

The Effect of Inflation and Interest Rate on Selected Stock Markets

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Abstract

This paper aims to study the relationships between inflation, interest rate, and stock indexes from six selected stock markets from 1997 to the year 2021 using panel regressions. The selected stock markets for their respective indexes are Brazil, China, Indonesia, Mexico, the United States (Russell), and Thailand. After selection and diagnostic processes, a fixed robust standard error model is selected. Findings show that inflation and interest rates have a negative relationship with stock indexes. Interest rates are slightly significant in moderating the inflation effect on stock indexes. Negative findings on lending interest rates and inflation validate the discount cash flow theory and rational expectation theory. Findings imply that monetary policy is effective in impacting the stock market, which policymakers should take into consideration, especially before applying monetary tightening measures. This study also contributed to investors understanding of the determinants of stock indexes when deciding to invest.

Keywords: Stock market, Inflation, Interest rate, Economic growth, Panel regression

Introduction

Research background

The stock market is a critical factor in a nation's economy as it serves a vital role in fostering the growth and progress of the country's industries and businesses which has a substantial impact on the overall economic performance of the country. The volatility of a stock index can be determined by the economic situation of a country, or other dimensions. Stock market development still relies on the country's economic foundation, yet the actual magnitude and relationship between various aspects of economic fundamentals to stock market performance may have differed from theories developed so many years ago. The change in economic situation will cause stock market floatation because it affects the firm's future earnings and investor cash capital to invest in the stock market. Previous studies have shown that there is a connection between the progression of the stock market and the real economy. However, there is ongoing debate regarding the relationship between them. Historically, stock markets in Southeast Asia rose sky-high prior to the Asian Financial Crisis that revealed the weaknesses of economic fundamentals then. Given the gradual increase of tolerance of inflation and the long period of low interest rates to combat economic depression, the contemporary impact of inflation and interest rates on the stock market may have changed. This has motivated the research focus of this paper.

Nonetheless, there is support for the notion that any movement in the lending interest rate has an impact on the performance of the stock market. Indeed, past studies indicate that changes in central bank monetary policy will indirectly impact the performance of the stock market. Economic factors can determine the long-term stock market performance (Conover et al., 1999) as well as affect the short-term fluctuation (Cook & Hahn, 1988). The performance of the stock market is important to a country's future economic development because a great functioning stock market efficiently allocates capital from investors and provides sufficient cash to rising, productive enterprises, which encourages rivalry and innovation and, eventually, fuels economic growth. Therefore, economic variables such as exchange rate, inflation, and unemployment are correlated to stock market performance because investors are always sensitive to economic development.

Increases in the cost of living are the main concern behind high inflation. It could be caused by several factors. Inflation harms consumers' buying power in terms of increased prices of goods and services. Therefore, it can lead to a decrease in the profits of listed firms, which can result in a decrease in stock value and prices. On the other side, when inflation is low, consumers have more purchasing power, which can cause upward trends in the profit of companies and an increase in stock prices. However, these reasons are not conclusive. Inflation, consumer purchasing power, and the firm's profit are still very much subject to the ability of the firm to pass on the extra cost to consumers. Therefore, stock market reactions to inflation will vary yet are important for investors' investment decisions in the equity market. Interest rate changes have a great impact on stock market performance. Interest rates are one of the key determinants of the performance of the stock market. Low interest rates encourage companies to borrow money to invest in their business, which can lead to an increase in their stock prices. In contrast, rising interest rates result in increased borrowing costs, which can cause a decline in stock prices. The operations of firms in most developed countries are governed by greater rules and stronger scrutiny. Investors expect larger profits from investing in developing countries that have higher potential economic growth, so the investment risk is higher also compared to developed countries.

Inflation and interest rate are important to study because there is a theoretical relationship between the stock market, there is also empirical evidence that proves there is a connection between inflation, interest rate, and stock index. Additionally, inflation and interest rates are always the variables targeted by policymakers. Hence, the relationship between the stock index, inflation, and interest rate is important to study because they give valuable insights into the effectiveness of policy interpretations. Another concerning issue is the interest rate has a moderation on inflation and stock market relationship. Economists often avoid high inflation as it can have negative effects on the economy. Elevated inflation has the potential to diminish the value of current money, making it harder for people to afford basic goods and services. Economists generally advocate for policies that can help to keep inflation at moderate levels, such as using monetary policy tools (such as interest rates) to control inflation and ensuring a stable and predictable economic environment. After several paradigm shifts from the emergence of globalization, digitalization, the Covid-19 pandemic, and the Fourth Industrialization revolution, the relationship and impact of economic factors may have changed from their original theoretical behaviour. This may cause severe losses to investors as well as not meeting policy maker's expectations of economic policy change in financial markets. These inconclusive debates have motivated this paper to study the relationships between the interest rate, inflation, and the stock market. This paper also aimed to determine the moderation effect of inflation on interest rate and stock market relationship nexus.

Theoretical Framework

Discounted cash flow, rational expectation theory, and demand-supply theory serve as the guiding theoretical framework for examining the relationship between interest rates, inflation, and stock market performance. The discount rate, referred to as the interest rate in discounted cash flow models, illustrates how monetary policy changes can impact the stock market. This method is based on the continuous operation premise of the enterprise, projecting future cash flows in the operating period. Using an appropriate discount rate, the intrinsic value of the enterprise is estimated. For a simplified illustration, a stock yielding dividend (cash flow for investors) of RM100 after one year is worth $100 / (1+0.10) = \text{RM}90.91$ with a 10% discount rate. A lower discount rate of 5% yields RM95.24 for the same situation. A lower discount rate is expected to result in a higher net present value of cash flows, establishing a theoretically positive relationship between interest rates and the stock market. The discounted cash flow model relies on assumptions and projections about future cash flows, encompassing revenue, earnings, dividends, or other forms of cash inflows. The discount rate represents the expected rate of return required by an investor to engage in the asset or opportunity. According to the economic idea of "rational expectations," choices are made based on the most recent market and historical data. While it is reasonable to be incorrect occasionally, the theory was introduced by American economist John F. Muth in 1961. Later, it was embraced in microeconomics during the 1970s new classical revolution. Recent applications of discounted cash flow theory on stock market return include Kaya (2023), Berkowitz (2011), and Mork *et al.* (2020).

