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RESEARCH ARTICLE

# Role of the government towards stock markets and carbon emissions: evidence from wavelet approach

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## Abstract

The government of any country can play a great role in promoting economic and environmental policy reforms in both normal and crisis periods, but during the crisis period, the role of the government should take the economy into a recovery position. The stock market is the backbone of the financial system that needs the government's attention, especially in the period of financial stress and environmental protection is the responsibility of every economy to live in a healthy environment. Combining this motive, this study analyzed the role of the government towards the stock market and carbon emission by using different approaches, including the wavelet approach, OLS regression, and the Granger causality test. The wavelet approach is useful for analyzing the role of the government at different time intervals by using the time horizon from 1993 to 2021. World governance's six indicators in terms of voice and accountability, control of corruption, rules of law, regulatory quality, political stability, and government effectiveness are used as the proxy for the role of the government. Our findings show that all WGI indicators have a positive relationship with the stock market of Malaysia except voice and accountability while concerning voice and accountability, the role of the government of Malaysia is negative on the stock market. Similarly, our findings also show that the effective government governance mechanism through WGI indicators has a significant positive impact on $CO_2$ emission due to industrialization. Furthermore, findings of the Granger causality test reveal that all the WGI indicators cause to stock market of Malaysia, and political stability has bi-directional causality indicating stock market index is also a factor that caused the political stability within Malaysia. In the Granger causality results of the $CO_2$ and WGI indicators, there is unidirectional causality found between rules of law and regulatory quality with $CO_2$ emission. This study advocated strong implementations for the investors for investment decisions in effective governance countries and implications for the government to remove their weakness by making effective governance related to the economy and as well as the environments within the country.

**Keywords** Political stability · WGI · Government effectiveness · MSCI · Malaysia · Carbon emission

## Introduction

The stock market is considered the barometer of the economic drivers on the ground providing stock trading among stock market participants and providing a venue for listed corporations to raise equity financing. According to Polyakov and Polyakova (2016), the development of the stock market has a significant impact on the financial system. Over the past 10 years, researchers have investigated several macroeconomic variables that affect the efficiency of the stock market, including inflation and deflation, interest rates, gold prices, exchange rates, changes in the world markets, and a wide range of other macroeconomic variables with the policies (Matadeen 2017). Moreover, carbon emission in the modern world creates another issue for businesses with growth in the sustainable environment. However, many factors affect the stock market performance and carbon emission policy including the country's governance mechanism. Similarly, the government of any country plays a very important role in the control and compliance of the regulations within the economy (Levine and Zervos 1996). These regulations cover a wide range of areas, including

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labor, environmental protection, consumer protection, and financial regulation (Safadi and Watson 2023).

Our study addresses the two problems for the investigation, stock market performance and environmental protection through carbon emission. We investigated the role of the government in these economical as well as environmental problems in this study. There is limited literature on these types of problems, especially in emerging economies such as Malaysia. Nowadays, carbon emission and their policy effectiveness take significance around the globe due to the increase in the pollution index that affects the lives of the population around the world creating an interesting research gap for the investigations. The government policies of any economy may boost their stock market through good governance, especially in emerging economies where policy effectiveness is considered critical due to political and other constrains, the investigation of the emerging economy creates another gap for investigation (Wan and Lee 2023). Moreover, some previous methodologies are not sufficient for investigating the relationship due to the frequent changes of the indicators and intensity such as simultaneous structuring, this study addresses the gap that motive by fulfilling through the wavelet transformation that measures the dual causal relationship in the simultaneously structuring studies. Moreover, we contributed to the existing literature that is helpful for investors, policymakers, and the government.

This study comprises two main objectives, first is the investigation of the role of government on the stock market before and after the crisis period from 1993 to 2021. The second objective includes the investigation of the role of the government in environmental protection related to carbon emissions. Moreover, the role of the government is measured by using governance six indicators (WGI indicators). All the factors of the WGI indicator describe the governance mechanism within the country, as previously described by Darsono et al. (2022) and Elshqirat (2022), and we aimed to fill the gap identified by them. Similarly, we used the wavelet approach which is very useful for the time series data analysis and provides accurate and reliable results by two ways of investigation, both time and frequency domains.

Our study contributed to the exiting literature and theory by providing new insight into the issue of carbon emission and stock market performance through the effective role of government in Malaysia. Similarly, the Malaysian government makes effective policies related to all indicators of governance that have boosted the stock market performance and control carbon emission ($CO_2$) by imposing taxes on the regulation of carbon emission and implementing a proper code of corporate governance within the organizations. Moreover, effective government leads increase the investors' confidence in the Malaysian stock and environmental policies to increase the stock market indices and also increase the carbon emission only for the industrialization within an economy. However, this study also contributed to the previous literature that voice and accountability could be dangerous for the stock market performance and carbon emission. While it is true that excessive or unfocused demands for voice and accountability can create uncertainty and potentially harm stock market performance and carbon reduction efforts.

This study has significant implications for the government, policy makers, investors, and legislators. Government and policy makers can develop clean and suitable business practices that reduce the risk associated with climate change by balancing economic growth through effective governance mechanisms. Other implications for the investors to invest in that country, where the governance mechanism is strong enough to protect their investment. Effective government policies attract foreign direct investment that leads to boosting their economic growth, which is a significant implication for the legislators.

The rest of the article is organized in the following manner. The "Literature review and theoretical framework" section provides an overview of recent literature and theoretical background and proposes several hypotheses that can be tested to elucidate the relationship between variables. The conceptual framework, research design, and methods are outlined in the "Methodology" section. The "Results and findings" section presents the study's findings, while the "Discussion" section includes the discussion. The "Concluding remarks and policy implications" section includes the concluding remarks, suggestions for further research, limitations, and practical implications.

## Literature review and theoretical framework

The government plays an important role in regulating the stock markets and reducing carbon emissions (Xiang et al. 2023). Several theories support this study such as market failure theory, regulatory capture theory investor confidence theory. According to the market failure theory, markets may fail to account for the negative externalities of carbon emissions, such as environmental damage and health costs. As a result, government intervention is necessary to correct this market failure by imposing taxes or regulations on carbon emissions. However, regulatory capture theory suggests that powerful corporations may use their influence to shape regulations in their favor (Rilinger 2023). Therefore, the government needs to remain vigilant in ensuring that regulations are designed to benefit society as a whole, rather than specific interest groups. Moreover, investor confidence theory suggests that the government's role in regulating the stock market is to ensure that investors have confidence in the market and that there is a level playing field for all participants. The government can establish regulations and

oversight mechanisms to prevent fraud, insider trading, and other abuses that may undermine investor confidence.

## Role of government in OECD and emerging countries

When the global economy faced the period of the crisis, the home country also faced many financial as well as other problems due to that crisis. All the business activities, including the stock market, are also affected due to the crisis period. Some crises have been health-related like COVID-19 which resulted in the crisis of the financial sector due to the lockdown in the global economy. The global economy was also hit by all types of the crisis. In the period of the crisis, every government should want to promote the economy by taking different steps and using different techniques. Some economies were successful in recovering from the period of the crisis but some economies like the developing economy failed to recover due to the lack of economic resources. Some economies put their hand on the back of the economy to promote and stabilize the economy by controlling the exchange rate, stock market speculation, and stock market index by creating value to stabilize the index, controlling the unemployment in the economy, and also controlling the inflation rate. Stabilizing the economy in the period of the crisis is a difficult task for the emerging economy but sometimes easy for the developed economy due to the resources.

According to Keynesians, when government spending increases the effective demand with consumption also increases, increase in the GDP leads to a decrease in the level of unemployment, corruption, and instability, and also stable the stock market prices, exchange rate, and the inflation rate in the economy. A long-term relationship exists between private consumption and the government's spending and other issues, such as taxation and the federal deficit. However, Javed et al. (2023) describe the government spending related to oil consumption and carbon emission in Italy and also describe the effect of policy uncertainty between natural resources volatility and economic growth by using a wavelet approach.

According to Cogan et al. (2010), there is a fiscal multiplier that is higher in the period of the recession. That is why any change in the government policy during the period of recession has a great impact on the economy that is the main reason fiscal policy of the government is more effective in the recession. Since higher tax rates induce a recession, the fiscal multiplier increases if government consumer spending increases. According to Liargovas and Psychalis (2019), a negative multiplier can occur when income and capital taxes are decreased to exceptionally low levels. Similarly, by using wavelet transformation, Subhan et al. (2023) show the asymmetric effect of carbon emission and government policies on financial development and find the long-term relationship between them.

Modern economies are plagued by financial crises. There is a strong likelihood that the government will intervene in the economy to help it recover. There are many ways to assess the modern economy, but stock markets and their related indexes are among the most famous. This makes it easy to analyze the impact of various government attempts to stimulate the economy. The stock market indices are a good place to start. This is exactly the lesson we can take away from experiencing the global financial crisis of 2007–2009. However, knowing which programs are the most effective will allow for a more effective response to future crises. Younis et al. (2023) found the relationship between different economies' risk linkage in the period of crisis by using wavelet methodology and also described the role of the governance in terms of policy making to control the risk factors and improving the stock market.

A significant amount of academic debate and controversy has erupted in recent years about the merits of the free-market system and the role of government in an economy, in part as a result of the current global financial and economic crises, as well as various governments' interventionist measures to stabilize their respective economies. Because they were concerned about a worsening of the financial crisis, policymakers in Western developed countries took extraordinary measures to save failing banking institutions in their respective countries in September of that year. Using a series of financial sector rescue packages, the USA initiated the most extensive government economic intervention in the country's history since the Great Depression. The UK and other European countries quickly followed suit with similar rescue packages for their banking institutions.

