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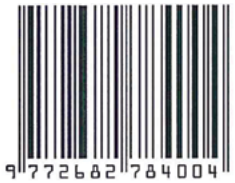

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CLIMATE CHANGE AND ITS IMPACT ON THE MALAYSIAN STOCK INDEX

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ABSTRACT

Climate change poses significant risks to the financial market. There are significant research concerns surrounding this matter. This paper aims to study the impact of climate change on the Malaysian stock index. Considering the time series data of 43 years (1980 to 2022), regression analysis is implemented to investigate the correlation of macroeconomic variables such as gross domestic product, inflation rate, interest rate, and climate change indicator with the Malaysia Stock Index, which is represented by the FTSE Bursa Malaysia KLCI Price Index. The findings revealed that both gross domestic product and climate change indicate positive and significant correlations with the Malaysian stock index. In contrast, the inflation and interest rates were negatively correlated with the stock index, suggesting that higher inflation and a higher interest rate may deteriorate stock performance. This study contributes to the existing literature by providing a better grasp to investors in making decisions for equity investment in emerging markets.

1. Introduction

Climate change is one of the most important events affecting everyone. According to a report published by the Intergovernmental Panel on Climate Change (2021), the world's temperature is expected to rise by more than 1.5 degrees Celsius in the next 12 years and by about 3 degrees Celsius by the end of the century. An estimation of $23 billion in long-term losses in gross domestic product per year was projected if the temperature increased to 4 degrees Celsius above preindustrial levels under various global warming scenarios by the year 2100 (Kompas, Pham, & Che, 2018). Thus, the preventive steps to keep global warming below 2 degrees Celsius from pre-industrial levels and additional efforts to keep it below 1.5 degrees Celsius by 2050 that were outlined in the 2015 Paris Agreement are indeed timely. The climate

crisis has many negative consequences, and the most notable effect is global warming, which leads to risks such as higher temperatures, severe storms, increased droughts, the loss of species, food insecurities, and health risks. According to the United Nations, since the 1980s, each decade has been warmer than the previous one, with 2011–2020 recording the warmest years. Increased greenhouse gas concentrations raise the global surface temperature, leading to more hot days and heat waves, which not only increase heat-related illness and make working outdoors more difficult but also bring severe wildfires that threaten the loss of lives and assets. Therefore, research on climate change is urgent due to its far-reaching, serious ramifications on the environment, human health, economy, and financial system.

The financial system is under threat from systemic risks related to climate change, which might disrupt the financial sector's regular operations and have detrimental effects on the real economy. Therefore, regulators should be more vigilant and make greater efforts to mitigate the effects of climate change. The financial system is impacted by two categories of climate-related risks, i.e., transition risks and physical risks (Grippa, Schmittmann, & Suntheim, 2019). Transition risks are related to the risks posed by the changes in climate policy and technology necessary to achieve a low-carbon economy. Transition risks occur when a market is moving toward a greener economy, leading to increased corporate costs and declining company profits. As a result, the urgent need to shift to a greener economy might result in quick losses to carbon-intensive assets, potentially disrupting financial markets and institutions. The physical risk, on the other hand, is related to the lasting environmental changes such as damage to infrastructure, property, and land due to severe climate change events. As a result, businesses are exposed to the direct physical hazards associated with climate change since natural disasters resulting from global warming have the potential to devalue their assets, disrupt operations, and lower their profitability.

