



**T.C.
YEDİTEPE UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES**

**TESTING FOR MARKET INTEGRATION:
FINANCIAL RETURN & VOLATILITY SPILLOVER AND CO-MOVEMENT**

By

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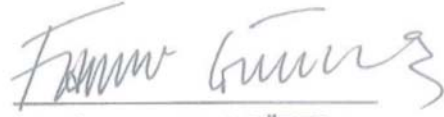
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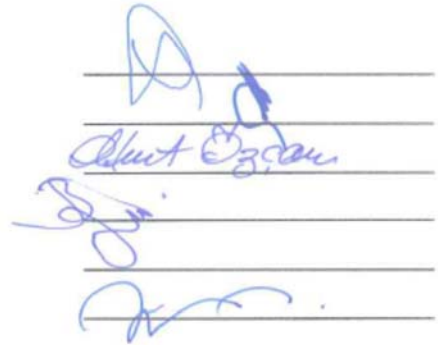
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ÖZET

Finans piyasalarının birbirlerinden etkilenip etkilenmediğinin cevabı, araştırmacılar tarafından küreselleşme zaman içerisinde kuvvetlendikçe daha yoğun bir şekilde aranmaktadır. Piyasaların bütünleşmesi; finansal piyasaların etkileşimi için kullanılan geniş kapsamlı bir tanım olarak, finansal kaynakçada getiri ve oynaklık yayılması, portföy çeşitlendirmesi, bölgesel iktisadi birlikler, Küresel Finansal Kriz ve onun Amerika Birleşik Devletleri'nde baş gösterip dünyanın kalan kısmına yayılması gibi farklı yönlerden ağırlık kazanmaktadır.,

Bu çalışma ABD'den diğer 31 ülkenin sermaye piyasalarına getiri ve oynaklık sıçraması olup olmadığı, bu etkileşimin (şayet varsa çift yönlü olarak) 2008'de patlak veren Küresel Finansal Kriz öncesinde, esnasında ve sonrasında nasıl değiştiği sorularına yanıt bulmayı amaçlamaktadır. Küresel Finansal Kriz öncesindeki-esnasındaki-sonrasındaki (2004-2014) dönemler için, getiri sıçramasını sınamak amacıyla VAR ve VECM modelleri ve onların alt fonksiyonları olan etki-tepki ve varyans ayrıştırması, ve Granger ve Toda-Yamamoto nedensellikleri kullanılmıştır. Oynaklık tarafında ise, 1994-2014 arasını kapsayan bir dönem için ABD'den eşlenen piyasaya (31 farklı eşlenmiş seri) olan sıçramayı irdelemek için sekiz adet GARCH modeli kullanılmıştır. Küresel Finansal Kriz esnasında sıçrama mekanizmasında değişim olup olmadığını ortaya çıkarmak içinse kukla değişkenli yordama (regresyon) analizi yürütülmüştür.

Sonuçlar ABD'den eşlenen ülkeye getiri ve oynaklık sıçramasının bulunduğu, tersi bir ilişkininse (eşlenen ülkeden ABD'ye) bazı piyasalarda tespit edildiği sonucuna varılabilineceğine işaret etmektedir. Küresel Finansal Kriz esnasında ise oynaklık sıçraması yapısında değişim olduğu gözlemlenmiştir.

Anahtar Sözcükler:*Bütünleşme, Getiri ve Oynaklık Sıçraması, VAR, VECM, Granger ve Toda-Yamamoto Nedensellikleri, M-GARCH*



ABSTRACT

The answer of if the financial markets are affected from each other is being pursuit by the researchers more intensively as the globalization gets stronger. The market integration has a gaining weight in the financial literature from many different perspectives such as return and volatility spillovers, portfolio diversification, regional economic unions, Global Financial Crisis (GFC) and its outbreak from the US economy to the rest of the world, etc.

This study attempts to show the return and volatility spillover among the US and other 31 countries' financial markets and how these bilateral interactions (if any) evolve before, during and after the GFC breaking out in 2008. VAR and VECM models with their sub-fuctions of impulse-response and variance decomposition, and Granger and Toda-Yamamoto causalities are employed for the return spillover tests for the period 2004-2014 (before-during-after the GFC). For volatility modelling, eight types of GARCH models are brought to scrutinize the spillover among the US stock market and the paired market (31 different pairs) for a data set ranging from 1994-2014. A dummy regression analysis is also conducted to explore if there is a change in the spillover mechanism in the volatility during the GFC.

There is significant evidence to conclude that return and volatility spillover exist from the US to the paired country; a reciprocal effect is detected in some markets as well. There is also change in the nature of the volatility spillover during the GFC.

Keywords: *Contagion, Return and Volatility Spillover, VAR, VECM, Granger and Toda-Yamamoto Causalities, M-GARCH*

DEDICATION

To my Mother...



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I am very grateful to my supervisor; Assoc. Prof. Dr. H. Gaye Gencer, for inspiring me in all the phases of my study, for her guidance and wisdom lighting my way.

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1. INTRODUCTION

The examination and measurement of the return and volatility linkages among various international stock markets have been attracted significant attention by academicians and authorities. A correct measurement of the degree to which world equity markets are interlinked in terms of return and volatility relationships is also important for investors who want to have profits from investing in overseas markets. A low level of association between two different stock markets implies that an average investors can diversify his/her portfolio by simply including these two low-linked equity markets into the portfolio and thereby provides additional benefits for investors' overall wealth.

1.1. The Core Dynamics – Return & Risk

In defining and measuring the degree of the linkages among financial markets, undoubtedly the return and risk universe described by Markowitz (1952) is the retaining theory. In his dissertation, Markowitz has given a mathematical framework of merging the two most important elements of portfolio management; return of the asset and the risk stemming from the volatility. Markowitz brings the idea that how a portfolio; set of assets, is affected from the return and volatility of a single asset in that portfolio. He showed; by assuming investors are risk averse, that the higher return asset will be picked among the equally risky assets or less risky asset will be favored in case of assets offering same return. Markowitz also mathematically depicted tha the co-movement between assets may contribute in the performance of the portfolio. In his definitions, he provided an efficient frontier marked on a return-variance domain

formulating the relationship between the portfolio return and variance where the portfolio risk is reduced simply by combining the assets that are not perfectly positively correlated (*optimum portfolio selection by diversification*).

1.2. The Study

The main objective in this study is to analyze the return and volatility interaction between the world's largest stock markets; the US stock market-S&P 500, and 31 selected equity markets of the OECD countries. Therefore, the results of this study offer important insights for different economic agents and answer several crucial research questions. Firstly, the results of this study would carry importance for international investors and fund managers, because the presence of considerable return and volatility linkages between the large markets and the world's most liquid market, US, implies that risk-reduction potential of an asset can diminish therefore global diversification may become useless. Secondly, for politicians and authorities, there is a need for new policy tools to design a more sustainable financial system if the markets become significantly more interlinked during the period of market crash or economic crisis.

In the first part of this study, we investigate return interactions between the US stock market and the other OECD member countries' equity markets by using causality analyses, impulse-response functions and variance decompositions. In the second section of the study, information and risk transmission between the US equity market and the other markets are modelled by using eight different multivariate GARCH (MGARCH) models. We also analyze if the interdependence between the US and the other markets substantially increases during the recent crisis of 2008.

In this regard, this study analyzes the dynamic nature of the return and volatility transmission mechanisms between the US stock market and those of the G20 countries. We expand the dataset by including twelve other EU member countries to provide a more comprehensive research and empirical evidence on the transmission dynamics of the markets under investigation.

The findings from this paper suggest that significant return, shock and volatility spillovers significantly are found from the US to the other G20 markets while we also observe that the transmission mechanism runs from some of the other markets to the US as well. The bilateral shock transmission is more common than the bilateral volatility transmission. We observe the dominant role of the US in transmitting shocks, however in case of the volatilities, the spillovers from the other markets to the US are also observed. Moreover, asymmetric news coefficients also provide evidence of negative shocks from the US bring higher volatility in 12 of the markets, while only in 6 markets positive shocks from the US affect the volatility. Our results also depict asymmetric response of the US stocks to the news from the other markets, however the sign of the reaction is mixed across the markets.

The empirical results related to the asymmetry suggest that bad shocks from the US possess more influence on the volatilities of the other markets. However, we arrive at the mixed results for the shock transmission from the other markets to the US, in almost half of the cases the findings signify that positive news have more effect on the volatility of the US equity market. This is plausible in the sense that this is a case in the finance literature, explained by the two theories. The first theory “leverage effect” implies that the risk of a stock increases with its debt to equity ratio. Another

theory relates the asymmetric effects to the volatility feedback impact that asserts that an unanticipated decrease in volatility results in a decline in the price-dividend ratio.

We also analyze whether the market variances and conditional correlations extracted from the Asymmetric BEKK model significantly change during the different stages of the GFC. By utilizing OLS regressions constructed with dummy variables, we report significant increases in both the correlations and the variances. Our findings suggest that the correlations between the US and the other markets significantly increase during the second and the third phases of the GFC. Moreover, the second phase of the crisis witnesses significant inclination in market variances signaling the contagious flow of the turmoil from the US to the markets under investigation. Our OLS regressions with dummy analysis underlie that emerging markets are more interdependent to the US economy; however, more industrialized emerging markets such as Russia and China demonstrate a lower level of interdependence with the US. This result points out to the heterogeneity of the emerging markets as a group, implying that some emerging markets offer better diversification opportunities to international investors.

In this regard, our results suggest indicative implications for investors and portfolio managers to capture higher returns and lower risk since analyzing the mechanism of shock and volatility transmission can be beneficial for cross market operations.

1.3. Contribution to the Literature

The market integration in overall; including the sub-concepts such as portfolio diversification, return spillover, volatility spillover, co-integration among financial markets, etc. are widely and deeply investigated by the researchers in the field of finance. Since the rigorous econometrical techniques are being employed starting from early 1900s and then followed by finance theories by Markowitz (1952), Fama (1970) and many other researchers', the literature has gained from the valuable works in the topic of market integration and portfolio management by diversification.

However, as an emerging need arising from the volatility in the global markets or fluctuations in the stock indexes regionally; no matter the first global financial crisis in 20th century which is The Great Depression, the emphasis on the market behaviour during the Oil Crisis (1973), Asian Crisis (1997) and Global Finance crisis (2008) is gaining importance. The interaction of the single assets, sectors, and market indexes is far better modeled mathematically thanks to introduction of new econometric models for time series also implemented by the new softwares. Wang (2014), Voronkova (2004), Pritsker (2001), Korajczyk (1996) and many other researchers have investigated either there is an interaction, spillover (contagion) and integration among the financial markets or not.

This study relies on the existing literature in a way that the return and volatility spillovers are attempted to be described via well-known and generally accepted econometric models of time-series. The interaction is also measured on a long-range period (1994 to 2014) like in many studies conducted so far as well as the Global Economic Crisis period is scrutinized. However, our study; differing itself from

current literature, embodies some uniquenesses. Firstly, from the data selection perspective, the research provides a long-range data analysis (1994 to 2014 with some exceptions due to availability) with high frequency (daily) stock market index series of G20 countries (32 indexes are investigated because some EU members are individually added in the research scope). To investigate the high frequency and long-range time series; either in return and volatility perspectives, a wide set of analysis methods are employed for descriptive and preliminary data analysis (such as ARCH modeling tests, Zivot-Andrews unit root tests), return spillover models (VAR and VECM, Granger and Toda-Yamamoto causalities, impulse-response and variance decomposition models) for a long period also covering GFC. Our study differs from the other work in the existing literature in the sense that we do not only examine the return dependencies by using a vector-based model but we also investigate whether these dependencies change during the Global Financial Crisis of 2008. Therefore, we contribute to the present literature by extensively analyzing the interactions at the stock market level specifically at times of the latest worldwide market crash in 2008. For the risk spillover analyses, volatility spillover models (eight types of VAR-GARCH models to extract the shock and volatility spillover) are utilized for a long term spillover diagnosis and a discrimination analysis is conducted via dummy variable embedded in the VAR Asymmetric BEKK GARCH Model within the Global Financial Crisis period. All in all, The study provides a macro perspective to return and volatility spillover in financial markets via its wide portfolio of selected countries on a long range data and a micro aspect by rigorous econometric models to distinguish itself from current literature.

2. THEORETICAL FRAMEWORK

The main objective of this study is to explore if there exist a co-integration among different financial markets. The interaction between those markets are described in terms of generic models such as return spillover and volatility spillover; as well as sub-parameters embedded in those models such as conditional and unconditional correlations, shock and asymmetry parameters, long term and short term cointegration estimates, impulse-response, variance decomposition, causalities (Granger and Toda-Yamamoto) and so forth. Also, dummy parameters are assigned to explore the variations between sub-periods in selected time frame. This section is dedicated to provide a summary of the previous studies about return and volatility spillover in the financial environment.

2.1. Literature for the Return Interactions

There is a vast literature which analyzes the return relationships between equity markets within the context of the Vector Autoregression (VAR) models and its complementary tools, such as innovation accounting analysis and Granger-type causality.

The VAR-class modeling dates back to Sims (1980). Since then, the VAR model and vector error correction mechanism (VECM) are commonly used by researchers to determine the return interactions between different international markets. Before estimating the short-run linkages between the equity markets, a possible long-run co-integration relationship should be detected. If the variables are co-integrated, this implies the presence of a probable common stochastic trends shared by the stock markets. In this case, the efficient market hypothesis (EMH), which states

that the future value of the stock market prices cannot be forecasted by using the price information of any other stock market, is violated. In other words, two stock markets sharing common stochastic trends violate the efficient market hypothesis given the fact that one of the markets contains information about the other stock market to forecast its price value in the future.

In addition, the presence of significant return interaction and co-integration between the international stock investments provides some implications in terms of portfolio management. As it is well known, portfolio theory suggests that an average investor should diversify his/her portfolio with the addition of the assets that are not perfectly correlated. If there exists positive return interactions and significant co-integration across the stock markets under examination, the advantage of international portfolio diversification is limited. The stock markets that have positive returns linkages and co-integration can generate similar return in the future. That's to say, as the international stock market returns become more interdependent and co-integrated, losses occurred in one stock market cannot be compensated by the profits resulted from diversification strategies and gained from the other market.

Kasa (1992) is among the first authors that utilize the co-integration and VAR methodologies to analyze stock market return linkages. During the period of 1974-1990, the results of the paper reveal that there is a single common stochastic trend among the markets of Canada, Germany, Japan, UK and US. Richards (1995) analyzes the return interactions from a different perspective and argue that stock markets have a common world component and one permanent and one transitory country-specific component. Conducting common stochastic trend analysis in a recursive estimation fashion, Rangvid (2001) investigates the degree of convergence among European

stock markets and finds that equity market convergence in the European continent has been significantly increased during the study period of 1960 and 1999. Bessler and Yang (2003) investigate the return interactions among international stock markets, namely Australia, Japan, Hong Kong, United Kingdom (England), Germany, France, Switzerland, United States, and Canada. Their empirical findings based on the innovation accounting procedure suggest that the US market is the only market that affects price movements of the other national equity markets in the sample even over the long horizon.

VECM model is utilized when the series are cointegrated. This model is classified under the category of multiple time series and employed for data having with long-run stochastic trend, named as cointegration. In their studies, Bianconi, Yoshino and Sousa (2013) have showed there is positive cointegration (effect of U.S. financial stress to paired economy) between U.S.-Brazil with negative permanent impulse-response level, negative cointegration between U.S.-India with negative permanent impulse-response level (significant speed of adjustment) and null cointegration between U.S.-Russia with negative permanent impulse-response level (significant speed of adjustment) and U.S.-China with negative cointegration temporary impulse-response level. Neaime (2016) investigated the vulnerability and the international and regional financial linkages of the MENA stock markets. In the study, Granger causality tests and impulse response functions gave the result that the GCC (Gulf Cooperation Council) equity markets still provide international portfolio diversification opportunities and those markets are less vulnerable to global and regional financial crises. It is also shown that strong cointegration between the MENA markets and the world stock markets in the long-run exist. VAR and VECM models are employed to

show lead-lag relations, long-run cointegration between the different markets as well as short-run adjustment speed (Qiao et al. (2008), Chiang et al. (2008)). Lucey and Muckley (2011) examined the international stock market diversification. They found that the European stock markets provide a more intense long-term diversification compared to Asian stock markets.

Some researchers make use of Granger causality, impulse response function and variance decomposition analyses as the complementary tools of the VAR models. Chen et al. (2002) apply the aforementioned multivariate methodologies to analyze the return interactions among the Latin American markets, namely Argentina, Brazil, Chile, Colombia, Mexico and Venezuela. Their results related to the impulse response functions imply that the markets significantly react to the shocks coming from Brazil and Mexico and there exists considerable degree of return interactions between the markets under investigation. Therefore, they state that diversification benefits from these markets can be limited.

Focusing on the causality relations between Central and Eastern European (CEE) countries, Poland, Czechia and Hungary, Gilmore and McManus (2002) find that Granger causality runs from Hungarian market to the Polish stock market, which shows that these three markets are not separated. Maneschiöld (2006) empirically analyzes the stock market integration between the Baltic States (Estonia, Latvia, Lithuania) and the global equity markets (Germany, France, Japan, UK and US). Their main results are twofold: First, they show that there is no significant evidence for the existence of a common trend between the Baltic markets and the global markets as found from the co-integration analysis. Second, their statistical findings based on the Granger-causalities indicate that the European and US markets cause the returns of the

Baltic markets. In a more recent study, Nikkinen et al. (2012) also study on the co-movement between Baltic equity markets and the aggregate European stock exchange (EUROSTOXX50) and analyze whether the market linkages differ at times of the severe financial turmoil experienced in 2008. Their results based on Granger causalities and variance decomposition methods show that the Baltic markets are in strong connection with the aggregate European index during the crisis. The variance of a particular Baltic market can be explained by the volatility of EUROSTOXX50 more in crisis period.

For the use of Toda-Yamamoto, the study of Hamori and Imamura (2000); an empirical analysis of the causal relationship among stock prices in the G7 countries by employing the lag augmented vector autoregression (LA-VAR) method developed by Toda and Yamamoto (1995) can be mentioned. In their studies, Hamori and Imamura used monthly data for the period from 1969 to 1995. They revealed that the causal relationship between US stock prices and those in the rest of the world is significant. They concluded that this may be because of the the dominating effect of the US economy on the global market.

2.2. Literature for Volatility Interactions

As we indicate earlier, volatility spillover mechanism is also examined. If a significant risk transmission from one market to another occurs, it implies that diversification potential of investing in diverse assets can still diminish. To this end, information (shock) and risk (volatility) transmission is modelled via eight different multivariate Generalized Autoregressive Conditional Heteroskedasticity (MGARCH)

models. We also test for the outperformance of these models in identifying the transmission process by using different residual tests.

The literature on financial integration shows variations by the methods applied as well as the economies investigated, however, recently the focus is on both return and volatility spillovers between stock markets, as the shocks in one market are instantaneously transmitted to other markets, diminishing the benefits of international diversification. Fleming et al. (1998) and Hassan and Malik (2007) attribute these spillovers to cross-market hedging. The October 1987 crash in the US, the 1992-93 ERM (Exchange Rate Mechanism) crisis, the 1990 turmoil in emerging stock markets have all intrigued researchers to study the transmission mechanisms of shocks among equity markets (Masson, 1998; Kaminsky and Reinhart, 2000; Pritsker, 2001; Claessens et al., 2001; Karolyi, 2003; Pericoli and Sbracia, 2003). In line with the literature on market integration, financial contagion is also widely discussed in the context of volatility spillovers (Kodres and Pritsker, 2002; Forbes and Rigobon, 2002; Cappiello et al., 2006; Dooley and Hutchison, 2009; Aloui et al., 2011). Abou-Zaid (2011) discusses that linkages between returns of different markets are either simultaneous interdependence or lead-lag relations, which are measured by contemporaneous correlations and cross-autocorrelations respectively. Furthermore, the spillover effects are found to be asymmetric and they are categorized as idiosyncratic, regional and global (Lin et al., 1994; Karolyi and Stulz, 1996; Booth et al., 1997). In the related literature, the correlations between equity markets are mostly found to be dynamic (Bekaert and Harvey, 1995; Chen et al., 2002; Voronkova, 2004; Kim et al., 2005; Cappiello et al., 2006) and the pioneering role of the US stock market for both the developed and the emerging markets is documented (Eun and

Shim, 1989; Cheung and Mak, 1992; Masih and Mash, 1997; Theodossiou et al., 1997; Baele, 2005; Bekaert et al., 2002; Cheung et al., 2010).

Previous literature on the interaction of different stock markets dates back to 1960's. Grubel (1968) documents that international diversification improves portfolio efficiency. Earlier studies focus on the return interactions (Levy and Sarnat, 1970; Panton et al., 1976; Hillard, 1979) while more recent studies concentrate on volatility linkages. Park and Fatemi (1993) examine the dependence structure of the seven Pacific-Basin economies (Australia, Hong Kong, Korea, New Zealand, Singapore, Taiwan, Thailand) on the three industrialized stock markets (the US, the UK and Japan). They report that despite the high level of economic integration between the developed and the Pacific-Basin countries, the Pacific-Basin equity markets display a weak bond with the US, the UK and the Japanese stock indices; a finding which the authors attribute to the unique structure of the Pacific-Basin economies. Beirne et al., (2009) use a tri-variate VAR-GARCH model with the BEKK representation to analyze the spillovers from mature markets to the local emerging markets. They document volatility spillovers from the mature markets to the emerging markets with significant shifts in the volatility parameters during market turbulence in the mature economies. Chudik and Fratzscher (2011) report that the co-movements between the US and particularly the developing equity markets in the Eastern Europe and the Latin America decline during the Global Financial Crisis (hereafter GFC). Wu et al. (2014) paraphrase interdependence as a "slow-burn spillover" and contagion as "fast and furious shock waves" and attest that during the GFC, the US was co-integrated with the Asian stock markets, however they evince no contagion from the US to the Asian economies. Wang (2014) conducts a multivariate VAR analysis to examine the level

of integration among six East Asian stock markets (Shanghai, Hong Kong, Taiwan, Singapore, South Korea, Japan) as well as their relation with the US equity market and finds that with the “Great Recession” the linkages among Asian economies intensify while the bound with the US weakens. Narayan et al. (2014) study the integration patterns among four Asian economies and Australia, China, India and the US over the period from 2001 to 2012. They acknowledge that for the Asia-US group, the GFC is a significant determinant for the pairwise correlations within the group, while the Asian economies are more intensely related to the Chinese stock market.

Didier et al. (2012) examine the co-movements between the US stocks and 83 equity markets during the GFC and evince that financial integration accentuates stronger co-movements. Bentes (2015) studies the integration of five stock markets (Japan, Portugal, Spain, the UK and the US) between 1999 and 2014, and finds that these markets are linked together by one long-run relationship. Babecky et al. (2013b) analyze the degree of stock market integration between China and Russia, as well as their integration with the US, the Eurozone and Japan between the period 1995 and 2010. They document an increasing convergence in stock market returns after both the 1997 Asian and 1998 Russian crises, which also continue after the global financial meltdown, ensuing a short disjunction during the crisis period. Chen et al. (2014) investigate the stock market integration between frontier and leading markets between the period 2000 and 2011 in a study whereby they manifest the leading power of the US stock market for frontier economies. Jawadi et al. (2015) analyze the volatility spillover between the US and three major European stock markets (Germany, France and the UK) using high frequency data and document increased bi-directional return

and volatility spillovers between the US and the European stock markets during the global crisis.

In this study, eight GARCH models are employed to extract the volatility interaction. Any model in our list has a set of parameters differing from others; to explain the interaction comprehensively, with high accuracy and also parsimoniously.

2.3. A Short Review of Efficient Market Hypothesis (EMH)

Regarding the spillover of return and volatility among the selected stock indices, the discussion about the previous studies are given above. However, it is deeply argued and studied by researchers that if the co-integration studies of financial markets are directly linked to market efficiency theory. As it is the core aim of this study, the correlation between markets in terms of price and volatility can be stochastically modeled and rigorously examined numerically in the past decades. However, these studies also bring the discussions of “Is the market efficient”, “Is it possible to trace out the links between different markets systematically”, and so forth. For that, this section is dedicated to a brief review of EMH for a better understanding of the previous studies about the mathematical representation, interpretation and discussion of the correlation among financial markets.

In their works of collection of EMH literature, Dimson and Mussavian (1998) refer to the dissertation of Bachelier (1900) in early 20th century (submitted to the Sorbonne for his PhD in Mathematics). In his dissertation, Bachelier asserts that “past, present and even discounted future events are reflected in market price, but often show no apparent relation to price changes”. In the further sections of the same study, it is

also argued that “if the market, in effect, does not predict its fluctuations, it does assess them as being more or less likely, and this likelihood can be evaluated mathematically”.

Until the ground breaking study of Fama (1970), numerous researches conducted about the foundations of EMH; random walk model in finance. In his study, Kendall (1953) defines the test procedure as “analysis an economic timeseries by extracting from it a long-term movement, or trend, for separate study and then scrutinising the residual portion for short-term oscillatory movements and random fluctuations”. In his study, Kendall examined 22 UK commodity and stock price series and came to the conclusion inconsistent with the other researchers and supported random walk model. Along with Kendall, Roberts (1959) and Osborne (1959) came to same conclusion with Kendall about the existence of random walk in the financial time series.

On the other hand, contrary to the random walk in the financial time series, researches were published supporting the existence of anomalies in the price behavior and series exhibiting predictable patterns. Working (1934), Cowles and Jones (1937), Working (1960), Alexander (1961) and many other researchers supported the existence of anomalies and set a pioneering idea for market microstructure.

Fama (1970) gave the literature of random walk theory in financial series and introduces his study supporting the weak form of market efficiency. In the further sections of his paper, Fama provided the tests results of semi-strong form and strong form of market efficiency and came to the conclusion that “in short, the evidence in

support of the efficient markets model is extensive, and (somewhat uniquely in economics) contradictory evidence is sparse”.

Fama (1970) had described the three types of the hypothesis: weak, semi-strong, and strong form. The weak form of the EMH asserts that prices reflect all the past information publicly available. The semi-strong form argues that prices reflect all information publicly available and that new public information reflected in the prices. The strong form of the EMH also incorporates the hidden information which is not available to everyone in the market and prices reflect it.

Following the introduction of different forms of efficiency by Fama, the EMH studies boomed. Event studies Fama, Fisher, Jensen and Roll (1969) and Ball and Brown (1968) tested the effect of stock splits and earning announcements on the share prices and concluded that the price adjustments were mostly completed before the event. Cowles (1933, 1944) concluded that fund managers assumed to be having insider information were not able to beat the market. A detailed analysis was conducted by Jensen (1968) over a 115 mutual funds covering a period between 1955-64. Jensen came to the conclusion of insufficient performance by funds taking the management and brokerage fees into account. However, on the contrary, Grossman and Stiglitz (1980) are on the side that EMH leaves some room for small anomalies enabling opportunities to rule out the market.

3. METHODOLOGY

3.1. Testing for a Unit-root

The initial requirement for a cointegration relationship is to analyze the presence of a unit-root; if the two stock markets have a unit-root (integrated) at the same order; it implies that the markets are cointegrated in the long-run. In this context, we analyze the unit-root with three econometric tests that are commonly used in the literature of economics: Augmented Dickey Fuller (ADF, 1979), Phillips-Perron (PP, 1988) and Zivot-Andrews (1992) tests.

We conduct the ADF to test for a unit-root in the existence of serial-correlation in the white noise errors. The test is based on the following regression:

$$z_t = \mu + \beta t + \psi z_{t-1} + \varepsilon_t \quad (1)$$

where μ , t and ε_t represent a constant, a time trend and the error term. The error terms are generated by a stationary ARMA (p, q) process:

$$\varepsilon_t = \sum_{i=1}^p \alpha_i \varepsilon_{t-i} + \sum_{i=1}^q \phi_i \eta_{t-i} + \nu_t \quad (2)$$

with α_i and ϕ_i being the AR and MA parameters, correspondingly. If ε_t is found to stationary and invertible, we can write the above equation as the AR (∞) process as:

$$\varepsilon_t = \sum_{i=1}^{\infty} k_i \varepsilon_{t-i} + \nu_t \quad (3)$$

where k is the sequence of the AR parameters.

We rewrite the equation as an AR (m) process:

$$\varepsilon_t = \sum_{i=1}^m k_i \varepsilon_{t-i} + v_t \quad (4)$$

Under the null hypothesis of presence of a unit-root, the ADF tests for the correlated errors such that $\Delta z_t = \varepsilon_t$

$$z_t = \mu + \psi z_{t-1} + \sum_{i=1}^m \psi_i \Delta z_{t-i} + v_t \quad (5)$$

Subtracting z_{t-1} gives,

$$\Delta z_t = \mu + \lambda z_{t-1} + \sum_{i=1}^m \psi_i \Delta z_{t-i} + v_t \quad (6)$$

and $\lambda = (\psi - 1)$

The test has the following hypotheses:

$$\begin{aligned} H_{null} : \lambda &= 0 \\ H_{alternative} : \lambda &< 0 \end{aligned} \quad (7)$$

The ADF test calculates the critical values based on the t-statistics that can be found in Dickey and Fuller (1979).

Another measure to test for a unit-root is the Phillips-Perron (PP) test, which is different from the ADF test in terms of serially correlated and heteroskedastic errors. The PP test makes a non-parametric correction to the test statistics instead of approximating the ARMA errors with a parametric regression. The test regression for the PP test is given as:

$$\Delta z_t = \mu + \beta t + \psi z_{t-1} + \varepsilon_t \quad (8)$$

The modified test statistics, Z_t and Z_π are expressed as:

$$\begin{aligned} Z_t &= \left(\frac{\hat{\sigma}^2}{\hat{\lambda}^2} \right)^{\frac{1}{2}} t_{\pi=0} - \frac{1}{2} \left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2} \right) \left(\frac{T \cdot SE(\hat{\pi})}{\hat{\sigma}^2} \right) \\ Z_\pi &= T\hat{\pi} - \frac{1}{2} \frac{T^2 SE(\hat{\pi})}{\hat{\sigma}^2} (\hat{\lambda}^2 - \hat{\sigma}^2) \end{aligned} \quad (9)$$

The expressions $\hat{\sigma}^2$ and $\hat{\lambda}^2$ are consistent estimates of the variance parameters:

$$\begin{aligned} \sigma^2 &= \lim_{T \rightarrow \infty} T^{-1} \sum_{t=1}^T E[\varepsilon_t^2] \\ \lambda^2 &= \lim_{T \rightarrow \infty} \sum_{t=1}^T E[T^{-1} S_T^2] \end{aligned} \quad (10)$$

where $S_T = \sum_{t=1}^T u_t$. The parameters $\hat{\sigma}^2$ and $\hat{\lambda}^2$ allow the correction for autocorrelation and heteroscedasticity, since $\hat{\sigma}^2$ is the consistent estimate of the error variance of the least squares residuals ε_t and $\hat{\lambda}^2$ is the Newey-West estimate of the long run variance.

Under the null hypothesis of $\pi=0$, the ADF and PP tests have the same asymptotic distributions with the ADF tests. However, there are two particular advantages of the PP test over the ADF. The first and the most important advantage is that PP is robust to heteroscedasticity which is present in our data. The second one is that we do not need to determine the lag order for the test regression unlike the ADF.

For unit-root process, we also take possible structural breaks into account.

Zivot-Andrews(1992) (ZA) test of unit-root is employed to analyze whether the results from previous unit-root tests significantly change once the breaks are accounted for. ZA test is an endogenous structural break test which is sequential and utilizes dummy

variable for each of the potential date of break. The break date is selected according to the minimum t-statistics of the ADF test.

3.2. Testing for Cointegration

In practice, two stock markets may be co-integrated since they have common stochastic trends, moving together in the long-run. We perform Johansen (1991) procedure to analyze whether the markets share common underlying trends over the long-term. For this, we rely on a VAR process:

$$z_t = \Pi_1 z_{t-1} + \dots + \Pi_m z_{t-m} + u_t \quad (11)$$

where u_t is a $p \times m$ vector. We write the above equation in the form of an error correction model as follows:

$$\Delta Z_t = \Gamma_1 \Delta z_{t-1} + \dots + \Gamma_{m-1} \Delta z_{t-m+1} + \Gamma_m z_{t-m} + u_t \quad (12)$$

with $\Gamma_i = -I_m + \Pi_1 + \dots + \Pi_i$ and $\Pi = \gamma \alpha'$ where α is the cointegrating vector. We analyze the cointegrating equation with two different tests and hypotheses: trace and the maximum eigenvalue statistics.

The null and alternative hypotheses of the trace statistic are:

$$\begin{aligned} H_{null} &: \text{rank}(\Pi) = r \\ H_{alternative} &: r < \text{rank}(\Pi) \leq M \end{aligned} \quad (13)$$

and asymptotically distributed as:

$$\lambda_{trace}(r, M) \xrightarrow{d} \text{trace}(D) \quad (14)$$

The null and alternative hypotheses of the maximum eigenvalue statistic are:

$$\begin{aligned} H_{null} : \text{rank}(\Pi) &= r \\ H_{alternative} : \text{rank}(\Pi) &= r + 1 \end{aligned} \quad (15)$$

and asymptotically distributed as:

$$\lambda_{\max}(r, r+1) \xrightarrow{d} \lambda_{\max}(D) \quad (16)$$

$$\text{For both of the tests } D := \left(\int_0^1 W dW' \right)' \left(\int_0^1 W W' ds \right)^{-1} \left(\int_0^1 W dW' \right)$$

where $W = W_{K-r}(s)$ is a $(K-r)$ dimensional standard Wiener process.

3.3. Vector Autoregression (VAR) and Vector Error Correction (VEC) Models

The VAR model proposed by Sims (1980) are widely used in time series econometrics, which enables us to analyze short-run interaction between the economic variables in the absence of cointegration. If the two variables are integrated at the same order and have a cointegration relation, then we use the VEC representation. These two methods also provide important and tractable application of the estimates, such as impulse responses and variance decompositions.

Consider a two variable VAR system at lag order of 2:

$$\begin{pmatrix} z_{1t} \\ z_{2t} \end{pmatrix} = \begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix} + \begin{pmatrix} \beta_{11}^1 & \beta_{12}^1 \\ \beta_{21}^1 & \beta_{22}^1 \end{pmatrix} \begin{pmatrix} z_{1t-1} \\ z_{2t-1} \end{pmatrix} + \begin{pmatrix} \beta_{11}^2 & \beta_{12}^2 \\ \beta_{21}^2 & \beta_{22}^2 \end{pmatrix} \begin{pmatrix} z_{1t-2} \\ z_{2t-2} \end{pmatrix} + \begin{pmatrix} \eta_{1t} \\ \eta_{2t} \end{pmatrix} \quad (17)$$

or

$$\begin{aligned} z_{1t} &= \alpha_1 + \beta_{11}^1 z_{1t-1} + \beta_{12}^1 z_{2t-1} + \beta_{11}^2 z_{1t-2} + \beta_{12}^2 z_{2t-2} + \eta_{1t} \\ z_{2t} &= \alpha_2 + \beta_{21}^1 z_{1t-1} + \beta_{22}^1 z_{2t-1} + \beta_{21}^2 z_{1t-2} + \beta_{22}^2 z_{2t-2} + \eta_{2t} \end{aligned} \quad (18)$$

where z is the market returns and α and β are the parameter vectors. The equations imply that the variables are treated as endogenous and stationary.

The model that we use in the existence of a common stochastic trend (co-integration) is the VEC model (VECM). Assume the 2-variable VECM;

$Z_t = (z_{1t}, z_{2t})'$ and Z_t is cointegrated with the vector $\beta = (1, -\beta_2)'$ so that

$\beta'Z_t = z_{1t} - \beta_2 z_{2t}$ is $I(0)$.

$$\begin{aligned}\Delta z_{1t} &= \alpha_1 + \theta_1(z_{1t-1} - \tau_2 z_{2t-1}) + \sum_j \beta_{11}^j \Delta z_{1t-j} + \sum_j \beta_{12}^j \Delta z_{2t-j} + \eta_{1t} \\ \Delta z_{2t} &= \alpha_2 + \theta_2(z_{1t-1} - \tau_2 z_{2t-1}) + \sum_j \beta_{21}^j \Delta z_{1t-j} + \sum_j \beta_{22}^j \Delta z_{2t-j} + \eta_{2t}\end{aligned}\tag{19}$$

The VEC mechanism provides the reaction of variables when they move out of long-run equilibrium, providing a speed of adjustment coefficient. If the absolute value of the adjustment parameter is low, this indicates a slow speed of adjustment towards the equilibrium.

3.4. Impulse Response Functions (IRF) and Variance Decompositions (VDC)

Impulse-response functions (IRF) and variance decomposition (VDC) analyses have complementary roles in the VAR analysis since they can provide easier ways of interpreting the coefficients within the system. Hence, we utilize IRF and VDC analyses to investigate the return interactions between a specific market and the US equity market.

We examine the effect of an exogenous shock of one variable on the other via generalized impulse-response functions (IRF) which are dynamic simulations of the

response of an endogenous variable over time and invariant to the variables' ordering. A VAR model can be written as a moving average MA (∞) in the Wold representation form as:

$$H_t = \mu + \varepsilon_t + \lambda_1 \varepsilon_{t-1} + \lambda_2 \varepsilon_{t-2} + \dots \quad (20)$$

where λ_l is the $(n \times n)$ moving average matrix. Impulse responses can be written as the row i , column j elements of the matrix λ_l as:

$$\frac{\partial y_{i,t+l}}{\partial \varepsilon_{j,t}} = \frac{\partial y_{i,t}}{\partial \varepsilon_{j,t-l}} = \lambda_{ij}^l, i, j = 1, \dots, n \quad (21)$$

The row i , column j elements of λ_l determines the outcomes of a one unit shock in the j th variable's shock at date t (ε_{jt}) for the value of the i th variable at time $t+l$ ($y_{i,t+l}$), holding all other shocks at all dates constant.

Another complementary method of a structural analysis is the variance decomposition (VDC), which exhibits the contribution of a shock to the future forecast error variance for the system variables. It distinguishes between own shock and other variable shock in forecast variances of a variable. H- period ahead forecast error can be written as

$$z_{t+h} - \hat{z}_{t+h|t} = \eta_{t+h} + \theta_1 \eta_{t+h-1} + \theta_2 \eta_{t+h-2} + \dots + \theta_{h-1} \eta_{t+1} \quad (22)$$

The Mean Square Error (MSE) of the forecast is,

$$\begin{aligned}
MSE(\hat{z}_{t+h|t}) &= E\left[\left(z_{t+h} - \hat{z}_{t+h|t}\right)\left(z_{t+h} - \hat{z}_{t+h|t}\right)'\right] \\
MSE(\hat{z}_{t+h|t}) &= \Omega + \theta_1 \Omega \theta_1' + \dots + \theta_{h-1} \Omega \theta_{h-1}' \\
MSE(\hat{z}_{t+h|t}) &= PP' + \theta_1 PP' \theta_1' + \dots + \theta_{h-1} PP' \theta_{h-1}' \\
MSE(\hat{z}_{t+h|t}) &= \sum_{i=1}^k \left(p_i p_i' + \theta_1 p_i p_i' \theta_1' + \dots + \theta_{h-1} p_i p_i' \theta_{h-1}' \right)
\end{aligned} \tag{23}$$

where $\Omega = E(\eta_t \eta_t')$, p_i is the i th column of the matrix P . The response at lag

p is $\theta_p p$ and the row j and column i element of $\theta_p p$ is the effect of a one standard

deviation shock to $z_{i,t}$ on $z_{i,t+p}$.

3.5. Granger Causality

The Granger causality identifies the causal relationship between the variables and occurs when a particular variable is able to forecast future values of another variable. Let us denote $z_{i,t}$ and $z_{j,t}$ as market returns, considering our two-variable system as below:

$$\begin{aligned}
z_{i,t} &= \tau_0 + \sum_{m=1}^M \tau_1 z_{i,t-m} + \sum_{n=1}^N \tau_2 z_{j,t-n} \\
z_{j,t} &= \theta_0 + \sum_{k=1}^K \theta_1 z_{i,t-k} + \sum_{s=1}^S \theta_2 z_{j,t-s}
\end{aligned} \tag{24}$$

• Unidirectional causality running from z_i to z_j (z_j to z_i) occurs when $\sum_{n=1}^N \tau_2 \neq 0$ and

$$\sum_{s=1}^S \theta_2 = 0 \left(\sum_{n=1}^N \tau_2 = 0 \text{ and } \sum_{s=1}^S \theta_2 \neq 0 \right).$$

• In the case of bidirectional (feedback) causality, $\sum_{n=1}^N \tau_2 \neq 0$ and $\sum_{s=1}^S \theta_2 \neq 0$.

- In the case of no causality-in-variance, $\sum_{n=1}^N \tau_2 = 0$ and $\sum_{s=1}^S \theta_2 = 0$.

3.6. Toda-Yamamoto Test

We also analyze causality relationship by using a more robust test proposed by Toda and Yamamoto (TY, 1995). The TY procedure uses a modified Wald test statistics to avoid the empirical problems related to the traditional Granger causality tests since it ignores any probable co-integration relation or non-stationary of the underlying series. In the TY procedure, we first calculate the maximum order of integration between the series (dmax) and then reestimate the VAR models at lag of (dmax+k).

$$\begin{aligned} z_{i,t} &= \tau_0 + \sum_{i=1}^k \tau_1 z_{i,t-i} + \sum_{i=1}^k \tau_2 z_{j,t-i} + \sum_{j=k+1}^{k+d \max} \tau_3 z_{i,t-i} + \sum_{j=k+1}^{k+d \max} \tau_4 z_{j,t-i} \\ z_{j,t} &= \theta_0 + \sum_{i=1}^k \theta_1 z_{i,t-i} + \sum_{i=1}^k \theta_2 z_{j,t-i} + \sum_{i=1}^{k+d \max} \theta_3 z_{i,t-i} + \sum_{i=1}^{k+d \max} \theta_4 z_{j,t-i} \end{aligned} \quad (25)$$

The TY Granger causality runs from i to j if $\tau_3 \neq 0$ and runs from j to I if $\theta_3 \neq 0$.