According to Lim et al. (2021), the crisis has a negative impact on the economy, as well as other indicators of development going down. Both developed and developing countries responded aggressively to the crisis of 2007–2008 and other crises, to avoid policy mistakes that had been made previously. Financial market flooding, nationalization, interest rate reductions, and increased discretionary spending were some of the methods used by the governments (Barrios et al. 2009). The effectiveness and efficiency of policies varied depending on the response's magnitude and economic vulnerabilities. Despite these efforts, the credit crunch suffocated the real economy and caused trade flows to collapse. The downturn has increased the likelihood of millions of people falling into poverty in OECD countries without social security systems.

Even though the recession in the USA began in 2007, many emerging and developing economies, but not all, were affected in 2008. Growth slowed in many developing countries, but there were also instances of recession in certain regions. A few of the countries hardest hit by the global

financial crisis are Armenia, Mexico, South Africa, Turkey, the Baltic States, and Ukraine. After a long period of stagnation, the two most successful globalizers in recent history helped jump-start the recovery in 2009 (Yalaman and Manahov 2022). The Chinese economy grew at an annual rate of 8.7% in 2009 thanks to the Chinese government's massive stimulus package (totaling US$585 billion). India's economy has remained resilient despite a smaller stimulus package in 2009, when growth slowed to 6.7% (Ji and Kim 2021).

According to Ko and Lee (2015), economic policy uncertainty has a negative impact on the stock market showing the role of the government in the country's development, and they also robustness their findings by using the wavelet transformations. Moreover, Islam et al. (2023) use the wavelet approach to describe the price volatility due to the voice and accountability, rules of law, and political instability that has negative consequences on the whole economy including the stock market. However, by using the wavelet method Nsor-Ambala and Asafo-Adjei (2023) explain the government expenditure and policy-making to promote their economic system have a positive impact on the stock market.

Throughout 2008 and 2009, it became increasingly clear that the global financial crisis was serious, and that action was required urgently to prevent a catastrophic collapse of the financial markets and real economy. Increased fiscal spending to boost aggregate demand, interest rate reductions to keep credit flowing, and other forms of assistance are all options being explored. These policies aimed to stop the economy from falling further and, in the end, to keep workers in their current positions while also helping to create new jobs for the unemployed. Even though the effectiveness has varied widely across countries, it has prevented a much more severe economic downturn (Agarwal and Banerjee 2020). On the grounds of previous literature, we developed the following hypothesis.

*H1:* Voice and accountability have a significant positive impact on the stock market before and after a crisis.
*H2:* Political stability has a significant positive impact on stock markets before and after a crisis.
*H3:* Government effectiveness has a significant positive impact on stock markets before and after a crisis.
*H4:* Regulatory quality has a significant positive impact on stock markets before and after a crisis.
*H5:* Rules of law have a significant positive impact on the stock market before and after the crisis.
*H6:* Control of corruption has a significant positive impact on the stock market before and after the crisis.

## Role of the government and carbon emission

Climate change has arisen as a major worldwide issue, capturing the attention of researchers, politicians, and academics due to its impact on human health and economic development (Koçak et al. 2023). However, despite various measures adopted by OECD member countries for environmental protection, developing countries remain vulnerable and lack the necessary safeguards to address this issue (Jeetoo and Jaunky 2023). The lack of inexpensive eco-friendly technologies also adds to the degradation of environmental quality. Furthermore, while environmental quality is an important aspect of development, it is frequently overshadowed by economic growth (Zhao et al. 2023). Halkos and Tzeremes (2013), on the other hand, used a non-parametric estimator technique to analyze the relationship between carbon emissions and governance dynamics in G-20 economies from 1996 to 2010. The study investigated a nonlinear association between $CO_2$ emissions and factors such as accountability and voice, absence of violence and political stability, state potential, controlling quality, corruption control, and law and order. The impact of political stability, corruption control, and the rule of law on carbon emissions has received much attention. Gani and Jermias (2012) links between carbon emissions and political stability, the rule of law, and corruption control. According to Wang and Jiang (2019) that the rise in carbon emissions is to blame for China's increased economic growth. Abid et al. (2021) investigated that the lack of regulatory quality, political instability, and corruption control were the key causes of carbon emissions in Sub-Saharan African countries. The study also investigated that government efficacy, political stability, and corruption control had a significant impact on $CO_2$ emissions levels. Furthermore, the rule of law and regulatory quality have a positive impact on carbon emissions. However, AlNemer et al. (2023) provide the role of the government in controlling carbon emissions within the economy by using the wavelet transformation and also concluded that the government can provide a clean and sustainable environment to the market system for the operating and attracting the users around the globe.

Sekrafi and Sghaier (2018) examined the relationship between corruption and environmental devastation from 1987 to 2000 and investigated how corruption negatively impacts environmental quality in higher-income countries. Another study looked at the relationship between political stability and corruption in the agriculture sector and investigated that global uncertainty and corruption had a negative impact on the strictness of environmental regulations (Peng et al. 2022). Similar findings were revealed by Salman et al. (2022) addressing the effects of corruption on environmental quality and laws in China. According to the report, the shadow economy and environmental legislation have a positive impact on ecological sustainability; however, corrupt officials have led to increased environmental degradation. Arif et al. (2022) investigated that financial development under economic sustainability contributes to

increasing industrial pollution and poor environmental quality. Finally, Pata and Samour (2022) concluded that economic growth and financial development exacerbated environmental degradation in South Asian countries from 2002 to 2016. Botteon et al. (2022) examined data from Central and Eastern EU countries between 1990 and 2019, discovering that economic progress had a negative impact on the environment. According to the study, economic development alone does not contribute to environmental conservation, and the Central and Eastern EU countries still have a long way to go to reach their sustainable development targets. To attain this goal, the study suggests that these countries prioritize a strong rule of law that promotes environmental protection, high-quality environmental rules, and effective corruption control. Furthermore, Bildirici et al. (2022) contend that a good governance system is critical for promoting environmental laws and lowering $CO_2$ emissions. Although economic growth and energy consumption have a significant positive impact on $CO_2$ emissions, the study suggests that increased economic growth can still contribute to reducing $CO_2$ emissions if coupled with effective governance systems. On the ground of the previous literature, we developed the following hypothesis.

*H7:* Voice and accountability have a significant negative impact on carbon emissions before and after a crisis.
*H8:* Political stability has a significant negative impact on carbon emissions before and after a crisis.
*H9:* Government effectiveness has a significant negative impact on carbon emissions before and after a crisis.
*H10:* Regulatory quality has a significant negative impact on carbon emissions before and after a crisis.
*H11:* Rules of law have a significant negative impact on carbon emissions before and after a crisis.
*H12:* Control of corruption has a significant negative impact on carbon emissions before and after a crisis.

## Methodology

### Data description

We use the MSCI index price of Malaysia from 1993 to 2021 and WGI's six indicators including control of corruption (CC), government effectiveness (GE), political stability (PS), regulatory quality, rule of law (RL), and voice and accountability (VA). The definitions and units of measurement are given in Table 1 of the variables. Data from WGI's six indicators are downloaded from the World Bank data portal. Data of indices (MSCI) is extracted for each stock market from the DataStream database using the University Utara, Malaysia Library access. The carbon emission data is collected from the World Bank data portal. The data timeline is selected on the ground to investigate some important events that occurred in the world economy with greater change and includes the period of 1993 to 2021 that describes the increasing trend of the oil prices globally, Mexican currency crisis (1994–1995), Asian economic crisis (1997–1998), Russian default (1998), major economic crisis (2007–2009) and also the period of COVID-19. Nowadays, the period of COVID-19 is also a hot topic due to the lockdown of business activities globally that has negative consequences on the global economy. It is being observed that when the COVID-19 daily active cases increase in the country decreases all the business activities and has negative consequences on the stock market due to the lockdown of the financial markets (Mazur et al. 2021). The financial crises of 1997–1998 and 2007–2009 affected the Malaysian stock market which led to a decrease in the Malaysian index.

In the given Fig. 1, we can see that there is fluctuation in all parameters that change with the change in time from 1993 to 2021. In the graph, we can observe that the MSCI index value of Malaysia dropped in the period of financial crisis 1997–1998, 2008–2009, and 2020. All the WGI indicators' values dropped in the financial crisis period like political stability dropped in 1997–1998 and 2008–2009, respectively. Similarly, all other indicators, including rule of law, regulatory quality, voice and accountability, government effectiveness, and control of corruption have declined in most financial events. Similarly, we can see in Fig. 1 that all the selected variables dropped down including the governance indicators and MSCI index in the overall selected period.

