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THE RELATIONSHIPS BETWEEN THE GLOBAL SUPPLY CHAIN AND THE STOCK MARKETS OF DEVELOPED AND EMERGING COUNTRIES: SECTORAL VIEW

Serap KAMIŞLI[1]

Abstract

The study aims to determine the long-run relationships between the increases in the global supply chain pressure index (GSCPI) and the decreases in different sector indices of developed and emerging markets. For this purpose, the relationships between GSCPI and 8 different sectors of 18 developed and emerging markets were first analyzed by Bayer & Hanck (2013) Combined Cointegration Test and then by Özer et al. (2024) Implicit Asymmetric Combined Cointegration Test. The results of the study indicated long-run relationships between the increases in GSCPI and the decreases in different sector indices of many countries. The most important finding of the study is that the decreases in the sector indices of emerging countries are more related with the increases in GSCPI in the long run compared to developed countries. Another important finding of the study is that the decreases in the communication, industry and technology sector indices are related with the increases in global supply chain pressure in the long run, then the other sector indices. The study provides investors important information about the differentiated relationships between global supply chain pressure and the stock indices at both country and sectoral basis, that they can use in portfolio management decisions.

Keywords: The Global Supply Chain Pressure Index, Negative shocks, Implicit Asymmetric Combined Cointegration

JEL Codes: F30, C50, G11

[1] Dr. Öğr. Üyesi, Bilecik Şeyh Edebali Üniversitesi, Uygulamalı Bilimler Fakültesi, serap.kamisli@bilecik.edu.tr, https://orcid.org/0000-0002-4714-6678

INTRODUCTION

The global supply chain is one of the most complex and dynamic issues in modern economies. With the development of production processes and international trade due to globalization, the countries that the companies supply the raw materials, intermediate goods and products differ. This situation, on the one hand provides companies cost advantage in production processes, and on the other hand provides flexibility in supply. However, rapidly globalizing trade networks and technological developments also cause supply chains to become more integrated and interdependent, and cause production or supply disruptions in one country to create fluctuations on a global scale. In this context, monitoring the developments in the global supply chain and supply management has critical importance for companies. It becomes mandatory for governments also to follow the global supply chain for international trade to take place through international agreements and for decision makers to take the necessary actions. The global supply chain plays a major role in economic stability, especially in terms of cost reduction and resource optimization. The global supply chain gives companies the opportunity of reducing production costs and enables products to reach a wider market. In other words, with the decrease in costs and the acceleration of trade, the prices of the products offered to consumers decrease and this supports economic growth by increasing sales. At the same time, the supply chain greatly affects capital flows and, so the financial system. The development of international trade is an important factor that directly affects the decisions of investors and financial institutions. Maintaining the general balance of supply and demand and the development of international trade plays a key role in a stable financial system. Disruptions in the global supply chain have the power to seriously affect the cash flows, production processes and financial performance of the companies (Hupka, 2022).

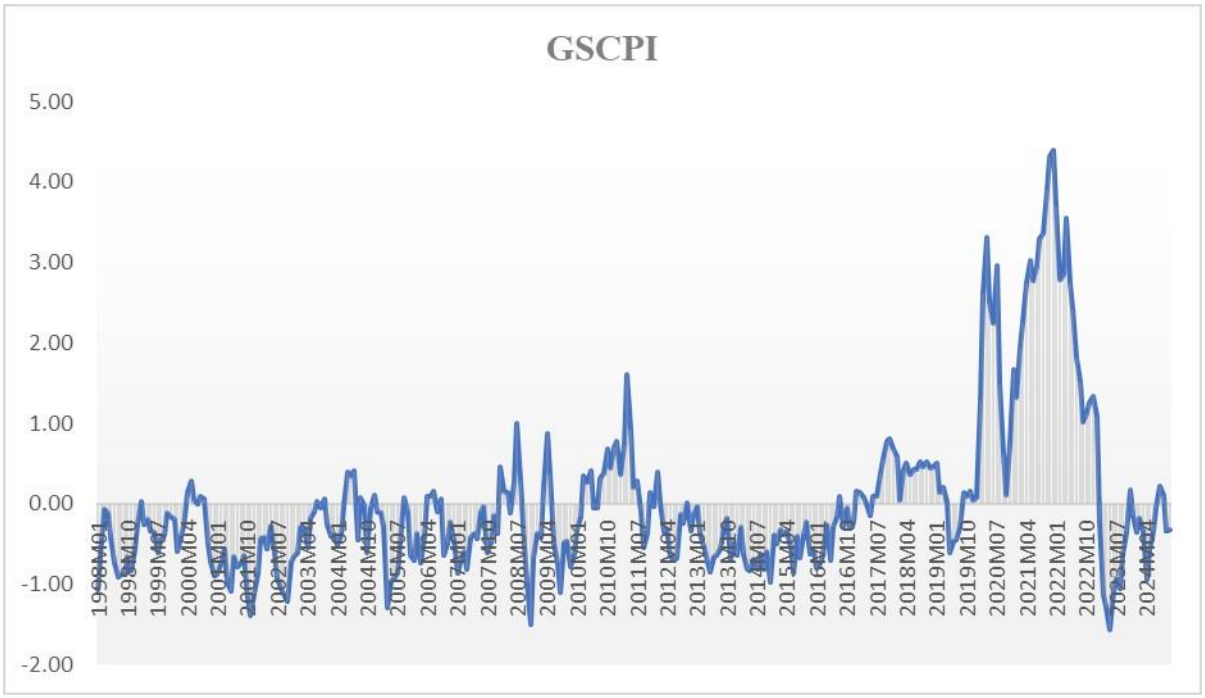
Problems experienced in the global supply chain negatively affect the activities of companies and the performance of the companies operating in different sectors. Disruptions in the supply chain are often caused by a variety of factors, such as transportation delays, production shortages or increased raw material costs. In addition, external shocks such as natural disasters, political uncertainties, wars, pandemics and cyber security problems may cause production to stop and, accordingly, disruption of the global supply chain (Kanike, 2023, p. 1). This situation basically leads increases in production costs by making difficult companies to access raw materials or intermediate goods. In addition, the problems in transportation and logistics processes prevent products from reaching the consumer on time. In other words, as a result of the disruption of the global supply chain, companies may not be able to respond to customer demands in the desired time and may cause customer loss. Disruptions in the global supply chain create more pronounced consequences, especially in sectors that have a complex structure and are sensitive in terms of the timing of production and delivery, such as automotive, electronics, food and pharmaceuticals (Tarigan et al., 2021;

Xu et al., 2020, p. 155-157). Problems in the global supply chain also have significant effects on financial markets and especially stock prices/returns. The disruptions in the supply processes cause negative effects on the profitability of the companies, due to the decrease in their production capacity and sales. This situation is also ultimately reflected in stock prices as a result of the deteriorating financial performance of the companies (Baghersad & Zobel, 2021). Supply chain problems have the potential to create rapid and large fluctuations in stock prices, especially in sectors whose production processes are highly dependent on supply chains. For example, in the automotive industry, supply chain disruption may increase production costs by causing production line delays, and this situation may lead to decreases in the company's stock prices (Arto, et al., 2015, p. 306). Similarly, companies operating in the technology sector are also negatively affected by the problems in the supply of critical components such as microchips. Therefore, it is very important for the investors to determine the different effects of the problems in the global supply chain on a sectoral basis.

Indices have been developed, such as the Baltic Dry Index and the Harpex Freight Index, in order to monitor and analyze the negative effects caused by disruptions in the global supply chain. These indices provide information to companies, decision makers and investors about the intensity and scope of problems experienced in supply chains by bringing together various data. The Global Supply Chain Pressure Index (GSCPI), developed by the Federal Reserve Bank of New York, is a composite indicator designed to measure the degree of stress and disruptions in the global supply chain (Benigno et al., 2022, p. 3). GSCPI was created using principal component analysis, which allows bringing together various supply chain-related data, notably transportation costs, delivery times, inventory levels and regional supply chain stress measurements.

GSCPI is one of the most popular indices used to track pressures in the global supply chain. GSCPI fills a critical measurement gap in understanding the effect of exogenous shocks such as the COVID-19 pandemic, geopolitical tensions and trade wars on the global supply chain. The index numerically expresses the pressure on the global supply chain by evaluating factors such as changes in lead times, transportation costs and disruptions in production processes. Figure 1 shows the GSCPI chart for the period of January 1998-November 2024.

Figure 1: Global supply chain pressure index



Source: The Federal Reserve Bank of New York (n.d.)

As can be seen in Figure 1, there have been significant changes in GSCPI over the years due to factors such as global crises, natural disasters, geopolitical developments and pandemics. Events such as the 1998 Asian Financial Crisis, the 2001 Dot-Com Bubble and the September 11 Attacks, the 2002 Western American Port Strike, the 2003 SARS Outbreak, the 2008 Global Financial Crisis, the 2011 Japan Earthquake and the 2011 Thailand Flood, the 2015-2016 China Stock Exchange Crisis and the US-China Trade War caused changes in the index. Also, as a result of the 2020 COVID-19 pandemic and the 2022 Russia-Ukraine war, the pressure on the global supply chain have increased and a major change have occurred in GSCPI (Sim et al., 2024, p. 1-2).

The effects of problems occurring in the global supply chain on developed and developing markets may differ (Ağca et al., 2023). In developed economies, the effects of problems in supply chains are often noticed more quickly than in developing economies. In addition, since developed economies generally have flexible and diversified supply networks, their recovery takes less time. On the contrary, the effects of supply chain problems in developing economies are deeper and protracted. In developing economies, production processes are often more dependent on certain raw materials and external resources. Therefore, an interruption in the supply chain can affect the entire production. Depending on the complex structure of the

global supply chain, this situation can have serious consequences both in the developing country where the problem occurs and in the global markets. Increasing pressure on the global supply chain has a greater impact than decreasing pressure. Problems in supply chains often occur unexpectedly and suddenly, creating deep and protracted effects on companies. As the intensity of pressure increases, the operational flexibility of companies decreases and this becomes a risk factor for investors. Fixing the problems in the supply chain requires a longer-term process, and reducing the intensity of pressure does not always create positive effects at the same speed. Investors generally focus on the duration of supply problems, the loss to the company and the recovery process. Therefore, when there is an increase in pressure on the supply chain, the decrease in stock prices is sharper, while if the pressure decreases, the recovery in prices may be more limited or slower.

