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EXPLORING THE DYNAMICS: GRANGER CAUSALITY BETWEEN MACROECONOMIC VARIABLES AND SECTORAL STOCK PRICES BEFORE AND AFTER THE 2008 FINANCIAL CRISIS: EVIDENCE FROM THE FTSE ALL-SHARE INDEX

Abstract:

This study provides a quantitative analysis of the causal association between macroeconomic factors and stock share prices at the sectoral level in the UK, with a specific emphasis on the periods prior and after the global financial crisis of 2008. Employing both conventional and quantile Granger causality analysis, we examine the causality between GDP, interest rates, money supply, inflation, exchange rates, and the sectors of the FTSE All-Share index covering the period from 1999 to 2022 by dividing the sample to prior the financial crisis from 1999 to 2007 and after the crisis from 2008 to 2022. Our results present complex and dynamic causation, which varies among different sectors and economic circumstances. The conventional Granger causality test revealed limited findings, whereas the quantile technique reveals deeper bidirectional causality in particular quantiles, implying that the impact of economic factors on stock prices is reliant upon the current economic circumstances. For instance, before the financial crisis of 2008, the standard Granger causality test revealed that GDP causes only the consumer staples and energy sectors, but there were no causation effects from stocks to GDP. However, the Granger causality test for quantiles suggested a bidirectional effect between GDP and stock prices across various distributional quantiles, which indicates that stock prices also cause changes in the GDP, particularly in the upper and middle quantiles of the distribution. However, After the financial crisis from 2008 to 2022, the traditional Granger causality analysis indicates that GDP do not predict the FTSE All-Share index or any of its sector indices. However, the index and its sectors (except the materials sector) caused significant changes in GDP. The more in-depth analysis of the quantile Granger causality tests revealed a significant causality from the FTSE All-Share index and its sectors to GDP in the majority of quantiles, in addition to causality from GDP to stock prices, but in fewer quantiles. The two tests agreed on the extreme effect of stock prices on GDP after the crisis, but they were dissimilar regarding causality in the other direction. These findings emphasise the significance of involving distributional elements in economic examination and present valuable implications for investors, policymakers, and economic analysts, emphasising the importance of customised strategies that meet distinct market situations and sectors.

Keywords:

Macroeconomic, Stock, Sectoral, Granger, Quantile

JEL Classification: E44, B26, C22

1. Introduction

Stock markets are deemed to be a major part of financial systems. The key role of the stock market is financing projects by transferring funds from investors to firms. Moreover, stock markets contribute to economic growth by mobilizing local savings and allocating them to projects with high returns (Rajan and Zingales, 1998). However, the primary concern of investors and portfolio managers is determining the optimal financial asset with which they can achieve a good return compared to its price. Thus, in order to obtain the highest yields, it is important to predict the values of financial assets. For this reason, several studies have been conducted to provide valuation methods for the estimation of financial asset values; they have employed factors such as macroeconomics, politics and international crises, all of which are crucial determinants of future returns (Chen et al., 1986; Li and Born, 2006; Mohamed et al., 2009). Moreover, stock prices play a vital role in the macroeconomy, because they are a reflection of expectations regarding future corporate earnings. Corporate earnings make up a significant portion of the Gross Domestic Product (GDP) and are associated with consumption and investment (Aylward and Glen, 2000).

The intricate and dynamic relationship between macroeconomic variables and stock prices has been a long-standing topic of investigation. Furthermore, financial crises can profoundly disturb the dynamics between macroeconomic variables and stock prices, redefining established correlations and forecasting models. This paper aims to explore this impact, focusing specifically on how the correlation between these parameters changes during periods of financial instability. The most common theories for examining the relationship between macroeconomic factors and stock returns is the capital asset pricing model (CAPM), which was introduced by Sharpe (1964) and Lintner (1965), and the arbitrage pricing theory (APT), which was established by Ross (1976) as an alternative for the CAPM. This paper will hypothesize the APT theory because, according to Copeland et al. (2004), the APT is more robust than CAPM for several reasons. Firstly, in contrast to the CAPM, which requires an efficient market portfolio, the APT assigns no special significance to the market portfolio. Secondly, the APT is easily adaptable to a multi-period context, allowing us to consider the impact of the financial crisis period in our examination. Moreover, there are no assumptions about the distribution of asset returns in the APT. Furthermore, the APT makes a statement regarding the valuation of any group of assets, implying that it is unnecessary to evaluate all the assets in the universe in order to verify the theory, and it permits multiple factors, not just one, to influence the balanced returns of assets. Lastly, numerous empirical studies have examined the relationship between macroeconomic variables and asset returns using the APT theory, and it is well documented for emerging and developed markets (Chen et al., 1986; Hamao, 1988; Humpe and Macmillan, 2009; Poon and Taylor, 1991).

In the recent past, several countries have faced economic and financial crises. For example, the global financial crisis 2007–2008 and the Asian financial crisis in 1997

led to significant changes in the financial economy. Several attempts have been made to explore the effects of these crises on the nature of the causality between macroeconomic variables and stock prices, and it has been concluded that stock prices responded differently prior to and after the crises (Sheikh et al., 2020). For example, Caporale et al. (2014) examined the impact of the 1997 Asian financial crisis on the causality between stock prices and exchange rate using daily data. In the pre-crisis sample they found a unidirectional causality from stock prices to the exchange rate in Indonesia and Thailand while the causality was bidirectional after the crisis.

Several challenges have affected macroeconomics in the United Kingdom (UK) and these have caused unexpected changes. In particular, the effects of the COVID-19 pandemic significantly disrupted the economies of countries across the globe, including that of the UK. Even though a robust vaccination was introduced, the UK still had to deal with the economic consequences that resulted from the pandemic, including an increase in unemployment (Bank of England, August 2021). Moreover, although the UK officially exited the European Union at the end of 2020, the economic effects of Brexit continue. Specifically, in terms of financial transactions, they remain a major obstacle for the UK (European Commission, 2020). In addition, inflation rates in the United Kingdom rose considerably in 2021, due to a variety of reasons such as rising energy prices (UK Office for National Statistics, 2020).

A large number of empirical studies has investigated the causality between macroeconomic variables and stock prices in developed, emerging markets and there various studies have investigate the causality in the UK. Despite this, the nature of this relationship is still debated among researchers (Abdalla and Murinde, 1997; Akbar et al., 2012; Alam and Uddin, 2009; Apergis and Eleftheriou, 2002; Caporale et al., 2002). For the UK, some studies have reported unidirectional causality from macroeconomic variables to stock prices, such as Azad and Serletis (2020) and Peiró (1996), while others found unidirectional causality in the opposite direction, such as Masuduzzaman (2012) and Shirvani (2008). Some have found bidirectional causality between the variables, for example Hasan (1999) and Cakan (2013). This difference in the results could be because of the variation in the used methodologies, selected periods and economic circumstances. Therefore, it is important to re-examine the causality in the UK with a new perspective. All of the previous studies investigated causality at an aggregate level and used traditional econometrics models such as VAR and the standard Granger causality. However, there is still a need for further research utilizing non-traditional methods and indicators.

Consequently, this study will contribute to the literature in three ways. First, while most of the current studies have examined the causality between macroeconomic variables and the aggregate stock indices, a limited number of studies have examined the causality at the sectoral level in the UK. Therefore, this study fills the gap in the limited sectoral studies in the UK by using the FTSE All Share index. The reason for the selection of this specific index is the fact that it includes around 600 companies and

represents 98–99% of the UK's market capitalization (FTSE Russell, 2023). Due to that, it reflects the local UK economy more than the FTSE 100 index, which includes only 100 international companies, which represent the global economy more than the UK's. Therefore, to represent causality in the UK specifically, we use the FTSE All Share index. The motivation for analyzing sector indices come from the fact that the estimated impact of macroeconomic indicators on the stock market varies among all stock sectors. For instance, research conducted in Switzerland on the same topic demonstrated that the industrial sector is more sensitive to changes in macroeconomic variables than the service sector (Hess, 2003). Hence, analyzing the causality at the sectoral level is helpful for investors and portfolio managers because it helps them to measure the risks and expected returns associated with their investments. Second, due to the variation in the previous results during some economic events, this paper will consider the impact of the 2008 financial crisis period on the causality between macroeconomic variables and stock sector indices in the UK in the long and short terms. Third, since most previous studies used the standard Granger causality model to test the causality between macroeconomic variables and the stock market, such as Bhattacharya and Mukherjee (2002), Ratanapakorn and Sharma (2007), Issahaku et al. (2013) and Ray (2014), we cannot rely on the results of this model only because it depends on the mean of the data. Therefore, this paper will contribute to the literature by providing a deeper understanding of the causality between macroeconomic variables and stock prices in the UK using an advanced quantitative method – quantile Granger causality. The quantile approach is distinct from the classical models because it considers the distribution of the dependent variable in the analysis, which will provide more precise results (Koenker and Bassett, 1978).

This empirical study aims to test the APT empirically in order to explain the two-way direction causality between macroeconomic variables and stock share prices at the comprehensive and sectoral levels in the UK, using a quantitative method. Several objectives have been developed such as analyzing the long- and short-term relationship between macroeconomic variables and stock sector indices in the UK. Providing comprehensive results for the causality between macroeconomic variables and stock prices by analyzing it for each quantile. Examining the impact of the 2008 financial crisis on causality at the sectoral level by testing the data for the aggregate period and before and after the financial crisis. lastly, providing an in-depth evaluation of stock indices to help investors mitigate the risk of their portfolios.

This paper is important for investors and policymakers for several reasons. The results will benefit investors by facilitating the forecasting of changes in stock prices and determining the direction that a fund will take if there is a change in macroeconomic variables, instead of moving out of the market. With regard to policymakers, they need to evaluate the outcomes and influences of their decisions on stock markets and the economy. Therefore, this paper will help them to manage the effects of their decisions on the stock market. In addition, the findings of this paper will make an essential contribution to the field of finance and economics research.

The remainder of the empirical chapter is structured as follows. Section 2 demonstrates the relevant previous studies. Section 3 presents the used model and describes the selected data. Section 4 presents the results and the discussion. Section 6 provide the conclusion of the paper.

2. Literature review

The literature review section explored the relationship between selected macroeconomic variables and stock prices. Our selected macroeconomic variables are the money supply, interest rate, inflation, GDP and exchange rate. The reason for selecting these variables is that they reveal a comprehensive picture of the macroeconomic conditions and they have a significant effect on corporate earnings, which is a major factor in determining stock prices and vice versa (Aylward and Glen, 2000; Granger et al., 2000; Sui and Sun, 2016). Consequently, these variables are frequently employed in studies examining the association between macroeconomic variables and stock prices. Furthermore, this literature review explored the causality between these variables and stock prices, and the effect of financial crises on this causality.

2.1 The causality between money supply and stock prices

Empirical studies have examined the relationship between money supply and stock prices with varying results. Positive relationships were found by Wongbangpo and Sharma (2002), Ratanapakorn and Sharma (2007), Ray (2014), and Chukwuani and Paul (2018). For example, Ray (2014) used VECM and Granger causality to analyze the Indian economy from 1990 to 2011, finding a positive relationship. Similarly, Chukwuani and Paul (2018) confirmed this relationship in Nigeria from 1995 to 2016 using regression analysis. Conversely, other studies indicate a negative correlation. Nawaz and Husain (2007) found a negative relationship in Pakistan, while Wongbangpo and Sharma (2002) observed the same in Indonesia and the Philippines due to inflationary effects.

Several studies have also investigated the causation between money supply and stock prices. Unidirectional causality from money supply to stock prices was reported by Mukhopadhyay and Sarkar (2003) in India, Rahman and Mustafa (2008) in the US, and Nguyen (2016) in Vietnam. Azad and Serletis (2020) highlighted similar findings for the UK from 1870 to 2016 using bivariate GARCH-in-mean VAR. There is also evidence that stock prices can cause changes in money supply. Ratanapakorn and Sharma (2007) and Issahaku et al. (2013) found this unidirectional causality in the US and Ghana, respectively. Some studies like Rogalski and Vinso (1977) and Hasan (1999) reported bidirectional causality in the US and the UK.

Overall, these mixed findings indicate a complex relationship influenced by economic contexts and methodologies used.

2.2 The causality between interest rates and stock prices

Research on the relationship between interest rates and stock returns also yields varied results. Some studies, like Sadorsky (1999) and Eldomiaty et al. (2019), found a positive relationship, suggesting that lower interest rates reflect higher risk, leading investors to shift to safer assets. However, most studies report a negative association. Humpe and Macmillan (2009) found a negative relationship in the US and Japanese markets from 1965 to 2005 using VECM. Similar results were observed by Kyereboah-Coleman and Agyire-Tettey (2008) in Ghana and Ratanapakorn and Sharma (2007) in the US.

Regarding causality, most research indicates unidirectional causality from interest rates to stock prices. Peiró (1996) found this in the UK, France, and Germany. Hasan (2008) and Mohapatra and Rath (2015) observed similar results in the UK, Brazil, India, and China. Some studies, like Suhaibu et al. (2017), reported bidirectional causality in African nations, while Bhattacharya and Mukherjee (2002) found no causality in India.

2.3 The causality between inflation and stock prices

The relationship between inflation and stock prices is also debated. Fama (1981) and Hunjra et al. (2014) found a negative correlation, with inflation reducing real returns on stocks. Kyereboah-Coleman and Agyire-Tettey (2008) confirmed these findings in Ghana. Conversely, studies by Goswami and Jung (1997), Giri and Pooja (2017), and Ratanapakorn and Sharma (2007) suggest a positive relationship. For instance, Giri and Pooja (2017) observed this in India from 1979 to 2014 using ARDL and VECM. Some research indicates that the correlation can change over time. Alkhazali and Pyun (2004) found a negative short-term but positive long-term relationship in Pacific Basin countries.

Causality studies also present mixed results. Abbas et al. (2018) found unidirectional causality from inflation to stock prices in G-7 countries. Tiwari et al. (2020) observed the opposite in the US from 1800 to 2017. Bhattacharya and Mukherjee (2002) and Pradhan et al. (2015) reported bidirectional causality in India and OECD countries.

2.4The causality between GDP and stock prices

The relationship between GDP and stock prices has been widely studied. Chakraborty (2008) found a negative relationship in India, while Beck and Levine (2004) and Alexius and Spang (2018) observed a positive correlation in 40 countries and G7 countries, respectively.

