ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΑ

ΤΜΗΜΑ ΣΤΑΤΙΣΤΙΚΗΣ ΚΑΙ ΑΣΦΑΛΙΣΤΙΚΗΣ ΕΠΙΣΤΗΜΗΣ

ΜΕΤΑΠΤΥΧΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΣΠΟΥΔΩΝ ΣΤΗΝ ΕΦΑΡΜΟΣΜΕΝΗ ΣΤΑΤΙΣΤΙΚΗ

ΑΝΑΛΥΣΗ ΤΗΣ ΑΛΛΗΛΕΠΙΔΡΑΣΗΣ ΜΕΤΑΞΥ ΑΝΑΠΤΥΣΣΟΜΕΝΩΝ ΧΡΗΜΑΤΙΣΤΗΡΙΑΚΩΝ ΑΓΟΡΩΝ

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Διπλωματική Εργασία

Που υποβλήθηκε στο τμήμα Στατιστικής και Ασφαλιστικής Επιστήμης του Πανεπιστημίου Πειραιά ως μέρος των απαιτήσεων για την απόκτηση του Μεταπτυχιακού Διπλώματος Ειδίκευσης στην Εφαρμοσμένη Στατιστική

ΠΕΙΡΑΙΑΣ

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UNIVERSITY OF PIRAEYS

DEPARTMENT OF STATISTICS AND INSURANCE SCIENCE

POSTGRADUATE PROGRAM IN APPLIED STATISTICS

AN ANALYSIS OF THE INTERDEPENDENCE AMONG DEVELOPING STOCK MARKETS

By

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MSc Dissertation

Submitted to the Department of Statistics and Insurance Science of the University of Piraeus in partial fulfilment of the requirements for the degree of Master of Science in Applied Statistics

PIRAEUS, GREECE

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To my family and my brother Bill

ΠΕΡΙΛΗΨΗ

Η παρούσα εργασία διερευνά την αλληλεξάρτηση μεταξύ των χρηματιστηριακών αγορών. Για τον σκοπό αυτό αναλύθηκαν τα δεδομένα δείγματος ανεπτυγμένων και αναπτυσσόμενων χωρών (ΗΠΑ, Αργεντινής, Γερμανίας, Ελλάδας, Ηνωμένου Βασιλείου, Ιαπωνίας και Κροατίας), για την περίοδο 2001-2015. Η περίοδος αυτή έχει σημαντικό ενδιαφέρον, δεδομένου ότι εμπεριέχει την πρόσφατη χρηματοοικονομική και οικονομική κρίση, που αναστάτωσε την παγκόσμια οικονομία και ιδιαίτερα τις οικονομίες ΗΠΑ και της Ευρώπης.

Η αλληλεξάρτηση των αγορών του δείγματος εξετάζεται τόσο για τη συνολική περίοδο όσο και για επιμέρους υποπεριόδους, οι οποίες χαρακτηρίζονται από διαφορετικές καταστάσεις του οικονομικού περιβάλλοντος.

Εφαρμόστηκαν VAR μοντέλα και οι καθιερωμένοι για το είδος της έρευνας έλεγχοι τάσης, μοναδιαίας ρίζας (Unit root tests) και συνολοκλήρωσης (Cointegration method). Η ανίχνευση αλληλεξάρτησης ελέγχθηκε με τις μεθόδους J-Maximum eigenvalue και J-Trace. Τέλος, ο έλεγχος των καταλοίπων (Innovation accounting) πραγματοποιήθηκε με δύο τρόπους: Την ανάλυση της διακύμανσης σε συνιστώσες (Variance decomposition) και την ανάλυση των αιφνίδιων αντιδράσεων (Impulse response functions) .

Τα ευρήματα της ανάλυσης υποστηρίζουν την άποψη ότι οι αγορές ασκούν επιρροή η μία στην άλλη και ότι η κατεύθυνση της επιρροής είναι από τις ανεπτυγμένες στις αναπτυσσόμενες. Ειδικότερα, μια σημαντική μεταβολή στη χρηματιστηριακή αγορά μιας οικονομικά ισχυρής χώρας, ακολουθείται από μεταβολές ίδιας κατεύθυνσης στα χρηματιστήρια ασθενέστερων χωρών σε λίγες ημέρες (συνήθως από 1 μέχρι 5). Σημαντικότερη επιρροή ασκούν οι αγορές των ΗΠΑ και της Γερμανίας.

Αντίστοιχα ήταν τα ευρήματα προγενέστερων συναφών εργασιών.

Πάντως, σε ορισμένες υποπεριόδους, υπάρχουν ευρήματα (π.χ. άσκηση επιρροής στη γερμανική χρηματιστηριακή αγορά από την αντίστοιχη αγορά της Αργεντινής) τα οποία δεν μπορούν να δικαιολογηθούν από τα πραγματικά δεδομένα. Μια εξήγηση θα μπορούσε να είναι ότι αυτά τα ευρήματα οφείλονται σε μεθοδολογικές αδυναμίες ή σε αδυναμίες του δείγματος.

ABSTRACT

The purpose of this study is to identify the existing interdependence among world stock markets. To this end, a sample of stock exchanges of developed and developing countries (USA, Argentina, Germany, Greece, UK, Japan, and Croatia) was formed and analyzed for the period 2001-2015. The above period is of high interest, given that it includes the recent financial crisis which has seriously affected world economy and especially the economies of USA and Europe.

Interdependence was examined for the whole period as well as for certain sub periods, which differ from the point of view of the prevailing conditions in the economic environment.

We have applied VAR models as well as the standard unit root tests, cointegration tests and trend tests. To trace interdependence we used J-Maximum, eigenvalue and J-Trace methods. Finally Innovation Accounting was performed by using Variance decomposition) and Impulse Response Functions.

The findings of this study support the argument that stock markets affect each other and especially that the developed markets affect the developing ones. In detail, a significant shock in the stock market of an economically strong country is followed by corresponding shocks in the stock markets of weaker economies, usually after 1 to 5 days. The strongest influence was exerted from the stock markets of USA and Germany to developing ones. Similar studies in the past derived the similar conclusions. However, the findings of certain sub periods (i.e. dominance of the stock market of Argentina over German stock market) cannot be interpreted in real terms. A possible explanation could be that these findings are due to methodological errors as well as to shortcomings of the sample.