### Improvement models and description

First of all, we used the ordinary least squares (OLS) method to investigate the relationship between the Malaysian index, $CO_2$ emission, and its WGI indictor. OLS has the property to diagnose the relationship between variables (Zulkarnain and Nawi 2023). According to the Sarstedt and Mooi (2014), regression analysis is useful for investigating the relationship between the endogenous and exogenous variables if all the assumptions of the regression are completely fulfilled. The econometric model that runs on E-view for this study analysis is given.

$$MSCI = \alpha_0 + \beta_1 VA + \beta_2 PS + \beta_3 GE + \beta_4 RQ + \beta_5 RL + \beta_6 CC + \varepsilon_t \quad (1)$$

$$CO2 = \alpha_0 + \beta_1 VA + \beta_2 PS + \beta_3 GE + \beta_4 RQ + \beta_5 RL + \beta_6 CC + \varepsilon_t \quad (2)$$

where CC is the control of corruption, PS is the political stability, GE is the government effectiveness, RQ is the regulatory quality, RL is the rule of law, VA is the voice and accountability, and MSCI is the Malaysian MSCI

**Table 1** Variables descriptions and unit of indices

| Variable name | Definitions | Units of indices |
|---|---|---|
| MSCI | Morgan Stanley capital international stock market indices are maintained by the organization on a daily basis for each economy globally | Indices is measured in USD |
| $Co_2$ | Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring | Metric tons per capita |
| VA | Voice and accountability reflect evaluations of how much a population can participate in choosing their government, as well as the freedoms of free speech, assembly, and independent media | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |
| RL | Rules of law reflect assessments of how much people rely on and follow societal norms, including the likelihood of criminal activity and violence, the success of contract enforcement, the protection of property rights, the dependability of law enforcement, and the judicial system | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |
| RQ | Regulatory quality reflects evaluations of the government's ability to develop and implement efficient laws and regulations that support and promote the expansion of the private sector | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |
| PS | The Political Stability and Absence of Violence/Terrorism indicator measures the likelihood that there will be political unrest or violence with political motivations, such as terrorism | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |
| GE | Government effectiveness conveys opinions about the quality of public services, the civil service's qualifications and independence from political influences, the success of developing and implementing policies, and the government's commitment to these goals | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |
| CC | Control of corruption includes instances of small and severe corruption as well as the phenomena of the state being co-opted by privileged elites and private interests. It also reflects assessments of the extent to which governmental authority is used for personal benefit | Estimate of governance in terms of range + 2.5 to − 2.5. The positive shows the highest performance of respect governance mechanism |

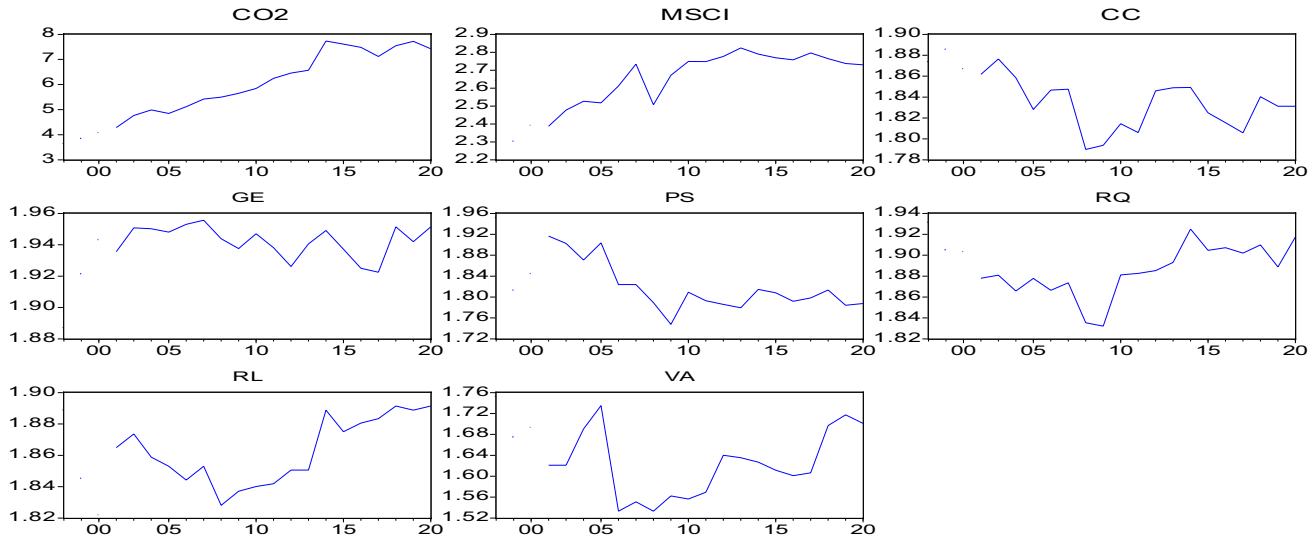



**Fig. 1** WGI indicators for Malaysia trend

index. Whereas $CO_2$ is the carbon emission of the country Malaysia.

Therefore, sometimes a simultaneous effect is found between endogenous and exogenous variables (Yasmin et al. 2022). However, to investigate the simultaneous effect at the same time, we used the wavelet approach which is also useful for time series data analysis and providing reliable results (J. Guo et al. 2022). The covariance between the two-time series is fully preserved at the frequencies by the cross-wavelet power (Adebayo and Ullah 2023). In this work, the cross-wavelet approach (XWP) is used to find common development regions with high stock market prices and carbon emissions, if the time repetition field of a two-period series occurs, it is fully preserved by the cross-wavelet transformation. This study, XWP is used to find common development regions with high stock market price and high carbon emissions, if a time-iteration domain occurs (Aguiar-Conraria et al. 2008). The two-time series wavelet analysis can be presented through $(W_n^{XY}(s))$ (Tian et al. 2023), given as

$$W_n^{XY}(s) = W_n^X(s)W_n^{Y^*}(s) \tag{3}$$

Here, $W_n^{Y*}(s)$ represents the complex conjugate of $W_n^X(s)$. $W_n^{XY}(s)$. The CWP is useful for detecting the covariance. The hypothetical dispersion of the cross-wavelet power of two signals with power spectra $P_\kappa^X$ and $P_\kappa^Y$ is given in the following form Eq. (4). Moreover, this equation was also used by Moradi (2022) for the decomposition of the time series.

$$D\left(\frac{\left|W_n^X(s)W_n^{Y^*}(s)\right|}{{}^{\sigma}X{}^{\sigma}Y} < p\right) = \frac{Z_v(p)}{v}\sqrt{P_{\mathcal{K}}^X P_{\mathcal{K}}^Y} \tag{4}$$

In equation (H), ${}^{\sigma}X$ and ${}^{\sigma}Y$ denote the standard deviation of $x$ and $y$. The confidence interval is denoted by $Z_v(p)$, *pdf* represents the probability density function that is exactly the probability denoted by $p$, which is defined as the squared root of $\chi^2$ distribution (Odgers et al. 2023).

$$R^2(u,s) = \frac{\left|S(s^{-1}W_{xy}(u,s))\right|^2}{S\left(s^{-1}\left|W_x(u,s)\right|^2\right).S\left(s^{-1}\left|W_y(u,s)\right|^2\right)} \tag{5}$$

In the above equation, $S$ represents the smoothing parameter. The coefficient of squared wavelet-coherence (CSWC) placates the disparity condition of $0 \le R^2(u,s) \le 1$. A value of $R^2(u,s)$ denotes a high correlation signified based on that approach, and if $R^2(u,s)$ approaches to zero, then it should be considered that there is a weak correlation between them (Sarfraz et al. 2022). On the following given aspects, it is considered that the wavelet approach is the best approach over the others to detect the co-movement between the variables based on time and frequency domain. The variables $\phi_{x,y}$ that is used for measuring phase-relationship (Gao et al. 2023). The difference between phases determined the positions in the pseudo cycle, it is specified as follows:

$$\phi_{x,y} = tan^{-1}\left(\frac{\mathfrak{T}\left\{W_n^{xy}\right\}}{\mathcal{R}\left\{W_n^{xy}\right\}}\right) with \phi_{x,y} \in [-\pi, \pi] \tag{6}$$

The arrows in the wavelet define the relationship or correlation between the two-time series (Elmelki et al. 2022). The arrows in the wavelet show the phase differences between the two-time series. The direction of the arrows is very important and also shows the positive and negative

correlation between the two-time series. If the arrows are towards the right, it means that the two variables have a positive relationship. If an arrow is towards right and up, the variable *x is* leading and there is a positive relationship, or if arrows are towards right and downward, the variable *x* is lagging and positive relationship. On the other side if arrows are towards left and up then *x* is lagging and the relationship between variables id negative, or if arrows towards left and down then *x* is leading, and the correlation is negative yet (Dastour et al. 2022).

From the work of Granger (1969), many studies applied the Granger causality test or the combination of the wavelet and Granger causality to examine the causation relationship between two-time series or financial series. Granger causality has been focused on the lead-lag correlation between the selected time series (Shojaie and Fox 2022). However, different studies use different methods of detecting the causation between two variables or time series. To robust the result of the wavelet analysis, the cause and effect of WGI-MSCI and WGI-$CO_2$ of Malaysians can be investigated through the Granger causality test in our study.

## Results and findings

### Summary of statistics

The descriptive statistics of the MSCI index of Malaysia and WGI indicators are given in Table 2. The average annual MSCI stock price of Malaysia is 2.6458 with a maximum value of 2.8241 and a minimum of 2.3012. This indicates the positive performance of the Malaysian stock market in the selected period by its strong measures and control. The standard deviation of the MSCI index (MSCI) of Malaysia is 15.58% which is a deviation from its means. Control of corruption (CC) has an average of 1.8383 with a minimum of 1.7899 and maximum value of 1.8854 and has a standard deviation of 0.0268, which means that the control on corruption improves due to a low deviation value. Government effectiveness (GE) has a mean value of 1.9389 with a maximum value of 1.9556 and a minimum value of 1.8868 and has a standard deviation of 0.0155, which means that government effectiveness is a good indicator for the economy for promoting different macroeconomic factors. Political stability (PS) has an average mean value is 1.8251 with a maximum of 1.9512 and a minimum of 1.8868. The rule of law (RL) has a mean value of 1.8614 with maximum and minimum of 1.8915 and 1.8218, respectively. The regulatory quality (Norris 2020) and voice and accountability (VA) have a mean of 1.8885 and 1.6331, with a maximum of 1.9331 and 1.7520 and a minimum of 1.8321 and 1.5332, respectively. All these indicators have the lowest standard deviation which shows the good governance of the Malaysian government in maintaining their code of conduct with many compliances. From the descriptive statistics, we can extract that the Malaysian government has a positive trend following the code of governance in the country in view to the World governance indicators (WGI). Moreover, $CO_2$ has a mean value of 5.9023 with a maximum of 7.73 and a minimum of 3.6255, indicating the increase in the trend of $CO_2$ emission from the previous years as we can see in Table 2.