For investors, it is very important to determine the long-term relationships of the pressure in the global supply chain with different countries and sectors. Because investors have the opportunity to shape their portfolio allocation decisions by investing in different countries and sectors in order to avoid the negative effects of the increase in pressure. In this context, the main motivation of the study is to determine the long-term implicit relationships between the increase in pressure in the global supply chain and the decreases in different sector indices. There have been studies in the literature that investigates the short-term effects of problems in supply chains with the event study approach (Baghersad & Zobel, 2021; Hendricks & Singhal, 2005; Liu et al., 2018; Liu et al., 2023), and in the most studies based on GSCPI the relationships between disruptions in the global supply chain and macroeconomic variables and commodities were analyzed (Ascari et al., 2024; Gozgor et al., 2023; Hernández et al., 2024; Li et al., 2023; Mrabet et al., 2025; Qin et al., 2023; Qin et al., 2024; Ren et al., 2024; Romero-Ramírez, 2024; Trif et al., 2024; Ye et al., 2023). But studies addressing the relationships between global supply chain disruptions and stock prices/returns based on GSCPI are quite limited (Hu et al., 2024; Sim et al., 2024; Wang et al., 2025). For investors investing in different sector indices for portfolio diversification, it is not sufficient to identify the relationships between GSCPI and the stock market. The long-term relationships between GSCPI and different sectors should be determined in order to develop effective portfolio management strategies. In addition, sectors in developed and emerging markets are not equally affected by pressures in the supply chain, and increasing or decreasing pressure on the global supply chain also causes effects at different levels. Therefore, determining the long-term relationships between GSCPI and different sector indices, depending on development level of countries, has crucial importance for portfolio and risk management strategies. In this context, the study aims to determine the long-term relationships between the increase in pressure in the global supply chain and the decreases in different sector indices, based on developed and developing markets. For this purpose, long-term relationships between GSCPI and 8 different sectors of 18 developed and emerging markets were

analyzed firstly with Bayer and Hanck (2013) Combined Cointegration test and then with the Implicit Asymmetric Combined Cointegration test developed by Özer et al. (2024). In addition to the main purpose determined, the following research questions are also sought to answer for a better understanding of the relationships;

• The decreases in which of the sector indices have relationships with the increases in the Global Supply Chain Pressure Index in the long term?

• Do the relationships between the increase in the Global Supply Chain Pressure Index and the decreases in sector indices differ according to development level of the market?

It is planned to provide detailed information to both investors in terms of risk and portfolio management strategies and decision makers in terms of evaluating the country and sectoral effects of global supply chain problems.

LITERATURE REVIEW

In studies addressing the effects of the problems occurring in the global supply chain on financial markets, there are generally two main approaches; consideration of different indices representing problems in the supply chain and the event studies for determining short-term effects. The event study approach has been applied in many studies examining the relationship between supply chain disruptions and the financial performance or stock returns of the companies (Baghersad & Zobel, 2021; Hendricks & Singhal, 2005; Liu et al., 2018; Liu et al., 2023). In their study, Baghersad and Zobel (2021) investigated the short-term effects of supply chain disruptions on the operations and stock market performances of companies for the period of 2005-2014 period. The study revealed that supply chain disruptions caused a significant decrease in companys' sales, operating income, sales profitability and asset profitability. It was also shown that supply chain disruptions are negatively related to abnormal returns on the day the disruptions are announced. Liu et al. (2018) examined the reaction of stock prices to supply chain disruptions in Japan and the USA between 2000 and 2013 with an event study. The study indicated negative relationships between disruption announcements and negative abnormal stock returns. The results also indicated that this relationship differs in time for companies operating in Japan and the USA. Hendricks and Singhal (2005) analyzed the long-term effects of supply chain disruptions on stock prices for the period of 1989 and 2000. As a result of the study based on 827 disruptions announcements, a significant decrease in the abnormal returns of companies experiencing supply problems was detected. In addition, it was determined that companies cannot quickly recover from the negative effects of supply chain disruptions, and it was revealed that the risk in stocks increases significantly around the disruption announcement date. Liu et al. (2023) investigated the impact

of supply chain quality efficiency announcements on the stock market value of companies in China between January 1, 2010 and December 31, 2021, with an event study approach. The study was based on 118 announcements and it was shown that supply chain quality effectiveness announcements had a negative impact on shareholder value.

Some of the recent studies investigating supply chain disruptions with an event study approach have focused on the effects of supply chain problems arising from the COVID-19 pandemic on stock prices/returns. Nguemgaing and Sant'Anna (2021) analyzed the relationship between supply chain disruptions caused by COVID-19 and stock returns with an event study approach. In the study, the change in the returns of meat processing enterprises was investigated based on the closure, restriction and quarantine dates during the pandemic process, and, unlike other studies, it was concluded that supply chain disruptions did not have a significant effect on the average abnormal returns of the enterprises. Wang et al. (2022) examined the effect of the global trade chain disrupted by the COVID-19 pandemic on the financial performance of the companies operating in China. In the study, which included 505 companies, it was determined that the pandemic had a sudden impact on the financial performance of companies using the event study method. It was also revealed that the trade chain disruptions experienced during the pandemic had different effects depending on the sectors. Wang et al. (2024) investigated the financial problems at the business level caused by supply chain disruptions during the COVID-19 pandemic period. In the study based on 222 companies operating in China, the results showed that there were significant decreases in shareholder value in a short time due to supply chain disruptions during the pandemic process. As a result of the inter-sectoral comparison, it was seen that service businesses were more negatively affected by supply chain disruptions than the manufacturing companies. Khan et al. (2024) analyzed herd behavior resulting from the response to supply chain disruptions in extreme market conditions. In the study, which was based on 60 companies in different sectors in India, a significant effect of supply chain disruptions in certain sectors was determined through the application of the event study, for the period of 2019-2022 in the context of the COVID-19 pandemic. Additionally, the study concluded that there was herd behavior in the automotive and pharmaceutical sectors for the said period.

Case studies allow examining the effects of disruptions in the supply chain that occur due to specific crises or shocks. However, studies based on the event study approach focus on a limited time period and generally provide short-term results. On the other hand, econometric analyzes based on indices provide a more suitable option for evaluating the long-term effects of pressures on the supply chain. In the literature, the effects of indices addressing changes in sea and air transportation prices/costs on financial markets are frequently investigated. “Baltic Dry Cargo Index” (BDI) has been used in many studies investigating the

relationship between supply chain disruptions and stock markets (Abakah et al., 2024; Kuo et al., 2020; Lin et al., 2019; Manoharan & Visalakshmi, 2019). Abakah et al. (2024) analyzed the relationships between BDI and financial markets for the period of 1995-2023 with time-varying wavelet correlation and Vector Autoregression model (TVP-VAR). In the study, important global financial shocks such as the Asian and Russian financial crises, the September 11 attack, the Iraq war, the 2008 Global Crisis, the COVID-19 pandemic and the Russia-Ukraine war were taken into account and data from shipping, stocks, bonds, commodity and foreign exchange markets were used. The empirical findings indicated a dynamic asymmetric dependence between BDI and financial markets that changes according to time and frequency and a dynamic transition between positive and negative relationships especially in the long term. Lin et al. (2019) examined the spillover effect of BDI on commodity futures, foreign exchange and stock markets for the period of October 1, 2007 and October 1, 2018. With the VAR-BEKK-GARCH-X model applied in the study, it was seen that the spillover effect changed over time. It was also revealed that BDI can be used as a short-term rather than long-term indicator for stock markets, especially during financial crises. Kuo et al. (2020) investigated the dynamic relationships between BDI and the stock markets of Brazil, Russia, India, China and the Republic of South Africa (BRICS) for the period of January 1996 and March 2019. With the wavelet analysis applied in the study, strong positive relationships were detected between the markets covered by BDI in different periods. Manoharan and Visalakshmi (2019) examined the relationships between BDI and Indian and Chinese stock indices. The study covered the period between January 1, 2011 and December 31, 2015 and impulse response function was applied. The results indicated that a shock in the BDI created a slight reaction in both the Indian and Chinese markets within ten days, and there was no relationship between the BDI and both the Indian and Chinese markets.

Studies Addressing the Global Supply Chain Pressure Index

The increasing complexity and interconnectedness of supply chains due to the effects of increasing geopolitical tensions, economic shocks and technological disruptions have increased the effects of supply chain disruptions on financial markets. For this reason, in recent years, the number of the studies analyzing the effects of disruptions in the global supply chain on macroeconomic variables such as inflation, interest, monetary policy has increased (Ascari et al., 2024; Hernández et al., 2024; Mrabet et al., 2025; Romero-Ramírez, 2024; Trif et al., 2024; Ye et al., 2023). In these studies, GSCPI index that reflects the disruptions in the global supply chain has been used, in general. Trif et al. (2024) investigated the relationship between GSCPI and inflationary movements occurring at the global level and revealed the connections between supply chain dynamics and inflationary pressures. Hernández et al. (2024) examined the effect of stress in global supply chains on inflation and monetary policy in Mexico and concluded that stress in GSCPI had a

non-linear effect on inflation. Ascari et al. (2024) studied on the effects of GSCPI on Euro area inflation and monetary policy for the period of April 2005-August 2023. With the structural VAR Model applied in the study, it was determined that GSCPI-induced shocks were a dominant driving force for Euro zone inflation in 2022 and that these shocks also have a very permanent effect on inflation. In their study Mrabet et al. (2025) investigated the time-varying effects of supply chain disruptions on macroeconomic stability in the United States (USA) and the European Union between January 2000 and December 2021. In the study, the relationships between GSCPI and inflation, real gross domestic product, interest rates and oil prices were analyzed with time-varying causality tests. As a result of the study, it was determined that there is a dynamic relationship between GSCPI and consumer prices, especially in periods of major shocks such as the 2008 global financial crisis and the COVID-19 pandemic. Romero-Ramírez (2024) analyzed the relationship between GSCPI and consumer sentiment, inflation expectation and monetary policy uncertainty in the USA between January 1998 and January 2024, using the VAR Model and Toda and Yamamoto causality tests. In the study, it was determined that surprise increases in the GSCPI pressure index reduced consumer sensitivity, and it was also revealed that GSCPI explained the changes in inflation expectations, consumer sensitivity and monetary policy uncertainty. Ye et al. (2023) investigated the effect of GSCPI and crude oil prices on inflation rates in developed and emerging markets between October 1997 and February 2022. As a result of the panel linear and non-linear (ARDL) tests applied in the study, it was demonstrated that GSCPI had asymmetric effects on the inflation in the long term. In addition, the study results show that the asymmetric effect in developed markets varies depending on the increases and decreases in GSCPI.