3.7. Shock and Volatility Spillovers

This study also investigates the volatility spillovers between the US stocks and the other equity markets by examining the asymmetric responses of volatility spillovers to the unexpected shocks. As indicated earlier, we conduct eight different MGARCH-type models to correctly determine the model characteristics and to assess the robustness of the empirical findings.

As a multivariate version of the univariate GARCH model, **model 1**; the VEC-GARCH specification introduced by Bollerslev, Engle and Wooldridge (1988) provides a straightforward generalization. Within the context of the VEC-GARCH model, conditional variances and covariances are treated as a function of all past conditional variances, covariances and lagged squared returns and cross-product returns as below:

$$H_t = \omega + A\eta_{t-1} + BH_{t-1} \quad (26)$$

where $h_t = \text{vech}(H_t)$ and $\eta_t = \text{vech}(\varepsilon_t \varepsilon_t')$. $\text{vech}(\bullet)$ represents the operator stacking the lower triangular element of a mxm matrix. A and B are the model parameters to be predicted.

In order to incorporate asymmetric volatility effects into the multivariate model; **model 2**, we construct an asymmetric version of the VEC-GARCH model as mathematically formulated below:

$$H_t = \omega + A\eta_{t-1} + BH_{t-1} + Gv_{t-1} \quad (27)$$

where $v_t = \varepsilon_t$ if $\varepsilon_t < 0$ and $v_t = 0$ elsewhere.

The BEKK-GARCH model; **model 3**, proposed by Engle and Kroner (1995) that enables us to quantify the influence of one market on another through spillover effects. The covariance matrices are directly generated from the model and hence the correlations are extracted. Specifically, a fully parameterized BEKK-GARCH (1,1) model with n assets yields $(p+q)kn^2 + n(n+1)/2$ parameter estimates. Thus, we assume that the lags $p=k=q=1$ leading to a BEKK-GARCH (1,1) model. The bilateral model can be mathematically expressed as:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B \quad (28)$$

where H_t , A and B are square matrices and C is an upper triangular matrix. H_t represents a conditional variance-covariance matrix at time t . The diagonal elements in the matrix H_t denote the return variances and the non-diagonal elements are the covariances between the US market and the others. Coefficient A quantifies the effects of the unanticipated shocks while parameter B measures the volatility spillovers.

From the full version of the BEKK model, it is possible to construct other MGARCH-class models. For example, **model 4**; the diagonal version of the model (Diagonal BEKK) can be derived if A and B are diagonal matrices. Besides, we derive **model 5**; Diagonal Shock Spillover BEKK model by modeling the diagonal matrix of the shock parameters only.

In order to examine the asymmetric effects on the volatility spillovers, we extend the BEKK-GARCH model in an asymmetric form following Kroner and Ng (1998). The asymmetric BEKK-GARCH (ABEKK) model; **model 6**, can be written as follows:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B + D'\eta_{t-1}\eta'_{t-1}D$$

$$\eta_{t-1} = \begin{bmatrix} \max(0, -\varepsilon_{1,t-1}) \\ \max(0, -\varepsilon_{2,t-1}) \end{bmatrix} \quad (29)$$

where D is a square matrix modeling asymmetry in variances as well as covariances through η_{t-1} . The positive (negative) and statistically significant scalar parameters of D in the diagonal elements of η_{t-1} imply that bad (good) news are found

to have a greater (lesser) impact in own volatility while the non-diagonal elements represent the cross asymmetric effects in the same manner.

Asymmetric Diagonal BEKK model; **model 7**, and its diagonal shock spillover model; **model 8**, are also used and derived from the above equations. For the former model, we incorporate the asymmetric term to the diagonal form of the full-parametric BEKK model, while in the latter model; we extend the former model with the shock spillover parameters.

3.8. Dummy Variables

We analyze the changes in the behavior of conditional correlations and conditional volatilities. If a significant change is observed in the time series of the underlying variables, it might indicate contagion effects. We split the entire crisis period into three different phases following the report of Federal Bank of St. Louis. The first phase (phase 1) is “initial financial turmoil” (August 1, 2007 – September 15, 2008); the second phase (phase 2) is described as “sharp financial market deterioration” (September 16, 2008 – December 31, 2008) and the last phase (phase 3) is a phase of “macroeconomic deterioration” (January 1, 2009 – March 31, 2009).

The following regression equations with dummy variables are specified on the changes of the dynamic correlations and volatilities:

$$\begin{aligned} corr_{ij,t} &= \omega + \alpha_1 dummy_{phase1} + \alpha_2 dummy_{phase2} + \alpha_3 dummy_{phase3} + \varepsilon_t \\ h_i &= c + \beta_1 dummy_{phase1} + \beta_2 dummy_{phase2} + \beta_3 dummy_{phase3} + \varepsilon_t \end{aligned} \quad (30)$$

where $corr_{ij,t}$ is the dynamic correlations between a stock market and S&P 500 and h_i is the conditional volatility of a particular market, which are all derived from the

ABEKK models. Any statistically significant and positive dummy coefficient in the conditional correlation or volatility series indicates a considerable increase during the crisis phases. On the contrary, a statistically significant and negative coefficient shows a decline in the series under examination. Therefore, the dummy analysis enables us to analyze contagion behavior at times of the crisis; any increase in the co-movement of a stock market with S&P 500 can be described as contagion from the US market to the other.



4. DATAANALYSES

In this section we uncover the basic properties of our data set. As the multivariate models conducted are on sub-periods of the whole sample along with the full series, we also analyze the summary statistics according to these sub-periods. Beside the results and analyses for full sample, the tables and discussions also divide the sample period into pre-crisis, crisis and post-crisis episodes.

The paired sets for the full sample are given in Table 1 below. The beginning and ending date of US-Denmark, US-Italy, US-Russia, US-S.Africa and US-S.Arabia paired sets differ from the others due to the availability of the data in those paired sets.

Table 1 – *Paired Data Sets and The Period*

Paired Set	Beginning Date	Ending Date	Paired Set	Beginning Date	Ending Date
US & Netherlands	09.12.1994	24.02.2014	US & Indonesia	09.12.1994	24.02.2014
US & Argentina	09.12.1994	24.02.2014	US & Italy	31.12.1997	24.02.2014
US & Greece	09.12.1994	24.02.2014	US & Japan	09.12.1994	24.02.2014
US & Australia	09.12.1994	24.02.2014	US & Mexico	09.12.1994	24.02.2014
US & Austria	09.12.1994	24.02.2014	US & Norway	29.12.1995	24.02.2014
US & Belgium	09.12.1994	24.02.2014	US & Poland	09.12.1994	24.02.2014
US & Brazil	09.12.1994	24.02.2014	US & Portugal	09.12.1994	24.02.2014
US & Canada	09.12.1994	24.02.2014	US & Russia	22.09.1997	24.02.2014
US & China	09.12.1994	24.02.2014	US & S.Africa	30.06.1995	24.02.2014
US & Czechia	12.12.1994	24.02.2014	US & S.Arabia	18.03.1996	24.02.2014
US & Germany	09.12.1994	24.02.2014	US & S.Korea	09.12.1994	24.02.2014
US & Denmark	29.12.1995	24.02.2014	US & Spain	09.12.1994	24.02.2014
US & Finland	09.12.1994	24.02.2014	US & Sweden	09.12.1994	24.02.2014
US & France	09.12.1994	24.02.2014	US & Switzerland	09.12.1994	24.02.2014
US & England	09.12.1994	24.02.2014	US & Turkey	09.12.1994	24.02.2014
US & India	09.12.1994	24.02.2014			

Table 2 – *Periods for the US Sub-Prime Mortgage Crisis*

	Pre-Crisis	Crisis	Post-Crisis
Beginning	02.01.2004	01.08.2007	01.04.2009
Ending	31.07.2007	31.03.2009	24.02.2014

Table 3 – *Sub-Periods within the US Subprime Mortgage Crisis*

	Turmoil	Deterioration	Recovery
Beginning	01.08.2007	16.09.2008	02.01.2009
Ending	15.09.2008	31.12.2008	31.03.2009

4.1. Data and Descriptive Statistics for the Whole Sample

We use daily data for the stock markets from late 1994 to early 2014 with a few exceptions due to data availability. The data is retrieved from Bloomberg. Bloomberg codes are listed in appendix Table 4. The summary statistics for the whole period are presented in Table 5a. The highest mean return is observed for Turkey with 0.121 followed by Brazil (0.075) and both Argentina and Russia (0.064). The most risky stock market measured by its standard deviation is Russia followed by Turkey and Argentina, whereas the market with the lowest standard deviation is Australia. Out of 32 markets, we find that 24 exhibit negative skewness which suggests that negative returns are more probable than positive returns. As can be seen from the kurtosis measures, all the series exhibit excess kurtosis, indicating that the series are not normally distributed and have fat tails which is typical for financial series. The non-normality of the return distributions is also verified from the Jarque-Bera test statistics.

In Table 5b we document the results from the unit root, autocorrelation and ARCH tests. Our test results confirm that the series under examination are suitable for further GARCH modeling. Furthermore, we substantiate that all the series have autocorrelation by conducting the Box-Pierce test for serial correlation on the raw and the squared returns. Besides, the ARCH tests up to 10 lags confirm that the series have statistically significant ARCH effects. The ADF and the KPSS tests demonstrate that the return data is stationary with no unit roots.

Our findings suggest that all the tests for the stock markets under investigation are rejected at the conventional significance levels, indicating no unit-root with a structural break in the intercept and the trend. Hence, the findings from the ZA test is consistent with the other unit-root type tests which do not account for the structural break in the unit-root process (Table 5a& ZA Structural Break Test Results given in Table 9).

4.2. Data and Descriptive Statistics for the Sub-Samples

As can be seen from Table 6a, Table 7a and Table 8a, the results show that the stock markets more or less yield the same mean returns in all three periods. The equity markets yielding the highest mean returns are Denmark, Norway and Canada while the ones exhibiting the lowest average returns are Turkey, Brazil and Mexico. Out of the 32 markets under investigation 18 of them display lower mean returns in the crisis period compared to the pre-crisis stage and moreover 15 markets have further decreases in the average returns during the post-crisis phase. In terms of unconditional risk, the standard deviations manifest that there is an observable increase in the stock market volatilities in the crisis period, however the volatilities are considerably reduced in the aftermath of the crisis. The equity markets with the highest standard deviations are Denmark and Norway, while the lowest standard deviations are observed for the emerging markets mostly such as Turkey, Brazil, South Africa and Mexico.

As is typical for financial data, the stock indices have leptokurtotic return distributions with fatter tails and higher peaks compared to the Gaussian distribution (normal distribution) implied by the skewness and kurtosis values listed on the tables.

This feature is also clearly evidenced from rejection of the the Jarque-Bera test statistics with the null hypotheses of normality.

Additionally, we compute the unconditional correlation coefficients for the logarithmic returns presented in Table 10. From the correlation coefficients, which are almost all statistically significant at conventional levels, it is clear that the highest return linkages are documented for the post-crisis period, which can be explained by the discussions on increased stock-market integration over time. Moreover, our analysis points out that the markets that are geographically close to the US exhibit the highest interdependence with the S&P 500; Brazil, Mexico and Canada are the markets that are highly related to the US stocks compared to the other equity markets.

5. EMPIRICAL RESULTS – APPLICATION OF THE RETURN SPILLOVER MODELS AND THE ILLUSTRATION OF THE ANALYSES

5.1. Unit Root Tests

Before proceeding to the analysis of the return interactions, we check for the existence of unit roots in both the price indices and the returns in logarithmic form. In this end, we utilize two distinct classes of unit root tests for the pre-crisis, crisis and the post-crisis periods; namely the ADF(Augmented-Dickey-Fuller)andthe PP(Philips-Peron) tests. Based on our results from the ADF and the PP tests presented in Table 5b, Table 6b, Table 7b and Table 8b for all of the periods studied, we observe that the null hypothesis of a unit root cannot be rejected in the price series, while the null of a unit root is clearly rejected for the log returns. Therefore, we can conclude that the stock returns are integrated at order 1, $I(1)$ as no unit root is evidenced in the log returns.

5.2. Cointegration Vectors

Before implementing further tests for co-integration analysis, the optimal lag lengths are determined. We choose the optimal lag numbers based on the Schwartz information criterion (SIC) for each bivariate model. As Table 14 shows, we specify the number of lag lengthsfor the different sub-periods. Furthermore, we run the multivariate models with the identified lag numbers in the next section and ensure that all data dynamics are captured.

It is a common fact that if two or more financial time series are co-integrated then combinations of these variables can display stationary linearity although the variables are non-stationary themselves. In other words, despite of an individual stochastic trend in each series, common stochastic trends may exist in the co-integration process. The existence of the co-integrating relation between stock markets provides an evidence of strong stock market integration and a long-run convergence in between. The higher the number of the co-integrating vectors, the higher the probability of the presence of a long-run equilibrium relation (Syriopoulos, 2011). In this part, we test for the number of the stochastic trends shared between the US and the equity markets under investigation by using Johansen procedure.

In Table 11, long term co-integration test statistics are given showing Trace statistics, Max-Eigen statistics and their p-values. For the entire period of paired sets (1994-2014), we have found no co-integration between the US and paired market.

For the sub-periods, the results of the trace and maximum eigenvalue statistics for the co-integrating equations are reported in Table 12a. We also present a summary for the co-integration relationships in Table 12b. As stated earlier, we split the sample size into three sub-periods; pre-crisis, crisis and post-crisis correspondingly, to analyze whether the co-integration structure changes during market turmoil. Our empirical findings related to the co-integration analysis point out to the fact that the interdependence between the US and some of the markets strengthens during certain stages of the crisis. For example, the null hypothesis of no co-integration is rejected before the crisis period in case of the US-Australia, US-China, US-Germany, US-Indonesia, US-Mexico and US-Portugal. During the crisis, the co-integrating relation is only found for three market pairs; namely US-Austria, US-Czechia and US-Japan.

In the post-crisis period, we find significant co-integrating vectors for US-S. Africa, US-Brazil, US-UK, US-India and US-Norway.

We can conclude that even if there is a long-run common stochastic trend shared by some markets with the US, our empirical results show no significant co-integrating vectors between most of the markets and the US. Therefore, the co-integration analysis suggests that the global financial crisis might not lead to greater linkages between most of the investigated markets and the US equities and the results also show the immunity of these markets to the 2007-2009 crisis. The specific finding of absence of no long-run co-movements between the G20 markets and the US also implies probable long-term benefits gained by international portfolio diversification.

5.3. Multivariate Granger Causality

While co-integration analysis provides information on whether the markets under investigation have common shared trends, it does not analyze the lead/lag relationship from a particular market to another. For this reason, we model the Granger causalities to investigate the market interactions as well as the direction and effect of any significant causal relationship before, during and after the financial crisis. The joint significance of the lagged stock market returns in the bilateral VAR system is tested with the F-statistics. The summary information of the Granger causalities is presented in Table 18b. The associate statistics from US to the others and from the other markets to US are displayed in Table 18a.

The most notable result that can be drawn from the Granger causality analysis is that almost all of the markets are significantly impacted by the changes in the US

stock market. The US market significantly Granger causes the other G20 stock markets. These causal relationships are mostly observed as unidirectional since most of the other G20 economies does not Granger cause the US market. In other words, according to our central result of the causalities, the US market is found to lead almost all of the equity markets, however it does not lag behind the other markets significantly. This supports the finding of increased market linkages at times of market turbulence found in some empirical studies. Most of the causal relations are observed during the crisis period; however, the US does not Granger cause Brazil and Mexico in that specific period.

Mexican and Brazilian stock markets are interestingly found to be the markets that the US does not have any significant effect under the three sub-periods. On the other hand, the bidirectional Granger causalities are observed in certain sub-periods. For example, Argentina (US) leads the US (Argentina) market both before and during the crisis, while South Korean (US) market significantly influence the US (S. Korea) before and after the crisis. These empirical results bring forth some kind of feedback effect between some of the markets and the US.

In overall, our findings from this Granger causality section remark the dominant role of the US in the global economic system as the movements in the S&P 500 Composite index can lead to significant changes in the other G20 markets during all the sub-periods evidenced from the causalities and lead/lag associations. To put it differently, international capital markets closely track the US market fluctuations during all of the periods analyzed in this study.

5.4. Toda-Yamamoto Test Results

In order to check for the sensitivity of the causality results we also conduct the Toda-Yamamoto (TY) causality approach. This approach consists of two stages: In the first stage we determine the optimal lag length based on the Schwartz Information Criterion (SIC) and the second step involves estimating the number of cointegrated vectors. Before estimating the models, the empirical properties of the VAR model residuals and the associated Portmanteau tests are analyzed to ensure that the proposed models are fully adequate in terms of serial correlation and heteroscedasticity. For this purpose, the autocorrelation Lagrange-Multiplier (LM) and White test are employed to examine the properties of the error terms; the existence of no serial correlation is analyzed with the LM tests and the presence of no remaining heteroskedastic effects in the residuals is tested by applying the White tests.

In the previous section, the number of cointegration vectors ($d_{\max}$) is documented and the optimal lag lengths (k) based on the SIC are given. The related TY statistics are computed by using the $d_{\max}$ and k values. The statistic results from the TY procedure are listed on Table 19a and the summary is given in Table 19b. As it is depicted on the table, there is stronger causality evidence from the US to the other markets in terms of the Chi-square parameters compared to the conventional Granger causality tests; however, the causality evidence is weaker from the other markets to the US. According to the TY results, in the pre-crisis phase US displays no causal effect on S.Arabia, Argentina, Brazil, China and Mexico; during the crisis period, only Brazil is exempt from the US causality and in the post-crisis episode, US does not cause Brazil, Canada and Mexico. In the pre-crisis episode only the Swedish equity market is found to cause the US, while for the crisis period the results reveal

Argentina, Austria, Canada, the Czechia and Greece to exert a causal influence on the US. The post-crisis stage witnesses the Czechia, Germany and Indonesia to have a causal effect on the US equities.

The empirical findings of the TY tests are slightly different than the conventional Granger causality tests. In overall, it can be deducted that the dominating role of the US stock market is significantly evinced in almost all of the market pairs with the exceptions of Brazil and Mexico. Both the TY and the Granger causality tests verify that US does not cause neither Brazil nor Mexico although these economies have strong economic ties with the US as a result of geographical proximity.

5.5. Impulse Response Functions

This part of the study focuses on the short-term relationships between the G20 economies and the US stock market. In this end, we firstly apply impulse response analysis which traces out the dynamic reaction of each equity market to shocks that stem from the US stocks. This analysis further allows us to analyze whether the influence of a shock coming from a specific market is transitory or permanent. In this regard, if the impact of a shock is permanent, the VAR system will readjust itself so that a new equilibrium is reached and the impact of an unanticipated shock does not die out soon, conversely, in case of a temporary shock impact, the system returns to its previous equilibrium and the effect of an unexpected shock to a specific market dies away quickly.

In Table 16a, Table 16b and Table 16c, we present the results from the generalized impulse response functions (GIRFs) which are not sensitive to the

ordering of the system variables. When computing the responses, we analyze the impact of a one standard deviation shock. Table 17a, Table 17b and Table 17c denote the effect of the one standard deviation impulse generated from the other equity markets on the return of the US index for three different periods, pre-crisis, crisis and post-crisis respectively.

The results from the GIRF analysis for the pre-crisis period manifest that a one standard deviation shock increase in the US leads to a greater response in the other equity markets compared to the shock flow from the other stock exchanges to the US. Besides disturbances in the US market are rapidly spilled over to the markets under investigation in the first day and lasts about three days and after the third day, the impact of a shock in the US fades out. The shocks in the US equity market exert a major influence on the stock markets of Brazil, Argentina and Mexico as these Latin American economies have significant and close economic ties with the US. When it comes to the influence of the innovations from the others to the US, it is apparent from the results in Table 17a, Table 17b and Table 17c that the shocks die away in two days with lower impact. Mexico, Brazil and Canada are the markets that transmit their disturbances with the highest impact on the returns of the US and they are followed by Germany, France, UK and Italy. From this result it can be expressed that geographical proximity and size of the economy play an important role in determining market interactions for the examined period. S.Arabia, Indonesia, China, Australia and Japan exhibit the lowest level of short-term market linkages with the US.

For the crisis period, we tabulate stronger bilateral responses, suggesting that markets under investigation have become much more reactive to the corresponding shocks during the 2007-2009 crises in comparison with the pre-crisis episode.

Furthermore, at the crisis stage the disturbances of the other markets lead to a more pronounced response in the US unlike the results reported for the pre-crisis.

Additionally, the effect of a one standard deviation shock during the crisis is more permanent than that of the pre-crisis period; the innovations do not die away quickly and last for about five trading days. Moreover, Brazil, Canada and Mexico are still the economies displaying stronger interactions with the US while China, Australia and Indonesia again exhibit limited interactions with the US.

As for the post-crisis period, our impulse response analysis indicate that the markets respond to the US disturbances at a lower magnitude relative to the crisis episode, however during this period, the reactions of the markets are stronger than those of the pre-crisis phase. A one standard deviation innovation in the US index leads to a longer lasting effect (about 4 days) on the other stock returns whilst the disturbances in the other markets provide a shorter lasting influence (about 2 days) on the US equities. This result is similar to the findings of the pre-crisis period in the sense that the US market is less responsive to the shocks generated in the other markets at less volatile episodes. The higher response to the US innovations is documented for Argentina, Italy and France, while the least affected stock exchanges are China, Japan and Australia. The US reacts more to the shocks from Canada, UK and Germany and it is least responsive to the disturbances in the Chinese, Japanese and Indonesian equity indices.

5.6. Innovation Accounting Procedures

The forecast error variance decomposition (innovation accounting) analysis is a quantitative measure of the short-term dynamic linkages and it is used to assess how

the variance of a particular market can be explained by the innovations of the other markets in the system. In other words, by means of the innovation accounting analysis, we measure the magnitude of a change in a market's variance that results from the other market's volatility.

We report the results from innovation accounting analysis for 1,2,3,4, and 5-day forecast error variances for each market pair in Table 17a, Table 17b and Table 17c. Our relevant empirical findings for 1-day error variance posit that none of the stock exchanges has a significant influence on the US during the pre-crisis episode. However for the 2-5 days, Austria, Belgium, Czechia, Greece, the Netherlands, Spain, Sweden, Switzerland and Turkey, explain the US volatility. At the same period, it seems that the US index significantly impacts the other markets' variances at varying magnitudes. The US accounts for about 40% of the forecast error variance in Brazil, Canada and Mexico for all prediction days. This is in line with our previous findings from the GIRF analysis that the US induces higher influence on the markets that are economically and geographically closer. This result can be expected as the GIRF and variance decomposition are complementary analyses. The analysis also shows that the US seems to explain a negligible fraction of the error variance in Saudi Arabia and China, while this effect is quite limited in some emerging countries such as Turkey, Czechia and Russia.

During the crisis episode, the impact of the US equity market on the volatility of the investigated indices tremendously increases. The US affects the variances of Brazil, Canada and Mexico by about 65%, 66% and 71% respectively for all days implying that these market variances result from the US related shocks rather their own market innovations at times of the Great Recession. As can be seen, in this

episode, the US economy exports its volatility to the global stock markets at much higher magnitudes indicating significant contagion effects. Even the volatility of the markets that were previously found to be not affected by the US index, display stronger sensitivity to the US in the crisis phase. The forecast error variances of China and Saudi Arabia increase to about 5% and 10% respectively. On the other hand, during the crisis, the volatility impacts of the other markets on the US are more or less the same with a minor increase in the accounted innovations.

As for the results related to the post-crisis episode, we substantiate the continued and somewhat increased influence of the US economy in determining the imposed volatility proportion. Our empirical findings clearly show that the crisis brings forth more imposed volatility from the US to those economies that are geographically closer; however, the impact of the variances coming from the US declines to a lesser degree in Brazil, Canada and Mexico following the crisis. Counter wise, the role of the US as a volatility precipitator is more pronounced in the European markets. The variance decompositions further demonstrate that the volatility of the other markets becomes totally negligible in explaining the forecast error variance of the US market. As the only exception, Australia accounts for approximately 10% of the US volatility in the post-crisis period.

5.7. Cointegration in the Sub-Periods

As we have discussed earlier, the long run interaction between US and other markets has been tested and no cointegration has been detected over the full period. However, the cointegration for the sub-periods are tested as well. The results of the Trace statistic and Max. Eigen value statistic along with their significance values are

given in the Table 12a and the summary results are depicted in Table 12b. For the pre-crisis period, Australia, China, Germany, Indonesia, Mexico and Portugal are cointegrated with the US. Austria, Czechia and Japan are the cointegrated stock markets with the US during crisis period. S.Africa, Brazil, England, India and Norway are the stock markets having cointegrated with the US in the post-crisis period. It is seen in the results that, for any of the single pair, no cointegration for the all episodes exists. To phrase in other words, the existence of long run relationship between the US and paired stock market differs over time as the time period between 2004-2014 is divided as pre-crisis, crisis and post-crisis episodes. We can also infer that the crisis period (2007-2009) has caused a change in the existing dynamics of precrisis period. The cointegration existing between the US-Australia, US-China, US-Germany, US-Indonesia, US-Mexico and US-Portugal have disappeared by the crisis and kept depleted after crisis. Cointegration between the US-Austria, US-Czechia and US-Japan have popped up in crisis period despite being nonexistent in precrisis and also disappeared back during post crisis. In the postcrisis period, the US-S.Africa, US-Brazil, US-England, US-India and US-Norway are cointegrated despite there is no cointegration between those markets in precrisis and crisis periods.

In Table 13, the speed of adjustment figures with the significance values are depicted. The empirical evidence of a short run adjustment to long term convergence is the cointegration between the paired series are extracted for precrisis, crisis and post crisis periods. The speed of adjustment term; in case statistically significant, with negative value stands for the speed of adjustment to the long run equilibrium. In the examined series, Australia, Germany and Mexico converges to the US market in the precrisis whereas the US does not converge any other market. During the crisis period,

Austria and Czechia exhibit cointegration with the US market. Brazil and S.Africa are the cointegrated markets with the US. We also note that, except the cointegration between the US and Brazil markets in the post crisis period, all the adjustment speed terms have low magnitudes.



6. EMPIRICAL RESULTS –

APPLICATION OF THE VOLATILITY SPILLOVER MODELS AND THE ILLUSTRATION OF THE ANALYSES

6.1. Results for the Eight MGARCH Models

In order to compare the MGARCH models, eight analogous models are utilized so that this research examines the model which provides best fit and the highest likelihood value. Through the Table 20a to Table 20h, we present empirical results for the aforementioned MGARCH models. All of the tables include associated parameters along with their statistical significance indicated by p-values. The diagonal shock parameters A_{11} and A_{22} stand for the coefficients of the own shock effects for the US and the other markets, respectively. The diagonal volatility parameters representing the own variance share are denoted as B_{11} for the US and B_{22} for the other equity markets

The first model that we employ is fully parameterized BEKK-GARCH (BEKK, henceforth) model that we generalize later in the search of asymmetric reaction to the news as asymmetric BEKK-GARCH (ABEKK) model. The results drawn from this section also stay the same in the other models since the diagonal type or the VEC models also directly parameterize the diagonal matrix elements. Assessing these two models together in Table 20a, Table 20b, Table 20c and Table 20d, it is realized that the lagged (past) own news and volatilities significantly impact the current conditional variance mostly. In the plain BEKK models, the largest own news coefficients are observed for Argentina 0.386. For the ABEKK models, we find

the largest coefficient 0.345 for the Indonesian stock market. Besides, the conditional volatility of each market mostly stems from their own past volatility as evidence from the diagonal variance parameters represented by B_{11} for the US and B_{22} for the other equity markets. The largest associated parameters are found for Finland in the BEKK (0.981) and ABEKK (0.976) models. All the diagonal volatility parameters are very close to unity, which shows that the conditional volatilities are strongly connected to the past conditional volatilities. In overall, examining the diagonal shock and volatility coefficients implies that all markets under our investigation are impacted by news (shocks) and volatility originated from their own markets.

The diagonal parameters are captured by all of the multivariate version of the GARCH models such as diagonal BEKK or VEC models. However, it is very vital to comprehend the cross market volatility transmission to make effective portfolio decisions as well as for policy makers. Cross market spillovers between international stock markets are highly relevant for international policymakers and investors alike. On the one hand, they show how much (domestic) markets respond to information, generated in foreign markets. On the other hand, they provide information on the speed and dimension of risk propagation across markets. The non-diagonal coefficients in the framework of both BEKK and ABEKK models enable us to examine the cross market spillovers.

Investigating the BEKK results in Table 20a, it is noticed that there is a significant shock and volatility transmission between the US and the other stock markets. The 24 coefficients representing shock spillovers from the US to the other markets ($A_{1,2}$) are highly significant for all of the models out of 31 coefficients. Among the statistically significant parameters, the negative sign is found for 14

coefficients, which implies that a shock in the US reduces the volatility of these markets. The highest coefficient of cross shock $A_{1,2}$ is -0.218 in the US-Brazil equation. The other cross shock spillover parameters $A_{2,1}$ indicate that 13 of 31 coefficients are statistically insignificant, which means that no shock spillover from the other markets to the US stock market are found. The largest relevant coefficient is -0.126 in the US-Denmark equation. Most importantly The results from the cross shock spillovers draw a conclusion that the US stock market has an influential role in the transmission of shocks over most of the markets. However, $A_{1,2}$ parameters are smaller than $A_{2,1}$ parameters in absolute value magnitude in case of the Netherlands, Canada, Denmark, Mexico, Norway, Portugal and Switzerland. The highest shock parameter of Mexico can be attributed to the bilateral trade agreements with the US market.

The parameters of cross volatility transmission $B_{1,2}$ stand for the spillovers from the US to the other markets. From Table 20a and Table 20b, it is clear that volatility stemming from the US transmits to Argentina, Canada, Czechia, Finland, S.Korea, Poland, Portugal, Russia, Spain, Sweden, Switzerland and Turkey as can be seen from the statistically significant coefficients. The other markets seem to be immune to the volatility shocks coming from the US stock market. The equity market mostly subject to volatility from the US market is Argentina, followed by Portugal and Russia. Interestingly, a rise in volatility in the other markets affect the volatility of the US market in an opposite way; all of the statistically significant $B_{2,1}$ coefficients are negative. The highest parameter in absolute terms is found for Switzerland followed by Denmark, Spain and Portugal. Besides, the US market has a clear dominant role in Argentina, Brazil, S. Korea and Turkey. The overall cross volatility results imply that

most of the stock markets display strong interdependence with the US markets. There is a significant bidirectional volatility links between the markets, which draw a conclusion of strong financial market integration.

It is a well known fact that information transmission mechanism can be in an asymmetric form since a bad or good news in any market would be significantly and instantaneously impact the other markets' variance. Hence, the asymmetric news impact coefficients are also investigated in terms of both statistical significance and magnitude. The diagonal news impact coefficients D_{11} and D_{22} show the asymmetry terms for the US and the other markets. The results reveal that all the diagonal elements are highly significant at the 1% significance level. Bad news seems to have higher impact for volatilities of 14 stock markets while positive return- volatility relation is found for the others markets' variances. The results for the US are varying across the models. Investigating the cross (off-diagonal) asymmetry terms, which is our main subject, the results evince that the good news(positive shocks) subject to the US market are significantly transmitted to Brazil, Canada, Germany, India, S.Korea and Mexico while the bad news from the US is spilled over S.Arabia, Argentina, Greece, Australia, Austria, Belgium, China, Finland, France, Japan, Poland and Turkey. The asymmetry coefficient which has the highest magnitude in absolute terms is India (0.325), followed by Turkey (0.209). Another off-diagonal parameter $D_{2,1}$ pronounce that the US market has a leading and dominant role over the other equity markets, since the asymmetry terms related to the shocks coming from the US ($D_{1,2}$) is larger than the asymmetry coefficients representing the news from most of the other markets to the news ($D_{2,1}$). The exceptions are Denmark, England, Indonesia, Norway, Portugal, Sweden, and Switzerland.

We also investigate diagonal BEKK as well as shock spillover diagonal BEKK model for comparing purposes and models' robustness. Starting with the diagonal BEKK model, all the coefficients are statistically significant at the conventional levels, which is consistent with the previous full- parametric models. Hence the present conditional volatilities of all the stock markets are highly linked to both its own lagged shock and previous variance. The shock spillover diagonal BEKK model is also employed to examine the robustness of the cross shock effects. Our model results reveal that there is a significant shock transmission from the US to the 14 of the markets. The remaining 17 markets are found to be immune to shocks arising from the US market. The own shock and volatility coefficients in the diagonal elements of the variance-covariance matrix are statistically significant at the 1% significance level, which is in line with the findings from the previous model that we employed.

Generalizing the shock spillover diagonal model, we apply a model containing both cross shock impacts and the own asymmetry terms. This model is similar to the Asymmetric BEKK model however no cross volatility effects are included. The overall results stay the same with the previous models in terms of own shock and volatility impacts as well as off diagonal shock spillover. In these models, asymmetry terms are found to be positive and statistically significant at the 1% level. If the coefficient of the D matrix is positive and significant then we concluded that bad news (shocks) will bring a higher volatility in the markets than the good news will. Hence, the empirical results related to the asymmetry imply that bad shocks have more effect on the market volatilities than good news. This is plausible in the sense that this is a case in the finance literature, explained by the leverage theory, which states that a

change in market value of a firm's equity has on the degree of leverage in its capital structure, with an increase in leverage producing an increase in stock volatility.

Through Table 21a to 21h, we present the results for the residual tests and assess the model specifications. To this end, we utilize Ljung-Box serial correlation tests on the squared residuals and the ARCH LM tests to analyze whether the model innovations depict remaining significant heteroskedastic effects.

The associated tests with regard to residual autocorrelation and heteroscedasticity suggest that the best fit model is the asymmetric version of the BEKK model (ABEKK) as the model captures the full cross term past shocks and lagged volatility effects as well as the volatility asymmetry. The second best model is the full-parametric BEKK model in that it produces fewer violations in terms of serial correlation and remaining ARCH impacts.

6.2. Dummy Regression Analysis

This section presents the results from the dummy regression analyses conducted on both the conditional volatilities and correlations. This further investigation enables us to detect the presence of any significant change in the time behavior of variances and co-movements. The statistical significance of the estimated dummy parameters shows the changes in the underlying series during the different stages of the GFC as explained in section 6.2. A significant dummy coefficient also implies that the behavior of the volatilities and/or the correlations during the crisis period is significantly different from that of both pre and post crisis periods. This

demonstrates a probable spillover effect from one market to another which also indicates that the portfolio diversification benefits reduce at times of crisis.

In Table 23, the dummy coefficients of the variance OLS equations are depicted. We find that most of the dummy coefficients are positive and statistically significant. The exceptions are observed at the first phase of the GFC “initial financial turmoil” (August 1, 2007 – September 15, 2008), as the flow of the crisis effects from the US to the other markets may have lags. Indeed, most of these exceptions are the emerging markets, namely Argentina, S.Korea, Russia and Turkey. The results reveal that the market variances tremendously increase during the second phase of the GFC “sharp financial market deterioration” (September 16, 2008 – December 31, 2008) compared to the first phase which signals the intensification of the contagious flows from the US to the other markets. During the third phase the dummy coefficients significantly decrease compared to the second phase indicating that the rise in the stock market volatilities in this phase is lower relative to the rise in the second phase.

In Table 24, the dummy variable analysis results for the conditional correlations are reported. Our findings substantiate that the dynamic correlations are significantly higher during the crisis episodes compared to the tranquil periods. However, the impacts of the crisis noticeably differ across both the markets and the crisis stages. In the first phase we find that some markets decouple from the US in the initial financial turmoil; Norway, China and Japan are the only equity markets that are found to be immune from the first flames of the GFC. However, in the second and the third phases all the markets examined display recoupling with the US. In the second and the third phases the interdependence of the US and the market pairs inclines, suggesting that contagion deepens when there is a sharp financial

market/macroeconomic deterioration. Although we find mixed results for the dummy coefficients in terms of their magnitudes, from the results it is apparent that emerging markets display a higher degree of co-movement during the crisis phases. However, our results also suggest the heterogeneity of the emerging markets; more industrialized developing countries such as Russia and China exhibit a much lower interdependence with the US while Turkey, South Africa, Argentina and Brazil show a higher degree of co-movement with the US during the GFC. Still some emerging markets possess diversification benefits for international investors as indicated by the dummy analyses.



7. CONCLUSION

7.1. The Concluding Remarks Derived from the Results

In this study, we elaborate the return and volatility interactions between the US index and the G20 economies' stock markets. The US has a pioneering role in the global financial markets and the G20 countries are among the major economies in the world. In this end, we make use of the VAR (Vector Autoregression) techniques to analyze the multivariate dynamics of international stock returns. In addition we conduct complementary tools of the VAR analysis, such as Generalized Impulse Response Functions (GIRFs), Variance Decompositions (VDCs) and causality methodologies.

Our data sample covers the period between 2004 and 2014. Overall, the empirical findings of this study can be summarized as follows:

1. Before estimating the base line models, we typically test for the unit roots and find that the price series have unit roots while the logarithmic returns display no unit roots.

2. We apply the VAR models to elaborate the short-term return dynamics between the the US index and the other equity markets. The short-run Granger causalities remark the dominant role of the US as it leads to significant changes in the stock returns of the markets under investigation during the different phases of the GFC. We also analyze the lead-lag relations within the context of the Toda-Yamamoto procedure and find mostly similar results with higher Chi-square parameters. To test cointegration, we employed the Johansen procedure both in full period and sub-periods. We found no cointegration in the full period; in sub-periods some stock

markets are found to be cointegrated with the US market yet changing from one sub-period to other. For the periods carrying cointegration, we also employed the VECM to explain the spillover and the test results are depicted.

3. We utilize impulse response analysis to find out how equity markets respond to one standard deviation shock from the US market. Our results suggest that the stock market returns are significantly affected by the shocks in the US index particularly during the global financial crisis. The innovations in the GIRF analysis at times of the crisis do not fade away quickly and last longer compared to the non-crisis periods.

4. By using the VDC method, we quantify how the variance of a specific market can be explained by the US index innovations. Our results reveal that the effect of the US market on the volatility of the other studied markets extremely increases during the crisis episode. This also reflects the flow of contagion from the US to the other economies. Furthermore for the post-crisis period the findings show the continued and somewhat heightened impact of the US economy in determining the volatility decompositions of the other markets.

This paper analyzes the dynamic nature of the volatility transmission mechanisms between the US stock market and those of the G20 countries. We expand the data set by including twelve other EU member countries to provide a more comprehensive research and empirical evidence on the transmission dynamics of the markets under investigation. The findings from this paper suggest that shock and volatility spillovers significantly exist from the US to the other G20 markets while we also observe that the transmission mechanism runs from some of the other markets to the US as well. The bilateral shock transmission is more common than the bilateral

volatility transmission. We observe the dominant role of the US in transmitting shocks, however in case of the volatilities, the spillovers from the other markets to the US are also observed. Moreover, asymmetric news coefficients also provide evidence of negative shocks from the US bring higher volatility in 12 of the markets, while only in 6 markets positive shocks from the US affect the volatility. Our results also depict asymmetric response of the US stocks to the news from the other markets, however the sign of the reaction is mixed across the markets.

We also analyze whether the market variances and conditional correlations significantly change during the different stages of the GFC. By utilizing OLS regressions constructed with dummy variables, we report significant increases in both the correlations and the variances. Our findings suggest that the correlations between the US and the other markets significantly increase during the second and the third phases of the GFC. Moreover, the second phase of the crisis witnesses significant inclination in market variances signaling the contagious flow of the turmoil from the US to the other markets. Bekaert et al. (2014) also assert contagion from the US to global equity markets during the credit-crunch crisis and ponder that countries with weak economic fundamentals, high fiscal and current account deficits are more prone to the contagious flows from the US. Alike, our OLS regressions with dummy analysis underlie that almost all of the equity markets under investigation are significantly affected by the contagion from the US where the impact on the emerging markets is greater. However, more industrialized emerging markets such as Russia and China demonstrate a lower level of interdependence with the US, whereas economies with high fiscal and current account deficits such as Turkey, South Africa, Argentina, Brazil and Greece are more severely influenced. This result points out to the

heterogeneity of the emerging markets as a group, implying that some emerging markets offer better diversification opportunities to international investors.

7.2. Future Work

The doctoral study analyzes the return linkages and volatility co-movement dynamics between the sample stock market returns and the US equity market. While modeling return interactions, the co-integration, VAR and VECM techniques are conducted. However, these models are static in that they do not provide a time-varying co-integration or dynamic causality. As a future work, dynamic co-integration vectors can be examined by recursive trace statistics. This method would allow us to examine the real financial integration process in a time-varying setting. Furthermore, the return interactions are investigated within the context of Granger and Toda-Yamamoto tests. For a further study, asymmetric spectral causality tests would provide important results in terms of asymmetric dynamics. In this way, we can analyze how causality in cross-market linkages changes with data frequency, which enables one to investigate the causal relation for different holding periods.