Causality studies often report unidirectional causality from stock prices to GDP. Masuduzzaman (2012) and Shirvani and Wilbratte (2008) found this in the UK. Nasseh and Strauss (2000) observed it in six European countries. Moreover, some studies, like Zhou and Shang (2018) in China, found GDP had a greater impact on stock prices.

Others, like Hunjra et al. (2014) in Pakistan, reported bidirectional causality, indicating a symbiotic relationship.

2.5 The causality between the exchange rate and stock prices

Research on exchange rates and stock prices shows diverse results. Nguyen (2019) found negative relationships in emerging markets and positive ones in developed markets. Aggarwal (1981) and Morley (2009) reported positive relationships in the US and the UK.

Causality studies also vary. Abdalla and Murinde (1997) and Nieh and Lee (2001) found unidirectional causality from exchange rates to stock prices in India, Korea, and G7 countries. Ajayi et al. (1998) observed causality from stock prices to exchange rates in developed markets. While Granger et al. (2000) and Caporale et al. (2014) reported bidirectional causality in some countries but no causality in others. Mohamed et al. (2009) found that economic circumstances could change causality directions, as seen in Malaysia before and after the Asian financial crisis.

2.6 Causality at the sectoral level

The association between sector indices and macroeconomic variables has been examined in compelling studies across a comprehensive range of literature. Different sectors behave differently to changes in these variables, indicating the asymmetrical character of their behaviour, as is well known. This is likely because of the diverse sensitivity of sectors to macroeconomic indicator movements. A few empirical studies have provided evidence for this: Hess (2003), Maysami et al. (2004), Gregoriou et al. (2009) and Bhuiyan and Chowdhury (2020).

Gregoriou et al. (2009) examined the relationship between interest rate changes and stock prices in the UK from June 1999 to March 2009, using the GMM method. They found that during the financial crisis, the relationship between the aggregate index and interest rates turned positive. Most sectors (80%) mirrored this pattern, while 20% showed a negative relationship. Before the crisis, both aggregate and sectoral levels exhibited a negative relationship with interest rates. Additionally, Hess (2003) analyzed the impact of macroeconomic factors on Swiss stock indices from 1975 to 2000 using VAR models. He found that the hotel sector was more sensitive to inflation, likely due to its unique financial structure, and the industrial sector was highly responsive to interest rate changes due to high capital requirements. Moreover, Bhuiyan and Chowdhury (2020) explored interactions between sector indices (energy, financials, real estate, industrials, healthcare, consumer discretionary, and consumer staples) and macroeconomic factors (industrial production, money supply, and long-term interest rates) in the US and Canada from 2000 to 2018, using the VEC model. They found no relationship in Canada but various levels of causality in the US. Money supply influenced multiple sectors, while interest rates impacted energy and materials sectors. Lastly, Maysami et al. (2004) investigated the relationship between Singapore’s aggregate index, sector indices (finance, property, and hotel), and

macroeconomic indicators (CPI, IP, short- and long-term interest rates, money supply, and exchange rates) from 1989 to 2001 using cointegration, VECM, and Granger causality. They found unidirectional causality from all macroeconomic variables to the aggregate index. Sector-level analysis revealed unidirectional causality from inflation rates, exchange rates, and interest rates to the finance sector, but no causality with money supply and IP. The property sector exhibited strong co-movement with the overall market, while the hotel sector showed causality with exchange rates only.

2.7 The models used

An overview of the relevant literature demonstrates that econometric techniques play a significant role in achieving unbiased findings, and economists argue that their use is essential. According to the assertions of numerous scholars, the lack of integrate novel innovations in econometric methods has the potential to reduce the credibility and reliability of research results (Baltagi, 2013). In addition, a significant insight from the literature is the heterogeneity of the techniques utilized, which has resulted in a variety of interpretations of the studied relationship.

Historically, the standard Granger causality test has been widely employed to determine cause-and-effect relationships between indicators, praised for establishing temporal precedence. Studies utilizing this method include Rogalski and Vinso (1977), Bhattacharya and Mukherjee (2002), Ratanapakorn and Sharma (2007), Issahaku et al. (2013), Ray (2014), and Nguyen (2016).

Linear models, particularly Vector Autoregression (VAR), have also been commonly used to analyze the relationship between stock prices and macroeconomic factors. Key studies employing VAR include Abbas et al. (2018), Camilleri et al. (2019), Sadorsky (1999), Suhaibu et al. (2017), and Sui and Sun (2016). However, Rahman et al. (2009) noted that these models have limitations when analyzing non-stationary data.

The Autoregressive Distributed Lag (ARDL) model is another widely used method for investigating stock returns and macroeconomic variables (Giri and Pooja, 2017; Pesaran et al., 2001). The ARDL method is effective for handling both stationary and non-stationary data, contributing to its popularity.

Overall, these econometric techniques play a significant role in uncovering the intricate relationships between macroeconomic variables and stock prices, with each method offering unique advantages and limitations.

3. Data description and Model

3.1 Data Description

Monthly price data are used for the stock share prices, represented by the FTSE All Share Index, and six sector indices (consumer discretionary, consumer staples, energy, industrials, materials, and utilities). All of the prices are expressed in GBP. Due to the mismatch of the frequency of GDP and rest of the variables used in the analysis, it is converted from quarterly to monthly by assuming the uniform distribution of GDP for a month of a given quarter. For the macroeconomic variables, the inflation rate is calculated by using the CPI and the money supply (M4) expressed in GPB, in

order to explore the relationship on the side of the Bank of England's actions. Furthermore, as a proxy for the interest rate, the UK Treasury bill tenders (TBRs) 3M are employed because they are always market clearing (Siklos and Wohar, 1997). GDP in GBP is employed to assess the causality by considering the real economy. Lastly, to examine the causality between foreign countries' markets and the UK markets, the exchange rate of USD to GBP is used as the foreign exchange rate. The sample includes 277 observations, and the selected variables are sourced from DataStream, except for the CPI, which is taken from The Office for National Statistics. The monthly data ranged from April 1999 to April 2022, considering the availability of data and their consistency within the accessible timeframe. All of the data are seasonally adjusted except the interest rate. GDP, M4 and stock prices are converted to the real prices using the CPI as a deflator, and all the variables are transformed into logarithm form, except inflation and the interest rate. Moreover, the study also introduces the global financial crisis 2008 as a dummy variable to capture structural breaks inherent in the data, where from 1999 to 2007 (pre-financial crisis period) and from 2008 to 2022 (After the financial crisis period). Figure 1 presents the time series plots for the variables used in the test. It shows that each macroeconomic variable performs differently, but also that there in a certain period there is unusual behaviour – this is the previous financial crisis in 2009. For the stock share prices, it is clear that the FTSE All Share Index and the six sectors tend to increase in the long term, but the index demonstrates more fluctuations than the sectors. Moreover, stock share prices also experience a shock in the financial crisis period. Regarding the relationship between the variables, it is concluded from the figure that each macroeconomic variable is related to the stock share prices differently.

3.2 Model

To examine the causality between macroeconomic variables and stock share prices at the aggregate and sectoral level in two ways, we used the FTSE All Share Index and six sector indices (consumer discretionary, consumer staples, energy, industrials, materials, and utilities). For the macroeconomic variables, the inflation rate, money supply (M4), interest rate, GDP and exchange rate were employed. All of these variables are standardised as done in the literature. This allows for the comparison of variable's explanatory power.

To achieve our objectives, long-term analysis using Vector Error Correction (VEC) model is applied to explore whether there are long-term relationships between the stock price and the macroeconomic variables. In addition, short-term analyses are employed using the standard Granger causality and the quantile Granger causality provided by Troster (2018). Quantile methodology can estimate the relationship between a dependent variable and explanatory variables at different specific quantiles. It also provides a broader method for investigating the relationship between current returns and various parts of the lagged conditional returns, even when extreme values are present (Chiang and Li, 2012). The reason behind expanding the analysis of the standard Granger causality by the Quantile Granger causality is the common Granger causality results provide useful results but only a part of the insight because they

analyse data based on the variables' means. To complement this, we utilise the Quantile Granger causality to investigate the causality on the conditional distribution of the variables at various quantiles.

The long-term relationships between the macroeconomic variables and stock share prices were tested utilising the following form:

$$SP_t = \beta_0 + \beta_1 GDP_t + \beta_2 M4_t + \beta_3 EXC_t + \beta_4 INF_t + \beta_5 IR_t + \varepsilon_t$$

Where SP represents the logarithm of the real FTSE All Share Index prices, GDP represents the logarithm of the real GDP, M4 represents the logarithm of the real money supply, EXC represents the logarithm of the exchange rate which is defined as the number of USD per GBP, INF represents inflation, IR represents the UK Treasury bill tender 3M, and $\boldsymbol{\varepsilon}$ represents the residual term.

The Johansen cointegration test (1988) method is used to establish the number of cointegrating vectors with trend and constant. Specifically, the trace and the max statistics were employed to determine the number of cointegrating vectors. For the lag length, due to the variation in lag values obtained from different lag length selection criteria, the test was applied based on various lag lengths, and the best lag length was specified by the number of lag lengths that the cointegration relationship was fairly consistent over. Then, to explore the short-term relationships between the variables, the standard Granger causality test was used, considering the same VAR model as that used in the cointegration, and the quantile Granger causality test, also considering 19 quantiles.

Table 1 shows the descriptive statistics of the selected variables. It can be seen that the highest mean price is the FTSE All Share Index, followed by M4, TRB, GDP, consumer staples, the energy sector, industrial sector, materials sector, consumer discretionary sector, exchange rate, utilities sector and inflation. The maximum price is for TRB, followed by the FTSE All Share Index, M4, industrial sector, consumer staples, energy sector, utilities sector, GDP, the materials sector, consumer discretionary sector, inflation and the exchange rate. The minimum price is the highest for the FTSE All Share Index followed by M4, GDP, the exchange rate, industrial sector, TRB, utilities sector, consumer staples, inflation, consumer discretionary sector, materials sector and energy sector. The standard deviation of prices is the highest for TRB followed by the energy sector, materials sector, consumer discretionary sector, utilities sector, consumer staples, industrial sector, inflation, M4, FTSE All Share Index, exchange rate and GDP.

To solve spurious regression problems which may arise when the variables are non-stationary at levels without having any cointegration, all of the variables are subjected to the augmented Dickey-Fuller (ADF) unit root test (Dickey and Fuller, 1979) and the Phillips and Perron (1988) test. They are conducted to check the stationarity of the series. These are conventional and regular tests carried out for stationarity

From the results in Table 2, according to the ADF test with a constant (or with trend), log of Real M4, log of Exchange rate, TRB, and log of real GDP are at stationary at

their first difference, while inflation is stationary at level. These results are consistent using the PP test for both kinds of specification. (p-value close to zero, leading the rejection of the null hypothesis of unit root).

For sectors CD, CS, energy, and utilities, the prices (in their natural log forms) are stationary at levels. This can be seen using both ADF and PP tests for both types of specification, with constant and trend. Prices for sector for materials is stationary at level, concluded using ADF and PP tests. Finally, the log of FTSE is stationary at its first difference. This is established using PP and ADF tests both.

Despite some of the variables in our analysis are stationary at level, the Johansen Cointegration test is still used to analyze whether there is a long run relationship amongst the variables or not. This is in consistency with the reasoning given by Johansen (1997) where he mentions that some of the variables that are stationary at level can still be included in the test, given there is a reasonable explanation for their inclusion (Stavarek, 2005)

4. Results

4.1 The long run results

The results for both the trace and max test statistics are presented in Table 3 and they reveal that there is a long-term relationship between the macroeconomic variables namely GDP, Exchange rate, Inflation, Real M4, TRB and the FTSE All Share Index and each sector. To the best of knowledge, according to the statisticians, if the trace and maximum tests provided different results, the preference will be for the trace test result (Johansen, 1988). It must be noted that despite some of the variables being stationary at level, the Johansen Cointegration test is conducted for checking the long run relationship. This is in consistency with Johansen (1997), according to whom the selection of variables to be included in the cointegration test should be based on the economic reasoning. This means the inclusion of stationary variables is allowed only if it is reasonable. However, it is required to have at least two variables to be non-stationary at level.

Though the results from the Johansen cointegration test suggest more than two cointegrating relationships in some cases, only one cointegrating relationship is considered. This is done not only for the sake of simplicity, but also as per the research question where the analysis is done to see the impact of macroeconomic variables on stock prices. This is done through the normalization of the stock index variables and hence, the effect of each of the macroeconomic variables is estimated on the dependent variable (the stock indices).

Next, after establishing that there exists a cointegrating relationship amongst the variables, the Vector Error Correction Model test (VECM) is estimated and the corresponding results for the long-term relationship amongst the variables through the cointegrating equations and the results are shown in Table 4. The cointegrating relationship that is estimated through the normalization of FTSE all share index, shows that all the macroeconomic variables (GDP, inflation, Exchange rate, M4, and TRB)

are all statistically significant at 1% level. Moreover, GDP, Inflation, and exchange rate affect the FSTE all share index negatively and these are consistent with the previous studies such as Florackis et al. (2014), David E. Rapach (2002) and Nguyen (2019), while money supply and TRB affect the overall index positively which supported by Gregoriou (2009) and Chukwuani and Paul's (2018).

The other cointegrating relationships which are estimated for each sector, also show that all the macroeconomic variables, except for GDP for its impact on consumer discretionary prices, are statistically significant, all at 1% level of significance. The utilities, industrials, consumer discretionary and consumer staples indices follow the main index in its relationship with the macroeconomic variables, which show a negative relationship with the GDP, inflation and exchange rate and a positive with the money supply and interest rate. However, materials and energy indices have inverse movement than the main index, which have a positive relationship with the GDP, inflation and exchange rate and a negative with the money supply and interest rate.

4.2 The short run results

4.2.1 Granger causality test

This analysis presents the causality between the selected macroeconomic indicators and the FTSE All-share index and its sector indices from 1999 to 2022, investigates the impact of the Global financial crisis 2008 on the direction of the causality by dividing the periods for 1999-2007 (before the crisis) and 2008-2022 (after the crisis) and contributes to the literature by examining the causality at sectoral level in the UK.