Several studies in the literature have examined the relationships between the GSCPI index representing global supply chain disruptions and different commodities, notably gold (Gozgor et al., 2023; Li et al., 2023; Qin et al., 2023; Qin et al., 2024; Ren et al., 2024). Gozgor et al. (2023) investigated the effects of global supply chain pressure on commodity markets in extreme market conditions for the period of January 2000 to July 2022 that contains the COVID-19 pandemic and the Russia-Ukraine war. With the quantile-based connectedness approach applied in the study, it was determined that supply chain pressure negatively affected commodity markets. Li et al. (2023) investigated the relationship between GSCPI and gold prices using wavelet analysis in their study. In the study covering January 1998-May 2022, positive effects from GSCPI on gold prices in the long, medium and short term were specified and it was stated that gold has the ability to resist global supply chain disruptions. Qin et al. (2023) examined the time-varying relationship between GSCPI and gold price in the period December 2000-November 2022. The study pointed out that increasing GSCPI could increase the safe haven demand for gold, on the other hand, it was emphasized that low GSCPI could reduce this demand. Qin et al. (2024) analyzed the bidirectional relationship between GSCPI and Bitcoin between July 2010 and October 2022 with time-varying models

and concluded that GSCPI affected Bitcoin prices both positively and negatively. Ren et al. (2024) investigated the time-changing relationships between supply chain pressures and steel, coal, oil and non-ferrous metals in China. As a result of the time-varying causality tests applied in the study covering the period between December 1999 and December 2022, bidirectional causality was determined between the GSCPI and China's resource industries, and the effect of the resource industries on the GSCPI was stated to be temporary.

Studies addressing the relationships between global supply chain disruptions and stock prices/returns based on GSCPI are quite limited (Hu et al., 2024; Sim et al. 2024; Wang et al., 2025). Sim et al. (2024) analyzed the relationship between GSCPI and stock prices of global logistics companies operating in different fields using a VAR model. The study showed that GSCPI has no impact on global logistics companies, except for shipping companies that tend to be negatively affected by supply chain disruptions. On the other hand, unlike the logistics sectors, maritime stocks were found to be positively affected by the GSCPI indicating that the sector offers opportunities to the investors in times of global instability. Hu et al. (2024) investigated the determinants of global renewable stock index returns for the period of November 2003 and August 2022. In the study, GSCPI was considered as an explanatory variable along with climate policy uncertainty, global economic activity and crude oil prices, and the long-term panel Autoregressive Distributed Lag (ARDL) model was applied. The results pointed out that GSCPI increased the returns of global renewable stocks. Wang et al. (2025) analyzed the dynamic impact of supply chain pressure, energy uncertainty and digitalization on renewable energy stocks in China during the 2002-2021 period. In the study using the ARDL model, it was determined that Chinese supply chain pressure increased renewable energy stocks in the short and long term. In addition, the study concluded that there are bidirectional causal relationships between Chinese supply chain pressure and renewable energy stocks. Hupka (2022) discussed the effects of GSCPI on the leverage ratios of companies operating in North America for the period of January 1998 and February 2022. As a result of the study, it was seen that moderate increases in GSCPI reduced the total debt ratios of companies, while sudden increases increased the short-term debt/asset ratios.

As can be seen from the studies reviewed, the effects of GSCPI on macroeconomic and financial variables in different markets have been frequently discussed. However, the number of comprehensive studies analyzing the relationships between GSCPI and stock indices is quite limited, and most of these studies have examined the short-term effects of GSCPI with an event study approach. On the other hand, it is unrealistic to assume that disruptions in the supply chain are related to all sectors at a similar level, and the development levels of the markets also have the potential to change the effects of disruptions. In addition, increases or decreases the pressure on the global supply chain cause effects at different levels. In this context,

the study aims to investigate the long-term asymmetric relationships between supply chain disruptions and different sectors based on the development level of the markets and to identify implicit relationships. Thus, it is thought that a gap will be eliminated in the literature and information will be provided to investors that they can use in portfolio and risk management decisions.

DATA AND METHODOLOGY

In the study, the Global Supply Chain Pressure Index (GSCPI) and monthly logarithmic price index of 8 sector indices (Energy-ENRJ, Finance-FNS, Real Estate-GYMK, Raw Materials-HMD, Communication-ILTM, Health-SGLK, Industry-SNY, Technology-TEK) of 18 developed and emerging markets (Germany-DEU, United States-USA, Australia-AUS, Brazil-BRA, China-CHN, France-FRA, South Africa-ZAF, India-IND, Hong Kong-HKG, England-GBR, Italy-ITA, Japan-JPN, Canada-CAN) were used. The study covers the period between November 2000 and November 2024 and data was obtained from the Thomson Reuters Refinitiv database.

In the first stage of the analysis, the long-term relationship between GSCPI and each sector on each selected countries were investigated with Bayer and Hanck (2013) Combined Cointegration test. Bayer and Hanck (2013) Combined Cointegration test include Engle and Granger (1987), Johansen (1988), Boswijk (1994) and Banerjee et al. (1998) cointegration tests and gives a single test statistic by combining the results of these four different cointegration tests. In the test, the sample value of the test statistics and the relevant probability values of each test statistic are calculated using the following expression;

$$EG-JOH-BO-BDM=-2\left[ln(p_{EG})+ln(p_{JOH})+(p_{BO})+(p_{BDM})\right] \quad (1)$$

Here, $EG-JOH-BO-BDM$ expresses the combination of Engle and Granger (1987), Johansen (1988), Boswijk (1994) and Banerje, et al. (1998) cointegration tests. p_{EG}, p_{JOH} , p_{BO} and p_{BDM} show the probability value of each cointegration test, respectively.

In the second stage of the analysis, the long-term relationships between the GSCPI and the series, that there was no cointegration between them according to Bayer and Hanck (2013) test results, were analyzed by Özer et al. (2024) Implicit Asymmetric Combined Cointegration test. In the Implicit Asymmetric Combined Cointegration test, each series is first divided into positive and negative shocks;

$$X_t=Z_{t-1}+e_t=Z_0+\sum_{i=1}^{t}e_i \quad (2)$$

$$Y_t = W_{t-1} + \varepsilon_t = W_0 + \sum_{i=1}^{t} \varepsilon_i \quad (3)$$

Here, X_t and Y_t are the variables that the existence of cointegration relationship is tested, t=1,2,3...,T, e_i and ε_i are white noise error terms. If the positive and negative shocks are defined as $e_i^+ = \max(e_i, 0)$, $e_i^- = \min(e_i, 0)$, $\varepsilon_i^+ = \max(\varepsilon_i, 0)$, $\varepsilon_i^- = \min(\varepsilon_i, 0)$, and since $e_i = e_i^+ + e_i^-$ and $\varepsilon_i = \varepsilon_i^+ + \varepsilon_i^-$, Equations (2) and (3) can be rewritten as;

$$X_t = Z_0 + \sum_{i=1}^{t} e_i^+ + \sum_{i=1}^{t} e_i^- \quad (4)$$

$$Y_t = W_0 + \sum_{i=1}^{t} \varepsilon_i^+ + \sum_{i=1}^{t} \varepsilon_i^- \quad (5)$$

In the Implicit Asymmetric Combined Cointegration test, after positive (increase) and negative (decrease) shocks are obtained, the long-term relationship between the shocks is tested with the Bayer and Hanck (2013) in order to determine implicit and asymmetric relationships. For example, the existence of the cointegration relationship between positive GSCPI and negative shock of the US financial sector index can be tested with Özer et al. (2024) Implicit Asymmetric Combined Cointegration test and can be expressed as follows;

$$\text{P\_GSCPI} = f(\text{USA\_FNS}) \quad (6)$$

The analysis steps applied in the study can be summarized as follows;

1. Application of Bayer and Hanck (2013) Combined Cointegration test to determine the long-term relationships between GSCPI and sectors of each selected country covered within the scope of the study.
2. Application of Özer et al. (2024) Implicit Asymmetric Combined Cointegration test in order to determine the long-term relationships between the increases in GSCPI and decreases in the indices for which cointegration with the GSCPI was not detected in the 1st step.

EMPIRICAL FINDINGS

In the study, firstly, descriptive statistics of the sector indices of each country and GSCPI were calculated and the results are given in Appendix-1. Sectoral stock price indices reflect the financial performance and market values of companies operating in certain sectors. According to descriptive

statistics, prices vary significantly by country and sector. These differences can be explained by the economic structures of the countries and sector-based dynamics shaped by the effect of global supply chain pressures. Sectoral development levels, sectors' dependence on the supply chain and investor perceptions significantly affect these differences. Especially in sectors such as energy, finance and real estate, price differences are shaped according to the level of integration into the global economy and the supply chain pressures encountered. As for communication and technology sectors, price differences can be explained by the innovative structures of these sectors and their dependence on technological developments. Raw material and industrial sectors constitute the most basic elements of production. The differentiation of stock price indices in these sectors can be evaluated by the effect of disruptions in the supply chain on production costs. Similarly, differences were detected in standard deviations of price indexes of sectors. Countries with high volatility are generally more sensitive to global and local economic shocks and their financial markets have more volatile structure. Factors such as dependency level of each sector to the global supply chain, local economic conditions and the growth potential of the sector stand out as the main factors that determine the standard deviation levels in price indices. Descriptive statistics also show that GSCPI and country-based sectoral price indices generally have negative skewness and low kurtosis values, and that series are not normally distributed according to Jarque-Bera Normality Test results. Unconditional correlations between GSCPI and the sector index of each country examined were calculated and the results are given in Table 1.

