia, Indonesia, Singapore, Thailand, and the Philippines, utilizing decade-long data from 2012 to 2022. Amid the COVID-19 pandemic that began in December 2019, this research expands the existing literature by exploring the correlations between the stock market indices of the ASEAN-5 countries and key economic indicators, including interest rates, consumer price index, exchange rates, and industrial production indices. The Generalized Method of Moments (GMM) is employed as the estimation procedure using E-views 12, providing a platform for exploring hypotheses and statistical correlations in econometric models, particularly for panel data with monthly observations spanning from January 2012 through December 2022. The research findings highlight a positive and significant association between the ASEAN-5 market index with the indices for consumer price and industrial production. In contrast, the interest rates and exchange rates exhibit a negative correlation coefficient. Consequently, these insightful findings can serve as a robust guideline for efficient management and encourage the adoption of indicators that remain unaffected during global

health crisis in the future. Moreover, when making investment decisions, investors should assess their long-term financial goals and risk tolerance and consider sectors that such problems might impact.
Keywords: ASEAN Markets, Macroeconomics, Stock Markets, Panel Data Analysis

Introduction

The stock markets are of utmost importance in the functioning of any economy. In recent decades, the correlation between stock prices and various macroeconomic factors has garnered significant attention from financial analysts and researchers. There exists a prevalent argument that the performance of the stock market is influenced by fundamental macroeconomic variables, including but not limited to the interest rate, currency rate, inflation, and money supply. The financial press often presents anecdotal data suggesting that investors hold a prevailing belief regarding the significant impact of monetary policy and macroeconomic events on stock market volatility. According to Pramod-Kumar and Puja (2012), it is imperative for investors to undertake a comprehensive reassessment of the correlation between the stock market and macroeconomic conditions, as the mechanics of this association have undergone significant alterations. The substantial influence of macroeconomic variables on the stock market, as well as the significant role played by the stock market in the economy through its impact on key factors that subsequently influence investment decisions, necessitates that investors possess an understanding of the dynamic relationship between the stock market and macroeconomic variables in order to effectively manage their investments (Osamwonyi and Evbayiro-Osagie, 2012).

Ogunsakin and Awe (2021) stated that the financial liberalisation in numerous emerging economies has resulted in substantial growth of their own stock markets. Furthermore, there has been an increased interconnection among various financial markets, resulting in a heightened level of interdependency and interconnectedness of associated risks. However, both established and emerging financial markets have witnessed tremendous volatility in the previous few years. The stock market can be influenced by abrupt shifts in the economic landscape, which in turn can impact the perceptions and decision-making of investors. This phenomenon is linked to the potential hazards arising from macroeconomic factors within the stock market. Extensive research has been conducted to examine the impact of macroeconomic conditions on the performance of stocks across various economies such as (Chang et al., 2019; Widarjono et al., 2021; Khan and Khan, 2018; Pavto and Raju, 2020). These studies demonstrate the importance of domestic macroeconomic variables, including interest rate, consumer price index, exchange rate and industrial production index, as factors influencing fluctuations in the stock market. However, the majority of available studies have predominantly concentrated on industrialised countries and other growing markets.

In addition, the stock market also experienced turbulence during the COVID-19 pandemic. The was the results of direct revenue impacts attributed to premature deaths, lockdowns, work absences, productivity declines, and a negative supply shock, with global supply chain disruptions and plant closures affecting manufacturing productivity. The effect of the pandemic was deeply intertwined with significant shifts in macroeconomic variables and resulted in far-reaching consequences on the global economy. To comprehensively grasp the multi-faceted consequences of the COVID-19 pandemic and macroeconomic factors, it is essential to examine how the macroeconomic variables influenced the performance of stock

markets within the ASEAN-5 nations during the most recent period, spanning from 2012 to 2022.

The estimation of macroeconomic effects entails two primary approaches: observational and modelling. For the observational assessment, we will adopt the technique previously employed by Keogh-Brown and Smith during the 2003 SARS pandemic, as documented in their earlier study. However, it is essential to acknowledge that this analysis was conducted several years after the SARS outbreak had subsided, allowing for extensive data and a more direct attribution of economic effects to SARS, notwithstanding the second Gulf War. Relatively, the recent COVID-19 pandemic poses additional complexity to the estimation process, due to its recent occurrence, data about various indicators and countries of interest are often limited. Moreover, for those indicators and sectors where data is accessible, it is typically provided yearly or quarterly, posing significant challenges in discerning whether observed effects can be attributed to the global recession or the COVID-19 pandemic. Given these complexities, the second method holds more incredible promise: employing a comprehensive mathematical model of the economy predating the recession, encompassing all relevant sectors, and introducing a pandemic-related 'shock' to estimate the influence of the COVID-19 pandemic while controlling for other variables. This approach enables a more nuanced understanding of the pandemic's impact while accounting for other potential contributing factors.

Our hypothesis posits that macroeconomic variables significantly influence the fluctuation of ASEAN-5 market reactions in the context of the COVID-19 period. This proposition finds support in the work of Topcu and Gulal (2020), who investigated the impact of COVID-19 on emerging stock markets. Their research revealed that the pandemic had the most pronounced impact on ASEAN emerging economies, while its effect on European emerging markets was milder. Given the concern surrounding the pandemic's impact on the economy, there arises an urgent need for a thorough analysis of financial markets to assess the consequences of the COVID-19 pandemic. Interestingly, the existing literature on infectious disease outbreaks has paid little attention to the stock market (Ali et al., 2010; Jiang et al., 2017; Donadelli et al., 2017). For instance, Ali et al (2010) demonstrated evidence of short-term stock overreaction in the Malaysian stock market in response to both internal and external significant events. The Malaysian stock market exhibited overreaction to foreign dramatic events, such as the SARS pandemic, in addition to experiencing fluctuations related to domestic economic crises and notable political events. Similarly, Jiang et al (2017) uncovered a noteworthy connection between the daily reported human avian influenza A (H7N9) cases and the Shanghai Composite Index stock price. Furthermore, the number of reported cases was associated with pricing the Avian Influenza sector index and a few China pharmaceutical indices. Donadelli et al. (2017) explored the impact of disease-related news on investor sentiment in the United States, focusing on infectious diseases such as SARS, Influenza A (H1N1), Polio, and Ebola. Their findings indicated that disease-related news positively and substantially influenced the mood of pharmaceutical company stock investors. In light of the limited research on the stock market's response during infectious disease outbreaks, our study aims to shed further light on the critical interplay between macroeconomic factors and the ASEAN-5 stock market in the context of the COVID-19 pandemic.