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CHAPTER 1

INTRODUCTION

There is no doubt that technological changes are on the edge in the past few years, mainly in information and data processing. Each and every country's financial system is affected by these changes. After the abolition of taxies, the international transactions were made without any extra charges. These are only some of the factors that made the analysts and the investors to study and invest to the stock markets.

To begin with, the investors can create their own international portfolio with the purpose to divide the risk. The goal of the investors is to maximize their profit and minimize their risk. Although it may look like a plain sailing, it is a challenging task that requires special skills. Having said that, the investors should be very cautious in the making of their portfolio. However the bigger the risk, the higher the yield for the investors. In order to achieve such a plan, they should keep up with the world news every single day.

It is clear that even a small change in a country (ex. technological development) can have both positive and negative impact in other countries. Therefore, more and more researchers have started to examine the correlation of returns between the domestic and foreign markets.

The main objective of this paper is to examine the long-run interdependence of eight international markets (developed and developing). A more detailed look reveals our goal to examine if a variation in one of these markets affect the prices of the other markets and how. If a change in a market has similar results to the other markets, the investors would be able to predict the price trend by analyzing only this index. In this way the investors will achieve much greater results than the results of the market.

The second chapter summarize some basic meanings about Financial System while the third focuses only in the part of the Stock market. The forth chapter covers the references, what researchers have investigated until now. The fifth chapter contains the presentation of the variables and the methodology that is used for the analysis. The sixth chapter features the results of the statistical analysis. Last but not least, the seventh chapter contains the deductions of this analysis.

CHAPTER 2

THE FINANCIAL SYSTEM

2.1 Introductions

The Financial system facilitates the transfer of funds from surplus to deficit units, thus satisfying needs which result from time differences between receipts and payments. The Financial system is divided into two main subsystems, the banking system and the capital markets (stock and derivatives markets).

2.2 The Banking system

The Banking system collects funds from privates and businesses which present liquidity surpluses (depositors) and lend to those who demand capital for a short or long intervals (borrowers). It redistributes the liquidity of the economy in order to effectively use the available funds, thus enhancing economic development. The banks are dealing with credit and monetary transactions. Depending on their characteristics they can accept deposits (borrow money), make loans and create new money. Moreover, they keep and manage commercial papers, provide different payments services for their customers and lend money in many forms.

The most important bank functions are the following:

- Asset Management function
- Cash function
- Investment Banking function

The Asset Management function provides services, manages assets and risk for third parties such as private banking and activities for mutual funds management.

The cash function realize receipts and payments for theirs clients.

Finally, investment banking provide services for businesses such as bonds and stock issuance and consulting support.

The revenue of a bank results from its operations in the form of commission, difference between borrowing and lending rate, management fees etc.

Banks are classified into two main categories, the commercial and investment banks.

Commercial banks derive the majority of funds from public savings and channel them to privates and businesses. As a result, they are carrying credit risk.

Investment banks are mainly financed by their stockholders and bondholders. They lend businesses to finance new investment projects. They also offer portfolio management services, underwriting and other similar services. Unlike commercial banks the investment banks usually do not accept deposits. The most significant functions of investment banks are private, namely assets management and public such as stock analysis. Investment banks support corporations to issue new shares and obtain debt financing, by underwriting the stock and bond issues.

The banks are supervised by the Central Bank, which sets the rules regarding fund requirements, competition etc. There is no doubt that banks are the base of Financial System in every country. They contribute to the development of the economic activity nationwide, by stimulating the domestic supply and financing dynamic sectors of the economy and innovative investment initiatives.

2.3 Capital markets

Capital markets are divided into two categories, the Stock Market and Derivatives.

The stock market is the place where the involved parties buy and sell securities and prices are formed according to supply and demand. The main categories of the quoted securities are Shares and Bonds. Shares represent rights on company's equity. That is, stockholders are owners of a part of the issuing company. Bonds are debt instruments declaring that the issuing company has to pay interest on a periodic basis as well as to return their nominal value to the bond buyers.

The Derivatives market deals with derivative instruments. The first derivatives market was established in 1688, in Amsterdam. Derivatives are financial instruments whose value depends on the values of other, underlying variables such us interest rates, common stocks, foreign exchange rates, bonds etc. They can be used to hedge risk or as a mean of speculation or on arbitrage.

CHAPTER 3

THE STOCK MARKET

3.1 Introductions

A **stock market** is a mechanism which facilitates transactions on securities, mainly shares and bonds. At the early stage of the stock markets, investors could transact directly. In other words, a prospective seller could find a prospective buyer and negotiate the However, as the number of investors was increasing, it was necessary to find an effective way to match a practically unlimited number of buy and sell orders and clear the corresponding transactions.

The transaction model which finally prevailed works as follows:

- Investors channel their orders to a limited number of intermediaries, called **brokers**.
- Brokers transact each other on behalf of their investors-clients.
- Transactions are cleared, that is investors pay the value of the purchased securities or receive the value of the sold ones. Brokers receive a fee for their services.

A variation of the above system includes another class of intermediaries, the traders, who are responsible for the supply and demand of securities. That is, traders define a bid price to buy (through the brokers) the offered securities and an ask price to sell the asked securities. Their income results from the positive difference between ask and **bid** price.

It is necessary to clarify that a company can sell shares or bods in a stock market only if it is listed, that is if it meets certain requirements, which are mainly related to viability, profitability and solvency.

3.2 Primary and secondary markets

The shares or bonds which are sold directly from the issuing company consist the primary market, which serves the long-term capital needs of the listed firms. More particularly, a company can raise equity by selling new shares and debt by selling bonds. So, it can plan an effective capital mix, which in turn enhances its viability, profitability etc. The primary market serves also the needs of Governments, municipalities and any other public sector institutions.

The new issues assume underwriters (usually investment banks) who arrange, for a network of brokers, to sell the issued securities.

Transactions among investors consist the secondary market, which provides liquidity to the shareholders and bond holders. Assuming that secondary market doesn't exist, an investor who participates in the primary market could not be able to sell the bought shares or bonds. As a result, she or she would be reluctant to invest on the listed companies' new issues. It is equivalent to say that primary market could not exist in the absence of the secondary market.

Investing in the stock markets offers some benefits to owners of securities (companies and privates), such as:

- Participation in the companies annual earnings (Dividends)
- Interest
- Capital gains (= positive difference between selling price and buying price of a share or a bond)
- Diversification that is dispersion of the invested capital to various shares and bonds with different risk-return characteristics.
- Liquidity, which is provided through the secondary market.