A significant number of projected losses from transition and physical risks could have a negative effect on financial markets and financial institutions. Therefore, the vulnerability of the financial system to exogenous shocks such as the catastrophic climate change event is a pressing issue that requires much attention. In addition to being a vital tool for diversification and exogenous shock mitigation, the stock market is a significant player in the financial market because it is an essential indicator for determining the effects of adverse climate events on the financial system. Participants in the financial markets face enormous challenges as a result of the shocks caused by climate change, which expose enterprises to new risks with potentially large financial consequences. The pricing and hedging of risks resulting from climate change are two important aspects of climate change economics that are financial in nature. However, investor awareness and attitudes toward these risks, as well as the impact of climate risks on investment decisions, have not received as much attention in the literature (Giglio, Kelly, & Stroebel, 2021). Furthermore, methods for assessing climate risk are still being developed, and it is still difficult to estimate hazards in some markets, such as the stock market, debt pricing, and real estate, in places where severe weather is common. As a result, the issue of how the stock market is impacted by climate change risk becomes pertinent. Drawing on the discussion above, this study examines the effects of climate change on the Malaysian stock market between 1980 and 2022. In addition to climate change, the stock market reaction function considers three other important macroeconomic variables: output, inflation rate, and interest rate. The evaluation of how climate change is affecting the stock market will help investors, companies, and financial regulators recognize and reduce the risks and shocks associated with climate change while preserving the stability of the financial system. Investors need reliable and accurate information to price climate risks precisely (Tay et al., 2024).

The remainder of the study is structured as follows: The following section reviews the selected literature. Section three offers the discussion on data and methodology. Section four explains the results and findings of the study. Finally, Section 5 presents the conclusion.

2. Literature Review

2.1 Stock Market and Climate Change

A burgeoning body of scholarship emphasizes the convergence of climate change and stock market dynamics. A recent study carried out by Vestrelli et al. (2024) utilized a total of 2013 U.S. firms, spanning three years from 2020 to 2022, to investigate the impact of four types of climate risk disclosure, i.e., emissions, physical risks, transition risks, and pollution, on firm market value. The findings demonstrate a strong positive relationship between climate risk disclosures and firm value. However, the impact will diminish when climate change attention increases, suggesting that increased attention may result in greater uncertainty and have a negative influence on business value. Their findings were aligned with Matsumura et al. (2024), Flammer et al. (2021), and Krueger et al. (2020).

Santi (2023) surveyed the sentiments of investors towards global warming through the analysis of StockTwits posts. The author compiles a portfolio covering the period from 2010 to 2019, including companies with varying degrees of emissions. The author employed a vector autoregressive model (VAR) to estimate a multivariate time series. The results suggest that the rise in attitudes towards climate change has a beneficial impact on the profits of investment portfolios and could influence the increase in carbon prices, thus partly reducing the emission of harmful pollutants into the environment.

Besides that, Ardia et al. (2023) found a significant positive correlation, indicating that green shares tend to perform better than brown shares on days when there is an unforeseen surge in attention towards climate change. When examining the returns of the green (brown) portfolio separately, they found a statistically significant positive (negative) correlation with unexpected media climate change concerns (UMC), a proxy of unexpected changes in climate change. Therefore, they concluded that a direct relationship exists between the level of emissions intensity and the extent of the firm's value volatility on days when there is an unexpected increase in concerns about climate change. Tay et al. (2024) also concluded that the overall effects may be positive or negative, with most of the effects being felt on the day of the event and some adjusting in the days that follow.

Liu et al. (2021) examined how the most notorious, economically damaging hurricanes can affect US energy companies' share prices using an event study methodology and regression analysis. The findings indicate that the impact of news about the most catastrophic US storms is negatively significant and differs among energy firms according to their carbon intensity: cleaner companies yield better returns compared to coal companies, while renewable energy stocks achieve the most resilient outcomes. Therefore, the researchers conclude that the proposition that energy capital markets react to climate-related events is probable and the evidence is stronger for more current events.

The reliance of the agricultural sector on weather patterns makes it one of the most vulnerable sectors to climate change. Reduced yields and crop failures may result from an increase in the frequency of floods and droughts. Droughts, for example, can significantly reduce food supply by impacting both crops and livestock. Extreme weather can also harm infrastructure, resulting in power outages and higher energy production costs. For example, droughts may restrict the amount of water available for thermal power plant cooling (Environmental Protection Agency,

2023). Governments' desire for greener energy sources during the transition to renewables may leave traditional fossil fuel sectors with stranded assets and higher operating costs as a result of new laws (Zurich, 2023).