Table 1. Correlation coefficients

	ENRJ	FNS	GYMK	HMD	ILTM	SGLK	SNY	TEK
AUS	-0.24	0.25	0.22	0.41	0.05	0.63	0.39	0.81
BRA	0.29	0.48	0.18	0.43	0.03	0.60	0.44	0.73
CAN	-0.37	0.43	0.29	0.44	0.09	-0.07	0.32	0.78
CHN	-0.17	0.37	0.34	0.41	-0.67	0.61	0.41	-0.36
DEU	-0.05	-0.01	0.44	0.66	0.15	0.32	0.45	0.80
EGY	-0.05	0.47	0.28	0.26	0.19	-0.57	0.48	0.71
FRA	-0.25	0.16	0.13	0.59	-0.63	0.63	0.43	0.69
GBR	-0.05	-0.19	-0.08	0.45	-0.52	0.43	0.44	0.72
GRC	0.18	-0.38	0.19	0.13	0.42	0.62	0.12	0.83
HKG	0.11	0.44	0.43	0.15	-0.62	0.67	0.21	0.41
IND	0.56	0.51	0.29	0.42	0.63	0.57	0.51	0.79
ITA	-0.42	-0.31	-0.29	0.50	-0.40	0.65	0.14	0.71
JPN	-0.17	-0.21	-0.06	-0.08	0.64	0.66	0.41	0.78
MYS	-0.23	0.31	-0.25	-0.17	-0.34	0.67	0.21	0.65
POL	0.32	0.20	-0.01	0.40	0.50	-0.20	0.17	0.75
ROU	-0.04	0.45	0.56	0.18	0.49	0.31	0.45	0.61
USA	-0.37	0.32	0.32	0.40	0.55	0.66	0.45	0.80
ZAF	-0.32	0.36	-0.25	0.42	-0.13	-0.16	0.30	0.84

According to the correlation results, there is a positive relationship between GSCPI and finance, real estate, raw materials, health and technology sector indices in most countries examined. On the other hand, generally negative correlations were detected between GSCPI and the energy and communications sectors of many countries. In the following stage of the study, in order to determine the long-term relationships between GSCPI and the sector indices of each country, firstly ADF and PP unit root tests were applied to the series and the results are presented in Appendix-2. According to the results of unit root tests, 151 of the 180 sector indices are stationary at their first difference. For this reason, 29 indices that were stable at their levels were excluded from the analysis, and the long-term relationship between GSCPI and the sector indices of each country was tested with the Bayer and Hanck (2013) Combined Cointegration test and the results are given in Table 2.

Table 2. Bayer and Hanck (2013) combined cointegration test

	E-J-B-B		E-J-B-B		E-J-B-B
AUS_ENRJ=f(GSCPI)	6.85	ROU_GYMK=f(GSCPI)	11.6	HKG_SGLK=f(GSCPI)	6.90
BRA_ENRJ= f(GSCPI)	12.2	USA_GYMK=f(GSCPI)	5.65	IND_SGLK=f(GSCPI)	6.55
CAN_ENRJ=f(GSCPI)	3.51	ZAF_GYMK=f(GSCPI)	3.84	ITA_SGLK=f(GSCPI)	12.3
CHN_ENRJ=f(GSCPI)	3.75	AUS_HMD=f(GSCPI)	13.5	JPN_SGLK=f(GSCPI)	10.8
DEU_ENRJ=f(GSCPI)	4.27	BRA_HMD=f(GSCPI)	3.89	POL_SGLK=f(GSCPI)	1.90
EGY_ENRJ=f(GSCPI)	4.52	CAN_HMD=f(GSCPI)	14.6	ROU_SGLK=f(GSCPI)	3.61
GBR_ENRJ=f(GSCPI)	7.69	CHN_HMD=f(GSCPI)	5.42	USA_SGLK=f(GSCPI)	9.68
HKG_ENRJ=f(GSCPI)	2.98	DEU_HMD=f(GSCPI)	11.9	ZAF_SGLK=f(GSCPI)	2.42
IND_ENRJ=f(GSCPI)	8.93	EGY_HMD=f(GSCPI)	5.33	AUS_SNY=f(GSCPI)	9.97
ITA_ENRJ=f(GSCPI)	7.10	FRA_HMD=f(GSCPI)	8.71	BRA_SNY=f(GSCPI)	8.95
MYS_ENRJ=f(GSCPI)	1.93	GBR_HMD=f(GSCPI)	17.7c	CAN_SNY=f(GSCPI)	7.05
POL_ENRJ=f(GSCPI)	9.06	IND_HMD=f(GSCPI)	7.43	DEU_SNY=f(GSCPI)	12.0
ROU_ENRJ=f(GSCPI)	7.72	ITA_HMD=f(GSCPI)	5.86	EGY_SNY=f(GSCPI)	3.75
USA_ENRJ=f(GSCPI)	8.53	JPN_HMD=f(GSCPI)	13.5	FRA_SNY=f(GSCPI)	10.1
ZAF_ENRJ=f(GSCPI)	3.89	POL_HMD=f(GSCPI)	7.67	GBR_SNY=f(GSCPI)	7.16
BRA_FNS=f(GSCPI)	5.87	ROU_HMD=f(GSCPI)	5.63	HKG_SNY=f(GSCPI)	10.0
CAN_FNS=f(GSCPI)	12.3	USA_HMD=f(GSCPI)	10.3	IND_SNY=f(GSCPI)	6.21
CHN_FNS=f(GSCPI)	4.42	ZAF_HMD=f(GSCPI)	6.68	ITA_SNY=f(GSCPI)	11.7
DEU_FNS=f(GSCPI)	9.06	AUS_ILTM=f(GSCPI)	9.08	JPN_SNY=f(GSCPI)	12.5
EGY_FNS=f(GSCPI)	2.84	CAN_ILTM=f(GSCPI)	12.2	POL_SNY=f(GSCPI)	4.63
GRC_FNS=f(GSCPI)	6.05	DEU_ILTM=f(GSCPI)	3.89	ROU_SNY=f(GSCPI)	5.66
HKG_FNS=f(GSCPI)	12.4	FRA_ILTM=f(GSCPI)	6.23	USA_SNY=f(GSCPI)	12.8
IND_FNS=f(GSCPI)	6.45	GBR_ILTM=f(GSCPI)	8.05	ZAF_SNY=f(GSCPI)	3.82
ITA_FNS=f(GSCPI)	4.12	GRC_ILTM=f(GSCPI)	4.44	AUS_TEK=f(GSCPI)	9.63
JPN_FNS=f(GSCPI)	6.74	HKG_ILTM=f(GSCPI)	4.29	BRA_TEK=f(GSCPI)	7.13
MYS_FNS=f(GSCPI)	5.55	IND_ILTM=f(GSCPI)	6.40	CAN_TEK=f(GSCPI)	23.7b
POL_FNS=f(GSCPI)	7.83	ITA_ILTM=f(GSCPI)	5.03	CHN_TEK=f(GSCPI)	13.0
ROU_FNS=f(GSCPI)	4.64	JPN_ILTM=f(GSCPI)	4.36	DEU_TEK=f(GSCPI)	9.49
USA_FNS=f(GSCPI)	12.6	MYS_ILTM=f(GSCPI)	1.83	EGY_TEK=f(GSCPI)	10.9
ZAF_FNS=f(GSCPI)	2.45	POL_ILTM=f(GSCPI)	4.45	FRA_TEK=f(GSCPI)	10.8
AUS_GYMK=f(GSCPI)	5.20	ROU_ILTM=f(GSCPI)	9.00	GBR_TEK=f(GSCPI)	6.32
CAN_GYMK=f(GSCPI)	57.8a	USA_ILTM=f(GSCPI)	4.02	GRC_TEK=f(GSCPI)	10.7
CHN_GYMK=f(GSCPI)	7.66	ZAF_ILTM=f(GSCPI)	10.2	HKG_TEK=f(GSCPI)	4.73

DEU_GYMK=f(GSCPI)	5.32	AUS_SGLK=f(GSCPI)	9.78	IND_TEK=f(GSCPI)	5.98
EGY_GYMK=f(GSCPI)	2.13	BRA_SGLK=f(GSCPI)	7.40	ITA_TEK=f(GSCPI)	14.9
FRA_GYMK=f(GSCPI)	4.48	CAN_SGLK=f(GSCPI)	6.04	JPN_TEK=f(GSCPI)	18.5c
GBR_GYMK=f(GSCPI)	5.58	DEU_SGLK=f(GSCPI)	5.55	MYS_TEK=f(GSCPI)	6.73
HKG_GYMK=f(GSCPI)	6.31	EGY_SGLK=f(GSCPI)	4.54	ROU_TEK=f(GSCPI)	6.44
ITA_GYMK=f(GSCPI)	4.99	FRA_SGLK=f(GSCPI)	12.8	USA_TEK=f(GSCPI)	12.9
JPN_GYMK=f(GSCPI)	5.98	GBR_SGLK=f(GSCPI)	5.98	ZAF_TEK=f(GSCPI)	1.11
POL_GYMK=f(GSCPI)	5.35	GRC_SGLK=f(GSCPI)	3.07		

The critical values according to the 10%, 5% and 1% significance level are 16.964, 21.931 33.969, respectively (Bayer and Hanck, 2013).

According to the cointegration test results, there are long-term relationships between GSCPI and only Japan technology, UK raw materials, Canadian real estate and Canadian technology sector indices. As can be seen in Table 2, there is no cointegration relationship between GSCPI and the energy, finance, communication, health and industry sector indices of any country. However, the fact that GSCPI does not have a long-term relationship with the sectors of most countries examined does not mean that there is no cointegration relationship between the increase in global supply chain pressure and the decreases in sector indices. In this context, in order to determine the implicit relationships between GSCPI and sector indices, each index was first divided into positive and negative components and their stationarity was tested with ADF and PP unit root tests and the results are presented in Appendix-3. Then, by excluding the 22 sector index positive shocks that were determined to be stationary at their levels, the implicit relationships between the GSCPI increase and the sector indices decreases were examined by Özer et al. (2024) Implicit Asymmetric Combined Cointegration test and the results are given in Table 3.