However, the study will determine whether the interest rate has a moderation effect on the inflation and interest rate relationship nexus. People will expect the government to combat inflation and ensure the price is rising in a steady and predictable way. When the interest rates are also predictable, these will encourage investment in the stock market as controlled inflation is good

for economic growth. Hence, the moderation effect of interest rates on inflation and the stock index will be tested in the study. The theory of demand and supply is an economic framework that explains how the amount of a product or service that customers are ready and able to purchase (demand) corresponds to the quantity that firms are prepared and able to produce at a particular price. Based on this theory, prices play a key role in balancing the forces of demand and supply and determining the market outcome. There will be greater demand in the stock market if the interest rate is considerably conducive to business (Alam & Uddin, 2009).

Conceptual Framework

Figure 1 illustrates the conceptual framework. Two independent variables that affect the stock index are inflation and interest rate. Other macroeconomic indicators which include GDP, exchange rate, and unemployment rate play the roles of control variables.

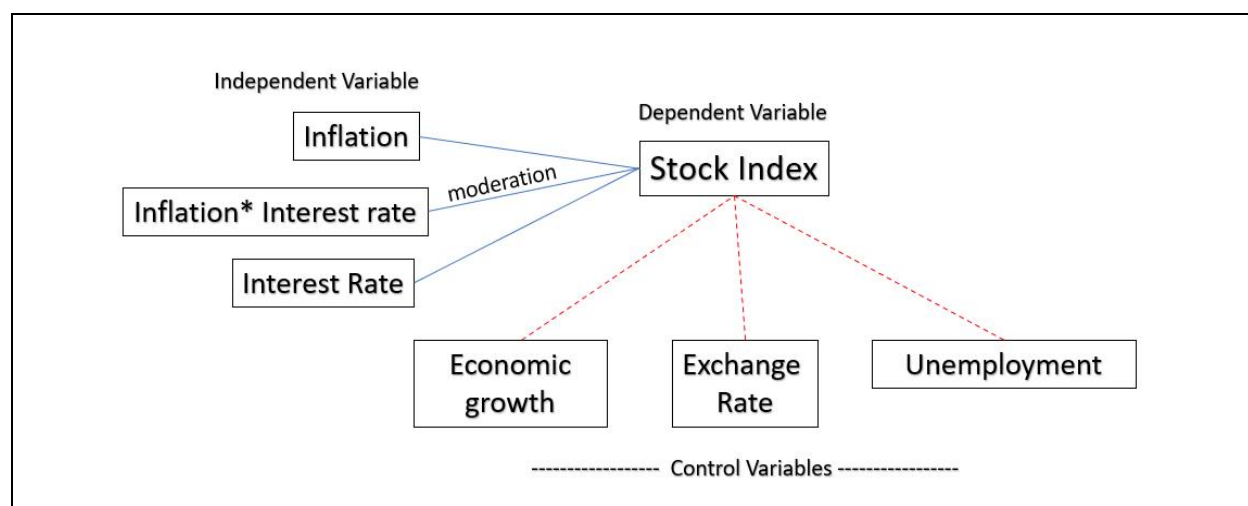


Figure 1: Conceptual Framework

Literature Review

Theoretical Review

Ioannidis and Kontonikas (2008) explained that stock prices can react in two ways to shifts in monetary policy under a discount cash flow model. A tighter monetary policy, which raises interest rates, can hamper companies' ability to generate future revenue, leading to a decrease in stock market indices. Conversely, easing monetary policy, which benefits the economy and increases economic activity, can cause a positive response in the equity market due to potential increased cash flow. Moreover, the discount rate is the rate of interest at which commercial banks can obtain funds directly from the central bank for a short period. Therefore, the cost of borrowing for companies from banks will increase. Investors assume that the future cash flow of a company decreases as the interest rate increases. Jensen & Johnson (1995) concluded that the stock market returned much more after periods of declining discount rates than after periods of rising discount rates. Therefore, the interest rate is a key determinant influencing the stock market in the discount rate model. According to the rational expectation theory, people learn from past mistakes and use

available information and relevant economic theories to make decisions. Hence, the public will adjust their behaviour based on the announced monetary policy, assuming that the future economy's status is identical to the current economy's situation. This contrasts sharply with the view that government economic policy dictates individual behaviour. If consumers anticipate future inflation, they are likely to borrow more money to buy durable goods at a given interest rate compared to when they expect no inflation (McCallum, 1980).

Similarly, people will purchase fewer stocks if they expect the government to increase the interest rate. The demand (buying) and supply (selling) of a stock index, either directly or through index-linked stocks, can be influenced by various factors such as inflation, exchange rates, and gross domestic product. For instance, an increase in inflation raises the cost of goods and services, leading to lower purchasing power and demand for the stock index. Kaul (1987) found that the negative relationship between the stock market and inflation is caused by money demand. On the other hand, an increase in the Consumer Price Index (CPI) is positive for the stock market, serving as a signal that consumer demand and spending activity are on the rise. This increased demand can result in higher corporate profits and a boost in the stock market. Inflation has a positive relationship and significant effect on stock return (Ibrahim & Abgaje, 2013). Inflation can lead to higher profits for businesses because they will increase prices if there is a demand-pull inflation. This shift in supply and demand can lead to higher profits for businesses and a boost in the stock market. Overall, the demand and supply in the stock market are complex and can be influenced by multiple factors. The impact of inflation on the stock market can vary depending on the supply push or demand push inflation, the ability of firms to transfer the rising cost to consumers, as well as the state of the broader economy.