The skewness value represents the asymmetrical and symmetrical normal distribution of the dataset. The skewness may be positive or negative representing the performance of the dataset regarding the asymmetrical and symmetrical of normal distribution. Positive skewness indices the excellent performance in indicating the proximation of the probabilities and quantiles of distribution but negative skewness shows the negative performance towards proximation of the probabilities and quantiles of distribution. In our data, all values of skewness are negative except political stability and voice and accountability, which show poor performance in indicating the proximation of the probabilities and quantiles of distribution in the dataset. Political stability voice and accountability have positively skewed, indicating the excellent performance in indicating the proximation of the probabilities and quantiles of distribution in the dataset.

Table 3 summarizes the correlation between stock price and WGI indicators. A positive correlation suggests a positive relationship existed between them, but a negative correlation suggests a negative direction existed between them. Variables are below the 0.80 value of correlation, indicating the week relationship between them. All these selected variables have a value below 0.80, indicating the week common movement for all couples. The correlation between regulatory quality and rule of law (RL) is highest is the selected

**Table 2** MSCI index and WGI indicators descriptive statistics

| | $CO_2$ | MSCI | CC | GE | PS | RL | RQ | VA |
|---|---|---|---|---|---|---|---|---|
| Mean | 5.902382 | 2.6458 | 1.8383 | 1.9389 | 1.8251 | 1.8614 | 1.8885 | 1.6331 |
| Median | 5.744726 | 2.7321 | 1.8431 | 1.9425 | 1.8107 | 1.8559 | 1.8870 | 1.6240 |
| Maximum | 7.732028 | 2.8241 | 1.8854 | 1.9556 | 1.9512 | 1.8915 | 1.9311 | 1.7520 |
| Minimum | 3.625577 | 2.3012 | 1.7899 | 1.8868 | 1.7476 | 1.8218 | 1.8321 | 1.5332 |
| Std. Dev | 1.365988 | 0.1558 | 0.0268 | 0.0155 | 0.0520 | 0.0221 | 0.0252 | 0.0666 |
| Skewness | 0.017211 | −0.8093 | −0.1142 | −1.8278 | 1.0204 | −0.0294 | −0.5374 | 0.1153 |

**Table 3** Correlation matrix of MSCI index and WGI indicator for Malaysia

| | $CO_2$ | MSCI | CC | GE | PS | RQ | RL | VA |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ | 1.000 | | | | | | | |
| MSCI | 0.811 | 1.000 | | | | | | |
| CC | −0.516 | −0.486 | 1.000 | | | | | |
| GE | 0.250 | 0.026 | −0.149 | 1.000 | | | | |
| PS | −0.648 | −0.518 | 0.606 | −0.244 | 1.000 | | | |
| RQ | 0.249 | 0.234 | 0.430 | −0.380 | 0.202 | 1.000 | | |
| RL | 0.519 | 0.415 | 0.134 | −0.188 | 0.167 | 0.651 | 1.000 | |
| VA | −0.104 | −0.183 | 0.493 | −0.290 | 0.439 | 0.564 | 0.448 | 1.000 |

**Table 4** OLS regression results of MSCI, $CO_2$, and WGI indicators

| *Variable* | MSCI | | $CO_2$ | |
|---|---|---|---|---|
| | *Coefficient* | *Prob* | *Coefficient* | *Prob* |
| C | −0.510 | 0.916 | −71.828 | 0.002*** |
| CC | −2.194 | 0.125 | −17.529 | 0.006*** |
| GE | 0.307 | 0.865 | −23.786 | 0.005*** |
| PS | −0.969 | 0.150 | −13.350 | 0.000*** |
| RL | 2.866 | 0.082* | −33.260 | 0.000*** |
| RQ | 2.039 | 0.226 | −14.352 | 0.045** |
| VA | −0.503 | 0.325 | −0.500 | 0.807 |
| *R*-squared | 0.6371 | | 0.9222 | |
| Adjusted *R*-squared | 0.4919 | | 0.8911 | |
| Prob (*F*-statistic) | 0.0093*** | | 0.000*** | |
| Durbin-Watson stat | 1.5952 | | 1.911 | |

*Note. The level of significance is 1%, 5%, and 10%, representing asterisks "***," "**," and "*," respectively*

data group. On that ground, data is considered suitable for analysis to avoid biases.

## Findings of estimated models

### Regression results

The result of the OLS is summarized in the given Table 4. Our results of the MSCI model show that all the variables except RL have no significance at 1%, 5%, and 10% levels of significance. RL has a significant relationship with the stock price of Malaysia at a 10% level of significance, which means that an increase in the rules of law increases the stock price of the Malaysian stock market. When the rule of law increased by 1 that led to an increase in stock price by 2.8656 times because of the positive relationship that existed between them. Our results are consistent with the result of Modugu and Dempere (2020) that RL has a significant positive impact on the stock price both before and after the crisis period with the political stability within the country. Our other findings of the MSCI model are not significant due to the reason of simultaneous effect between the MSCI and the WGI indicators and that is why not significant. The regression analysis has a weakness in capturing the simultaneous effects between the variables. We used robustness analysis through cross-wavelet and wavelet coherence to make the real impact of the simultaneously affected variables. Malaysian government with effective law enforcement and regulations controls the factors for economic development. Moreover, *R*-squared and adjusted *R*-squared are 0.63 and 0.49, respectively, indicating the model fit.

In our findings of the $CO_2$ model, the *R*-squared and adjusted *R*-squared are 0.9222 and 0.8911 indicating that all the explanatory variables represent the 92% effects on the $CO_2$, which also indicates the model fitness and the correctness of our estimations. Similarly, there are only 8% of other factors that are not included in our estimation that represent the $CO_2$ emission. Durbin Watson's value is 1.91 which is also favorable. Moreover, the results show that the control of corruption within the country has a significant negative impact on carbon emission due to significant at 1% level of significance, indicating that a 1 unit increase in the control of corruption (CC) point leads to a decrease 17.52 in the $CO_2$ emission. Effective government policies (GE) have a negative significant relationship with CO2, which means that a 1-point increase in the number of government effective policies within the country then 23.78 points increase in the $CO_2$ emission of that country. Political stability has a significant and negative relationship with $CO_2$ emission, indicating that the 1-point increase in political stability leads to a decrease in the 13.35 in $CO_2$ emission. Moreover, rules of law (RL) and regulatory quality have also a negative and significant relationship with $CO_2$ emission, indicating that when these factors increase leads to a decrease in $CO_2$ emission. We applied another methodology to make more accurate our results that gives the two-way relationship on both the time and frequency domain wavelet approach.

### Cross-wavelet transformation: Malaysia governance vs stock market index

The cross-wavelet transform approach is employed for trademark emphasis extraction when there are only localized

similarities observed between the Malaysian stock market price and WGI indicators. The advantage of this method is that it needs fewer restrictions than other methods to distinguish between regular and uncommon classes by highlighting time outlines. Additionally, this approach can produce more accurate results due to its ability to work in noisy environments (Banerjee and Mitra 2014). As a result, it also preserves information about the phase due to the ability to handle the imaginary part of the inputs without using the absolute functions. It shall be noticed that arrows indicate the phase information, which helps us to understand the interrelationship in different time and frequency domains. Cross-wavelet power spectra are considered significant at the level of 5% under the red noise prediction that is defined by Monte Carlo by using the random phase replacement of series when there is a thick black outline surrounding the region. The lighter shade limiting the key power zone represents the COI (cone of influence). The arrows in the wavelet show the phase differences between the two-time series. The direction of the arrows is very important because it also shows the positive and negative correlation between the two-time series. If the arrows are towards the right, it means that the two variables have a positive relationship. If the arrow is towards right and up, the first variable leading and there is a positive relationship, or if the arrows are towards right and downward, the variable first is lagging in and positive relationship. On the other side if the arrows are towards left and up then the first variable is lagging and the relationship between variables is negative, or if the arrows are towards left and down then the variable is leading, and the correlation is negative. The time (in terms of the year) and frequency (in terms of the period) are shown on the horizontal and vertical axis.

The in-phase relationship is being observed in all pairs, WGI indicators, and stock prices of Malaysia shown in Fig. 2, indicated by the arrow and found numerous significant regions. Our results are significant at both high and low frequencies for all pairs. Political stability-stock price pairs show the in-phase (anti-phase) relationship as political stability leading (lagging) effect at different time and frequency domains. In the crisis period of 1997–1998, political stability was in phase with a leading effect on the stock market price at a higher frequency region, which means that political stability had a positive relationship with the Stock price of Malaysia during 1997–1998. During the period of 2000 to 2003, there were in-phase and anti-phase relationships seen because the arrows are right (left), which means that in the selected period political stability had positive and negative impacts. There is a negative relationship being observed during 2004–2006 because arrows are from left to right and led by the stock market price. Similarly, in this context, our results indicate that the stock market leads to political stability, which means news of the decline in the stock market causes political instability within Malaysia. The positive relationship is being seen during 2008–2009, the period of the global financial crisis because arrows are left to right and have in-phase with political stability leading effect. It means that during the period of the global financial crisis, the government-controlled their stability and control over the stock price due to the strong management that led to control in overall stock performance. From 2010 to 2015, the same pattern was observed, arrows are in a phase that shows the positive relationship between political stability and stock price, and political stability is a leading effect because the stock market has a positive direction with the political stability in one of the most important factors in it. From 2015 onward, our results are not significant; it means that the period of COVID-19 did not influence the political stability and has no significant impact on the stock prices.