4.2.1.1 For the aggregate period from 1999 to 2022

The Granger causality test is used to check causality between the variables. To the best of our knowledge, previous studies examined the causality between the variables at aggregate level in the UK, but this study is the first in studying the causality at sectoral level. Table7 presents the causality running from the macroeconomic variables to the stock share prices and vice versa from 1999 to 2022. The results show that there is no causality directed from GDP to stock prices at aggregate and sectoral levels except Consumer discretionary index shows bidirectional causality. While the GDP is granger caused by the FTSE All-share, Consumer discretionary and industrials indices and this finding is aligned with several studies conducted examined the UK such as Shirvani (2008), Thornton (1993), Masuduzzaman (2012) and Nasseh and Strauss (2000). For the inflation, there is bidirectional causality between the inflation and the FTSE All-share index, and this result is consisting with Cakan (2012) analysis, while the sector indices observed various results. In particular, there is bidirectional causality between the inflation and industrials index, unidirectional causality from the inflation to materials and Consumer discretionary indices. In the opposite direction, there is a unidirectional causality from utilities index to the inflation. Interestingly for money supply, there is no causality between itself and stock prices at aggregate and sectoral levels except the Consumer discretionary index Grange causing the money supply. These results diverge from the results reported by most of the studies such as Thornton, 1993, which found unidirectional causality from stock prices to the money

supply. With the regard to the exchange rate, it does not cause changes in the stock prices overall and, but it is affected by the FTSE All-share index and the sector indices (Industrials, Materials and Utilities). These results are supported by Caporale et al. (2014), Ajayi and Mougoue (1996). Lastly, for the interest rate, it Granger causes only the Consumer discretionary index, but it caused by the FTSE All-share index and industrials index while most of studies found unidirectional causality from interest rate to the main index such as Mohapatra and Rath, 2015 and Peiro, 1996.

4.2.1.2 Before the financial crisis period from 1999 to 2007

Table 8 presents the causality running from the macroeconomic variables to the stock share prices and vice versa before the global financial crisis from 1999 to 2007 using the Granger causality test. The results observed that there is no causality between GDP and stock prices before the Global financial crisis 2008 with the exception of two sector indices (energy and consumer staples), which they are caused by the GDP. For the inflation, there is a bidirectional causality between the inflation and the FTSE All-share index, but the varying results are observed with the regards of sectors. Bidirectional with the industrials index, causality is directed from the inflation to materials index and causation directed from utilities to the inflation. There is no causality for the rest of the sectors in either direction. Still there is no causality between money supply and the FTSE All-share index. But regarding the sectors, there is unidirectional causality from the money supply to the indices (energy, materials and consumer staples. For the exchange rate, there is no causality at the aggregate level, but the exchange rate Granger causes energy, materials, utilities and consumer staples but not vice versa. Lastly, for the interest rate, FTSE All-share index and most of the sector indices granger cause the interest rate. Conversely, the interest rates cause changes only in energy and utilities indices.

4.2.1.3 After the financial crisis period from 2008 to 2022

Table 9 presents the causality running from the macroeconomic variables to the stock share prices and vice versa after the global financial crisis from 2008 to 2022 using the Granger causality test. It is found that stock prices at the aggregate and the sectoral levels Granger cause the GDP but not vice versa. For the inflation, similar to the previous investigated periods, there is bidirectional causality between the inflation and the FTSE All-share index. Varying results are observed regarding the sectors with bidirectional causality with the Consumer discretionary index, unidirectional causality to materials index and unidirectional causality from energy index to the inflation. Money supply Granger causes the FTSE All-share and materials indices, but not vice versa. For the exchange rate, no causality is directed from the exchange rate to stock prices. Conversely, only materials and utilities indices Granger cause the exchange rate. For the interest rate, bidirectional causality is found between the interest rate and the FTSE All-share index, while various results found regarding the sectors.

4.2.2 Quantile Granger causality test

Using the Quantile Granger causality test, we contribute to the literature by expanding the standard Granger causality analysis results for the period from 1999 to 2022. Then,

we investigate the impact of the Global financial crisis of 2008 on the direction of the causality by examining the periods from 1999 to 2007 (before the Global financial crisis) and from 2008 to 2022 (After the Global financial crisis). Overall, the Quantile Granger causality results suggest that the causality between macroeconomic variables and the FTSE All-share index and its various sectors depends on the quantile under consideration. This sheds light into the importance of considering the specific characteristics of each sector index and each quantile of the variables in the causality examination. Therefore, this test provides a deeper understanding of the causality between macroeconomic variables and stock prices. The following sections demonstrate the results in particular.

4.2.2.1 For the aggregate period from 1999 to 2022

Table 10 showed the analysis of the causality from GDP and interest rate to the FTSE All-share index and its sector indices showed that both GDP and interest rate strongly Granger cause the stock prices, but the causality to the FTSE All index is observed in fewer quantiles than the indices. In contrast, the results show highly significant causality from stock prices to the two indicators in most of quantiles. For the money supply, there is significant causality in the upper quantiles to all index and sector indices at 1%, while the significance of the causality become less in the lower quantiles at 5% level. On the other hand, the analysis of the causality from stock prices to the money supply shows that the causality from the FTSE All-share index is centralised only in the lower quantiles, while sector indices Grange cause the money supply in most of the quantiles. For the inflation, the causality from inflation to the FTSE All-share index is found in the quantiles 0.2-0.6, 0.85 and 0.9, while the causality to sector indices presents uniform pattern which is found in the quantiles 0.05, 0.4,0.45, 0.7, 0.75 and 0.95. Conversely, the causality from the FTSE All-share index to the inflation found in the middle and lower quantiles, while sector indices significantly predict the inflation in most of the quantiles at 1%. For exchange rate, the causality from exchange rate to stock prices in the FTSE All-share index and its sector indices found in the upper quantiles. However, the causality from the FTSE All-share index to the exchange also found in the upper quantiles, but is observed in sector indices in most of the quantiles.

4.2.2.2 Before the financial crisis from 1999 to 2007

Table 11 presents the results of the Quantile Granger causality between macroeconomic variables and stock prices for the period before the global financial crisis from 1999 to 2007. It is found that causality from the GDP to stock prices exists throughout all quantiles for the FTSE All-Share index and sector indices. At the aggregate level, the index causes changes significantly in the GDP in most quantiles. However, sector indices show causality to the GDP, but less significance than the index and lower quantiles, which it exists in the upper, middle and the last quantiles. For the interest rate, it is observed that interest rate Granger causes the FTSE All-share index and its sectors in the majority of the quantiles, but they vary based on the quantile. For example, in the quantile 0.55, interest rate cause changes in the FTSE All-share index and three sector indices (Energy, Material and Consumer Staples), but

it does not cause Utilities and Industrial indices. On the other hand, the FTSE All-share index and its sector indices follow similar trend in their causations on the interest rate. The causality appears only in the quantiles 0.3, 0.35, 0.6, 0.65 and 0.85, but there is no causality in the rest of the quantiles.

For the money supply, it is reported that money supply predicts the FTSE All-share index in the quantiles 0.2, 0.45-0.65 and 0.85-0.95. But when we look at the sector indices, it observed a causality from money supply to the sectors in the majority of the quantiles. However, in the direction from stock prices to the money supply, the Quantile test results are consistent with the standard Granger causality in observing the absence of causality except in the quantile 0.6, which shows causality from the FTSE All-share index and the indices (Consumer Staples, Utilities, Material and Industrial) to money supply. For inflation, there is causality from the inflation to the FTSE All-share index at 5% in various quantiles. However, the causality at sectoral level is observed in the majority of the quantiles in the whole sectors indices. Contrary, the analysis of the causality from stock prices to inflation showed that the causality is missing in the most of FTSE All-share index's quantiles except the upper and lowest ones, while it is missing in the whole sector indices across all quantiles except the utilities index observed high significant causality at 1%. For exchange rate, the causality from exchange rate to the FTSE All-share index is centralised in the middle and the lower quantiles, while majority of the quantiles showed causality from exchange rate to sector indices. In contrast, the test showed an absence of the causality from the stock prices except the 0.1 quantile.

4.2.2.3 After the financial crisis from 2008 to 2022

Table 12 shows the causality between macroeconomic variables and stock prices for the period after the global financial crisis from 2008 to 2022. The results observe that GDP Granger causes the overall stock market (at aggregate and sectoral levels) randomly among different quantiles. Particularly, it is shown that the FTSE All-share index is caused significantly by the GDP in the quantiles 0.15, 0.25, 0.5 and the 0.85. While at the sectoral level, surprisingly the causality between the Material, Utilities sectors indices and GDP does not show stable level of significance among all quantiles, indicating that GDP demonstrates a precise impact on these specific sectors. On the other hand, the opposite direction of the analysis show that the FTSE All-share index and all sectors' indices Granger cause the GDP significantly almost among all the quantiles except the 0.4, 0.45 and the 0.95, where the causality is missing in these quantiles. For the interest rate, the table shows that the control of interest rate on the FTSE All-share index and its sectors is found only in a few quantiles most of them centralised in the upper quantiles. However, the index and the sectors granger cause the interest rate significantly in most quantiles except in the 0.5 and 0.55. For money supply, the causality from money supply to the FTSE All-share index and the sector indices is found random trend of causality across the quantiles. For instance, in the quantile 0.15, there is causality to the FTSE All-share index and the indices (Energy, Industrial and Consumer discretionary), while in the quantile 0.35 there is a causality only to Energy index. On contrast, the causality from the FTSE All-

share index and its sector indices shows similar pattern. Specifically, there is a strong causality from the FTSE All-share index and all the indices to the money supply in the quantiles 0.1, 0.3, 0.35 and 0.7-0.9. For inflation, the causality to the FTSE All-share index is limited only in three quantiles 0.25, 0.5 and 0.85, while it is showed in the upper quantiles in the sector indices. On the other hand, the FTSE All-share index granger cause the inflation in three quantiles 0.3, 0.9 and 0.95, while the sectors showed highly significant causality to the inflation except the Utilities sector. For exchange rate, the causality from exchange rate to the FTSE All-share index and its sector indices is found randomly across quantiles. For instance, in the quantile 0.25, there is a causality to all the index and sector indices except the utilities, while there is no causality in the quantile 0.3 except in Consumer discretionary. On the other hand, there is a uniform pattern of the causality from stock prices to exchange rate. Specifically, the causality is found in the 0.15-0.25, 0.45, 0.9 and 0.95 quantiles in the whole market (index and sector indices).

5. Discussion and Implications

5.1 Long run relationship

In the long run, concentrating on the aggregate level, a positive impact is indicated by rises in the Money Supply and Interest Rate. This implies that expansionary policies could have a positive impact on stock prices. However, the surprising result in this analysis is the positive association between the interest rate and stock prices because usually the increase in interest rate causes an increase in firms' cost which leads to a decline in the stock prices, which is a negative relationship. However, this result could be observed due to the investors' behaviour or the prediction of economic stability over periods of higher interest rates.

In addition, the analysis showed that sectors may have separate behavior than the main index, this implies the importance of examining the specific sector indices' response to the macroeconomic indicators to achieve precise predictions. For instance, the effect of the exchange rate on the share prices of different sectors varies. While for sectors like utilities, industrials, consumer discretionary, and consumer staples, the effect is negative, which means as the GBP appreciates (~USD depreciates), the share prices for the mentioned sectors decrease. The economic reasoning for this relationship can be tied with the exports which fall after the rise in GBP value against USD. This decrease in demand for exports for these sectors could contribute to a fall in prices. This requires further research on how the sectors are outward-oriented in terms of trade. On the other hand, the effect is exactly the opposite for the materials and energy sectors, having a positive relationship with the exchange rate. Concerning GDP, its negative relationship with the indices of utilities, industrials, consumer discretionary and consumer staples can be explained through the monetary mechanism. The reason for this result might be because, according to statistics, the service sector makes the greatest contribution to the UK GDP (Bank World, 2022). This implies that when the GDP increases, it leads to inflationary pressures in the economy forcing the central banks to contract the money supply, which in turn

decreases the liquidity, and hence, causes a fall in stock prices. However, the long-term relationship between GDP and the sectoral prices of materials and energy have positive relationships with GDP. This positive relationship can be attributed to the income effect.

5.2 Causality

This empirical study examines the causality between macroeconomic variables and the FTSE All-Share index and its sector indices from 1999 to 2022 and during the periods before and after the financial crisis of 2008. The econometrics approaches employed in this study are the standard Granger causality test and the quantile Granger causality tests. The examination highlighted the complex nature of the economic dynamics, and for policymakers and investors it yielded significant implication regarding the causality between the selected macroeconomic variables and stock prices. The results are presented in the following sections.

5.2.1 The causality between GDP and stock share prices

From 1999 to 2022 in the aggregate sample, the traditional Granger causality analyses revealed that GDP had an impact on the FTSE All-Share index only in the consumer discretionary sector. Nevertheless, the FTSE All-Share index and two sectors (industrial and consumer discretionary), caused changes in the GDP. This indicates that the FTSE All-Share index and the indices of these sectors may be valuable indicators for predicting changes in GDP. The standard Granger causality test revealed a limited insight, whereas the Granger causality test for quantiles went deeper and showed that GDP had a bidirectional causal effect on the FTSE All-Share index and all sectors at distinct quantiles. This indicated the possibility of different levels of predictability in different economic circumstances. This complexity demonstrates that decision makers and investors should take into account the distribution of the variables in evaluating their portfolios.

The sample was divided into before and after the 2008 financial crisis. Before the crisis from 1999 to 2007, the traditional Granger causality test revealed that GDP led the consumer staples and energy sectors, but there were no causation effects from stocks to GDP. However, the Granger causality test for quantiles suggested a more pervasive effect of GDP across various distributional quantiles and vice versa, suggesting that stock prices also cause changes in the GDP, particularly in the upper and middle quantiles of the distribution. This differed from the results of the standard Granger causality test, highlighting the importance of considering causality among quantiles.

After the financial crisis, from 2008 to 2022, the traditional Granger causality analyses indicate that GDP did not predict the FTSE All-Share index or any of its sector indices. However, the index and its sectors (except the materials sector) caused significant changes in GDP. The more in-depth analyses of the quantile Granger causality tests revealed a significant causality from the FTSE All-Share index and its sectors to GDP in the majority of quantiles, in addition to causality from GDP to stock prices, but in fewer quantiles. The two tests agreed on the extreme effect of stock prices on GDP, but they were dissimilar regarding causality in the other direction. The implication of

this is that while the classical Granger causality test implies that the FTSE All-Share index is not predicted by the GDP, the quantile Granger causality suggests causality in certain circumstances. Therefore, investors should rely solely on macroeconomic variables such as GDP to forecast stock market changes.