2.2 Stock Market and Output

Keynesian theory posits that stock prices are sensitive to economic expectations, which are frequently associated with the overall production of a country. Predictions of economic growth indicate increased business revenues, which in turn result in a corresponding increase in stock values. In contrast, expected reductions in production may result in a decrease in stock prices when investors modify their assessments of future profitability (Keynes, 1936). This theoretical connection is substantiated by several empirical studies. For instance, a study conducted by Elfeituri et al. (2023) demonstrated a positive correlation between the stock market and economic growth in the Gulf countries. The relationship was influenced by the stock turnover and stock capitalization.

Islam et al. (2023) investigated the impact of the gross domestic growth rate on the Dhaka stock exchange by using statistical techniques such as descriptive statistics, Pearson correlation analysis, and multiple regression analysis. Their study has unambiguously established that the GDP has a pivotal role in influencing the performance of the stock markets in Bangladesh. A rise in the GDP means increased investment opportunities, consequently driving the stock markets upwards. Furthermore, the findings also disclosed that the stock market positively influences the economy by creating new job opportunities and promoting entrepreneurial activities.

Furthermore, the global recuperation from the COVID-19 epidemic has emerged as a highly consequential economic occurrence in recent times. Hassan et al. (2023) studied the link between GDP growth and stock market performance in developed economies during the period of post-pandemic recovery. A study revealed that when GDP growth recovered because of fiscal stimulus, vaccination campaigns, and relaxation of lockdown measures, stock markets in industrialized nations saw significant increases. This was particularly true for industries like technology and consumer goods, which benefited from accumulated demand and heightened retail expenditure. This study highlights the positive connection between GDP growth and stock market performance, particularly during phases of economic recuperation. The expectation of ongoing GDP expansion bolstered investor confidence, leading to an increase in stock prices across several industries.

However, Hsu et al. (2022) fail to find any relationship between GDP and stock market performance. An analysis of the data from 15 emerging and 21 developed equity markets over samples ranging from 32 to 120 years reveals that the effect of inflation and GDP variables follows a nonlinear pattern based on the nonlinear autoregressive distributed lag (NARDL) method. Similar results using quantitative regression showed that the impacts of inflation and GDP on the stock market transactions have been asymmetrical.

2.3 Stock Market and Inflation Rate

The Fama hypothesis suggested a negative association between inflation and stock return activity. He provides evidence that actual activity and stock returns are positively associated, whereas real activity and inflation are inversely correlated (Fama and French, 1988). There is increased interest among researchers to investigate the effect of inflation rate on the stock market fluctuation (Baker et al., 2020; Białkowski et al., 2022; Dridi and Boughrara, 2023). The recent study executed by Karagiannopoulou and Sariannidis (2024) verified Fama's hypothesis. They conducted a bibliometric analysis using R packages covering the period of three crises:

after the financial crisis, the COVID-19 crisis, and the war in Ukraine. The researchers applied the vector autoregressive model (VECM), impulse response, and variance decomposition to explore the dynamic relationships between inflation and the Greek stock market. They employed monthly data for the period of 1 March 2020 until 31 August 2023. The result shows a negative relationship between inflation and stock returns during the Ukrainian war. Meanwhile, the correlation after the financial crisis and COVID-19 crisis is uncertain. The result is consistent with other researchers (Chiang and Chen, 2023; Raghutla et al., 2020).

Chiang (2023) studied the connection between inflation forecasts and stock market performance using data from 20 developed countries throughout the testing sample period of January 1990 to June 2023. The results show that most countries have unfavorable relationships, except for Brazil and Russia. The study concluded that stock returns are negatively impacted by both equity market volatility (EMV) and predicted domestic inflation. Conversely, the Fisher hypothesis asserts the positive correlation between inflation and the stock market. Fisher states that nominal assets ought to act as a built-in inflation hedge. However, there is a lack of empirical evidence that conforms with the Fisher effect. The research conducted by Phiri (2023) on South Africa found that the full Fisher effect only existed in the pre-financial crisis period. The findings demonstrate how well the South African Reserve Bank has used inflation targeting to guide economic agents' expectations during the tenures of the last three governors.