The government's effectiveness plays a very important role in the stock market development, if the government is effective then the stock market rises (Asongu 2012). In the pair of government effectiveness and stock market prices, the relationship is in phase at both high and low-frequency domains during 1999 to 2006, because arrows are mostly from left to right and have different behavior like in 2002 and 2004–2005, the government effectiveness has leading behavior due to arrows are upward (downward). During the period of 2007–2009, the relationship between government effectiveness and the stock price was positive, which is a good trend maintained by the Malaysian government for promoting the stock market in the period of great recession and government effectiveness has a leading effect. During the period of 2010 to 2015, in-phase relationship is seen in both pairs with government effectiveness as a leading effect. In the period of financial crisis 1997–1998 and the COVID-19 period 2020–2021, there is no significant relationship being observed in the pairs.

In pairs voice and accountability-stock prices, the arrows are mostly from right to left including the period of financial crisis that shows the negative relationship existed between the pair. Our results of cross-wavelet (XWT) indicated that the second variable stock price is the cause of the decline in voice and accountability indicator value because when the stock price increases it leads to a decrease in the accountability by misreporting of the stock information. While, in pairs of control of corruption-stock market price, rule of law market price, and regulatory quality-stock market price, the arrows of the significant region placed at in-phase and anti-phase in different time domains including the period of the financial event and normal period, indicating the both positive and negative relationship in different time intervals with these indicators leading (lagging) effects on stock market price but mostly arrows are from left to right (in-phase) indicating positive relationship existed between them. From these

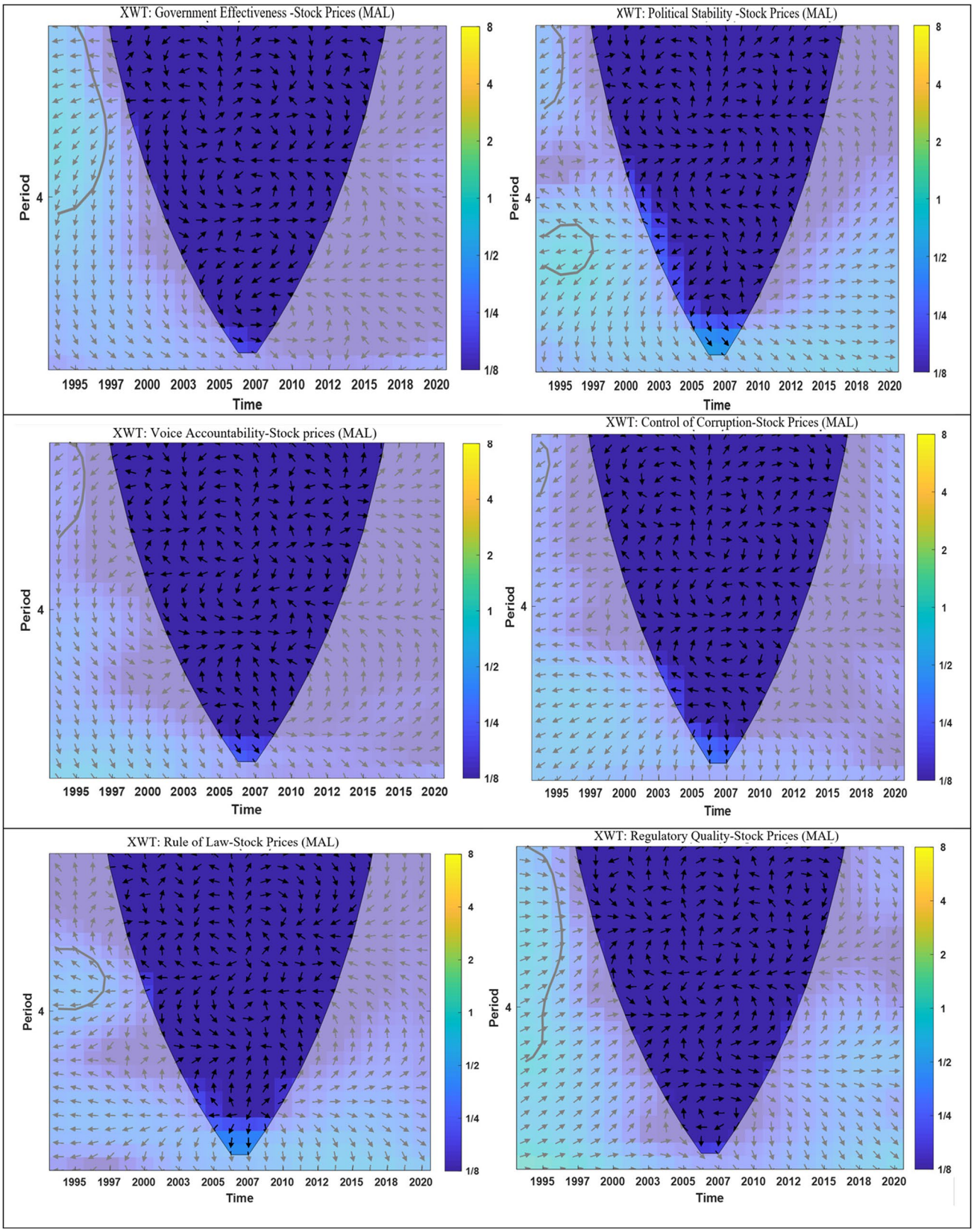



**Fig. 2** Cross-wavelet power spectra of WGI-stock market

pair results on the in-phase arrows, we can conclude that there is a positive relationship between control of corruption and stock market price, and the same relationship existed between the other two pairs, rule of law market price and regulatory quality-stock market price.

The cross-wavelet (XWT) analysis has determined the co-movement of some degree between the role of the government (WGI indicators) and the stock market price at the short, medium, and long-horizon from 1993 to 2021. In order to validate these findings, further investigations are conducted through wavelet coherence (WCOH) due to its more authentic results and accuracy in two-time series.

### *Wavelet coherence transformation: Malaysia governance vs stock market index*

Figure 3 exhibits the wavelet coherence results. It is shown overall that the government's effectiveness has a significant positive relationship with the stock market prices, because the arrows are in-phase, and the arrows are from left to right.

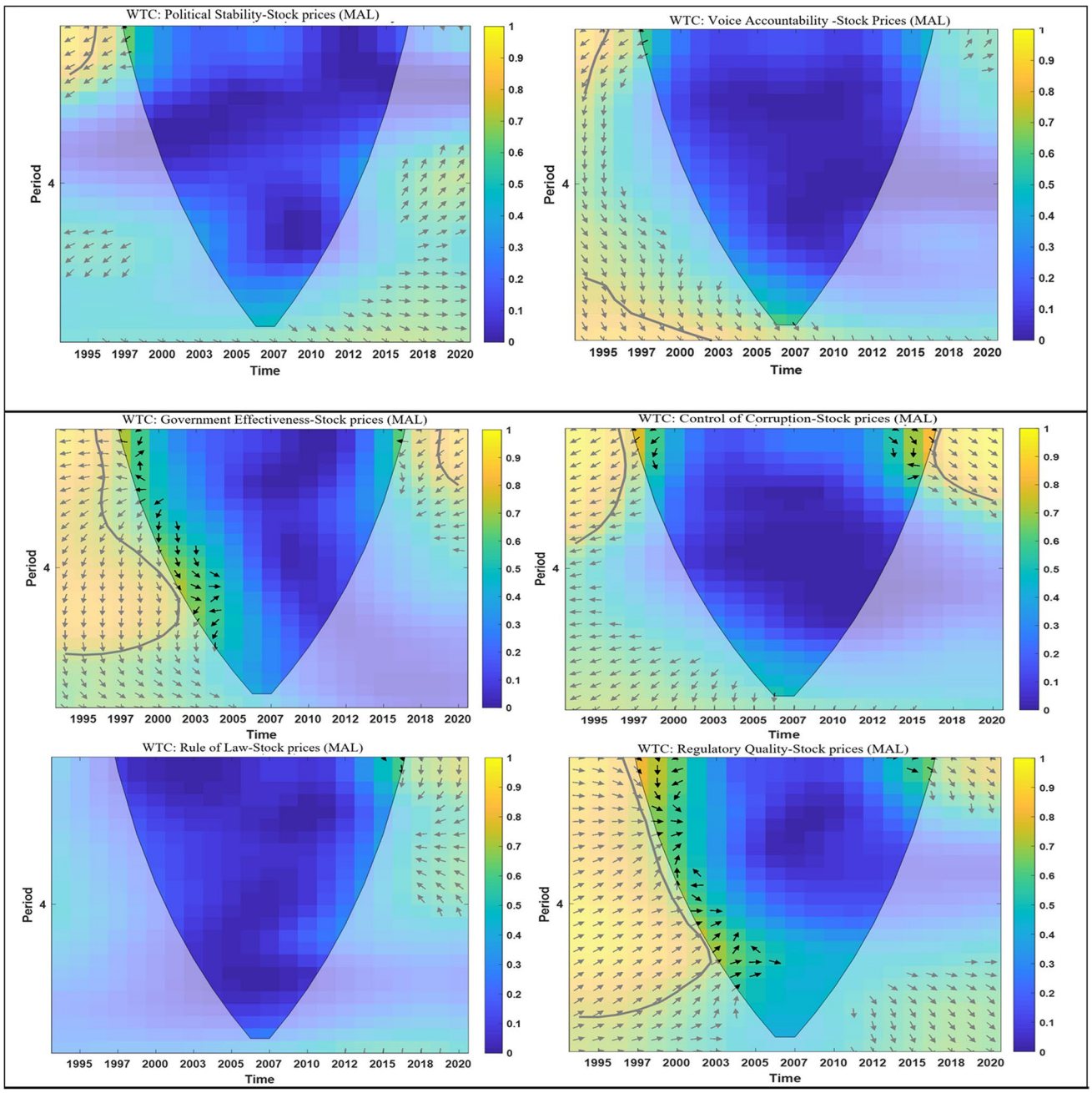



**Fig. 3** Wavelet coherence of WGI and stock market

It means that when the government effective index increases then increases in the stock market prices. In the result of pair, control of corruption-stock market prices, arrows are left to right indicating the in-phase relationship. It means that control of corruption has a positive impact on the stock market prices. While in pair regulatory quality-stock market prices, there is an in-phase relationship between them, showing a positive relationship. When regulatory quality within the country increases, then there is an increase in the stock prices. The results of other WGI indicators and stock prices are not significant. The wavelet coherence approach takes the correlation of the time series for the matching of the (COI) core of influence or significant region. Many other factors directly affect the stock market prices but COI also small fluctuation in the stock market prices caused by the different governance indicators of Malaysia. To complement our finding of the OLS regression, cross-wavelet (XWT), and wavelet coherence (WCOH), we used the robustness test for the final decision on our findings.