3.3 The Shares

Shares (or stocks) are units of ownership. They represent an equal proportion of a company's capital or financial asset. Shareholders are the owners of the shares and so they own part of the company. However, this does not mean that all shareholders have the full control of respective corporation.

Shares split in to two main categories, common (ordinary) stocks and preference stocks. Common stocks are less safe. They do not trigger danger in business but their cost is way more significant. Also, the holder can takes important decisions for the limited company. Preference shares provide some extra privileges and they are safer than common. The owners of the preference shares take dividend before the owners of common stocks.

Shareholders have many privileges and rights:

- Voting power (one vote per share)
- The right to buy new shares before published in the market
- The right to transfer their shares
- They can inspect corporate books and records whenever they consider it necessary and to sue if they find wrongful acts
- The right to profitability and dividends

- They have a degree of control the company

However, most of these rights are relating to common shareholders. Preference shareholders have some distinctions, like voting power. Occasionally, they do not have that power. Also, they receive fixed dividend whether the company makes profit or not. If corporation fails or liquidates, preference shareholders have higher priority to receive their payments of company’s assets.

A closer look at the figures reveals that, investors of common stocks have the right to vote and also they have high returns in case of company grows and makes profits. However, common stocks are less safe because investors are at the end of the list to receive company’s assets. On the other hand, businesses have some benefits with common stocks. Common stocks are not dangerous and businesses are not liable to pay back wages dividends or interests. Nevertheless, the capitals which they took by issuing new shares cost a lot to companies.

The preference stocks are safer than common but more dangerous than bonds for investors. They are preferred when investors expect long-term incomes with low risk. Also, preference stocks offer to investors a steadier flow of dividends. The disadvantage for investors is that they do not have the same benefits. First of all, they can not vote. Furthermore, they can not take high returns. Even though the preference shares are more secured, they are treated like dividend and not like interest and they cost more than common’s stocks.

3.3.1 Evaluation of shares

Share evaluation is a very complex and difficult task. However, in an attempt to effectively estimate share prices as closer as possible, many models, indices, indicators etc have been suggested and are usually applied.

The most popular of them are the following:

- P/E
- PEG
- Dividend Yield

P/E or multiple of profits expresses how many years investors need to take back your money if company’s profit is stable. The formula of P/E is:

P/E = (market value per share)/(earnings per share (EPS))

Corporations are not always profitable. When companies are deficient the EPS are negative and the P/E does not exist or it is 0. For this reason we have two kinds of P/E, trailing P/E and leading or forward P/E. The first one uses historical data and EPS comes from the last four quarters (one year). The second one uses estimation data and EPS comes from estimated earnings over the next four quarters (one year).

One of the most important characteristic is that the P/E is helpful when we want to compare companies in the same industry. The average P/E ratio in the market varies around 15-25. Also, it is characterized better indicator of the value of a stock than the market price alone. However, to define the P/E we have to take into account two main considerations, the industry and company growth rate.

This index has many problems and few of them are mentioned bellow:

- It is too simple
- Does not account for any type of growth
- The P (market value per share) considers only the share price and it has nothing to do with the dept.
- It is backward looking index
- P/E does not consult the quality of earnings

PEG (price, earning, growth) expresses how much investors are paying in relation to the growth. The basic formula of PEG ratio is:

PEG = ((P/E ratio))/(annual EPS growth)

If PEG ratio is lower than 1, it will be considered to be a good value. If PEG ratio is between 0 and 1, returns will be higher and if it is greater than 1, investors will pay more than they will take back. Nevertheless, the PEG ratio can be negative if P/E ration is negative or growth is negative.

Companies with high growth rate have high P/E ratio. This is problem because many of these companies appear overvalued in relation to others. Consequently, PEG ratio is better because it can be compared with companies with different growth rate. Also, this index takes into account future growth. The PEG ratio is better when shares have small or no dividend yield.

PEG ratio have also some disadvantages:

- It is not convenient for companies with low or none growth
- It is simple and it is not consult important values

- The growth rate of the companies is an estimated value
- The calculation of PEG ration is not correct in case of the volatility of highly risky and speculative share.

In general, PEG ratio gives a better picture of share valuation than P/E ratio.

Dividend yield is a financial ratio that shows how much cash flow investors get for every monetary units ($,€) that the stock it worth. It is expressed as a percentage and the formula is:

Dividend yield = (annual dividends per share)/(price per share)

When companies share high dividend yield to shareholders, companies might be undervalued or they attempt to attract investors. However, when companies share a low dividend yield to shareholders, companies might be overvalued or they attempt to increase their capital.

Investors prefer the dividend yield when they want regular income without risk. In addition, some investors accept to pay high dividend rate because they expect that they will get back a part of their investments.

On the other hand, they should be careful with their investments. Many corporations prefer to reinvest their profits to growth their business from to pay a dividend or to invest them somewhere else. A high dividend yield not always represent the best price of shares, thus investors must be sure that they will not lose out in the long term. One more problem with this index is that it uses the previous year dividend rate for its calculation. Finally, investors should attend the dividend yield over time and they analyze the profit or liquidity ratio before make any movement.

Summing up, the investors must remember that whatever happened in the past is not sure that continues to the future.

3.4 The Bonds

The bonds are debt securities and are issued by companies, public authorities, credit institutions and supranational institutions. They are used to raise money and finance long-term investments and other activities.

The issuers (borrowers) issue and sell bonds to holders (lenders). The issuer is obliged to pay to holder a specified rate of interest (coupons) during the life of a bond at regular intervals and on the maturity date, to repay the nominal value (principal).

Bondholders have some rights which are following:

- Bondholders buy a piece of the company's debt
- They receive information about company's financial
- When the company bankruptcy, bondholders receive their money before shareholders
- They receive an interest payment as long as the company does not bankruptcy.

Generally, bonds are a kind of investment that provide holders a predictable and standard income and preserved their capital investment.

There are three basic ways for investors to invest in bonds. The first one is the individual bonds. The second is to invest in bond funds which provide investors a professional management of their portfolios. The third is a unit investment trusts. The benefit of this mode is that investors know every time how much they earn from their investments.

Before investors decide to invest to bond they must evaluate their choices. They have to consider some important factors which will also determine the value of bonds. Some of these factors are:

Assessing risk (higher risk → higher return)

- Price
- Interest rate
- Yield
- Maturity date
- Credit rating
- Tax status
- Default history

Specifically, the interest rate can be fixed, floating or payable at maturity.