Other literature highlights the effects of time on the stock market and inflation connection. Tiwari et al. (2022) examined the relationship between stock market returns and inflation using wavelet techniques on a long historical set of annual U.S. data spanning from 1800 to 2017. The finding shows evidence of a modest short-run co-movement and a strong long-run co-movement between stock returns and inflation. Alam (2020) investigated the impact of macroeconomic variables such as inflation, short-term interest rate, money supply, crude oil price, and oil price shocks on the Saudi stock market. The study employs the time series data for a period of 2009 to 2016 using the Johansen test of co-integration, the vector error correction model, and the Wald test. The study reveals the existence of a positive relationship between the money supply and the stock market. However, the inflation, short-term interest rate, and crude oil price variables show a negative relationship. The finding indicates the presence of both long-run and short-run unidirectional causality running from inflation, short-term interest rates, money supply, and the oil price shocks to the Saudi stock market.

Beh and Yew (2020) examined the long-term and short-term impact of the macroeconomic indicators on the U.S. and Chinese stock index markets. By using the ARDL method, the Shanghai Composite Index (SSE) and Shenzhen Stock Exchange Index (SZSE) markets are found to have long-term and short-term relationships with the macroeconomic factors in the United States. Besides, China's macroeconomic factors such as the Consumer Price Index (CPI) and real effective exchange rate have a significant impact on the SZSE market in the long-term and short-term period.

2.4 Stock Market and Interest Rate

Interest rates are a tool of monetary policy and one of the key determinants for stock market performance. An increase in interest rates would result in increased borrowing costs, and vice versa. The increase in borrowing costs would lead to a slowdown in business activity, and this will impact the stock price. In contrast, the lower interest rates encourage economic activities and increase purchasing power (Saha, 2024). Akin (2024) conducted a recent study on the effects of behavioral finance on S&P 500 stock market fluctuation in the United States. They tested the effects of behavioral biases while testing a time-series data set spanning ten years and

including the S&P 500, real interest rates, consumer confidence, market volatility, and credit default swaps. The findings indicate the negative correlation of market volatility, real interest rates, and credit default swaps with the stock market because of risk perception, loss aversion, and herding behavior.

Fransisca and Herijawati (2022) examined the impact of interest rate, exchange rate, profitability on gross profit margin, and liquidity on the current ratio of stock prices for the food and beverage sub-sector manufacturing companies listed on the Indonesia Stock Exchange from 2017 until 2020. The result shows that only profitability (gross profit margin) impacts the stock price of manufacturing companies in the food and beverage sub-sector. There are studies examining the differing effects of interest rates and stock market relationships on both developed and developing countries. Saha (2024) examined the divergence of the impact of monetary policy in five emerging nations and five developed nations. The result indicates a significant negative relationship between interest rates and stock prices. The finding particularly highlights that the market in emerging nations has a greater sensitivity towards monetary policy adjustment due to lower market liquidity, increased dependence on foreign capital, and weak financial infrastructure. Meanwhile, the developed nations suggested a more stable result as the countries have stronger financial systems and higher investor sophistication.

By investigating the reaction of emerging market firms towards the U.S. interest rate shock, Kim (2023) discovered that the firms with more export revenues, higher foreign ownership, and larger market capitalization tend to outperform the less export-oriented firms. The result also revealed that low-foreign-ownership firms become more volatile and experience more negative returns in the U.S. interest rate shock.

3. Data and Methodology

The data chosen for this study are the annual data based on their availability. The total observation of the study is 43 years, ranging from 1980 to 2022. The stock index (*SI*) is represented by the FTSE Bursa Malaysia KLCI Price Index, output (*Y*) is represented by the gross domestic product per capita, the inflation rate (*I*) is calculated based on consumer prices, the interest rate (*R*) is represented by the central bank policy rate, and the climate change indicator (*C*) is represented by greenhouse gas emissions (GHG). GHG is obtained from the manufacturing and construction industries in the form of millions of metric tons of CO2 equivalent. Data on stock index, gross domestic product, inflation rate, and interest rate were retrieved from the DataStream, while data on greenhouse gas emissions was collected from the Greenhouse Gas Inventory Data, United Nations Framework Convention on Climate Change (UNFCCC).