### *Cross-wavelet transformation: Malaysia governance vs $CO_2$ emission*

In the cross-wavelet transformation, we can observe the covariance similarities that existed between them at different time periods and frequency domains. Due to the existence of the crisis period in this study, cross-wavelet is useful due to the investigating the effect of the crisis period between governance indicators and the $CO_2$ emissions. As we discussed in the model specification of the wavelet transformation that cross-wavelet is useful due to the investigating the effect of the crisis period.

In our transformations of the cross-wavelet in Fig. 4, we can observe that rules of law (RL) had significant positive contagion with $CO_2$ in the 1997–1998 crisis only because arrows are from left to right and rules of law are leading to $CO_2$ emission. VA and GE are positive, but this indicator is lagging behavior and $CO_2$ is leading in the period of 1997–1998 only. RQ has a negative association with $CO_2$ because the arrows are from right to left. Moreover, the CC has no contagion effect with $CO_2$ in cross-wavelet. Finally, we can conclude that only the period of 1997 to 1998 found significant regions and governance indicators found leading and lagging during the period of crisis 1997–1998, it means that due to change in the governance within the country especially during the crisis then leads to change in the $CO_2$ emissions. From the findings, we can conclude that if the governance indicator increases leads to an increase in $CO_2$ emission due to the industrial revolution within the economy.

### Wavelet coherence transformation: Malaysia governance vs CO2 emission

The wavelet coherence is useful for the investigations of the co-movement between two variables at different time periods. In the wavelet transformation Fig. 5 shows that voice and accountability have significant in 1997–1998 and 2020–2021 and shows the in-phase in 1997–1998 and anti-phase relationship in 2020–2021 existed between them where voice and accountability lags to the $CO_2$ emission that describe the change in the $CO_2$ may lead to a change in the voice and accountability.

The COI regions of the CC and $CO_2$ are significant during 2020–2021 indicating the in-phase relationship. Political stability and $CO_2$ transformation are significant during 1997–1998 and 2020–2021 and also indicate the in-phase relationship.

The government's effectiveness and $CO_2$ transformation are significant throughout the sample period. From 1993 to 1998, both GE and $CO_2$ emissions had an in-phase relationship indicating the positive relation between them. After the global financial crisis Malaysian government wanted to recover its position which is the first motive behind its economic reform on priority and other things such as environmental protection from the corporations set aside. Rule of law and $CO_2$ emission are significant and in-phase relationship in which $CO_2$ is leading during 1993–1994 and also 2020–2021, whereas the regulatory quality has a significant and anti-phase relationship with $CO_2$ emission during 1993–2000, in that year, there is strict rules and law is made for the environmental protection due to increase in the global warming in the globe.

### Robustness analysis: Granger causality test

To complement our findings using the robustness test for XWT and WCOH, we employ the wavelet-based Granger causality test. The results of the Granger causality test are exhibited in Table 5. The causality may be unidirectional and bi-directional. If there is only one-way Granger causality that is unidirectional, if there is two-way Granger causality then there will be bi-directional causality transformation. In our results control of corruption (CC) causes the stock price with a 1% level of significance. Malaysian government effectiveness (GE) causes Malaysian stock prices at a 5% level of significance. Same as political stability (PS) causes the MSCI index value and the rule of law (RL) also causes the MSCI index of Malaysia. Regulatory quality and voice and accountability (VA) cause the Malaysian index value. Now going forward, there is bi-directional causality found between the MSCI and political stability, MSCI index causes to decline in political stability, indicating both variables are cause and effect and vice versa.

In our results, there is unidirectional causality between control of corruption (CC) and government effectiveness (GE), GE causes the control of corruption (CC), indicating that government effectiveness plays a very important role in the control of corruption by making the law and order

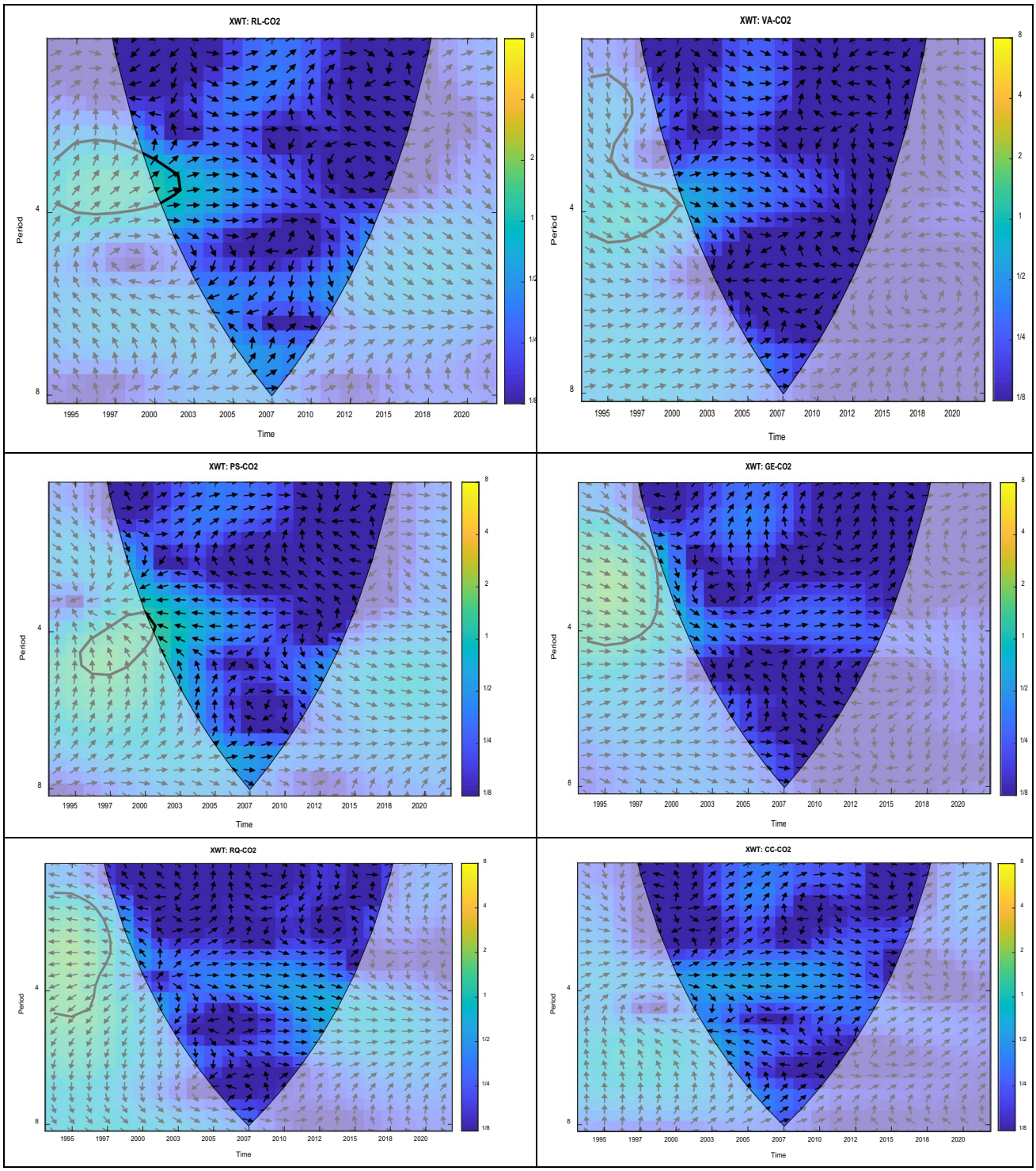



**Fig. 4** Cross-wavelet WGI and $CO_2$

within the country. In addition, we find unidirectional causality between control of corruption (CC) and voice and accountability (VA), voice and accountability (VA) causes the control of corruption, indicating the proper maintenance of accountability has control on the corruption indicator. Political stability (PS) and MSCI have bi-directional causality existed between them. Similarly, we find unidirectional causality between political stability and control of corruption, control of corruption (CC) causes political stability (PS). In addition, the unidirectional causality finds between