This study utilizes the generalized method of moments (GMM) framework to examine the associations between the stock index of the ASEAN-5 countries and several significant macroeconomic indicators, precisely the interest rate, exchange rate, index of consumer price, and industrial production. The analysis is conducted using monthly data spanning from 2012 to 2022. This research investigates the correlation between stock markets and macroeconomic indicators in the ASEAN-5 region amidst the COVID-19 pandemic. Furthermore, this paper aims to comprehensively analyze the causal relationships between stock markets and the macroeconomic factors mentioned earlier. In order to examine the short-term relationship between the ASEAN-5 stock markets and the chosen macroeconomic variables, we utilize a generalized method of moments (GMM) estimator. This estimation technique provides a reliable and effective means of capturing the dynamics of relationships, especially when dealing with panel data. In brief, this study enhances comprehension of the interaction between stock market dynamics and macroeconomic indicators within the ASEAN-5 nations amidst the COVID-19 pandemic. It elucidates the causal connections and immediate fluctuations that underlie this relationship.

Studying the causal relationships between stock markets and macroeconomic factors is a highly motivating endeavour with significant implications across various domains. Firstly, understanding these relationships can greatly impact investment decisions by providing valuable insights into how macroeconomic factors influence stock market performance. This knowledge is crucial for investors seeking to optimize asset allocation, manage risks effectively, and diversify their portfolios intelligently. Moreover, this research can have important implications for economic policymakers, as it can contribute to the development of more effective policy strategies aimed at stabilizing financial markets and promoting sustainable economic growth. Finally, this comprehensive analysis of causal relationships can lead to the development of more accurate forecasting models, aiding individuals and organizations in anticipating market trends and making proactive decisions. Overall, the motivation behind studying these causal relationships lies in their potential to drive informed decision-making, shape effective policies, and deepen our understanding of the dynamics that underpin financial markets.

Literature Review

The Correlation between the Stock Market and Macroeconomic Variables

Given the pivotal role of stock markets in driving economic expansion, research on the factors influencing market growth has increased. These factors can be categorized into two broad groups: macroeconomic variables, such as GDP growth, exchange rates, inflation, manufacturing output, interest rates, oil prices, market volatility, stock market liquidity, investment returns, and future consumption potential; and portfolio characteristics, including book-market relationships, dividends or earnings, firm size, return rates, and asset return variances. The focus of this research lies on the first group. Academic literature has extensively debated how these variables relate to stock market growth (Farah et al., 2018). Almira et al (2021) conducted a time series study from 1990 to 2020 titled "Impact of Macroeconomic Variables, the American Stock Market Index, and the Covid-19 Pandemic on Indonesia's Capital Market Development." Their analysis revealed that the Covid-19 pandemic significantly and unfavourably impacted the growth of the Indonesian capital market during the studied period.

Angesti and Setyadharma (2020) conducted a study to examine the influence of changes in macroeconomic variables, such as interest rate, inflation, exchange rate, and global oil prices, on both long- and short-term fluctuations in the Jakarta Islamic Index. Employing an Error Correction Model (ECM) analysis with weekly time series data from March 2020 to March 2021, they found that the Covid-19 pandemic's increasing instances negatively impacted the long-term performance of the Jakarta Islamic Index. The researchers emphasized the government's need to adopt effective and efficient policies to address the pandemic's threats to public health and the economy. Similarly, İlhan and Akdeniz (2020) investigated the impact of macroeconomic factors on stock market performance, revealing that interest rates, the VIX (CBOE Volatility Index), and oil prices significantly affected the Turkish Stock Index during the examined periods. Meanwhile, Lee et al (2021) employed a structural VAR framework in China to assess the dynamics between the COVID-19 pandemic, macroeconomic volatility, and hospitality stock returns. Their analysis demonstrated that an unexpected positive change in the COVID-19 outbreak led to increased exchange rates and subsequent declines in the stock market and hospitality industry returns.

Priyono and Kartiko (2021) examined the relationship between the Indonesian Sharia stock index (ISSI), the exchange rate of the rupiah against the US dollar, and inflation. Their study revealed a negative influence on the selected variables. Notably, during the Covid-19 pandemic, the Sharia index witnessed a decrease in both the short-term and long-term periods as a result of the devaluation of the Indonesian rupiah in relation to the United States dollar. Nordin et al (2014) sought to investigate the impact of commodities prices (specifically palm oil, oil, and gold prices), interest rates, and exchange rates on the performance of the Malaysian stock market. The study findings demonstrated that interest and exchange rates significantly influenced the market's performance, aligning with the results of previous empirical investigations (Lee et al., 2001; Bekhet and Mbleh, 2012).

Jelilov et al (2020) revealed a positive correlation between stock market returns and inflation during the COVID-19 period. The escalating COVID-19 infection cases resulted in increased volatility and a distorted positive relationship between inflation and stock market returns, consistent with the Fama Proxy Hypothesis while contradicting the Fisher hypothesis Fisher (1930) proposed by (Fama, 1981). Before the pandemic, studies showed a negative correlation between inflation and stock market growth on economic growth in ASEAN countries in 2018 (Purnamasari et al., 2020). Similarly, Nurasyikin et al (2017) researched different ASEAN countries (Singapore, Malaysia, and Indonesia), indicating a negative correlation between inflation and stock market performance.