Empirical Review based on Variables Used

Stock Index

The primary function of stock markets is to facilitate the conversion of savings into capital for the actual sector and for hedging purposes (El Wassal, 2013). Savings and investments in the stock market can be used as a tool to hedge against the negative impact of inflation. By mobilizing and increasing domestic savings and enhancing the quantity and quality of investments, stock markets can accelerate economic growth. Investments in the stock market that generate more savings are always associated with higher risk (Pollet & Wilson, 2010). According to Fama (1965), there is no memory in the series of price changes, implying that there is no meaningful way to predict the future based on the past. The homogeneous distribution of market information is reflected in an efficient stock market's price fluctuation, but we can forecast potential stock market trends by examining historical data (Zhang & Zhang, 2009). From both studies' arguments, stock prices can move independently, but the stock index is predictable with past information.

Lending interest rate

Ioannidis and Kontonikas (2008) explored the links between monetary conditions and equity indices, analyzing data from thirteen OECD countries. They utilized interest variables for their research and concluded a correlation between periods of tight money and simultaneous falls in stock market valuation. However, stock market valuations might not be uniformly affected by monetary policy changes across various monetary situations since the study solely employs interest variables such as the short-term Treasury Bill rate. Thorbecke (1997) posited that the value of

stocks equals the projected current value of forthcoming net cash inflows. The researcher found that ex-ante and ex-post stock returns are significantly influenced by monetary policy, impacting businesses' access to credit. Thorbecke (1997) concluded that lowering the interest rate has real effects due to the positive association between monetary shocks and equity returns. Positive relationships between interest rates and the stock market were also reported by Siang & Rayappan (2023) for Malaysia and Ghani et al. (2022) for Pakistan. Specifically, an expansionary monetary policy has a direct impact on increasing anticipated future cash flows or decreasing the discount rate used in capitalizing those cash flows. Research across six countries reveals a strong negative correlation between interest rates and stock prices (Alam & Uddin, 2009). Interest rates are one of the most effective tools to control the money market and financial market. Alam & Uddin (2009) suggest that if interest rates are significantly regulated in these countries, the stock market will benefit greatly from increased demand due to more investors entering the share market and increased supply from more corporations making long-term investments. In contrast, Alzoubi (2022) found a negative association between interest rates and the stock market, claiming that higher levels of inflation and interest rates have a negative impact on stockholder wealth.

Inflation Rate

Policymakers often use the consumer price index as an indicator to track inflation and implement policies to stabilize economic growth. A study investigates the connection between the rate of inflation and stock returns on the aggregate stock market in the UK, as well as on the stock markets of ten distinct industries (Li, Narayan, Zheng, 2010). Unlike expected inflation, which has minimal effect on stock returns, the researchers found that unexpected inflation announcements have a negative effect. The medium-term analysis reveals a positive correlation between expected inflation and market returns and a negative correlation between unexpected inflation and stock returns. Similarly, Siang & Rayappan (2023) and Ghani et al. (2022) also found a positive relationship between inflation and the stock market in Malaysia and Pakistan, respectively.

A past study explained the negative correlations between stock returns and inflation in the post-war period in four industrialized countries (Kaul, 1987). Returns on stocks are either unrelated to or favourably correlated with measures of inflation. One reason for the unexpected link between inflation and stock returns is its existence (Tobin, 1998). The researcher found that financial markets believe that news of inflation will cause the Federal Reserve to tighten money, lowering the present value of future earnings and, in turn, returns on stocks today.

The study from Ibrahim & Agbaje (2013) looked at how long-term relationships between stock returns and inflation in Nigeria change over time. The data indicated a significant positive correlation between stock returns and inflation, along with the existence of a co-integration relationship between the two. A study in Pakistan concludes that stock market gains in Pakistan are not negatively affected by inflation, at least not in the long run (Tiwari et al., 2015). The researchers proved that Pakistan's stock market returns are connected to and independent of the country's inflation rate. However, it was discovered that stock returns and inflation are in phase for longer time scales. Inflation will benefit the stock market when the demand in the economy increases, leading to increased company revenue and cash flow. At the same time, inflation will harm the stock market in counter-cyclical monetary responses. Kaul's (1987) study indicates a negative association between stock returns and inflation. There is an absence of agreement in developing countries regarding the relationship between inflation and the stock market, as some argue for a positive relationship while others argue for a negative relationship.

Gross National Product (Economic growth)

Enhancing stock markets is crucial for maintaining healthy economic expansion (Mian et al., 2010). Jareño & Negrut (2016) examined the US stock market from both real and financial economy perspectives by using S&P500 and Dow Jones as representative indicators. The researchers stated that stock market performance in the United States significantly and positively correlates with GDP growth. Kulhánek (2012) discussed the connection and interplay between real economic activity indicators (represented by real GDP), money supply, and stock prices in Central and Eastern Europe. In the long run, the direction of the stock market can be used as a proxy for the health of the economy. Macroeconomic variables are key indicators of equity market fluctuations (Pilinkus & Boguslauskas, 2009). The critical result of this study is that short-term stock market prices are very sensitive to GDP and monetary supply growth. By conducting the Granger causality test, stock prices can be used to forecast economic conditions (Comincioli, 1995). According to Comincioli (1995), the idea that shifts in stock prices "Granger-cause" shifts in GDP is crucial because it bolsters the case that the stock market plays a central role in the economy. Researchers explain the "wealth impact" brought on by swings in stock prices, providing theoretical justification for the idea that stock prices could drive economic growth.