Figure 1 illustrates the conceptual framework undertaken by this study. The diagram shows that the stock index is affected by the four variables in this study.

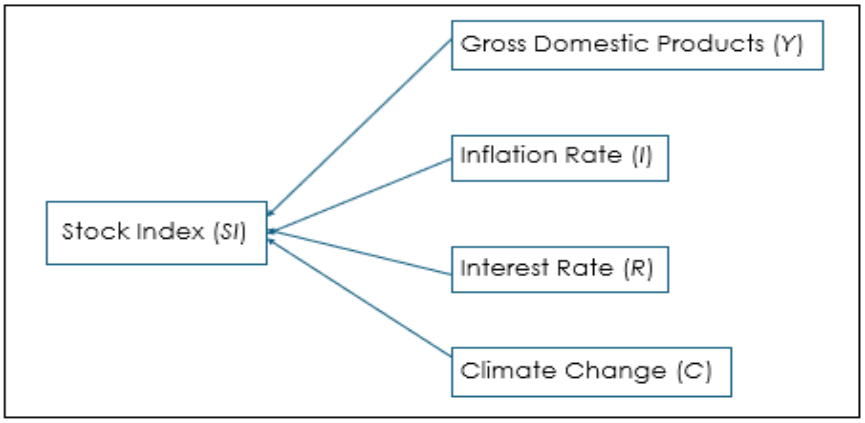

Figure 1. Conceptual Framework

Note: Stock index (*SI*) is the dependent variable, while gross domestic product (*Y*), inflation rate (*I*), interest rate (*R*), and climate change (*C*) are independent variables.

The multiple linear regression method is used to analyze the relationship between the stock index and the above-mentioned independent variables. Based on the conceptual framework, the regression model for this study is expressed as follows:

$$SI = \sigma + \beta_1 Y + \beta_2 I + \beta_3 R + \beta_4 C + e \quad (1)$$

where σ is the constant, $\beta_1, \beta_2, \beta_3,$ and β_4 are the coefficients for each variable, and e is the error term. The expected signs of the coefficients of β_1 and β_4 are positive, while β_3 and β_4 are negative. The independent variables are important determinants of the stock market if they have a statistically significant relationship with the stock index.

The present study posits that there is an upward relationship between the stock market and climate change. This is supported by the indicator of climate change, which is sourced from the manufacturing and construction industries, which account for more than 50 per cent of Malaysia's gross domestic product. As higher output is positively correlated with stock market performance, the proposition of an upward relationship between climate change and the stock market is established. The positive influence of climate change sentiment on portfolio returns may have an impact on the rise in carbon prices, which may limit the amount of damaging emissions released into the atmosphere (Santi, 2023). A positive correlation between firm value and carbon emissions indicates that investors consider environmental disclosures to be significant for firm value (Matsumura et al., 2014, 2022; Vestrelli et al., 2024). Extreme weather does, in fact, benefit utility companies, as rising temperatures are more likely to present an opportunity than a hazard as the need for cooling increases with rising temperatures (Pankratz et al., 2023), and, over time, CO2 emissions have a beneficial effect on agricultural productivity (Chandio et al., 2023). Changes in long-term temperature are associated with a notably positive stock risk premium (Bansal, Kiku, & Ochoa, 2016).

Events in the world economy that are marked by erratic economic activity have made stock market movements volatile. Stock price volatility reflects economic activity uncertainty and has an impact on the stock market's performance (Segal, Shaliastovich, and Yaron, 2015). Therefore, this study postulates that output is positively related to stock market performance. Output is correlated with capital productivity, which is determined by how well management uses the

company's capital (Shiri et al., 2015). More stock returns are produced by higher capital productivity because it allows managers to employ capital more effectively and creates more sensible and successful investment strategy rules. Stock return and economic growth are positive during the period of persistent output volatility, as indicated by the rise in labor productivity (Madsen et al., 2013). Long-term predicted stock returns are explained by labor income fluctuation because changes in consumption growth led to adjustments in the equity premium (Santos and Veronesi, 2006).