5.2.2 The causality between interest rates and stock share prices

In the period from 1999 to 2022, the standard Granger causality test revealed that on the whole, the interest rate did not cause changes in the stock market. The exceptions were the consumer discretionary sector and the interest rate, which were affected by the FTSE All-Share index and the industrials sector. However, the quantile Granger causality reported bidirectional causality across the interest rate and all of the stock market across quantiles except in the middle quantiles, indicating the ability of the quantile approach to capture a broader causality.

For the period from 1999 to 2007, prior to the global financial crisis, the traditional Granger causality analyses indicate that variations in interest rates predicted the stock prices just for the energy and utilities indices, and that the interest rates were affected by the FTSE All-Share index and its sectors, except for the energy and consumer discretionary sectors. However, the quantile Granger causality results provided a broader picture of the causality between interest rates and stock prices. These demonstrated bidirectional causality between interest rates and the index and all sectors, but the level of the quantiles are differed depending on the market conditions. For example, the interest rate Granger cause the main index and the sectors in most of the quantiles, while the stock prices Granger cause the interest rate only in the middle and the lower quantiles. This highlights the significance of the quantile Granger causality test for investigating causal relationships in various portions of the distribution.

For the period from 2008 to 2022, after the financial crisis, a bidirectional causality was found between interest rates and the main stock index. However, the quantile Granger causality outcomes presented a different scenario. There was a significant causal relationship from interest rates to the index and all sectors, but only with high market conditions. Conversely, stock prices predicted changes in interest rates in the majority of market conditions. For investors, this implies that the causality between interest rates and stock prices fluctuates, depending on market circumstances. Therefore, investment strategies should be applied to particular market circumstances, such as high or low market conditions. Moreover, as the analysis revealed an important causal relationship during high market conditions, investors should also consider individual sectors to evaluate the causality between the interest rate and stock prices. Policymakers should acknowledge that the efficacy of interest rate changes may vary based on the prevailing market conditions. Hence, they have to implement policies that are flexible to hedge against the market changes.

5.2.3 The causality between money supply and stock share prices

In the period from 1999 to 2022, the Granger causality results indicate the money supply did not Granger cause the stock market, except in the consumer discretionary

sector, where a unidirectional causality was found from the money supply to the sector. Nevertheless, the inverse analysis of the causality found that changes in the FTSE All-Share index and its sectors don not predict the money supply. However, the quantile Granger causality test found that the level of causality from money supply to stock prices varied across percentiles. In particular, at the 30^{th} and 70^{th} to 75^{th} percentiles, a significant causal relationship was clearly observable. This indicates that a variation in the money supply had a significant effect on the median and lower percentiles of the stock prices. On the other hand, in the opposite direction the outcomes were notably different from those derived from the standard Granger causality results. A significant causality across the majority of quantiles was observed, except for the median (0.5) quantile. This may mean that variations in stock prices have an impact on the distribution of the money supply, differing from the outcomes of the standard Granger causality test when the mean is examined.

Prior to the financial crisis, from 1999 to 2007, the conventional Granger causality analysis revealed that the money supply Granger caused indices (energy, materials, and consumer staples), whereas it did not cause changes in the FTSE All-Share index. This indicates that sector indices-specific causations cannot be captured by examining the aggregate market index. Employing the quantile Granger causality test showed that the majority of quantiles were similarly affected by changes in the money supply, but that this effect was seen in the whole stock market, not in certain sector indices. Nonetheless, in the 60th percentile, there was a significant causal relationship from the FTSE All-Share index and all its sector indices to the money supply, indicating that high fluctuations in stock prices could impact the money supply.

After the financial crisis period from 2008 to 2022, the traditional Granger causality test showed unidirectional causality from the money supply only to the FTSE All-Share index and the materials sector, but there are no causations between money supply and other indices. However, the quantile Granger causality analyses provided a deeper understanding of the causality; they indicated strong causality from the FTSE All-Share index and all the sector indices to money supply in the upper, middle, and lower quantiles. Given that quantile causality depends on varying market dynamics, portfolio managers should diversify their portfolios and develop strategies to mitigate the risks arising from future changes in the money supply. For policymakers, the significant impact of the FTSE All-Share index and all sector indices on the money supply over quantiles indicates that stock market movements could be used by the central bank as a useful indicator of the money supply.

5.2.4 The causality between inflation and stock share prices

Taken together from 1999 to 2022, the findings indicate a bidirectional causality between inflation and stock prices, indicating a dynamic and complex relationship. At the sectoral level, the effect of inflation on sector indices, and the causality in the opposite direction, varied, indicating that sectors react in diverse ways to inflation. The variation among sectors is due to the variation in the economic fundamentals of their interactions with macroeconomic factors. In addition, the quantile Granger causality

analysis showed a comprehensive picture of the causality between the variables. The outcomes indicate that the causality is consistent among all percentiles, meaning that inflation affects stock prices in the same way over all the stock distributions.

Considering the period prior to the financial crisis (1999–2007), the classical Granger causality analyses reveal that inflation had a limited effect on stock prices, with a bidirectional causality between the main index and the industrials index. Conversely, the quantile Granger causality analyses show more in-depth results, with inflation demonstrating a significant impact on stock prices in various market conditions, except for certain sectors at times of low prices. This result implies that, because inflation has diverse effects on stock prices through sectors and market circumstances, investors should mitigate the inflation risks by diversifying their portfolios' assets.

The post-financial crisis period (2008–2022) suggests that the complexity of the causation between inflation and the stock market is greater than that which can be observed with classical Granger causality analysis. As indicated by the quantile Granger causality test, the causality seems to be state-dependent because of the various impacts of inflation among the economic channels in different economic circumstances.

5.2.5 The causality between exchange rates and stock share prices

Over the period from 1999 to 2022, the standard Granger causality test indicates that there was no causal relationship from exchange rates to the overall stock market. However, there was a causal relationship from certain sectors to the exchange rates. In contrast, the quantile Granger causality test observed causality from the exchange rate to the stock market across quantiles, highlighting the importance of employing more advanced econometric approaches to investigate deeper causality. Moreover, the outcomes of the standard Granger causality analysis show that policymakers and investors cannot consider exchange rate fluctuations as reliable indicators of the overall stock market movements. However, there may be certain market conditions (e.g., specific percentiles) in which exchange rates present useful information regarding stock market changes.

Prior to the financial crisis, from 1999 to 2007, the standard Granger causality analysis found that the exchange rate had a greater effect on some sectors than on others. On the other hand, the finding of the quantile Granger causality analysis revealed that the exchange rates had an asymmetric influence on the overall stock market, implying that the standard Granger causality test was incapable of capturing the causality in depth. In addition, the outcomes highlighted the heterogeneity among indices and the importance of analysing all the distributions. This implies that examining these conditions can help investors and portfolio managers to develop deeper strategies for their investments. Particularly in times of anticipated currency volatility, decisions over asset allocation can be influenced by the knowledge of which sectors could be affected by exchange rate fluctuations.

After the financial crisis, from 2008 to 2022, the standard Granger causality test presents a unidirectional causality directed from only two sector indices to the exchange rate. Conversely, the quantile Granger causality findings showed bidirectional causality at various distribution levels, indicating the influence of the exchange rate on the overall market. The dynamics of the causality changed after the global crisis. This indicates that the economy and the market as a whole are still undergoing structural changes, with these indices playing a major role in the dynamics of the foreign exchange market. Furthermore, it can be essential for investors to comprehend bidirectional causality. Those who previously had only considered the exchange rate's effect on stock prices may now need to account for how fluctuations in stock prices impact exchange rates, which may affect a broader range of investments.

To sum up, these results indicate that the causality between macroeconomic variables and stock prices is not consistent. The direction of this causality varies based on the economic situation, the selected sectors, and certain economic circumstances at various times. Moreover, the results shed light on the crucial of examining the distribution of the variables when investigating the relationship between macroeconomic variables and stock prices to achieve deeper understanding. These findings provide important implications for economic analysts, policymakers, and investors because they shed light on the dynamic and multifaceted causality between macroeconomic factors and stock prices in the United Kingdom on an aggregate and sectoral level.

6. Conclusion

This empirical chapter examines the causality between macroeconomic indicators and stock share prices in the UK. To the best of our knowledge, this is the first study to consider the issue at the sectoral level in the UK using the causality in quantiles. Moreover, this chapter investigates whether the global financial crisis of 2008 changed the direction of the causality. To achieve our objectives, we performed long-term analysis using the VECM test and short-term analysis using Granger causality. We then expanded the standard Granger causality analysis by applying the Granger causality test for quantiles, to provide deeper understanding of our issue.

In the long term, the relationship between the macroeconomic indicators and the FTSE All-Share index varies depending on the selected indicators. Some sector indices follow the main index in their relationship with the indicators, while others behave differently from the main index. This implies the importance of considering the individual behaviour of each sector index when evaluating the stock prices for investment purposes.

For the short term, the standard Granger causality test was employed, and again expanded by the quantile Granger causality test. The results indicate that the causality between the macroeconomic variables and stock prices is not consistent. The direction of this causality varies based on the economic situation, the selected sectors, and

certain economic circumstances at different times. Moreover, the results shed light on the importance of examining the distribution of the variables when investigating the relationship between macroeconomic variables and stock prices to achieve a deeper understanding. These findings provide important implications for economic analysts, policymakers, and investors because they shed light on the dynamic and multifaceted causality between macroeconomic factors and stock prices in the United Kingdom on an aggregate and sectoral level. In the future, researchers could examine why certain sectors are more sensitive to changes in each macroeconomic variable than others, as well as why the predictive potential of macroeconomic variables varies according to market conditions and time periods.

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8. Appendix

Figure 1: prices for macroeconomic variables and FTSE All-share index and six sectors:

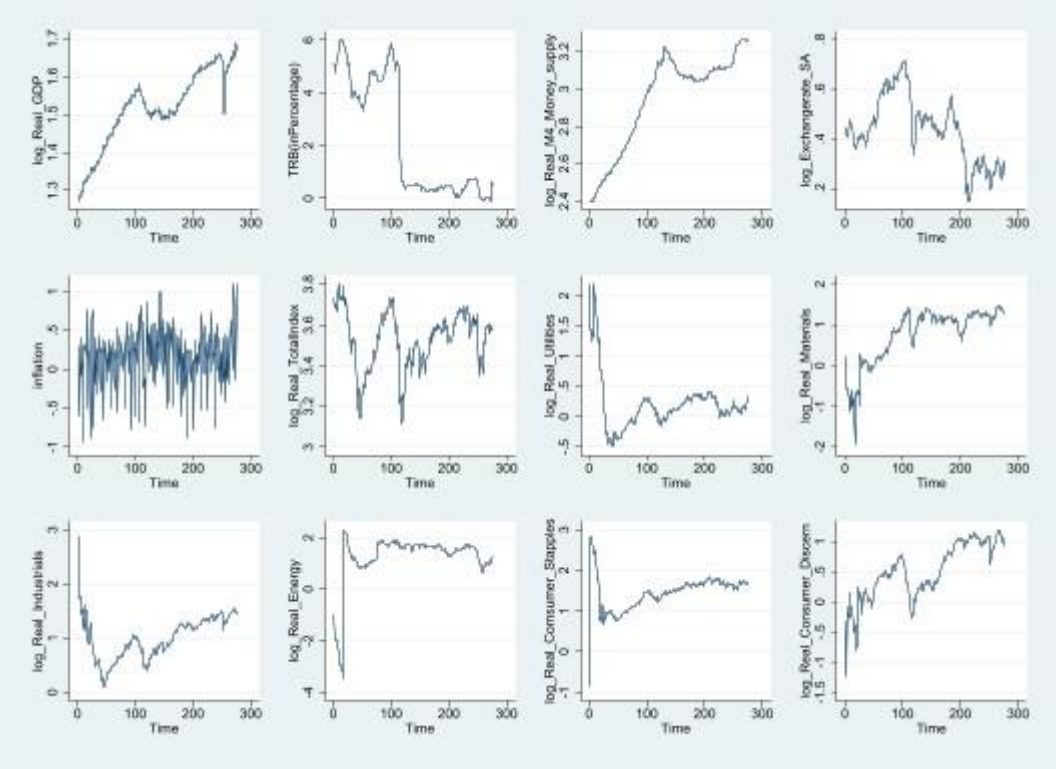

Table 1: Summary Statistics of the variables

VARIABLES	P-value	Mean	SD	Minimum	Maximum
Log Real GDP	0.00000	1.517091	0.0994406	1.270506	1.687389
log_Exchangerate_SA	0.00043	0.4362756	0.1327114	0.1481605	0.715
Inflation	0.00000	0.1767883	0.3586138	-0.9350685	1.093873
log_Real_M4	0.00000	2.946189	0.2550803	2.397593	3.269305
TRBinPercentage	0.00000	2.206225	2.211852	-0.118469	6.04649
log_Real_Consumer_Discern	0.00000	0.5081752	0.470163	-1.225	1.19893
log_Real_Comsumer_Stappl es	0.00000	1.455	0.4040541	-0.8743037	2.819788
log_Real_Energy	0.00000	1.220059	1.044503	-3.469704	2.309684
log_Real_Industrials	0.00000	1.000108	0.3914243	0.0919715	2.863293
log_Real_Materials	0.00000	0.7606131	0.6644137	-1.92377	1.486562
log_Real_Utilities	0.00000	0.192633	0.4264471	-0.4905497	2.191378
log_Real_totalindex	0.00000	3.529139	0.1408721	3.115309	3.798793

Table 2: Unit root using ADF test and PP test.