In modeling the bivariate volatility spillovers, we employ the fully-parametric asymmetric BEKK-GARCH model. In their nature, the MGARCH models are cumbersome when it comes to estimate high-dimensional matrices. Indeed, this is not a problem for our bilateral work, however would be a problem for a multi-country study. A directional volatility spillover analysis can be conducted to see bidirectional volatility interactions in a time-varying setting. By doing so, we can also trace the net sources and recipients of volatility transmission (see, for further details, Diebold and Yilmaz, 2012). Moreover, we analyze the conditional correlations by using the BEKK-

GARCH model that parameterizes the conditional correlations indirectly. Instead, the Dynamic Conditional Correlation (DCC) or its asymmetric counterpart (ADCC) would be utilized in order to directly estimate the conditional correlation matrices.



8. REFERENCES

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9. APPENDIX

9.1. AppendixA – Tables

Table 4 - Bloomberg Index Code

Country	Bloomberg Index Code	Country	Bloomberg Index Code
US	S&P500	United Kingdom	UKX
Netherlands	AEX	India	NIFTY
Argentina	BURCAP	Indonesia	JCI
Greece	ASE	Italy	FTSEMIB
Australia	AS51	Japan	TPX
Austria	ATX	Mexico	MEXBOL
Belgium	BEL20	Norway	OSEAX
Turkey	XU100	Poland	WIG20
Brazil	IBOV	Portugal	PSI20
Canada	SPTSX60	Russia	INDEXCF
China	SHCOMP	South Africa	TOP40
Czechia	PX	Saudi Arabia	SASEIDX
Germany	DAX	South Korea	KOSPI
Denmark	KAX	Spain	IBEX
Finland	HEX	Sweden	OMX
France	CAC	Switzerland	SPI

Table 5a – *Summary Statistics for the Whole Period (Basic Statistics)*

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Jarque-Bera (p)
US	0,031	0,069	1,235	-0,233	10,950	12770,94	0
Amsterdam	0,015	0,059	1,440	-0,139	9,023	7568,951	0
Argentina	0,064	0,126	2,078	0,028	9,670	9112,6	0
Athens	0,003	0,016	1,791	-0,018	6,692	2834,273	0
Australia	0,020	0,040	0,980	-0,477	9,049	7809,919	0
Austria	0,016	0,060	1,392	-0,378	10,496	11714,88	0
Belgium	0,015	0,044	1,225	0,006	9,064	7656,443	0
Brazil	0,075	0,114	2,300	0,458	14,506	27427,13	0
Canada	0,027	0,077	1,189	-0,659	12,268	18244,1	0
China	0,021	0,037	2,026	1,262	27,014	117869,7	0
Czechia	-0,001	0,024	1,413	-0,423	14,137	25432,98	0
Germany	0,031	0,102	1,508	-0,126	7,365	3982,092	0
Denmark	0,038	0,083	1,096	-0,433	8,995	6968,933	0
Finland	0,027	0,071	1,836	-0,255	8,814	7091,491	0
France	0,015	0,043	1,458	-0,012	7,478	4176,204	0
England	0,014	0,051	1,182	-0,160	8,965	7403,11	0
India	0,034	0,068	1,603	-0,181	9,382	8473,159	0
Indonesia	0,045	0,084	1,608	-0,185	10,802	12451,65	0
Italy	-0,004	0,059	1,570	-0,080	7,047	2806,976	0
Tokyo	-0,007	0,004	1,354	-0,272	8,727	6784,084	0
Mexico	0,057	0,076	1,553	0,062	9,356	8415,185	0
Norway	0,036	0,109	1,389	-0,627	9,219	7596,66	0
Poland	0,017	0,026	1,820	-0,211	5,828	1675,984	0
Portugal	0,012	0,029	1,164	-0,340	11,008	13455,3	0
Russia	0,064	0,123	2,832	0,112	16,792	32298,44	0
S.Africa	0,048	0,089	1,382	-0,404	9,180	7552,766	0
S.Arabia	0,039	0,089	1,326	-1,002	15,746	34648,82	0
S.Korea	0,011	0,055	1,789	-0,269	7,244	3811,963	0
Spain	0,021	0,080	1,480	-0,009	7,877	4953,849	0
Sweden	0,031	0,071	1,523	0,074	6,628	2744,303	0
Switzerland	0,028	0,066	1,120	-0,204	8,782	6985,294	0
Turkey	0,121	0,135	2,599	0,030	8,040	5277,806	0

Table 5b – *Summary Statistics for the Whole Period (Statistics for ARCH Tests)*

	ARCH (10)	ARCH (10) - p	Q (10)	Q (10) - p	Q2 (10)	Q2 (10) - p	ADF	KPSS
US	159,0257	0,000	57,887	0,000	3625,100	0,000	-53,600	0,171
Netherlands	167,7249	0,000	70,893	0,000	4017,800	0,000	-33,992	0,124
Argentina	91,61678	0,000	50,398	0,000	696,490	0,000	-64,582	0,058
Greece	61,94888	0,000	74,811	0,000	1335,600	0,000	-63,013	0,098
Australia	124,5008	0,000	11,411	0,000	3074,600	0,000	-72,570	0,047
Austria	176,6234	0,000	28,344	0,002	4706,900	0,000	-65,915	0,120
Belgium	127,9244	0,000	75,872	0,000	3268,100	0,000	-42,406	0,091
Brazil	59,86915	0,000	84,548	0,000	1262,200	0,000	-67,601	0,088
Canada	161,5966	0,000	37,483	0,000	3778,700	0,000	-53,097	0,048
China	106,6343	0,000	43,140	0,000	1597,100	0,000	-69,412	0,043
Czechia	183,1183	0,000	73,544	0,000	3974,800	0,000	-62,920	0,229
Germany	107,4933	0,000	25,146	0,005	2585,000	0,000	-71,185	0,095
Denmark	141,9856	0,000	40,311	0,000	3296,600	0,000	-63,207	0,108
Finland	46,6018	0,000	27,353	0,002	927,420	0,000	-68,913	0,081
France	100,7686	0,000	47,946	0,000	2363,300	0,000	-72,589	0,085
England	145,5119	0,000	86,565	0,000	3554,000	0,000	-32,083	0,079
India	47,71792	0,000	60,774	0,000	861,690	0,000	-65,308	0,127
Indonesia	53,27518	0,000	144,230	0,000	1112,600	0,000	-59,716	0,065
Italy	88,55817	0,000	41,371	0,000	1979,300	0,000	-63,993	0,087
Tokyo	140,2502	0,000	26,672	0,003	3244,800	0,000	-68,395	0,064
Mexico	61,3578	0,000	56,748	0,000	1152,800	0,000	-64,442	0,045
Norway	170,7086	0,000	21,924	0,015	4487,400	0,000	-65,969	0,077
Poland	83,91286	0,000	66,997	0,000	2112,500	0,000	-63,171	0,036
Portugal	66,82634	0,000	77,291	0,000	1387,500	0,000	-63,937	0,112
Russia	70,98669	0,000	50,177	0,000	1291,100	0,000	-58,662	0,060
S.Africa	82,09819	0,000	46,609	0,000	1635,200	0,000	-64,856	0,037
S.Arabia	139,685	0,000	81,025	0,000	3494,400	0,000	-65,417	0,136
S.Korea	86,15133	0,000	55,174	0,000	1956,200	0,000	-65,608	0,071
Spain	81,75073	0,000	41,188	0,000	1863,700	0,000	-51,918	0,067
Sweden	79,84723	0,000	29,703	0,001	1800,600	0,000	-71,117	0,103
Switzerland	152,4322	0,000	59,577	0,000	3866,700	0,000	-33,198	0,106
Turkey	73,76933	0,000	34,591	0,000	1310,600	0,000	-68,964	0,041

Table 6a– *Summary Statistics for the Period 2004-2007 (Basic Statistics)*

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Jarque-Bera (p)
US	0,080	0,081	0,007	-0,387	2,200	45,604	0,000
Amsterdam	0,247	0,252	0,040	-0,008	1,644	68,362	0,000
Argentina	0,025	0,022	0,010	0,464	1,943	71,604	0,000
Athens	0,031	0,030	0,008	0,282	1,727	70,671	0,000
Australia	0,023	0,022	0,004	0,219	1,914	50,341	0,000
Austria	0,034	0,030	0,012	0,638	2,036	92,220	0,000
Belgium	0,031	0,030	0,007	0,365	1,954	60,563	0,000
Brazil	0,003	0,003	0,001	0,128	1,855	49,483	0,000
Canada	0,170	0,165	0,031	0,134	1,624	72,013	0,000
China	0,066	0,070	0,020	-0,639	2,507	65,416	0,000
Czechia	0,085	0,074	0,026	0,822	2,397	111,473	0,000
Germany	0,020	0,020	0,004	-0,089	1,703	63,647	0,000
Denmark	0,315	0,295	0,073	0,272	1,754	67,554	0,000
Finland	0,013	0,013	0,003	0,218	1,998	43,680	0,000
France	0,022	0,022	0,004	0,022	1,593	73,598	0,000
England	0,019	0,019	0,003	0,181	1,653	71,544	0,000
India	0,041	0,040	0,013	0,241	1,767	63,106	0,000
Indonesia	0,089	0,088	0,028	0,313	2,081	43,746	0,000
Italy	0,003	0,003	0,000	0,187	1,777	60,650	0,000
Tokyo	0,074	0,071	0,014	0,095	1,289	105,243	0,000
Mexico	0,007	0,006	0,002	0,173	1,767	60,213	0,000
Norway	0,317	0,284	0,112	0,455	1,783	84,556	0,000
Poland	0,043	0,041	0,012	0,104	1,471	86,961	0,000
Portugal	0,012	0,012	0,002	-0,489	1,866	83,443	0,000
Russia	0,120	0,117	0,050	0,087	1,343	98,367	0,000
S.Africa	0,007	0,007	0,002	0,213	1,658	72,004	0,000
S.Arabia	0,012	0,011	0,005	0,537	2,341	41,697	0,000
S.Korea	0,091	0,083	0,023	0,314	1,839	62,322	0,000
Spain	0,010	0,010	0,002	0,027	1,732	59,338	0,000
Sweden	0,115	0,114	0,023	0,002	1,699	61,939	0,000
Switzerland	0,019	0,019	0,004	-0,006	1,469	86,290	0,000
Turkey	0,003	0,003	0,001	0,620	2,098	85,164	0,000

Table 6b– *Summary Statistics for the Period 2004-2007 (Stationary Tests)*

	Price				Return			
	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value
US	-0,773	0,826	-0,608	0,866	-30,772	0,000	-31,049	0,000
Amsterdam	-0,124	0,945	-0,135	0,944	-30,363	0,000	-30,366	0,000
Argentina	-0,066	0,951	-0,069	0,951	-29,093	0,000	-29,103	0,000
Athens	-0,137	0,943	-0,212	0,934	-28,066	0,000	-28,057	0,000
Australia	-0,147	0,942	-0,070	0,951	-32,978	0,000	-33,138	0,000
Austria	-0,878	0,795	-0,888	0,792	-28,241	0,000	-28,256	0,000
Belgium	-0,919	0,783	-0,917	0,783	-30,446	0,000	-30,443	0,000
Brazil	0,441	0,985	0,757	0,993	-29,167	0,000	-29,437	0,000
Canada	-0,148	0,942	-0,010	0,956	-30,263	0,000	-30,447	0,000
China	2,967	1,000	3,442	1,000	-29,616	0,000	-29,618	0,000
Czechia	-1,033	0,743	-1,032	0,744	-27,368	0,000	-27,340	0,000
Germany	0,484	0,986	0,646	0,991	-30,579	0,000	-30,586	0,000
Denmark	0,456	0,985	0,404	0,983	-28,753	0,000	-28,774	0,000
Finland	0,249	0,976	0,202	0,973	-27,822	0,000	-27,833	0,000
France	-0,555	0,878	-0,426	0,902	-32,238	0,000	-32,473	0,000
England	-0,726	0,838	-0,640	0,859	-32,127	0,000	-32,107	0,000
India	0,532	0,988	0,553	0,988	-22,697	0,000	-22,697	0,000
Indonesia	1,818	1,000	1,815	1,000	-25,584	0,000	-25,456	0,000
Italy	-0,946	0,773	-0,926	0,780	-32,256	0,000	-32,200	0,000
Tokyo	-0,954	0,771	-0,953	0,771	-27,918	0,000	-27,894	0,000
Mexico	0,517	0,987	0,617	0,990	-26,879	0,000	-26,777	0,000
Norway	-0,105	0,947	-0,118	0,946	-30,500	0,000	-30,500	0,000
Poland	-0,265	0,927	-0,274	0,926	-28,862	0,000	-28,866	0,000
Portugal	2,015	1,000	1,722	1,000	-27,847	0,000	-27,958	0,000
Russia	-2,566	0,296	-2,530	0,313	-29,839	0,000	-29,849	0,000
S.Africa	0,352	0,981	0,746	0,993	-30,615	0,000	-30,749	0,000
S.Arabia	-1,363	0,601	-1,408	0,580	-12,300	0,000	-25,386	0,000
S.Korea	1,260	0,999	1,270	0,999	-28,035	0,000	-28,010	0,000
Spain	-2,745	0,219	-2,737	0,222	-30,185	0,000	-30,185	0,000
Sweden	-0,243	0,930	-0,258	0,928	-33,410	0,000	-33,410	0,000
Switzerland	-0,082	0,949	-0,083	0,949	-30,902	0,000	-30,886	0,000
Turkey	-0,101	0,947	-0,160	0,941	-28,693	0,000	-28,685	0,000

Table 7a– *Summary Statistics for the Period 2007-2009 (Basic Statistics)*

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Jarque-Bera (p)
US	0,086	0,076	0,022	1,017	2,619	7,354	0,000
Amsterdam	0,275	0,229	0,094	0,900	2,262	65,375	0,000
Argentina	0,017	0,013	0,006	0,966	2,280	70,827	0,000
Athens	0,033	0,026	0,015	0,905	2,253	64,246	0,000
Australia	0,021	0,019	0,005	0,762	2,180	51,388	0,000
Austria	0,035	0,026	0,016	1,007	2,351	75,149	0,000
Belgium	0,035	0,028	0,013	0,861	2,170	63,203	0,000
Brazil	0,002	0,002	0,000	0,800	2,266	51,591	0,000
Canada	0,144	0,128	0,031	0,994	2,370	74,049	0,000
China	0,034	0,031	0,013	0,246	1,589	36,437	0,000
Czechia	0,081	0,066	0,031	1,072	2,673	79,732	0,000
Germany	0,017	0,015	0,004	0,939	2,571	63,613	0,000
Denmark	0,295	0,255	0,091	0,917	2,322	64,839	0,000
Finland	0,013	0,011	0,004	0,897	2,465	59,625	0,000
France	0,024	0,021	0,040	0,006	0,852	2,429	0,000
England	0,019	0,018	0,004	0,826	2,278	55,754	0,000
India	0,091	0,037	0,033	0,763	2,372	53,448	0,000
Indonesia	0,052	0,044	0,016	0,842	2,090	59,121	0,000
Italy	0,004	0,003	0,001	1,147	3,374	3,374	0,000
Tokyo	0,087	0,078	0,024	0,834	2,198	56,241	0,000
Mexico	0,004	0,004	0,001	0,953	2,486	66,113	0,000
Norway	0,246	0,206	0,083	0,865	2,039	66,758	0,000
Poland	0,041	0,035	0,014	0,869	2,443	56,180	0,000
Portugal	0,011	0,010	0,003	0,510	1,696	47,354	0,000
Russia	0,087	0,061	0,044	1,002	2,304	73,523	0,000
S.Africa	0,004	0,004	0,001	0,770	2,152	52,410	0,000
S.Arabia	0,014	0,012	0,004	0,950	2,374	40,204	0,000
S.Korea	0,067	0,061	0,015	0,774	2,208	50,025	0,000
Spain	0,009	0,008	0,002	0,879	2,539	56,550	0,000
Sweden	0,117	0,107	0,027	0,497	1,895	37,581	0,000
Switzerland	0,018	0,017	0,004	0,912	2,809	57,046	0,000
Turkey	0,003	0,002	0,001	0,667	2,022	46,044	0,000

Table 7b – *Summary Statistics for the Period 2007-2009 (Stationary Tests)*

	Price				Return			
	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value
US	0,041	0,961	-0,105	0,947	-18,160	0,000	-24,249	0,000
Amsterdam	-0,161	0,940	-0,087	0,949	-21,642	0,000	-21,786	0,000
Argentina	-0,301	0,922	-0,352	0,914	-19,626	0,000	-19,701	0,000
Athens	-0,018	0,956	-0,044	0,953	-18,703	0,000	-18,699	0,000
Australia	-0,453	0,897	-0,374	0,911	-22,062	0,000	-22,136	0,000
Austria	-0,243	0,930	-0,222	0,933	-19,242	0,000	-19,225	0,000
Belgium	-0,224	0,933	-0,175	0,939	-19,703	0,000	-19,692	0,000
Brazil	-0,952	0,771	-0,802	0,817	-20,002	0,000	-20,327	0,000
Canada	-0,443	0,899	-0,418	0,903	-17,305	0,000	-24,063	0,000
China	-0,575	0,873	-0,587	0,870	-20,333	0,000	-20,329	0,000
Czechia	-0,186	0,937	-0,134	0,944	-16,101	0,000	-19,109	0,000
Germany	-0,319	0,919	-0,246	0,930	-20,928	0,000	-20,966	0,000
Denmark	-0,154	0,941	-0,153	0,941	-18,925	0,000	-18,891	0,000
Finland	-0,019	0,955	0,130	0,968	-20,779	0,000	-20,779	0,000
France	-0,539	0,880	-0,303	0,922	-22,274	0,000	-22,720	0,000
England	-0,732	0,836	-0,461	0,895	-21,828	0,000	-22,259	0,000
India	-0,641	0,858	-0,603	0,867	-19,357	0,000	-19,371	0,000
Indonesia	-0,434	0,900	-0,491	0,890	-17,192	0,000	-17,213	0,000
Italy	-0,137	0,943	0,027	0,960	-20,302	0,000	-20,359	0,000
Tokyo	-0,879	0,794	-0,747	0,832	-21,056	0,000	-21,619	0,000
Mexico	-0,689	0,847	-0,701	0,844	-18,099	0,000	-18,007	0,000
Norway	-0,423	0,902	-0,435	0,900	-20,050	0,000	-20,122	0,000
Poland	-0,487	0,891	-0,478	0,892	-19,657	0,000	-19,653	0,000
Portugal	-0,654	0,855	-0,663	0,853	-19,635	0,000	-19,623	0,000
Russia	-1,823	0,692	-1,819	0,694	-19,749	0,000	-19,818	0,000
S.Africa	-0,807	0,816	-0,654	0,855	-19,654	0,000	-19,904	0,000
S.Arabia	-0,278	0,925	-0,412	0,904	-13,799	0,000	-13,734	0,000
S.Korea	-0,908	0,785	-0,892	0,790	-20,016	0,000	-20,016	0,000
Spain	-2,947	0,149	-2,789	0,202	-21,050	0,000	-21,466	0,000
Sweden	-1,194	0,678	-1,120	0,709	-21,008	0,000	-21,244	0,000
Switzerland	-0,660	0,854	-0,433	0,901	-16,333	0,000	-20,438	0,000
Turkey	-0,743	0,833	-0,744	0,833	-19,077	0,000	-19,065	0,000

Table 8a – *Summary Statistics for the Period 2009-2014 (Basic Statistics)*

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Jarque-Bera (p)
US	0,079	0,077	0,015	0,444	2,906	39,536	0,000
Amsterdam	0,306	0,300	0,035	1,141	4,702	412,714	0,000
Argentina	0,011	0,011	0,003	1,119	5,328	505,287	0,000
Athens	0,091	0,083	0,039	0,581	2,526	78,208	0,000
Australia	0,022	0,022	0,002	0,396	2,746	34,863	0,000
Austria	0,043	0,041	0,006	0,638	2,589	88,666	0,000
Belgium	0,041	0,040	0,004	0,748	3,005	113,900	0,000
Brazil	0,002	0,002	0,000	0,501	2,505	61,411	0,000
Canada	0,142	0,142	0,010	0,820	5,001	336,366	0,000
China	0,040	0,040	0,006	0,005	1,784	70,640	0,000
Czechia	0,097	0,099	0,011	0,066	1,896	61,385	0,000
Germany	0,015	0,015	0,003	0,387	2,886	30,977	0,000
Denmark	0,277	0,269	0,052	0,682	3,544	106,882	0,000
Finland	0,016	0,016	0,002	0,246	2,190	44,868	0,000
France	0,028	0,027	0,003	0,572	2,434	83,136	0,000
England	0,018	0,017	0,002	1,142	4,645	393,384	0,000
India	0,019	0,019	0,002	2,087	9,914	3204,119	0,000
Indonesia	0,030	0,026	0,009	1,643	5,699	879,657	0,000
Italy	0,006	0,005	0,001	0,432	2,161	73,399	0,000
Tokyo	0,113	0,115	0,017	-0,419	2,335	55,261	0,000
Mexico	0,003	0,003	0,000	1,576	5,770	879,557	0,000
Norway	0,223	0,216	0,037	1,080	4,806	395,527	0,000
Poland	0,042	0,042	0,005	1,115	5,556	572,201	0,000
Portugal	0,015	0,015	0,003	0,484	2,334	70,359	0,000
Russia	0,071	0,069	0,011	1,906	7,590	1748,764	0,000
S.Africa	0,004	0,003	0,001	0,462	2,936	42,676	0,000
S.Arabia	0,015	0,015	0,002	-0,103	3,060	1,403	0,496
S.Korea	0,055	0,053	0,006	1,361	4,647	499,067	0,000
Spain	0,011	0,011	0,002	0,689	3,118	97,158	0,000
Sweden	0,096	0,094	0,013	0,930	4,023	225,008	0,000
Switzerland	0,017	0,017	0,002	-0,082	2,822	2,914	0,000
Turkey	0,002	0,002	0,000	2,002	8,202	2138,604	0,000

Table 8b – *Summary Statistics for the Period 2009-2014 (Stationary Tests)*

	Price				Return			
	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value	ADF (t-stat.)	p value	PP (Adj. t-Stat.)	p value
US	-0,801	0,818	-0,625	0,863	-37,333	0,000	-38,008	0,000
Amsterdam	-2,659	0,082	-2,624	0,088	-33,955	0,000	-34,056	0,000
Argentina	-0,396	0,907	-0,441	0,900	-31,549	0,000	-31,548	0,000
Athens	-0,995	0,757	-0,989	0,759	-32,687	0,000	-32,653	0,000
Australia	-2,216	0,201	-2,179	0,214	-35,270	0,000	-35,385	0,000
Austria	-2,596	0,094	-2,530	0,109	-31,439	0,000	-31,475	0,000
Belgium	-2,287	0,176	-0,627	0,862	-34,160	0,000	-34,707	0,000
Brazil	-2,485	0,119	-2,432	0,133	-35,291	0,000	-35,347	0,000
Canada	-3,072	0,029	-2,856	0,051	-34,204	0,000	-35,276	0,000
China	-1,417	0,575	-1,454	0,557	-33,910	0,000	-33,911	0,000
Czechia	-2,630	0,087	-2,600	0,093	-26,213	0,000	-33,125	0,000
Germany	-1,049	0,738	-1,008	0,752	-33,457	0,000	-33,568	0,000
Denmark	0,092	0,965	0,109	0,966	-33,277	0,000	-33,260	0,000
Finland	-2,256	0,187	-2,254	0,188	-17,651	0,000	-38,384	0,000
France	-2,453	0,128	-2,260	0,185	-35,356	0,000	-35,813	0,000
England	-2,326	0,164	-2,267	0,183	-34,658	0,000	-34,830	0,000
India	-3,859	0,002	-3,861	0,002	-32,751	0,000	-32,724	0,000
Indonesia	-2,414	0,138	2,401	0,142	-21,575	0,000	-32,067	0,000
Italy	-1,815	0,374	-1,755	0,403	-34,724	0,000	-34,848	0,000
Tokyo	-0,775	0,825	-0,783	0,823	-34,109	0,000	-34,109	0,000
Mexico	-3,073	0,029	-3,142	0,024	-32,995	0,000	-33,079	0,000
Norway	-1,792	0,385	-1,672	0,445	-35,625	0,000	-36,172	0,000
Poland	-3,684	0,005	-3,650	0,005	-26,547	0,000	-33,561	0,000
Portugal	-1,325	0,620	-1,317	0,624	-32,550	0,000	-32,489	0,000
Russia	-3,309	0,065	-3,253	0,075	-35,178	0,000	-35,319	0,000
S.Africa	-0,474	0,894	-0,176	0,939	-27,005	0,000	-36,116	0,000
S.Arabia	-1,023	0,747	-1,356	0,605	-24,609	0,000	-24,550	0,000
S.Korea	-3,205	0,020	-3,185	0,021	-34,358	0,000	-34,572	0,000
Spain	-2,531	0,313	-2,464	0,346	-20,080	0,000	-32,788	0,000
Sweden	-2,130	0,233	-1,921	0,323	-36,143	0,000	-37,579	0,000
Switzerland	-0,621	0,863	-0,678	0,850	-31,905	0,000	-31,820	0,000
Turkey	-2,883	0,048	-2,881	0,048	-34,660	0,000	-34,659	0,000

Table 9 – Zivot&Andrews Test Statistics

	Return	
	Zivot-Andrews (t-stat.)	p value
US	-52,237	0,003
Amsterdam	-69,112	0,000
Argentina	-47,153	0,009
Athens	-47,533	0,002
Australia	-71,800	0,002
Austria	-48,583	0,001
Belgium	-63,846	0,001
Brazil	-48,694	0,011
Canada	-52,040	0,007
China	-47,010	0,000
Czechia	-48,854	0,004
Germany	-50,518	0,000
Denmark	-45,323	0,004
Finland	-49,497	0,000
France	-51,115	0,070
England	-51,884	0,005
India	-48,539	0,015
Indonesia	-57,946	0,001
Italy	-45,583	0,000
Tokyo	-48,535	0,006
Mexico	-47,832	0,000
Norway	-65,709	0,001
Poland	-47,891	0,001
Portugal	-62,734	0,003
Russia	-57,554	0,021
S.Africa	-64,295	0,000
S.Arabia	-53,307	0,000
S.Korea	-48,356	0,000
Spain	-50,934	0,002
Sweden	-50,473	0,001
Switzerland	-48,674	0,001
Turkey	-66,355	0,000

Table 10 – *Unconditional Correlation Test Statistics*

	Pre-Crisis	p-value	Crisis	p-value	Post-Crisis	p-value
US - S.Africa	0,259	0,000	0,382	0,000	0,527	0,000
US - Netherlands	0,458	0,000	0,592	0,000	0,706	0,000
US - S.Arabia	-0,082	0,040	0,262	0,000	0,376	0,000
US - Argentina	0,453	0,000	0,693	0,000	0,658	0,000
US - Greece	0,235	0,000	0,427	0,000	0,297	0,000
US - Australia	0,099	0,004	0,118	0,017	0,212	0,000
US - Austria	0,307	0,000	0,486	0,000	0,625	0,000
US - Belgium	0,412	0,000	0,558	0,000	0,668	0,000
US - Brazil	0,630	0,000	0,788	0,000	0,710	0,000
US - Canada	0,638	0,000	0,814	0,000	0,790	0,000
US - China	0,086	0,013	0,041	0,417	0,133	0,000
US - Czechia	0,202	0,000	0,417	0,000	0,428	0,000
US - Germany	0,476	0,000	0,635	0,000	0,712	0,000
US - Denmark	0,322	0,000	0,487	0,000	0,540	0,000
US - Finland	0,351	0,000	0,502	0,000	0,642	0,000
US - France	0,463	0,000	0,578	0,000	0,714	0,000
US - England	0,447	0,000	0,563	0,000	0,706	0,000
US - India	0,148	0,000	0,358	0,000	0,282	0,000
US - Indonesia	0,054	0,114	0,191	0,000	0,184	0,000
US - Italy	0,457	0,000	0,540	0,000	0,657	0,000
US - Japan	0,130	0,000	0,213	0,000	0,160	0,000
US - S.Korea	0,162	0,000	0,258	0,000	0,230	0,000
US - Mexico	0,633	0,000	0,818	0,000	0,733	0,000
US - Norway	0,277	0,000	0,484	0,000	0,657	0,000
US - Poland	0,229	0,000	0,408	0,000	0,512	0,000
US - Portugal	0,278	0,000	0,424	0,000	0,526	0,000
US - Russia	0,197	0,000	0,335	0,000	0,513	0,000
US - Spain	0,447	0,000	0,565	0,000	0,613	0,000
US - Sweden	0,403	0,000	0,560	0,000	0,670	0,000
US - Switzerland	0,388	0,000	0,565	0,000	0,671	0,000
US - Turkey	0,165	0,000	0,395	0,000	0,392	0,000

Table 11 – Long Term Cointegration Test Statistics

	Trace Statistic	p- value	Max. Eigen Statistics	p- value	1994 - 2014	
S.Africa	7,839	0,483	7,086	0,479	US-S.Africa	No Cointegration
Netherlands	6,085	0,685	6,066	0,605	US-Netherlands	No Cointegration
S.Arabia	3,469	0,942	2,350	0,980	US-S.Arabia	No Cointegration
Argentina	9,111	0,355	6,827	0,510	US-Argentina	No Cointegration
Greece	5,690	0,732	5,551	0,671	US-Greece	No Cointegration
Australia	4,782	0,832	2,743	0,962	US-Australia	No Cointegration
Austria	3,514	0,939	2,448	0,977	US-Austria	No Cointegration
Belgium	4,757	0,834	4,475	0,806	US-Belgium	No Cointegration
Brazil	3,515	0,939	2,855	0,956	US-Brazil	No Cointegration
Canada	5,304	0,776	2,879	0,955	US-Canada	No Cointegration
China	6,642	0,620	4,491	0,804	US-China	No Cointegration
Czechia	3,719	0,925	2,479	0,975	US-Czechia	No Cointegration
Germany	12,071	0,154	9,363	0,257	US-Germany	No Cointegration
Denmark	9,195	0,348	9,126	0,276	US-Denmark	No Cointegration
Finland	8,166	0,448	7,053	0,483	US-Finland	No Cointegration
France	9,200	0,347	8,774	0,305	US-France	No Cointegration
England	12,148	0,150	10,412	0,186	US-England	No Cointegration
India	4,642	0,846	4,548	0,797	US-India	No Cointegration
Indonesia	5,626	0,739	5,306	0,703	US-Indonesia	No Cointegration
Italy	5,559	0,747	5,435	0,686	US-Italy	No Cointegration
Japan	7,157	0,560	4,099	0,849	US-Japan	No Cointegration
S.Korea	5,137	0,794	4,666	0,783	US-S.Korea	No Cointegration
Mexico	4,209	0,886	4,131	0,845	US-Mexico	No Cointegration
Norway	4,850	0,825	4,657	0,784	US-Norway	No Cointegration
Poland	5,714	0,729	4,083	0,851	US-Poland	No Cointegration
Portugal	4,677	0,842	4,500	0,803	US-Portugal	No Cointegration
Russia	3,610	0,932	2,264	0,983	US-Russia	No Cointegration
Spain	5,345	0,771	5,151	0,723	US-Spain	No Cointegration
Sweden	8,109	0,454	5,904	0,626	US-Sweden	No Cointegration
Switzerland	7,526	0,517	5,969	0,617	US-Switzerland	No Cointegration
Turkey	5,774	0,722	4,953	0,748	US-Turkey	No Cointegration

Table 12a –Cointegration Test Statistics for Pre-Crisis, Crisis and Post-Crisis Periods

	2004 - 2007				2007 - 2009				2009 - 2014			
	Trace Statistic	p- value	Max. Eigen Statistics	p- value	Trace Statistic	p- value	Max. Eigen Statistics	p- value	Trace Statistic	p- value	Max. Eigen Statistics	p- value
S.Africa	12,070	0,154	11,971	0,112	6,479	0,639	6,477	0,553	14,384	0,073	14,286	0,050
Netherlands	6,703	0,612	6,637	0,533	12,454	0,136	12,442	0,095	10,225	0,264	10,210	0,199
S.Arabia	4,822	0,828	4,441	0,810	9,277	0,340	9,195	0,270	11,120	0,204	10,323	0,192
Argentina	10,377	0,253	10,376	0,188	6,190	0,673	6,190	0,589	4,432	0,866	4,285	0,828
Greece	11,277	0,195	11,242	0,143	5,700	0,731	5,688	0,654	2,465	0,986	2,118	0,988
Australia	15,339	0,053	15,304	0,034	4,394	0,869	4,393	0,816	5,752	0,725	5,644	0,659
Austria	6,783	0,603	6,197	0,588	14,649	0,067	14,649	0,044	6,562	0,629	6,463	0,555
Belgium	11,332	0,192	9,267	0,265	8,282	0,436	8,272	0,352	6,217	0,670	6,188	0,589
Brazil	12,817	0,122	12,689	0,087	3,775	0,921	3,767	0,883	23,117	0,003	22,229	0,002
Canada	9,676	0,307	9,650	0,236	3,880	0,913	3,851	0,875	10,579	0,239	10,569	0,177
China	21,585	0,005	21,580	0,003	2,817	0,975	2,506	0,974	12,592	0,131	12,586	0,091
Czechia	7,908	0,475	7,383	0,445	25,918	0,001	25,914	0,001	9,338	0,335	9,115	0,277
Germany	15,493	0,050	15,445	0,032	10,963	0,214	10,961	0,156	5,470	0,757	5,006	0,741
Denmark	12,893	0,119	12,888	0,082	14,164	0,079	14,163	0,052	3,001	0,967	2,976	0,948
Finland	8,327	0,431	8,305	0,349	5,395	0,766	5,395	0,691	6,005	0,695	5,987	0,615
France	6,441	0,643	6,030	0,609	4,692	0,841	4,687	0,781	6,374	0,651	6,331	0,571
England	5,626	0,739	4,728	0,776	8,446	0,419	8,444	0,335	16,468	0,036	16,406	0,023
India	12,802	0,122	12,780	0,085	8,194	0,445	8,188	0,360	17,777	0,022	17,699	0,014
Indonesia	20,112	0,009	19,818	0,006	5,621	0,740	5,620	0,662	6,689	0,614	6,495	0,551
Italy	7,012	0,576	5,313	0,702	5,133	0,795	5,122	0,726	5,355	0,770	5,320	0,701
Japan	3,560	0,936	3,121	0,938	15,459	0,051	15,440	0,033	3,835	0,916	3,673	0,892
S.Korea	9,187	0,348	8,893	0,295	6,992	0,579	6,983	0,491	9,777	0,298	9,311	0,261
Mexico	21,192	0,006	20,854	0,004	9,184	0,349	9,174	0,272	12,551	0,132	12,516	0,093
Norway	9,346	0,334	9,303	0,262	7,445	0,527	7,442	0,438	14,554	0,069	14,478	0,046
Poland	10,475	0,246	10,389	0,188	7,575	0,512	7,516	0,430	10,854	0,221	10,649	0,173
Portugal	16,033	0,042	15,906	0,027	5,454	0,759	5,124	0,726	3,406	0,946	3,166	0,935
Russia	5,261	0,781	5,245	0,711	3,685	0,927	3,680	0,892	11,684	0,173	11,314	0,139
Spain	12,610	0,130	12,603	0,090	5,759	0,724	5,756	0,645	6,867	0,593	6,817	0,511

Sweden	12,424	0,138	12,270	0,101	10,710	0,230	9,571	0,242	9,275	0,341	9,197	0,270
Switzerland	9,530	0,319	9,464	0,250	6,940	0,585	6,936	0,497	4,098	0,896	3,530	0,905
Turkey	4,317	0,876	4,147	0,844	3,825	0,917	3,818	0,878	9,489	0,322	9,204	0,270

Table 12b –*Cointegration Test Remarks for PreCrisis, Crisis and Post-Crisis Periods*

	2004 - 2007	2007 - 2009	2009 - 2014
US-S.Africa	No Cointegration	No Cointegration	Cointegrated
US-Netherlands	No Cointegration	No Cointegration	No Cointegration
US-S.Arabia	No Cointegration	No Cointegration	No Cointegration
US-Argentina	No Cointegration	No Cointegration	No Cointegration
US-Greece	No Cointegration	No Cointegration	No Cointegration
US-Australia	Cointegrated	No Cointegration	No Cointegration
US-Austria	No Cointegration	Cointegrated	No Cointegration
US-Belgium	No Cointegration	No Cointegration	No Cointegration
US-Brazil	No Cointegration	No Cointegration	Cointegrated
US-Canada	No Cointegration	No Cointegration	No Cointegration
US-China	Cointegrated	No Cointegration	No Cointegration
US-Czechia	No Cointegration	Cointegrated	No Cointegration
US-Germany	Cointegrated	No Cointegration	No Cointegration
US-Denmark	No Cointegration	No Cointegration	No Cointegration
US-Finland	No Cointegration	No Cointegration	No Cointegration
US-France	No Cointegration	No Cointegration	No Cointegration
US-England	No Cointegration	No Cointegration	Cointegrated
US-India	No Cointegration	No Cointegration	Cointegrated
US-Indonesia	Cointegrated	No Cointegration	No Cointegration
US-Italy	No Cointegration	No Cointegration	No Cointegration
US-Japan	No Cointegration	Cointegrated	No Cointegration
US-S.Korea	No Cointegration	No Cointegration	No Cointegration
US-Mexico	Cointegrated	No Cointegration	No Cointegration
US-Norway	No Cointegration	No Cointegration	Cointegrated
US-Poland	No Cointegration	No Cointegration	No Cointegration
US-Portugal	Cointegrated	No Cointegration	No Cointegration
US-Russia	No Cointegration	No Cointegration	No Cointegration
US-Spain	No Cointegration	No Cointegration	No Cointegration
US-Sweden	No Cointegration	No Cointegration	No Cointegration
US-Switzerland	No Cointegration	No Cointegration	No Cointegration
US-Turkey	No Cointegration	No Cointegration	No Cointegration

Table 13 – *VECM Test Statistics (*C(1): Dependent variable is the US, C(2): Dependent variable is paired stock index)*

[illegible]

[illegible]

Table 14 – *Number of Lags for the Return Series*

	US		
	2004-2007	2007-2009	2009-2014
S.Africa	1	1	2
Netherlands	1	2	1
S.Arabia	1*	1	1
Argentina	1*	1	1
Greece	1	1	1
Australia	1	2	2
Austria	1	2	1
Belgium	1	1	1
Brazil	1*	1	1*
Canada	1*	1	1
China	1*	1	1
Czechia	1	1	1
Germany	1	1	1
Denmark	1	2	1
Finland	1	2	1
France	1	2	1
England	1	2	2
India	2	1	1
Indonesia	1	1	1
Italy	1	2	1
Japan	1	1	1
S.Korea	2	2	2
Mexico	1*	1	1*
Norway	1	1	2
Poland	1	1	2
Portugal	1	1	1
Russia	1	1	1
Spain	1	1	1
Sweden	1	2	1
Switzerland	1	1	1
Turkey	1	1	1

*Picked as 1 (originally 0 due to Vector AutoRegression Lag Order Criteria)

Table 15a –*VAR Test Statistics (Effect of the US Stock Index on the Paired Stock Index)*

	2004 - 2007				2007 - 2009				2009 - 2014			
	Lag 1	p-value	Lag 2	p-value	Lag 1	p-value	Lag 2	p-value	Lag 1	p-value	Lag 2	p-value
US to S.Africa	0,523	0,000	-	-	0,380	0,000	-	-	0,326	0,000	0,150	0,000
US to Netherlands	0,418	0,000	-	-	0,537	0,000	0,080	0,237	0,330	0,000	-	-
US to S.Arabia	0,112	0,383	-	-	0,282	0,000	-	-	0,126	0,001	-	-
US to Argentina	0,194	0,039	-	-	0,202	0,010	-	-	-0,013	0,834	-	-
US to Greece	0,365	0,000	-	-	0,270	0,000	-	-	0,339	0,000	-	-
US to Australia	0,522	0,000	-	-	0,561	0,000	0,202	0,000	0,592	0,000	0,198	0,000
US to Austria	0,493	0,000	0,101	0,070	0,537	0,000	0,139	0,052	0,372	0,000	-	-
US to Belgium	0,352	0,000	-	-	0,344	0,000	-	-	0,296	0,000	-	-
US to Brazil	0,146	0,164	-	-	0,201	0,051	-	-	-0,026	0,625	-	-
US to Canada	0,088	0,080	-	-	0,302	0,000	-	-	0,064	0,125	-	-
US to China	0,010	0,902	-	-	0,240	0,000	-	-	0,210	0,000	-	-
US to Czechia	0,441	0,000	-	-	0,526	0,000	-	-	0,361	0,000	-	-
US to Germany	0,483	0,000	-	-	0,391	0,000	-	-	0,317	0,000	-	-
US to Denmark	0,340	0,000	-	-	0,419	0,000	0,060	0,243	0,253	0,000	-	-
US to Finland	0,466	0,000	-	-	0,460	0,000	0,106	0,065	0,273	0,000	-	-
US to France	0,486	0,000	-	-	0,606	0,000	0,159	0,015	0,381	0,000	-	-
US to England	0,354	0,000	-	-	0,527	0,000	0,130	0,032	0,370	0,000	0,163	0,000
US to India	0,574	0,000	0,221	0,003	0,242	0,000	-	-	0,280	0,000	-	-
US to Indonesia	0,564	0,000	-	-	0,364	0,000	-	-	0,435	0,000	-	-
US to Italy	0,321	0,000	-	-	0,506	0,000	0,109	0,076	0,264	0,000	-	-
US to Japan	0,598	0,000	-	-	0,557	0,000	-	-	0,516	0,000	-	-
US to S.Korea	0,621	0,000	0,186	0,003	0,407	0,000	0,128	0,016	0,519	0,000	0,247	0,000
US to Mexico	0,088	0,237	-	-	0,048	0,537	-	-	-0,034	0,406	-	-
US to Norway	0,553	0,000	-	-	0,421	0,000	-	-	0,360	0,000	0,245	0,000
US to Poland	0,410	0,000	-	-	0,310	0,000	-	-	0,230	0,000	0,167	0,000
US to Portugal	0,191	0,000	-	-	0,327	0,000	-	-	0,174	0,000	-	-
US to Russia	0,577	0,000	-	-	0,442	0,000	-	-	0,286	0,000	-	-
US to Spain	0,360	0,000	-	-	0,458	0,000	-	-	0,181	0,000	-	-