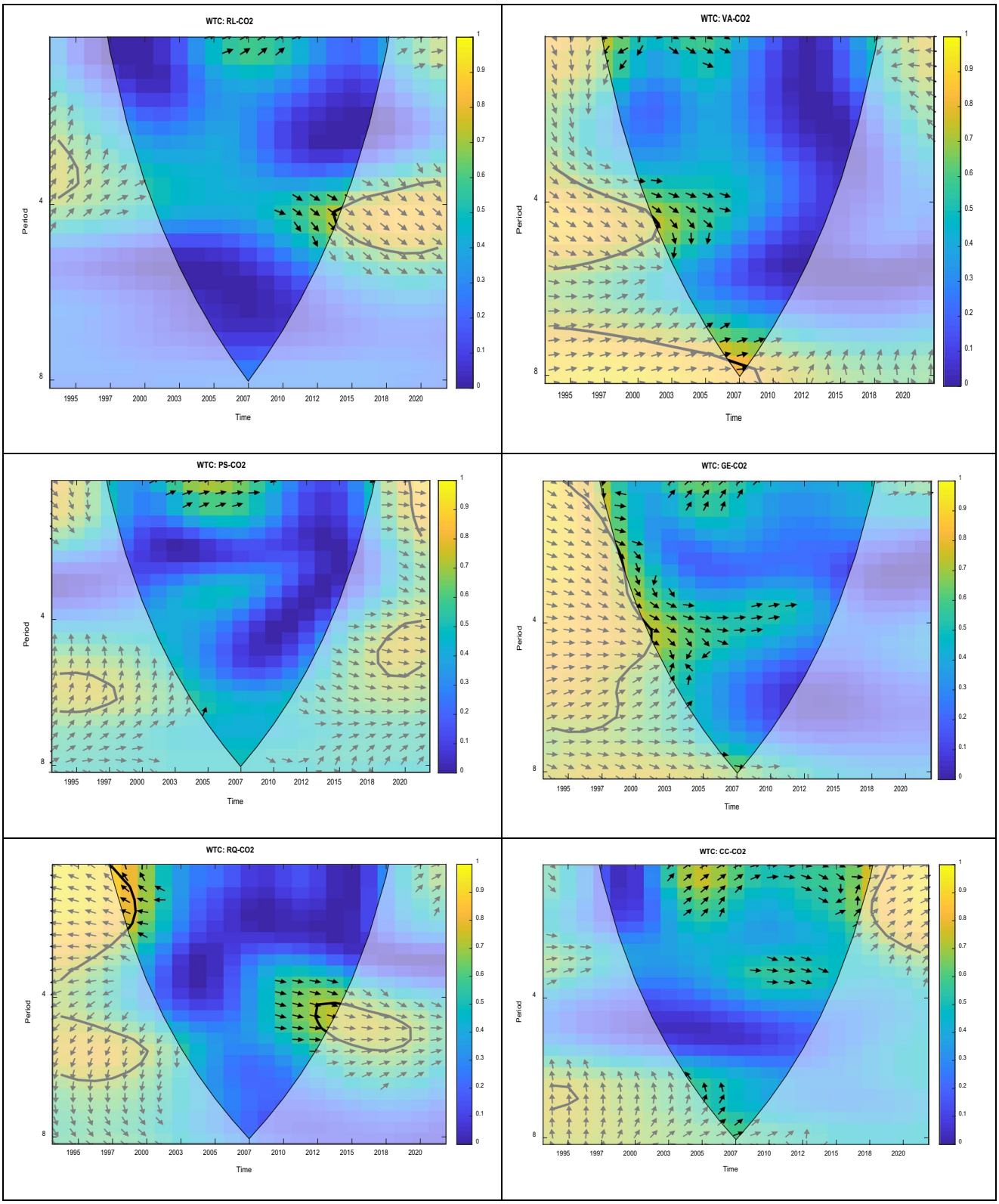



**Fig. 5** Wavelet coherence WGI and $CO_2$

**Table 5** Granger causality between MSCI index, $CO_2$ emission, and WGI of Malaysia

| Independent variable | Dependent variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $CO_2$ | MSCI | CC | GE | PS | RL | RQ | VA |
| $CO_2$ | - | 10.2204 | 0.2177 | 0.2363 | 2.54466 | 7.4475** | 3.1241* | 0.80806 |
| MSCI | 0.1526 | - | 0.6990 | 1.3686 | 7.3739** | 1.5490 | 2.1718 | 0.0815 |
| CC | 0.8312 | 8.5137*** | - | 0.9240 | 4.2878** | 1.1434 | 1.0614 | 0.4961 |
| GE | 0.8443 | 4.4925** | 6.2818** | - | 1.0856 | 1.2160 | 1.2866 | 0.2675 |
| PS | 0.54512 | 10.7217*** | 1.8973 | 0.4466 | - | 2.9175* | 5.0077** | 0.4496 |
| RL | 1.0435 | 2.1775* | 0.0015 | 0.0088 | 1.9755 | - | 0.5574 | 2.8350* |
| RQ | 0.02371 | 5.6944** | 0.3414 | 1.5246 | 0.1771 | 0.1249 | - | 0.6787 |
| VA | 0.52305 | 4.2817** | 2.2124* | 0.7228 | 0.1234 | 0.0479 | 0.1860 | - |

*Note. The level of significance is 1%, 5%, and 10%, representing asterisks "***," "**," and "*," respectively*

political stability and the rule of law (RL), indicating the political (PS) cause rule of law value. In our result, we find unidirectional causality between political stability (PS) and regulatory quality, indicating that political stability causes regulatory quality. Similarly, we find the unidirectional causality between the rule of law (RL) and voice-accountability (VA), where the rule of law causes voice and accountability (VA). Moreover, there is unidirectional causality found between $CO_2$ and rules of law (RL), regulatory quality (RQ) only, where the $CO_2$ Granger causes the rules of law and regulatory quality through the selected period. From our overall findings, the most reliable information is attained from the wavelet transformation due to the decomposition of the time into different segments and we easily investigate the pattern of the influence between them.

## Discussion

The stock market, which drives financial activity and significantly boosts economic growth, serves as the financial market's beating heart (Levine and Zervos 1996). On the other hand, voice and accountability are very necessary for the promotion of the financial as well as making a strong role in economic development. Maintaining the voice and accountability is the responsibility of the government. If the government maintains this factor in a proper way, then the government can achieve the target. Voice and accountability are important, because low institutional setting, cronyism, and partiality in resource distribution may result from a lack of voice and responsibility, which may be detrimental to innovation (Nadeem et al. 2020).

In our results, we find that there is a significant negative relationship between voice-accountability and stock market prices, also verified from the Granger causality test the voice and accountability (VA) causes to stock market prices. It indicated that the implied democratic practice in Malaysia does not lead to improvement in the market capitalization value. The findings of this study reveal that freedom of speech, freedom of associations, as well as government accountability, and freedom of social media, have a negative impact on the stock market due to some factors, factors that may be misreporting, or others. Our findings are consistent with the findings of Lehkonen and Heimonen (2015) and Modugu and Dempere (2020), who found a negative relationship between voice and accountability with stock market performance. According to Low et al. (2011), voice and accountability also include democratic accountability and military involvement in politics, which enhance corruption and reduce investor confidence and FDI inflows. Additionally, it encompasses aspects related to freedom of expression, access to a free press and media, political rights, and civil liberties. A strong governance framework must have voice and accountability as key components. Higher levels of voice and responsibility should imply the existence of the necessary conditions for the expansion of numerous associations and civil society organizations, as well as ensure stronger commercial associations (Kaufmann et al. 2013). Our findings are opposite to the findings of Sabry (2019) who reveals the positive relationship between voice and accountability and stock market prices with the rise in foreign direct investment. He concluded that the free media and press help in the free flow of information about the stock market and attract foreign direct investment within the economy that rises in the stock prices due to demands.

Political stability is a necessary part of the governance effectiveness of an economy. Political stability within the country also impacts the financial system with a significant impact on the stock market index value (Milyo 2012). According to Chiu et al. (2005), political events disturb the whole economy, he investigated South Korea in the study. According to Bailey et al. (2005), Faria Shamas and Khalid (n.d.), and Frey and Waldenström (2004), political instability has a significant influence on the trading volume as well as the stock market return leading to a decline in the stock prices. In our results, political stability has a significant

positive impact on the stock market, it means when political stability increases within the country leads to a rise in the stock price and a decrease in political stability leads to a decrease in the stock price within Malaysia. When political stability in the country investor confidence increases and the investment from foreign as well as national investors increases leading to an increase in the stock price level (Lehkonen and Heimonen 2015). Our results extend the findings of Lehkonen and Heimonen (2015), when the political stability increases then increases in the stock market index of Malaysia, shown in the figure of cross-wavelet transformation (XWT) on different time domains. Our results are also similar to Beaulieu et al. (2005) revealing that political risk is directly on the return of the global mutual funds. According to their research, investors in international stock mutual funds see materially abnormal gains notwithstanding the political unrest of the time. Political environments make behavior of the investors towards the investment, if there is unstable political environment within the country investors afraid for the risk of being loss from their investment and hence, they hesitate for investment in such countries.

Government effectiveness is a sign of good governance within the economy. With good governance, some factors of the economy improve leading to improved stock prices. The stock market of an economy may change with the government policies. The government of any country makes policies, if policies are concerned with growth, then it will be shown the government effectiveness, if policies fail or following the interest of some person then government effectiveness is low. Low government effectiveness is harmful for the countries' economies. In our findings, government effectiveness (GE) has positive impact on the stock prices, indicated that when the government play an effective role in making policies and implement that policies and control overall mechanism with enhancing the quality of public services, civil services, separation from political pressure, and fulfilling the government commitment. These points are necessary for the government's effectiveness overall. Some country's governments make policies but there is lack of the implementation and control. According to the Riggirozzi and Ryan (2022) that in the less developed countries, there is the lack of effective policy making by the government, and policy should be successfully made but its implementation is very difficult task.