Theoretically and empirically, a positive relationship is expected between industrial production and stock returns, given that industrial production indicates actual activity. Fama (1990); Schwert (1990) have demonstrated a positive association between actual economic activity and stock market returns. They also discussed the connection between stock returns and production growth rates, illustrating how industrial production influences future expected cash flows. Numerous studies, including those by Kwon et al (1997); Kwon and Shin (1999); Chen (1991); Mukherjee and Naka (1995); Apergis (1998); Gjerde and Saettem (1999); Wongbangpo and Sharma (2002); Sari and Soytas (2005); Erdogan (2018), among others, have consistently found a positive and significant link between industrial production and stock

market returns. In contrast, Flannery and Protopapadakis (2002) reported a limited impact of industrial production on stock market returns.

Relationship between the Stock Market and COVID-19

The existing literature examining between macroeconomic conditions and the ASEAN-5 market for stocks encompasses cross-country studies as country-specific investigations. However, the results from these studies could be more conclusive to divergent conclusions on the nature of this relationship. Some studies show a negative association dissociation between COVID-19 and the stock market, while others suggest a positive link. Among those supporting a positive relationship, several studies have reported a decline in the return on indices during the COVID-19 period (Baker et al., 2020; Yan, 2020; Bora and Basistha, 2021; Harjoto, 2021; Liu et al., 2022; Kamaludin et al., 2021; Sutrisno et al., 2021). On the other hand, studies that fall into the category of adverse stock market reaction to the pandemic announcement include those by Rahman et al (2021) and Al-Awadhi et al. (2020). Additionally, Lee (2020) presents a comprehensive view of the initial impact of COVID-19 sentiment on the US stock market by industry, considering time lag perspectives by visualizing changes in correlation levels over time. Furthermore, studies by Yousfi et al (2021); Hong et al (2021); Thorbecke (2020) also fall into this category. However, their findings are mixed, further contributing to the inconclusive relationship between the stock market and COVID-19. In conclusion, the diversity of results in the existing literature underscores the need for further research to establish a more definitive understanding of the intricate the correlation within the value of the stock market and the COVID-19 pandemic.

Furthermore, our analysis delves into prior research that investigates the repercussions of the SARS pandemic on the economy and capital markets. Nevertheless, the findings on the economic consequences and stock market responses to the SARS epidemics remain inconclusive. Still, there must be more conclusions about the SARS epidemic's nonfinancial and economic ramifications in Hong Kong (Siu and Wong, 2004). Their study revealed a substantial, albeit temporary, influence of the SARS outbreak on demand, particularly impacting domestic consumption and service industries, such as travel and aviation, in the short term. However, no significant effects were observed on the supply side. On the contrary, Chou et al (2004) focused on the government's measures to curb the outbreak and the subsequent economic repercussions. Furthermore, Erdogan (2018) utilized a multiregional computable general equilibrium model (Global Trade Analysis Project model version 6.2) to assess the impact of the SARS epidemic on the economies of Taiwan and China. Furthermore, Nippani and Washer (2004) examined the effect of the 2003 SARS pandemic on the stock market returns of eight nations. Their analysis employed a non-parametric Mann-Whitney test and a heteroscedastic t-test to explore the stock market's response to the outbreak. In summary, the available literature on the impact of the SARS pandemic on the economy and capital markets yields mixed results, underscoring the need for comprehensive research to unravel the complexities of such crises' effects on various economic indicators and financial markets. Based on their findings, the SARS pandemic had a limited impact on the stock markets of the studied nations. Surprisingly, they observed an overall increase in the stock market index when SARS was prevalent. Additionally, Wong (2008) investigated the effects of the SARS epidemic on the Hong Kong property market. The research revealed a generally negative impact on average pricing; however, it also indicated the absence of unnecessary panic during the pandemic.

Conclusively, the pandemic adversely affected business ties between China and the rest of Asia. Researchers Ali et al (2010) examined short-term stock overreaction in Malaysia, demonstrating that the stock market in Malaysia indeed overreacted to the SARS crisis. Chen et al (2007) investigated the impact of the SARS pandemic on hotel stocks listed on the Taiwan Stock Exchange, revealing a significant decline in hotel performance during the outbreak. The research highlights the tourism sector as susceptible to severe consequences during epidemics. Employing an event research technique, Chen et al (2009) explored the repercussions of the SARS pandemic across various sectors of the economy. Their report reveals a detrimental impact on the retail, wholesale, and tourism industries while presenting a favourable effect on stock prices in the biotechnology sector. Additionally, Chen et al (2013) investigated the influence of the SARS outbreak on stock returns in the Philippine service industry and the Hong Kong primary material business. In aggregate, these empirical investigations highlight the phenomenon of investors engaging in stock price adjustments in reaction to the influence of the COVID-19 epidemic on the stock markets.

Research Methodology

This paper primarily explores macroeconomic factors' influencers on the stock market index during health crises, utilizing panel regressions within a GMM estimation framework. We collected monthly data from ASEAN-5 countries, namely Malaysia, Indonesia, Singapore, Philippines, and Thailand, spanning 2012 to 2022. Table 1 provides a comprehensive overview of the variables employed in the panel data, including their modelling and data sources. In this study, we focused on four macroeconomic indicators which is INT (interest rate), CPI (Consumer Price Index), EXR (exchange rate), and IPI (industrial production index). Notably, all variables were collected at the country level, enabling them to depict the adjusted closing price that amends a stock's closing price, accurately reflecting its value after accounting for any corporate actions in the respective countries.

Table 1
Summary of variables

Variable	Notation and Measurement	Definition	Data Source
Stock Market Index	SMI (2010 = 100)	A theoretical collection of securities intended to provide a concise representation of the stock market's performance, wherein their values are consistently computed using the preceding trading day's price levels.	Financing.com
Interest Rate	INT (%)	The prevailing yield on long-term government bonds in the secondary market, typically with a maturity of 10 years.	Euromonitor International
Consumer Price Index	CPI (2010 = 100)	A metric that tracks fluctuations in the overall price level of goods and services acquired, utilized, or paid for by a designated population for consumption.	Euromonitor International
Exchange Rate	EXR (CCY per USD)	The exchange rate refers to the value of bills denominated in USD currency that can be purchased using a specific currency.	Investing.com
Industrial Production Index	IPI (2010 = 100)	The objective is to quantify the fluctuations in the quantity of output produced by production units falling under the industrial sectors B (Mining), C (Manufacturing), D, and E (Electricity, gas, and water) as defined by the International Standard Industrial Classification of all Economic Activities.	Euromonitor International

Based on extant research and empirical evidence, our research hypothesis suggests that fluctuations in interest rates will exert a detrimental influence on the stock market index, whereas other variables are anticipated to have a favourable effect. Table 2 provides a succinct overview of the statistical descriptions for the variables encompassing the complete sample of nations and the time under analysis. The accompanying part will feature a full presentation and discussion of the values and patterns of the variables across nations and years. The results will be provided in detail.