Inflation is a useful tool for forecasting future actual activity and stock returns (Fama, 1981). This study proposes that the inflation rate is negatively related to stock prices. Inflation can impact economic performance by causing uncertainty, eroding purchasing power, and distorting judgments about investments and relative costs (Côté, 2014). Investors' time-varying aversion to risk in relation to inflation raises the real discount rate and equity premium, which lowers stock prices (Brandt and Wang, 2003). The present investigation suggests a positive correlation between interest rates and stock prices. Increasing interest costs that worsen a company's balance sheet can explain how stock prices respond to changes in interest rates (Bernanke and Kuttner, 2005). Interest rate increases raise operating costs, which in turn reduce projected future cash flows and stock prices (Pirovano, 2012). Therefore, through their effect on borrowing costs, interest rates may influence stock returns. The price of stocks decreases as interest rates rise in the inverse relationship between the two.

4. Results and Discussion

Table 1 shows the descriptive statistics for the selected variables for this study. The observed series shows considerable variation across the study period, ranging from a minimum of -1.14 for the inflation rate to a maximum of 11993.19 for the gross domestic product. The stock index, gross domestic product, inflation rate, interest rate, and climate change indicator have positive mean values. Regarding the benchmark normal distribution, the overall kurtosis for the distributions is less than three, i.e., varies from a minimal value of -1.42 for the stock index to a maximum of 2.81 for the inflation rate, indicating less leptokurtic behavior of the data observed. Except for the climate change indicator, the other series are right-skewed, with inflation data recording the higher degree of skewness, while the stock index and gross domestic product are relatively symmetric.

Table 1
Descriptive Statistics

	SI	***Y***	***I***	***R***	***C***
Mean	952.74	5791.18	2.82	4.13	24.24
Standard Error	81.82	530.57	0.30	0.30	1.60
Median	894.36	4454.53	2.66	3.23	26.54
Standard Deviation	536.52	3479.19	1.94	1.94	10.50
Sample Variance	287854	12104752	3.75	3.75	110.33
Kurtosis	-1.42	-1.39	2.81	-0.66	-1.11
Skewness	0.23	0.47	1.07	0.84	-0.16
Minimum	206.54	1782.54	-1.14	1.75	7.90
Maximum	1852.95	11993.19	9.70	8.33	43.58

Note: *SI* denotes stock index, *Y* denotes gross domestic product, *I* denotes inflation rate, *R* denotes interest rate, and *C* denotes climate change.

Table 2 reports the correlation analysis between the stock index and its determinants, namely gross domestic product, inflation rate, interest rate, and climate change. Both gross domestic product and climate change recorded positive and significant correlations with the stock index. In contrast, the inflation and interest rates were negatively correlated with the stock index, suggesting that higher inflation and a higher interest rate may deteriorate stock performance. However, the inflation rate is not significantly correlated with the stock index, as indicated by the correlation coefficient of -0.2442. The stock index has the highest correlation with gross domestic product, with a coefficient of 0.8960, suggesting the importance of economic activities in explaining stock market performance.

Table 2
Correlation Analysis

	SI	***Y***	***I***	***R***	***C***
SI	1.0000				
Y	0.8960***	1.0000			
I	-0.2442	-0.3113**	1.0000		
R	-0.4589***	-0.5647***	0.3701**	1.0000	
C	0.8325***	0.7936***	-0.3094**	-0.5696***	1.0000

Note: *SI* denotes stock index, *Y* denotes gross domestic product, *I* denotes inflation rate, *R* denotes interest rate, and *C* denotes climate change. *** and ** indicate significance at 1% and 5% levels.