US to Sweden	0,505	0,000	-	-	0,441	0,000	0,121	0,055	0,289	0,000	-	-
US to Switzerland	0,389	0,000	-	-	0,433	0,000	-	-	0,203	0,000	-	-
US to Turkey	0,728	0,000	-	-	0,444	0,000	-	-	0,193	0,000	-	-

Table 15b –VAR Test Statistics (Effect of the Paired Stock Index on the US Stock Index)

	2004 - 2007				2007 - 2009				2009 - 2014			
	Lag 1	p-value	Lag 2	p-value	Lag 1	p-value	Lag 2	p-value	Lag 1	p-value	Lag 2	p-value
S.Africa to US	-0,047	0,022	-	-	-0,066	0,226	-	-	0,038	0,277	0,027	0,416
Netherlands to US	0,030	0,342	-	-	-0,065	0,359	-0,092	0,142	0,048	0,193	-	-
S.Arabia to US	0,002	0,887	-	-	-0,024	0,679	-	-	0,061	0,136	-	-
Argentina to US	-0,034	0,026	-	-	-0,188	0,002	-	-	-0,029	0,237	-	-
Greece to US	0,020	0,402	-	-	-0,063	0,281	-	-	0,016	0,271	-	-
Australia to US	-0,082	0,013	-	-	-0,010	0,892	-0,026	0,665	0,027	0,515	-0,012	0,709
Austria to US	0,008	0,734	0,050	0,032	0,013	0,783	-0,199	0,089	0,038	0,148	-	-
Belgium to US	0,000	0,989	-	-	-0,046	0,493	-	-	0,059	0,087	-	-
Brazil to US	0,006	0,742	-	-	-0,116	0,069	-	-	0,037	0,254	-	-
Canada to US	0,029	0,443	-	-	-0,398	0,000	-	-	-0,034	0,525	-	-
China to US	0,002	0,895	-	-	-0,062	0,177	-	-	0,037	0,132	-	-
Czechia to US	-0,005	0,812	-	-	-0,181	0,000	-	-	0,006	0,828	-	-
Germany to US	0,025	0,376	-	-	-0,047	0,498	-	-	0,067	0,045	-	-
Denmark to US	-0,029	0,375	-	-	0,058	0,482	0,013	0,854	0,001	0,976	-	-
Finland to US	0,011	0,643	-	-	-0,025	0,721	-0,011	0,863	0,049	0,094	-	-
France to US	0,009	0,772	-	-	-0,075	0,334	-0,058	0,392	0,043	0,174	-	-
England to US	0,000	0,990	-	-	-0,002	0,979	-0,056	0,425	0,067	0,146	0,017	0,700
India to US	0,000	0,978	0,022	0,161	-0,027	0,576	-	-	0,065	0,011	-	-
Indonesia to US	-0,036	0,054	-	-	-0,046	0,363	-	-	0,034	0,188	-	-
Italy to US	0,005	0,883	-	-	-0,036	0,627	-0,128	0,045	0,033	0,183	-	-
Japan to US	-0,027	0,247	-	-	-0,093	0,066	-	-	0,018	0,489	-	-
S.Korea to US	0,042	0,042	0,029	0,139	0,089	0,121	-0,023	0,657	-0,043	0,178	-0,084	0,003
Mexico to US	0,021	0,418	-	-	-0,020	0,833	-	-	0,048	0,281	-	-
Norway to US	-0,048	0,019	-	-	-0,106	0,034	-	-	0,046	0,186	0,015	0,663
Poland to US	0,002	0,923	-	-	-0,091	0,106	-	-	0,018	0,497	-0,061	0,020
Portugal to US	-0,032	0,414	-	-	-0,224	0,001	-	-	0,017	0,550	-	-
Russia to US	0,000	0,996	-	-	-0,020	0,510	-	-	0,020	0,368	-	-
Spain to US	0,033	0,302	-	-	-0,158	0,013	-	-	0,042	0,087	-	-

Sweden to US	0,009	0,729	-	-	-0,034	0,617	-0,055	0,374	0,036	0,271	-	-
Switzerland to US	0,012	0,738	-	-	-0,187	0,014	-	-	0,048	0,298	-	-
Turkey to US	-0,013	0,365	-	-	-0,083	0,094	-	-	-0,006	0,775	-	-

Table 16a –Impulse-Response Test Statistics (Pre-Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US to S.Africa	0,191	-0,057	0,003	0,001	0,000	S.Africa to US	0,311	0,322	-0,053	-0,001	0,002
US to Netherlands	0,339	0,004	0,000	0,000	0,000	Netherlands to US	0,393	0,214	-0,050	0,012	-0,003
US to S.Arabia	-0,063	0,008	-0,001	0,000	0,000	S.Arabia to US	-0,200	0,090	-0,006	0,000	0,000
US to Argentina	0,314	-0,061	0,000	0,000	0,000	Argentina to US	0,774	0,118	-0,009	-0,001	0,000
US to Greece	0,175	0,011	0,001	0,000	0,000	Greece to US	0,246	0,250	-0,013	0,003	0,000
US to Australia	0,086	-0,052	0,006	0,001	-0,001	Australia to US	0,076	0,344	-0,070	-0,003	0,004
US to Austria	0,231	-0,004	0,036	0,000	0,002	Austria to US	0,342	0,310	0,047	-0,001	0,010
US to Belgium	0,300	-0,012	0,000	0,000	0,000	Belgium to US	0,319	0,191	-0,039	0,006	-0,001
US to Brazil	0,433	-0,013	0,001	0,000	0,000	Brazil to US	1,035	0,070	-0,007	0,000	0,000
US to Canada	0,443	-0,007	0,000	0,000	0,000	Canada to US	0,508	0,025	-0,005	0,001	0,000
US to China	0,058	0,000	0,000	0,000	0,000	China to US	0,134	0,004	0,000	0,000	0,000
US to Czechia	0,154	-0,012	0,000	0,000	0,000	Czechia to US	0,239	0,309	-0,007	0,000	0,000
US to Germany	0,352	0,002	0,000	0,000	0,000	Germany to US	0,463	0,238	-0,060	0,015	-0,004
US to Denmark	0,239	-0,028	0,000	0,000	0,000	Denmark to US	0,253	0,216	-0,025	0,000	0,000
US to Finland	0,262	-0,003	0,001	0,000	0,000	Finland to US	0,386	0,302	-0,030	0,004	0,000
US to France	0,346	-0,009	0,000	0,000	0,000	France to US	0,410	0,224	-0,072	0,020	-0,006
US to England	0,329	-0,013	0,000	0,000	0,000	England to US	0,322	0,163	-0,049	0,012	-0,003
US to India	0,127	-0,007	0,025	0,000	-0,005	India to US	0,267	0,401	0,097	-0,080	-0,012
US to Indonesia	0,046	-0,044	-0,005	0,000	0,000	Indonesia to US	0,081	0,398	0,036	-0,004	-0,001
US to Italy	0,330	-0,010	0,000	0,000	0,000	Italy to US	0,349	0,143	-0,040	0,009	-0,002
US to Japan	0,113	-0,030	0,000	0,001	0,000	Japan to US	0,152	0,417	-0,024	-0,006	0,001
US to S.Korea	0,141	0,039	0,020	-0,005	-0,001	S.Korea to US	0,235	0,420	0,072	-0,056	0,005
US to Mexico	0,440	-0,003	-0,006	0,002	-0,001	Mexico to US	0,755	0,113	-0,012	-0,009	0,000
US to Norway	0,204	-0,059	0,003	0,001	0,000	Norway to US	0,334	0,341	-0,060	-0,001	0,002
US to Poland	0,162	-0,004	0,000	0,000	0,000	Poland to US	0,303	0,273	-0,016	0,001	0,000
US to Portugal	0,199	-0,025	-0,001	0,000	0,000	Portugal to US	0,174	0,131	-0,004	-0,001	0,000
US to Russia	0,148	-0,006	0,000	0,000	0,000	Russia to US	0,418	0,379	-0,042	0,004	0,000
US to Spain	0,328	0,007	-0,001	0,000	0,000	Spain to US	0,378	0,187	-0,039	0,009	-0,002
US to Sweden	0,306	-0,008	0,000	0,000	0,000	Sweden to US	0,433	0,236	-0,078	0,022	-0,006
US to Switzerland	0,294	-0,006	0,000	0,000	0,000	Switzerland to US	0,295	0,211	-0,051	0,011	-0,002
US to Turkey	0,126	-0,026	0,000	0,000	0,000	Turkey to US	0,301	0,495	-0,034	-0,003	0,001

Table 16b –Impulse-Response Test Statistics (Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US to S.Africa	1,090	-0,289	0,030	0,004	-0,002	S.Africa to US	1,008	0,757	-0,241	0,031	0,002
US to Netherlands	1,582	-0,371	-0,285	0,087	0,034	Netherlands to US	1,499	0,619	-0,357	-0,085	0,050
US to S.Arabia	0,895	-0,227	0,030	-0,004	0,001	S.Arabia to US	0,988	0,817	-0,104	0,014	-0,002
US to Argentina	1,676	-0,583	0,021	0,022	-0,004	Argentina to US	1,934	0,251	-0,125	0,009	0,004
US to Greece	1,141	-0,276	0,023	0,003	-0,001	Greece to US	1,044	0,568	-0,131	0,010	0,001
US to Australia	0,688	-0,139	-0,122	0,044	0,009	Australia to US	0,441	1,158	-0,107	-0,168	0,036
US to Austria	1,378	-0,269	-0,169	0,079	0,017	Austria to US	1,539	0,895	-0,166	-0,239	0,092
US to Belgium	1,484	-0,287	0,032	0,001	-0,002	Belgium to US	1,258	0,559	-0,232	0,052	-0,007
US to Brazil	1,862	-0,448	0,027	0,009	-0,002	Brazil to US	2,387	0,151	-0,102	0,014	0,000
US to Canada	1,836	-0,680	0,070	0,028	-0,013	Canada to US	1,837	-0,079	-0,108	0,037	-0,003
US to China	0,148	-0,176	0,021	0,000	0,000	China to US	0,161	0,570	-0,082	0,001	0,001
US to Czechia	1,159	-0,492	-0,026	0,055	-0,008	Czechia to US	1,227	1,037	-0,318	-0,046	0,041
US to Germany	1,666	-0,306	0,038	0,001	-0,003	Germany to US	1,448	0,465	-0,286	0,098	-0,026
US to Denmark	1,449	-0,196	-0,202	0,081	0,017	Denmark to US	1,099	0,732	-0,178	-0,100	0,060
US to Finland	1,402	-0,282	-0,207	0,085	0,024	Finland to US	1,221	0,676	-0,276	-0,179	0,104
US to France	1,597	-0,371	-0,226	0,090	0,029	France to US	1,383	-0,078	-0,193	-0,084	0,088
US to England	1,577	-0,294	-0,273	0,095	0,032	England to US	1,299	0,604	-0,398	-0,123	0,119
US to India	0,963	-0,225	0,034	-0,004	0,000	India to US	1,048	0,519	-0,127	0,019	-0,002
US to Indonesia	0,602	-0,174	0,005	0,001	0,000	Indonesia to US	0,570	0,865	-0,059	-0,005	0,001
US to Italy	1,519	-0,327	-0,352	0,085	0,040	Italy to US	1,347	0,705	-0,272	-0,159	0,039
US to Japan	0,797	-0,303	0,037	0,012	-0,007	Japan to US	0,690	1,182	-0,439	0,051	0,018
US to S.Korea	0,870	0,033	-0,246	0,049	0,031	S.Korea to US	0,809	0,821	0,015	-0,208	0,039
US to Mexico	1,981	-0,279	0,029	-0,003	0,000	Mexico to US	1,778	0,218	-0,002	0,001	0,000
US to Norway	1,295	-0,395	0,029	0,017	-0,006	Norway to US	1,387	0,734	-0,292	0,036	0,008
US to Poland	1,112	-0,337	0,033	0,006	-0,003	Poland to US	1,038	0,613	-0,189	0,019	0,003
US to Portugal	1,173	-0,469	0,009	0,038	-0,010	Portugal to US	0,850	0,623	-0,218	-0,003	0,019
US to Russia	0,894	-0,252	0,048	-0,007	0,001	Russia to US	1,552	0,856	-0,283	0,058	-0,009
US to Spain	1,505	-0,425	0,024	0,031	-0,014	Spain to US	1,312	0,643	-0,376	0,086	0,002
US to Sweden	1,489	-0,313	-0,269	0,094	0,033	Sweden to US	1,405	0,551	-0,227	-0,180	0,080
US to Switzerland	1,579	-0,418	-0,002	0,044	-0,016	Switzerland to US	1,121	0,660	-0,367	0,072	0,010
US to Turkey	1,090	-0,292	0,008	0,012	-0,003	Turkey to US	1,111	0,901	-0,235	0,005	0,010

Table 16c –Impulse-Response Test Statistics (Post-Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US to S.Africa	0,624	0,001	0,022	-0,006	-0,001	S.Africa to US	0,623	0,234	-0,008	-0,042	0,014
US to Netherlands	0,820	-0,042	0,008	-0,002	0,001	Netherlands to US	0,871	0,207	-0,067	0,019	-0,005
US to S.Arabia	0,548	-0,001	0,010	-0,001	0,000	S.Arabia to US	0,513	0,209	-0,008	0,004	0,000
US to Argentina	0,752	-0,089	0,000	0,000	0,000	Argentina to US	1,180	0,086	0,009	0,001	0,000
US to Greece	0,345	0,007	0,001	0,000	0,000	Greece to US	0,694	0,376	-0,026	0,004	-0,001
US to Australia	0,362	-0,010	0,004	0,000	-0,001	Australia to US	0,263	0,583	-0,004	-0,001	0,003
US to Austria	0,746	-0,042	0,012	-0,003	0,001	Austria to US	1,031	0,340	-0,066	0,015	-0,003
US to Belgium	0,774	-0,027	0,006	-0,002	0,000	Belgium to US	0,853	0,196	-0,056	0,015	-0,004
US to Brazil	0,792	-0,038	0,003	0,000	0,000	Brazil to US	1,021	-0,039	0,003	0,000	0,000
US to Canada	0,881	-0,072	0,003	0,000	0,000	Canada to US	0,787	0,038	-0,006	0,000	0,000
US to China	0,173	0,033	-0,003	0,001	0,000	China to US	0,205	0,232	-0,029	0,005	-0,001
US to Czechia	0,516	-0,031	0,003	0,000	0,000	Czechia to US	0,586	0,354	-0,058	0,008	-0,001
US to Germany	0,826	-0,030	0,010	-0,003	0,001	Germany to US	0,988	0,214	-0,059	0,017	-0,005
US to Denmark	0,628	-0,042	0,003	0,000	0,000	Denmark to US	0,606	0,219	-0,041	0,006	-0,001
US to Finland	0,746	-0,028	0,006	-0,002	0,000	Finland to US	0,933	0,207	-0,048	0,011	-0,003
US to France	0,825	-0,041	0,005	-0,001	0,000	France to US	1,045	0,193	-0,076	0,024	-0,007
US to England	0,843	-0,035	0,028	-0,005	0,001	England to US	0,792	0,183	-0,012	-0,019	0,013
US to India	0,347	0,042	0,000	0,001	0,000	India to US	0,399	0,306	-0,035	0,010	-0,002
US to Indonesia	0,276	0,006	0,003	0,000	0,000	Indonesia to US	0,297	0,487	-0,061	0,015	-0,003
US to Italy	0,747	-0,032	0,004	-0,001	0,000	Italy to US	1,146	0,168	-0,043	0,009	-0,002
US to Japan	0,231	0,005	0,000	0,000	0,000	Japan to US	0,244	0,567	-0,077	0,013	-0,002
US to S.Korea	0,316	-0,067	-0,060	0,005	-0,001	S.Korea to US	0,294	0,513	0,100	-0,064	-0,015
US to Mexico	0,820	-0,046	0,008	-0,001	0,000	Mexico to US	0,785	0,022	0,005	0,000	0,000
US to Norway	0,775	-0,035	0,053	-0,007	0,004	Norway to US	0,874	0,180	0,083	-0,038	0,016
US to Poland	0,584	-0,034	-0,030	-0,005	0,006	Poland to US	0,736	0,206	0,033	-0,036	0,002
US to Portugal	0,599	-0,034	0,005	-0,001	0,000	Portugal to US	0,704	0,188	-0,017	0,002	0,000
US to Russia	0,594	-0,017	0,001	0,000	0,000	Russia to US	0,874	0,218	-0,047	0,009	-0,002
US to Spain	0,691	-0,015	0,006	-0,001	0,000	Spain to US	1,019	0,189	-0,018	0,004	-0,001
US to Sweden	0,778	-0,045	0,004	-0,001	0,000	Sweden to US	0,915	0,138	-0,056	0,016	-0,004
US to Switzerland	0,788	-0,051	0,010	-0,002	0,000	Switzerland to US	0,652	0,177	-0,035	0,007	-0,001
US to Turkey	0,444	-0,043	0,003	0,000	0,000	Turkey to US	0,637	0,177	-0,027	0,003	0,000

Table 17a –Variance Decomposition Test Statistics (Pre-Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US of S.Africa	7,738%	14,636%	14,811%	14,811%	14,811%	S.Africa of US	0,000%	0,543%	0,553%	0,553%	0,553%
US of Netherlands	24,809%	24,751%	24,746%	24,746%	24,746%	Netherlands of US	0,000%	8,904%	9,358%	9,385%	9,387%
US of S.Arabia	0,636%	0,762%	0,763%	0,763%	0,763%	S.Arabia of US	0,000%	0,324%	0,325%	0,325%	0,325%
US of Argentina	20,689%	21,060%	21,061%	21,061%	21,061%	Argentina of US	0,000%	0,562%	0,562%	0,562%	0,562%
US of Greece	6,375%	6,382%	6,382%	6,382%	6,382%	Greece of US	0,000%	5,896%	5,916%	5,917%	5,917%
US of Australia	0,000%	25,701%	26,381%	26,381%	26,383%	Australia of US	1,601%	2,169%	2,173%	2,173%	2,173%
US of Austria	11,203%	11,178%	11,381%	11,371%	11,371%	Austria of US	0,000%	8,964%	8,948%	8,950%	8,954%
US of Belgium	19,416%	19,414%	19,414%	19,414%	19,414%	Belgium of US	0,000%	8,140%	8,421%	8,428%	8,428%
US of Brazil	39,903%	39,993%	39,993%	39,993%	39,993%	Brazil of US	0,000%	0,012%	0,013%	0,013%	0,013%
US of Canada	41,249%	41,185%	41,185%	41,185%	41,185%	Canada of US	0,000%	0,066%	0,067%	0,067%	0,067%
US of China	0,686%	0,686%	0,686%	0,686%	0,686%	China of US	0,000%	0,002%	0,002%	0,002%	0,002%
US of Czechia	4,954%	4,973%	4,973%	4,973%	4,973%	Czechia of US	0,000%	7,064%	7,067%	7,067%	7,067%
US of Germany	26,777%	30,810%	31,038%	31,053%	31,054%	Germany of US	0,000%	0,076%	0,081%	0,082%	0,082%
US of Denmark	11,920%	18,902%	18,990%	18,990%	18,990%	Denmark of US	0,000%	0,082%	0,082%	0,082%	0,082%
US of Finland	14,530%	21,479%	21,541%	21,542%	21,542%	Finland of US	0,000%	0,022%	0,022%	0,022%	0,022%
US of France	25,844%	29,730%	30,118%	30,150%	30,152%	France of US	0,000%	0,008%	0,009%	0,009%	0,009%
US of England	23,155%	26,310%	26,600%	26,618%	26,620%	England of US	0,000%	0,000%	0,000%	0,000%	0,000%
US of India	3,312%	10,015%	10,228%	10,468%	10,470%	India of US	0,000%	0,009%	0,205%	0,206%	0,213%
US of Indonesia	0,453%	10,040%	10,112%	10,112%	10,112%	Indonesia of US	0,000%	0,389%	0,392%	0,392%	0,392%
US of Italy	23,368%	25,367%	25,533%	25,542%	25,543%	Italy of US	0,000%	0,002%	0,002%	0,002%	0,002%
US of Japan	2,619%	18,666%	18,705%	18,707%	18,707%	Japan of US	0,000%	0,131%	0,131%	0,131%	0,131%
US of S.Korea	4,099%	15,146%	15,419%	15,580%	15,582%	S.Korea of US	0,000%	0,474%	0,624%	0,641%	0,641%
US of Mexico	41,072%	41,479%	41,448%	41,451%	41,451%	Mexico of US	0,000%	0,111%	0,169%	0,171%	0,171%
US of Norway	8,776%	16,234%	16,444%	16,444%	16,444%	Norway of US	0,000%	0,564%	0,576%	0,576%	0,576%
US of Poland	5,648%	9,786%	9,801%	9,801%	9,801%	Poland of US	0,000%	0,001%	0,001%	0,001%	0,001%
US of Portugal	8,563%	12,805%	12,809%	12,809%	12,809%	Portugal of US	0,000%	0,071%	0,071%	0,071%	0,071%
US of Russia	4,396%	7,694%	7,734%	7,734%	7,734%	Russia of US	0,000%	0,000%	0,000%	0,000%	0,000%
US of Spain	22,939%	22,891%	22,887%	22,887%	22,887%	Spain of US	0,000%	7,017%	7,317%	7,333%	7,333%
US of Sweden	19,642%	19,607%	19,607%	19,607%	19,607%	Sweden of US	0,000%	9,210%	10,018%	10,082%	10,087%
US of Switzerland	18,333%	18,306%	18,305%	18,305%	18,305%	Switzerland of US	0,000%	10,917%	11,463%	11,489%	11,490%
US of Turkey	3,344%	3,471%	3,471%	3,471%	3,471%	Turkey of US	0,000%	8,226%	8,255%	8,255%	8,255%

Table 17b –Variance Decomposition Test Statistics (Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US of S.Africa	21,768%	29,969%	30,728%	30,739%	30,739%	S.Africa of US	0,000%	0,284%	0,303%	0,303%	0,303%
US of Netherlands	47,700%	48,517%	49,016%	49,083%	49,072%	Netherlands of US	0,000%	14,377%	16,269%	16,225%	16,208%
US of S.Arabia	10,642%	10,965%	10,970%	10,970%	10,970%	S.Arabia of US	0,000%	5,441%	5,525%	5,526%	5,526%
US of Argentina	53,272%	56,036%	56,008%	56,010%	56,011%	Argentina of US	0,000%	1,416%	1,449%	1,449%	1,450%
US of Greece	23,691%	24,456%	24,463%	24,463%	24,463%	Greece of US	0,000%	6,194%	6,384%	6,384%	6,384%
US of Australia	8,898%	41,325%	41,064%	41,384%	41,381%	Australia of US	0,000%	0,004%	0,020%	0,025%	0,025%
US of Austria	35,283%	40,952%	41,162%	41,586%	41,648%	Austria of US	0,000%	0,019%	0,048%	0,049%	0,050%
US of Belgium	40,741%	41,206%	41,217%	41,216%	41,216%	Belgium of US	0,000%	8,832%	9,633%	9,662%	9,662%
US of Brazil	65,575%	66,760%	66,755%	66,755%	66,755%	Brazil of US	0,000%	0,842%	0,870%	0,870%	0,870%
US of Canada	66,475%	62,925%	62,954%	62,960%	62,958%	Canada of US	0,000%	4,842%	5,241%	5,241%	5,242%
US of China	0,382%	4,960%	5,049%	5,049%	5,049%	China of US	0,000%	0,441%	0,450%	0,450%	0,450%
US of Czechia	25,306%	36,260%	37,028%	37,028%	37,042%	Czechia of US	0,000%	2,619%	2,693%	2,703%	2,705%
US of Germany	50,673%	50,817%	51,549%	51,644%	51,651%	Germany of US	0,000%	0,082%	0,097%	0,099%	0,099%
US of Denmark	38,897%	46,723%	46,980%	47,106%	47,156%	Denmark of US	0,000%	0,115%	0,118%	0,118%	0,119%
US of Finland	36,650%	40,688%	41,618%	41,979%	42,107%	Finland of US	0,000%	0,030%	0,029%	0,032%	0,032%
US of France	48,460%	47,503%	49,147%	49,292%	49,433%	France of US	0,000%	0,212%	0,210%	0,247%	0,250%
US of England	46,855%	46,758%	48,501%	48,672%	48,832%	England of US	0,000%	0,000%	0,103%	0,149%	0,149%
US of India	16,479%	19,684%	19,869%	19,874%	19,874%	India of US	0,000%	0,071%	0,074%	0,074%	0,074%
US of Indonesia	6,957%	19,747%	19,795%	19,796%	19,796%	Indonesia of US	0,000%	0,177%	0,177%	0,177%	0,177%
US of Italy	43,300%	46,529%	47,249%	47,424%	47,406%	Italy of US	0,000%	0,055%	0,556%	0,725%	0,725%
US of Japan	11,503%	33,101%	35,293%	35,313%	35,315%	Japan of US	0,000%	0,553%	0,611%	0,611%	0,611%
US of S.Korea	13,743%	23,973%	23,913%	24,496%	24,516%	S.Korea of US	0,000%	0,576%	0,768%	0,766%	0,771%
US of Mexico	71,355%	71,588%	71,587%	71,587%	71,587%	Mexico of US	0,000%	0,009%	0,009%	0,009%	0,009%
US of Norway	30,701%	35,466%	36,245%	36,251%	36,252%	Norway of US	0,000%	0,866%	0,932%	0,932%	0,933%
US of Poland	22,315%	27,662%	28,148%	28,151%	28,151%	Poland of US	0,000%	0,539%	0,569%	0,569%	0,569%
US of Portugal	26,071%	34,644%	35,540%	35,527%	35,534%	Portugal of US	0,000%	1,856%	1,950%	1,951%	1,952%
US of Russia	15,854%	19,605%	20,005%	20,021%	20,022%	Russia of US	0,000%	0,096%	0,104%	0,104%	0,104%
US of Spain	41,923%	43,681%	43,575%	43,559%	43,560%	Spain of US	0,000%	13,808%	15,454%	15,474%	15,476%
US of Sweden	41,354%	41,788%	42,171%	42,252%	42,251%	Sweden of US	0,000%	11,337%	11,770%	12,121%	12,166%
US of Switzerland	45,844%	47,410%	47,266%	47,252%	47,254%	Switzerland of US	0,000%	16,654%	18,333%	18,330%	18,337%
US of Turkey	22,112%	23,193%	23,179%	23,180%	23,180%	Turkey of US	0,000%	12,763%	13,171%	13,170%	13,171%

Table 17c –Variance Decomposition Test Statistics (Post-Crisis Period, 5 Days Response)

	day I	day II	day III	day VI	day V		day I	day II	day III	day VI	day V
US of S.Africa	32,044%	34,098%	33,764%	33,743%	33,752%	S.Africa of US	0,000%	0,095%	0,115%	0,124%	0,124%
US of Netherlands	55,429%	55,144%	55,124%	55,123%	55,122%	Netherlands of US	0,000%	4,123%	4,474%	4,501%	4,503%
US of S.Arabia	15,640%	15,363%	15,356%	15,356%	15,356%	S.Arabia of US	0,000%	1,486%	1,495%	1,496%	1,496%
US of Argentina	44,262%	44,543%	44,543%	44,543%	44,543%	Argentina of US	0,000%	0,004%	0,004%	0,004%	0,004%
US of Greece	9,763%	12,283%	12,295%	12,295%	12,295%	Greece of US	0,000%	0,098%	0,098%	0,098%	0,098%
US of Australia	0,000%	37,201%	37,164%	37,161%	37,161%	Australia of US	10,667%	10,604%	10,571%	10,569%	10,568%
US of Austria	44,724%	44,359%	44,340%	44,339%	44,339%	Austria of US	0,000%	3,817%	3,974%	3,982%	3,982%
US of Belgium	49,399%	49,033%	49,007%	49,005%	49,005%	Belgium of US	0,000%	3,520%	3,783%	3,802%	3,804%
US of Brazil	50,362%	50,396%	50,397%	50,397%	50,397%	Brazil of US	0,000%	0,109%	0,111%	0,111%	0,111%
US of Canada	63,199%	63,209%	63,210%	63,210%	63,210%	Canada of US	0,000%	0,033%	0,033%	0,033%	0,033%
US of China	2,341%	5,187%	5,230%	5,231%	5,231%	China of US	0,000%	0,190%	0,193%	0,193%	0,193%
US of Czechia	21,458%	27,032%	27,171%	27,174%	27,174%	Czechia of US	0,000%	0,003%	0,004%	0,004%	0,004%
US of Germany	55,914%	56,577%	56,621%	56,625%	56,625%	Germany of US	0,000%	0,279%	0,301%	0,303%	0,303%
US of Denmark	32,155%	34,648%	34,739%	34,741%	34,741%	Denmark of US	0,000%	0,000%	0,000%	0,000%	0,000%
US of Finland	44,863%	45,782%	45,831%	45,833%	45,833%	Finland of US	0,000%	0,209%	0,220%	0,221%	0,221%
US of France	56,107%	55,788%	55,819%	55,823%	55,823%	France of US	0,000%	0,128%	0,142%	0,144%	0,144%
US of England	57,328%	56,643%	56,630%	56,576%	56,576%	England of US	0,000%	0,170%	0,174%	0,175%	0,175%
US of India	9,728%	14,601%	14,656%	14,660%	14,660%	India of US	0,000%	0,494%	0,502%	0,503%	0,503%
US of Indonesia	6,022%	19,068%	19,238%	19,249%	19,249%	Indonesia of US	0,000%	0,123%	0,125%	0,125%	0,125%
US of Italy	45,638%	45,877%	45,900%	45,901%	45,901%	Italy of US	0,000%	0,136%	0,143%	0,144%	0,144%
US of Japan	4,173%	21,680%	21,937%	21,944%	21,945%	Japan of US	0,000%	0,033%	0,033%	0,033%	0,033%
US of S.Korea	8,116%	25,555%	26,054%	26,262%	26,274%	S.Korea of US	0,000%	0,146%	0,548%	0,584%	0,584%
US of Mexico	54,127%	54,003%	54,003%	54,003%	54,003%	Mexico of US	0,000%	0,095%	0,095%	0,095%	0,095%
US of Norway	48,542%	48,050%	48,210%	48,186%	48,192%	Norway of US	0,000%	0,139%	0,139%	0,140%	0,140%
US of Poland	27,758%	29,208%	28,806%	28,851%	28,847%	Poland of US	0,000%	0,038%	0,499%	0,509%	0,509%
US of Portugal	29,539%	30,993%	31,004%	31,004%	31,004%	Portugal of US	0,000%	0,028%	0,028%	0,028%	0,028%
US of Russia	28,130%	29,082%	29,131%	29,133%	29,133%	Russia of US	0,000%	0,065%	0,067%	0,067%	0,067%
US of Spain	39,376%	39,050%	39,041%	39,041%	39,041%	Spain of US	0,000%	0,903%	0,918%	0,918%	0,918%
US of Sweden	48,690%	48,255%	48,284%	48,287%	48,288%	Sweden of US	0,000%	0,090%	0,099%	0,100%	0,100%
US of Switzerland	49,865%	49,608%	49,598%	49,598%	49,598%	Switzerland of US	0,000%	2,910%	3,019%	3,023%	3,023%
US of Turkey	16,158%	16,209%	16,210%	16,210%	16,210%	Turkey of US	0,000%	1,503%	1,529%	1,529%	1,529%

Table 18a – Granger Causality Test Statistics

	Pre-Crisis		Crisis		Post-Crisis			Pre-Crisis		Crisis		Post-Crisis	
	Chi-sq	p-value	Chi-sq	p-value	Chi-sq	p-value		Chi-sq	p-value	Chi-sq	p-value	Chi-sq	p-value
US => S.Africa	83,963	0,000	59,440	0,000	92,604	0,000	S.Africa => US	5,253	0,022	1,467	0,226	1,576	0,455
US => Netherlands	90,704	0,000	79,317	0,000	59,845	0,000	Netherlands => US	0,904	0,342	2,387	0,303	1,693	0,193
US => S.Arabia	0,762	0,383	14,865	0,000	11,655	0,001	S.Arabia => US	0,020	0,887	0,171	0,679	2,221	0,136
US => Argentina	4,277	0,039	6,729	0,010	0,044	0,834	Argentina => US	4,965	0,026	9,803	0,002	1,400	0,237
US => Greece	55,187	0,000	28,992	0,000	30,946	0,000	Greece => US	0,702	0,402	1,162	0,281	1,212	0,271
US => Australia	309,138	0,000	296,681	0,000	711,617	0,000	Australia => US	6,167	0,013	0,192	0,909	0,684	0,710
US => Austria	84,628	0,000	63,487	0,000	52,956	0,000	Austria => US	4,664	0,097	0,178	0,915	2,095	0,148
US => Belgium	80,847	0,000	47,564	0,000	49,356	0,000	Belgium => US	0,000	0,989	0,471	0,493	2,932	0,087
US => Brazil	1,943	0,163	3,833	0,050	0,240	0,624	Brazil => US	0,109	0,742	3,327	0,068	1,301	0,254
US => Canada	3,063	0,080	13,622	0,000	2,357	0,125	Canada => US	0,588	0,443	22,904	0,000	0,405	0,525
US => China	0,015	0,902	19,331	0,000	35,901	0,000	China => US	0,018	0,895	1,830	0,176	2,269	0,132
US => Czechia	66,772	0,000	52,670	0,000	98,668	0,000	Czechia => US	0,056	0,812	14,975	0,000	0,047	0,828
US => Germany	92,361	0,000	50,235	0,000	42,531	0,000	Germany => US	0,784	0,376	0,461	0,497	4,022	0,045
US => Denmark	80,461	0,000	86,808	0,000	58,323	0,000	Denmark => US	0,788	0,375	0,500	0,779	0,001	0,976
US => Finland	76,720	0,000	76,542	0,000	33,897	0,000	Finland => US	0,215	0,643	0,137	0,934	2,806	0,094
US => France	116,788	0,000	115,333	0,000	54,928	0,000	France => US	0,084	0,772	1,207	0,547	1,848	0,174
US => England	90,672	0,000	99,618	0,000	81,243	0,000	England => US	0,000	0,990	0,726	0,696	2,122	0,346
US => India	66,820	0,000	17,566	0,000	65,587	0,000	India => US	1,968	0,374	0,313	0,576	6,416	0,011
US => Indonesia	86,977	0,000	55,411	0,000	186,279	0,000	Indonesia => US	3,708	0,054	0,830	0,362	1,736	0,188
US => Italy	64,211	0,000	83,754	0,000	20,625	0,000	Italy => US	0,022	0,883	4,039	0,133	1,777	0,183
US => Japan	165,516	0,000	158,850	0,000	270,723	0,000	Japan => US	1,344	0,246	3,387	0,066	0,478	0,489
US => S.Korea	116,597	0,000	69,360	0,000	356,825	0,000	S.Korea => US	6,192	0,045	2,812	0,245	9,816	0,007
US => Mexico	1,310	0,519	0,382	0,537	0,690	0,406	Mexico => US	1,576	0,455	0,045	0,833	1,163	0,281
US => Norway	93,167	0,000	49,478	0,000	73,096	0,000	Norway => US	5,553	0,018	4,489	0,034	1,767	0,413
US => Poland	39,751	0,000	37,975	0,000	36,667	0,000	Poland => US	0,009	0,923	2,615	0,106	6,120	0,047
US => Portugal	38,991	0,000	71,874	0,000	19,470	0,000	Portugal => US	0,668	0,414	10,362	0,001	0,358	0,550
US => Russia	33,633	0,000	23,300	0,000	32,916	0,000	Russia => US	0,000	0,996	0,435	0,510	0,812	0,368
US => Spain	68,462	0,000	79,262	0,000	11,600	0,001	Spain => US	1,067	0,302	6,239	0,013	2,928	0,087
US => Sweden	93,123	0,000	54,929	0,000	40,279	0,000	Sweden => US	0,120	0,729	0,884	0,643	1,214	0,271
US => Switzerland	110,999	0,000	106,152	0,000	40,242	0,000	Switzerland => US	0,112	0,738	6,028	0,014	1,083	0,298
US => Turkey	78,176	0,000	65,236	0,000	18,476	0,000	Turkey => US	0,823	0,364	2,814	0,093	0,082	0,775

Table 18b – Granger Causality (Summary)

	Pre-Crisis	Crisis	Post-Crisis		Pre-Crisis	Crisis	Post-Crisis
US => S.Africa	✓	✓	✓	S.Africa => US	✓	×	×
US => Netherlands	✓	✓	✓	Netherlands => US	×	×	×
US => S.Arabia	×	✓	✓	S.Arabia => US	×	×	×
US => Argentina	✓	✓	×	Argentina => US	✓	✓	×
US => Greece	✓	✓	✓	Greece => US	×	×	×
US => Australia	✓	✓	✓	Australia => US	✓	×	×
US => Austria	✓	✓	✓	Austria => US	×	×	×
US => Belgium	✓	✓	✓	Belgium => US	×	×	×
US => Brazil	×	×	×	Brazil => US	×	×	×
US => Canada	×	✓	×	Canada => US	×	✓	×
US => China	×	✓	✓	China => US	×	×	×
US => Czechia	✓	✓	✓	Czechia => US	×	✓	×
US => Germany	✓	✓	✓	Germany => US	×	×	✓
US => Denmark	✓	✓	✓	Denmark => US	×	×	×
US => Finland	✓	✓	✓	Finland => US	×	×	×
US => France	✓	✓	✓	France => US	×	×	×
US => England	✓	✓	✓	England => US	×	×	×
US => India	✓	✓	✓	India => US	×	×	✓
US => Indonesia	✓	✓	✓	Indonesia => US	×	×	×
US => Italy	✓	✓	✓	Italy => US	×	×	×
US => Japan	✓	✓	✓	Japan => US	×	×	×
US => S.Korea	✓	✓	✓	S.Korea => US	✓	×	✓
US => Mexico	×	×	×	Mexico => US	×		×
US => Norway	✓	✓	✓	Norway => US	✓	✓	×
US => Poland	✓	✓	✓	Poland => US	×	×	✓
US => Portugal	✓	✓	✓	Portugal => US	×	✓	×
US => Russia	✓	✓	✓	Russia => US	×	×	×
US => Spain	✓	✓	✓	Spain => US	×	✓	×

US => Sweden	✓	✓	✓	Sweden => US	×	×	×
US => Switzerland	✓	✓	✓	Switzerland => US	×	✓	×
US => Turkey	✓	✓	✓	Turkey => US	×	×	×

Table 19a – Toda&Yamamoto Causality Test Statistics

	Pre-Crisis		Crisis		Post-Crisis			Pre-Crisis		Crisis		Post-Crisis	
	Chi-sq	p-value	Chi-sq	p-value	Chi-sq	p-value		Chi-sq	p-value	Chi-sq	p-value	Chi-sq	p-value
US => S.Africa	80,010	0,000	54,654	0,000	81,098	0,000	S.Africa => US	4,657	0,097	1,299	0,522	1,468	0,480
US => Netherlands	85,273	0,000	82,545	0,000	62,260	0,000	Netherlands => US	3,381	0,184	1,525	0,467	1,633	0,442
US => S.Arabia	0,901	0,637	8,948	0,011	11,957	0,003	S.Arabia => US	1,406	0,495	0,927	0,629	4,777	0,092
US => Argentina	2,326	0,313	11,426	0,003	0,420	0,811	Argentina => US	3,363	0,186	11,808	0,003	2,516	0,284
US => Greece	63,439	0,000	36,611	0,000	27,996	0,000	Greece => US	1,817	0,403	7,648	0,022	2,088	0,352
US => Australia	344,066	0,000	285,844	0,000	578,684	0,000	Australia => US	4,849	0,089	3,157	0,206	4,000	0,135
US => Austria	85,257	0,000	65,164	0,000	48,124	0,000	Austria => US	1,034	0,596	8,508	0,014	2,370	0,306
US => Belgium	71,234	0,000	51,483	0,000	51,717	0,000	Belgium => US	2,241	0,326	0,400	0,819	3,824	0,148
US => Brazil	3,040	0,219	3,300	0,192	1,218	0,544	Brazil => US	0,012	0,994	1,758	0,415	0,985	0,611
US => Canada	6,946	0,031	8,349	0,015	2,604	0,272	Canada => US	3,127	0,209	13,675	0,001	0,801	0,670
US => China	1,569	0,456	24,927	0,000	30,937	0,000	China => US	0,736	0,692	4,174	0,124	2,102	0,350
US => Czechia	76,623	0,000	107,090	0,000	95,456	0,000	Czechia => US	0,893	0,640	14,498	0,001	6,246	0,044
US => Germany	93,092	0,000	50,919	0,000	47,732	0,000	Germany => US	3,182	0,204	0,964	0,617	6,128	0,047
US => Denmark	87,503	0,000	92,588	0,000	56,053	0,000	Denmark => US	0,559	0,756	1,303	0,521	1,343	0,511
US => Finland	84,174	0,000	69,349	0,000	35,043	0,000	Finland => US	5,880	0,053	5,263	0,072	3,686	0,158
US => France	106,230	0,000	119,819	0,000	56,081	0,000	France => US	3,242	0,198	4,277	0,118	1,061	0,588
US => England	83,793	0,000	98,399	0,000	77,548	0,000	England => US	1,779	0,411	1,752	0,416	1,899	0,387
US => India	91,775	0,000	34,562	0,000	77,055	0,000	India => US	0,822	0,663	1,767	0,413	3,480	0,176
US => Indonesia	130,367	0,000	57,560	0,000	184,416	0,000	Indonesia => US	3,493	0,174	0,396	0,821	10,970	0,004
US => Italy	63,626	0,000	85,047	0,000	18,584	0,000	Italy => US	1,908	0,385	4,780	0,092	1,169	0,557
US => Japan	158,915	0,000	172,062	0,000	260,222	0,000	Japan => US	2,576	0,276	0,847	0,655	1,830	0,400
US => S.Korea	129,077	0,000	92,203	0,000	292,652	0,000	S.Korea => US	3,197	0,202	0,079	0,961	0,576	0,750
US => Mexico	0,372	0,830	12,254	0,002	0,962	0,618	Mexico => US	2,991	0,224	2,766	0,251	0,256	0,880
US => Norway	90,915	0,000	51,340	0,000	50,537	0,000	Norway => US	4,408	0,110	2,587	0,274	3,361	0,186
US => Poland	43,536	0,000	39,446	0,000	29,459	0,000	Poland => US	0,330	0,848	4,426	0,109	2,405	0,300
US => Portugal	45,374	0,000	60,488	0,000	17,981	0,000	Portugal => US	1,976	0,372	5,379	0,068	0,347	0,841
US => Russia	40,829	0,000	25,858	0,000	34,207	0,000	Russia => US	0,287	0,866	1,303	0,521	0,902	0,637
US => Spain	57,638	0,000	80,621	0,000	13,007	0,002	Spain => US	2,261	0,323	8,173	0,017	1,970	0,373
US => Sweden	87,365	0,000	56,156	0,000	49,875	0,000	Sweden => US	11,384	0,003	2,049	0,359	1,337	0,512
US => Switzerland	96,264	0,000	112,786	0,000	53,094	0,000	Switzerland => US	4,866	0,088	3,604	0,165	1,705	0,426
US => Turkey	82,286	0,000	70,241	0,000	27,298	0,000	Turkey => US	1,273	0,529	3,378	0,185	1,611	0,447