Table 2
Descriptive statistics of variables (at level specification)

Variables	SMI	INT	CPI	EXR	IPI
Mean	156.3830	3.6149	121.2144	2633.8870	123.1600
Median	156.1000	2.9750	115.3000	32.5170	124.9500
Maximum	251.4000	9.6400	166.7000	15867.4300	197.5000
Minimum	84.1000	0.1900	104.5000	1.2210	26.4000
Std. Dev.	41.4124	2.0642	13.8962	5287.0580	24.4647
Skewness	0.1295	0.9262	1.3861	1.5738	-0.2015
Kurtosis	1.6873	2.8523	4.0634	3.5735	3.3826

Visual plots are an essential initial step in analysing time series data, including panel data. Figure 1 displays the graphical representation of each variable. The graphs illustrate that four chosen variables exhibit non-stationary behavior, implying that their means and variances are not consistent. For instance, the graphs of variables INT, CPI, and EXR exhibit increasing trends with occasional declines during the early 2022 period, attributed to the impact of the COVID-19 crisis. On the other hand, the graph of the variable IPI displays

fluctuating decreasing curves during the 2020-2021 downturn, resulting from the global health crisis. Furthermore, SMI exhibits highly volatile movements, marked by two significant drops; the first occurred at the onset of the COVID-19 pandemic in early 2020 when the health crisis began, and the second was linked to implementing the Movement Control Order (MCO).

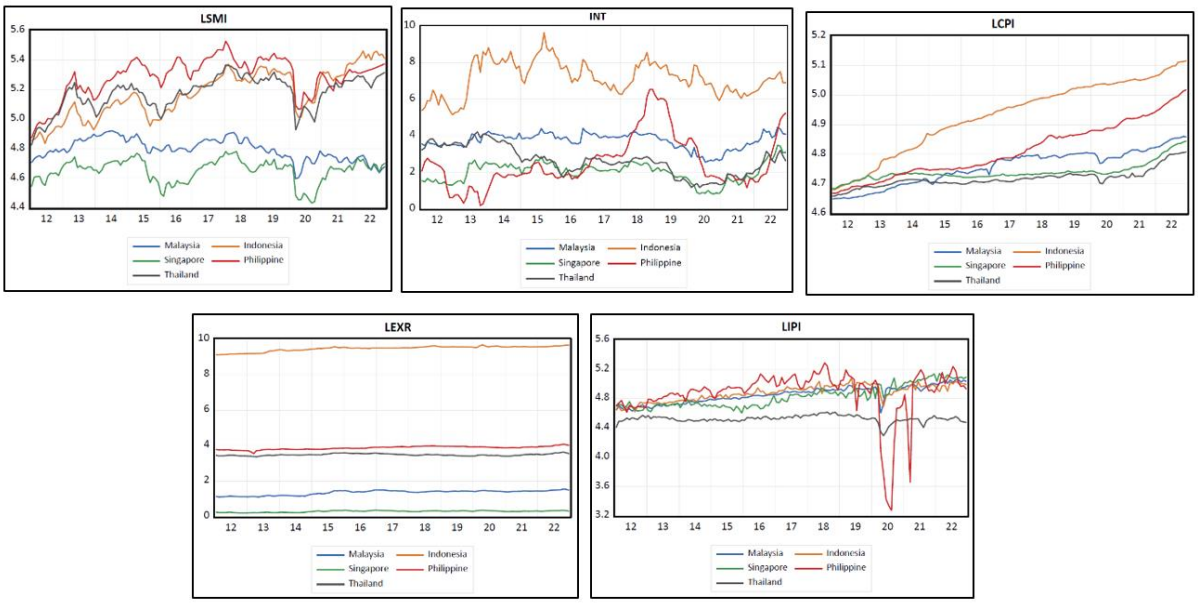

Figure 1. Depicts a graphical representation of the variables (at level)

As illustrated in Figure 2, the application of the first-order log difference results in the absence of any discernible trend in the variables, suggesting that they have achieved stationarity at the first difference.

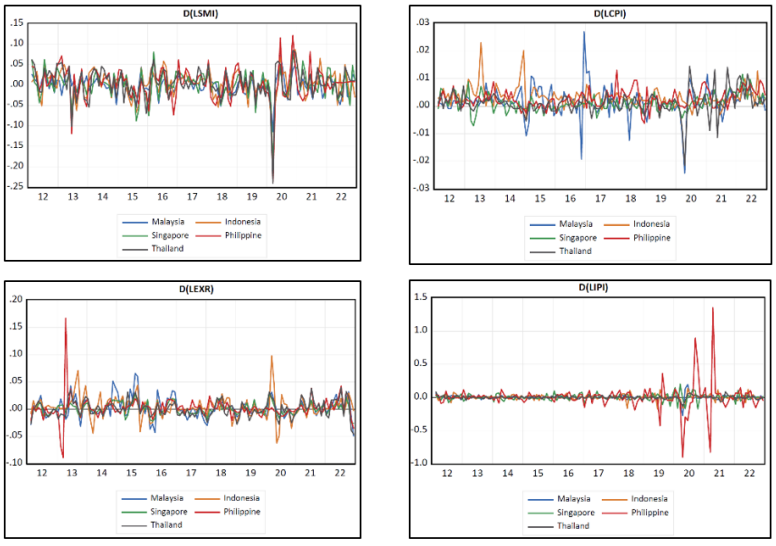

Figure 2. Displays graphical representations of the variables (at first difference).