Table 3 summarizes the results of the regression analysis. Four models were presented: model 1 captures all four independent variables; model 2 ignores the interest rate; model 3 does not include the inflation rate; and model 4 only captures gross domestic product and climate change. The reason for including more than one model is because there were two insignificant variables, i.e., inflation rate and interest rate, in model 1. Dropping the insignificant variables is a systematic way of building models that capture only the significant variables. The coefficients of determination (R^2) for the four models were 85.55%, 84.60%, 85.44%, and 84.26%, respectively. The results suggest that the independent variables explain more than 80 per cent of the variation in the stock index. This is further supported by the results of the ANOVA, which indicate that all the independent variables explain the variation in the dependent variable.

Table 3
Summary of Regression Models

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Y	0.0001***	0.0001***	0.0001***	0.0001***
I	0.0129	0.0213		
R	0.0433		0.0468*	
C	0.0239***	0.0215***	0.0237***	0.0209***
Constant	5.1153***	5.3652***	5.1457***	5.4536
R^2	0.8555	0.8460	0.8544	0.8426
ANOVA	52.2645***	71.4151***	76.2660***	107.0616***
AIC	0.3071	0.3246	0.2687	0.2999
Test of Assumptions				

Normality Test	16.6004***	9.2250***	17.7012***	8.4584**
Autocorrelation	9.7413***	12.6716***	10.2970***	13.9429***
Heteroscedasticity	13.1986	6.6360	3.3931	5.6536
Multicollinearity	No serious multicollinearity	No serious multicollinearity	No serious multicollinearity	No serious multicollinearity

Note: *Y* denotes gross domestic product, *I* denote the inflation rate, *R* denotes the interest rate, and *C* denotes climate change. *** and ** indicate significance at 1% and 5% levels. R^2 represents the coefficient of determination, and AIC denotes Akaike Info Criteria.

Overall, the results revealed that gross domestic product and climate change were the two variables that had statistically significant relationships with the stock index in the four models. The inflation rate did not significantly affect the stock index, as indicated in models 1 and 2, giving support to the results of the correlation analysis, which showed that the inflation rate is not significantly correlated with the stock index. Interest rate is not important in explaining the stock index in model 1 but is statistically significant at the 10 per cent level in model 3, however, with an incorrect expected sign. A good regression model should include only significant independent variables; thus, the selected model is model 4, which encompasses two significant variables that are affecting the stock index, i.e., gross domestic product and climate change. Model four revealed that the error term has a constant variance as indicated by the result of heteroscedasticity, and the model has no serious multicollinearity problem. However, the error term is found to be not normally distributed and not serially independent. The presence of autocorrelation is because of the use of time series data. Therefore, the model must be interpreted cautiously.

The mathematical equation for model 4 is expressed in the following equation:

$$SI = 5.4536 + 0.0001Y + 0.0209C + e \quad (2)$$

Based on model 4, gross domestic product is statistically significant at the one percent level in explaining the stock index. This means one unit increase in gross domestic product will increase the stock index marginally by 0.0001. The results are consistent with the study of Elfeituri et al. (2023), Islam et al. (2023) and Hassan et al. (2023), who found that there was a significant relationship between output and the stock market. On the other hand, climate change is a significant variable in explaining the stock index. Increasing by one unit in the climate change indicator will increase the stock index by 0.0209 units. The results are aligned with Santi (2023), Matsumura et al. (2014, 2022), Vestrelli et al. (2024), and Pankratz et al. (2023), who revealed that the relationship between climate change and the stock market was positive.

4.1 Findings of the study

An analysis of the data above proves that GDP is positively significant in influencing stock indexes, as proposed by Keynesian theory (1936), which suggests that an increase in the GDP leads to a corresponding increase in the stock market trends. The positive correlation may indicate that economic expansion fosters a favorable environment for businesses, leading to higher corporate earnings, which in turn drives stock prices upward. This relationship highlights the interconnected nature of the economy and the stock market, where robust economic fundamentals typically result in enhanced investor confidence and increased stock valuations. According to Islam et al. (2023), an increase in GDP can result in a corresponding increase in the stock market through two distinct mechanisms. First, a rise in GDP results in elevated levels of consumer expenditure, improved firm operations, and expanded investment prospects, thereby

propelling the stock market in an upward direction. Second, the stock market directly contributes to the economy by creating new job opportunities and fostering entrepreneurial endeavors.