Exchange rate

The foreign exchange market is part of the original financial market that connects the global economy and businesses. For international monetary transactions and financial investments, the Foreign Exchange Market (Forex) is a vital facilitator. Apart from providing a venue for buying and selling, speculation and hedging for currencies are also available in the foreign exchange market. According to Chiang et al., (2000), market trends have revealed increased linkages between international financial markets, interacting with both bonds and foreign exchange markets. The results showed a rise in the value of a nation's currency is positively correlated with a rise in the value of its stock market, implying that a rise in stock market returns is encouraged by a rise in the value of the nation's currency. There are thousands of studies that analysed the relationship between the foreign exchange market and the stock market. Research in ASEAN-5 countries found that a 1% appreciation in local currencies will lead to a 4% better performance in the stock market (Liang et al. 2013). Siang & Rayappan (2023) and Ghani et al. (2022) also found a positive relationship between the real effective exchange rate and the stock market in Malaysia and Pakistan respectively. Capital mobility is the mechanism through which exchange rates have a negative effect on stock prices. The government should not interrupt the flow of the exchange rate and should let it be determined by the economic fundamentals. Fluctuations in emerging stock markets can be influenced by foreign exchange rates during different events. Alterations in foreign exchange rates have a considerable impact on the transition between calm and volatile periods in emerging stock markets (Walid et al., 2011).

The exchange rate has a significant positive correlation with the stock market index. However, an appreciation in the local currency that leads to an increasing stock market value will tend to harm the U.S. stock market index. According to Mun (2007), the relationship between changes in exchange rates and local equity market returns is more robust than the relationship between changes in exchange rates and US stock return; therefore, the volatility of local markets is more affected by foreign exchange fluctuation than that of the US market. This suggests that

exchange rate variations have a detrimental effect on the linkage between the US stock market and local stock markets, as rising local currencies are linked to decreasing US stock markets. In addition, Gulati and Kakhani (2012) found no positive correlation between the Indian stock index and the foreign exchange rate. They examined the causal relationship between the India Sensex index and the foreign exchange rate by applying the Granger causality test and correlation test.

Unemployment rate

Unemployment rates represent the percentage of people in the labour force who are not employed. Sometimes, we use the unemployment rate to measure productivity in an economy. Jareño & Negrut (2016) found an inverse relationship between the unemployment rate and the stock index. The unemployment rate drops when stock markets are active. The increased stock market activity appears to have a slight but observable effect on unemployment. One possible explanation for this beneficial effect is the role that active stock markets play in helping to mobilize savings, direct those savings toward productive investment, and keep an eye on the performance of companies (Feldmann, 2011). Hussain et al. (2013) also concluded that the unemployment rate and stock index have a negative relationship in the Pakistan stock market.

On the other hand, there is plausible justification for the impact of unemployment on stock market values. According to Gonzalo and Taamouti (2017), when investors expect that the unemployment rate will decrease in the future, this expectation tends to increase stock prices. This is because the Federal Reserve typically lowers interest rates in response to high unemployment rates, according to the Fisher and Phillips curve equations (Phillips 1958). Lower interest rates, in turn, can stimulate the stock market. However, the reaction of the stock market may be varied from different economic cycles. A study by Boyd et al., (2005) concluded that stock prices increase during expansions when there is negative labour market news and decrease during recessions. When there is unfavourable news about the labour market, investors expect interest rates to go down, which is good for the stock market. However, stock prices tend to be dominated by growth anticipation effects. The reason is, that during both expansions and contractions, growth expectations react negatively to unemployment news, with stronger responses during contractions.

Methodology

Data and Variables

The dynamic link between independent factors and the stock index is assessed using a series of empirical analyses. In this study, six stock indexes serve as the central focus of analysis, acting as the dependent variables. Data for the stock index is collected from Yahoo Finance. Selected stock markets for their respective indexes are Brazil, China, Indonesia, Mexico, the United States (Russell), and Thailand. These stock markets are randomly selected proxies for stock markets of developed and developing countries on different continents. The stock index is a statistical measure that represents the performance of a particular group of stocks, usually in a specific market or stock exchange. All independent and control variables are sourced entirely from the World Bank database. They are inflation, interest rate, economic growth, exchange rate, and unemployment. The Consumer Price Index (CPI) is used as a proxy for inflation.

The lending rate is the interest rate charged by banks on loans and is generally used for short and medium-term financing needs of individuals and businesses. The higher interest rate means a higher cost of borrowing which will lead to lower revenue for firms. The averaging method is used to fill up the missing data for lending rates for Thailand in the years 2002 and 2003. The acceptable formula is $(Y_{2000} + Y_{2001} + Y_{2004} + Y_{2005})/4$. GDP is the value of all completed goods and services produced within a country's borders during a period. Growth of GDP or economic growth is a commonly used measure of a country's economic health and productivity. The exchange rate is the measure of one currency's value in relation to another currency. It is the rate at which a local currency can be swapped or exchanged for another currency. The unemployment rate refers to the proportion of people in the workforce who are jobless but are actively seeking employment and willing to work. It is one of the most widely used indicators of the health of a country's labour market. The data set consists of annual panel data spanning from 1997 to 2021, encompassing a period of 25 years and comprising 150 observations. This extensive dataset provides a robust foundation for the research, offering valuable insights into the relationship between the stock index and other relevant variables.