The bond yield is a return that is based on the price and the interest. It has two types, the current yield and the yield to maturity.

The maturity date is the date when holders want to take back their investments. Depending on the years of repaid there are three categories, short (until 5 years), medium (between 5 and 12) and long (above 12).

Three of the most important corporations dealing with the credit ratings are Moody's, Standard & Poor's and Fits.

According to the place investors live, the tax status is altered.

Default history refers to the issuer who cannot pay the interest or principal at the right time.

Moreover, the investors use some techniques which will help them to their strategies. The first refers to the management of the portfolio, ¨active vs passive¨. The second is related to diversification of the portfolio. It is divided into tree subcategories, bond type, laddering and barbells. The third is a bond swap which is used to manage many objectives like tax savings.

The types of bonds are plenty. They are depending on their characteristics and the benefits that are offered to investors. The fixed rate, zero-coupon, high-yield, convertible, government and municipal bonds are some among these types.

The bonds have their own market, the bond market. It is a part of the credit market, where bank loans are also included. The largest bond market is in the US (33%) and the next is Japan's (14%). As it was mentioned before, bonds are part of Exchanges with demanding rules. They are safer and provide long-term funding for businesses and privets.

3.5 The Stock Indices

The stock indices are an imaginary size that expresses the terms of a change from a base value. To calculate it we use the prices of shares that are included in each index and it is expressed as a percentage. In other words the stock indices are a list of securities.

Because of the huge number of companies and information, investors sometimes cannot understand correctly the market trend. The stock indexes are created to solve this problem. Indices help investors to understand the changes of the price. Also, they can find and study the parameters which affect the stock prices. Finally, the stock indices help investors to study short- terms and long-terms of market and calculate the sensitivity of shares.

The stock indices split into two main categories. The first one depends on the methods of calculating the stock prices. Thus, there are three main subcategories, the value weight the equally weight and the price weight indices. The second one relies on the kind of stocks. In this group there are three subcategories. The first group is about stocks with the same characteristics, for example the size of the companies. The second group concerns shares in the same branch like manufacturing and the third group is about all the listed shares of the market of the country.

3.6 Significant indices of the developed economies

When people talk about stock market usually they refer to indexes and not to shares of the companies. The most ordinary and significant indices are the following:

- DJIA
- DAX
- NIKKEI
- FTSE

The DJIA (Dow Jones Industrial Average) includes the shares of 30 of the largest companies (Blue chip companies) in the United States and it is the most famous indices in the world.

It was created in 1885 by Charles Henry Dow and Edward Jones and the initial name was DJA (Dow Jones Average). The index was a transportation average, where 11 stocks were included. In 1896 the average was split into two, transportation and industrial. Its name was changed in DJIA and it has used 12 of the top companies stocks in the market. The main purpose of this index is to give the investors a full image of the stock market and the entire U.S. economy.

It is a price weight index. In the beginning of its calculation, the index was a simple average. However, the results were not absolute accurate. So, in 1928 a divisor was added to avoid the distortions in the prices, known as the multiplier. One reason of distortion is that the stocks are split in subcategories. At first, the DJIA was calculated every hour unlikely to latest years where it was and still is calculated every second hour based on recently transactions.

The basic formula is:

$$DJIA = \frac{\sum p}{d}, \quad \text{p = price of 30 shares and d = the Dow divisor}$$

As it is expected, the calculating of this index is not a simple average because the division is continually being adjusted.

It is the most important and accepted index in the world and it becomes the key benchmark to the nation’s economy.

Some of these companies are 3M, Apple, Boeing, Microsoft, Nike, IBM, Walt Disney etc.

In the table below (Table 3.1) the best and worst close prices are presented over the years and in the Chart 1 is showed the course of index over the years.

Year	***Best close prices***	***Year***	***Worst close prices***
1904	69.61	1903	49.11
1905	96.20	1907	58.75
1908	86.15	1917	74.38
1928	300.00	1920	71.95
1933	99.90	1930	164.58
1935	144.13	1931	77/90
1954	404.39	1932	59.93
1958	583.65	1937	120.85
1975	852.41	1974	616.24
1995	5117.12	2008	8776.39

Table 3.1 : Best and Worst close prices for DJIA

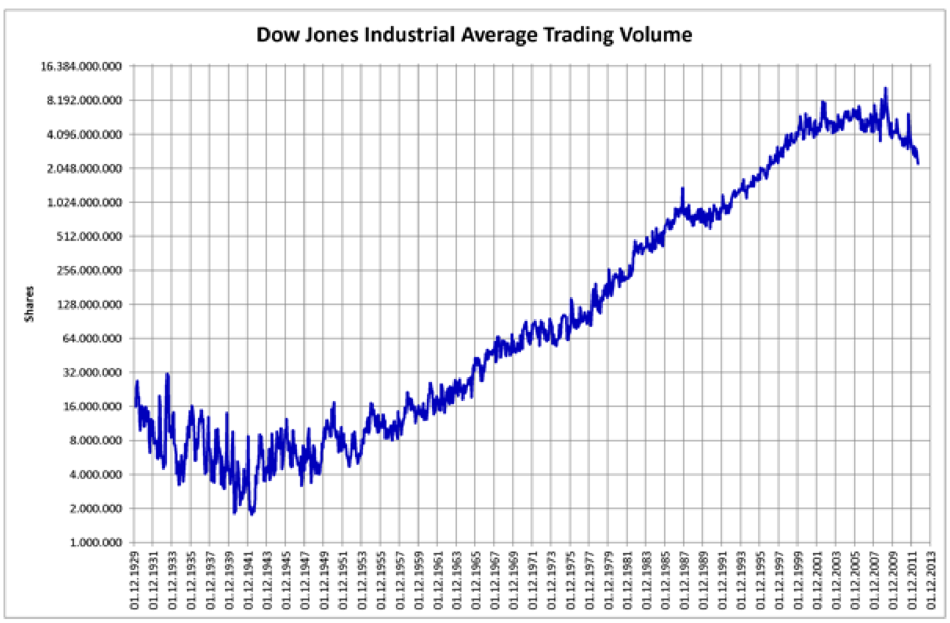


Chart 1: DJIA volume

The DAX (Deutshe Aktien Xchange 30) includes the shares of 30 of the largest companies in German (Blue chip stock market) and they are trading on the Frankfurt Stock Exchange.