The methodology employed in this study is founded on the General Method of Moments (GMM), a technique first presented by Arellano and Bond (1991) and widely employed in previous scholarly investigations on corporate profitability. This includes

investigations on the profitability and efficiency of banks. Prominent instances of these investigations encompass the works of (Farooq et al., 2021; Doan, 2020; Bakar et al., 2018; Awo and Akotey, 2019). The GMM methodology has been widely recognized in the field of panel regression analysis due to its ability to effectively tackle endogeneity issues through the utilization of lagged values of the response variable and exogenous regressors as instrumental variables. Moreover, the application of the GMM methodology offers a mechanism to address unobserved heterogeneity and consider the long-term existence of the variable that is being studied. This leads to more dependable estimations of the regression coefficients in comparison to conventional FEM and REM model.

The computation of the variables that influence the stock market index is predicated upon a comprehensive model, which we shall outline as follows:

$$\begin{aligned} Y_{it} &= \alpha + \sum_{j=1}^{k} \beta_j Z_{it}^{k} + \mu_{it} \\ i &= 1, 2, \dots, 5 \\ t &= 1, 2, \dots, 12 \end{aligned} \tag{1}$$

where Y_{it} is the stock market index, i is the ith subject and t is the time period for the variables, α is the constant, Z_{it}^{k} are the regressors (predictor variables), and μ_{it} is error term ($\mu_{it} = \theta_{it} + \tau_{it}$, where θ_{it} is undiscovered country-specific impacts and τ_{it} is the idiosyncratic error, $\theta_{it} \sim IIN(0, \sigma_{\theta}^{2})$ independently and the variables are assumed to follow a normal distribution with a mean of zero and a specified variance, and they are assumed to be independent of the variable of $\tau_{it} \sim (0, \sigma_{\tau}^{2})$.

The lagged stock market index is incorporated into the Equation (1)

$$Y_{it} = \alpha + \delta Y_{i,t-1} + \sum_{j=1}^{k} \beta_j Z_{it}^{k} + \mu_{it}$$

where $Y_{i,t-1}$ is the one-month finite (lag) stock market index, and δ is the rate at which a system reaches equilibrium, the values of δ serve as indicators of price persistence and the tendency for prices to revert to their long-term level, with δ being a fractional number ranging from 0 to 1, depending on whether the stock market index in the ASEAN-5 countries is more or less competitive (δ closer to 0 or 1, respectively). Since we are interested in the relationships between the stock market index, on the macroeconomic conditions, in Equation (2), variables Z_{it}^{k} will encompass the four components as regressors which is INT, CPI, EXR, and IPI.

Within the field of econometrics, two primary iterations of the Generalized Method of Moments (GMM) estimators exist, namely the GMM estimator and the system GMM estimator. The Generalized Method of Moments (GMM) estimator, originally introduced by Arellano and Bond (1991), is utilized to tackle the problem of individual nation effects in panel equations. This methodology involves calculating the initial discrepancy of the panel equation for every temporal interval. In this methodology, the regressors of the first difference equation that have been instrumented are the values of the variable from the previous period or lagged values. In an alternative approach, Blundell and Bond (1998) proposed the

implementation of the Generalized Method of Moments (GMM) system, specifically the two-step GMM system. This methodology entails employing the initial difference in the panel solution with a function at the level, where the tools are denoted by the initial differences of the regressors. The efficiency of the system GMM technique in mitigating biases inherent in the difference GMM estimator has been supported by prior research undertaken by Arellano and Bover (1995) as well as (Blundell and Bond, 1998). Additionally, this method enables the inclusion of lagged initial differences in equations involving levels. As a result, the study employed the two-phase generalized method of moments (GMM) estimate approach.

Regarding the association among the variables that are explicable employed in the panel models, the findings presented in Table 3 suggest that, overall, the correlation between the regressors lacks statistical significance. Notably, the greatest correlation coefficient observed is 0.7783, which pertains to the relationship between LEXR and INT, followed by a correlation coefficient of 0.6520 between LEXR and LCPI. Table 4 presents the Pearson correlation coefficients for each variable while considering first differences. This discovery suggests that there are no significant issues of multicollinearity in our models.

Table 3
Pearson correlation coefficients

	LSMI	**INT**	**LCPI**	**LEXR**	**LIPI**
LSMI	1				
INT	0.2650	1			
LCPI	0.4403	0.6176	1		
LEXR	0.6215	**0.7883**	**0.6520**	1	
LIPI	0.0071	0.2414	0.4311	0.0930	1

Table 4
Pearson Correlation Coefficients

	D(LSMI)	**INT**	**D(LCPI)**	**D(LEXR)**	**D(LIPI)**
D(LSMI)	1				
INT	-0.0370	1			
D(LCPI)	0.1093	0.1672	1		
D(LEXR)	-0.4208	0.0893	0.0002	1	
D(LIPI)	0.0134	-0.0217	0.0631	-0.0138	1

System GMM estimate outputs are only as reliable as the instruments matrix and the no-residual-autocorrelation assumption. We used the Sargan test to determine whether or not our instruments were reliable, and We added the second-order serial correlation test suggested by Arellano and Bond (1991) to our system GMM estimation.

Empirical Results

Panel Unit Root Tests

We begin our empirical analysis by testing for roots in all of our variables. This is to ensure that the variables are stationary. The tests for stationarity or panel unit roots employ the Levin, Lin and Chu (LLC) test, Im, Pesaran, and Shin W-stat (IPS) test, Augmented Dickey-Fuller (ADF) – Fisher Chi-square and the Phillips-Perron (PP) – Fisher Chi-square test performed on

the variables in levels and first differences. The t-statistics and p-values for the unit root test outcomes are shown at a specific level in Table 5 as shown below:

Table 5
Results of Unit Root Test (Level Specifications and First Difference)