Model Specification

Static panel regression is used to analyse the relationship between the stock market, inflation, interest rate, economic growth, exchange rate, and unemployment. The equation for the general model is as follows.

$$SI_{i,t} = \beta_0 + \beta_1 IR_{i,t} + \beta_2 INF_{i,t} + \beta_3 (IR * INF)_{i,t} + \beta_4 UR_{i,t} + \beta_5 GDP_{i,t} + \beta_6 EXR_{i,t} + \varepsilon_{i,t}$$

..... Equation 1

Where SI is the stock index, IR is the interest rate, INF is inflation, UN is the unemployment rate, GDP is the gross domestic product, EXR is the exchange rate, β are the coefficients, and ε is the error term. The moderation term of IR*INF is interest rate multiply the inflation rate. The cross-section and time-series components are represented by the subscript of i and t respectively. SI, GDP, and EXR are in natural logarithm form, thus implying the growth rate of the respective variables. IR, INF, and UN are in percentage. This general model is enhanced and tested through three different static panel regression models, namely the Pooled Ordinary Least Square (POLS), Fixed Effect Model (FEM), and Random Effect Model (REM). A poolability test is applied to determine whether the fixed effects or pooled ordinary least squares are more appropriate. If the data consist a number of countries and a number of years, there are two methods of analysis - (1) run as panel data that take into consideration the cross-section (countries) and time-series (years) effect in models such as the FEM, or (2) run as pool time-series data, where cross-section (countries) are ignored as in the POLS model. The Poolability test is to determine which method [1 or 2] is more suitable. The Breusch-Pagan LM test (BP-LM) determines whether a linear regression model is better suited to a random effects specification or a POLS specification. The Hausman test is used to contrast the estimated coefficients of the two models and determine which model provides a better fit. In this case, the FEM model is more appropriate than REM if the null hypothesis is rejected. Test statistics for Poolability test are F-statistics while test statistics for both the Breusch-Pagan LM test and Hausman test are Chi-squared. The selected best model among the three static regression models will go through diagnostic testing and remedies accordingly.

Pooled Ordinary Least Square (POLS)

Pooled Ordinary Least Squares (POLS) is a type of linear regression model that combines data from different cross-sectional units or time periods to estimate the relationship between a dependent variable and independent variables. The equation is like the Equation 1.

Fixed Effect Model (FEM)

A fixed effects model is a statistical model that controls for differences in certain variables that are constant over time or across different individuals or entities. The error term ε is decomposed into two independent components or composite error term of λ_i to capture the time-invariant individual-specific effect and u_{it} as the remainder disturbance. Hence, the FEM equation is as follows.

$$SI_{i,t} = (\beta_0 + \lambda_i) + \beta_1 IR_{i,t} + \beta_2 INF_{i,t} + \beta_3 (IR * INF)_{i,t} + \beta_4 UR_{i,t} + \beta_5 GDP_{i,t} + \beta_6 EXR_{i,t} + u_{i,t} \quad \dots\dots\dots \text{Equation 2}$$

Random Effect Model (REM)

In a random effects model, the unique effects are assumed to be no relationship with the explanatory variables and are modelled as a random variable with a normal distribution. The model implies that individual-specific effects are independent and equally distributed across individuals and that individual-specific effect variance is stable over time and individuals. The REM equation is as follows.

$$SI_{i,t} = \beta_0 + \beta_1 IR_{i,t} + \beta_2 INF_{i,t} + \beta_3 (IR * INF)_{i,t} + \beta_4 UR_{i,t} + \beta_5 GDP_{i,t} + \beta_6 EXR_{i,t} + (\lambda_i + u_{i,t}) \quad \dots\dots\dots \text{Equation 3}$$

Diagnostic Tests

Heteroskedasticity tests are used to determine if there is unequal variance in the errors of a regression model. The Pesaran CD test is to identify the presence of cross-sectional dependence in panel data. The Wooldridge test is a mathematical method utilized for detecting the presence of autocorrelation, which is also known as serial correlation, in a regression model.

Findings & Discussions

Descriptive analyses

The summary statistics as in Table 1 display the descriptive statistics of means, standard deviation, maximum, and minimum for all variables. For instance, the lending interest rate has a mean of 16.77, a standard deviation of 17.38, the highest value of 86.36, and the lowest value of 3.06.

Variable	Abbr.	Obs.	Mean	Std. Dev.	Minimum	Maximum
Stock Index	SI	150	14649.06	22510.80	303.49	116892.50
Interest Rate	IR	150	16.77	17.38	3.06	86.36
Inflation	INF	150	6.52	9.21	-1.40	85.75
IR*INF	IR*INF	150	154.25	350.92	-8.19	3405.99
Unemployment Rate	UR	150	5.32	3.035	0.25	14.40
Gross Domestic Product	GDP	150	2.97	4.21	-14.35	13.64
Exchange Rate	EXR	150	1758.15	4047.06	1.08	14582.20

Note: “Abbr.” is an abbreviation for the variables, “Obs.” is the number of observations, and “Std. Dev.” is standard deviation.

Table 1: Descriptive Statistic

Static Panel Regression Analysis

Table 2 presents the static regression findings. The F-test result of the Poolability test indicates that the individual-specific effects are statistically significant, thus FEM is preferred over POLS. The Breusch-Pagan LM test is used to determine the significance of the random effect. Thus, its insignificant result implied that POLS is preferred to REM. Hausman test result is significant, implying FEM is preferred to REM. Overall, FEM is the selected model. Diagnostic tests on the selected model as in Table 3 revealed the existence of heteroskedasticity, cross-sectional dependence, and autocorrelation. Significant results of the respective test statistics for all diagnostic tests as in Table 3 mean there are heteroskedasticity, cross-sectional dependence, and autocorrelation problems respectively. The remedy is to apply a fixed robust standard error model (FEMR), which is the FEM model adjusted with robust standard error. The results for FEMR are shown in the last column of Table 2. Based on the results, there is a significant and negative relationship between the lending interest rate (IR) and the stock market in both the FEM and FEMR. The result is consistent with studies done by (Ioannidis and Kontonikas 2008, Pilinkus & Boguslauskas 2009, Jareño & Negrut 2016, and Alzoubi 2022) and the theory of discount cash flows. The rising interest rates can increase the borrowing costs for companies, which can negatively impact their earnings and cash flows. As a result, the present value of their expected future cash flows may decline, which can reduce the intrinsic value of their stock.