This index was created in 1988 to measure the performance of the companies' shares and thus it provides a whole performance of the German economy. The DAX has two versions, performance index and price index. These two are depending on the calculation of dividends. Also it represents about 80% of the market capitalization and gives to its investors many opportunities to invest according to their needs.

The DAX index is a capitalization weighted. To calculate DAX indices price it is a necessity to take the prices from the Xetra trading venue, which is the platform/trade system (price source). Moreover, we need to compute the market capitalization using the next formula:

FFM = Share Price * (Shares outstanding – locked in shares)

So the basic formula is

$$DAX = \frac{current\ total\ market\ cap\ of\ constituents * previous\ value}{previous\ period}$$

In more depth, FFM (Free Float Methodology) is a better method to calculate a market capitalization because it provides a more reliable picture of market and trading in the market. Dividend yield is been taken in order to reinvested once a year. Then it is redistributed to the companies as a reward. At the beginning of its existence it was calculated every 60 seconds. Since 2006, though, it is calculated every second.

Just to name a few Adidas, Bayer, BMW, SAP, Fresenius, Siemens, Deutche Bank etc.

The NIKKEI (NIKKEI Stock Exchange) is the oldest and most important index from the Tokyo Stock Exchange First Section and it has the same importance with the DJIA index. The NIKKEI index participated of 225 stocks of the best companies in Japanese economy.

It was started to be calculated and published in 1950 in Singapore Exchange. Then it continued to Osaka Securities Exchange, Mercantile Exchange and now it is an internationally recognized futures index. It is used to reflect the whole Japanese economy and it is characterized as one of the indexes with the fastest growing.

This index can be split into two categories, price average (DJIA, NIKKEI) and market value ratio (TOPIX) depending on the calculating method. It is a price weighted index. The point of this index is that every time the market capitalization is redefined, the 225 stocks must have an equal weight in the index.

It is an adjusted price average and the formula to calculate is:

$$\textit{Nikkei 225} = \frac{\textit{Sum of Adjusted stock price}}{\textit{Divisor}}$$

while the formula of numerator is:

$$\textit{stock price} * \frac{50\ (yen)}{\textit{presumed par value}\ (yen)}$$

In this type the presumed par value succeed the ex-par value and adjust the price of the constituents to the presumed par value of 50¥. The index is calculated every 15 seconds and is reviewed once a year.

Another type of index is:

$$\textit{NIKKEI 225} = \sum \textit{price of shares} * \textit{number of shares outstanding} * \textit{free float factor} * \\ * \textit{exchange rate} * \textit{adjustment fact}$$

with

$$\textit{adjustment factor} = \frac{\textit{index specific constant "Z"}}{\textit{number of shares outstanding} * \textit{adjusted stock market value before re-balancing}}$$

Some of the companies that are contained in this index are Honda, Mazda, Olympus, Japan tobacco, Bank of Yokohamma, JX Holdings, Toyota Tsusho etc.

The FTSE (Financial Times Stock Exchange) includes the shares of 100 of the largest companies in UK and it is supported by the FTSE group. The 81% of the market capitalization is represented by this index.

It is started to be calculated in 1984 and it is a part of FTSE group which is a subsidiary of London Stock Exchange Group. The point is to provide a full image of UK economy. However, the FTSE 100 index is not so reliable because it consists of many international companies. For this reason FTSE 250 index is used, which includes less international companies than FTSE 100 index and thus the development of the economy is more credible.

The weighting method that is used for this index is a capitalization weighted. At the very beginning of its calculations, the index had a random value of 1000.

The formula of FTSE index is:

$$\textbf{\textit{FTSE 100}} = \frac{\sum_i price\ of\ share_i * number\ of\ shares_i * free\ float\ adjustment\ factor}{Index\ divisor}$$

The free float adjustment factor is a percentage of all issued shares and it is rounded up to the nearest multiply of 5%. In addition, the type of free float capitalization of a company is:

Free Float cap of a company = market cap*free float factor

with

market cap = number of shares*price of shares

The divisor and the price of shares that they used for calculation must be adjusted over the time. This is necessary for price movements to be reflected efficiently by the index, thus remaining comparable over time.

The formula of divisor is:

$$\textbf{\textit{Divisor}} = \frac{Sum\ of\ market\ cap}{intial\ index\ value}$$

The most significant companies that are included in this index are Admiral Group, Barclays, Burberry, BP, Easy Jet, Johnson Matthey, Tesco, etc.

CHAPTER 4

THE INTERDEPENDENCE OF INTERNATIONAL STOCK MARKETS – LITERATURE REVIEW

4.1 Introduction

After globalization all economies are interconnected. Many researchers have studied if the economies interconnect with stock markets too.

The first researches started in 1970 and examined the diversification of portfolio. The correlation among the returns was not their first priority. The effects in many of them saw that the correlation among economies was very low. The most important reason for this result was that most of the countries had closed economies and the movement of capitals was limited. Also, the monetary and economy policy had many differences among countries.

However, the results of the latest researches are different (after 1980-1990). Many researchers proved that economies had high rate of interdependence especially among nearest counties or countries with important economy relationships. Some of the causes are the globalization, the improvement of telecommunications and the deregulation in the movements of capitals. Finally, they showed that this interdependence among the markets is growing over the time.

4.2 Previous researches for Cointegration method

In 1989, Taylor and Tonks used two methods, the cointegration method and the granger causality, to examine the long-run relationship among England, Germany, Holland, Japan and US. Data had been taken on a daily basis while they examined 2 periods of time, 1973 to1979 and 1979 to 1986. As we can see from the results, the US was dominant while England-Germany and Holland-Japan had long-term interdependence.

In 1992, Cheung and Mac used the cointegration method for the same objective. US, Japan, Hong Kong, Malaysia, Indonesia, Filipinas, S. Korea, Taiwan and Thailand were among the countries that had been examined. The period of time that was analyzed was from 1978 to 1988 and the data had been taken every week. Therefore, from the results, the US had not had long-term interdependence with S. Korea, Taiwan and Thailand.

In 1993 there were two main researches for cointegration. Arshanapalli and Douka examined the US, England, Germany, France and Japan during the 80s. Byers and Peel also had a closer look on the same countries except France that was switched with Holland. The results were the same and they proved that there was not any relationship between these markets.

Blackman, Holden and Thomas inspected the correlation among 17 different countries in 1994. The analysis divided into two periods of time, 1970 to 1979 and 1984 to 1989. As demonstrated, only in the late 80s the markets had long-term interdependence.