Table 19b – Toda&Yamamoto Causality (Summary)

	Pre-Crisis	Crisis	Post-Crisis		Pre-Crisis	Crisis	Post-Crisis
US => S.Africa	✓	✓	✓	S.Africa => US	×	×	×
US => Netherlands	✓	✓	✓	Netherlands => US	×	×	×
US => S.Arabia	×	✓	✓	S.Arabia => US	×	×	×
US => Argentina	×	✓	✓	Argentina => US	×	✓	×
US => Greece	✓	✓	✓	Greece => US	×	✓	×
US => Australia	✓	✓	✓	Australia => US	×	×	×
US => Austria	✓	✓	✓	Austria => US	×	✓	×
US => Belgium	✓	✓	✓	Belgium => US	×	×	×
US => Brazil	×	×	×	Brazil => US	×	×	×
US => Canada	✓	✓	×	Canada => US	×	✓	×
US => China	×	✓	✓	China => US	×	×	×
US => Czechia	✓	✓	✓	Czechia => US	×	✓	✓
US => Germany	✓	✓	✓	Germany => US	×	×	✓
US => Denmark	✓	✓	✓	Denmark => US	×	×	×
US => Finland	✓	✓	✓	Finland => US	×	×	×
US => France	✓	✓	✓	France => US	×	×	×
US => England	✓	✓	✓	England => US	×	×	×
US => India	✓	✓	✓	India => US	×	×	×
US => Indonesia	✓	✓	✓	Indonesia => US	×	×	✓
US => Italy	✓	✓	✓	Italy => US	×	×	×
US => Japan	✓	✓	✓	Japan => US	×	×	×
US => S.Korea	✓	✓	✓	S.Korea => US	×	×	×
US => Mexico	×	✓	×	Mexico => US	×	×	×
US => Norway	✓	✓	✓	Norway => US	×	×	×
US => Poland	✓	✓	✓	Poland => US	×	×	×
US => Portugal	✓	✓	✓	Portugal => US	×	×	×
US => Russia	✓	✓	✓	Russia => US	×	×	×
US => Spain	✓	✓	✓	Spain => US	×	×	×
US => Sweden	✓	✓	✓	Sweden => US	✓	×	×

US => Switzerland	✓	✓	✓	Switzerland => US	×	×	×
US => Turkey	✓	✓	✓	Turkey => US	×	×	×

US-Russia	0,269	0,017	-0,009	0,243	0,958	-0,007	0,002	0,970	-14.223
p-value	0,000	0,284	0,007	0,000	0,000	0,155	0,062	0,000	
US-Spain	0,240	-0,075	0,042	0,317	0,968	0,025	-0,014	0,942	-13.862
p-value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Sweden	0,236	-0,042	0,041	0,266	0,966	0,011	-0,009	0,961	-13.835
p-value	0,000	0,002	0,000	0,000	0,000	0,023	0,001	0,000	
US-Switzerland	0,222	-0,053	0,078	0,324	0,973	0,017	-0,028	0,935	-12.251
p-value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Turkey	0,287	0,094	0,002	0,216	0,954	-0,025	-0,001	0,975	-16.805
p-value	0,000	0,000	0,647	0,000	0,000	0,000	0,142	0,000	

Table 20b – Results of VAR GARCH Asymm. Model (BEKK Representation)

	A _{1,1}	A _{1,2}	A _{2,1}	A _{2,2}	B _{1,1}	B _{1,2}	B _{2,1}	B _{2,2}	D _{1,1}	D _{1,2}	D _{2,1}	D _{2,2}	LL
US-S.Africa	0,109	0,132	-0,034	0,205	0,947	0,001	0,005	0,937	-0,350	0,053	-0,049	-0,259	-13.353
p-value	0,000	0,000	0,032	0,000	0,000	0,846	0,398	0,000	0,000	0,139	0,004	0,000	
US-Netherlands	0,157	0,123	-0,102	0,077	0,944	-0,008	0,010	0,960	-0,323	0,048	-0,046	-0,336	-12.982
p-value	0,000	0,000	0,000	0,014	0,000	0,291	0,063	0,000	0,000	0,134	0,027	0,000	
US-S.Arabia	0,038	-0,045	-0,005	0,361	0,928	0,001	0,000	0,928	0,487	0,027	-0,018	0,114	-10.021
p-value	0,062	0,000	0,601	0,000	0,000	0,821	0,949	0,000	0,000	0,073	0,114	0,001	
US-Argentina	0,076	-0,270	0,010	0,317	0,962	0,029	-0,009	0,908	0,360	0,095	0,005	0,281	-15.015
p-value	0,000	0,000	0,081	0,000	0,000	0,000	0,000	0,000	0,000	0,011	0,492	0,000	
US-Grece	0,012	0,002	0,015	0,316	0,957	0,007	-0,008	0,936	0,363	0,058	0,033	0,184	-15.076
p-value	0,477	0,933	0,140	0,000	0,000	0,338	0,020	0,000	0,000	0,064	0,001	0,000	
US-Australia	0,032	0,116	0,065	0,171	0,951	-0,005	0,023	0,935	0,363	0,087	0,037	-0,258	-11.854
p-value	0,318	0,000	0,015	0,000	0,000	0,211	0,043	0,000	0,000	0,000	0,176	0,000	
US-Austria	0,006	-0,090	-0,042	-0,179	0,954	0,007	0,000	0,941	-0,374	0,046	-0,011	-0,295	-13.299
p-value	0,890	0,000	0,040	0,000	0,000	0,152	0,940	0,000	0,000	0,067	0,491	0,000	
US-Belgium	0,108	-0,083	-0,108	-0,139	0,956	0,002	-0,012	0,934	0,342	0,066	0,065	0,329	-12.655
p-value	0,000	0,000	0,000	0,000	0,000	0,767	0,079	0,000	0,000	0,001	0,002	0,000	
US-Brazil	0,027	-0,218	0,008	0,243	0,960	0,009	-0,004	0,945	-0,369	-0,071	-0,007	-0,276	-14.945
p-value	0,177	0,000	0,079	0,000	0,000	0,179	0,005	0,000	0,000	0,045	0,180	0,000	
US-Canada	0,029	-0,086	0,020	0,223	0,949	-0,016	0,006	0,973	-0,372	-0,166	-0,013	-0,133	-11.513
p-value	0,294	0,000	0,449	0,000	0,000	0,018	0,455	0,000	0,000	0,000	0,597	0,000	
US-China	0,050	-0,001	0,006	0,248	0,955	-0,005	-0,004	0,962	0,388	0,061	-0,035	-0,156	-15.000
p-value	0,011	0,902	0,331	0,000	0,000	0,144	0,003	0,000	0,000	0,001	0,034	0,000	
US-Czechia	0,026	-0,022	0,010	0,314	0,957	0,016	-0,003	0,931	0,361	0,030	0,019	0,155	-13.643
p-value	0,184	0,393	0,456	0,000	0,000	0,007	0,618	0,000	0,000	0,315	0,231	0,000	
US-Germany	0,091	-0,158	-0,035	0,154	0,961	0,009	-0,008	0,954	-0,322	-0,068	-0,057	-0,291	-13.350
p-value	0,000	0,000	0,091	0,000	0,000	0,162	0,117	0,000	0,000	0,011	0,001	0,000	
US-Denmark	0,078	-0,077	-0,126	-0,191	0,953	0,003	-0,004	0,936	-0,356	-0,015	-0,037	-0,258	-11.930
p-value	0,001	0,000	0,000	0,000	0,000	0,670	0,655	0,000	0,000	0,622	0,229	0,000	
US-Finland	0,070	-0,001	-0,008	0,193	0,948	-0,014	0,002	0,976	0,363	0,127	0,032	0,114	-14.578
p-value	0,000	0,941	0,477	0,000	0,000	0,025	0,387	0,000	0,000	0,000	0,001	0,000	
US-France	0,146	0,120	-0,073	0,076	0,952	0,000	0,003	0,962	-0,309	0,083	-0,050	-0,321	-13.359
p-value	0,000	0,000	0,000	0,009	0,000	1,000	0,460	0,000	0,000	0,007	0,008	0,000	
US-England	0,127	-0,101	-0,201	-0,018	0,954	0,006	0,001	0,958	0,314	0,020	0,029	0,301	-12.140
p-value	0,000	0,000	0,000	0,483	0,000	0,429	0,823	0,000	0,000	0,373	0,351	0,000	
US-India	-0,041	0,217	0,045	0,247	0,952	-0,002	0,003	0,895	-0,369	-0,325	-0,018	0,361	-14.822
p-value	0,133	0,000	0,000	0,000	0,000	0,790	0,505	0,000	0,000	0,000	0,152	0,000	
US-Indonesia	0,067	0,198	0,001	0,345	0,954	0,005	0,011	0,884	0,366	0,056	0,000	-0,294	-14.261
p-value	0,002	0,000	0,919	0,000	0,000	0,582	0,039	0,000	0,000	0,116	0,977	0,000	
US-Italy	0,033	0,003	0,024	0,228	0,961	0,009	-0,003	0,947	-0,329	0,041	-0,035	-0,291	-11.719
p-value	0,276	0,925	0,165	0,000	0,000	0,317	0,483	0,000	0,000	0,275	0,034	0,000	
US-Japan	0,062	0,137	0,017	0,222	0,952	0,008	0,006	0,926	0,379	0,067	-0,013	-0,256	-13.532
p-value	0,003	0,000	0,238	0,000	0,000	0,148	0,302	0,000	0,000	0,006	0,317	0,000	
US-S.Korea	0,033	-0,007	0,042	0,273	0,952	-0,012	-0,009	0,958	-0,399	-0,179	0,010	0,109	-14.709
p-value	0,180	0,785	0,000	0,000	0,000	0,019	0,000	0,000	0,000	0,000	0,606	0,086	
US-Mexico	0,040	-0,133	0,007	0,212	0,958	-0,003	-0,002	0,960	-0,368	-0,070	-0,009	-0,272	-13.351
p-value	0,044	0,000	0,279	0,000	0,000	0,538	0,416	0,000	0,000	0,003	0,359	0,000	
US-Norway	0,109	0,095	0,001	0,235	0,952	-0,003	-0,006	0,928	0,338	-0,029	0,048	0,275	-12.788
p-value	0,000	0,000	0,954	0,000	0,000	0,621	0,216	0,000	0,000	0,373	0,013	0,000	
US-Poland	0,056	-0,175	-0,002	0,230	0,957	0,011	-0,002	0,964	0,359	0,088	0,022	0,087	-15.067
p-value	0,020	0,000	0,843	0,000	0,000	0,030	0,332	0,000	0,000	0,000	0,008	0,003	
US-Portugal	0,009	0,102	0,067	0,283	0,961	0,022	-0,013	0,908	0,349	-0,033	0,047	0,273	-12.769
p-value	0,786	0,000	0,001	0,000	0,000	0,002	0,153	0,000	0,000	0,220	0,047	0,000	

US-Russia	0,036	-0,001	-0,023	0,311	0,951	0,021	0,007	0,939	-0,376	0,018	0,000	-0,173	-14.053
p-value	0,049	0,961	0,000	0,000	0,000	0,040	0,000	0,000	0,000	0,637	0,966	0,000	
US-Spain	0,083	0,022	-0,015	0,214	0,957	0,015	-0,002	0,942	-0,321	0,059	-0,052	-0,298	-13.711
p-value	0,008	0,591	0,414	0,000	0,000	0,043	0,630	0,000	0,000	0,121	0,002	0,000	
US-Sweden	-0,014	-0,235	0,104	0,143	0,957	0,016	-0,012	0,946	0,366	0,007	0,014	0,326	-13.675
p-value	0,654	0,000	0,000	0,000	0,000	0,077	0,035	0,000	0,000	0,862	0,299	0,000	
US-Switzerland	0,045	-0,160	-0,080	0,126	0,966	0,013	-0,019	0,931	-0,309	-0,005	-0,096	-0,367	-12.078
p-value	0,074	0,000	0,003	0,000	0,000	0,019	0,021	0,000	0,000	0,817	0,000	0,000	
US-Turkey	0,021	-0,077	0,004	0,279	0,954	-0,018	-0,006	0,952	0,380	0,209	0,019	0,132	-16.632
p-value	0,223	0,003	0,228	0,000	0,000	0,005	0,000	0,000	0,000	0,000	0,003	0,000	

Table 20c – *Results of VAR GARCH Model (VECH Representation)*

	A _{1,1}	A _{2,1}	A _{2,2}	B _{1,1}	B _{2,1}	B _{2,2}	LL
US-S.Africa	0,084	0,038	0,078	0,904	0,945	0,910	-13.459
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Netherlands	0,073	0,051	0,078	0,915	0,936	0,912	-13.094
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-S.Arabia	0,120	0,012	0,134	0,863	0,974	0,859	-10.111
p-value	0,000	0,022	0,000	0,000	0,000	0,000	
US-Argentina	0,085	0,081	0,111	0,905	0,900	0,861	-15.132
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Grece	0,075	0,033	0,101	0,915	0,950	0,898	-15.198
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Australia	0,084	0,016	0,064	0,905	0,963	0,926	-11.984
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Austria	0,080	0,040	0,085	0,909	0,945	0,899	-13.403
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Belgium	0,075	0,053	0,090	0,913	0,931	0,896	-12.792
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Brazil	0,082	0,065	0,080	0,911	0,923	0,906	-15.055
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Canada	0,062	0,052	0,056	0,927	0,938	0,937	-11.628
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-China	0,087	0,002	0,071	0,904	0,996	0,927	-15.092
p-value	0,000	0,074	0,000	0,000	0,000	0,000	
US-Czechia	0,078	0,039	0,107	0,910	0,942	0,878	-13.744
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Germany	0,073	0,049	0,067	0,915	0,940	0,925	-13.446
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Denmark	0,076	0,041	0,090	0,910	0,940	0,892	-12.053
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Finland	0,076	0,034	0,043	0,910	0,956	0,954	-14.680
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-France	0,073	0,045	0,060	0,916	0,943	0,931	-13.456
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-England	0,070	0,000	0,060	0,879	-0,928	0,891	-12.623
p-value	0,000	0,899	0,000	0,000	0,000	0,000	
US-India	0,085	0,019	0,102	0,903	0,957	0,852	-14.951
p-value	0,000	0,001	0,000	0,000	0,000	0,000	
US-Indonesia	0,090	0,020	0,154	0,900	0,947	0,830	-14.379
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Italy	0,073	0,050	0,080	0,913	0,936	0,912	-11.828
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Japan	0,086	0,014	0,110	0,902	0,964	0,859	-13.662
p-value	0,000	0,001	0,000	0,000	0,000	0,000	
US-S.Korea	0,083	0,020	0,076	0,905	0,956	0,921	-14.841
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Mexico	0,076	0,062	0,069	0,916	0,929	0,924	-13.467
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Norway	0,077	0,048	0,096	0,909	0,931	0,884	-12.882
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Poland	0,075	0,030	0,056	0,915	0,957	0,935	-15.168
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Portugal	0,084	-0,001	0,108	0,888	-0,857	0,863	-13.109
p-value	0,000	0,877	0,000	0,000	0,006	0,000	

US-Russia	-0,014	0,009	0,087	0,928	0,946	0,883	0,139	0,041	0,053	-14.042
p-value	0,024	0,039	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Spain	-0,001	0,015	0,034	0,921	0,931	0,912	0,128	0,069	0,082	-13.700
p-value	0,841	0,003	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Sweden	-0,004	0,012	0,029	0,924	0,940	0,927	0,127	0,061	0,067	-13.678
p-value	0,368	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Switzerland	-0,005	0,009	0,016	0,926	0,934	0,912	0,126	0,071	0,102	-12.072
p-value	0,378	0,072	0,012	0,000	0,000	0,000	0,000	0,000	0,000	
US-Turkey	-0,014	0,012	0,067	0,930	0,959	0,923	0,138	0,029	0,019	-16.653
p-value	0,010	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,023	



Table 20e – *Results of VAR GARCH Model (Diagonal BEKK Representation)*

	A ₁	A ₂	B ₁	B ₂	LL
US-S.Africa	0,090	0,097	0,899	0,891	-13.775
p-value	0,000	0,000	0,000	0,000	
US-Netherlands	0,089	0,101	0,903	0,891	-14.051
p-value	0,000	0,000	0,000	0,000	
US-S.Arabia	0,133	0,132	0,852	0,863	-10.173
p-value	0,000	0,000	0,000	0,000	
US-Argentina	0,092	0,135	0,900	0,822	-15.944
p-value	0,000	0,000	0,000	0,000	
US-Grece	0,088	0,120	0,903	0,881	-15.330
p-value	0,000	0,000	0,000	0,000	
US-Australia	0,088	0,067	0,903	0,925	-12.057
p-value	0,000	0,000	0,000	0,000	
US-Austria	0,092	0,101	0,899	0,884	-13.836
p-value	0,000	0,000	0,000	0,000	
US-Belgium	0,089	0,117	0,902	0,872	-13.547
p-value	0,000	0,000	0,000	0,000	
US-Brazil	0,090	0,110	0,902	0,868	-16.139
p-value	0,000	0,000	0,000	0,000	
US-Canada	0,087	0,078	0,904	0,916	-13.358
p-value	0,000	0,000	0,000	0,000	
US-China	0,087	0,072	0,904	0,927	-15.102
p-value	0,000	0,000	0,000	0,000	
US-Czechia	0,090	0,117	0,900	0,870	-13.938
p-value	0,000	0,000	0,000	0,000	
US-Germany	0,090	0,091	0,901	0,901	-14.508
p-value	0,000	0,000	0,000	0,000	
US-Denmark	0,090	0,105	0,897	0,885	-12.430
p-value	0,000	0,000	0,000	0,000	
US-Finland	0,092	0,058	0,899	0,939	-15.237
p-value	0,000	0,000	0,000	0,000	
US-France	0,088	0,075	0,903	0,918	-14.481
p-value	0,000	0,000	0,000	0,000	
US-England	0,085	0,081	0,906	0,912	-13.188
p-value	0,000	0,000	0,000	0,000	
US-India	0,090	0,107	0,900	0,843	-15.033
p-value	0,000	0,000	0,000	0,000	
US-Indonesia	0,089	0,153	0,902	0,832	-14.421
p-value	0,000	0,000	0,000	0,000	
US-Italy	0,085	0,101	0,904	0,898	-12.599
p-value	0,000	0,000	0,000	0,000	
US-Japan	0,088	0,112	0,902	0,860	-13.729
p-value	0,000	0,000	0,000	0,000	
US-S.Korea	0,090	0,080	0,901	0,918	-14.917
p-value	0,000	0,000	0,000	0,000	
US-Mexico	0,089	0,101	0,902	0,892	-14.783
p-value	0,000	0,000	0,000	0,000	
US-Norway	0,090	0,125	0,898	0,858	-13.333
p-value	0,000	0,000	0,000	0,000	
US-Poland	0,086	0,061	0,905	0,929	-15.435
p-value	0,000	0,000	0,000	0,000	
US-Portugal	0,089	0,113	0,902	0,887	-13.277
p-value	0,000	0,000	0,000	0,000	

US-Russia	0,084	0,120	0,905	0,875	-14.351
p-value	0,000	0,000	0,000	0,000	
US-Spain	0,088	0,097	0,904	0,895	-14.565
p-value	0,000	0,000	0,000	0,000	
US-Sweden	0,092	0,079	0,899	0,913	-14.544
p-value	0,000	0,000	0,000	0,000	
US-Switzerland	0,089	0,111	0,902	0,867	-12.974
p-value	0,000	0,000	0,000	0,000	
US-Turkey	0,089	0,084	0,902	0,914	-16.901
p-value	0,000	0,000	0,000	0,000	



Table 20f – *Results of VAR Asymm. GARCH Model (Diagonal BEKK Representation)*

	A ₁	A ₂	B ₁	B ₂	D ₁	D ₂	LL
US-S.Africa	-0,014	0,045	0,916	0,888	0,162	0,101	-13.651
p-value	0,012	0,000	0,000	0,000	0,000	0,000	
US-Netherlands	-0,013	0,028	0,919	0,904	0,159	0,112	-13.901
p-value	0,014	0,000	0,000	0,000	0,000	0,000	
US-S.Arabia	-0,018	0,138	0,867	0,864	0,251	-0,013	-10.072
p-value	0,002	0,000	0,000	0,000	0,000	0,162	
US-Argentina	-0,017	0,078	0,918	0,826	0,166	0,102	-15.828
p-value	0,002	0,000	0,000	0,000	0,000	0,000	
US-Grece	-0,019	0,086	0,920	0,876	0,164	0,075	-15.211
p-value	0,001	0,000	0,000	0,000	0,000	0,000	
US-Australia	-0,014	0,015	0,921	0,925	0,155	0,088	-11.928
p-value	0,009	0,009	0,000	0,000	0,000	0,000	
US-Austria	-0,017	0,025	0,918	0,892	0,167	0,120	-13.693
p-value	0,001	0,001	0,000	0,000	0,000	0,000	
US-Belgium	-0,015	0,032	0,918	0,882	0,164	0,138	-13.392
p-value	0,006	0,000	0,000	0,000	0,000	0,000	
US-Brazil	-0,022	0,022	0,921	0,872	0,171	0,146	-15.977
p-value	0,000	0,005	0,000	0,000	0,000	0,000	
US-Canada	-0,013	0,027	0,920	0,914	0,153	0,092	-13.241
p-value	0,027	0,000	0,000	0,000	0,000	0,000	
US-China	-0,014	0,055	0,921	0,924	0,157	0,041	-14.997
p-value	0,002	0,000	0,000	0,000	0,000	0,000	
US-Czechia	-0,012	0,083	0,920	0,866	0,152	0,064	-13.834
p-value	0,007	0,000	0,000	0,000	0,000	0,000	
US-Germany	-0,017	0,031	0,919	0,902	0,166	0,105	-14.367
p-value	0,001	0,000	0,000	0,000	0,000	0,000	
US-Denmark	-0,022	0,057	0,920	0,885	0,169	0,080	-12.308
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Finland	-0,019	0,038	0,919	0,935	0,168	0,047	-15.122
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-France	-0,015	0,016	0,918	0,921	0,162	0,102	-14.330
p-value	0,008	0,001	0,000	0,000	0,000	0,000	
US-England	-0,011	0,003	0,922	0,931	0,147	0,111	-13.044
p-value	0,057	0,676	0,000	0,000	0,000	0,000	
US-India	-0,017	0,047	0,918	0,829	0,166	0,136	-14.897
p-value	0,001	0,000	0,000	0,000	0,000	0,000	
US-Indonesia	-0,019	0,097	0,924	0,824	0,160	0,114	-14.301
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Italy	-0,030	0,042	0,939	0,905	0,157	0,093	-12.465
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Japan	-0,020	0,051	0,919	0,860	0,167	0,115	-13.593
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-S.Korea	-0,017	0,050	0,918	0,915	0,168	0,063	-14.800
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Mexico	-0,017	0,029	0,919	0,897	0,166	0,132	-14.616
p-value	0,002	0,000	0,000	0,000	0,000	0,000	
US-Norway	-0,022	0,064	0,922	0,854	0,168	0,108	-13.206
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Poland	-0,018	0,041	0,923	0,932	0,160	0,035	-15.326
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Portugal	-0,014	0,072	0,917	0,881	0,162	0,081	-13.160
p-value	0,013	0,000	0,000	0,000	0,000	0,000	

US-Russia	-0,022	0,084	0,929	0,879	0,157	0,058	-14.249
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Spain	-0,017	0,033	0,921	0,901	0,162	0,106	-14.426
p-value	0,002	0,000	0,000	0,000	0,000	0,000	
US-Sweden	-0,017	0,031	0,918	0,912	0,165	0,092	-14.408
p-value	0,002	0,000	0,000	0,000	0,000	0,000	
US-Switzerland	-0,019	0,009	0,924	0,890	0,159	0,148	-12.806
p-value	0,000	0,179	0,000	0,000	0,000	0,000	
US-Turkey	-0,019	0,074	0,924	0,909	0,159	0,029	-16.795
p-value	0,000	0,000	0,000	0,000	0,000	0,000	

Table 20g – *Results of VAR Shock Spill. GARCH Model (Diag. BEKK Representation)*

	A _{1,1}	A _{1,2}	A _{2,1}	A _{2,2}	B ₁	B ₂	LL
US-S.Africa	0,087	0,012	0,040	0,086	0,898	0,886	-13.763
p-value	0,000	0,028	0,000	0,000	0,000	0,000	
US-Netherlands	0,088	0,001	0,020	0,089	0,902	0,892	-14.049
p-value	0,000	0,897	0,014	0,000	0,000	0,000	
US-S.Arabia	0,130	0,016	-0,037	0,135	0,853	0,865	-10.162
p-value	0,000	0,032	0,000	0,000	0,000	0,000	
US-Argentina	0,098	-0,012	-0,029	0,148	0,902	0,818	-15.936
p-value	0,000	0,000	0,003	0,000	0,000	0,000	
US-Grece	0,086	0,005	0,021	0,115	0,903	0,882	-15.328
p-value	0,000	0,130	0,012	0,000	0,000	0,000	
US-Australia	0,083	0,033	0,018	0,067	0,904	0,917	-12.046
p-value	0,000	0,000	0,000	0,000	0,000	0,000	
US-Austria	0,089	0,007	0,036	0,082	0,898	0,888	-13.828
p-value	0,000	0,110	0,000	0,000	0,000	0,000	
US-Belgium	0,087	0,005	0,042	0,090	0,902	0,877	-13.539
p-value	0,000	0,381	0,000	0,000	0,000	0,000	
US-Brazil	0,095	-0,005	-0,011	0,114	0,902	0,868	-16.137
p-value	0,000	0,029	0,283	0,000	0,000	0,000	
US-Canada	0,075	0,019	-0,001	0,080	0,902	0,916	-13.357
p-value	0,000	0,038	0,763	0,000	0,000	0,000	
US-China	0,088	-0,007	-0,005	0,072	0,904	0,927	-15.100
p-value	0,000	0,078	0,436	0,000	0,000	0,000	
US-Czechia	0,088	0,010	0,012	0,114	0,899	0,869	-13.936
p-value	0,000	0,084	0,089	0,000	0,000	0,000	
US-Germany	0,089	0,003	0,030	0,075	0,900	0,901	-14.502
p-value	0,000	0,496	0,000	0,000	0,000	0,000	
US-Denmark	0,090	0,001	0,018	0,093	0,897	0,887	-12.427
p-value	0,000	0,869	0,004	0,000	0,000	0,000	
US-Finland	0,087	0,008	0,009	0,056	0,898	0,939	-15.235
p-value	0,000	0,045	0,073	0,000	0,000	0,000	
US-France	0,087	0,001	0,016	0,065	0,903	0,919	-14.479
p-value	0,000	0,822	0,024	0,000	0,000	0,000	
US-England	0,082	0,008	0,009	0,076	0,905	0,912	-13.187
p-value	0,000	0,286	0,241	0,000	0,000	0,000	
US-India	0,090	-0,002	0,038	0,103	0,900	0,843	-15.029
p-value	0,000	0,711	0,000	0,000	0,000	0,000	
US-Indonesia	0,087	0,010	0,037	0,158	0,902	0,823	-14.417
p-value	0,000	0,066	0,000	0,000	0,000	0,000	
US-Italy	0,085	-0,001	-0,001	0,101	0,904	0,898	-12.599
p-value	0,000	0,886	0,902	0,000	0,000	0,000	
US-Japan	0,089	-0,016	0,027	0,103	0,904	0,865	-13.723
p-value	0,000	0,007	0,000	0,000	0,000	0,000	
US-S.Korea	0,090	-0,001	-0,003	0,081	0,902	0,918	-14.917
p-value	0,000	0,726	0,622	0,000	0,000	0,000	
US-Mexico	0,095	-0,008	-0,010	0,106	0,903	0,893	-14.781
p-value	0,000	0,076	0,119	0,000	0,000	0,000	
US-Norway	0,088	0,006	0,041	0,111	0,897	0,852	-13.325
p-value	0,000	0,346	0,000	0,000	0,000	0,000	
US-Poland	0,086	0,001	0,008	0,059	0,905	0,929	-15.434
p-value	0,000	0,748	0,103	0,000	0,000	0,000	
US-Portugal	0,083	0,019	0,039	0,105	0,901	0,876	-13.260
p-value	0,000	0,001	0,000	0,000	0,000	0,000	

US-Russia	0,084	-0,001	0,008	0,119	0,905	0,875	-14.351
p-value	0,000	0,772	0,344	0,000	0,000	0,000	
US-Spain	0,088	0,000	0,008	0,094	0,904	0,895	-14.564
p-value	0,000	0,953	0,260	0,000	0,000	0,000	
US-Sweden	0,088	0,008	0,008	0,076	0,897	0,913	-14.543
p-value	0,000	0,115	0,343	0,000	0,000	0,000	
US-Switzerland	0,087	0,004	0,012	0,104	0,902	0,865	-12.973
p-value	0,000	0,579	0,084	0,000	0,000	0,000	
US-Turkey	0,090	0,005	0,002	0,084	0,899	0,914	-16.899
p-value	0,000	0,015	0,760	0,000	0,000	0,000	

Table 20h – Results of VAR Shock Spill. Asymm. GARCH Model (Diag. BEKK Representation)

	A _{1,1}	A _{1,2}	A _{2,1}	A _{2,2}	B ₁	B ₂	D ₁	D ₂	LL
US-S.Africa	-0,014	-0,004	0,023	0,044	0,917	0,885	0,162	0,092	-13.647
p-value	0,017	0,290	0,000	0,000	0,000	0,000	0,000	0,000	
US-Netherlands	-0,016	0,004	-0,012	0,032	0,918	0,904	0,160	0,117	-13.900
p-value	0,006	0,282	0,151	0,000	0,000	0,000	0,000	0,000	
US-S.Arabia	-0,018	0,018	-0,037	0,136	0,866	0,865	0,250	-0,002	-10.062
p-value	0,001	0,007	0,000	0,000	0,000	0,000	0,000	0,872	
US-Argentina	-0,012	-0,010	-0,054	0,090	0,920	0,819	0,166	0,121	-15.812
p-value	0,050	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Grece	-0,019	-0,002	0,007	0,085	0,921	0,876	0,164	0,074	-15.211
p-value	0,001	0,483	0,441	0,000	0,000	0,000	0,000	0,000	
US-Australia	-0,014	0,007	0,014	0,013	0,921	0,919	0,154	0,091	-11.923
p-value	0,007	0,406	0,000	0,036	0,000	0,000	0,000	0,000	
US-Austria	-0,017	-0,002	0,024	0,016	0,919	0,895	0,167	0,111	-13.690
p-value	0,002	0,486	0,001	0,029	0,000	0,000	0,000	0,000	
US-Belgium	-0,018	0,006	0,023	0,021	0,918	0,883	0,164	0,131	-13.389
p-value	0,003	0,178	0,009	0,003	0,000	0,000	0,000	0,000	
US-Brazil	-0,018	-0,004	-0,015	0,026	0,921	0,873	0,172	0,147	-15.973
p-value	0,002	0,003	0,096	0,001	0,000	0,000	0,000	0,000	
US-Canada	-0,014	0,002	-0,010	0,033	0,920	0,914	0,154	0,095	-13.240
p-value	0,042	0,776	0,055	0,000	0,000	0,000	0,000	0,000	
US-China	-0,014	-0,004	-0,007	0,055	0,921	0,924	0,157	0,041	-14.996
p-value	0,001	0,155	0,265	0,000	0,000	0,000	0,000	0,000	
US-Czechia	-0,012	0,001	0,007	0,082	0,920	0,865	0,152	0,064	-13.834
p-value	0,009	0,756	0,392	0,000	0,000	0,000	0,000	0,000	
US-Germany	-0,018	0,002	0,005	0,030	0,918	0,902	0,167	0,103	-14.367
p-value	0,001	0,540	0,490	0,000	0,000	0,000	0,000	0,000	
US-Denmark	-0,020	-0,015	0,010	0,052	0,923	0,885	0,171	0,078	-12.305
p-value	0,000	0,002	0,097	0,000	0,000	0,000	0,000	0,000	
US-Finland	-0,018	-0,003	0,001	0,038	0,921	0,935	0,168	0,047	-15.121
p-value	0,001	0,311	0,841	0,000	0,000	0,000	0,000	0,000	
US-France	-0,015	0,000	-0,007	0,018	0,918	0,922	0,162	0,105	-14.330
p-value	0,022	0,912	0,305	0,000	0,000	0,000	0,000	0,000	
US-England	-0,013	0,004	0,002	0,002	0,921	0,931	0,148	0,111	-13.044
p-value	0,041	0,481	0,771	0,810	0,000	0,000	0,000	0,000	
US-India	-0,016	-0,011	0,022	0,046	0,918	0,830	0,170	0,131	-14.893
p-value	0,002	0,002	0,030	0,000	0,000	0,000	0,000	0,000	
US-Indonesia	-0,019	0,003	0,036	0,099	0,923	0,815	0,160	0,118	-14.298
p-value	0,000	0,349	0,001	0,000	0,000	0,000	0,000	0,000	
US-Italy	-0,029	-0,002	-0,028	0,048	0,939	0,907	0,157	0,103	-12.460
p-value	0,000	0,564	0,000	0,000	0,000	0,000	0,000	0,000	
US-Japan	-0,017	-0,012	0,016	0,047	0,921	0,862	0,162	0,111	-13.590
p-value	0,001	0,027	0,041	0,000	0,000	0,000	0,000	0,000	
US-S.Korea	-0,017	-0,003	-0,008	0,051	0,920	0,915	0,166	0,064	-14.799
p-value	0,000	0,249	0,227	0,000	0,000	0,000	0,000	0,000	
US-Mexico	-0,009	-0,013	-0,026	0,033	0,923	0,903	0,162	0,138	-14.602
p-value	0,171	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
US-Norway	-0,021	-0,009	0,023	0,060	0,925	0,850	0,168	0,102	-13.202
p-value	0,000	0,034	0,020	0,000	0,000	0,000	0,000	0,000	
US-Poland	-0,018	-0,002	-0,002	0,041	0,924	0,932	0,160	0,036	-15.326
p-value	0,000	0,531	0,689	0,000	0,000	0,000	0,000	0,000	
US-Portugal	-0,014	0,005	0,035	0,067	0,915	0,870	0,162	0,080	-13.151

p-value	0,011	0,235	0,000	0,000	0,000	0,000	0,000	0,000	
US-Russia	-0,025	0,003	-0,010	0,085	0,929	0,878	0,159	0,061	-14.248
p-value	0,000	0,136	0,270	0,000	0,000	0,000	0,000	0,000	
US-Spain	-0,015	-0,004	-0,004	0,034	0,922	0,901	0,162	0,106	-14.425
p-value	0,014	0,124	0,555	0,000	0,000	0,000	0,000	0,000	
US-Sweden	-0,017	0,000	-0,012	0,034	0,918	0,913	0,166	0,096	-14.407
p-value	0,004	0,926	0,115	0,000	0,000	0,000	0,000	0,000	
US-Switzerland	-0,020	0,002	-0,005	0,012	0,924	0,891	0,160	0,148	-12.805
p-value	0,001	0,623	0,346	0,103	0,000	0,000	0,000	0,000	
US-Turkey	-0,019	0,003	-0,007	0,074	0,920	0,909	0,164	0,030	-16.794
p-value	0,000	0,034	0,434	0,000	0,000	0,000	0,000	0,000	

Table 21a – Results of Portmanteu Tests of VAR GARCH Model (BEKK Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	16,536	0,085	19,849	0,178	23,174	0,280	1,547	0,116
US - Netherlands	41,782	0,000	44,157	0,000	46,550	0,001	1,509	0,005
US - S.Arabia	16,145	0,096	23,896	0,067	26,533	0,149	1,580	0,106
US - Argentina	26,633	0,003	32,159	0,006	33,513	0,030	1,419	0,052
US - Greece	26,141	0,004	35,769	0,002	44,434	0,001	1,318	0,052
US - Australia	8,317	0,598	8,983	0,878	10,720	0,953	0,002	1,000
US - Austria	18,620	0,045	21,209	0,130	22,791	0,299	1,588	0,104
US - Belgium	15,627	0,111	18,364	0,244	21,366	0,376	1,319	0,214
US - Brazil	41,838	0,000	42,300	0,000	47,199	0,001	1,295	0,053
US - Canada	3,901	0,952	5,869	0,982	11,282	0,939	0,348	0,968
US - China	5,394	0,863	6,157	0,977	6,766	0,997	0,521	0,877
US - Czechia	6,997	0,637	14,769	0,468	17,227	0,638	0,791	0,637
US - Germany	26,862	0,003	35,721	0,002	39,606	0,006	1,308	0,093
US - Denmark	3,882	0,953	7,889	0,928	12,762	0,887	0,342	0,970
US - Finland	10,781	0,375	14,911	0,458	16,769	0,668	1,003	0,438
US - France	26,620	0,003	30,692	0,01	36,122	0,015	1,383	0,080
US - England	43,502	0,000	49,825	0,000	51,103	0,000	1,334	0,039
US - India	1,735	0,998	1,960	1,000	2,447	1,000	0,172	0,998
US - Indonesia	16,627	0,083	20,422	0,156	24,112	0,238	1,620	0,095
US - Italy	43,154	0,000	45,639	0,000	49,684	0,000	1,294	0,060
US - Japan	29,749	0,001	31,755	0,007	37,417	0,010	1,437	0,058
US - S.Korea	15,679	0,109	16,488	0,350	20,460	0,430	1,478	0,141
US - Mexico	33,507	0,000	36,176	0,002	40,345	0,005	1,320	0,114
US - Norway	12,277	0,267	14,448	0,492	23,008	0,288	1,044	0,403
US - Poland	33,764	0,000	35,799	0,002	38,162	0,008	1,412	0,068
US - Portugal	12,547	0,250	14,633	0,478	15,249	0,762	1,201	0,285
US - Russia	42,989	0,000	43,852	0,000	45,624	0,001	1,312	0,070
US - Spain	31,304	0,001	32,960	0,005	35,013	0,020	1,237	0,175
US - Sweden	34,705	0,000	39,995	0,000	46,921	0,001	1,252	0,133
US - Switzerland	26,293	0,003	28,878	0,017	37,210	0,011	1,289	0,134
US - Turkey	33,719	0,000	36,225	0,002	38,110	0,009	1,391	0,077