	Level Specifications				First Difference			
Variable	**LLC**	**IPS**	**ADF**	**PP**	**LLC**	**IPS**	**ADF**	**PP**
SMI	-1.1073 (0.1341)	-2.1820 (0.0146)	20.7592 (0.0228)	22.2826 (0.0137)	-22.1321 (0.0000**)	-20.5155 (0.0000**)	297.3010 (0.0000**)	297.8850 (0.0000**)
INT	-0.0884 (0.4648)	-1.3337 (0.0912)	14.3476 (0.1577)	13.5877 (0.1926)	-24.6264 (0.0000**)	-22.4091 (0.0000**)	319.7370 (0.0000**)	319.3370 (0.0000**)
CPI	2.6850 (0.9964)	6.8373 (1.0000)	1.9664 (0.9966)	1.6927 (0.9982)	-21.8595 (0.0000**)	-18.6554 (0.0000**)	265.3330 (0.0000**)	268.1060 (0.0000**)
EXR	-1.8379 (0.0330)	-1.0105 (0.1561)	13.4112 (0.2016)	7.4144 (0.6858)	-20.3479 (0.0000**)	-19.3258 (0.0000**)	273.1130 (0.0000**)	258.1050 (0.0000**)
IPI	-1.5955 (0.0553)	-1.3480 (0.0888)	24.4180 (0.0066)	31.5099 (0.0005)	-22.7384 (0.0000**)	-25.5498 (0.0000**)	372.2130 (0.0000**)	269.0150 (0.0000**)

Note: ** Indicates statistical significance at level of 5% where *SMI = Stock Market Index, INT = Interest rate, CPI = Consumer Price Index, EXR = Exchange Rate and IPI = Industrial Production Index*

The numbers presented in Table 5 correspond to the t-statistics and p-values for both the level and first difference. Based on the outcomes of the LLC, IPS, ADF, and PP tests, it is shown that the panel unit root null hypothesis can be rejected at a 5% significance level when considering the first difference. Consequently, it can be inferred that all the chosen macroeconomic variables possess a panel unit root at the level. In order to obtain stationary data, it is necessary to apply the first difference order. Given that all chosen macroeconomic variables are now integrated at the same order, specifically I (1) and one at I (0), we proceed to analyze the following estimate method.

In the field of econometric modelling of panel data, two major methodologies, namely fixed-effects and random-effects estimators, are commonly employed. The fixed-effects approach incorporates either the inclusion of dummy variables to explicitly account for unobservable, time-invariant factors for each unit of observation or the removal of such factors through a process known as time-demeaning. On the other hand, the random-effects model incorporates the presence of a time-invariant unobservable factor into the disturbances, under the assumption that these factors are not linked with the regressors. Given the assumption of veracity, it can be posited that the random-effects estimator exhibits superior time efficiency in comparison to the fixed-effects estimator. Nevertheless, in the event that the underlying premise is invalidated, it can result in outcomes that are not precise. The Hausman specification test, as proposed by Hausman in 1978, is frequently employed to assess the suitability of these two methodologies. The justification lies on the accuracy of the orthogonality assumption between the unobservable, individual-specific effects and the regressors. There should not be any systematic differences between the set of coefficient estimates derived from fixed-effects estimation and those acquired from random-effects estimation. In applied research, it is common practice for researchers to draw conclusions based on fixed-effects estimates. This approach involves disregarding the random-effects estimates if statistical tests indicate that the coefficients from both sets are not equal.

Nevertheless, it is intriguing to ascertain whether the inequality is applicable to all coefficients or if there exist certain factors that deviate from this pattern.

The findings of the FEM and REM estimations for the association between the stock market index and four chosen macroeconomic variables (INT, CPI, EXR, and IPI) are displayed in Tables 6 and 7. Based on the obtained data, it is feasible to discern, within the framework of our two distinct specifications, that the stock market index exhibits a statistically significant coefficient in relation to the CPI and the EXR. The FEM model demonstrates that variables such as INT, EXR, and IPI exhibit negative effects on the SMI, whereas the variable CPI has a favourable influence. In the REM model, it is seen that both INT and EXR exhibit negative impacts, whereas CPI and IPI demonstrate positive benefits. The FEM models exhibit a larger R^2 value in comparison to the REM models, suggesting that the FEM models provide a more comprehensive explanation for the variability observed in the dependent variable. Based on the implementation of the Hausman Test, as presented in Table 8, it can be deduced that both the FEM and REM exhibit comparable levels of goodness-of-fit.

Table 6
Fixed effect model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INT)	-0.0040	0.0014	-2.8471	0.0046
D(LCPI)	0.9304	0.3097	3.0040	0.0028
D(LEXR)	-0.8302	0.0704	-11.7860	0.0000
D(LIPI)	-0.0017	0.0124	-0.1333	0.8940

*R^2=0.2013, F-stat=0.0000

Table 7
Random effect model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INT)	-0.0003	0.0006	-0.5114	0.6093
D(LCPI)	0.9639	0.3066	3.1438	0.0017
D(LEXR)	-0.8356	0.0704	-11.8717	0.0000
D(LIPI)	1.87E-05	0.0124	0.0015	0.9988

*R^2=0.1894, F-stat=0.0000

Table 8
Hausman results

Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	9.623186	4	0.0433

Since the correlation between c_i and x_{it} is the most crucial factor in choosing between a random effects and fixed effects strategy, it is essential to have a mechanism for evaluating this assumption. So, the result showed in Table 8 that the Hausman Test received H_1 or p-value < 0.05, then a fixed effects panel regression was selected for the subsequent analysis.

System of GMM Estimation on Panel Data Sets

The next part of this research study presents the findings derived from the one-step system generalized method of moments (GMM) estimations conducted on panel datasets that

incorporated macroeconomic factors as regressors. As outlined in Section 2, all models incorporate the previous values of the dependent variables as explanatory variables. The findings of the GMM panel regressions, specifically examining the impact of macroeconomic factors as aggressors, are presented in Table 9. In the present scenario, the post-time coefficient indicates that the current values of stock market index variables are significantly influenced by their respective values with a 1-period lag. In relation to the macroeconomic variables D(INT), D(LCPI), D(LEXR), and D(LIPI), our analysis indicates that D(LCPI), D(LEXR), and D(LIPI) exhibit statistical significance, while D(INT) does not. This finding aligns with existing literature that emphasizes the significance of the macroeconomic framework in influencing the performance of the stock market index, for example, Koapaha (2022) and Putra (2016) for Indonesia countries, Asmy et al. (2009) and Qing and Kusairi (2019) for Malaysia, Wongbangpo and Sharma (2002) for ASEAN-5 countries, Srihapan et al. (2018) for Malaysia and Thailand, Fernandez and Li (2020) for the Philippines, to name just a few. At the same time, the relevance of each macroeconomic variable considered in our models differs depending on the stock market index used.