In the next year, Richard used the cointegration method to study 16 countries. This time the period of time that was examined was from 1970 to 1994. As has been pointed out, the long-term interdependence did not exist.

In 1997, Choudhry analyzed the long-run relationship among US and six countries of S.US (Argentina, Brazil, Chilly, Colombia, Mexico and Venezuela). Data had been taken on a weekly basis while they examined the period between 1989 and 1993. All in all, the US was supreme while the Brazil and Colombia were exogenous factors.

In 2000, Huang, Yang and Hu used the cointegration method as long as the method of granger causality to examine the long-run correlation among US, Japan, S. China, Hong Kong, Taiwan and S. Korea. The period of data analysis was from 1992 to 1997. In the same year, Chen, Firth and Rui used the method of cointegration to study six markets of S.US (Argentina, Brazil, Chilly, Colombia, Mexico and Venezuela). In the first research as shown the countries did not associate with each other. However, in the second research the markets had been correlated until 1999.

In 2001 Ostermark and Masih used different markets to examine the same problem (long-term interdependence among markets). Specifically, the first researcher examined only two countries, Finland and Japan between 1990 and 1993. From the results we can point the correlation between these markets. The second researcher examined US, Australia, England, Germany, Hong Kong, Japan, S.Korea, Singapore, and Taiwan. Data had been taken on a monthly basis while the examined period of time was 1992 to1994. The US was dominant while Hong Kong, Japan, S.Korea, Singapore, and Taiwan had long-term interdependence.

CHAPTER 5

METHODOLOGY

5.1 Introductions

As it was mentioned before, the goal of this thesis is a long-term analysis of the interdependence among developed and developing stock markets.

In a more detailed look, eight indexes of four developed and four developing countries are used for analysis. In the table below (Table 5.1) these indexes are presented as long as their countries. The first 4 concern 4 of the most developed stock markets in the world and the last 4 are about the developing stock markets.

INDEX	**COUNTRY**
FTSE 100	UK
DAX	German
S&P 500	US
NIKKEI 225	Japan
Crobex	Croatia
Athens General	Greece
Kenya NSE 20 (NSE20)	Kenya
Merval (MERV)	Argentina

Table 5.1: Indexes

In addition, the data were updated on a daily basis and the period of analysis is from May 2001 to December 2015. They have mentioned to the daily returns. Also, they have transformed to logarithm for two main reasons. First, with this transformation the variables will have the same measurement scale and second, the variance will be stabilized. These data are characterized as time series because they are collected through time and so they are changing over time.

As it is shown from the table below (Table 5.2) there are 5 periods of time, from May 2001 to December 2015, where the indexes are examined.

PERIOD		INDEX	
From	**To**	**Developed Stock Markets**	**Developing Stock Markets**
May 2001	Marc 2003	Nikkei, DAX	All
April 2003	December 2006	DAX, FTSE 100	All (except GEN)
January 2007	December 2008	DAX, FTES 100, SP500	All (except GEN)
January 2009	December 2012	DAX, FTES 100, SP500	All
January 2013	December 2015	All	All

Table 5.2:Periods of analysis

The main methodology that is selected is the cointegration method because the point of this thesis is to analyze the long-term interdependence. However, to apply this method the data must remain unchanged. At first the appropriate test must be done in order to check the stability. These tests are called unit root tests and they are analyzed on the next chapter. If the time series are stable, then we can continue with our analysis (cointegration).

5.2 Unit root test

A stationary time series is one whose properties do not depend over time. These properties are the mean, variance and autocorrelation. Formally, if we have {Xt,tϵz} with Z=integer set, the conditions are:

$$E(X_t^2) < \infty \, \forall \, t \in Z$$

$$E(X_t) = \mu \, \forall \, t \in Z$$

$$\gamma x(s,t) < \gamma x(s+h, t+h) \forall \, s,h,t \in Z$$

However, most economic time series are not stationary at the beginning. So, to be checked if the time series is stationary, it must be applied the unit root tests. This means that time series variable has unit root. If time series has unit root, it is not stationary.

The general type of these tests have the following hypotheses:

Ho : time series is not stationary

H1 : time series is stationary

If the time series is not stationary (most of time), it can be transformed with some techniques, in order to be stationary. Some of these techniques are differences (first, second) and logarithms. The first category stabilizes the mean of a time series and the second stabilizes the variance of a time series.

A first check of stationary is graphically (correlograms). However, this is only a chart and it does not give safe effects. So, the best way is the unit root tests. The most common types of these tests are Dickey-Fuller, Augmented Dickey-Fuller and Phillips-Perron which are analyzed next.

5.2.1 Dickey –Fuller

The first unit root test is Dickey-Fuller. Consider an AR(1) model (autoregressive model)

$$Yt = a*Yt-1 + et$$

where a = coefficient, t = time index and et = error term.

The hypothesis test has the following type:

Ho : a=1

H1 : a<1

If the model has a unit root (a=1), a time series is not stationary. However, it can be done if we take first difference. So the model can be formulated as

$$\Delta Yt = (a-1)*Yt-1 + et$$

$$=\delta*Yt-1 + et$$

where δ = a-1

For this alternative form is used three different versions that are concerned an AR(1) model.

- $\Delta Yt = \delta*Yt-1 + et$, **random walk**
- $\Delta Yt = a_0 + \delta*Yt-1 + et$, **with constant**
- $\Delta Yt = a_0 + \delta*Yt-1 + a1 + et$, **with constant and linear time trend**

Thus, the unit’s root test hypotheses translate into:

$$\mathbf{Ho : \delta=0}$$

$$\mathbf{H1 : \delta<0}$$

Actually, the DF test is a t-test. The null hypothesis has the following type:

$$\hat{\boldsymbol{\tau}} = \frac{(\hat{\boldsymbol{a}}-\mathbf{1})}{se(\hat{\boldsymbol{a}})} = \frac{\hat{\boldsymbol{\delta}}}{se(\hat{\boldsymbol{\delta}})}$$

However, if the time series is not stationary, the distribution is not known (not valid test) and this is a problem. Thus, there is built a table by researchers to help the analysts with their results. This table has the critic values (τ) for specific significant level (a) and sample size.