Table 21b – Results of Portmanteu Tests of VAR Asymm. GARCH Model (BEKK Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	8,272	0,602	11,829	0,692	14,224	0,819	0,831	0,598
US - Netherlands	24,972	0,005	27,277	0,027	30,470	0,063	2,478	0,006
US - S.Arabia	16,145	0,096	23,896	0,067	26,533	0,149	1,580	0,106
US - Argentina	22,167	0,014	27,095	0,028	27,694	0,117	2,313	0,010
US - Greece	10,569	0,392	20,506	0,153	28,442	0,099	0,997	0,443
US - Australia	2,947	0,983	4,436	0,996	5,415	0,999	0,003	1,000
US - Austria	6,680	0,755	8,969	0,879	11,971	0,917	0,677	0,746
US - Belgium	4,798	0,904	6,675	0,966	8,633	0,987	0,461	0,916
US - Brazil	24,793	0,006	25,617	0,042	31,834	0,045	2,465	0,006
US - Canada	4,338	0,931	6,948	0,959	14,080	0,826	0,446	0,924
US - China	3,178	0,977	4,184	0,997	4,893	1,000	0,310	0,979
US - Czechia	8,357	0,594	15,664	0,405	17,714	0,606	0,863	0,568
US - Germany	15,780	0,106	21,988	0,108	26,172	0,160	1,570	0,109
US - Denmark	3,584	0,964	7,366	0,947	12,965	0,879	0,359	0,964
US - Finland	5,905	0,823	9,415	0,855	10,991	0,946	0,597	0,818
US - France	6,336	0,786	11,698	0,702	16,458	0,688	0,631	0,789
US - England	11,771	0,301	21,445	0,123	23,528	0,264	1,125	0,339
US - India	3,012	0,981	3,475	0,999	5,515	0,999	0,301	0,981
US - Indonesia	8,876	0,544	18,367	0,244	22,864	0,296	0,905	0,528
US - Italy*	32,671	0,000	35,356	0,002	39,841	0,005	3,651	0,000
US - Japan	11,855	0,295	15,592	0,410	22,803	0,299	1,204	0,283
US - S.Korea	10,594	0,390	13,259	0,582	20,196	0,446	1,039	0,407
US - Mexico	14,718	0,143	19,286	0,201	24,515	0,221	1,431	0,160
US - Norway	5,243	0,874	6,583	0,968	14,012	0,830	0,532	0,869
US - Poland	17,826	0,058	20,477	0,154	24,138	0,236	1,774	0,060
US - Portugal	6,880	0,737	10,079	0,815	11,845	0,921	0,723	0,704
US - Russia	10,234	0,420	11,737	0,699	13,355	0,862	0,991	0,449
US - Spain	17,765	0,059	19,653	0,186	22,602	0,309	1,812	0,053
US - Sweden	4,760	0,907	7,963	0,925	13,893	0,836	0,454	0,920
US - Switzerland	9,520	0,484	10,783	0,768	18,832	0,533	0,952	0,484
US - Turkey	7,440	0,683	11,436	0,721	13,476	0,856	0,719	0,708

* p-value (0,057) at ARCH(40)

Table 21c – Results of Portmanteu Tests of VAR GARCH Model (VECH Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	16,434	0,088	19,526	0,191	23,005	0,289	1,517	0,126
US - Netherlands	49,280	0,000	51,398	0,000	53,656	0,000	1,549	0,003
US - S.Arabia	16,762	0,080	23,890	0,067	26,349	0,155	1,637	0,089
US - Argentina	25,791	0,004	32,064	0,006	34,630	0,022	1,270	0,096
US - Greece	15,849	0,104	26,129	0,037	35,169	0,019	1,435	0,157
US - Australia	4,315	0,932	5,220	0,990	7,061	0,996	0,001	1,000
US - Austria	7,674	0,661	10,307	0,800	12,243	0,907	0,693	0,732
US - Belgium	24,003	0,008	26,490	0,033	29,124	0,085	1,276	0,183
US - Brazil	35,304	0,000	35,745	0,002	41,486	0,003	1,443	0,056
US - Canada	6,412	0,780	7,782	0,932	12,124	0,912	0,538	0,864
US - China	2,509	0,991	3,556	0,999	4,297	1,000	0,242	0,992
US - Czechia	7,720	0,656	14,984	0,453	18,247	0,571	0,804	0,625
US - Germany	22,509	0,013	30,744	0,010	34,782	0,021	1,788	0,057
US - Denmark	3,778	0,957	7,558	0,940	12,311	0,905	0,330	0,973
US - Finland	13,484	0,198	18,285	0,248	20,159	0,448	1,214	0,276
US - France	23,711	0,008	27,644	0,024	33,244	0,032	1,524	0,063
US - England	134,680	0,000	161,460	0,000	196,280	0,000	3,549	0,000
US - India	1,306	0,999	1,515	1,000	1,955	1,000	0,132	0,999
US - Indonesia	15,553	0,113	19,726	0,183	24,018	0,242	1,538	0,119
US - Italy	44,965	0,000	47,186	0,000	51,478	0,000	1,287	0,064
US - Japan	15,419	0,118	18,727	0,226	23,709	0,255	1,521	0,125
US - S.Korea	9,978	0,442	12,319	0,655	18,421	0,560	0,956	0,480
US - Mexico	33,507	0,000	36,176	0,002	40,345	0,005	1,320	0,114
US - Norway	12,220	0,271	14,366	0,498	23,235	0,277	1,004	0,437
US - Poland	16,861	0,077	17,923	0,267	20,978	0,398	1,681	0,079
US - Portugal	7,062	0,720	8,448	0,905	9,909	0,970	0,673	0,751
US - Russia	11,396	0,328	12,941	0,607	14,829	0,786	1,111	0,349
US - Spain	27,426	0,002	29,249	0,015	31,793	0,046	1,532	0,061
US - Sweden	29,802	0,001	34,336	0,003	40,971	0,004	1,369	0,087
US - Switzerland	26,777	0,003	29,004	0,016	37,184	0,011	1,281	0,140
US - Turkey	11,000	0,358	14,425	0,494	16,695	0,673	1,033	0,412

US-Netherlands; ARCH(65), US-Argentina; ARCH(50), US-Belgium; ARCH(20), US-Brazil; ARCH(30), US-France; ARCH(20), US-Italy; ARCH(63), US-Mexico; ARCH(30), US-Spain; ARCH(20), US-Swden; ARCH(30), US-Switzerland; ARCH(30)

Table 21d – Results of Portmanteu Tests of VAR Asymm. GARCH Model (VECH Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	10,476	0,400	14,161	0,513	17,608	0,613	1,048	0,400
US - Netherlands	27,024	0,003	29,394	0,014	32,523	0,038	1,608	0,042
US - S.Arabia	16,846	0,078	24,335	0,06	26,969	0,136	1,647	0,088
US - Argentina	23,700	0,008	29,184	0,015	30,531	0,062	1,285	0,137
US - Greece	11,706	0,305	22,807	0,088	31,478	0,049	1,106	0,353
US - Australia	3,295	0,974	4,060	0,998	5,422	0,999	0,001	1,000
US - Austria	6,984	0,727	9,354	0,858	12,279	0,906	0,694	0,731
US - Belgium	11,150	0,346	13,692	0,549	15,221	0,764	1,045	0,402
US - Brazil	20,429	0,025	20,760	0,145	27,590	0,119	1,338	0,143
US - Canada	3,115	0,979	4,850	0,993	10,630	0,955	0,305	0,980
US - China	3,827	0,955	4,827	0,993	5,515	0,999	0,375	0,958
US - Czechia	7,583	0,670	15,268	0,432	17,93	0,592	0,782	0,646
US - Germany	10,629	0,387	17,198	0,307	21,579	0,364	1,039	0,408
US - Denmark	3,423	0,970	8,231	0,914	14,393	0,810	0,339	0,971
US - Finland	7,288	0,698	11,402	0,724	12,916	0,881	0,720	0,706
US - France	7,177	0,709	12,359	0,652	17,251	0,637	0,704	0,722
US - England	17,114	0,072	26,324	0,035	28,363	0,101	1,600	0,100
US - India	1,272	0,999	1,366	1,000	1,753	1,000	0,128	1,000
US - Indonesia	12,850	0,232	16,551	0,346	20,019	0,457	1,280	0,236
US - Italy	35,729	0,000	38,665	0,001	43,468	0,002	1,217	0,142
US - Japan	15,469	0,116	20,085	0,169	21,229	0,384	0,727	0,700
US - S.Korea	6,751	0,749	8,926	0,881	16,230	0,702	0,659	0,764
US - Mexico	13,547	0,195	18,016	0,262	22,509	0,314	1,290	0,230
US - Norway	5,921	0,822	8,333	0,910	16,381	0,693	0,580	0,832
US - Poland	15,684	0,109	16,832	0,329	20,702	0,415	1,575	0,108
US - Portugal	6,792	0,745	8,658	0,895	8,756	0,986	0,672	0,752
US - Russia	13,299	0,864	9,500	0,485	11,433	0,721	0,911	0,522
US - Spain	17,023	0,074	18,939	0,217	21,865	0,348	1,735	0,067
US - Sweden	6,771	0,747	11,044	0,749	16,975	0,655	0,634	0,786
US - Switzerland	12,774	0,237	15,089	0,445	24,763	0,211	1,266	0,243
US - Turkey	10,963	0,360	14,599	0,481	17,013	0,652	1,043	0,404

US-Netherlands; ARCH(20), US-Argentina; ARCH(30), US-Belgium; ARCH(20), US-Italy; ARCH(50)

Table 21e – Results of Portmanteu Tests of VAR GARCH Model (Diagonal BEKK Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	9,115	0,521	12,141	0,668	15,477	0,749	0,863	0,568
US - Netherlands	30,950	0,001	34,776	0,003	37,034	0,012	1,481	0,010
US - S.Arabia	16,624	0,083	23,610	0,072	26,122	0,162	1,624	0,093
US - Argentina	21,051	0,021	26,103	0,037	27,347	0,126	1,420	0,101
US - Greece	12,768	0,237	23,120	0,082	31,597	0,048	1,186	0,295
US - Australia	4,265	0,935	5,228	0,990	7,166	0,996	0,001	1,000
US - Austria	6,090	0,808	8,882	0,884	10,974	0,947	0,614	0,803
US - Belgium	14,823	0,139	18,352	0,245	21,292	0,380	1,298	0,225
US - Brazil	20,729	0,023	21,397	0,125	26,958	0,136	1,282	0,179
US - Canada	2,771	0,986	5,006	0,992	10,479	0,959	0,270	0,988
US - China	2,466	0,991	3,519	0,999	4,263	1,000	0,238	0,992
US - Czechia	7,969	0,632	15,087	0,445	18,332	0,566	0,842	0,588
US - Germany	9,405	0,494	16,538	0,347	21,229	0,384	0,913	0,520
US - Denmark	2,585	0,990	7,601	0,939	14,278	0,816	0,256	0,990
US - Finland	6,205	0,798	10,521	0,786	12,241	0,908	0,612	0,805
US - France	13,018	0,223	18,660	0,230	24,047	0,240	1,239	0,260
US - England	19,354	0,036	28,133	0,021	30,078	0,069	1,766	0,061
US - India	1,298	0,999	1,485	1,000	1,921	1,000	0,131	0,999
US - Indonesia	15,887	0,103	19,835	0,178	24,085	0,239	1,572	0,108
US - Italy	15,263	0,123	18,830	0,222	23,857	0,249	1,251	0,093
US - Japan	36,692	0,000	39,152	0,001	43,023	0,002	1,512	0,128
US - S.Korea	9,784	0,460	12,454	0,644	18,857	0,531	0,950	0,486
US - Mexico	19,269	0,037	23,596	0,072	28,050	0,108	1,732	0,068
US - Norway	4,759	0,907	7,793	0,932	17,042	0,650	0,472	0,909
US - Poland	14,498	0,151	15,602	0,409	19,023	0,520	1,448	0,153
US - Portugal	7,818	0,647	10,680	0,775	11,139	0,943	0,781	0,647
US - Russia	10,155	0,427	11,763	0,697	13,390	0,860	0,996	0,445
US - Spain	21,905	0,016	24,002	0,065	27,556	0,12	1,380	0,120
US - Sweden	12,514	0,252	18,921	0,217	26,531	0,149	1,154	0,317
US - Switzerland	13,411	0,202	15,783	0,397	25,026	0,200	1,311	0,218
US - Turkey	8,372	0,593	12,028	0,677	14,160	0,822	0,791	0,638

US-Netherlands; ARCH(60), US-S.Arabia; ARCH(20), US-Brazil; ARCH(20), US-Italy; ARCH(60), US-Spain; ARCH(20)

Table 21f – *Results of Portmanteu Tests of VAR Asymm. GARCH Model (Diagonal BEKK Representation)*

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	6,990	0,726	10,561	0,783	13,668	0,847	0,713	0,713
US - Netherlands	19,992	0,029	23,098	0,082	26,182	0,160	1,304	0,164
US - S.Arabia	16,808	0,079	24,246	0,061	26,821	0,140	1,644	0,088
US - Argentina	24,791	0,006	29,113	0,016	29,740	0,074	1,504	0,069
US - Greece	9,933	0,446	20,780	0,144	28,892	0,090	0,950	0,486
US - Australia	3,326	0,973	4,103	0,997	5,489	0,999	0,001	1,000
US - Austria	7,642	0,664	9,988	0,821	13,510	0,854	0,771	0,657
US - Belgium	7,392	0,688	10,084	0,814	11,570	0,930	0,707	0,719
US - Brazil	17,966	0,056	18,396	0,242	24,284	0,230	1,786	0,058
US - Canada	4,097	0,943	6,115	0,978	12,103	0,912	0,436	0,930
US - China	3,844	0,954	4,845	0,993	5,532	0,999	0,377	0,957
US - Czechia	7,840	0,644	15,554	0,412	18,294	0,568	0,806	0,623
US - Germany	9,285	0,505	15,124	0,443	19,610	0,483	0,971	0,467
US - Denmark	3,658	0,961	8,961	0,880	16,284	0,699	0,364	0,962
US - Finland	5,407	0,862	9,364	0,858	10,733	0,953	0,555	0,851
US - France	5,280	0,872	10,965	0,755	15,647	0,738	0,539	0,864
US - England	11,300	0,335	21,768	0,114	23,690	0,256	1,075	0,378
US - India	1,278	0,999	1,356	1,000	1,748	1,000	0,129	1,000
US - Indonesia	12,569	0,249	16,391	0,357	19,837	0,468	1,254	0,251
US - Italy	31,123	0,001	33,882	0,004	38,586	0,008	1,318	0,087
US - Japan	6,913	0,734	11,084	0,747	16,155	0,707	0,708	0,717
US - S.Korea	6,941	0,731	9,232	0,865	16,452	0,688	0,680	0,745
US - Mexico	8,726	0,558	12,681	0,627	17,148	0,643	0,850	0,580
US - Norway	4,779	0,905	6,869	0,961	14,722	0,792	0,491	0,897
US - Poland	13,945	0,176	15,190	0,438	19,309	0,502	1,393	0,177
US - Portugal	6,733	0,750	9,163	0,869	9,304	0,979	0,676	0,748
US - Russia	9,305	0,503	11,030	0,750	12,547	0,896	0,895	0,537
US - Spain	16,399	0,089	18,339	0,245	21,347	0,377	1,664	0,083
US - Sweden	2,966	0,982	7,368	0,947	13,426	0,858	0,300	0,981
US - Switzerland	10,746	0,378	12,673	0,628	22,712	0,303	1,091	0,365
US - Turkey	7,272	0,700	10,670	0,776	12,626	0,893	0,698	0,728

US-Netherlands; ARCH(20), US-Argentina; ARCH(20), US-Italy; ARCH(40)

Table 21g – Results of Portmanteu Tests of VAR Shock Spillover GARCH Model (Diagonal BEKK Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	7,688	0,659	10,991	0,753	14,307	0,815	0,723	0,704
US - Netherlands	29,937	0,001	33,637	0,004	36,103	0,015	1,489	0,009
US - S.Arabia	16,687	0,082	25,081	0,049	28,261	0,103	1,643	0,089
US - Argentina	21,297	0,019	26,128	0,037	27,235	0,129	1,419	0,102
US - Greece	12,636	0,245	22,517	0,095	30,787	0,058	1,174	0,303
US - Australia	4,114	0,942	5,190	0,990	7,308	0,996	0,002	1,000
US - Austria	5,428	0,861	8,009	0,923	10,03	0,968	0,541	0,862
US - Belgium	12,175	0,274	15,564	0,412	18,843	0,532	1,056	0,393
US - Brazil	21,109	0,020	21,852	0,112	27,279	0,128	1,305	0,164
US - Canada	2,759	0,987	5,009	0,992	10,508	0,958	0,269	0,988
US - China	2,457	0,991	3,506	0,999	4,253	1,000	0,238	0,993
US - Czechia	7,903	0,638	14,854	0,462	17,593	0,614	0,839	0,591
US - Germany	8,861	0,545	15,999	0,382	20,692	0,415	0,863	0,568
US - Denmark	2,597	0,989	7,548	0,941	14,069	0,827	0,259	0,990
US - Finland	6,171	0,801	10,289	0,801	12,034	0,915	0,610	0,807
US - France	12,020	0,284	17,655	0,281	22,942	0,292	1,149	0,321
US - England	18,630	0,045	27,149	0,028	29,129	0,085	1,699	0,075
US - India	1,454	0,999	1,651	1,000	2,160	1,000	0,148	0,999
US - Indonesia	14,787	0,140	18,903	0,218	23,380	0,271	1,482	0,139
US - Italy	36,718	0,000	39,192	0,001	43,053	0,002	1,287	0,085
US - Japan	16,760	0,080	20,717	0,146	26,421	0,152	1,665	0,083
US - S.Korea	9,835	0,455	12,508	0,640	18,945	0,525	0,955	0,481
US - Mexico	19,303	0,037	23,700	0,070	28,293	0,103	1,744	0,066
US - Norway	4,632	0,914	6,580	0,968	15,418	0,752	0,485	0,901
US - Poland	14,286	0,160	15,328	0,428	18,881	0,530	1,427	0,162
US - Portugal	8,249	0,605	11,284	0,732	11,867	0,921	0,846	0,584
US - Russia	10,199	0,423	11,734	0,699	13,310	0,864	1,000	0,440
US - Spain	21,373	0,019	23,420	0,076	26,925	0,137	1,349	0,136
US - Sweden	11,866	0,294	18,077	0,259	25,429	0,185	1,089	0,366
US - Switzerland	12,889	0,23	14,939	0,456	23,855	0,249	1,270	0,241
US - Turkey	8,307	0,599	11,969	0,681	14,073	0,827	0,784	0,645

US-Netherlands; ARCH(60), US-Brazil; ARCH(20), US-Italy; ARCH(60), US-Spain; ARCH(20)

Table 21h – Results of Portmanteu Tests of VAR Shock Spillover Asymm. GARCH Model (Diagonal BEKK Representation)

	Q2(10)	p-value	Q2(15)	p-value	Q2(20)	p-value	ARCH(10)	p-value
US - S.Africa	6,798	0,744	10,375	0,796	13,454	0,857	0,691	0,734
US - Netherlands	20,149	0,028	23,160	0,081	26,144	0,161	1,304	0,164
US - S.Arabia	16,753	0,080	25,210	0,047	28,376	0,101	1,649	0,087
US - Argentina	22,548	0,013	26,833	0,030	27,690	0,117	1,407	0,107
US - Greece	9,949	0,445	20,685	0,147	28,684	0,094	0,951	0,485
US - Australia	3,690	0,960	4,579	0,995	6,125	0,999	0,001	1,000
US - Austria	6,781	0,746	9,115	0,871	12,456	0,900	0,684	0,741
US - Belgium	6,898	0,735	9,548	0,847	11,120	0,943	0,654	0,768
US - Brazil	18,689	0,044	19,084	0,210	24,799	0,209	1,210	0,235
US - Canada	4,130	0,941	6,175	0,977	12,162	0,910	0,440	0,928
US - China	3,810	0,956	4,808	0,994	5,491	0,999	0,374	0,958
US - Czechia	7,896	0,639	15,550	0,413	18,076	0,582	0,812	0,618
US - Germany	9,166	0,516	15,086	0,445	19,529	0,488	0,960	0,476
US - Denmark	3,534	0,966	8,681	0,894	15,853	0,726	0,352	0,966
US - Finland	5,405	0,863	9,354	0,858	10,727	0,953	0,555	0,852
US - France	5,500	0,855	11,041	0,750	15,651	0,738	0,562	0,846
US - England	11,201	0,342	21,651	0,117	23,571	0,262	1,065	0,385
US - India	1,357	0,999	1,439	1,000	1,889	1,000	0,137	0,999
US - Indonesia	11,568	0,315	15,560	0,412	19,159	0,512	1,161	0,313
US - Italy	31,304	0,001	34,482	0,003	38,745	0,007	1,364	0,064
US - Japan	7,382	0,689	11,716	0,700	17,114	0,646	0,758	0,670
US - S.Korea	6,931	0,732	9,198	0,867	16,532	0,683	0,679	0,745
US - Mexico	8,654	0,565	13,088	0,595	18,322	0,566	0,852	0,578
US - Norway	5,273	0,872	6,844	0,962	14,562	0,801	0,542	0,862
US - Poland	13,972	0,174	15,235	0,435	19,338	0,500	1,396	0,176
US - Portugal	7,143	0,712	9,873	0,828	10,512	0,958	0,729	0,698
US - Russia	9,163	0,517	11,008	0,752	12,579	0,895	0,879	0,553
US - Spain	16,477	0,087	18,445	0,240	21,440	0,372	1,672	0,081
US - Sweden	3,086	0,979	7,632	0,938	14,250	0,818	0,313	0,978
US - Switzerland	11,040	0,354	13,084	0,596	23,395	0,270	1,119	0,343
US - Turkey	7,257	0,701	10,629	0,778	12,655	0,892	0,696	0,729

US-Netherlands; ARCH(20), US-Argentina; ARCH(20), US-Brazil; ARCH(20), US-Italy; ARCH(40)

Table 22 – Summary Table For Eight GARCH Models (Number of Significant and Insignificant Parameters)

	A _{1,1}	A _{1,2}	A _{2,1}	A _{2,2}	B _{1,1}	B _{1,2}	B _{2,1}	B _{2,2}	D _{1,1}	D _{1,2}	D _{2,1}	D _{2,2}
VAR BEKK (significant)	31	22	16	31	31	20	15	31	-	-	-	-
<i>VAR BEKK (insignificant)</i>	0	9	15	0	0	11	16	0	-	-	-	-
VAR Asym. BEKK (significant)	17	23	14	30	31	11	11	31	31	15	15	31
<i>VAR Asym. BEKK (insignificant)</i>	14	8	17	1	0	20	20	0	0	16	16	0
VAR BEKK VEC (significant)	31	-	28	31	31	-	31	31	-	-	-	-
<i>VAR VEC (insignificant)</i>	0	-	3	0	0	-	0	0	-	-	-	-
VAR Asym. BEKK VEC (significant)	12	-	24	30	31	-	31	31	31	-	28	30
<i>VAR Asym. BEKK VEC (insignificant)</i>	19	-	7	1	0	-	0	0	0	-	3	1
VAR BEKK Diagonal (significant)	31	-	-	31	31	-	-	31	-	-	-	-
<i>VAR BEKK Diagonal (insignificant)</i>	0	-	-	0	0	-	-	0	-	-	-	-
VAR Asym. BEKK Diagonal (significant)	30	-	-	29	31	-	-	31	31	-	-	30
<i>VAR Asym. BEKK Diagonal (insignificant)</i>	1	-	-	2	0	-	-	0	0	-	-	1
VAR BEKK Diagonal Shock Spillover (significant)	31	10	16	31	31	-	-	31	-	-	-	-
<i>VAR BEKK Diagonal Shock Spillover (insignificant)</i>	0	21	15	0	0	-	-	0	-	-	-	-
VAR Asym. BEKK Diagonal Shock Spillover (significant)	29	8	13	29	31	-	-	31	31	-	-	30
<i>VAR Asym. BEKK Diagonal Shock Spillover (insignificant)</i>	2	23	18	2	0	-	-	0	0	-	-	1

Table 23 – *Dynamic Conditional Correlation*

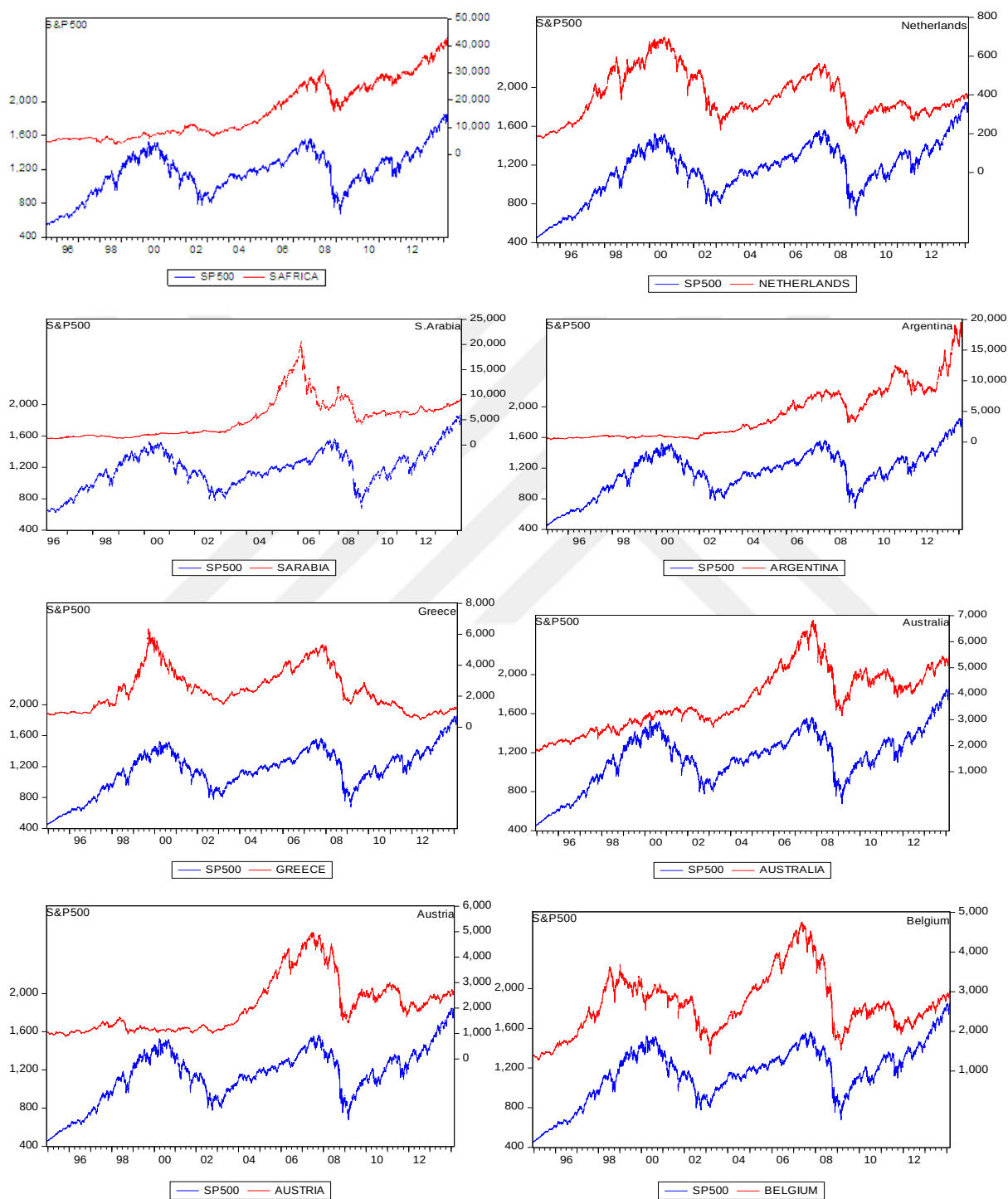
	ω	α_1	p value	α_2	p value	α_3	p value
US - S.Africa	0,329	0,037	0,000	0,154	0,000	0,097	0,000
US - Netherlands	0,544	0,066	0,000	0,158	0,000	0,152	0,000
US - S.Arabia	0,137	0,006	0,471	0,051	0,001	0,133	0,000
US - Argentina	0,477	0,066	0,000	0,272	0,000	0,287	0,000
US - Greece	0,201	0,109	0,000	0,286	0,000	0,246	0,000
US - Australia	0,177	0,025	0,000	0,066	0,000	0,056	0,000
US - Austria	0,361	0,091	0,000	0,211	0,000	0,194	0,000
US - Belgium	0,483	0,091	0,000	0,140	0,000	0,055	0,001
US - Brazil	0,558	0,118	0,000	0,261	0,000	0,222	0,000
US - Canada	0,693	0,048	0,000	0,137	0,000	0,120	0,000
US - China	0,015	-0,050	0,000	0,011	0,192	0,035	0,000
US - Czechia	0,254	0,091	0,000	0,193	0,000	0,240	0,000
US - Germany	0,541	0,066	0,000	0,203	0,000	0,187	0,000
US - Denmark	0,366	0,121	0,000	0,171	0,000	0,141	0,000
US - Finland	0,427	0,082	0,000	0,274	0,000	0,183	0,000
US - France	0,561	0,057	0,000	0,092	0,000	0,119	0,000
US - England	0,527	0,091	0,000	0,140	0,000	0,174	0,000
US - India	0,144	0,056	0,000	0,064	0,000	0,011	0,532
US - Indonesia	0,124	0,014	0,006	0,028	0,004	0,089	0,000
US - Italy	0,543	0,053	0,000	0,107	0,000	0,151	0,000
US - Japan	0,179	-0,018	0,000	0,049	0,000	0,149	0,000
US - S.Korea	0,180	0,056	0,000	0,175	0,000	0,098	0,000
US - Mexico	0,592	0,174	0,000	0,239	0,000	0,248	0,000
US - Norway	0,400	-0,019	0,007	0,161	0,000	0,118	0,000
US - Poland	0,287	0,117	0,000	0,244	0,000	0,158	0,000
US - Portugal	0,347	0,081	0,000	0,157	0,000	0,157	0,000
US - Russia	0,297	0,017	0,017	0,024	0,087	0,044	0,006
US - Spain	0,493	0,043	0,000	0,144	0,000	0,217	0,000
US - Sweden	0,488	0,064	0,000	0,105	0,000	0,132	0,000
US - Switzerland	0,474	0,105	0,000	0,233	0,000	0,182	0,000
US - Turkey	0,180	0,153	0,000	0,397	0,000	0,322	0,000

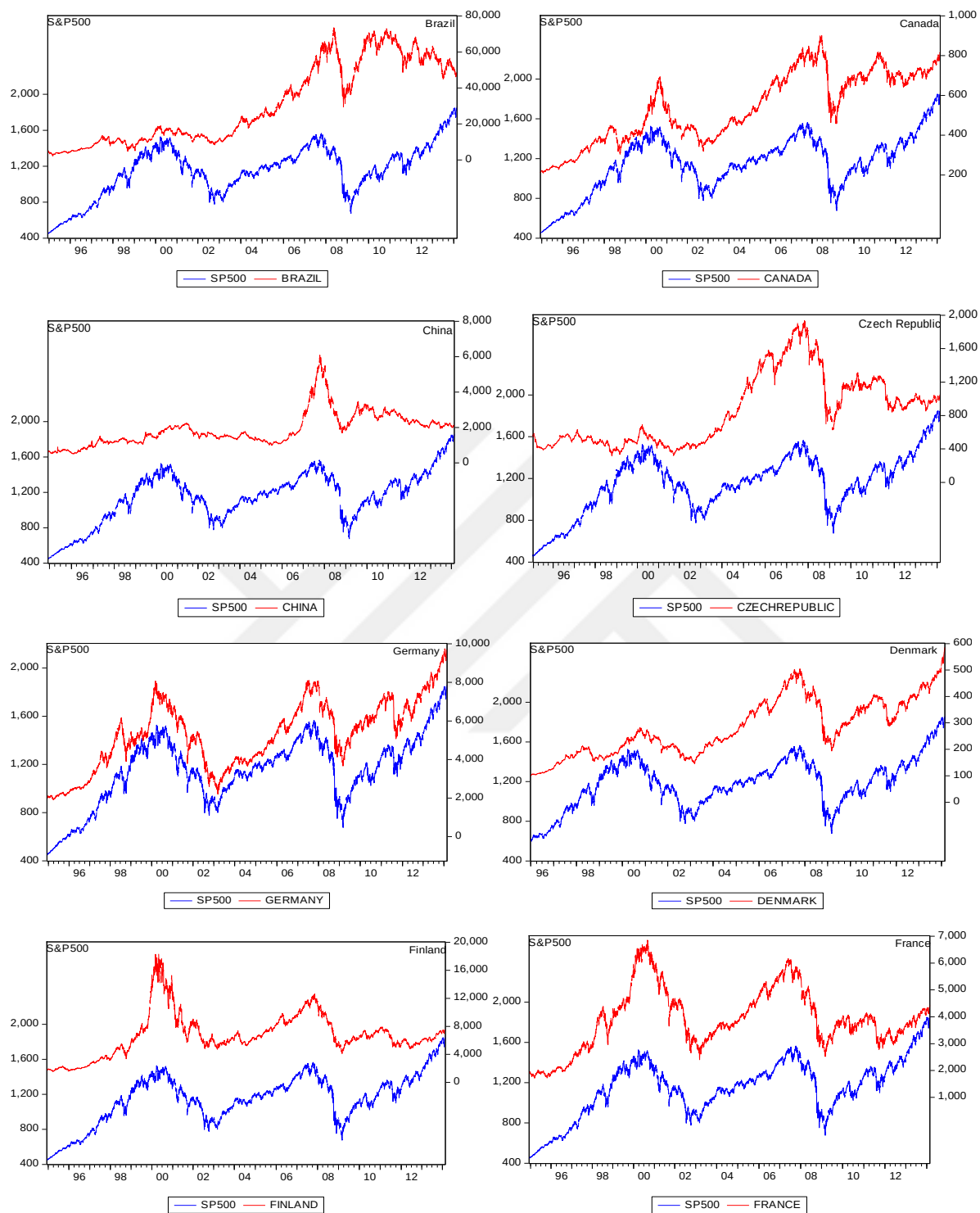
Table 24 – *Dynamic Conditional Volatility*

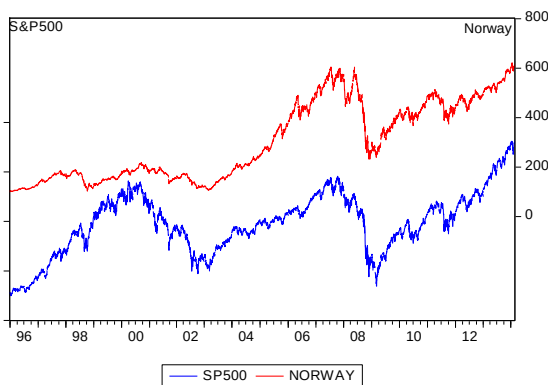
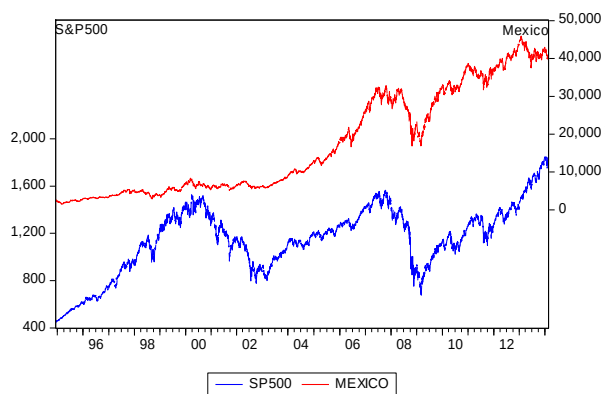
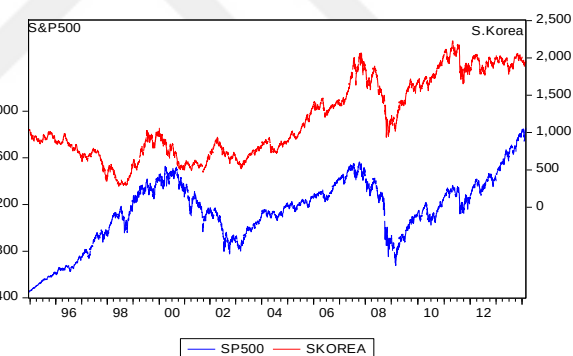
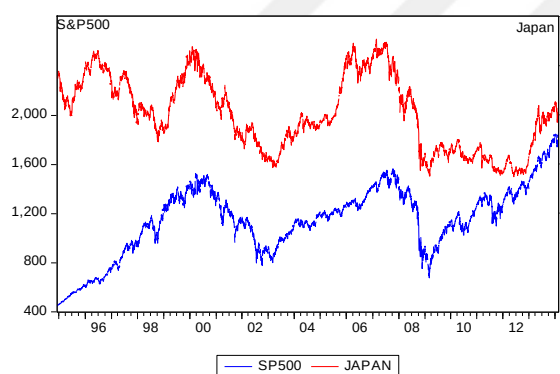
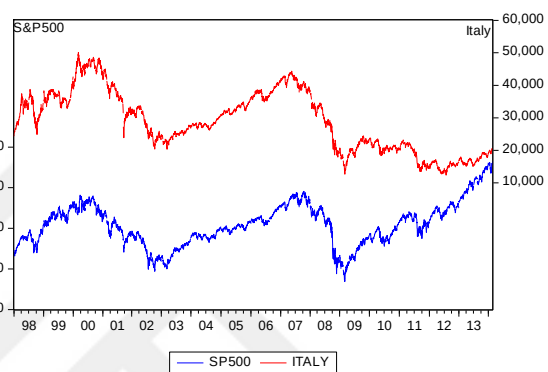
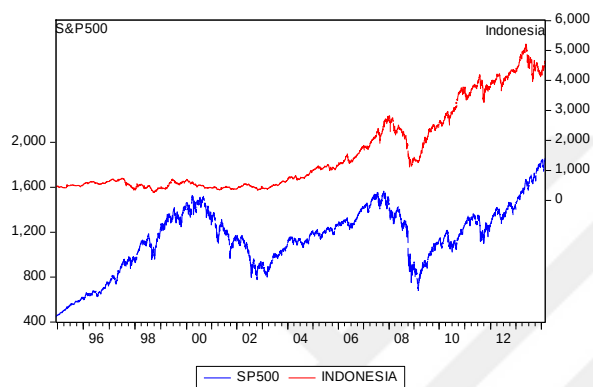
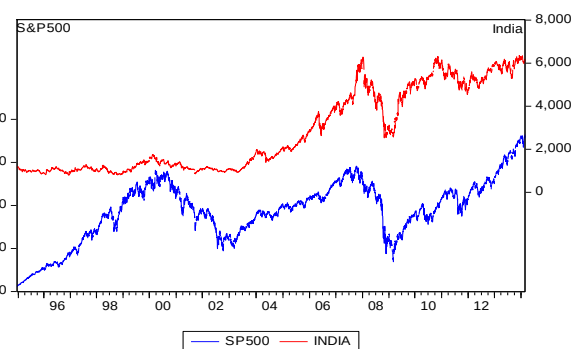
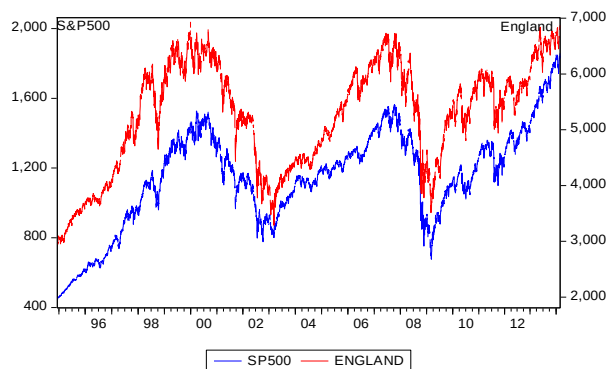
	ω	β_1	p value	β_2	p value	β_3	p value
US	1,179	0,347	0,000	2,390	0,000	1,109	0,000
S.Africa	1,179	0,346	0,000	2,389	0,000	0,053	0,001
Netherlands	1,160	0,193	0,000	2,586	0,000	1,275	0,000
S.Arabia	1,349	0,835	0,000	3,236	0,000	1,506	0,000
Argentina	1,883	-0,134	0,000	2,508	0,000	0,850	0,000
Greece	1,661	-0,055	0,000	1,813	0,000	0,868	0,000
Australia	0,725	0,327	0,000	1,447	0,000	0,720	0,000
Austria	1,135	0,425	0,000	3,148	0,000	1,828	0,000
Belgium	1,022	0,380	0,000	2,528	0,000	0,906	0,000
Brazil	1,959	0,057	0,322	2,593	0,000	0,637	0,000
Canada	0,988	0,263	0,000	3,009	0,000	1,564	0,000
China	1,663	0,947	0,000	1,360	0,000	0,528	0,000
Czechia	1,192	0,209	0,000	3,136	0,000	1,138	0,000
Germany	1,292	0,112	0,002	2,130	0,000	1,288	0,000
Denmark	0,916	0,276	0,000	2,116	0,000	0,938	0,000
Finland	1,600	-0,002	0,964	1,539	0,000	0,941	0,000
France	1,244	0,181	0,000	2,049	0,000	1,084	0,000
England	0,954	0,353	0,000	2,243	0,000	1,206	0,000
India	1,481	0,522	0,000	2,686	0,000	1,120	0,000
Indonesia	1,393	0,410	0,000	2,132	0,000	0,519	0,000
Italy	1,380	-0,092	0,017	1,890	0,000	1,226	0,000
Japan	1,143	0,302	0,000	2,224	0,000	0,628	0,000
S.Korea	1,598	-0,079	0,113	2,044	0,000	0,694	0,000
Mexico	1,398	0,062	0,104	1,807	0,000	0,784	0,000
Norway	1,119	0,333	0,000	3,188	0,000	1,459	0,000
Poland	1,603	0,003	0,925	1,654	0,000	1,355	0,000
Portugal	1,016	0,270	0,000	2,061	0,000	0,676	0,000
Russia	2,323	-0,405	0,000	4,949	0,000	1,931	0,000
Spain	1,312	0,157	0,000	1,954	0,000	0,958	0,000
Sweden	1,295	0,320	0,000	2,374	0,000	1,398	0,000
Switzerland	0,921	0,248	0,000	1,828	0,000	0,865	0,000
Turkey	2,420	-0,309	0,000	1,369	0,000	0,100	0,472