Table 3. Özer et al. (2024) implicit asymmetric combined cointegration test results

	E-J-B-B		E-J-B-B		E-J-B-B
N_LAUS_ENRJ=f(P_GSCPI)	8.00	N_LROU_GYMK=f(P_GSCPI)	4.18	N_LEGY_SGLK=f(P_GSCPI)	19.0c
N_LBRA_ENRJ=f(P_GSCPI)	4.73	N_LTHA_GYMK=f(P_GSCPI)	10.5	N_LFRA_SGLK=f(P_GSCPI)	3.12
N_LCAN_ENRJ=f(P_GSCPI)	9.51	N_LUSA_GYMK=f(P_GSCPI)	3.99	N_LGBR_SGLK=f(P_GSCPI)	8.74
N_LDEU_ENRJ=f(P_GSCPI)	41.6a	N_LZAF_GYMK=f(P_GSCPI)	18.2c	N_LGRC_SGLK=f(P_GSCPI)	1.16
N_LEGY_ENRJ=f(P_GSCPI)	9.33	N_LAUS_HMD=f(P_GSCPI)	13.1	N_LHKG_SGLK=f(P_GSCPI)	7.39
N_LFRA_ENRJ=f(P_GSCPI)	5.36	N_LBRA_HMD=f(P_GSCPI)	19.3c	N_LIND_SGLK=f(P_GSCPI)	4.78
N_LGBR_ENRJ=f(P_GSCPI)	8.50	N_LCAN_HMD=f(P_GSCPI)	9.87	N_LITA_SGLK=f(P_GSCPI)	21.5c
N_LGRC_ENRJ=f(P_GSCPI)	3.20	N_LCHN_HMD=f(P_GSCPI)	17.3c	N_LJPN_SGLK=f(P_GSCPI)	4.93
N_LIND_ENRJ=f(P_GSCPI)	9.92	N_LDEU_HMD=f(P_GSCPI)	9.76	N_LMYS_SGLK=f(P_GSCPI)	6.63
N_LITA_ENRJ=f(P_GSCPI)	2.58	N_LEGY_HMD=f(P_GSCPI)	27.5b	N_LPOL_SGLK=f(P_GSCPI)	<99a

N_LJPN_ENRJ=f(P_GSCPI)	10.6	N_LFRA_HMD=f(P_GSCPI)	9.86	N_LROU_SGLK=f(P_GSCPI)	18.3c
N_LPOL_ENRJ=f(P_GSCPI)	19.8c	N_LGRC_HMD=f(P_GSCPI)	4.76	N_LTHA_SGLK=f(P_GSCPI)	15.7
N_LROU_ENRJ=f(P_GSCPI)	10.6	N_LHKG_HMD=f(P_GSCPI)	3.80	N_LUSA_SGLK=f(P_GSCPI)	7.17
N_LUSA_ENRJ=f(P_GSCPI)	6.26	N_LIND_HMD=f(P_GSCPI)	22.5	N_LZAF_SGLK=f(P_GSCPI)	9.53
N_LZAF_ENRJ=f(P_GSCPI)	22.7b	N_LITA_HMD=f(P_GSCPI)	5.82	N_LAUS_SNY=f(P_GSCPI)	3.36
N_LAUS_FNS=f(P_GSCPI)	2.74	N_LJPN_HMD=f(P_GSCPI)	5.21	N_LBRA_SNY=f(P_GSCPI)	22.9b
N_LBRA_FNS=f(P_GSCPI)	17.1c	N_LMYS_HMD=f(P_GSCPI)	19.0c	N_LCAN_SNY=f(P_GSCPI)	10.5
N_LCAN_FNS=f(P_GSCPI)	18.2c	N_LPOL_HMD=f(P_GSCPI)	17.0c	N_LCHN_SNY=f(P_GSCPI)	23.1b
N_LDEU_FNS=f(P_GSCPI)	43.6a	N_LROU_HMD=f(P_GSCPI)	9.20	N_LDEU_SNY=f(P_GSCPI)	5.58
N_LEGY_FNS=f(P_GSCPI)	21.5c	N_LTHA_HMD=f(P_GSCPI)	2.93	N_LEGY_SNY=f(P_GSCPI)	18.2c
N_LFRA_FNS=f(P_GSCPI)	6.01	N_LUSA_HMD=f(P_GSCPI)	6.32	N_LFRA_SNY=f(P_GSCPI)	6.77
N_LGBR_FNS=f(P_GSCPI)	3.65	N_LZAF_HMD=f(P_GSCPI)	1.40	N_LGBR_SNY=f(P_GSCPI)	14.7
N_LGRC_FNS=f(P_GSCPI)	5.75	N_LAUS_ILTM=f(P_GSCPI)	4.19	N_LGRC_SNY=f(P_GSCPI)	19.4c
N_LHKG_FNS=f(P_GSCPI)	20.0c	N_LCAN_ILTM=f(P_GSCPI)	34.6a	N_LHKG_SNY=f(P_GSCPI)	15.7
N_LIND_FNS=f(P_GSCPI)	18.7c	N_LDEU_ILTM=f(P_GSCPI)	17.1c	N_LIND_SNY=f(P_GSCPI)	24.1b
N_LITA_FNS=f(P_GSCPI)	2.54	N_LEGY_ILTM=f(P_GSCPI)	<99a	N_LITA_SNY=f(P_GSCPI)	19.6c
N_LJPN_FNS=f(P_GSCPI)	2.19	N_LFRA_ILTM=f(P_GSCPI)	23.5b	N_LJPN_SNY=f(P_GSCPI)	2.85
N_LPOL_FNS=f(P_GSCPI)	17.6c	N_LGBR_ILTM=f(P_GSCPI)	22.6b	N_LPOL_SNY=f(P_GSCPI)	22.3b
N_LROU_FNS=f(P_GSCPI)	13.5	N_LGRC_ILTM=f(P_GSCPI)	12.1	N_LROU_SNY=f(P_GSCPI)	5.07
N_LUSA_FNS=f(P_GSCPI)	4.81	N_LHKG_ILTM=f(P_GSCPI)	13.5	N_LTHA_SNY=f(P_GSCPI)	40.4a
N_LAUS_GYMK=f(P_GSCPI)	4.10	N_LIND_ILTM=f(P_GSCPI)	8.73	N_LUSA_SNY=f(P_GSCPI)	3.69
N_LBRA_GYMK=f(P_GSCPI)	17.8c	N_LITA_ILTM=f(P_GSCPI)	2.12	N_LZAF_SNY=f(P_GSCPI)	85.2a
N_LDEU_GYMK=f(P_GSCPI)	9.99	N_LJPN_ILTM=f(P_GSCPI)	24.5b	N_LAUS_TEK=f(P_GSCPI)	7.52
N_LEGY_GYMK=f(P_GSCPI)	17.2c	N_LPOL_ILTM=f(P_GSCPI)	1.46	N_LBRA_TEK=f(P_GSCPI)	19.2c
N_LFRA_GYMK=f(P_GSCPI)	7.48	N_LROU_ILTM=f(P_GSCPI)	13.2	N_LCHN_TEK=f(P_GSCPI)	<99a
N_LGBR_GYMK=f(P_GSCPI)	1.59	N_LUSA_ILTM=f(P_GSCPI)	6.93	N_LEGY_TEK=f(P_GSCPI)	2.20
N_LGRC_GYMK=f(P_GSCPI)	26.5b	N_LZAF_ILTM=f(P_GSCPI)	24.3b	N_LGRC_TEK=f(P_GSCPI)	18.9c
N_LHKG_GYMK=f(P_GSCPI)	30.6b	N_LAUS_SGLK=f(P_GSCPI)	9.10	N_LHKG_TEK=f(P_GSCPI)	20.0c
N_LIND_GYMK=f(P_GSCPI)	8.83	N_LBRA_SGLK=f(P_GSCPI)	22.3b	N_LMYS_TEK=f(P_GSCPI)	22.9b
N_LITA_GYMK=f(P_GSCPI)	9.95	N_LCAN_SGLK=f(P_GSCPI)	9.85	N_LROU_TEK=f(P_GSCPI)	73.7a
N_LJPN_GYMK=f(P_GSCPI)	16.9	N_LCHN_SGLK=f(P_GSCPI)	20.0c		
N_LPOL_GYMK=f(P_GSCPI)	18.6c	N_LDEU_SGLK=f(P_GSCPI)	8.65		

The symbols N and P indicate the negative and positive component of the respective stock market, respectively. a, b, c indicate the significance level of 1%, 5% and 10%, respectively. The critical values according to the 10%, 5% and 1% significance levels are 16.964, 21.931 and 33.969, respectively (Bayer & Hanck, 2013).

The most important finding obtained from the study is that, according to the results of the Implicit Asymmetric Combined Cointegration Test, there are long-term relationships between the increase in GSCPI and the decreases in different sector indices of many countries. Test results indicate the existence of cointegration relationships between the increases in the GSCPI index and the decreases in 3 of 15 countries for the energy, 6 of 15 countries for the finance, 6 of 16 countries for the real estate, 6 of 18 countries for

the raw material, 7 of 15 countries for the communication, 6 of 19 countries for the health, 9 of 18 countries for the industry and 6 of 8 countries for the technology sector indices. Compared to other sectors, the decreases especially in the communication, industry and technology sectors are related to the increase in global supply chain pressure in the long term. On the other hand, it is generally seen that the decreases in the sector indices of developing countries compared to developed countries are related to the increase in GSCPI in the long term. According to the test results, the increase in GSCPI is not related with the decrease of any sector index in the USA and Australia. It was determined that only the decreases in the communication sector index were cointegrated with the increase in GSCPI in France, Japan and the UK. Additionally, decreases in the limited sector indices in Germany, India, Hong Kong, Italy, Canada, Romania and Greece are related with the increases in GSCPI. However, decreases in almost all of the sector indices of Brazil, China, South Africa, Malaysia, Egypt and Poland are related with the increase in GSCPI in the long term.

CONCLUSION

The study aims to determine the long-term relationships between the increase in pressure in the global supply chain and the decreases in different sector indices, for developed and emerging markets. For this purpose, long-term relationships between GSCPI and 8 different sectors of 18 developed and emerging markets were first analyzed with Bayer and Hanck (2013) Combined Cointegration test, and long-term relationships were determined between GSCPI and only Japan technology, UK raw materials, Canadian real estate and Canadian technology sector indices. However, the limited number of long-term relationships detected by the Combined Cointegration test do not fully reflect the asymmetric effects that supply chain pressures can create. In this context, in order to determine implicit relationships between increases in the GSCPI index and decreases in sector indices Özer et al. (2024) Implicit Asymmetric Combined Cointegration test was applied.