There is also a significant and negative relationship between inflation (INF) and the stock market in both the FEM and FEMR. The finding is consistent with Kaul (1987), Tobin (1998), and Alzoubi (2022). A negative relationship between the demand and supply theory implies the inability of firms to pass on any rising cost to consumers. In addition, discounted cash flow theory will imply a lower net present value of cash flow, hence lowering the value of stocks value and the stock market. There is a small, positive, and significant moderation effect of interest rate and inflation (IR*INF). When interest rates are used to moderate rising inflation, policymakers typically raise interest rates to slow down inflation when it becomes too high. This implies that an increase in interest rate successfully slows down inflation, thus reversing the negative relationship between inflation and the stock market.

Variables	POLS	REM	FEM	FEMR
IR	-0.0062 (0.0119)	-0.0062 (0.0119)	-0.0619*** (0.0079)	-0.0619*** (0.0115)
INF	-0.1400*** (0.0439)	-0.1400*** (0.0439)	-0.0772*** (0.0210)	-0.0772* (0.0318)
IR*INF	0.0020* (0.0012)	0.0020* (0.0012)	0.0020*** (0.0006)	0.0020* (0.0009)
UR	0.2011*** (0.0558)	0.2011*** (0.0558)	-0.0002 (0.0319)	-0.0002 (0.0602)
GDP	-0.0497* (0.0281)	-0.0497* (0.0281)	-0.0072 (0.0133)	-0.0072 (0.0097)
EXR	-0.1911*** (0.0455)	-0.1911*** (0.0455)	0.2490 (0.1578)	0.2490 (0.2909)
Constant	8.8412*** (0.3283)	8.8412*** (0.3283)	8.7191*** (0.6886)	8.7191*** (1.1627)
Obs.	150	150	150	150
R2	0.3729		0.5000	0.5000
Breusch-Pagan LM		0.00		
Poolability test			151.36***	
Hausman test			1211.36***	

Note: SI, GDP, and EXR are in natural logarithm form, thus implying the growth rate of the respective variables. "Obs." is the number of observations, and R2 is R-Squared. *, **, and *** denote significant at 10%, 5%, and 1% respectively. FEMR is the FEM model with robust standard error.

Table 2: Static Panel Regression Findings

Diagnostic Tests	Test-statistics	Results	Findings
Heteroskedasticity test	Chi-squared	71.34***	Heteroskedasticity exists
Pesaran CD test	Pesaran CD	8.019***	Cross-sectional dependence exists
	Statistics		
Wooldridge test	F-test	29.41***	Autocorrelation exists

Note: *, **, and *** denote significant at 10%, 5%, and 1% respectively. FEMR is the FEM model with robust standard error.

Table 3: Diagnostic Test Findings

The regression result showed that there is no significant correlation between stock market and gross domestic product (GDP) in both the FEM and FEMR. The findings are inconsistent with past studies such as Jareño & Negrut (2016) and Kulhánek (2012) which stated a strong positive impact between GDP and the stock market. However, this might be in line with (Pilinkus & Boguslauskas, 2009) study, in which the GDP is only positive relative to the stock index in the short run. The relationship between the stock market and the unemployment rate (UR) is also not significant, which is like Ağırman, Karcıoğlu & Osman (2018). The exchange rate (EXR) does not have a significant relationship with the stock market. The result is inconsistent with Liang et al. (2013), which found a negative relationship. Results from the POLS and REM are presented for reporting purposes, and their results are not considered as they are not chosen as the best model.

Robustness Analysis

This paper re-runs the results of the selected model (FEMR) with slight modification of the control variables as a robustness check. The findings are considered robust if they are mostly consistent, especially regarding findings of the main independent variables, namely IR, INF, and IR*INF. The results of the three robustness test models are shown in Table 4. Results indicate the findings of the main model are robust. All the independent variables have the same results in terms of significance and correct sign in the main model and the three robustness test models. The only minor exception is the negative and significant result for GDP, its control variable.

Variables	(Main) FEMR	(1) FEMR1	(2) FEMR2	(3) FEMR3
IR	-0.0619*** (0.0115)	-0.0619*** (0.0117)	-0.0613*** (0.0112)	-0.0681*** (0.0140)
INF	-0.0772* (0.0318)	-0.0772* (0.0331)	-0.0774* (0.0309)	-0.0814* (0.0342)
IR*INF	0.0020* (0.0009)	0.0020* (0.0009)	0.0021* (0.0009)	0.0022* (0.0010)
UR	-0.0002 (0.0602)		-0.0000 (0.0616)	-0.0027 (0.0606)
GDP	-0.0072 (0.0097)	-0.0072 (0.0097)		-0.0112* (0.0045)
EXR	0.2490 (0.2909)	0.2491 (0.2888)	0.2654 (0.2726)	
Constant	8.7191*** (1.1627)	8.7179*** (1.0418)	8.6278*** (1.0695)	9.7565*** (0.5119)
Obs.	150	150	150	150
R2	0.5000	0.5000	0.4989	0.4910

Note: SI, GDP, and EXR are in natural logarithm form, thus implying the growth rate of the respective variables. "Obs." is the number of observations, and R2 is R-Squared. *, **, and *** denote significant at 10%, 5%, and 1% respectively.

Implications of Study and Recommendations

The results imply that the relationship between lending interest rates and inflation still conforms to existing theories despite many deeming a paradigm shift in the global economy. Kenichi Ohmae (1987) has questioned the importance of interest rates and their related theories following the globalization phenomenon. COVID-19, a sustainable development-oriented economy, and the wave of digitalization and the Fourth Industrialization have been touted as paradigm shifts that can change almost everything in our economy and society. However, the results, at least empirically, imply that the relationship between interest rates, inflation, and the stock market remains adherent to theories set a long time ago. Policymakers can use this study as a guide to understand the dynamics of the stock market and give more consideration to the stability of the stock index when planning to increase the interest rate. The paper mainly examines the relationship between interest rates, inflation, and the stock market. The government is responsible for setting monetary or fiscal policy. The study finds that higher interest rates may negatively impact the stock market with lower stock prices. Thus, policymakers may want to consider the potential trade-offs between controlling inflation and sustaining the stock market. Moreover,

policymakers should adjust the policy cautiously as the lending interest rate has a negative impact on the stock market. The stock market allows qualified companies to increase operating resources by offering to sell their equity to investors. Therefore, it enables companies to have sufficient funds for their businesses or invest in new projects, which can promote economic growth and job creation. Policymakers may need to consider the potential impact of their actions on the stock market and take steps to mitigate any unintended consequences.