		Constant				Trend			
		ADF Test		PP Test		ADF Test		PP Test	
Variables	**Form**	**Test statistics**	**P-Value**	**Test statistics**	**P-Value**	**Test statistics**	**P-Value**	**Test statistics**	**P-Value**
log real M4	Level	-2.415	0.1374	-2.578	0.0977*	-1.344	0.8765	-1.162	0.9181
	First diff	-5.832	0.0000***	-14.32	0.0000***	-6.149	0.0000***	-14.612	0.0000***
log EX_SA	Level	-1.622	0.4716	-1.388	0.5881	-2.553	0.3022	-2.167	0.5086
	First diff	-6.900	0.0000***	-13.799	0.0000***	-6.938	0.0000***	-13.805	0.0000***
TR	Level	-1.319	0.6207	-1.206	0.6709	-2.269	0.4511	-1.427	0.8528
	First diff	-6.655	0.0000***	-8.987	0.0000***	-6.652	0.0000***	-8.974	0.0000***
Inflation	Level	-17.193	0.0000***	-17.193	0.0000***	-17.318	0.0000***	-17.318*	0.0000***
	First diff	-30.075	0.0000***	-30.075	0.0000***	-30.024	0.0000***	-30.024	0.0000***
log real GDP	Level	-1.858	0.3519	-1.941	0.3128	-2.567	0.2954	-2.831	0.1857
	First diff	-10.214	0.0000***	-18.535	0.0000***	-10.26	0.0000***	-18.552	0.0000***
log real CD	Level	-3.645	0.0050***	-2.505	0.1144	-4.803	0.0005***	-4.075*	0.0069***
	First diff	-16.603	0.0000***	-18.877	0.0000***	-16.69	0.0000***	-18.921	0.0000***
log real CS	Level	-3.419	0.0103**	-7.432	0.0000***	-5.121	0.0001***	-7.849*	0.0000***
	First diff	-10.896	0.0000***	-49.919	0.0000***	-11.144	0.0000***	-50.9	0.0000***
log real Energy	Level	-3.715	0.0039***	-3.227	0.0184**	-3.614	0.0287**	-3.223**	0.0800*
	First diff	-9.473	0.0000***	-15.47	0.0000***	-9.525	0.0000***	-15.493	0.0000***
log real Industrials	Level	-2.142	0.2278	-4.818	0.0001***	-4.31	0.0030***	-7.741*	0.0000***
	First diff	-8.056	0.0000***	-21.193	0.0000***	-8.206	0.0000***	-21.456	0.0000***
log real Materials	Level	-1.957	0.3057	-1.568	0.4998	-2.195	0.4929	-2.934	0.1515
	First diff	-9.598	0.0000***	-23.062	0.0000***	-9.627	0.0000***	-23.056	0.0000***
log real Utilities	Level	-2.919	0.0432*	-4.94	0.0000***	-2.8250	0.1877	-4.692*	0.0007***
	First diff	-6.687	0.0000***	-20.456	0.0000***	-6.914	0.0000***	-20.685	0.0000***
log_real_FTSE	Level	-2.589	0.0953*	-2.652	0.0828*	-2.665	0.2511	-2.737	0.2212
	First Diff	-12.329	0.0000***	-16.006	0.0000***	-12.332	0.0000***	-15.992	0.0000***

Unit root tests include a constant and trend term. The lag length is determined based on the AIC test. *The 5% significance level and ** for the 10% significance level.

Table 3: Johansen cointegration analysis.

FTSE All-share index					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	150	3056.5778	.	130.4518	94.15
1	161	3087.034	0.20196	69.5395	68.52
2	**170**	**3101.7929**	**0.10356**	**40.0216***	**47.21**
3	177	3112.5852	0.07683	18.437	29.68
4	182	3116.9904	0.0321	9.6266	15.41
5	185	3120.9211	0.0287	1.7653	3.76
6	186	3121.8037	0.00652		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	150	3056.5778	.	60.9123	39.37
1	**161**	**3087.034**	**0.20196**	**29.5179***	**33.46**
2	170	3101.7929	0.10356	21.5846	27.07
3	177	3112.5852	0.07683	8.8104	20.97
4	182	3116.9904	0.0321	7.8613	14.07
5	185	3120.9211	0.0287	1.7653	3.76
6	186	3121.8037	0.00652		
Energy					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	150	2440.3337	.	144.2348	94.15
1	161	2472.6224	0.21272	79.6573	68.52
2	**170**	**2489.8231**	**0.11963**	**45.2560***	**47.21**
3	177	2502.0222	0.0864	20.8577	29.68
4	182	2507.8971	0.04258	9.1079	15.41
5	185	2511.702	0.02779	1.4981	3.76
6	186	2512.4511	0.00553		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	150	2440.3337	.	64.5775	39.37
1	161	2472.6224	0.21272	34.4013	33.46
2	**170**	**2489.8231**	**0.11963**	**24.3983***	**27.07**
3	177	2502.0222	0.0864	11.7498	20.97
4	182	2507.8971	0.04258	7.6098	14.07
5	185	2511.702	0.02779	1.4981	3.76
6	186	2512.4511	0.00553		
Industrials					
constant	**Johansen tests for cointegration**				

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	150	2874.2221	.	151.6794	94.15
1	161	2908.7172	0.22549	82.6892	68.52
2	**170**	**2927.0465**	**0.12696**	**46.0306***	**47.21**
3	177	2938.9849	0.08463	22.1539	29.68
4	182	2945.9495	0.05028	8.2246	15.41
5	185	2949.366	0.02499	1.3917	3.76
6	186	2950.0618	0.00514		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	150	2874.2221	.	68.9902	39.37
1	161	2908.7172	0.22549	36.6586	33.46
2	**170**	**2927.0465**	**0.12696**	**23.8767***	**27.07**
3	177	2938.9849	0.08463	13.9292	20.97
4	182	2945.9495	0.05028	6.833	14.07
5	185	2949.366	0.02499	1.3917	3.76
6	186	2950.0618	0.00514		
Consumer discretionary					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	78	2742.4674	.	207.4864	94.15
1	89	2800.5913	0.34779	91.2386	68.52
2	98	2822.3459	0.14782	47.7292	47.21
3	**105**	**2835.0064**	**0.08889**	**22.4084***	**29.68**
4	110	2841.9475	0.04976	8.5261	15.41
5	113	2845.5653	0.02625	1.2906	3.76
6	114	2864.2106	0.00473		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	78	2742.4674	.	116.2478	39.37
1	89	2800.5913	0.34779	43.5093	33.46
2	**98**	**2822.3459**	**0.14782**	**25.3209***	**27.07**
3	105	2835.0064	0.08889	13.8823	20.97
4	110	2841.9475	0.04976	7.2355	14.07
5	113	2845.5653	0.02625	1.2906	3.76
6	114	2864.2106	0.00473		
Utilities					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	150	2829.1807	.	141.6568	94.15

1	161	2862.0989	0.21639	75.8206	68.52
2	**170**	**2877.6923**	**0.10909**	**44.6337***	**47.21**
3	177	2887.8608	0.07256	24.2966	29.68
4	182	2894.9124	0.05089	10.1935	15.41
5	185	2899.0835	0.03042	1.8514	3.76
6	186	2900.0091	0.00683		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	150	2829.1807	.	60.9123	39.37
1	**161**	**2862.0989**	**0.21639**	**29.5179***	**33.46**
2	170	2877.6923	0.10909	21.5846	27.07
3	177	2887.8608	0.07256	8.8104	20.97
4	182	2894.9124	0.05089	7.8613	14.07
5	185	2899.0835	0.03042	1.7653	3.76
6	186	2900.0091	0.00683		
Materials					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	150	2680.3326	.	130.4983	94.15
1	**161**	**2711.3658**	**0.20537**	**68.4320***	**68.52**
2	170	2726.769	0.10783	37.6256	47.21
3	177	2734.902	0.05847	21.3596	29.68
4	182	2740.8789	0.04331	9.4057	15.41
5	185	2744.8111	0.02871	1.5414	3.76
6	186	2745.5818	0.00569		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	150	2680.3326	.	62.0663	39.37
1	**161**	**2711.3658**	**0.20537**	**30.8064***	**33.46**
2	170	2726.769	0.10783	16.266	27.07
3	177	2734.902	0.05847	11.9538	20.97
4	182	2740.8789	0.04331	7.8644	14.07
5	185	2744.8111	0.02871	1.5414	3.76
6	186	2745.5818	0.00569		
Consumer stapples					
constant	**Johansen tests for cointegration**				
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Trace statistic**	**Critical value 5%**
0	114	2824.8799	.	189.9245	94.15
1	125	2866.108	0.26234	107.4684	68.52
2	134	2891.2502	0.16935	57.1839	47.21
3	141	2904.4481	0.09281	30.7882	29.68

4	**146**	**2916.0232**	**0.08188**	**7.6380***	**15.41**
5	149	2919.2655	0.02364	1.1533	3.76
6	150	2919.8422	0.00425		
Maximum rank	**Params**	**LL**	**Eigenvalue**	**Maximum statistic**	**Critical value 5%**
0	114	2824.8799	.	82.4562	39.37
1	125	2866.108	0.26234	50.2844	33.46
2	**134**	**2891.2502**	**0.16935**	**26.3958***	**27.07**
3	141	2904.4481	0.09281	23.1501	20.97
4	146	2916.0232	0.08188	6.4847	14.07
5	149	2919.2655	0.02364	1.1533	3.76
6	150	2919.8422	0.00425		

The cointegration model is including intercept term and based on the vector autoregressive model (VAR) with 5 lags for FTSE All-share index, Utilities, Materials, Industrials, Energy, 3 lags for consumer discretionary and 4 lags for consumer stapples.

Table 4: Results for Co-integrating relationship

VAR lag	Stock share prices	GDP	Inflation	Exchange rate	M4	TRB
5	**FTSE All-share index**	-1.4974*	- 2.3947***	-1.6437***	2.5264***	0.2780***
5	**Utilities**	-9.0000***	-7.1554***	-4.7484***	8.3414***	0.7237***
5	**Materials**	7.9738***	6.9158***	3.8165***	-4.7790***	-0.5355***
5	**Industrials**	-2.712**	-3.9434***	-3.3741***	4.6936***	0.4020***
5	**Energy**	18.6460***	12.2258***	9.8601***	-13.8457***	18.6460***
3	**Consumer discretionary**	1.6512	-4.7577***	-1.6766**	3.0341***	0.2690***
4	**Consumer stapples**	-6.7415**	-7.8607***	-4.7129***	7.8009***	0.7132***

VECM test to test the long run relationship including constant term. ** and *** denote statistical significance at the 5% and 1% level respectively.

Table 7: Granger causality test for the aggregate period.

Panel A: Causality from macroeconomic variables to stock share prices.						
VAR	Dependant variables	Independent values				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	0.814	**0.003*** **	0.298	0.93	0.394
5	Energy	0.944	0.300	0.45	0.925	0.791
5	Industrials	0.553	**0.001*** **	0.578	0.814	0.062
5	Materials	0.448	**0.017** **	0.062	0.098	0.302
5	Utilities	0.9560	0.5510	0.9700	0.6210	0.3280
3	Consumer discretionary	**0.043** **	**0.006*** **	**0.030** **	0.047	**0.004*** **
4	Consumer stapples	0.426	0.188	0.91	0.064	0.279

Panel B: Causality from stock share prices to macroeconomic variables.						
VAR	Independent variables	Dependant values				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	**0.001*** **	**0.001*** **	0.469	**0.016** **	**0.000*** **
5	Energy	0.705	**0.004*** **	0.111	0.086	0.372
5	Industrials	**0.008** **	**0.006*** **	0.998	**0.021** **	**0.035** **
5	Materials	0.708	0.062	0.213	**0.024** **	0.258
5	Utilities	0.158	**0.008*** **	0.332	**0.023** **	0.613
3	Consumer discretionary	**0.000*** **	0.101	0.526	0.321	0.067
4	Consumer stapples	0.576	0.431	0.590	0.068	0.115

Panel A represent the causality from macroeconomic variables to stock share prices. Panel B represent the causality from stock share prices to macroeconomic variables. The Bold values represent the p-values ** and *** denote statistical significance at the 5% and 1% level respectively.

Table 8: Granger causality test for before the financial crisis period.

Before financial crisis						
Panel A: Causality from macroeconomic variables to stock share prices.						
VAR	Dependant variables	Independent variables				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	0.899	**0.024** **	0.424	0.051	0.436
5	Energy	**0.001*** **	0.088	**0.001*** **	**0.000*** **	**0.000*** **
5	Industrials	0.570	**0.034** **	0.828	0.080	0.708
5	Materials	0.304	**0.049** **	**0.011** **	**0.026** **	0.306
5	Utilities	0.179	0.496	0.180	**0.01*** **	**0.001*** **
3	Consumer discretionary	0.342	0.722	0.186	0.244	0.322
4	Consumer stapples	**0.016** **	0.247	**0.04** **	**0.008*** **	0.086

Panel B: Causality from stock share prices to macroeconomic variables.						
VAR	Independent variables	Dependant variables				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	0.123	**0.021** **	0.078	0.502	**0.000*** **
5	Energy	0.091	**0.009** **	0.201	0.714	0.090
5	Industrials	0.132	**0.031** **	0.798	**0.005*** **	**0.045** **
5	Materials	0.144	0.229	0.162	0.338	**0.029** **

5	Utilities	0.08	**0.011****	0.240	0.348	**0.027****
3	Consumer discretionary	0.602	0.398	0.576	0.377	0.177
4	Consumer stapples	0.222	0.170	0.169	0.234	**0.016****

Panel A represent the causality from macroeconomic variables to stock share prices before the financial crisis. Panel B represent the causality from stock share prices to macroeconomic variables before the financial crisis. The Bold values represent the p-values ** and *** denote statistical significance at the 5% and 1% level respectively.

Table 9: Granger causality test for after the financial crisis period.

After the financial crisis						
Panel A: Causality from macroeconomic variables to stock share prices.						
VAR	Dependant variables	Independent variables				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	0.236	**0.026****	**0.011****	0.669	**0.022****
5	Energy	0.459	0.099	0.121	0.611	0.576
5	Industrials	0.536	0.112	0.153	0.984	**0.047****
5	Materials	0.965	**0.012****	**0.019****	0.999	0.236
5	Utilities	0.875	0.95	0.573	0.314	**0.007*****
3	Consumer discretionary	0.354	**0.011****	0.170	0.725	**0.000*****
4	Consumer stapples	0.259	0.340	0.196	0.264	**0.001*****

Panel B: Causality from stock share prices to macroeconomic variables.						
VAR	Independent variables	Dependant variables				
		GDP	Inflation	M4	Exchange rate	TRB
5	FTSE All-share index	**0.001*****	**0.013****	0.258	0.151	**0.000*****
5	Energy	**0.002*****	**0.000*****	0.234	0.982	0.129
5	Industrials	**0.000*****	0.266	0.944	0.387	**0.001*****
5	Materials	0.699	0.135	0.178	**0.014****	**0.000*****
5	Utilities	**0.016****	0.474	0.257	**0.045****	0.438
3	Consumer discretionary	**0.000*****	**0.033****	0.653	0.411	0.134
4	Consumer stapples	**0.002*****	0.168	0.698	0.368	0.364

Panel A represent the causality from macroeconomic variables to stock share prices after the financial crisis. Panel B represent the causality from stock share prices to macroeconomic variables after the financial crisis. The Bold values represent the p-values ** and *** denote statistical significance at the 5% and 1% level respectively.