Problems in supply chains cause different problems in various sectors, especially as they lead to increases in production costs and failure to deliver products on time. This situation becomes a factor that negatively affects the stock prices of the sectors in the long term. In this context, the most important finding obtained from the study is that there are long-term relationships between the increase in GSCPI and the decreases in different sector indices of many countries and increases in the GSCPI may affect the stock prices. Differently from the studies of Hu et al. (2024), Sim et al. 2024 and Wang et al. (2025), the study reveals the asymmetric nature of supply chain pressures and suggests that disruptions in the global supply chain not only have short-term effects on sectoral stock price indices but also lead to long-term changes.

Another important finding of the study is that, compared to other sectors, the decreases especially in the communication, industry and technology sectors are related to the increase in global supply chain pressure in the long term. The communications sector is highly dependent on the global supply chain, especially in terms of infrastructure investments and technology-based products. Increasing supply chain problems and delays in the production and distribution processes increase operational costs of the companies in the communication sector and negatively affect stock prices in the long term. Similarly, the industrial sector is one of the sectors most dependent on the global supply chain. Due to its structure, the industrial sector requires a regular and uninterrupted supply of raw materials, intermediate goods and products in production processes. Therefore, the industrial sector is highly sensitive to supply chain pressures. Any disruption in the supply chain reduces the production capacity of industrial companies, which ultimately leads to a decrease in profitability. The technology sector stands out with its innovative structure. Most of the critical components used in the production processes of technology companies are provided through the global supply chain. Supply problems, especially in microchips, electronic components and software-based products, significantly limit the production capacities of technology companies. The common feature of the three sectors mentioned is the production structures and the characteristics of the products they need in the production processes. The majority of the products needed by companies operating in the communication, industry and technology sectors require certain raw material resources and technological production level, and therefore companies are limited to certain country groups in terms of product supply. This makes companies significantly dependent on the supply chain and makes companies in these three sectors more susceptible to supply chain disruptions compared to other sectors. In this context, increases in global supply chain pressure have a more negative impact on the market performance and stock prices of companies operating in these sectors in the long term.

Emerging countries have a very low capacity to create alternative supply channels, and problems in the supply chain create more permanent and profound effects on the sectors of these countries. When the results are evaluated, it is seen that the long-term relationship between the decreases in sector indices of emerging countries and the increase in GSCPI is more intense than in the developed countries. Therefore, this result supports the thought that dependence of the emerging countries to the global supply chain is higher than developed countries and that they are more vulnerable to supply chain pressures. When the results of the study are evaluated as a whole, investors can be advised to follow the developments in the global supply chain. It would be especially useful for the investors investing in emerging markets to consider that there may be a long-term decline in the indices if the pressure on the supply chain increases and to shape their portfolio management decisions to this possibility. On the other hand, investing in developed markets as well as emerging markets will allow the total portfolio risk to be reduced, as the effects of

disruptions in the global supply chain are more limited in those countries. Similarly, there are diversification opportunities for investors investing on a sectoral basis. In this context, it would be appropriate for the investors who invest in sectors, such as communication, industry and technology, that are highly dependent on the supply chain, to reduce their total portfolio risk by investing in alternative sectors in case the pressure increases. However, the results can be evaluated differently for institutional and individual investors. Institutional investors, who have the opportunity to reduce portfolio risk by investing more in terms of portfolio size and who are more advantageous in terms of analysis compared to individual investors, may be less affected by disruptions in the global supply chain compared to individual investors. However, institutional investors who concentrate on certain stocks in their portfolios and make sector-based investments may be exposed to higher levels of risk. Disruptions in supply chains can cause significant problems that may affect not only companies and stockholders, but also the economy in general. Monitoring the supply chain is of great importance, especially in countries with high external dependence on raw materials and energy resources, in order to detect problems in advance, prevent them, eliminate them or take protective measures. In this context, it is thought that the analysis results provide important information to decision makers and policy makers. In further studies, determining the effects of disruptions in the global supply chain on the indices, as well as their relationship with macroeconomic variables such as exchange rate, inflation and interest rate on a country-specific basis, may increase the benefits of the study.

AUTHOR STATEMENT

Researcher declared that all contributions to the article were his own. Researcher have not declared any conflict of interest.

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APPENDIX

Appendix 1: Descriptive statistics

	Mean	S.D	S.	K.	JB		Mean	S.D	S.	K.	JB
GSCPI	-0.03	0.95	2.32	9.35	>99[a]	ZAF_FNS	10.3	0.65	-0.18	1.63	24.2[a]
AUS_ENRJ	7.43	0.49	-0.85	2.28	40.9[a]	AUS_GYMK	6.98	0.28	-0.27	2.71	4.42
BRA_ENRJ	7.53	0.86	-0.95	3.21	44.0[a]	BRA_GYMK	5.82	0.30	-1.25	5.62	>99[a]
CAN_ENRJ	6.96	0.45	-0.68	2.26	29.0[a]	CAN_GYMK	5.66	0.43	-0.52	1.91	27.6[a]
CHN_ENRJ	5.36	0.69	-0.82	2.36	37.6[a]	CHN_GYMK	7.60	1.56	-0.66	1.97	33.5[a]
DEU_ENRJ	3.49	0.66	0.82	2.72	21.7[a]	DEU_GYMK	6.53	0.44	0.15	2.30	6.96[b]
EGY_ENRJ	4.33	0.42	0.21	2.81	1.77	EGY_GYMK	5.25	1.01	-0.76	2.18	36.1[a]
FRA_ENRJ	7.92	0.21	-0.67	3.66	26.6[a]	FRA_GYMK	6.73	0.41	-0.46	1.81	27.2[a]
GBR_ENRJ	8.62	0.25	-0.52	2.10	22.7[a]	GBR_GYMK	8.04	0.28	0.43	3.18	9.18[a]
GRC_ENRJ	6.78	0.33	0.27	2.80	3.86	GRC_GYMK	9.19	0.81	-1.33	6.72	<99[a]
HKG_ENRJ	7.41	0.78	-0.70	2.07	33.9[a]	HKG_GYMK	7.56	0.43	-0.46	2.29	16.4[a]
IND_ENRJ	5.96	0.77	-0.61	2.44	21.6[a]	IND_GYMK	3.70	0.57	1.12	3.81	43.0[a]
ITA_ENRJ	5.38	0.27	0.17	2.54	3.92[a]	ITA_GYMK	5.78	0.59	0.42	2.24	15.3[a]
JPN_ENRJ	5.45	0.26	0.86	3.26	36.8[a]	JPN_GYMK	5.61	0.38	-0.13	1.65	22.7[a]
MYS_ENRJ	6.40	0.64	-0.29	1.63	26.8[a]	MYS_GYMK	5.76	0.35	-0.75	3.04	27.3[a]
POL_ENRJ	6.28	0.64	-0.68	2.43	26.0[a]	POL_GYMK	5.05	0.43	1.42	4.18	83.8[a]
ROU_ENRJ	4.87	0.48	-0.64	2.16	28.1[a]	ROU_GYMK	5.04	0.62	0.09	1.97	11.8[a]
USA_ENRJ	7.21	0.43	-0.44	1.78	27.4[a]	USA_GYMK	7.32	0.36	-0.28	1.96	16.7[a]
ZAF_ENRJ	8.91	0.91	-0.83	2.49	36.6[a]	ZAF_GYMK	6.08	0.73	-0.48	2.00	23.2[a]
AUS_FNS	7.17	0.26	-0.28	1.89	18.5[a]	AUS_HMD	6.44	0.75	0.59	1.83	33.4[a]
BRA_FNS	6.56	0.85	-0.60	1.96	30.4[a]	BRA_HMD	5.58	1.00	0.19	1.49	21.3[a]
CAN_FNS	7.63	0.43	-0.36	2.24	13.2[a]	CAN_HMD	5.96	0.49	0.57	2.33	20.9[a]
CHN_FNS	6.77	0.70	-1.13	3.20	61.5[a]	CHN_HMD	5.38	0.92	0.31	2.03	12.2[a]
DEU_FNS	6.71	0.27	-0.04	2.38	4.64[c]	DEU_HMD	6.11	0.52	0.15	1.93	15.0[a]
EGY_FNS	5.45	0.83	-0.53	2.08	23.6[a]	EGY_HMD	4.96	0.78	-0.20	1.78	12.7[a]
FRA_FNS	7.74	0.27	-0.08	3.00	0.31	FRA_HMD	7.61	0.61	0.42	2.03	19.6[a]
GBR_FNS	8.28	0.22	-0.50	3.81	19.7[a]	GBR_HMD	7.05	0.47	1.05	2.83	53.8[a]
GRC_FNS	5.18	2.76	-0.62	1.74	37.5[a]	GRC_HMD	7.07	0.96	-0.78	3.13	29.4[a]
HKG_FNS	8.05	0.30	-0.61	2.83	18.1[a]	HKG_HMD	5.17	0.44	0.41	3.25	8.89[b]
IND_FNS	8.44	1.02	-0.51	1.95	26.0[a]	IND_HMD	6.16	1.08	0.69	2.09	30.3[a]
ITA_FNS	7.67	0.47	0.07	1.81	17.3[a]	ITA_HMD	6.25	0.58	0.60	2.32	23.1[a]
JPN_FNS	5.43	0.35	0.01	2.43	3.95	JPN_HMD	5.68	0.37	0.36	2.32	11.9[a]