Table 9
Results of system GMM estimations for macroeconomic variables panels

Variables	**SMI**	
	Coefficient	***p*-Value**
D(LSMI)(-1)	**0.4608**	0.0000
D(INT)	-0.0005	0.1530
D(LCPI)	**1.2903**	0.0000
D(LEXR)	**-0.5802**	0.0000
D(LIPI)	0.0180	0.0100
S.E of regression		0.0014
Sargan test		0.7370
p-value		0.0000
AR(1) test	z = -0.7000	p = 0.4860
AR(2) test	z = -10.8500	p = 0.0000

Note: The data presented in the table is derived through the application of Equation (2). Coefficients that are bolded in the analysis show statistical significance at a significance level of 5%. The Sargan test is a statistical test used to assess the validity of over-identifying limitations. The AR (1) test, also known as the Arellano-Bond test, examines whether the average auto covariance in residuals of order 1 is equal to 0. The null hypothesis (H_0) being tested is that there is no autocorrelation. The AR (2) test, also known as the Arellano-Bond test, examines whether the average auto covariance in residuals of order 2 is equal to 0. The null hypothesis (H_0) being tested is that there is no autocorrelation.

Discussion

Previous research on the influence of interest rates on the stock market index has consistently yielded the same results, indicating negative correlations. Investors' increasing demand to buy more stocks, even during crises, drives this negative trend. Financial markets can be highly volatile, and investors should exercise caution and consider the broader economic context before making investment decisions. Diversification across asset classes can help mitigate the risks associated with interest rate changes and stock market fluctuations during challenging economic times. Ferrer et al (2014) posit that interest rates influence the stock

market through two primary mechanisms. The alteration of interest rates has a direct impact on the discount rate employed in the majority of contemporary valuation methodologies. Furthermore, fluctuations in interest rates can potentially modify the borrowing expenses, consequently impacting the projected cash flow of a company. Several studies conducted in Malaysia Murthy et al (2017); Nordin and Ismail (2014); Geetha et al (2011) have observed a negative correlation between stock market returns and interest rates. These findings align with research conducted in China, revealing a comparable negative association. The study by Lv et al (2015) investigates the impact of official interest rate fluctuations on stock returns in China, considering various economic scenarios, including bullish, moderate, and bearish conditions. Numerous empirical studies have consistently demonstrated that interest rates substantially influence stock market indices. Consequently, it is reasonable to anticipate a negative correlation between interest rates and the stock market index within our analytical frameworks. The findings of our study demonstrate a statistically significant inverse relationship between interest rates and the stock market index.

Our models incorporated the consumer price index (CPI) as the second macroeconomic variable. Due to inconclusive results in the existing literature, we needed a specific expectation for its impact. However, our findings reveal a significant positive relationship between consumer prices and stock market indexes. This implies that a higher consumer price index indicates a higher cost of living and reduced consumer purchasing power. Such a scenario can have divergent effects on different stock market sectors. Consumer staples stocks may experience a bullish trend as they provide essential products that consumers need regardless of economic conditions. On the other hand, consumer discretionary stocks may suffer as consumers have less disposable income to spend on luxury items and entertainment. It is essential to note that a sustained increase in the CPI signals rising inflation, which can significantly influence stock market performance. Higher inflation may lead investors to demand higher returns from their investments to counter the diminishing purchasing power of their money. Consequently, this could trigger selling activity in the stock market, potentially resulting in a decline in the overall stock market index. Previous studies have supported the consumer price index's beneficial impact on stock market performance. Adjasi et al (2008) found similar results for Ghana, while Barakat et al (2016) observed this effect in Egypt, and Maysami et al (2004) demonstrated the correlation in Singapore.

The impact of exchange rate volatility on firms' competitiveness and profitability is a significant concern about the third macroeconomic variable. According to Tsagkanos and Siriopoulos (2013), exporters are anticipated to experience advantages due to the depreciation of the local currency, whereas importers may encounter disadvantages in similar circumstances. Due to its simplicity of implementation, central banks frequently use currency depreciation as a monetary tool. However, studies have shown that these policies, if poorly implemented, can significantly impact the world's global economy, as evidenced by the example of the Beggar-thy-neighbour policy in 1930. This policy led to a significant decline in international trade and exacerbated the Great Depression. In contrast, Ayub and Masih (2013) observed that the association between exchange rates and Islamic stock indices exhibits dynamic characteristics and variations in both the short and long run when employing Wavelet filtering techniques. Significant negative correlations were observed between exchange rates and all FTSE Bursa Malaysia indices across various time scales. Nevertheless, it is crucial to acknowledge that this association needs to be systematically monitored. A

significant relationship between exchange rates and the stock market is observed in only a minority of countries. The positive relationship of Japan may be subject to distortion due to its distinctive economic environment, commonly referred to as The Lost Decades, which is characterized by a prolonged period of deflation spanning two decades. The results of our investigation demonstrate a statistically significant negative relationship between the exchange rate and the stock market index. This observation implies a clear correlation between the performance of the stock market and the devaluation of the domestic currency, wherein a larger quantity of domestic currency is required to acquire a single unit of foreign currency. A weaker currency benefits export-oriented companies by making their goods and services cheaper for foreign buyers. As a result, these companies experience improved competitiveness, leading to higher revenues and potentially higher stock prices. Conversely, when the local currency appreciates (i.e., fewer units of the local currency are needed to purchase one unit of a foreign currency), the stock market may need help. A stronger currency increases the cost of imports for domestic companies, potentially resulting in lower profitability and stock price declines for import-reliant businesses.