Table 10: Evidence for Troster's quantile causality test between macroeconomic variables and stock share prices for the period 1999-2022.

Panel A: Causality from GDP to stock prices.							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discern	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.4493
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.6256
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1806
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0573
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0485**
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**
0.35	0.1101	0.1101	0.1101	0.1101	0.1101	0.1101	0.0044***
0.4	0.7181	0.7489	0.7357	0.7489	0.8238	0.8238	0.0352**
0.45	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0088***
0.5	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.55	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.6	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1013
0.65	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2203
0.7	0.0573	0.0352**	0.0352**	0.0352**	0.0352**	0.0352**	0.8502
0.75	0.0441**	0.0441**	0.0441**	0.0441**	0.0441**	0.0441**	0.8194
0.8	0.0573	0.0573	0.0573	0.0573	0.0573	0.0573	0.0793
0.85	0.0176**	0.0176**	0.0176**	0.0176**	0.0176**	0.0176**	0.0396**
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0308**
0.95	0.0837	0.0837	0.0837	0.0044***	0.0837	0.0837	0.1586
Panel B: Causality from stock prices to GDP.							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0044***	1	0.0044***	0.0132**	0.1586	0.0132**	0.0044***
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1101
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**	0.8943
0.45	0.0044***	0.0044***	0.022**	0.0044***	0.0044***	0.2159	0.0044***
0.5	0.0705	0.0044***	0.0925	0.0044***	0.0132**	1	0.0044***
0.55	0.0044***	0.4185	0.1057	0.1145	0.8458	0.1278	0.0044***
0.6	0.0044***	0.8811	0.0264**	0.0088***	0.207	0.0881	0.0044***
0.65	0.0044***	0.1982	0.022**	0.0044***	0.0529	0.0044***	0.0044***
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0352**
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0441***
0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0573
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***

0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0837

Panel C: Causality from Inflation to stock prices.							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0044***	0.0044***	0.0132**	0.0132**	0.0044***	0.0044***	0.3128
0.1	0.1101	0.1145	0.1145	0.1189	0.1145	0.1101	0.4229
0.15	0.2511	0.1982	0.1498	0.2247	0.2026	0.2291	0.2115
0.2	0.348	0.326	0.3744	0.3524	0.348	0.3304	0.0044***
0.25	0.3436	0.3392	0.3568	0.3612	0.3568	0.3524	0.0308**
0.3	0.1498	0.1454	0.1542	0.1718	0.1586	0.1454	0.0132**
0.35	0.1189	0.1145	0.1145	0.1145	0.1145	0.1145	0.0044***
0.4	0.022**	0.022**	0.022**	0.0264**	0.0264**	0.0264**	0.0396**
0.45	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***
0.5	0.0529	0.0617	0.0573	0.0617	0.0617	0.0529	0.0044***
0.55	0.141	0.141	0.141	0.141	0.141	0.141	0.022**
0.6	0.1189	0.141	0.1233	0.141	0.141	0.1189	0.022**
0.65	0.0969	0.1057	0.0969	0.1057	0.1057	0.0925	0.1454
0.7	0.022**	0.0264**	0.022**	0.0264**	0.0264**	0.0264**	0.4273
0.75	0.0308**	0.0308**	0.0308**	0.0308**	0.0308**	0.022**	0.696
0.8	0.0661	0.0661	0.0661	0.0661	0.0661	0.0661	0.0793
0.85	0.1498	0.1454	0.1322	0.1498	0.141	0.0749	0.0396**
0.9	0.0925	0.0925	0.0925	0.0925	0.0925	0.0749	0.0308**
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1586
Panel D: Causality from stock prices to Inflation.							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0044***	0.0485**	0.0044***	0.0264**	0.0969	0.0044***	0.0044***
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1101
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.207
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.348
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.3568
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1586
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1145
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0264**
0.45	0.0044***	0.0044***	0.0132***	0.0044***	0.0044***	0.1057***	0.0088***
0.5	0.0705	0.0044***	0.1013	0.0044***	0.0044***	0.0573	0.0617
0.55	0.0044***	0.163	0.1057	0.1322	0.2996	0.0837	0.141
0.6	0.0044***	0.5066	0.0308**	0.0925	0.0396**	0.0881	0.141
0.65	0.0044***	0.3128	0.0044***	0.0044***	0.0529	0.0044***	0.106
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**	0.0044***	0.0264**
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0308**

0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0661
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.141
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0925
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***

Panel E: Causality from TRB to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0308**	0.0308**	0.0308**	0.0308**	0.0308**	0.0308**	0.4493
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.7225
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1806
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0573
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0485**
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0352
0.45	0.0749	0.0749	0.0749	0.0749	0.0749	0.0749	0.0088***
0.5	0.7357	0.7489	0.5771	0.7489	0.7489	0.7401	0.0044***
0.55	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.6	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0793
0.65	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2203
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.8502
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.6432
0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0396**
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0396**
0.9	0.2070	0.2070	0.2070	0.2070	0.2070	0.2070	0.0308**
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1366
Panel F: Causality from stock prices to TRB							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.05	0.0044***	0.6652	0.0044***	0.0132**	0.1586	0.0132**	0.0308**
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**	0.0044***
0.45	0.0044***	0.0044***	0.022**	0.0044***	0.0044***	0.185	0.0749
0.5	0.0700	0.0044***	0.1674	0.0044***	0.0132	1	0.7489
0.55	0.0044***	0.4405	0.1057	0.1057	0.8282	0.1013	0.0044***
0.6	0.0044***	0.8987	0.0264**	0.0088***	0.2026	0.0881	0.0088***
0.65	0.0044***	0.1894	0.0264**	0.0044***	0.0529	0.0044***	0.0044***

0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2070
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***

Panel G: Causality from M4 to stock prices.

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0661	0.0661	0.0661	0.0661	0.0661	0.0661	0.0044***
0.05	0.2203	0.2203	0.2203	0.2203	0.2203	0.2203	0.4493
0.1	0.1013	0.1013	0.1013	0.1013	0.1013	0.1013	0.6256
0.15	0.207	0.207	0.207	0.207	0.207	0.207	0.1806
0.2	0.2996	0.2247	0.304	0.2247	0.2247	0.2379	0.0573
0.25	0.0396**	0.0396**	0.0396**	0.0396**	0.0396**	0.0396**	0.0485
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132
0.35	0.022**	0.022**	0.022**	0.022**	0.022**	0.022**	0.0044***
0.4	0.2819	0.37	0.37	0.37	0.37	0.37	0.0352**
0.45	0.8943	0.7974	0.8282	0.7974	0.793	0.8458	0.0088***
0.5	1	0.5727	0.9163	0.5551	0.7048	1	0.0044***
0.55	0.2467	0.2467	0.2467	0.2467	0.2467	0.2467	0.0176**
0.6	0.1586	0.1586	0.1586	0.1586	0.1586	0.1586	0.1013
0.65	0.1322	0.1322	0.1322	0.1322	0.1322	0.1322	0.2203
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.8502
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.8194
0.8	0.0176**	0.0176**	0.0044***	0.0176**	0.0176**	0.0176**	0.0793
0.85	0.0176**	0.0176**	0.0176**	0.0176**	0.0176**	0.0176**	0.0396**
0.9	0.0396**	0.0396**	0.0396**	0.0396**	0.0396**	0.0396**	0.0308**
0.95	0.0308**	0.0308**	0.022**	0.0308**	0.0308**	0.0308**	0.1586

Panel H: Causality from stock prices to M4.

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0661
0.05	0.0044***	1	0.0044***	0.0132**	0.1586	0.0132**	0.2203
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.1013
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.207
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2247
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0396
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.022
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**	0.37
0.45	0.0044***	0.0044***	0.022**	0.0044***	0.0044***	0.2115	0.815
0.5	0.0705	0.0044***	0.0925	0.0044***	0.0132**	1	1
0.55	0.0044***	0.4185	0.1057	0.1145	0.8458	0.1278	0.2467

0.6	0.0044***	0.8811	0.0264**	0.0088***	0.207	0.0881	0.1586
0.65	0.0044***	0.1982	0.022**	0.0044***	0.0529	0.0044***	0.1322
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0176**
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0396**
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0308**

Panel I: Causality from Exchange rate to stock prices.

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0088***	0.0044***
0.05	1	1	0.5595	1	1	0.8018	0.4493
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.6256
0.15	0.0264**	0.0264**	0.0264**	0.0264**	0.0264**	0.0264**	0.1806
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0573
0.25	0.0793	0.0044***	0.0749	0.0044***	0.0044***	0.0793	0.0485**
0.3	0.0264**	0.0264**	0.0264**	0.0264**	0.0264**	0.0264**	0.0132**
0.35	0.3744	0.3744	0.3744	0.3744	0.3744	0.3744	0.0044***
0.4	0.0132**	0.0529	0.0529	0.0132**	0.0132**	0.0132**	0.0352**
0.45	0.0793	0.1057	0.1057	0.1057	0.1057	0.1057	0.0088***
0.5	0.63	0.6256	0.63	0.63	0.6256	0.63	0.0044***
0.55	0.3392	0.3216	0.3612	0.3392	0.3304	0.348	0.0176**
0.6	0.489	0.4714	0.4714	0.4846	0.4714	0.4714	0.1013
0.65	0.7885	1	0.793	1	1	0.696	0.2203
0.7	0.3436	0.2775	0.2952	0.4009	0.4581	0.2775	0.8502
0.75	0.0573	0.0573	0.0573	0.0573	0.0573	0.0573	0.8194
0.8	0.3436	0.4185	0.4978	0.5154	0.4802	0.5154	0.0793
0.85	0.326	0.2379	0.2996	0.2379	0.2379	0.2379	0.0396**
0.9	0.2115	0.2115	0.2115	0.2115	0.2115	0.2115	0.0308**
0.95	0.022**	0.022**	0.022**	0.022**	0.022**	0.022**	0.1586

Panel J: Causality from stock prices to Exchange rate.

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer Discretionary	Total index
0.05, 0.95]	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0088***
0.05	0.0044***	1	0.0044***	0.0132**	0.1586	0.0132**	1
0.1	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.15	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0264**
0.2	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.25	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***
0.3	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0264**
0.35	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.3744
0.4	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0132**	0.022**
0.45	0.0044***	0.0044***	0.022**	0.0044***	0.0044***	0.2115	0.1057
0.5	0.0705	0.0044	0.0925	0.0044***	0.0132**	1	0.6256
0.55	0.0044***	0.4185	0.1057	0.1145	0.8458	0.1278	0.3128

0.6	0.0044***	0.8811	0.0264**	0.0088***	0.207	0.0881	0.4714
0.65	0.0044***	0.1982	0.022**	0.0044***	0.0529	0.0044***	1
0.7	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.4714
0.75	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0573
0.8	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.3348
0.85	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2379
0.9	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.2115
0.95	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.0044***	0.022**

The table reports p-values for Troster's (2018) quantile causality test. Bold values indicate causality at 1% and 5% significance level and denoted by *** and ** respectively.

Table 11: Evidence for Troster's quantile causality test between macroeconomic variables and stock share prices before the global financial crisis from 1999-2007.

Panel A: Causality from GDP to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.05	**0.0141****	0.5775	0.2254	0.1127	0.0704	0.0282	0.4789
0.1	**0.0141****	0.7887	**0.0423****	0.1549	0.1268	**0.0141****	0.4366
0.15	**0.0141****	**0.0141****	**0.0141****	0.0704	**0.0141****	**0.0141****	0.5352
0.2	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.25	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1831
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2394
0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.169
0.4	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0845
0.45	0.1127	**0.0141****	0.3944	**0.0141****	**0.0141****	**0.0282****	**0.0141****
0.5	0.2254	**0.0141****	0.4366	**0.0141****	**0.0141****	0.3803	**0.0141****
0.55	**0.0141****	0.0563	**0.0423****	0.0563	**0.0423****	0.2676	**0.0282****
0.6	**0.0141****	0.9859	**0.0141****	**0.0423****	0.4648	**0.0141****	**0.0141****
0.65	**0.0141****	0.6479	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.7	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.4085
0.75	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.8169
0.8	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2535
0.85	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.9	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.95	**0.0141****	0.4366	0.0986	**0.0141****	0.2958	**0.0282****	**0.0141****

Panel B: Causality from stock prices to GDP							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0044*****
0.05	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0044*****
0.1	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0044*****
0.15	0.7887	0.7887	0.8169	0.7887	0.7887	0.7887	**0.0044*****
0.2	0.1972	0.1972	0.1972	0.1972	0.1972	0.1972	**0.0044*****
0.25	**0.0282****	0.0563	0.0563	0.0563	0.0563	0.0563	**0.0044*****
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0044*****

0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1101
0.4	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.8943
0.45	0.1268	0.1268	0.1268	0.0423**	0.1408	0.1268	**0.0044*****
0.5	0.3099	0.1127	0.3099	0.0986	0.338	0.2535	**0.0044*****
0.55	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0044*****
0.6	0.1831	0.1831	0.1831	0.1831	0.1831	0.1831	**0.0044*****
0.65	**0.0282****	**0.0282****	**0.0282****	**0.0282****	**0.0282****	**0.0282****	**0.0044*****
0.7	0.5211	0.5211	0.507	0.507	0.5211	0.5211	**0.0352****
0.75	0.0845	0.0845	0.0704	0.0845	0.0845	0.0845	**0.0441****
0.8	0.4789	0.7746	0.3239	0.662	0.7606	0.3099	0.0573
0.85	0.4366	0.4366	0.3239	0.4507	0.4366	0.4366	**0.0176****
0.9	0.1127	0.1127	0.1127	0.1127	0.1127	0.1127	**0.0044*****
0.95	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0837