The stability, liquidity, and effectiveness of a country's stock market are directly influenced by its quality of governance. Investor sensitivity to corporate operations has increased, on the one hand, as a result of the ongoing global financial scandals affecting prominent corporations systems of their host environments. However, investors are increasingly more interested in the quality of national governance than they are in corporate governance practices. Our findings are similar with the findings of Hafeez et al. (2022) that find the positive relationship between government effectiveness and the stock prices in Pakistan. Our findings are also consistent with the findings of Elshqirat (2022) that also the similar finding on the middle east countries. He concludes that the government effectiveness is very critical due to the effective implementation of the policies and control of the policies within the country that directly hit the stock market. Our finding enhances the finding conducted by Maroof et al. (2019), indicating the positive relationship between the government effectiveness and the stock market prices on South Asian economies. Hooper et al. (2009) also find the positive relationship between the government effectiveness and the return on equity, these findings also confirm that countries with better governance mechanism support the higher stock return and lower level of the risk.

The regulatory quality that is measured through the general perception about the ability of the government to formulate and implement the sound policies that promote the private sectors development within the country has significant positive relationship in both period of crisis and normal period. In different time domain, we can see that on the XWT transformation, regulatory quality has negative relationship with stock market prices in same years for short run but positive relationship in long run in the respective years' time domain, see Figure XWT. We conclude our finding in this respect as the positive relationship because of the long run in all years on the time domain and also verified through the WCOH transformation, where regulatory quality shows the positive relationship with stock prices. However, relying on the XWT and WCOH results, the positive direction between regulatory quality and stock market index is found. Our findings are consistent with the findings of Sanga and Aziakpono (2022) reveal that the countries with higher regulatory quality increase the stock market performance by increasing their stock index value. Our findings are not similar with the finding by Modugu and Dempere (2020), he concluded that high regulatory control experience the decrease in the stock market. Our findings are also not conforming the findings of Boadi and Amegbe (2017) and Albuquerue and Wang (2008) that poor regulatory framework within the country increase investment in the capital market in the emerging economies. In emerging economies, the wealthy investors take advantage of the poor regulatory mechanism to manipulate the stock prices leading to increase the business and trading activities volume that effect the total market capitalization. Our finding is contradicted with the finding by Low et al. (2011) that find the negative relationship between regulatory quality and the equity return as proxy for stock market performance.

Control of corruption within the economy is the responsibility of the government. If the government officials control the corruption, then the free flow of the rule and law should be there in the economic as well as in admirative

departments. The rate of the corruption is different in different nations depends on its governance structure. Most developed countries as well as the emerging economies faced the corruption in their financial as well as in their other departments. After the year the transparency international issue an index value about the corruption rating and also another international organization that measure the governance World governance indicators (WGI) also measure the control of corruption value for each economy separately through the proper surveys. Our results shows that the control of corruption has positive impact on the stock prices, it means that when the control of the corruption in Malaysia increases leads to increase in the stock prices level. When all the departments of the economy ethical work, then there will be development in the economic system. Our findings are consistent with the findings of the Modugu and Dempere (2020), they found the positive impact of the control of corruption on the stock market on the study of GCC countries. Our findings are contradicted the findings of Aidt (2009), Bardhan (1997), Cuervo-Cazurra (2008), Egger and Winner (2005), and Sharma and Mitra (2019) which reveal that corruption has positive impact on the stock market development and also effective in attracting the foreign development investment due to the expediting the transactions and allowing the private to overcome the ineffective regulation. Mashal (2011) suggested that the rate of corruption decreased the stock development within the country. According to Obuah (2010), corruption is a cankerworm that eats away at the foundations of a country's economy over time and invisibly while also stunting growth across all spheres.

The rule of law is the perception of public confidence in the rules of society, quality of the contracts, contracts enforcement, property rights, police, and justice as well as crime and violence. If there are weeks these factors, then the rule of law is considered low. If these factors are strong then rule of law is considered effective and good indicators for the governance. Our findings are consistent with the findings of Brown et al. (2013) reveals that there is positive impact between the rule of law and stock market prices. He concludes that the rule of law increases the confidence level within the investors and public that enhances the stock investment local as well as foreign investment. Our findings are also agreeing with the previous findings of Arvian et al. (2022), Djankov et al. (2003), and La Porta et al. (1999) which reveal that countries with strong judicial system and strong administrative rules may protect the investors leads to increase in the stock performance. Finally, rule of law is the important part of the good governance, if the rule of law is going effectiveness, then the role of the government within Malaysia is positive. If rule of law in Malaysia goes to decline, it indicates the week judicial system in Malaysia and has negative consequences for the country.

Moreover, the research findings suggest that there is a complex relationship between various governance indicators and $CO_2$ emissions in Malaysia over time. In particular, the study highlights the in-phase relationship between voice and accountability and $CO_2$ emissions, suggesting that improved voice and accountability may lead to an increase in $CO_2$ emissions. This finding is somewhat surprising, as we might expect improved accountability to lead to more effective environmental regulation and thus increase carbon emissions. In this way, our findings are opposite to Fan et al. (2020) founded that improvements in democratic governance were associated with lower levels of $CO_2$ emissions across a sample of countries. They suggest that democratic institutions may help to promote environmental protection by allowing for greater public participation in decision-making and facilitating the adoption of more environmentally friendly policies.

This study also finds that political stability and government effectiveness have complex relationships with $CO_2$ emissions, with the relationship shifting over time. Specifically, government effectiveness and $CO_2$ emissions had an in-phase relationship from 1993 to 1998 and also covered the crisis of 1997–1998. In this way, our findings are opposite with Ali et al. (2023) found that the relationship between governance and environmental performance may depend on economic development levels. Specifically, they found that in countries with lower levels of economic development, better governance was associated with lower levels of environmental pollution. However, in countries with higher levels of economic development, the relationship between governance and environmental outcomes was less clear. This finding suggests that economic priorities may have taken precedence over environmental concerns during the period of economic recovery. Additionally, the study finds that rule of law and $CO_2$ emissions have a significant and in-phase relationship during the period of 1993–1994, 1997–1998, and 2020–2021, suggesting that weak environmental protection regulations were in place during this time. We found similar findings as Wang et al. (2018) found that the rule of law was positively associated with environmental performance in a sample of countries. Specifically, they found that stronger rule of law was associated with lower levels of air pollution, water pollution, and greenhouse gas emissions. Moreover, in this way, we contradicted with previous theory and literature findings such as Guo et al. (2020) found that the relationship between the rule of law and environmental outcomes varies across different regions of China. Specifically, they found that in regions with higher levels of economic development, stronger rule of law was associated with lower levels of air pollution.

However, in less developed regions, the relationship between the rule of law and environmental outcomes was less clear. Conversely, regulatory quality has a significant

and anti-phase relationship with $CO_2$ emissions during 1997–1998, indicating that stricter environmental protection regulations were implemented during this time. Finally, the findings of this research highlight the complexity of the relationship between governance indicators and $CO_2$ emissions in Malaysia over time. The study suggests that economic priorities may have influenced the effectiveness of environmental protection policies in the past, and that stricter regulations may be necessary to reduce emissions in the future.

## Concluding remarks and policy implications

The success of a country's stock market directly affects its financial stability and also its economic growth. The effect of WGI on stock prices was investigated in this study. We answered our research question, how role of government by using WGI six indicators as a proxy affect the stock prices in different time domain (before and after crisis period)? In particular, the study looked into how Malaysia's MSCI stock price was affected by the government's ability to control corruption, political stability and a lack of violence, the rule of law, the quality of the regulatory system, and voice and accountability. Overall, our findings show that government effectiveness through the policy making, and their implementation increase the stock price level within Malaysia. When the government make effective policies and its implementations are successful through the law and order then government will be successful and effective, and we can say that the role of the government is positive in Malaysia in the selected period. From our results, we conclude that in the selected period there is government positive role in according with government effectiveness indicator of the WGI. Government of an economy can leads to crisis and also can goes to the recovery as well as on boom position with long term stability with the government effectiveness policies. Government role may be negative when the government effectiveness value for the Malaysia decreases that has the negative consequences on the Malaysian economy in shape of the financial crisis. Reasons may be Malaysian government expensed more amount on the development expenditure. Moreover, from the results of the environmental protection through controlling the $CO_2$ emission, the Malaysian government increased their carbon emissions to promote their business sector for the economic development. By taking these findings, the Malaysian government makes policies related to the stock market regulations and the environmental protection.

The study suggests several policy implications for Malaysia and other countries that seek to improve environmental outcomes while maintaining economic growth and political stability. First, the finding that voice and accountability lead to rise the levels of $CO_2$ emissions suggests that promoting transparency and civic engagement can be an effective strategy for reducing emissions and can make balance in environment and the development by policy making. Governments can work to increase public awareness of environmental issues and engage citizens in the policymaking process, which can help to build support for environmental regulations and encourage individuals and businesses to adopt more sustainable practices. Second, governments can work to balance economic growth with environmental sustainability by implementing policies that promote green technologies and investments in renewable energy, while also enforcing environmental regulations and promoting public awareness of the importance of reducing emissions. Third, legal institutions can play a crucial role in regulating emissions and enforcing environmental regulations. Governments can work to strengthen legal institutions and create an effective regulatory framework for addressing environmental issues, which can help to ensure that businesses and individuals are held accountable for their environmental impact. Finally, the study suggests that promoting transparency, civic engagement, and strong legal institutions can be effective strategies for reducing $CO_2$ emissions while maintaining political stability and economic growth. These policy implications may be relevant not only for Malaysia but also for other countries that face similar environmental challenges. In our selected period we found the Malaysian policies and their implementation are very effective leads to rise in the stock market and environmental protection through $CO_2$ emission even in the period of financial crisis and also during the crucial period of COVID-19 pandemic. Future research should be conducted on the political stability and exchange rate and also other governance indicators with stock markets of different nations.

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