The study can be used as a guide for investors or companies to understand the factors that cause stock volatility. The findings suggest that high interest rates and high inflation are associated with lower stock prices, so investors can adjust their investment strategies accordingly. Based on the findings, it is not a good time to initiate public listing during a high inflation and rising interest rate period as they will have a negative impact on individual stock prices and the overall stock market. An aggressive fiscal expansionary policy that is likely to cause inflation may be a hint to expand a company's capital through the stock market. Nonetheless, investors' decisions will depend on their individual investment goals and risk tolerance.

Future research may wish to involve different data frequencies. While annual data is commonly used in this paper and many other studies, it may not capture all the shorter-term fluctuations of the phenomenon being studied. By using different data frequencies, such as quarterly, monthly, or daily, researchers can potentially gain a more detailed and accurate understanding of the phenomenon under investigation. There is a belief that stock market movement is influenced by collective investors' behaviours. Hence, applying qualitative and behavioural finance theory in future research is highly recommended.

Reference

- Ağırman, E., Karcıoğlu, R., & Osman, A. B. (2018). Unemployment news and stock market returns: A study on OECD countries. *Proceedings of International Conference of Eurasian Economies 2018*, 94-99, Tashkent, Uzbekistan. <https://doi.org/10.36880/c10.02112>.
- Alam, M. D., & Uddin, G. (2009). Relationship between interest rate and stock price: empirical evidence from developed and developing countries. *International Journal of Business and Management*, 4(3), 43-51. <http://doi.org/10.5539/ijbm.v4n3p43>
- Alzoubi, M. (2022). Stock market performance: Reaction to interest rates and inflation rates. *Banks and Bank Systems*, 17(2), 189 – 198. [https://doi.org/10.21511/bbs.17\(2\).2022.16](https://doi.org/10.21511/bbs.17(2).2022.16).
- Berkowitz, J. (2011). Valuing Equity when Discounted Cash Flows are Markov. In: Gregoriou, G.N. & Pascalau, R. (eds) *Nonlinear Financial Econometrics: Markov Switching Models, Persistence and Nonlinear Cointegration*. London: Palgrave Macmillan, 3 – 20.
- Boyd, J.H., Hu, J. & Jagannathan, R. (2005). The stock market's reaction to unemployment news: Why bad news is usually good for stocks. *The Journal of Finance*, 60(2), 649–672. <https://doi.org/10.1111/j.1540-6261.2005.00742.x>.

- Chiang, T. C., Yang, S. Y., & Wang, T. S. (2000). Stock return and exchange rate risk: Evidence from Asian stock markets based on a bivariate GARCH model. *International Journal of Business*, 5(2), 97-117. <https://api.semanticscholar.org/CorpusID:221556996>.
- Comincioli, B. (1995). The stock market as a leading economic indicator: An application of Granger causality. Honors Projects. *Paper 54*. <https://core.ac.uk/download/pdf/59213381.pdf>.
- Conover, C. M., Jensen, G. R., & Johnson, R. R. (1999). Monetary conditions and international investing. *Financial Analysts Journal*, 55(4), 38–48. <https://doi.org/10.2469/faj.v55.n4.2283>.
- Cook, T., & Hahn, T. (1988). The information content of discount rate announcements and their effect on market interest rates. *Journal of Money, Credit and Banking*, 20(2), 167. <https://doi.org/10.2307/1992108>.
- El Wassal, K.A. (2013). The Development of Stock Markets: In Search of a Theory. *International Journal of Economics and Financial Issues*, 3(3), 606 - 624. <https://www.econjournals.com/index.php/ijefi/article/view/489>.
- Fama, E. F. (1965). The behavior of stock-market prices. *The Journal of Business*, 38(1), 34-105. <https://doi.org/10.1086/294743>.
- Feldmann, H. (2011). Stock markets and unemployment in industrial countries. *Applied Economics Letters*, 18(9), 845–849. <https://doi.org/10.1080/13504851.2010.503929>.
- Ghani, M., Guo, Q., Ma, F., & Li, T. (2022). Forecasting Pakistan stock market volatility: Evidence from economic variables and the uncertainty index. *International Review of Economics & Finance*, 80, 1180 – 1189. <https://doi.org/10.1016/j.iref.2022.04.003>.
- Gulati, D., & Kakhani, M. (2012). Relationship between stock market and foreign exchange market in India: An empirical study. *Pacific Business Review International*, 5(5), 66-71. http://www.pbr.co.in/2012/2012_month/Nov/7.pdf.
- Gonzalo, J., & Taamouti, A. (2017). The reaction of stock market returns to unemployment. *Studies in Nonlinear Dynamics & Econometrics*, 21(4), 1-31. <https://doi.org/10.1515/snde-2015-0078>.
- Hussain, A., Rafique, M., Khalil, A., & Nawaz, M. (2013). Macroeconomic determinants of stock price variations: an economic analysis of KSE-100 index. *Pakistan Journal of*

Humanities and Social Sciences, 1(1), 28-46.
<https://doi.org/10.52131/pjhss.2013.0101.0003>