MYS_FNS	7.00	0.48	-0.89	3.12	38.0[a]	MYS_HMD	6.04	0.54	-0.01	3.07	0.06
POL_FNS	4.83	0.40	-0.56	2.26	21.6[a]	POL_HMD	4.81	0.73	0.37	1.80	17.8a
ROU_FNS	5.60	1.03	-0.81	2.33	37.0a	AUS_ILTM	5.73	0.27	0.36	2.53	8.92[b]
USA_FNS	7.47	0.32	-0.11	3.19	1.02	BRA_ILTM	5.91	0.17	-0.20	3.70	7.87[b]
CAN_ILTM	7.25	0.37	-0.06	1.84	16.5[a]	BRA_SNY	7.36	1.09	-0.77	2.40	33.2 [a]
CHN_ILTM	5.47	0.29	-0.72	3.72	24.9[a]	CAN_SNY	7.27	0.49	0.34	1.99	18.0 [a]
DEU_ILTM	5.38	0.45	1.83	6.67	<99[a]	CHN_SNY	5.62	0.74	-1.51	4.76	<99[a]
EGY_ILTM	7.00	0.87	-1.14	3.50	64.0[a]	DEU_SNY	6.76	0.37	0.07	2.20	7.92[b]
FRA_ILTM	4.87	0.46	1.12	5.03	<99[a]	EGY_SNY	6.34	1.08	-0.77	1.92	43.0[a]
GBR_ILTM	7.73	0.34	0.61	3.02	18.2[a]	FRA_SNY	8.39	0.47	0.04	2.20	7.84[b]
GRC_ILTM	5.00	0.46	-1.50	6.57	Z99[a]	GBR_SNY	8.24	0.48	-0.10	2.04	11.6[a]
HKG_ILTM	6.22	0.46	-0.70	2.37	28.3[a]	GRC_SNY	9.07	0.50	-0.28	44.1	44.4[a]
IND_ILTM	5.84	0.65	-1.02	3.10	50.0[a]	HKG_SNY	7.82	0.29	-0.88	37.7	37.7[a]
ITA_ILTM	7.24	0.64	0.36	1.83	22.9[a]	IND_SNY	7.12	1.08	-0.46	23.2	23.2[a]
JPN_ILTM	7.46	0.43	0.27	1.98	16.1[a]	ITA_SNY	6.49	0.27	-0.24	10.5	10.5[a]
MYS_ILTM	5.74	0.45	-0.35	2.03	17.2[a]	JPN_SNY	6.17	0.35	0.24	16.8	16.8[a]
POL_ILTM	4.25	0.56	-0.30	1.97	16.5[a]	MYS_SNY	5.94	0.20	-0.77	32.3	32.3[a]
ROU_ILTM	4.39	0.13	-0.45	2.45	2.64	POL_SNY	4.78	0.38	1.30	145.6	<99[a]
USA_ILTM	6.39	0.29	0.36	2.98	6.37[b]	ROU_SNY	7.35	0.80	-0.58	22.4	22.4[a]
ZAF_ILTM	7.54	0.95	-0.95	2.58	45.5[a]	USA_SNY	7.64	0.49	0.55	19.5	19.5[a]
AUS_SGLK	7.51	0.79	0.44	1.93	23.0 [a]	ZAF_SNY	9.90	0.61	-0.42	27.7	27.7[a]
BRA_SGLK	4.98	0.61	0.40	2.52	6.24 [b]	AUS_TEK	6.04	0.98	0.09	2.03	11.7[a]
CAN_SGLK	8.28	0.60	1.50	5.26	<99[a]	BRA_TEK	6.19	0.72	-0.37	2.56	7.03[b]
CHN_SGLK	7.92	1.22	-1.69	4.76	<99[a]	CAN_TEK	6.57	0.63	0.46	2.51	13.1[a]
DEU_SGLK	6.97	0.63	0.04	1.60	23.5[a]	CHN_TEK	3.77	0.37	-0.29	2.68	2.05
EGY_SGLK	5.81	0.98	0.01	1.69	20.7[a]	DEU_TEK	8.87	0.56	0.20	1.94	15.5[a]
FRA_SGLK	8.00	0.32	0.25	2.20	10.7[a]	EGY_TEK	3.85	1.03	0.85	2.55	29.9[a]
GBR_SGLK	8.97	0.30	0.48	1.95	24.6[a]	FRA_TEK	8.11	0.52	0.19	2.06	12.4[a]
GRC_SGLK	3.67	1.37	0.18	1.90	16.1[a]	GBR_TEK	7.89	0.75	-0.13	1.55	26.0[a]
HKG_SGLK	7.79	1.71	-0.21	1.78	17.9[a]	GRC_TEK	3.60	0.80	0.33	2.27	11.5[a]
IND_SGLK	8.45	0.92	0.08	1.55	25.8[a]	HKG_TEK	8.01	1.19	0.07	1.55	25.5[a]
ITA_SGLK	5.70	0.74	0.92	2.65	42.0[a]	IND_TEK	11.87	1.01	-0.06	1.99	12.6[a]
JPN_SGLK	6.72	0.39	0.65	2.18	28.3[a]	ITA_TEK	2.22	0.77	-0.14	2.26	7.60[b]
MYS_SGLK	7.89	1.40	-0.85	2.86	30.3[a]	JPN_TEK	6.52	0.38	0.10	2.39	4.97[c]
POL_SGLK	5.09	0.19	-0.15	2.54	0.79	MYS_TEK	7.14	1.21	-1.10	3.01	32.5[a]
ROU_SGLK	6.27	0.85	-0.47	2.33	16.0[a]	POL_TEK	4.64	0.25	0.30	2.06	15.0[a]

USA_SGLK	7.95	0.55	0.71	2.02	36.0[a]	ROU_TEK	6.60	0.84	-1.07	3.11	21.6[a]
ZAF_SGLK	9.66	1.08	-0.16	1.63	23.9[a]	USA_TEK	7.74	0.82	0.69	2.26	29.4[a]
AUS_SNY	6.90	0.30	0.27	1.93	17.4 [a]	ZAF_TEK	7.22	1.84	-0.35	1.82	22.7[a]

S.D., S., K. and JB denote mean, standard deviation, skewness, kurtosis and Jarque-Bera test statistic, respectively. a, b, c denote 1%, 5% and 10% level of significance, respectively.

Appendix 2: Unit Root test results for GSCPI and country based sector indices

	ADF	PP		ADF	PP		ADF	PP
GSCPI	-2.26	-1.80	ZAF_FNS	-0.85	-0.78	ZAF_HMD	-1.13	-1.14
AUS_ENRJ	-1.97	-1.96	AUS_GYMK	-1.72	-1.65	AUS_ILTM	-2.11	-2.35
BRA_ENRJ	-2.30	-2.33	BRA_GYMK	-4.49[a]	-4.78[a]	BRA_ILTM	-3.88[a]	-3.94[a]
CAN_ENRJ	-1.84	-1.83	CAN_GYMK	-0.74	-0.89	CAN_ILTM	-1.59	-1.63
CHN_ENRJ	-1.20	-1.35	CHN_GYMK	-1.61	-1.61	CHN_ILTM	-2.81[c]	-2.81[c]
DEU_ENRJ	-2.08	-2.09	DEU_GYMK	-1.61	-1.99	DEU_ILTM	-1.54	-1.73
EGY_ENRJ	-1.88	-2.32	EGY_GYMK	-1.03	-1.24	EGY_ILTM	-2.82[c]	-2.79[c]
FRA_ENRJ	-3.20[b]	-3.05[b]	FRA_GYMK	-1.85	-2.02	FRA_ILTM	-1.61	-1.82
GBR_ENRJ	-2.56	-2.46	GBR_GYMK	-1.76	-2.16	GBR_ILTM	-1.62	-1.98
GRC_ENRJ	-3.37[b]	-3.72[a]	GRC_GYMK	-4.21[a]	-3.50[a]	GRC_ILTM	-1.93	-2.11
HKG_ENRJ	-1.00	-1.02	HKG_GYMK	-1.87	-1.88	HKG_ILTM	-1.92	-2.05
IND_ENRJ	-0.47	-0.43	IND_GYMK	-2.66[c]	-2.69[c]	IND_ILTM	-1.15	-1.20
ITA_ENRJ	-2.11	-2.10	ITA_GYMK	-0.85	-1.03	ITA_ILTM	-0.95	-0.90
JPN_ENRJ	-2.61[c]	-2.72[c]	JPN_GYMK	-1.58	-1.70	JPN_ILTM	-0.99	-1.14
MYS_ENRJ	-1.28	-1.29	MYS_GYMK	-3.02[b]	-2.97[b]	MYS_ILTM	-1.34	-1.43
POL_ENRJ	-1.91	-1.91	POL_GYMK	-1.78	-2.08	POL_ILTM	-1.21	-1.14
ROU_ENRJ	-1.62	-1.66	ROU_GYMK	-1.15	-1.16	ROU_ILTM	-1.71	-1.71
USA_ENRJ	-1.82	-1.79	USA_GYMK	-0.90	-0.94	USA_ILTM	-1.49	-1.58
ZAF_ENRJ	-1.70	-1.67	ZAF_GYMK	-1.62	-1.62	ZAF_ILTM	-2.22	-2.35
AUS_FNS	-2.06	-2.09	AUS_HMD	-0.54	-0.62	AUS_SGLK	0.60	0.57
BRA_FNS	-1.37	-1.35	BRA_HMD	-0.52	-0.69	BRA_SGLK	-0.56	-0.69
CAN_FNS	-1.01	-1.00	CAN_HMD	-0.61	-0.41	CAN_SGLK	-1.77[b]	-2.25[b]
CHN_FNS	-1.64	-1.66	CHN_HMD	-0.85	-1.05	CHN_SGLK	-3.41	-3.17
DEU_FNS	-2.26	-2.39	DEU_HMD	-1.14	-1.18	DEU_SGLK	-0.58	-0.57
EGY_FNS	-0.78	-0.89	EGY_HMD	-1.15	-1.20	EGY_SGLK	-0.31	-0.34
FRA_FNS	-2.91[b]	-3.08[b]	FRA_HMD	-0.95	-0.99	FRA_SGLK	-1.19	-1.14
GBR_FNS	-2.63[c]	-2.81[c]	GBR_HMD	-1.06	-1.20	GBR_SGLK	-0.89	-0.64
GRC_FNS	0.49	0.34	GRC_HMD	-2.70[c]	-2.59[c]	GRC_SGLK	-1.22	-1.29
HKG_FNS	-2.44	-2.53	HKG_HMD	-3.05[b]	-2.77[c]	HKG_SGLK	-1.83	-1.47
IND_FNS	-0.80	-0.78	IND_HMD	-0.87	-0.95	IND_SGLK	-0.50	-0.50
ITA_FNS	-1.57	-1.59	ITA_HMD	-1.29	-1.17	ITA_SGLK	1.06	0.83
JPN_FNS	-2.15	-2.26	JPN_HMD	-1.38	-1.57	JPN_SGLK	-0.41	-0.35
MYS_FNS	-1.71	-2.56	MYS_HMD	-2.61[c]	-2.71[c]	MYS_SGLK	-2.68[c]	-2.85[c]