Panel C: Causality from Inflation to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.05	**0.0141****	0.7887	0.2254	0.1127	0.0986	0.0845	0.4648
0.1	**0.0141****	0.7324	**0.0423****	0.2676	0.1831	**0.0141****	0.4366
0.15	**0.0141****	**0.0141****	**0.0141****	0.0704	**0.0141****	**0.0141****	0.2394
0.2	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.25	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1268
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1408
0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0282****
0.4	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0845
0.45	0.1127	**0.0141****	0.4648	**0.0141****	**0.0141****	0.0423	**0.0141****
0.5	0.1127	**0.0141****	0.6056	**0.0141****	**0.0141****	0.8169	**0.0141****
0.55	**0.0141****	0.2254	**0.0423****	**0.0282****	**0.0141****	0.2676	0.0986
0.6	**0.0141****	1	**0.0141****	0.1408	0.7183	**0.0141****	**0.0282****
0.65	**0.0141****	0.5634	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.7	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.5211
0.75	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.6761
0.8	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.3944
0.85	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.9	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1127
0.95	**0.0141****	0.4225	0.0563	**0.0141****	0.2958	**0.0423****	0.2254

Panel D: Causality from stock prices to Inflation							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	0.3239	0.3662	0.3239	**0.0077*****	0.3803	0.3239	**0.0141****
0.05	0.2676	0.3239	0.2113	0.0769	0.3099	0.3099	0.338

0.1	0.3944	0.5352	0.2817	**0.0077*** **	0.5211	0.3662	0.7042
0.15	0.831	0.831	0.8028	**0.0077*** **	0.8732	0.831	0.1549
0.2	0.6901	0.5493	0.5634	**0.0077*** **	0.6056	0.6056	0.5352
0.25	0.7606	0.7183	0.7465	**0.0077*** **	0.7465	0.6761	0.4789
0.3	0.2958	0.2958	0.2113	**0.0077*** **	0.2958	0.2394	0.4789
0.35	0.507	0.5211	0.5634	**0.0077*** **	0.5634	0.507	0.1549
0.4	0.4507	0.4225	0.4225	**0.0077*** **	0.4507	0.4085	0.169
0.45	0.5352	0.5634	0.5352	**0.0077*** **	0.5634	0.4789	0.0986
0.5	0.338	0.2958	0.338	**0.0077*** **	0.3099	0.2817	0.1831
0.55	0.2535	0.2676	0.2535	**0.0077*** **	0.2676	0.2676	0.0986
0.6	0.2676	0.3099	0.2535	**0.0077*** **	0.2817	0.2817	0.0141
0.65	0.1408	0.2113	0.2113	**0.0077*** **	0.2113	0.2113	0.1127
0.7	0.507	0.5775	0.5775	**0.0077*** **	0.5775	0.5493	0.0423
0.75	0.6338	0.662	0.6479	**0.0077*** **	0.662	0.662	0.0308
0.8	0.5493	0.4789	0.5775	**0.0077*** **	0.493	0.493	0.0661
0.85	0.4085	0.338	0.4085	**0.0077*** **	0.338	0.4085	0.141
0.9	0.1831	0.1831	0.1831	**0.0154** **	0.1831	0.1831	0.0925
0.95	0.6197	0.6056	0.6197	0.2385	0.6197	0.6197	**0.0044** **

Panel E: Causality from TRB to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **
0.05	**0.0141** **	0.3803	0.2254	0.1127	0.0704	**0.0282** **	0.4789
0.1	**0.0141** **	0.7887	**0.0423** **	0.1549	0.1268	**0.0141** **	0.4366
0.15	**0.0141** **	**0.0141** **	**0.0141** **	0.0704	**0.0141** **	**0.0141** **	0.5352
0.2	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0423** **
0.25	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.1831
0.3	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.2394
0.35	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.169
0.4	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.0845
0.45	0.1127	**0.0141** **	0.3944	**0.0141** **	**0.0141** **	**0.0282** **	**0.0141** **
0.5	0.2254	**0.0141** **	0.4366	**0.0141** **	**0.0141** **	0.3803	**0.0141** **
0.55	**0.0141** **	0.0563	**0.0423** **	0.0563	**0.0423** **	0.2676	**0.0282** **
0.6	**0.0141** **	0.9859	**0.0141** **	**0.0423** **	0.4648	**0.0141** **	**0.0141** **
0.65	**0.0141** **	0.6479	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0423** **
0.7	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.4085
0.75	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.8169
0.8	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	0.2535
0.85	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **
0.9	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **	**0.0141** **
0.95	**0.0141** **	0.4366	0.0986	**0.0141** **	0.2958	**0.0282** **	**0.0141** **

Panel F: Causality from stock prices to TRB

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.05	1	1	1	1	1	1	1
0.1	0.8169	0.8169	0.7887	0.8169	0.8169	0.7606	0.8169
0.15	0.493	0.0704	0.493	0.3803	0.0704	0.0704	0.1268
0.2	0.4648	0.2676	0.4648	0.5352	0.2676	0.2113	0.338
0.25	0.6901	0.6901	0.6901	0.6901	0.6901	0.6901	0.6901
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.4	0.0845	0.0845	0.0845	0.0845	0.0845	0.0845	0.0845
0.45	0.2676	0.4789	0.2676	0.5634	0.4507	0.2676	0.3944
0.5	0.831	0.7746	0.831	0.7183	0.7746	0.7746	0.7746
0.55	0.6338	0.493	0.7042	0.4789	0.5352	0.6338	0.4789
0.6	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****
0.65	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****	**0.0423****
0.7	0.3803	0.3803	0.3803	0.3803	0.3803	0.3803	0.3803
0.75	0.1408	0.1408	0.1408	0.1408	0.1408	0.1408	0.1268
0.8	**0.0141****	**0.0141****	0.0986	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.85	0.4366	0.0563	0.4366	0.2254	0.0563	0.0845	0.0563
0.9	0.5352	0.5211	0.6761	0.8028	0.5915	0.5211	0.5493
0.95	0.3944	0.3944	0.3944	0.3944	0.3944	0.3944	0.3944

Panel G: Causality from M4 to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.05	**0.0141****	0.5775	0.2254	0.1127	0.0704	**0.0282****	0.4789
0.1	**0.0141****	0.7887	**0.0423****	0.1549	0.1268	**0.0141****	0.4366
0.15	**0.0141****	**0.0141****	**0.0141****	0.0704	**0.0141****	**0.0141****	0.5352
0.2	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.25	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1831
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2394
0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.169
0.4	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0845
0.45	0.1127	**0.0141****	0.3944	**0.0141****	**0.0141****	**0.0282****	**0.0141****
0.5	0.2254	**0.0141****	0.4366	**0.0141****	**0.0141****	0.3803	**0.0141****
0.55	**0.0141****	0.0563	**0.0423****	0.0563	**0.0423****	0.2676	**0.0282****
0.6	**0.0141****	0.9859	**0.0141****	**0.0423****	0.4648	**0.0141****	**0.0141****
0.65	**0.0141****	0.6479	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.7	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.4085
0.75	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.8169
0.8	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2535
0.85	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****

0.9	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.95	**0.0141****	0.4366	0.0986	**0.0141****	0.2958	**0.0282****	**0.0141****

Panel H: Causality from stock prices to M4							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	0.8169	0.9437	0.831	0.8451	0.9437	0.9155	0.9437
0.05	0.662	0.662	0.662	0.662	0.662	0.662	0.662
0.1	0.7324	0.4225	0.5915	0.4225	0.4225	0.4225	0.4225
0.15	0.2958	0.7042	0.6197	0.6197	0.7042	0.6056	0.7042
0.2	0.493	0.5352	0.4366	0.4225	0.4366	0.4085	0.4085
0.25	0.3944	0.8169	0.7606	0.8169	0.8169	0.7746	0.8169
0.3	0.6901	1	1	0.662	1	0.8592	1
0.35	0.3662	0.3803	0.3662	0.3662	0.3662	0.3662	0.3662
0.4	0.3944	0.3944	0.3944	0.3944	0.3944	0.3803	0.3944
0.45	0.7324	1	1	0.6197	1	0.7183	1
0.5	0.4366	0.4366	0.4366	0.4366	0.4366	0.4366	0.4366
0.55	0.5775	0.6056	0.6479	0.6056	0.5915	0.5915	0.5915
0.6	0.0704	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0282	**0.0141****
0.65	0.5211	0.3803	0.4366	0.4366	0.3803	0.5211	0.3803
0.7	0.7324	0.5634	0.6056	0.5634	0.5775	0.7887	0.5634
0.75	0.5211	0.4366	0.4366	0.4366	0.4366	0.4366	0.4366
0.8	0.507	0.507	0.3944	0.507	0.507	0.507	0.507
0.85	0.1127	0.1127	0.3662	0.1127	0.1127	0.1127	0.1127
0.9	0.507	0.507	0.5634	0.507	0.507	0.507	0.507
0.95	0.4648	0.6479	0.493	0.6479	0.6479	0.5775	0.6479

Panel I: Causality from Exchange rate to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.05	**0.0141****	0.5775	0.2254	0.1127	0.0704	**0.0282****	0.4789
0.1	**0.0141****	0.7887	**0.0423****	0.1549	0.1268	**0.0141****	0.4366
0.15	**0.0141****	**0.0141****	**0.0141****	0.0704	**0.0141****	**0.0141****	0.5352
0.2	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****
0.25	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.1831
0.3	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2394
0.35	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.169
0.4	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.0845
0.45	0.1127	**0.0141****	0.3944	**0.0141****	**0.0141****	**0.0282****	**0.0141****
0.5	0.2254	**0.0141****	0.4366	**0.0141****	**0.0141****	0.3803	**0.0141****
0.55	**0.0141****	0.0563	**0.0423****	0.0563	**0.0423****	0.2676	**0.0282****
0.6	**0.0141****	0.9859	**0.0141****	**0.0423****	0.4648	**0.0141****	**0.0141****
0.65	**0.0141****	0.6479	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0423****

0.7	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.4085
0.75	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.8169
0.8	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	0.2535
0.85	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.9	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.95	**0.0141****	0.4366	0.0986	**0.0141****	0.2958	**0.0282****	**0.0141****

Panel J: Causality from stock prices to Exchange rate							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	0.8592	0.8873	0.9014	0.8873	0.8873	0.8732	0.8873
0.05	0.4648	0.3803	0.2817	0.5493	0.2817	0.5634	0.6338
0.1	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****	**0.0141****
0.15	0.8732	0.8592	0.8732	0.8592	0.8592	0.8592	0.8592
0.2	0.662	0.8732	0.7183	1	0.831	0.662	0.831
0.25	0.6197	0.6197	0.6197	0.6197	0.6197	0.5915	0.6197
0.3	0.6761	0.9718	1	0.7183	0.6901	0.7746	1
0.35	0.2676	0.2817	0.507	0.3521	0.2676	0.2676	0.2676
0.4	0.1972	0.4789	0.2958	0.3099	0.3239	0.338	0.3239
0.45	0.7324	0.7324	0.7324	0.7324	0.7324	0.7324	0.7324
0.5	0.8451	0.8592	0.9296	0.8592	0.8451	0.8451	0.8451
0.55	0.5915	1	1	0.9155	1	0.6197	1
0.6	0.3521	0.7324	0.7465	0.7324	0.7324	0.7324	0.7324
0.65	0.831	0.7465	0.7042	0.6901	0.6338	0.6197	1
0.7	0.3662	0.3662	0.3662	0.3662	0.3662	0.2394	0.3662
0.75	0.4085	0.4085	0.4366	0.4085	0.4085	0.4225	0.4085
0.8	0.1972	0.2817	0.2113	0.3099	0.3239	0.3239	0.3239
0.85	0.3099	0.4085	0.4085	0.4085	0.4085	0.4085	0.3099
0.9	1	1	1	0.8169	1	1	1
0.95	0.5915	0.6056	0.2394	0.6056	0.6056	0.6056	0.6056

The table reports p-values for Troster's (2018) quantile causality test. Bold values indicate causality at 1% and 5% significance level and denoted by *** and ** respectively.

Table 12: Evidence for Troster's quantile causality test between macroeconomic variables and stock share prices after the global financial crisis from 2008 to 2022.

Panel A: Causality from GDP to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0462****	**0.0154****	0.4385	0.2308	0.4462	**0.0231****	**0.0077*****
0.05	0.6923	0.3846	0.4615	0.0615	0.3462	**0.0077*****	0.7077
0.1	0.0538	**0.0077*****	0.0154	0.6077	**0.0154****	**0.0077*****	0.6231
0.15	**0.0077*****	**0.0077*****	0.0769	0.1385	0.1923	**0.0077*****	**0.0077****
0.2	0.1	**0.0077*****	**0.0154****	0.4769	0.0615	**0.0077*****	0.1923
0.25	**0.0077*****	**0.0077*****	**0.0154****	0.3538	**0.0077*****	**0.0077*****	**0.0077*****
0.3	0.3	0.1231	0.4923	0.7462	1	**0.0308****	0.1538

0.35	**0.0462****	0.3385	1	1	0.5154	0.1923	0.1077
0.4	0.2692	0.6077	1	0.2231	0.3615	0.2	0.3769
0.45	0.4077	0.2385	0.6385	0.0538	0.3923	0.5154	0.1923
0.5	1	0.4231	0.5769	**0.0154****	1	1	**0.0077*****
0.55	0.6615	1	1	0.1231	1	1	0.3769
0.6	0.3846	0.7	**0.0077*****	0.5077	0.3846	0.6692	0.6077
0.65	0.3538	0.0538	0.0692	0.6769	0.6462	0.7538	0.5769
0.7	0.0538	0.4538	0.8769	0.2308	0.6385	0.2769	0.4692
0.75	**0.0154****	0.7154	0.7385	0.7231	0.8231	**0.0385****	0.5231
0.8	0.1692	**0.0077*****	0.6769	0.7846	0.3923	**0.0154****	0.1615
0.85	**0.0077*****	0.1769	0.4769	0.7692	0.4	**0.0154****	**0.0077*****
0.9	0.2538	**0.0385****	0.7385	0.6846	**0.0385****	**0.0077*****	0.2077
0.95	**0.0308****	0.2	**0.0077*****	**0.0077*****	**0.0077*****	0.2538	0.1154

Panel B: Causality from stock prices to GDP							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.05	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.1	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.15	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.2	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.25	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.3	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.35	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.4	0.3308	0.3308	0.3308	0.3308	0.3308	0.3308	0.3308
0.45	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615
0.5	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.55	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.6	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.65	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.7	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.75	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.8	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.85	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.9	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.95	0.1923	0.1923	0.1923	0.1923	0.1923	0.1923	0.1923