5.2.2 Augmented Dickey – Fuller

The Augmented Dickey-Fuller test is an extension of DF test. It is used for a larger and more complicated data. Consider an AR(p) with regression model:

$$\mathbf{Yt = a0 + a1{*}Yt\text{-}1 + a2{*}Yt\text{-}2 + \ldots + ap{*}Yt\text{-}p + et}$$

and alternative

$$\Delta Y_t = a_0 + \gamma * Y_{t-1} + \sum_{i=1}^{p-1} \beta_i * \Delta Y_{t-i+1}\, e_t$$

where $\gamma = -(1-\sum_{i=1}^{p} a_i)$ and $\beta = -\sum_{i=1}^{p} a_i$

The hypothesis of unit root test is:

$$\mathbf{Ho : \delta=0}$$

$$\mathbf{H1 : \delta<0}$$

and the value of test statistic is:

$$\hat{\boldsymbol{\tau}} = \frac{\hat{\gamma}}{se(\hat{\gamma})}$$

Thus, if the test statistic is less than the critical value (τ), we accepted the alternative hypothesis. So, the time series is stationary. The values of τ are took by the t-table. Also, to be estimated the results is used the Ordinary Least Squared method (OLS). The point of this is the results do not be autocorrelated. Finally, for this test the leagues of p must be known. There are a lot criterions (AIC, SIC) which are helped to be chosen the right p.

5.2.3 Philips – Perron

The Phillips-Perron test is a generalization of DF and ADF test. The mathematical formula for this test is:

$$Y_t = a_0' + a_1' * Y_{t-1} + u_t$$

And hypothesis are:

$$H_0 : a_1' = 1$$
$$H_1 : a_1' < 1$$

The test statistic (Zt) is more complicate and difficult than ADF t-statistic but the critical values are the same. If the test statistic is bigger than τ (Zt > τ), we accept the alternative hypothesis. Thus, the time series is stationary.

The only restriction in this test is E(ut) = 0. Also, the users do not need to calculate lags as in the ADF test. The PP test is robust to general forms of heteroscedasticity in the error terms (ut).

Even though, all these tests have a low power, they are used until now to examine the unit root and so if the time series is stationary.

5.3 Cointegration

The cointegration is the method that will be used to estimate the long-term relationship among variables (indexes). If (X,Y,Z) are each integrated of order 1 (I(1)) and there exist coefficients a,b,c such that aX+bY+cZ is integrated of order o (I(0)) then X,Y,Z are cointegrated.

Two main methods for studying for cointegration are Engle and Granger and Johansen-Juselious with the latter will be the one analyzed.

The first method is the Engle and Granger method. The Engle and Granger was proved that if two time series are integrated of order d and there is a linear combination of this collection which is stationary, then the collection is said to be cointegrated. This method is simple but it has many problems. One of these is that analysts do not know the real long-term relationship among the variables. Thus, they cannot known which coefficients must be used.

Accordingly, we choose the Johansen-Juselious method in order to avoid some of Engle and Granger method's problems.

5.3.1 Johansen – Juselious

The Johansen-Juselious method is a maximum likelihood method. The point of this method is to estimate and check many cointegrating vectors.

Consider an AR(p) with regression model:

$$\mathbf{Yt = \mu + A1Yt\text{-}1 + \ldots + ApYp\text{-}1 + \varepsilon t}$$

where Yt = nx1 vector of variables I(1) and εt = nx1 vector of innovations, εt ~ iidN(0,Σ)

The alternative formula (with lag operation Δ= 1-L) is:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

where matrix $\Pi = \sum_{i=1}^{p} A_i$ and $\Gamma_i = -\sum_{j=i+1}^{p} A_j$

The matrix Π is a long-term interaction among the variables. If rank(Π)=0, there are not long-term relationships among variables. If rank(Π)=n, the model is stationary. If 1<rank(Π)<n, there are more than one cointegration vectors.

Also, this matrix Π can be calculated as product of two matrix A and B. The form is:

$$\Pi = AB'$$

where matrix A = adjustment parameters in vector error correction model and each column of matrix B = a cointegration vector.

There are two statistic test which are checked the number of cointegrating vectors. The first on is the trace test, and the formula is:

$$\mathbf{J_{trace} = -T\sum_{i=n+1}^{n} \ln(1 - \widehat{\lambda_i})}$$

with T = size of observations and λ = the estimate values of eigenvalues

And the hypotheses are:

H0: cointergation vectors ≤ r

H1: cointergation vectors > r

The second one is the maximum eigenvalue test, and the formula is:

$$\mathbf{J_{max} = -T * \ln(1 - \widehat{\lambda_i})}$$

And the hypotheses are:

H0: cointergation vectors ≤ r

H1: cointergation vectors > r+1

The trace test counts all the (n-r) eigenvalues. So, it has larger power than maximum eigenvalue test. On the other hand, the second test has larger power than first when the values of λi are very low or very high.

In the next chapter (Chapter 6) we will see how this model works with real data.

5.3.2 Vector error Correction model

The error correction models are used for data where the variables have a long-term stochastic trend (cointegration). These models are used for estimating the sort-term effects and the long-term equilibrium.

There are two methods for estimating, the Engle and Granger and the Vector Error Correction model (VECM).

The Engle and Granger method has two steps. In the first step is estimated the model and the residuals of them. The method that is used is an Ordinary least squares (OLS). In the second step these predicted residuals are used in a regression. This method gives good results when the time series have two variables (X,Y) and they are stationary.

If there are more than two variables this method is not possible. In this case the model is named Vector Error Correction model and it use the method of Johansen (maximum likelihood).

As was mentioned before the Johansen-Juselious model has the formula that is following:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

or

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

where $\Delta Y\_(t-i)$ = short-term effects of variables and Yt-1 = long-term equilibrium.

This model is a Vector error correction model. If there are n variables, the cointegration vector will be max (n-1). The matrix Π has such as columns as the results of cointegration test. After this, is calculated a VAR model and then the VECM. The point of this is to be created some autoregression vectors which are involved the estimations of the sort-term effects and the log-term equilibriums.

5.3.3 Innovation accounting

The innovation accounting is a last part of the analysis. It is divided in impules response analysis and the variance decomposition.

The point of impules response analysis is to examine the interaction among the time series. It is based on the VMA (vector moving average) representation of a (stationary) VAR(p) process with p being the order of the VAR. The main causes are two. First, the time series must be stationary. Second, the estimations (et) must be white noise and they should be uncorrelated.

An impulse response function (φij) traces the effect of a one-time shock to one of the values of the endogenous variables. It is caught by shocks in the estimates (et) of VAR(p) models.