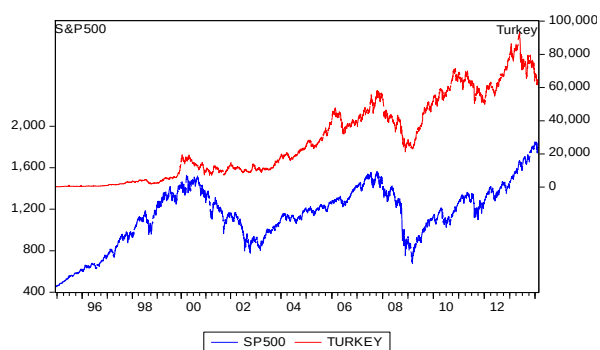
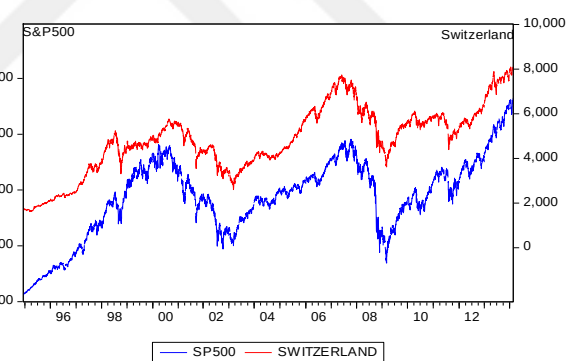
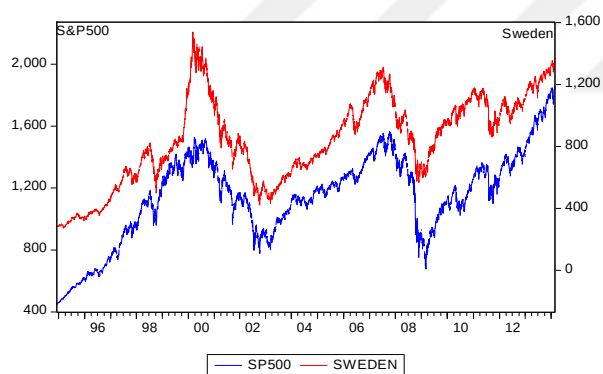
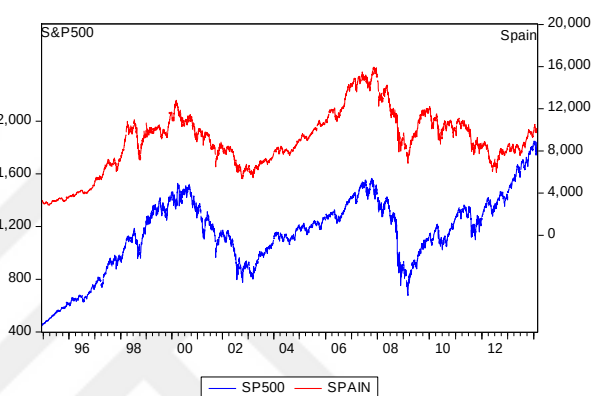
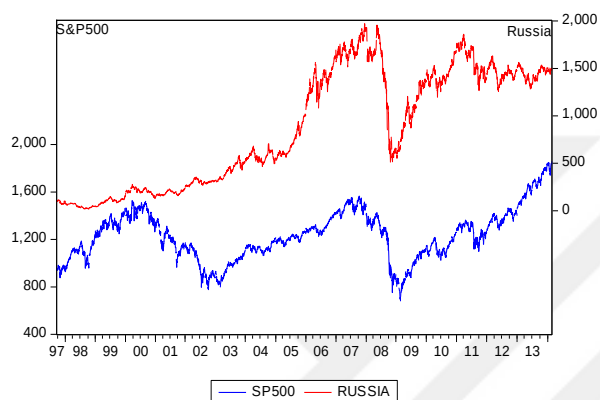
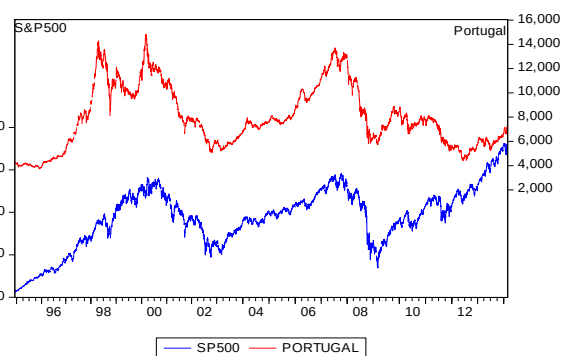
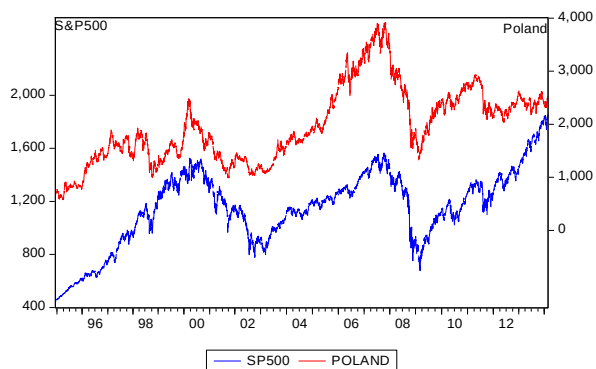
9.2. Appendix B – Graphs

9.2.1. Index Price Graphs (Paired Series)



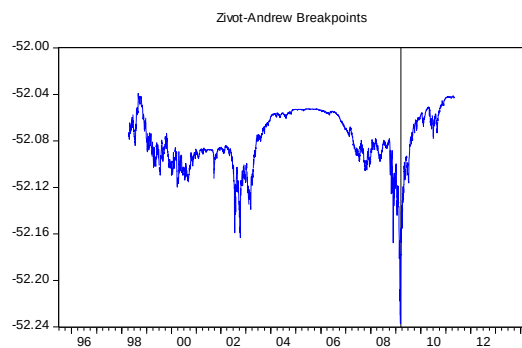




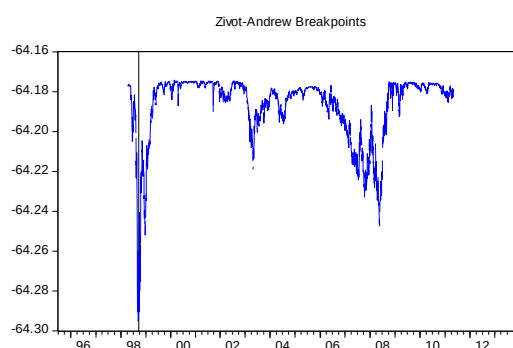


9.2.2. Zivot & Andrews Structural Break Test Graphs

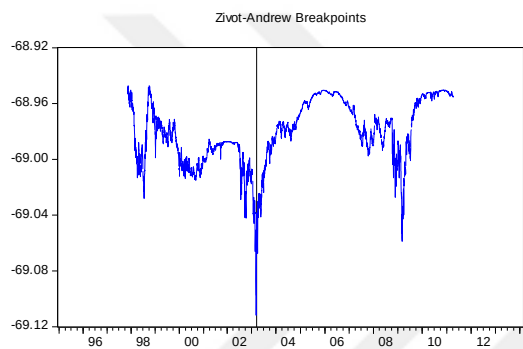
US



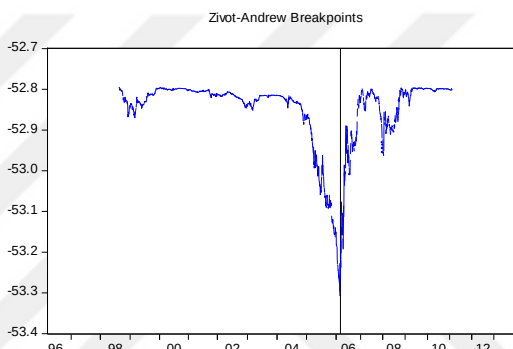
S.Africa



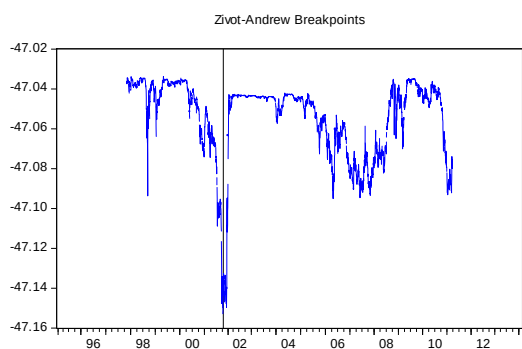
Netherlands



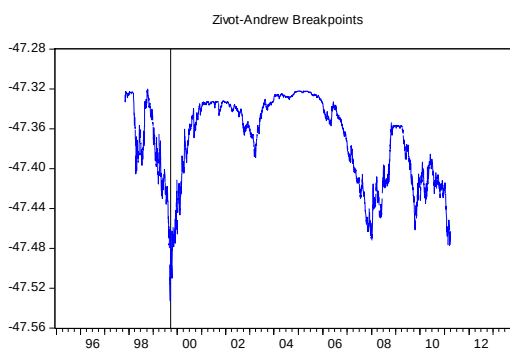
S.Arabia



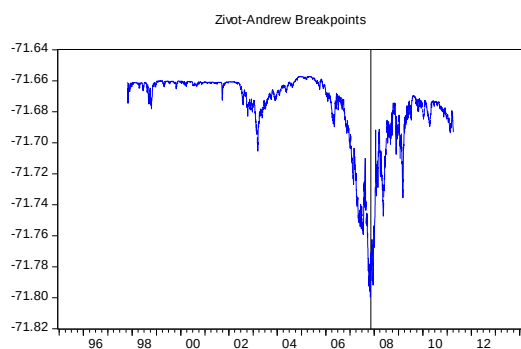
Argentina



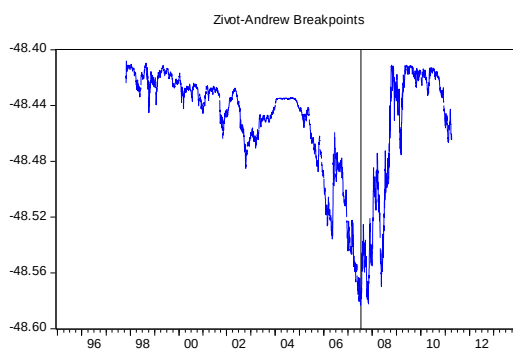
Greece



Australia

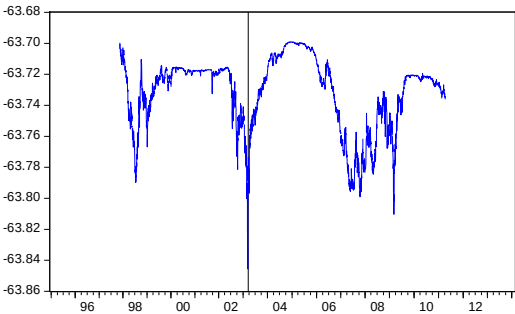


Austria



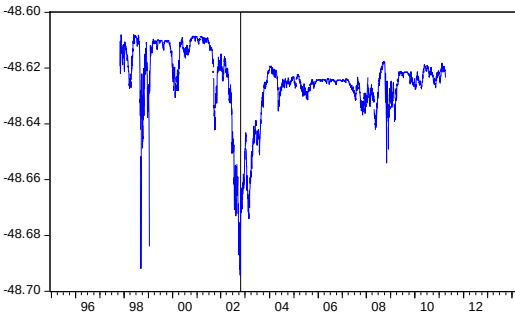
Belgium

Zivot-Andrew Breakpoints



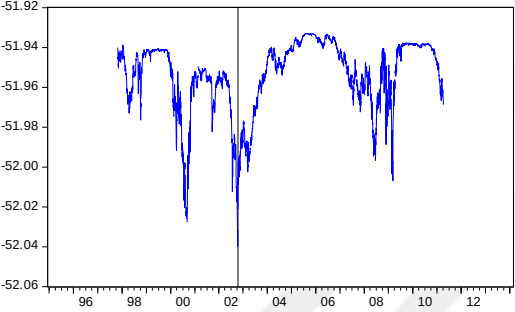
Brazil

Zivot-Andrew Breakpoints



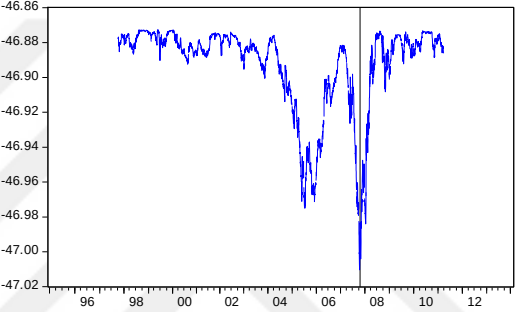
Canada

Zivot-Andrew Breakpoints



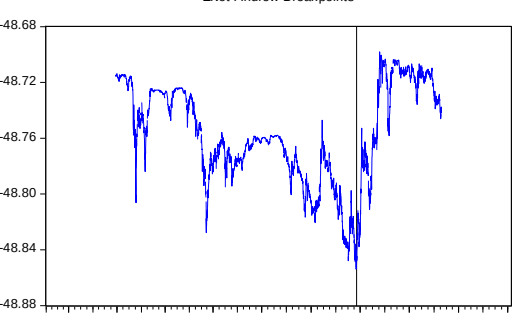
China

Zivot-Andrew Breakpoints



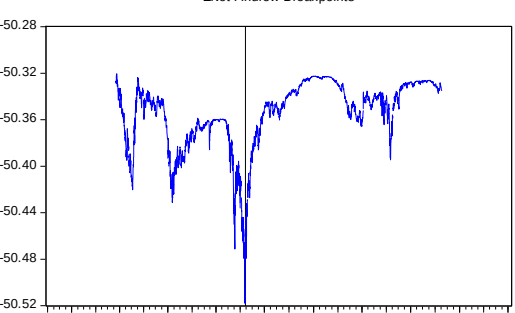
Czechia

Zivot-Andrew Breakpoints



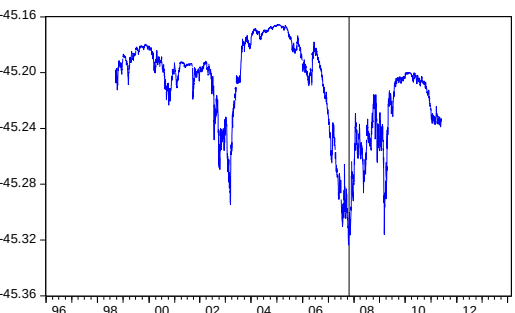
Germany

Zivot-Andrew Breakpoints



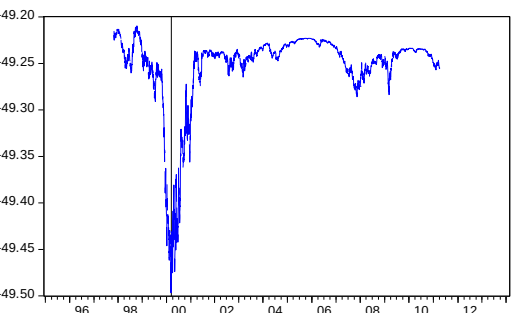
Denmark

Zivot-Andrew Breakpoints

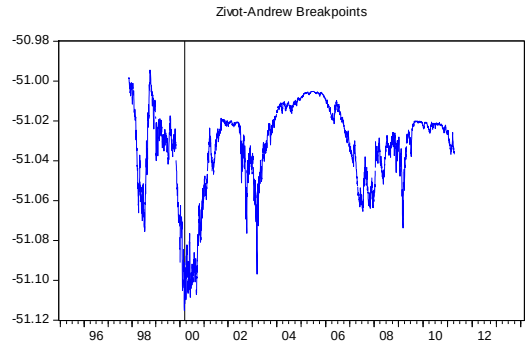


Finland

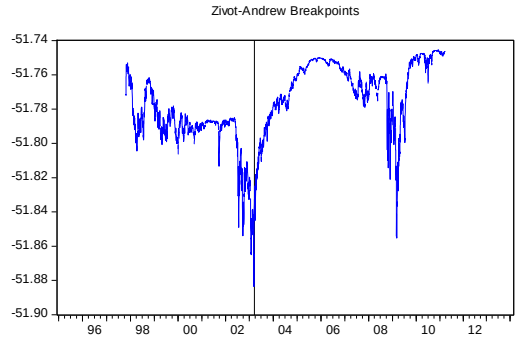
Zivot-Andrew Breakpoints



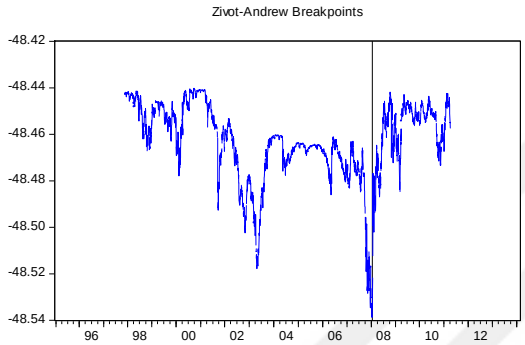
France



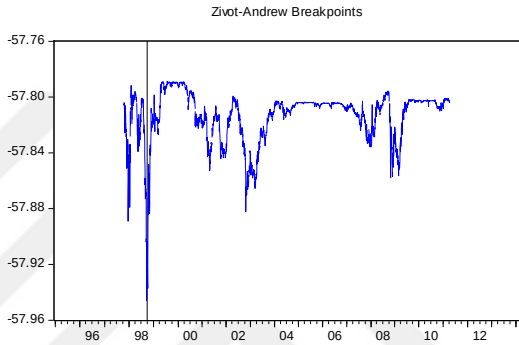
England



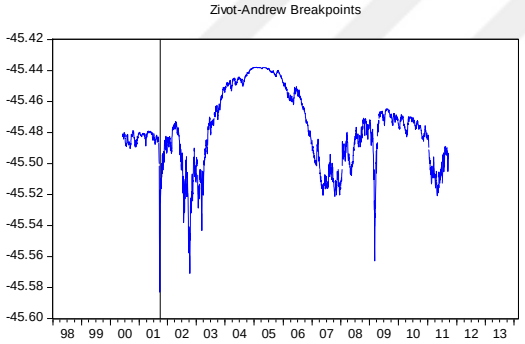
India



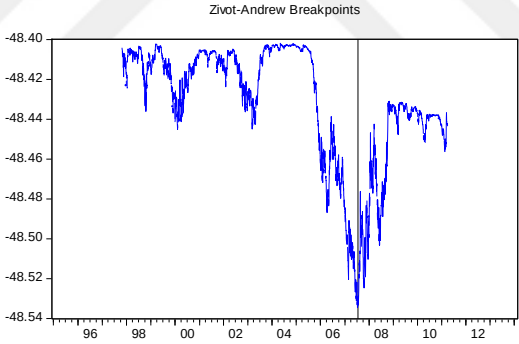
Indonesia



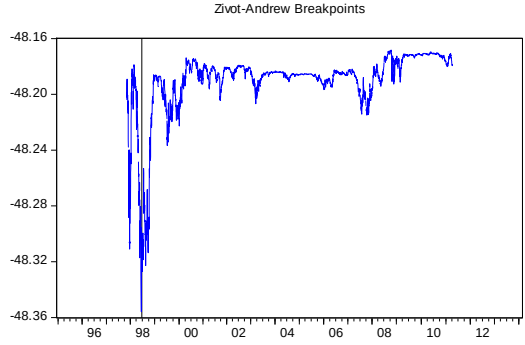
Italy



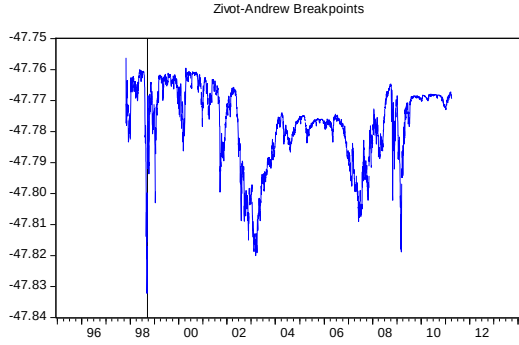
Japan



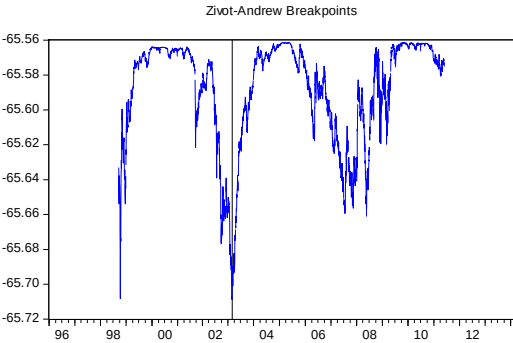
S.Korea



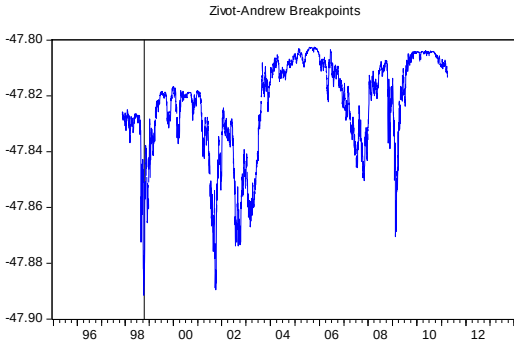
Mexico



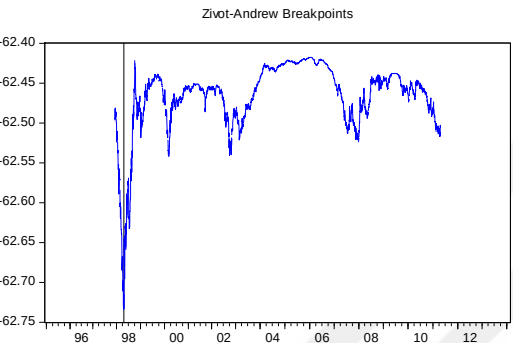
Norway



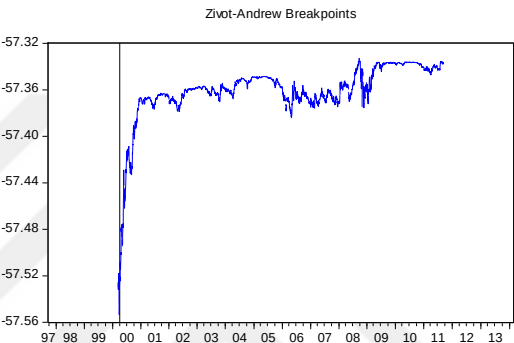
Poland



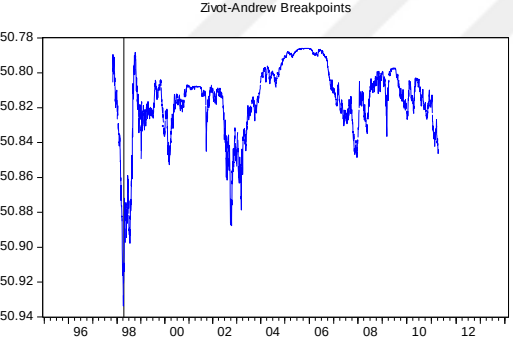
Portugal



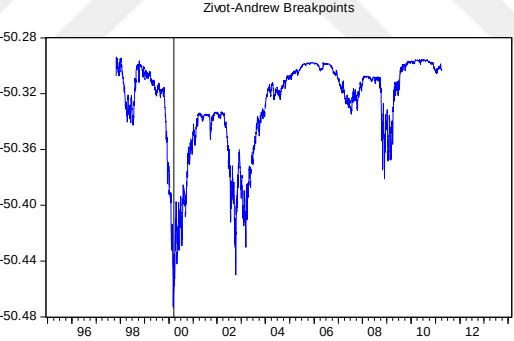
Russia



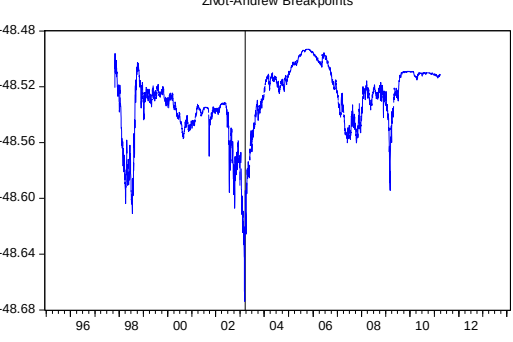
Spain



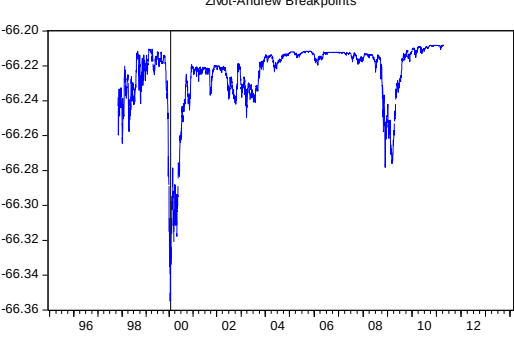
Sweden



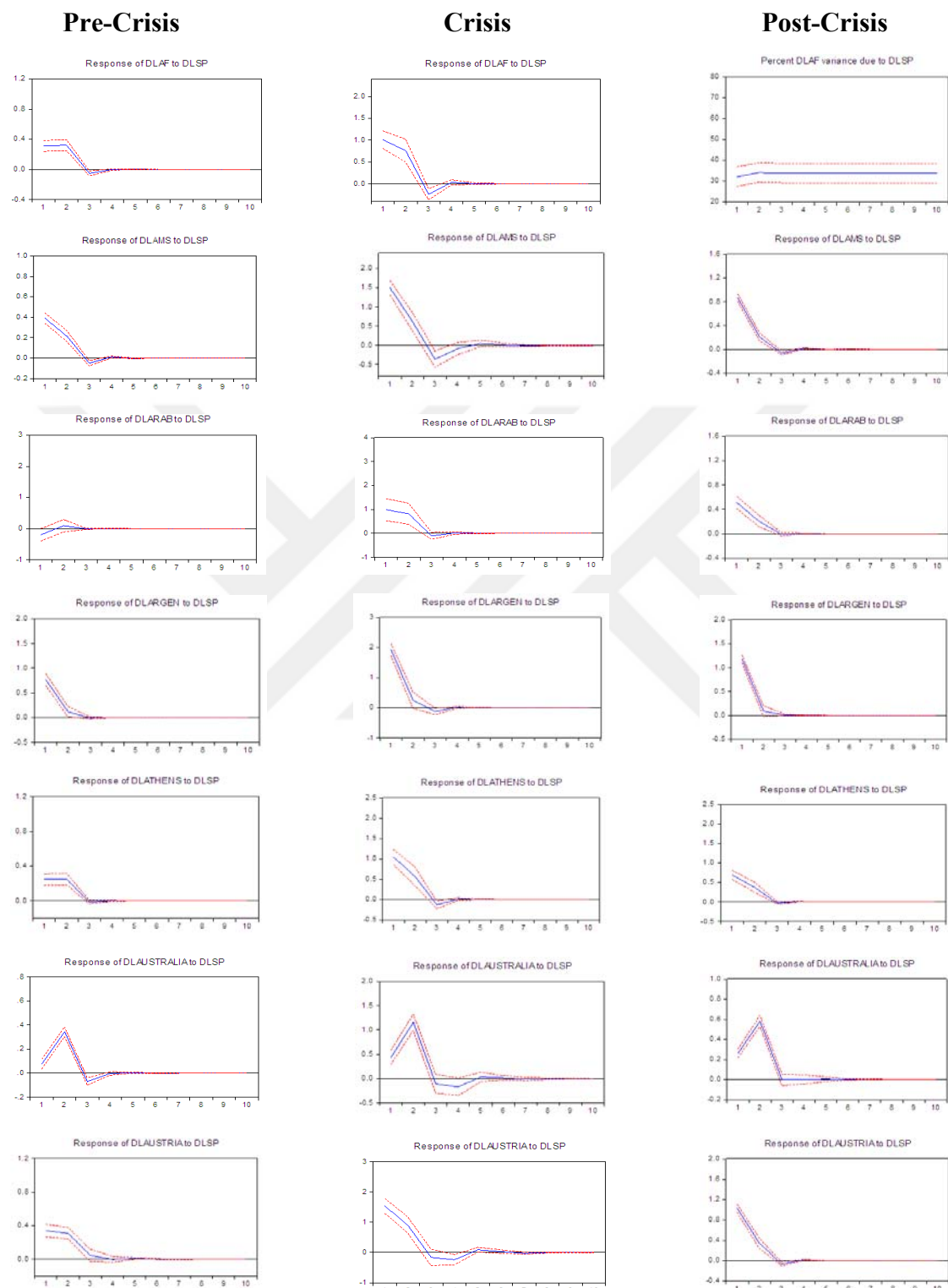
Switzerland



Turkey



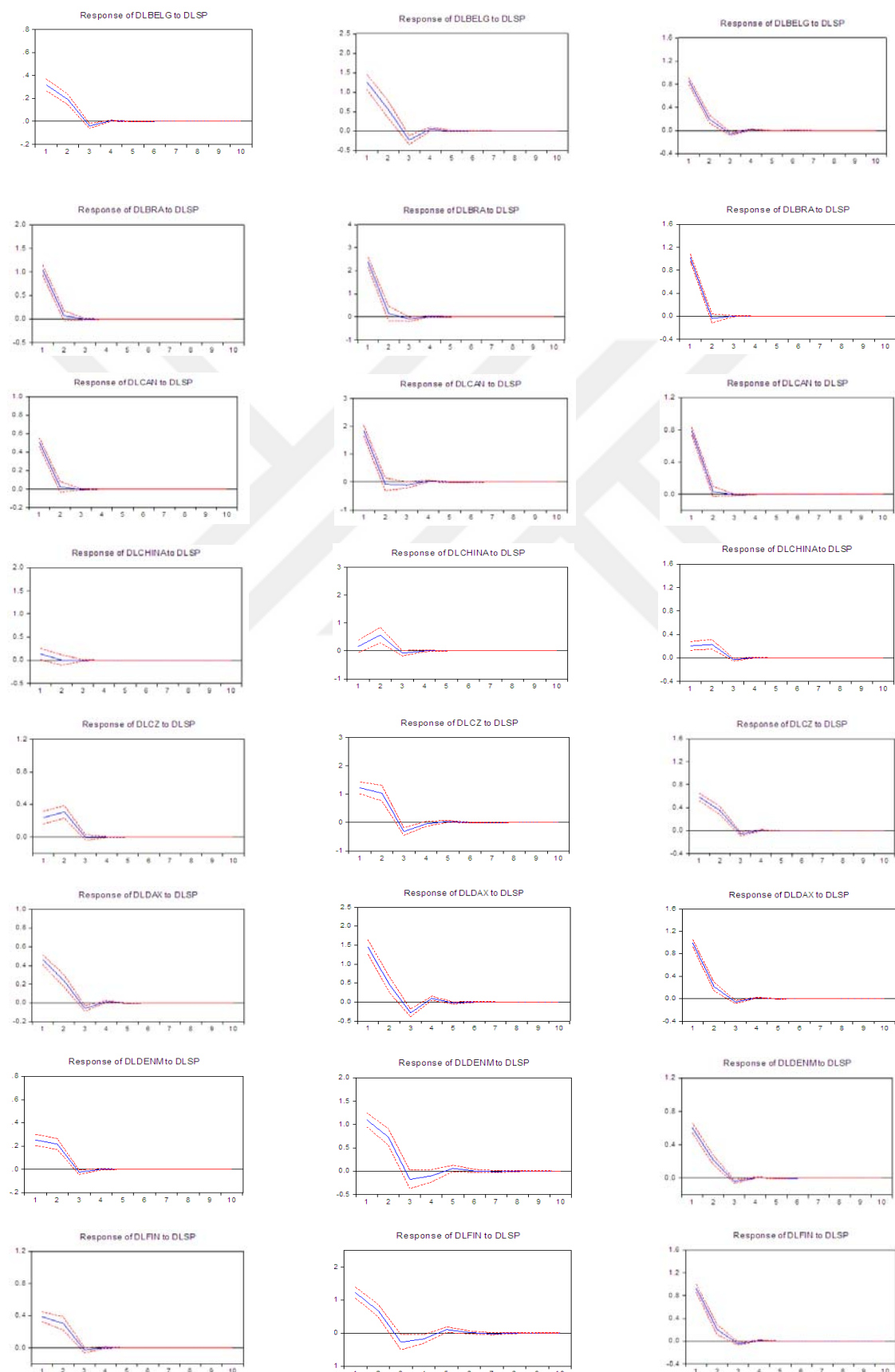
9.2.3. Impulse-Response Graphs (Paired Series)



Pre-Crisis

Crisis

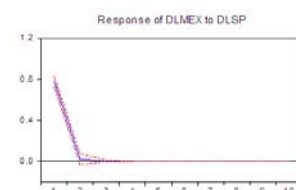
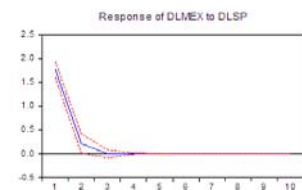
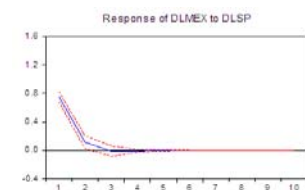
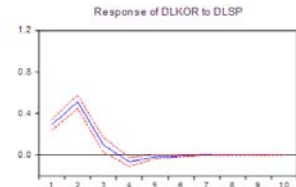
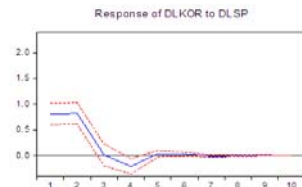
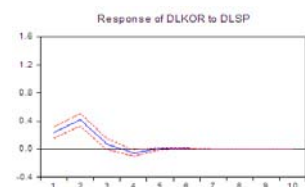
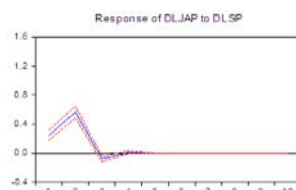
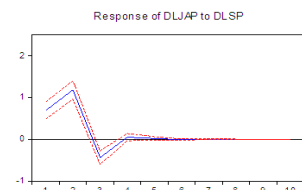
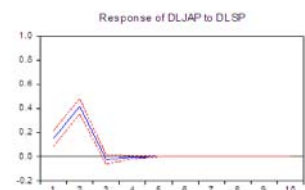
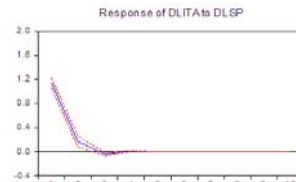
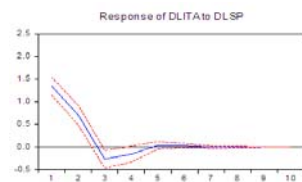
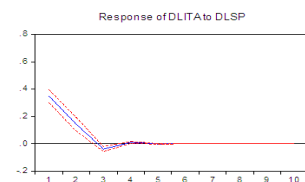
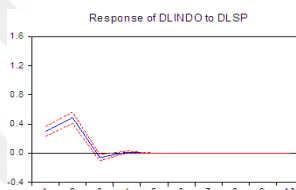
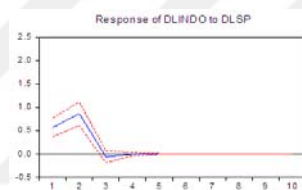
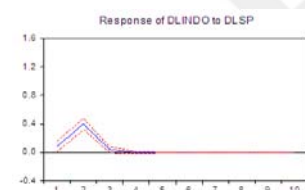
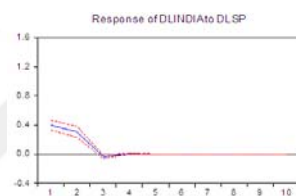
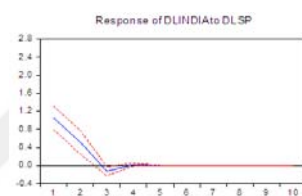
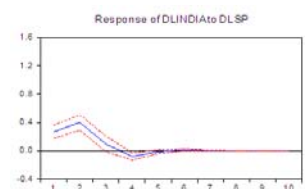
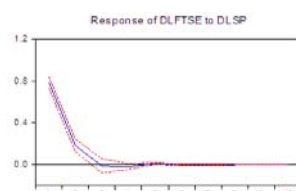
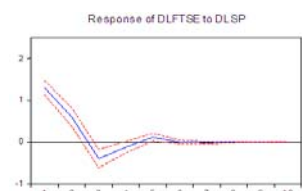
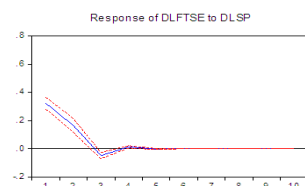
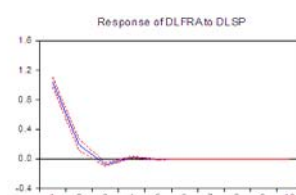
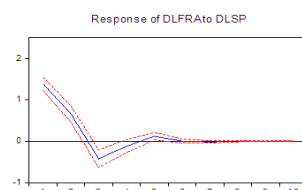
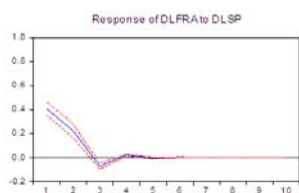
Post-Crisis



Pre-Crisis

Crisis

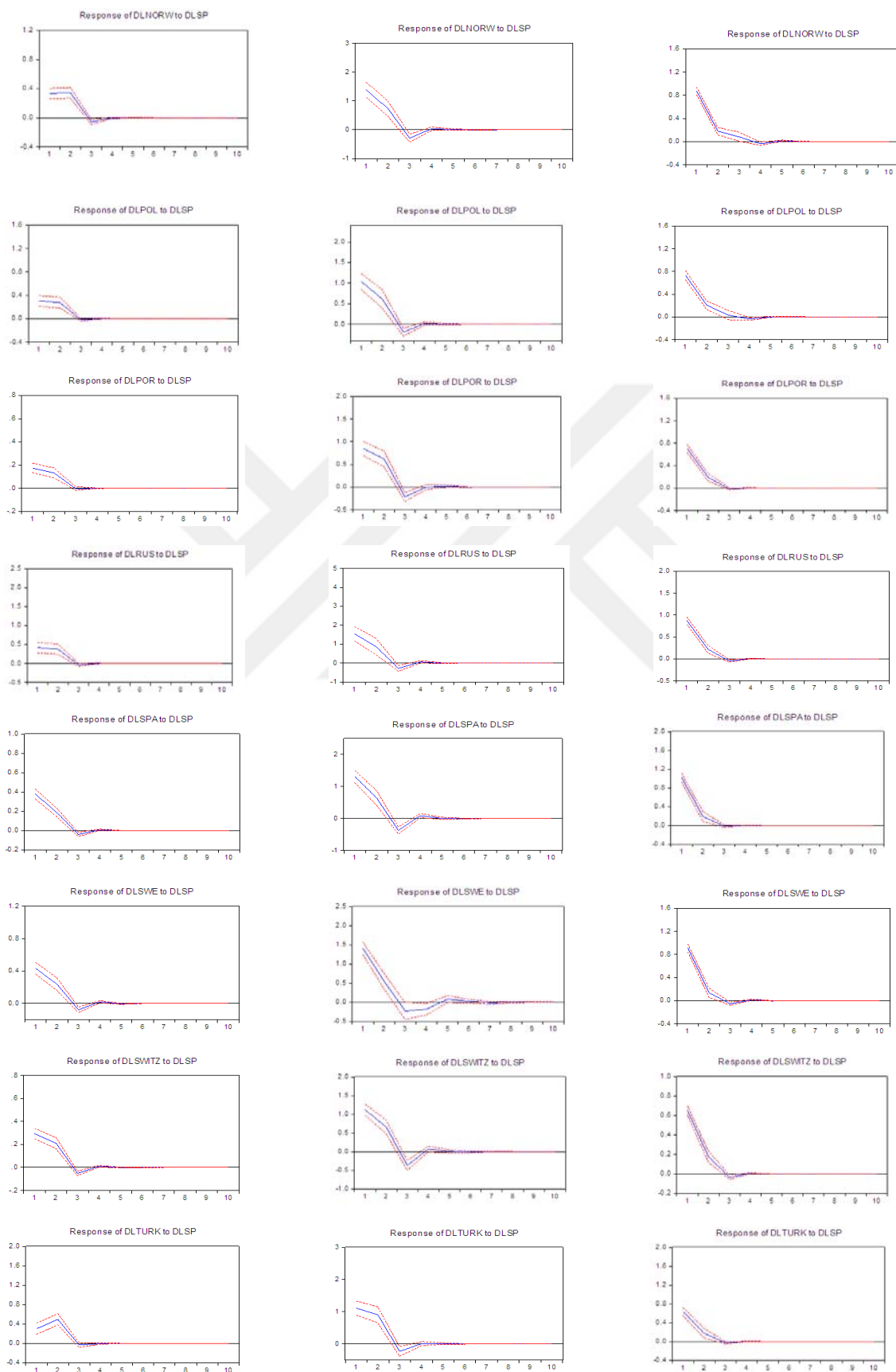
Post-Crisis



Pre-Crisis

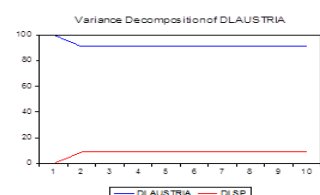
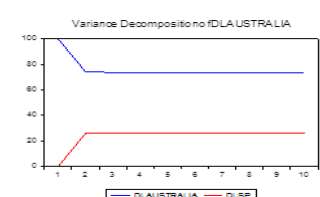
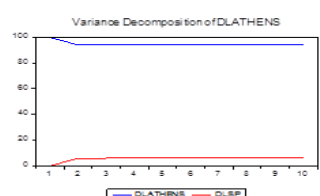
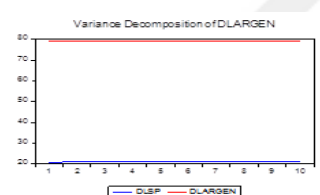
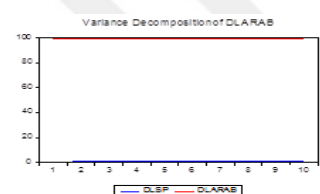
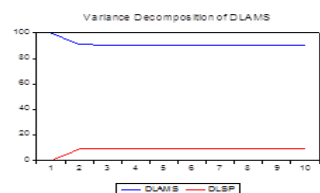
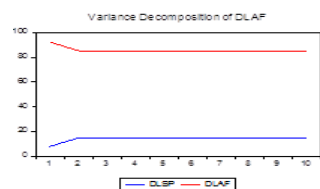
Crisis