- Ibrahim, T. M., & Agbaje, O. M. (2013). The relationship between stock return and inflation in Nigeria. *European Scientific Journal*, 9(4), 146-157.
<https://doi.org/10.19044/esj.2013.v9n4p%25p>.
- Ioannidis, C., & Kontonikas, A. (2008). The impact of monetary policy on stock prices. *Journal of Policy Modeling*, 30(1), 33–53. <https://doi.org/10.1016/j.jpolmod.2007.06.015>.
- Jareño Cebrián, F., & Negrut, L. (2016). US stock market and macroeconomic factors. *Journal of Applied Business Research*, 32(1), 325–340. <https://doi.org/10.19030/jabr.v32i1.9541>.
- Jensen, G.R. and Johnson, R.R. (1995) “Discount rate changes and security returns in the U.S., 1962–1991,” *Journal of Banking & Finance*, 19(1), 79–95. [https://doi.org/10.1016/0378-4266\(94\)00048-8](https://doi.org/10.1016/0378-4266(94)00048-8).
- Kaul, G. (1987). Stock returns and inflation. *Journal of Financial Economics*, 18(2), 253–276.
[https://doi.org/10.1016/0304-405x\(87\)90041-9](https://doi.org/10.1016/0304-405x(87)90041-9).
- Kaya, E. (2023). Accruals, cash flows, and stock returns: evidence from BIST 100, *Macroeconomics and Finance in Emerging Market Economies*, 16(1), 137-156.
<https://doi.org/10.1080/17520843.2021.1983702>
- Kulhánek, L. (2012). *The relationship between stock markets and gross domestic product in the Central and Eastern Europe*. In Proceedings of the 7th International Conference on Currency, Banking and International Finance-How Does Central and Eastern Europe Cope Up With The Global Financial Crisis (pp. 135-145).
<https://www.researchgate.net/publication/233898501>
- Li, L., Narayan, P. K., & Zheng, X. (2010). An analysis of inflation and stock returns for the UK. *Journal of International Financial Markets, Institutions and Money*, 20(5), 519–532.
<https://doi.org/10.1016/j.intfin.2010.07.002>.
- Liang, C.-C., Lin, J.-B., & Hsu, H.-C. (2013). Reexamining the relationships between stock prices and exchange rates in ASEAN-5 using panel Granger causality approach. *Economic Modelling*, 32, 560–563. <https://doi.org/10.1016/j.econmod.2013.03.001>.

- McCallum, B.T. (1980) “The significance of rational expectations theory, *Challenge*, 22(6), 37–43. <https://doi.org/10.1080/05775132.1980.11470578>.
- Mian, S. N., Muhammad, M. N., & Usman, J. G. (2010). Relationship between economic growth and stock market development. *African Journal of Business Management*, 4(16), 3473–3479. <https://doi.org/10.5897/AJBM.9000484>.
- Mork, K.A., Eap, H.M., & Haraldsen, M.E. (2020). Portfolio Choice for a Resource-Based Sovereign Wealth Fund: An Analysis of Cash Flows. *International Journal of Financial Studies*, 8(1):14. <https://doi.org/10.3390/ijfs8010014>.
- Mun, K.-C. (2007). Volatility and correlation in international stock markets and the role of exchange rate fluctuations. *Journal of International Financial Markets, Institutions and Money*, 17(1), 25–41. <https://doi.org/10.1016/j.intfin.2005.08.006>.
- Muth, J.F. (1961). Rational Expectations and the Theory of Price Movements. *Econometrica*, 29, 315. <https://doi.org/10.2307/1909635>.
- Ohmae, K. (1987). What moves exchange rates? New dynamics challenge traditional theories. Japan Times [Reproduced in Ohmae, Kenichi. 1995. *The end of nation state: The rise of regional economies*. New York: Simon & Schuster Inc.]
- Phillips, A. W. (1958). The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957. *Economica*, 25(100), 283–299. <https://doi.org/10.2307/2550759>.
- Pilinkus, D., & Boguslauskas, V. (2009). The short-run relationship between stock market prices and macroeconomic variables in Lithuania: an application of the impulse response function. *Inžinerinė ekonomika - Engineering Economics*, 5(65), 26-34. <https://inze.ktu.lt/index.php/EE/article/view/11607>.
- Pollet, J. M., & Wilson, M. (2010). Average correlation and stock market returns. *Journal of Financial Economics*, 96(3), 364–380. <https://doi.org/10.1016/j.jfineco.2010.02.011>.
- Siang, C. C & Rayappan, P. (2023). A study on the effect of macroeconomic factors on stock market performance in Malaysia. *E3S Web of Conferences*, 389(09037), 1 – 14. <https://doi.org/10.1051/e3sconf/202338909037>.
- Tiwari, A. K., Dar, A. B., Bhanja, N., Arouri, M., & Teulon, F. (2015). Stock returns and inflation in Pakistan. *Economic Modelling*, 47, 23–31. <https://doi.org/10.1016/j.econmod.2014.12.043>.

- Tobin, J. (1998). Monetary policy: recent theory and practice. In: Wagner, H. (eds) Current Issues in Monetary Economics. *Contributions to Economics.*, 13-21.
https://doi.org/10.1007/978-3-642-99797-6_2
- Thorbecke, W. (1997). On stock market returns and monetary policy. *The Journal of Finance*, 52(2), 635-654. <https://doi.org/10.1111/j.1540-6261.1997.tb04816.x>.
- Walid, C., Chaker, A., Masood, O., & Fry, J. (2011). Stock market volatility and exchange rates in emerging countries: A Markov-state switching approach. *Emerging Markets Review*, 12(3), 272–292. <https://doi.org/10.1016/j.ememar.2011.04.003>.
- Zhang, D., & Zhang, X. (2009). Study on forecasting the stock market trend based on Stochastic Analysis Method. *International Journal of Business and Management*, 4(6).
<https://doi.org/10.5539/ijbm.v4n6p163>.