Panel C: Causality from Inflation to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	0.0538	**0.0077*****	0.5154	0.2538	0.1538	**0.0077*****	0.0538
0.05	0.8385	0.3385	0.4769	0.4692	0.6769	**0.0077*****	0.7077

0.1	**0.0462****	**0.0077*****	**0.0154****	0.6231	0.0154	**0.0077*****	0.8154
0.15	**0.0077*****	**0.0077*****	0.0615	0.1308	0.1	**0.0077*****	0.1231
0.2	0.0923	**0.0077*****	**0.0154****	0.3692	0.0154	**0.0077*****	0.1308
0.25	**0.0077*****	**0.0077*****	**0.0154****	0.5615	**0.0077*****	**0.0077*****	**0.0077*****
0.3	0.2308	**0.0077*****	0.5692	0.6308	0.6385	**0.0077*****	0.0769
0.35	**0.0462****	0.2154	0.7923	0.6462	0.4385	0.0923	0.1
0.4	0.1385	0.2308	0.7923	0.2538	0.0308	0.1077	0.3308
0.45	0.3385	**0.0385****	0.7231	**0.0385****	0.1462	0.7231	0.2154
0.5	0.6692	0.2308	0.6692	**0.0077*****	0.5538	0.7538	**0.0077*****
0.55	0.6769	0.5769	0.7077	**0.0462****	0.6385	0.5231	0.2308
0.6	0.4692	0.5923	0.0769	0.4615	0.2769	0.7769	0.3538
0.65	0.4615	0.0538	0.2769	0.6385	0.3923	0.8231	0.5538
0.7	0.2077	0.5154	0.8077	0.2615	0.6385	0.2923	0.7077
0.75	0.0769	0.7385	0.6385	0.7692	0.7308	**0.0385****	0.7308
0.8	0.2231	**0.0077*****	0.6923	0.7769	0.3923	**0.0308****	0.2692
0.85	**0.0154****	0.2077	0.4846	0.5923	0.4	0.0769	**0.0077*****
0.9	0.4	**0.0385****	0.8538	0.6	**0.0385****	**0.0077*****	0.2769
0.95	0.1385	0.2	**0.0077*****	0.0923	**0.0077*****	0.2538	0.1538

Panel D: Causality from stock prices to Inflation							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0077*****	**0.0077*****	**0.0077*****	0.3803	**0.0077*****	**0.0077*****	0.2769
0.05	0.0769	0.0769	0.0769	0.3239	0.0769	**0.0077*****	0.2231
0.1	**0.0077*****	**0.0077*****	**0.0077*****	0.3099	**0.0077*****	**0.0077*****	0.1154
0.15	**0.0077*****	**0.0077*****	**0.0077*****	0.8169	**0.0077*****	**0.0077*****	0.7231
0.2	**0.0077*****	**0.0077*****	**0.0077*****	0.5915	**0.0077*****	**0.0077*****	0.3846
0.25	**0.0077*****	**0.0077*****	**0.0077*****	0.831	**0.0077*****	**0.0077*****	0.3615
0.3	**0.0077*****	**0.0077*****	**0.0077*****	0.338	**0.0077*****	**0.0077*****	**0.0308****
0.35	**0.0077*****	**0.0077*****	**0.0077*****	0.5493	**0.0077*****	**0.0077*****	0.0769
0.4	**0.0077*****	**0.0077*****	**0.0077*****	0.3662	**0.0077*****	**0.0077*****	0.0769
0.45	**0.0077*****	**0.0077*****	**0.0077*****	0.5775	**0.0077*****	0.3615	0.2538
0.5	**0.0077*****	**0.0077*****	**0.0077*****	0.3239	**0.0077*****	**0.0077*****	0.2692
0.55	**0.0077*****	**0.0077*****	**0.0077*****	0.2676	**0.0077*****	**0.0077*****	0.3462
0.6	**0.0077*****	**0.0077*****	**0.0077*****	0.3099	**0.0077*****	**0.0077*****	0.3538
0.65	**0.0077*****	**0.0077*****	**0.0077*****	0.2113	**0.0077*****	**0.0077*****	0.2692
0.7	**0.0077*****	**0.0077*****	**0.0077*****	0.5775	**0.0077*****	**0.0077*****	0.4
0.75	**0.0077*****	**0.0077*****	**0.0077*****	0.6479	**0.0077*****	**0.0077*****	0.5077
0.8	**0.0077*****	**0.0077*****	**0.0077*****	0.493	**0.0077*****	**0.0077*****	0.2615
0.85	**0.0077*****	**0.0077*****	**0.0077*****	0.338	**0.0077*****	**0.0077*****	0.0615
0.9	**0.0154****	**0.0154****	**0.0154****	0.1831	**0.0154****	**0.0077*****	**0.0462****
0.95	0.2385	0.2385	0.2385	0.6197	0.2385	**0.0077*****	**0.0154****

Panel E: Causality from TRB to stock prices

	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0462****	**0.0154****	0.4077	0.2231	0.3769	**0.0231****	**0.0154****
0.05	0.6923	0.3846	0.4615	0.0615	0.3692	**0.0077*****	0.7077
0.1	0.0846	**0.0077*****	0.0154	0.6	0.0154	**0.0077*****	0.4538
0.15	**0.0154****	**0.0077*****	0.0769	0.1385	0.2077	**0.0077*****	**0.0077*****
0.2	0.1	**0.0077*****	**0.0077*****	0.4692	0.0615	**0.0077*****	0.1923
0.25	**0.0077*****	**0.0077*****	0.0154	0.3615	0.0615	**0.0077*****	**0.0077*****
0.3	0.3077	0.1231	0.5077	0.6154	1	**0.0308****	0.1538
0.35	**0.0462****	0.3385	0.9462	0.5846	0.5385	0.1923	0.1077
0.4	0.2692	0.6077	0.9769	0.1923	0.3615	0.2154	0.3769
0.45	0.4077	0.2385	0.6692	0.0538	0.3923	0.5308	0.1923
0.5	1	0.4538	0.6231	**0.0154****	1	1	**0.0077*****
0.55	0.6615	1	0.9846	0.1231	1	1	0.3769
0.6	0.3769	0.7077	**0.0077*****	0.5	0.5231	0.4	0.6154
0.65	0.3	0.0615	0.0692	0.6769	0.6231	0.6077	0.5769
0.7	0.0538	0.4308	0.7231	0.2308	0.7615	0.2769	0.3769
0.75	0.0769	0.7308	0.7462	0.5846	0.8231	**0.0154****	0.5154
0.8	0.1692	**0.0077*****	0.7077	0.7846	0.3462	**0.0154****	0.1385
0.85	0.0154	0.1769	0.4769	0.7692	0.3077	**0.0385****	0.0769
0.9	0.2538	**0.0385****	0.7385	0.6615	**0.0077*****	**0.0077*****	0.2077
0.95	**0.0308****	0.2	**0.0077*****	**0.0077*****	**0.0077*****	0.2538	0.1308

Panel F: Causality from stock prices to TRB							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.05	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.1	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.15	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.2	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.25	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.3	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.35	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.4	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.45	**0.0154****	**0.0154****	**0.0154****	**0.0154****	**0.0154****	**0.0154****	**0.0154****
0.5	0.3462	0.3462	0.3462	0.3462	0.3462	0.3462	0.3462
0.55	0.0615	0.0615	0.0615	0.0615	0.0615	0.0615	0.0615
0.6	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.65	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.7	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.75	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.8	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****
0.85	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****	**0.0077*****

0.9	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.95	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **

Panel G: Causality from M4 to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0462** **	**0.0154** **	0.4385	0.2308	0.4462	**0.0231** **	**0.0154** **
0.05	0.6923	0.3846	0.4615	0.0615	0.3462	**0.0077*** **	0.7077
0.1	0.0538	**0.0077*** **	**0.0154** **	0.6	**0.0154** **	**0.0077*** **	0.4538
0.15	**0.0077*** **	**0.0077*** **	0.0769	0.1385	0.1923	**0.0077*** **	**0.0077*** **
0.2	0.1	**0.0077*** **	**0.0154** **	0.4769	0.0615	**0.0077*** **	0.1923
0.25	**0.0077*** **	**0.0077*** **	**0.0154** **	0.3538	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.3	0.3	0.1231	0.4923	0.7462	1	**0.0308** **	0.1538
0.35	**0.0462** **	0.3385	1	1	0.5154	0.1923	0.1077
0.4	0.2692	0.6077	1	0.2231	0.3615	0.2	0.3769
0.45	0.4077	0.2385	0.6385	0.0538	0.3923	0.5154	0.1923
0.5	1	0.4231	0.5769	**0.0154** **	1	1	**0.0077*** **
0.55	0.6615	1	1	0.1231	1	1	0.3769
0.6	0.3846	0.6923	0.0077***	0.5077	0.3846	0.6692	0.6154
0.65	0.3538	0.0538	0.0692	0.6769	0.6462	0.7538	0.5769
0.7	0.0538	0.4538	0.8923	0.2308	0.6385	0.2769	0.3769
0.75	0.0154	0.7154	0.7385	0.7231	0.8231	**0.0385** **	0.5154
0.8	0.1692	**0.0077*** **	0.6769	0.7846	0.3923	**0.0154** **	0.1385
0.85	**0.0077*** **	0.1769	0.4769	0.7692	0.4	**0.0154** **	0.0769
0.9	0.2538	**0.0385** **	0.7385	0.6846	**0.0385** **	**0.0077*** **	0.2077
0.95	**0.0308** **	0.2	**0.0077*** **	**0.0077*** **	**0.0077*** **	0.2538	0.1308

Panel H: Causality from stock prices to M4							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.05	0.2615	0.2615	0.2615	0.2615	0.2615	0.2615	0.2615
0.1	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.15	0.1385	0.1385	0.1385	0.1385	0.1385	0.1385	0.1385
0.2	0.1231	0.1231	0.1231	0.1231	0.1231	0.1231	0.1231
0.25	0.1154	0.1154	0.1154	0.1154	0.1154	0.1154	0.1154
0.3	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.35	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **
0.4	0.1462	0.1462	0.1462	0.1462	0.1462	0.1462	0.1462
0.45	0.9769	0.9923	0.8923	1	1	0.9692	1
0.5	0.1462	0.1462	0.1462	0.1462	0.1462	0.1462	0.1462
0.55	0.3	0.3	0.3	0.3	0.3	0.3	0.3
0.6	0.0846	0.0846	0.0846	0.0846	0.0846	0.0846	0.0846
0.65	0.0692	0.0692	0.0692	0.0692	0.0692	0.0692	0.0692

0.7	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.75	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.8	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.85	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.9	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.95	0.6077	0.5538	0.5538	0.5538	0.5538	0.5538	0.5538

Panel I: Causality from Exchange rate to stock prices							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0462** **	**0.0154** **	0.4385	0.2308	0.4462	**0.0231** **	**0.0077*** **
0.05	0.6923	0.3846	0.4615	0.0615	0.3462	**0.0077*** **	0.7077
0.1	0.0538	**0.0077*** **	**0.0154** **	0.6077	**0.0154** **	**0.0077*** **	0.6231
0.15	**0.0077*** **	**0.0077*** **	0.0769	0.1385	0.1923	**0.0077*** **	**0.0077*** **
0.2	0.1	**0.0077*** **	**0.0154** **	0.4769	0.0615	**0.0077*** **	0.1923
0.25	**0.0077*** **	**0.0077*** **	**0.0154** **	0.3538	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.3	0.3	0.1231	0.4923	0.7462	1	**0.0308** **	0.1538
0.35	**0.0462** **	0.3385	1	1	0.5154	0.1923	0.1077
0.4	0.2692	0.6077	0.9846	0.2231	0.3615	0.2	0.3769
0.45	0.4077	0.2385	0.6385	0.0538	0.3923	0.5154	0.1923
0.5	1	0.4231	0.5769	**0.0154** **	1	1	**0.0077*** **
0.55	0.6615	1	1	0.1231	1	1	0.3769
0.6	0.3846	0.7	**0.0077*** **	0.5077	0.3846	0.6692	0.6077
0.65	0.3538	0.0538	0.0692	0.6769	0.6462	0.7538	0.5769
0.7	0.0538	0.4538	0.9077	0.2308	0.6385	0.2769	0.4692
0.75	**0.0308** **	0.7154	0.7385	0.7231	0.8231	0.0385	0.5231
0.8	0.1692	**0.0077*** **	0.6769	0.7846	0.3923	**0.0154** **	0.1615
0.85	**0.0077*** **	0.1769	0.4769	0.7692	0.4	0.0154	**0.0077*** **
0.9	0.2538	**0.0385** **	0.7385	0.6846	**0.0385** **	**0.0077*** **	0.2077
0.95	**0.0308** **	0.2	**0.0077*** **	**0.0077*** **	**0.0077*** **	0.2538	0.1154

Panel J: Causality from stock prices to Exchange rate							
	Energy	Industrial	Material	Utilities	Consumer Stapples	Consumer discretionary	Total index
0.05, 0.95]	**0.0231** **	**0.0231** **	**0.0231** **	**0.0231** **	**0.0231** **	**0.0231** **	**0.0231** **
0.05	0.6462	0.3462	0.3462	0.3462	0.3462	0.3462	0.3462
0.1	0.8231	0.8231	0.2692	0.8231	0.8231	0.8231	0.8231
0.15	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.2	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.25	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **	**0.0154** **
0.3	0.1538	0.1538	0.1538	0.1538	0.1538	0.1538	0.1538
0.35	0.1077	0.1077	0.1077	0.1077	0.1077	0.1077	0.1077
0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.45	**0.0462** **	**0.0462** **	**0.0462** **	**0.0462** **	**0.0462** **	**0.0769**	**0.0462** **

0.5	1	1	0.6462	1	1	1	1
0.55	1	1	1	1	1	1	1
0.6	0.7231	0.7231	0.7231	0.7231	0.7231	0.7231	0.7231
0.65	0.2385	0.2385	0.2385	0.2385	0.2385	0.2385	0.2385
0.7	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615	0.1615
0.75	0.0538	0.0538	0.0538	0.0538	0.0538	0.0538	0.0538
0.8	0.9154	0.8154	0.6769	0.9846	0.8692	0.7385	0.7538
0.85	0.7308	0.7308	0.7308	0.7308	0.7308	0.7308	0.7308
0.9	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **
0.95	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **	**0.0077*** **

The table reports p-values for Troster's (2018) quantile causality test. Bold values indicate causality at 1% and 5% significance level and denoted by *** and ** respectively.