POL_FNS	-2.31	-2.44	POL_HMD	-0.73	-1.00	POL_SGLK	-2.53	-2.61[c]
ROU_FNS	-0.89	-0.97	ROU_HMD	-2.18	-2.68[c]	ROU_SGLK	-0.97	-0.92
USA_FNS	-1.37	-1.33	USA_HMD	-1.37	-1.35	USA_SGLK	0.68	1.02
ZAF_SGLK	-0.85	-0.86	JPN_SNY	-1.07	-1.21	GBR_TEK	-1.20	-1.39
AUS_SNY	-0.95	-1.04	MYS_SNY	-2.91[b]	-3.08[b]	GRC_TEK	-2.53	-2.49
BRA_SNY	-1.90	-1.86	POL_SNY	-1.66	-2.12	HKG_TEK	-0.23	-0.39
CAN_SNY	-0.35	-0.43	ROU_SNY	-0.52	-0.57	IND_TEK	0.16	0.04
CHN_SNY	-2.78	-2.77	USA_SNY	-0.35	-0.27	ITA_TEK	-1.97	-2.02
DEU_SNY	-1.02	-1.09	ZAF_SNY	-1.57	-1.55	JPN_TEK	-1.38	-1.52
EGY_SNY	-1.15	-1.22	AUS_TEK	-0.02	0.04	MYS_TEK	-1.97	-1.88
FRA_SNY	-1.20	-1.21	BRA_TEK	-1.77	-1.76	POL_TEK	-3.06[b]	-3.17[b]
GBR_SNY	-0.51	-0.48	CAN_TEK	-2.03	-2.31	ROU_TEK	-2.52	-2.62
GRC_SNY	-3.52[a]	-3.86[a]	CHN_TEK	-2.04	-2.07	USA_TEK	0.96	1.03
HKG_SNY	-2.53	-2.62[c]	DEU_TEK	-0.61	-0.46	ZAF_TEK	-1.16	-0.23
IND_SNY	-0.18	-0.33	EGY_TEK	0.20	0.21			
ITA_SNY	-2.46	-2.72[c]	FRA_TEK	-2.12	-2.16			

a, b, c ise sırasıyla %1, %5 ve %10 anlam düzeyini ifade etmektedir.

Appendix 3: Unit root test results for negative sector index shocks based countryand positive GSCPI shocks

	ADF	PP		ADF	PP		ADF	PP
P_GSCPI	-0.81	-0.94	N_ZAF_ENRJ	-1.11	-1.42	N_ZAF_FNS	-3.71[b]	-3.70[b]
N_AUS_ENRJ	-1.80	-1.81	N_AUS_FNS	-1.71	-1.89	N_AUS_GYMK	-2.13	-1.88
N_BRA_ENRJ	-1.32	-1.32	N_BRA_FNS	-2.38	-2.58	N_BRA_GYMK	-2.24	-2.22
N_CAN_ENRJ	-1.48	-1.78	N_CAN_FNS	-2.18	-2.47	N_CAN_GYMK	-1.76	-1.98
N_CHN_ENRJ	-4.11[a]	-4.71[a]	N_CHN_FNS	-3.52[b]	-3.52[b]	N_CHN_GYMK	-3.41[c]	-3.52[b]
N_DEU_ENRJ	-2.72	-2.39	N_DEU_FNS	-1.60	-1.88	N_DEU_GYMK	-1.72	-1.75
N_EGY_ENRJ	-1.14	-1.21	N_EGY_FNS	-2.47	-2.65	N_EGY_GYMK	-2.07	-2.17
N_FRA_ENRJ	-1.24	-1.35	N_FRA_FNS	-1.75	-2.01	N_FRA_GYMK	-2.01	-2.03
N_GBR_ENRJ	-1.38	-1.56	N_GBR_FNS	-1.22	-1.53	N_GBR_GYMK	-1.45	-1.75
N_GRC_ENRJ	-1.97	-2.35	N_GRC_FNS	-1.53	-1.59	N_GRC_GYMK	-1.03	-1.11
N_HKG_ENRJ	-3.81[b]	-4.39[a]	N_HKG_FNS	-2.06	-2.41	N_HKG_GYMK	-2.97	-3.05
N_IND_ENRJ	-2.00	-2.01	N_IND_FNS	-1.74	-1.97	N_IND_GYMK	-2.16	-2.14
N_ITA_ENRJ	-1.43	-1.55	N_ITA_FNS	-1.67	-1.80	N_ITA_GYMK	-1.56	-1.62
N_JPN_ENRJ	-2.01	-2.22	N_JPN_FNS	-0.78	-0.84	N_JPN_GYMK	-1.48	-1.43
N_MYS_ENRJ	-3.76[b]	-3.65[b]	N_MYS_FNS	-5.35[a]	-4.97[a]	N_MYS_GYMK	-4.79[a]	-4.40[a]
N_POL_ENRJ	-2.81	-2.91	N_POL_FNS	-2.39	-2.44	N_POL_GYMK	-2.39	-2.41
N_ROU_ENRJ	-1.59	-1.72	N_ROU_FNS	-1.53	-1.51	N_ROU_GYMK	-1.67	-1.86
N_USA_ENRJ	-0.76	-1.20	N_USA_FNS	-1.17	-1.63	N_USA_GYMK	-1.98	-1.51
N_ZAF_GYMK	-0.75	-1.15	N_JPN_ILTM	-1.91	-1.87	N_GBR_SNY	-2.14	-2.22
N_AUS_HMD	-0.95	-0.78	N_MYS_ILTM	-5.83[a]	-5.62[a]	N_GRC_SNY	-0.50	-0.80
N_BRA_HMD	-2.11	-1.95	N_POL_ILTM	-1.48	-1.57	N_HKG_SNY	-2.08	-2.45
N_CAN_HMD	-1.32	-1.46	N_ROU_ILTM	-1.37	1.06	N_IND_SNY	-1.64	-2.03
N_CHN_HMD	-2.64	-2.60	N_USA_ILTM	-2.49	-1.40	N_ITA_SNY	-2.54	-2.46
N_DEU_HMD	-2.04	-2.14	N_ZAF_ILTM	-2.83	-2.79	N_JPN_SNY	-1.88	-1.85
N_EGY_HMD	-0.79	-0.83	N_AUS_SGLK	-2.08	-2.37	N_MYS_SNY	-4.36[a]	-4.11[a]
N_FRA_HMD	-2.64	-2.45	N_BRA_SGLK	-1.65	-1.64	N_POL_SNY	-2.24	-2.63
N_GBR_HMD	-1.61	-1.17	N_CAN_SGLK	-0.94	-0.66	N_ROU_SNY	-0.92	-1.08
N_GRC_HMD	-0.10	-0.44	N_CHN_SGLK	-2.07	-2.00	N_USA_SNY	-1.44	-1.78
N_HKG_HMD	-1.91	-1.70	N_DEU_SGLK	-1.53	-1.74	N_ZAF_SNY	-3.24[c]	-2.57
N_IND_HMD	-1.78	-2.11	N_EGY_SGLK	-2.79	-2.79	N_AUS_TEK	-1.81	-2.12
N_ITA_HMD	-1.42	-1.45	N_FRA_SGLK	-1.72	-1.73	N_BRA_TEK	-1.74	-1.75
N_JPN_HMD	-1.56	-2.08	N_GBR_SGLK	-2.29	-2.40	N_CAN_TEK	-4.73[a]	-4.69[a]
N_MYS_HMD	-1.93	-1.94	N_GRC_SGLK	-1.60	-1.67	N_CHN_TEK	1.78	1.62
N_POL_HMD	-2.74	-2.73	N_HKG_SGLK	-2.08	-2.26	N_DEU_TEK	-7.17[a]	-6.26[a]
N_ROU_HMD	-2.11	-2.03	N_IND_SGLK	-1.73	-1.75	N_EGY_TEK	-2.58	-2.61
N_USA_HMD	-1.02	-0.65	N_ITA_SGLK	-2.43	-2.26	N_FRA_TEK	-4.62[a]	-5.20[a]

N_ZAF_HMD	-0.53	-0.95	N_JPN_SGLK	-1.90	-2.13	N_GBR_TEK	-7.18[a]	-8.67[a]
N_AUS_ILTM	-1.59	-1.64	N_MYS_SGLK	-2.43	-1.93	N_GRC_TEK	-0.09	-0.07
N_BRA_ILTM	-3.52[b]	-3.51[b]	N_POL_SGLK	6.52	5.95	N_HKG_TEK	-3.03	-3.18
N_CAN_ILTM	-2.84	-2.78	N_ROU_SGLK	-2.10	-2.03	N_IND_TEK	-6.29[a]	-6.16[a]
N_CHN_ILTM	-3.27[c]	-3.15[c]	N_USA_SGLK	-2.14	-2.43	N_ITA_TEK	-4.37[b]	-3.72[b]
N_DEU_ILTM	-1.30	-1.38	N_ZAF_SGLK	-1.05	-1.49	N_JPN_TEK	-3.88[b]	-3.63[b]
N_EGY_ILTM	-1.55	-2.15	N_AUS_SNY	-1.37	-1.56	N_MYS_TEK	-0.77	-0.82
N_FRA_ILTM	-1.42	-1.52	N_BRA_SNY	-2.35	-2.65	N_POL_TEK	-3.70[b]	-3.65[b]
N_GBR_ILTM	-2.48	-1.85	N_CAN_SNY	-1.11	-1.11	N_ROU_TEK	0.72	0.47
N_GRC_ILTM	-1.26	-1.18	N_CHN_SNY	-1.21	-1.64	N_USA_TEK	-5.17[a]	-5.59[a]
N_HKG_ILTM	-1.91	-1.94	N_DEU_SNY	-1.64	-1.80	N_ZAF_TEK	-7.25[a]	-6.43[a]
N_IND_ILTM	-1.95	-1.98	N_EGY_SNY	-2.88	-2.45			
N_ITA_ILTM	-2.17	-2.47	N_FRA_SNY	-1.84	-2.12			

The symbols N and P indicate the negative and positive component of the respective stock market, respectively. a, b, c indicate the significance level of 1%, 5% and 10%, respectively.