The industrial production index (IPI) is the final macroeconomic variable considered in our assessments of the stock market index in ASEAN-5 countries. Previous research has recognized its significance as it provides valuable insights into an economy's health and performance. However, the existing research has not established a definitive positive or negative link between industrial production and stock market indexes. While Ibrahim and Aziz (2003) confirm a positive correlation between the stock market and industrial production, other studies present different findings. According to the theory, producers respond by decreasing their production when consumer spending decreases. This, in turn, leads to lower profits and reduced dividend expectations. Consequently, there is a decrease in demand for securities, resulting in falling prices. Conversely, an increase in consumer spending leads to higher production levels. As people spend more, firm earnings rise, resulting in higher profits and dividend expectations. This makes securities more attractive, establishing a positive relationship between industrial production and the stock market. Based on the theory above, our estimations indicate a negative linkage between the IPI and the ASEAN-5 stock market index. However, the coefficients are not statistically significant due to health crises, such as the COVID-19 pandemic, which have caused a contraction in industrial production. During these periods, reduced consumer demand, declining investments, and supply chain disruptions have led to decreased manufacturing and production levels, ultimately resulting in a decline in the IPI.

During the COVID-19 period, the relationship between INT and the SMI contingent upon the prevailing economic conditions. In the earliest phases of the pandemic, characterised by considerable economic uncertainty and adverse economic indicators, the stock market experienced a decrease. Stock markets in certain places experienced a resurgence as a result of the implementation of rate reductions and other forms of economic stimulus by central banks. This positive response from investors can be attributed to their anticipation of the potential effects of these measures on the overall economic recovery. This analysis reveals a negative correlation coefficient, whereby the presence of exceptionally low interest rates signifies economic uncertainty and the possibility of a financial crisis. These conditions can exert pressure on investor sentiment and contribute to fluctuations in market volatility. In the interim, the SMI was notably impacted by economic disruptions, lockdown measures, and

fiscal stimulus initiatives targeting the CPI. Conversely, certain organisations, particularly those with the flexibility to set prices and transfer heightened expenses to customers, experience advantages as a result of moderate inflation. Moreover, equities function as a safeguard against inflation, rendering them appealing to investors who have apprehensions regarding escalating prices. Moreover, the devaluation of the USD in comparison to other currencies has adverse implications EXR on the SMI. The process of depreciation can also contribute to the escalation of expenses associated with imported products and services, potentially resulting in an increase in inflation. The aforementioned phenomenon has the potential to exert adverse effects on consumer sentiment, corporate profit margins, and stock prices within businesses that heavily depend on imports. Finally, within the COVID-19 epidemic, numerous nations experienced disturbances in their industrial production as a consequence of imposed lockdown measures, pauses in supply chains, and a decrease in consumer demand. Consequently, the IPI serves as a prominent indicator of economic activity and, subsequently, the stock market index. An upward trend in the IPI could indicate a positive trajectory in economic recuperation and enhanced business efficacy, which in turn may result in favourable outcomes in the stock market.

Conclusion

This research aimed to examine the influence of macroeconomic variables on the ASEAN-5 countries during the COVID-19 pandemic, which served as an external shock. The empirical investigation utilized monthly data from January 2012 through December 2022. The findings revealed significant negative relationships between interest rates, exchange rates, the industrial production index, and the movement of the stock market index during COVID-19. On the contrary, a noteworthy positive correlation existed between the consumer price index and the stock market index. Economic crises can profoundly impact corporate earnings and profitability. The decline in the industrial production index (IPI) leads to reduced output and revenues for industrial companies, consequently causing a decrease in their profits. This reduction in corporate earnings can generate pessimistic sentiment among investors, prompting them to sell off stocks and ultimately leading to a decline in the stock market index.

Our findings significantly impact investors and governments, particularly in ASEAN nations. Before investing, investors must carefully consider the stability of a country's fiscal and monetary policies. A crucial factor in this assessment is the absence of a health crisis, as it directly impacts the movement of the composite stock price index, allowing it to be used as a predictor of stock market returns and informing investment decisions. During times of crisis, investors tend to become risk-averse and seek safe-haven assets or maintain cash positions. This risk aversion often leads to a flight from equities, which are perceived as riskier assets, resulting in a decline in stock prices and the overall stock market index. Investors should conduct fundamental and technical analyses, assessing stock market returns and trading volume, before making investment decisions. Our study employs a short-term forecast, and for future research, we recommend conducting either long-term or dynamic estimations. Furthermore, it is essential to consistently observe the interconnectedness among asset markets in the ASEAN-5 economies to better understand the transmission effects of financial instability, precisely the persistent consequences of the COVID-19 pandemic. Policymakers must develop strategies for effectively monitoring fluctuations in the stock market, as such measures can significantly contribute to the improvement of corporations' cash flow and shareholder value. Implementing such measures would potentially mitigate drawdowns and

risk exposures within the financial system during periods of stock market decline, which a significant crisis may exacerbate. Future studies could benefit from incorporating a broader range of macroeconomic factors to enhance our comprehension of these dynamics, thereby expanding the scope of analysis.

The more independent variables employed to investigate a relationship, the greater the potential for obtaining additional results and valuable information. In future research, researchers are expected to incorporate more independent variables, such as unemployment, GDP, exports, and imports, as these variables can provide deeper insights into the phenomena under study. Researchers are encouraged to consider these variables carefully, as they can offer a better understanding of the research context. To enhance the robustness of the research, future researchers are advised to experiment with various data structures, including quarterly, monthly, and weekly data. Different variables may respond differently to different frequencies, and exploring such variations can enrich the research findings. On the other hand, gathering secondary data poses challenges and limitations for many researchers. While collecting data, researchers often encounter difficulties and restrictions that must be addressed and accounted for during data collection. The present analysis used data from the ASEAN-5 countries during the COVID-19 pandemic. It is essential to acknowledge that the determining variables in ASEAN-5 countries may differ from those in other nations, leading to potential variations in research outcomes. Therefore, data from countries such as Vietnam, Cambodia, and Myanmar can benefit future scholars to gain broader perspectives. Furthermore, future studies may also involve comparing the U.S. stock market with other nations, providing valuable insights into the global financial landscape.

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