The above result of this study shows that there is a significant relationship between climate change and stock index. Climate conditions that are favorable, including sufficient rainfall and comfortable temperatures, boost agricultural productivity and raise GDP. In addition, utilities and renewable energy sectors do benefit from increasing rainfall and rising temperatures brought about by climate change, which represent a chance to boost the performance of stocks in this industry. The stock market performs better because of this growth since these sectors report stronger profitability and growth prospects. Positive information about the market's climate affects stock prices, which has the potential to boost stock values, especially in industries like oil and gas that are vulnerable to climate policy. Companies are beginning to include climate considerations in their portfolio plans, indicating that these aspects have a favorable impact on stock market performance (Yang et al., 2023). Non-linear characteristics are revealed by the effects of climate change on stock returns, as demonstrated by shock reversal, which happens both before and after climate change occurrence. A more sophisticated knowledge of how climate change affects stock returns has been made possible by the development of strategies for climate adaptation and mitigation, such as weather forecasting technologies (Li et al., 2024). Overall, this research indicates that stock index performance is eventually supported by the long-term link between climate variables and GDP.

5. Conclusion

Climate change is increasingly recognized as a significant risk to economic growth due to its extensive effects, such as extreme weather events, resource scarcity, infrastructure damage, and shifts in labor productivity. There are increasing numbers of researchers investigating the effects of climate change in different dimensions. This study adds to an existing body of literature by investigating the connection between the stock market and climate change. In this article, we put forward the selected macroeconomic factors of gross domestic product (GDP), inflation rate, interest rate, and the climate change indicator to capture the effects on stock market performance. The results reflect a similar outcome from most of the previous literature: climate change has a significant impact on the stock market. The agricultural, utilities and renewable energy sectors do benefit from increasing rainfall and rising temperatures brought about by climate change, which represent a chance to boost the performance of stocks in this industry. Apart from that, climate change also has the potential to boost stock values, especially in industries like oil and gas that are vulnerable to climate policy.

5.1 Policy implication

Climate change-related information is crucial for the financial market because it conveys risks and uncertainties that affect investors' reasoning and, ultimately, their capacity to make prudent investment decisions. Consequently, authorities must outline policies that lower market uncertainty about climate change while enhancing financial stability. Furthermore, the disclosure of information on environmental issues and climate change, along with related policies, is essential for investors to minimize information asymmetries that could significantly impact their decision-making.

For policymakers, these findings underscore the need to develop robust regulatory frameworks that facilitate transparent communication of climate risks and opportunities. Investors and corporations must also adapt their strategies to incorporate climate risk management into their decision-making processes, recognizing both the potential for sustainable investment

opportunities and the necessity of compliance with evolving regulatory requirements to mitigate financial risks associated with climate change.

5.2 Limitations and recommendations

This study, however, is subject to a few limitations. The study focuses solely on Malaysian data. Therefore, we suggest that future researchers explore broader coverage, such as developed and emerging markets, to distinguish the impact of climate change on different types of countries. Potential future research could be enhanced by including methodologies such as the dynamics heterogeneous panel cointegration model, ARDL, or nonlinear ARDL that consider real-world factors. To conduct a comprehensive multiple analysis of climate change, this study recommends an examination of a diverse range of indicators, including temperature extremes, rainfall patterns, and the frequency of extreme weather events. This broader approach allows for a more nuanced understanding of climate change's impacts, enhancing the robustness and reliability of the findings. To enhance the robustness of the findings, it is recommended that future research incorporate additional climate variables, such as more specific environmental factors, e.g., deforestation rates, extreme weather events, or carbon emissions by sector. Additionally, the inclusion of more recent data, as well as a comparison with other regional markets, could provide deeper insights into the cross-country impacts of climate change on stock indices. Engaging in scenario analysis or stress testing could also add value by projecting future impacts of climate change on the stock index.

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