Post-Crisis

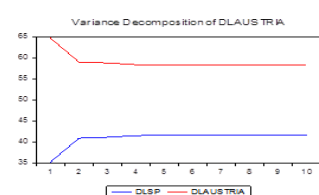
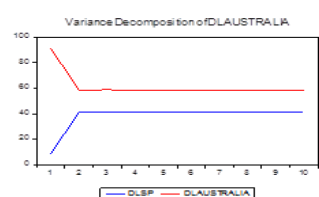
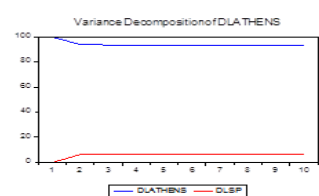
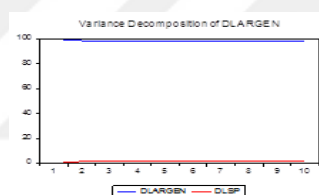
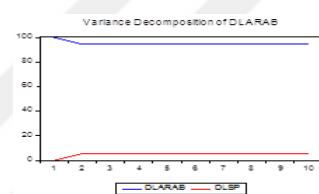
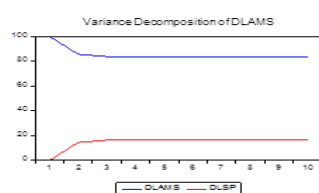
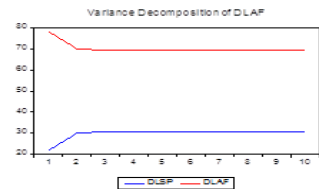


9.2.4. Variance Decomposition Graphs (Paired Series)

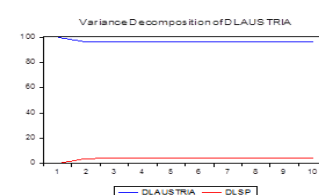
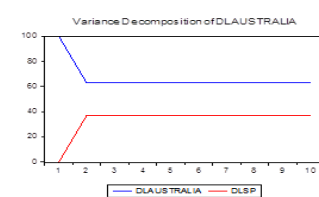
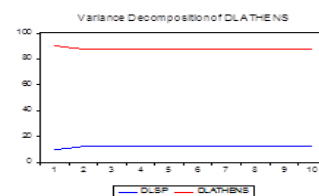
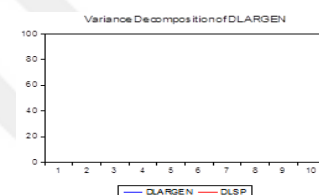
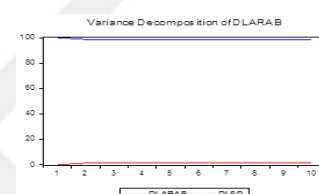
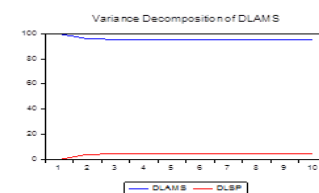
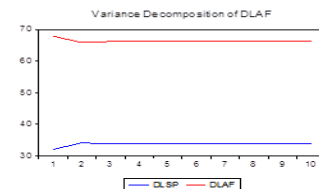
Pre-Crisis



Crisis



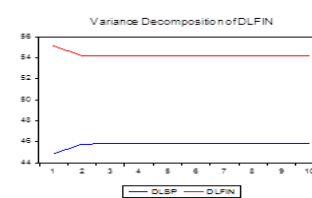
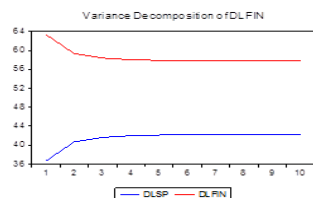
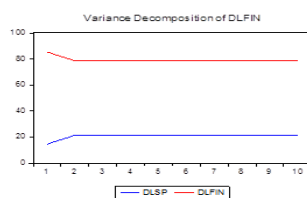
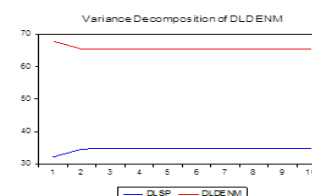
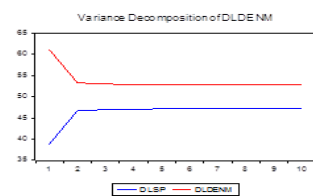
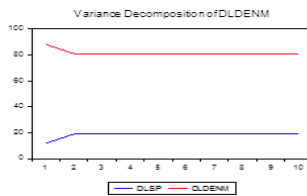
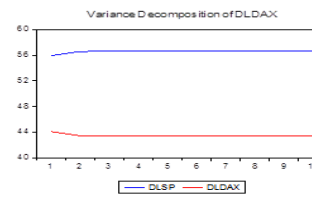
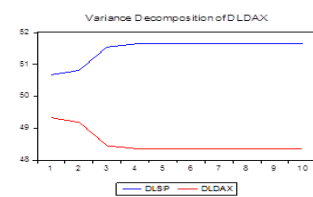
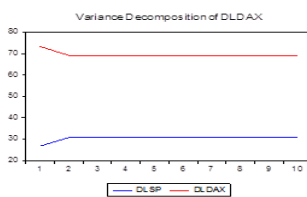
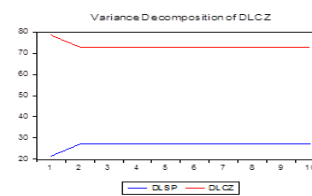
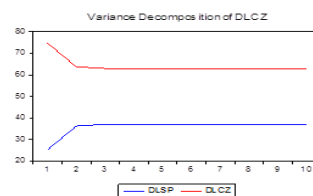
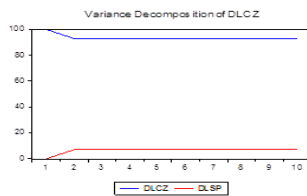
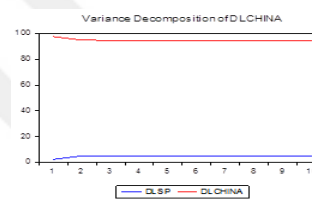
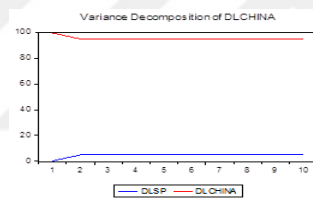
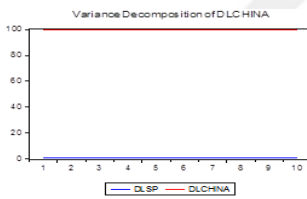
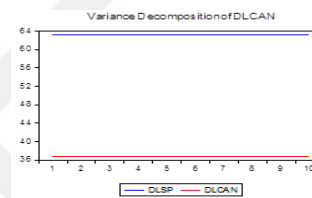
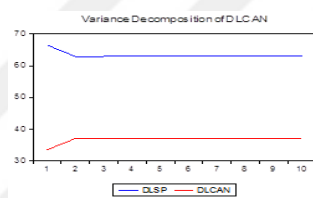
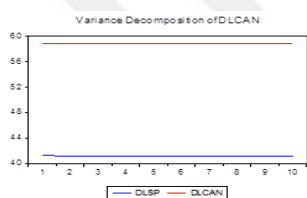
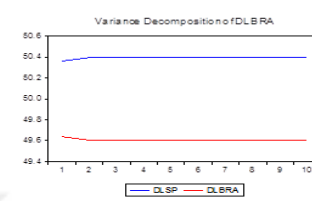
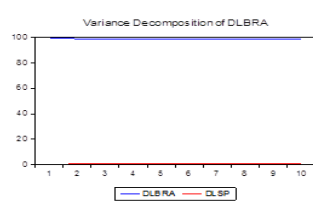
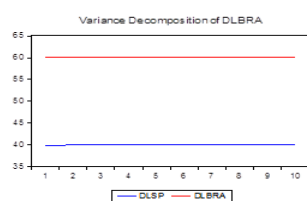
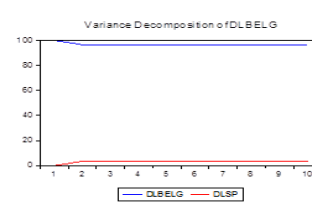
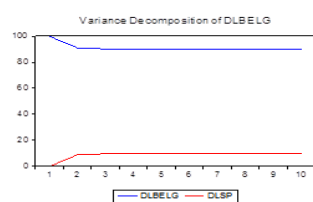
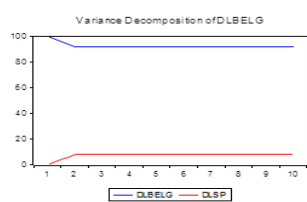
Post-Crisis



Pre-Crisis

Crisis

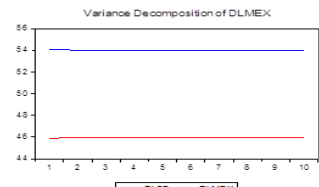
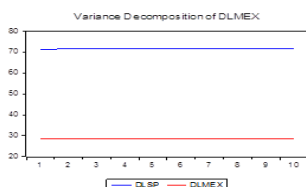
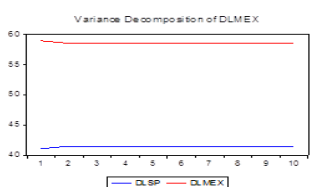
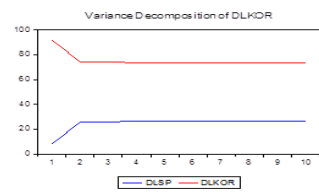
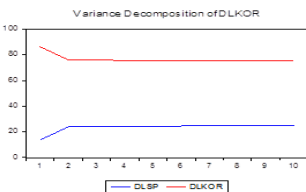
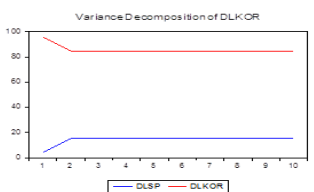
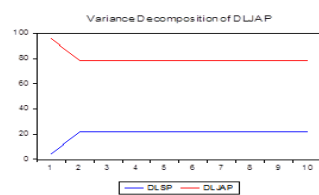
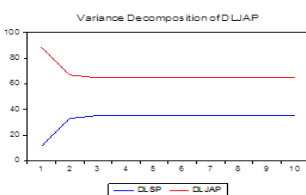
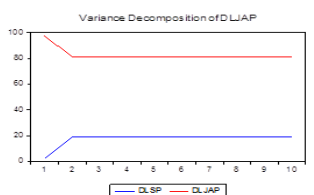
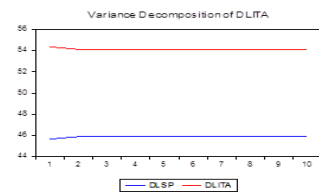
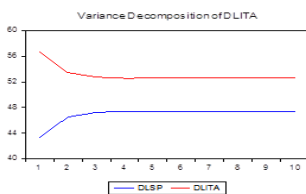
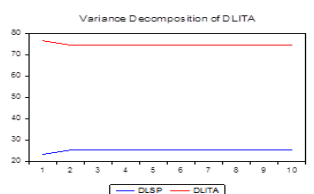
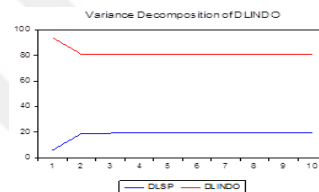
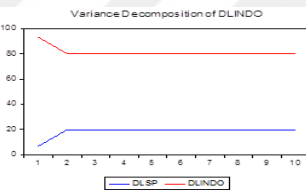
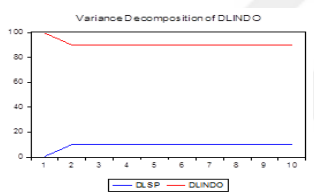
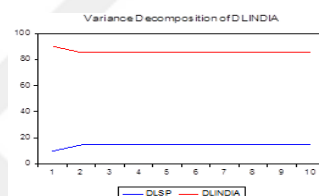
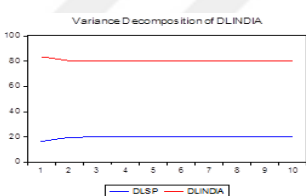
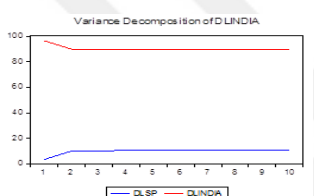
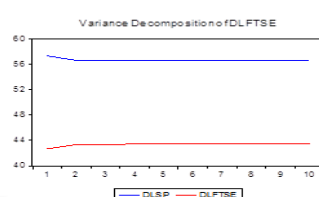
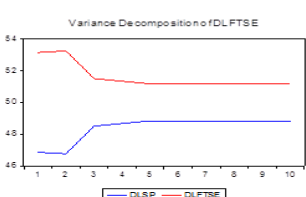
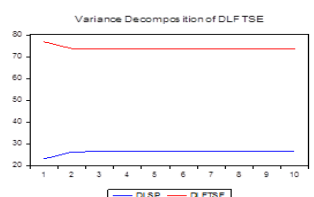
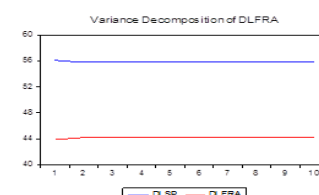
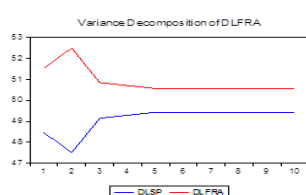
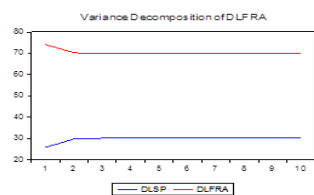
Post-Crisis



Pre-Crisis

Crisis

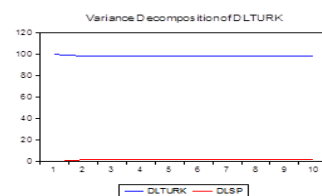
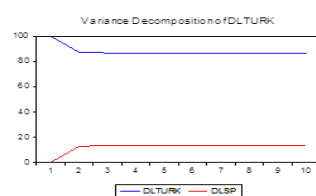
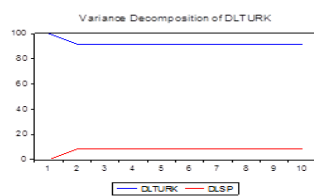
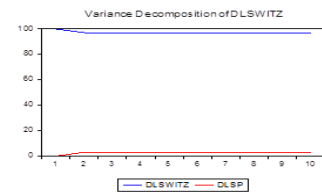
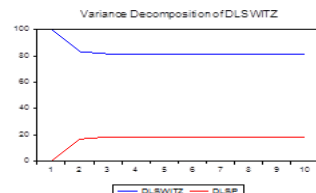
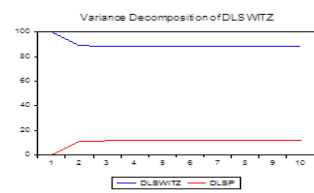
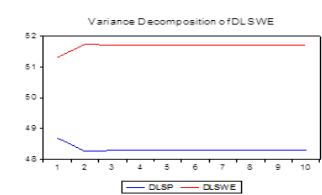
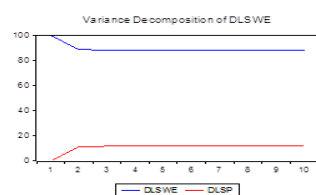
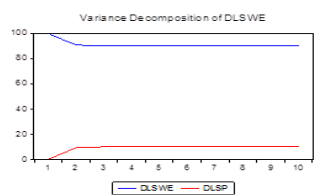
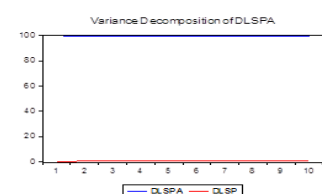
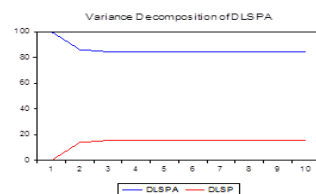
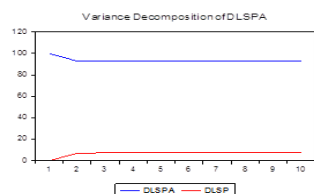
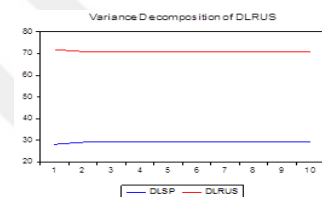
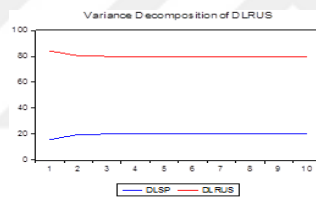
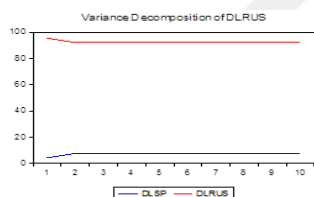
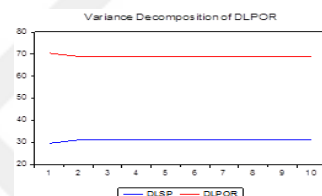
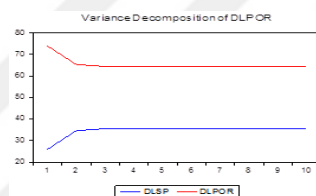
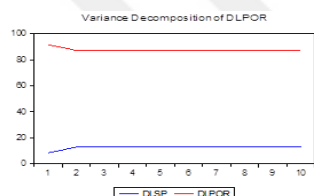
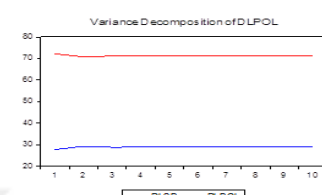
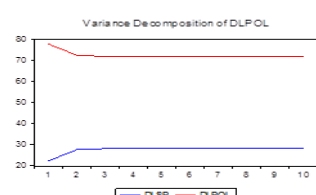
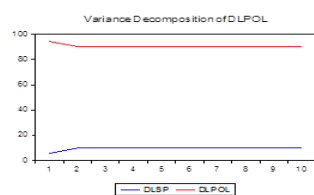
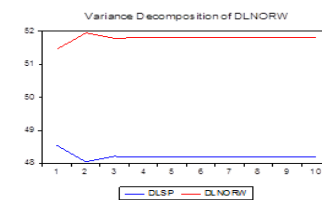
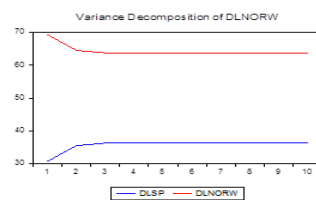
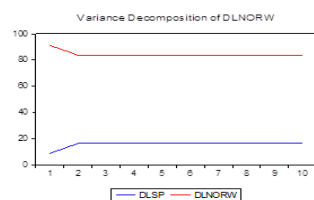
Post-Crisis



Pre-Crisis

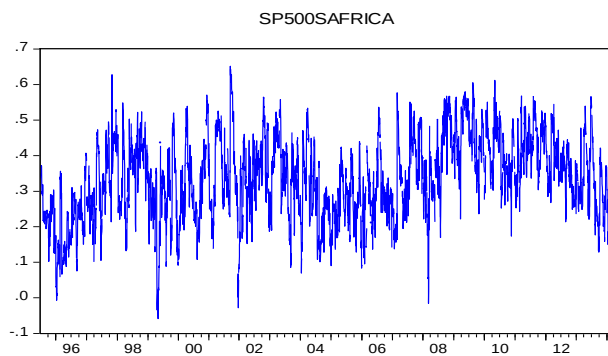
Crisis

Post-Crisis

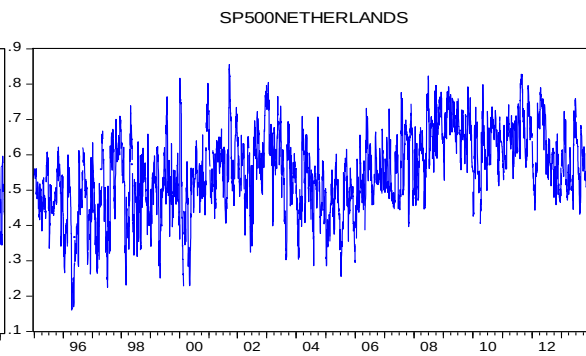


9.2.5. Conditional Correlations Extracted from the ABEKK-GARCH (1, 1) Model

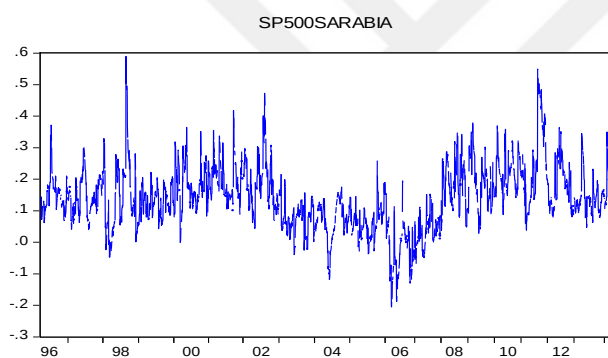
US – S.Africa



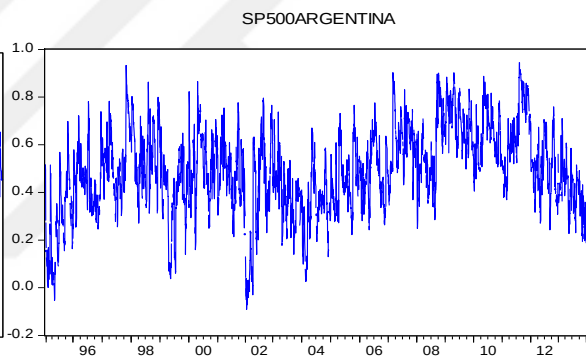
US – Netherlands



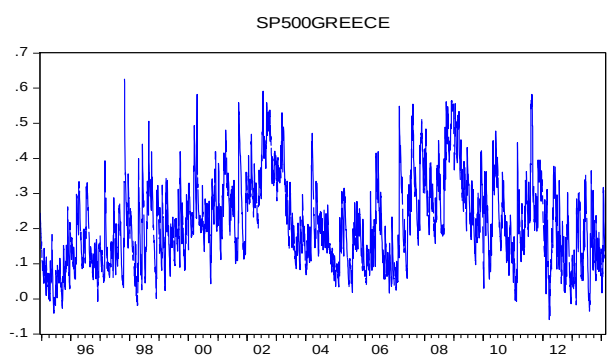
US – S.Arabia



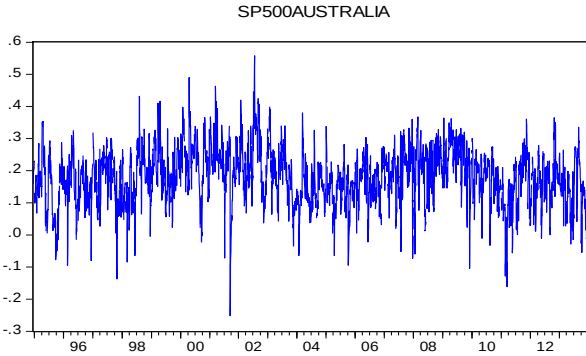
US – Argentina

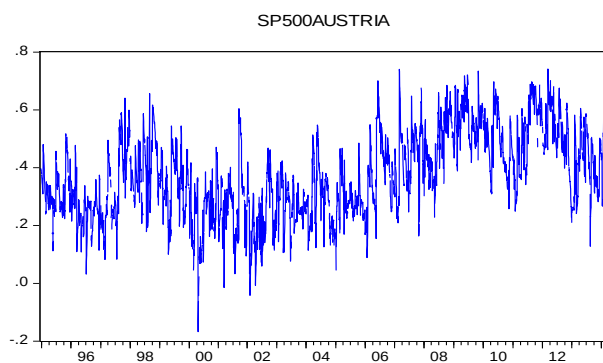
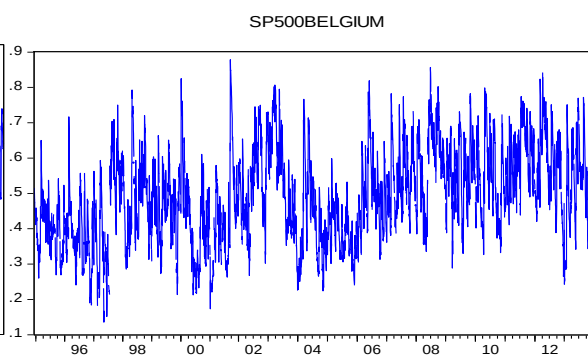
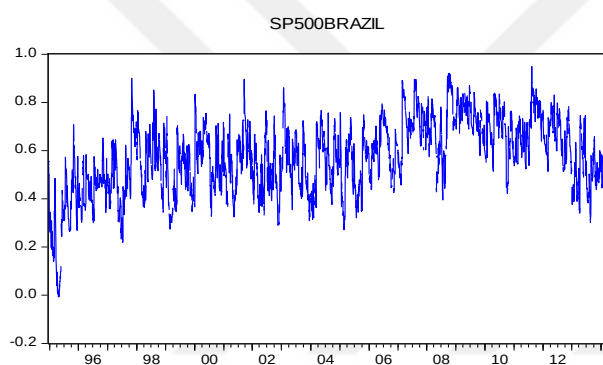
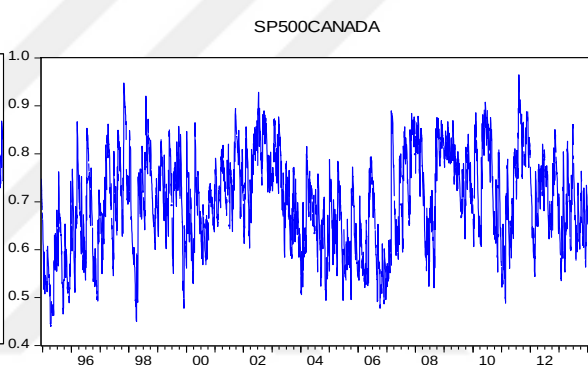
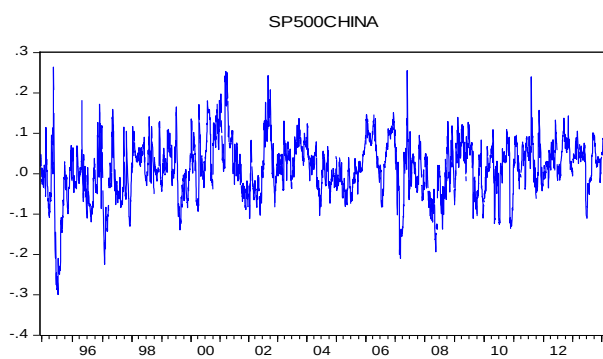
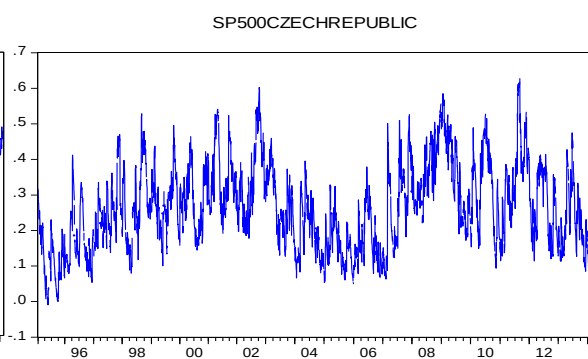


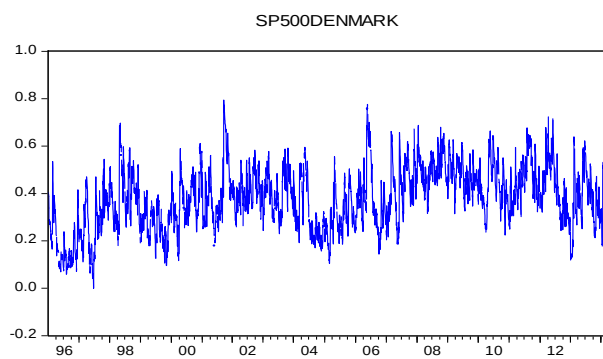
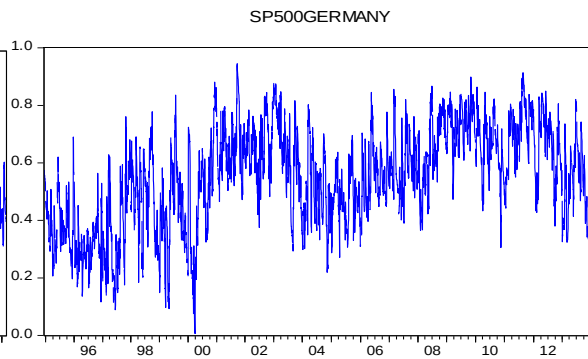
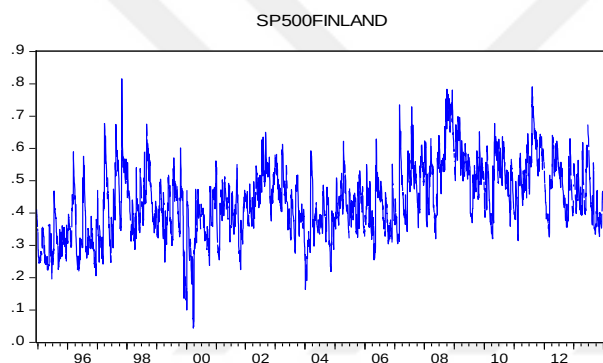
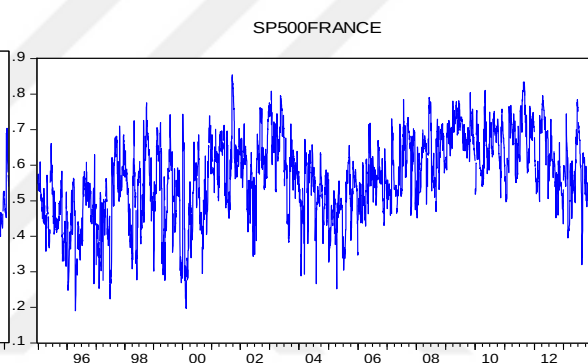
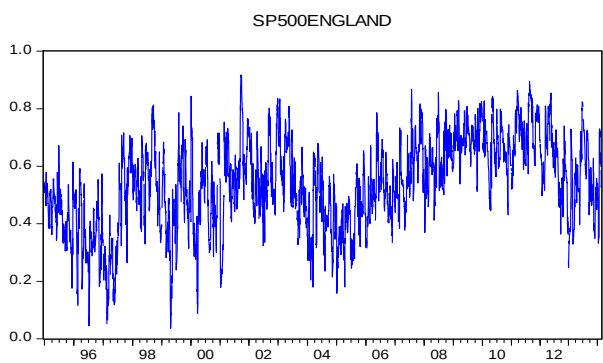
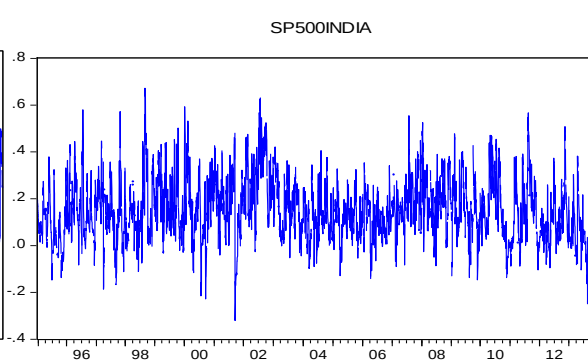
US – Greece

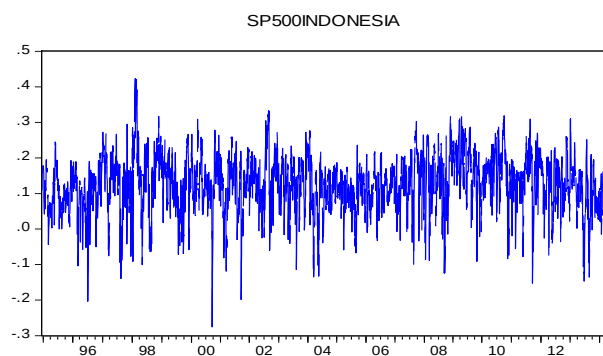
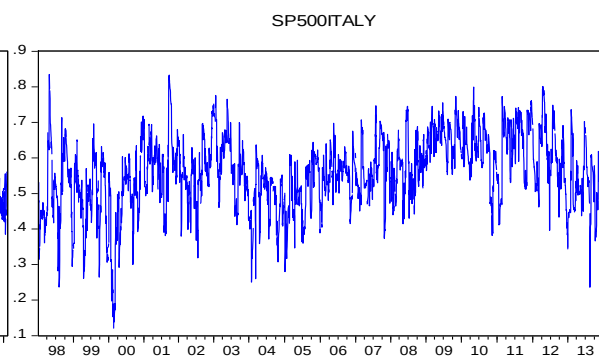
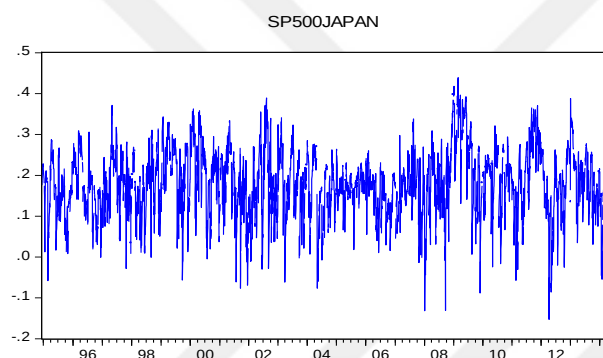
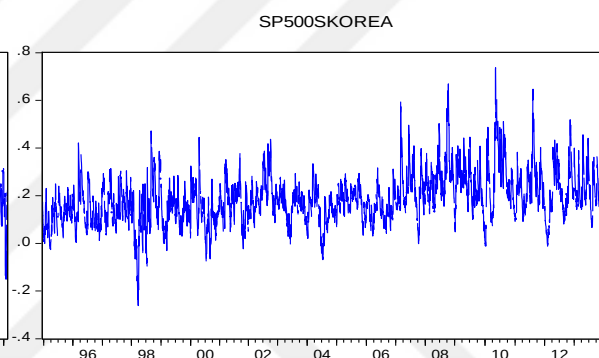
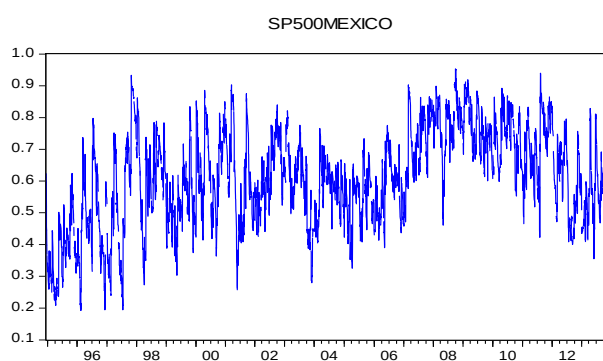
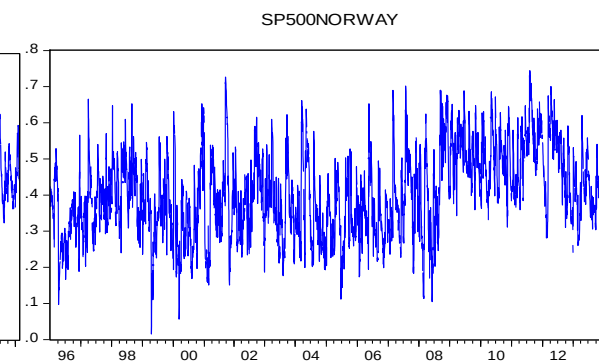


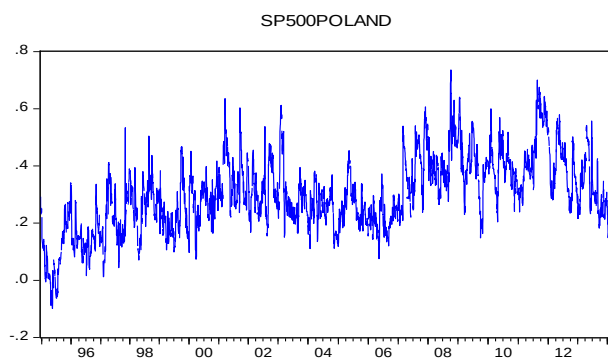
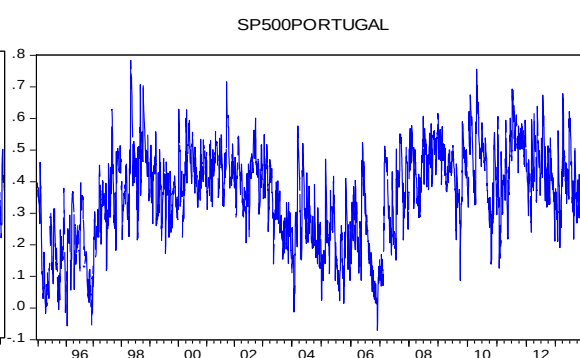
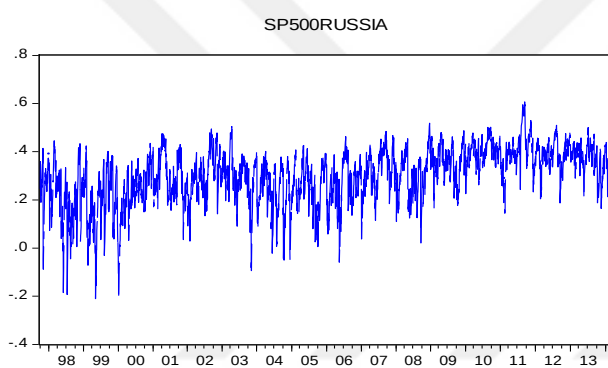
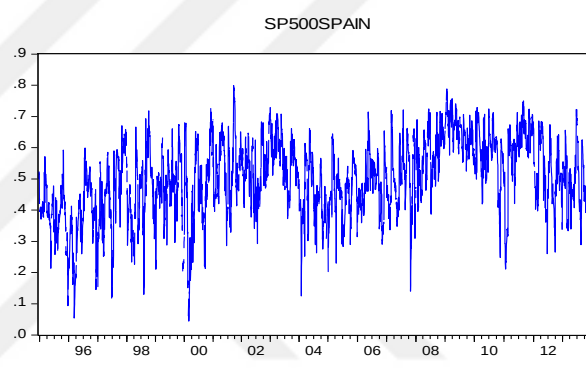
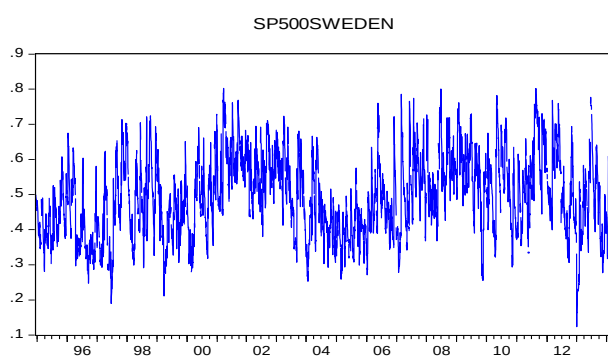
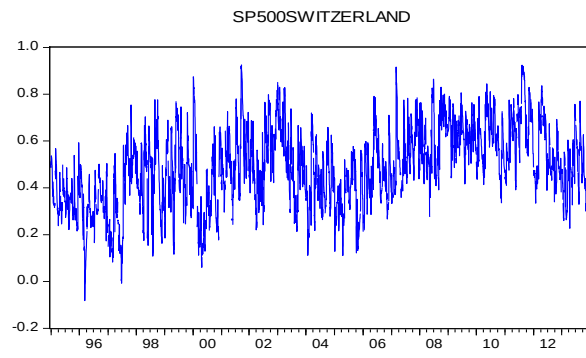
US – Australia

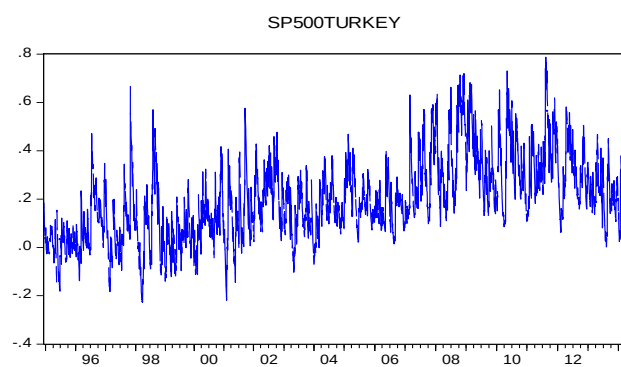


US – Austria**US – Belgium****US – Brazil****US – Canada****US – China****US – Czechia**

US – Denmark**US – Germany****US – Finland****US – France****US – UK****US – India**

US – Indonesia**US – Italy****US – Japan****US – S.Korea****US – Mexico****US – Norway**

US – Poland**US – Portugal****US – Russia****US – Spain****US – Sweden****US – Switzerland**

US – Turkey

CURRICULUM VITAE

Mehmet Yasin Hürata graduated with a Bachelor of Science degree from Yeditepe University Istanbul in Systems Engineering in 2005, Double Major Degree in Business and Administration in 2006, Master of Financial Engineering Degree from Malardalen University Sweden in 2008 and Business and Administration Degree in 2008. He had been previously employed by YapıKredi Bankası, HSBC, Denizbank and currently by Türk Ekonomi Bankası as Financial Analyst and Corporate Credit Underwriter.