The second computation is a variance decomposition or forecast error variance decomposition (FEVD). It determines the percentage of the forecast estimation variance which can be explained by exogenous shocks to the other variables. This measurement feature how powerful is the effect of each variable.

For these two methods, the VAR should be expressed in such a way that the estimates become orthogonal. The test which is preferred for this transformation is a decomposition of Choleski. The ambition is the shock of error does not have directly (ameses) effects to the prices of the other time series.

This methodology will be used in the next chapter to examine our real data and the results.

CHAPTER 6

DATA ANALYSIS – INTERPRETATION OF RESULTS

6.1 Descriptive Statistics

Before the analysis we can feature some basic descriptive measures which are concerned the daily returns of indexes (rij). The period of analysis is for January 2001 to December 2015.

The formula of daily returns is following:

$$r_{ij} = \frac{P_{it} - P_{it-1}}{P_{it-1}}$$

where P_(it-1) = the close price of i country and (t-1) day and P_it = the close price of i country and t day.

As we can see in Table 6.1, the most values of mean daily returns are positive, excepting the General Index. The SP500 index has the maximum value (0.000473) and the General index has the minimum value (-0.000270). Even thought the values are quite small they have not big inflection.

Also, Nikkei and Crobex have the maximum std. Deviation (0.0154729) and NSE20 the minimum (0.0084861). This is means that Nikkei and Crobec have the highest total risk (systematic and specific) and NSE20 has the lowest total risk.

The daily returns ranged from -0.1623 (General) to 0.1749 (Merv). This is another measure which shows the small volatility of daily returns.

Statistics

	NIKKEI	DAX	FTSE100	SP500	CROBEX	NSE20	MERV	GENERAL
Mean	,000209	,000463	,000300	,000473	,000209	,000448	,001144	-,000270
Median	,000500	,000800	,000400	,000700	,000500	,000000	,001200	,000050
Std. Deviation	,0154729	,0153496	,0121423	,0129388	,0154729	,0084861	,0219157	,0190880
Skewness	-,200	,134	,000	-,082	-,200	,671	,009	-,025
Std. Error of Skewness	,040	,040	,040	,049	,040	,040	,040	,040
Kurtosis	6,212	4,907	6,924	10,976	6,212	13,027	4,411	5,796
Std. Error of Kurtosis	,081	,079	,080	,098	,081	,080	,081	,080
Minimum	-,1141	-,0840	-,0880	-,0900	-,1141	-,0820	-,1215	-,1623
Maximum	,1415	,1140	,0984	,1158	,1415	,0902	,1749	,1437

Table 6.1 : Descriptive statistics

6.2 Unit root tests

The first step of the analysis is to examine if the stationarity of the time series under study, by applying a unit root test in two steps:

First we used the Dickey-Fuller model and at a second stage Philips-Perron test was applied.

The first method is a Dickey-Fuller test and specifically an Augmented Dichey-Fuller test. In Table 6.2,Table 6.3,Table 6.4,Table 6.5,Table 6.6 the results of Dickey-Fuller test and specifically an Augmented Dickey-Fuller test are given, both in the levels and in the first differences for all periods of time as was mentioned before. The time series are not stationary in the levels and are be stationary when we take first differences.

	Level				1rst Difference			
	Lag length p	ADF t-statistic	p-value	Deterministic terms	Lag Length p	ADF t-statistic	p-value	Deterministic terms
DAX	0	-2.289073	0.4388	Trend & Intercept	0	-24.65045	0.0000	None
NIKKEI	0	-2.716920	0.2301	Trend & Intercept	0	-24.50842	0.0000	None
CROBEX	0	-2.707129	0.2341	Trend & Intercept	0	-24.51049	0.0000	None
MERV	1	-1.552432	0.8102	None	0	-21.11168	0.0000	None
NSE20	3	0.172226	0.9978	None	2	-8.866510	0.0000	Trend & Intercept
GEN	4	-3.046140	0.1207	Trend & Intercept	3	-10.17983	0.0000	None

Table 6.2 : 2001-2003

	Level				1rst Difference			
	Lag length p	ADF t-statistic	p-value	Deterministic terms	Lag Length p	ADF t-statistic	p-value	Deterministic terms
DAX	10	-3.045776	0.1203	Trend & Intercept	9	-11.43026	0.0000	Intercept
FTSE	0	-2.452603	0.3520	Intercept	0	-32.81888	0.0000	None
CROBEX	0	-1.787261	0.7104	None	0	-30.82006	0.0000	None
MERV	0	-2.049042	0.5730	Intercept	0	-30.54536	0.0000	Intercept
NSE20	1	-1.924021	0.6410	Intercept	0	-29.57532	0.0000	Intercept
GEN	0	-1.706470	0.7480	None	0	-30.40527	0.0000	Trend & Intercept

Table 6.3 : 2003-2006

	Level				1rst Difference			
	Lag length p	ADF t-statistic	p-value	Deterministic terms	Lag Length p	ADF t-statistic	p-value	Deterministic terms
DAX	5	-1.696474	0.7517	Trend & Intercept	4	-11.10526	0.0000	None
FTSE	6	-2.257522	0.4560	Intercept	5	-8.573244	0.0000	None
CROBEX	0	-2.279157	0.4441	Intercept	0	-22.74431	0.0000	None
SP	3	-2.442964	0.3568	Intercept	2	-12.91070	0.0000	None
MERV	0	-1.968599	0.6165	None	0	-21.70488	0.0000	None
NSE20	2	-2.909842	0.1602	Intercept	1	-12.79649	0.0000	None

Table 6.4 : 2007-2008

	Level				1rst Difference			
	Lag length p	ADF t-statistic	p-value	Deterministic terms	Lag Length p	ADF t-statistic	p-value	Deterministic terms
DAX	1	-2.473912	0.3412	Intercept	2	-19.28133	0.0000	None
FTSE	0	-3.967071	0.5173	Intercept	0	-31.29908	0.0000	None
SP	5	-1.941553	0.6317	Intercept	4	-14.62646	0.0000	None
CROBEX	0	-2.796771	0.1988	Intercept	0	-32.45175	0.0000	None
MERV	3	-1.523648	0.8212	None	2	-18.88887	0.0000	Trend & Intercept
NSE20	2	-1.511555	0.8254	None	1	-16.10349	0.0000	None
GEN	2	-0.606933	0.9780	None	1	-23.42073	0.0000	None

Table 6.5 : 2009-2012

	Level				1rst Difference			
	Lag length p	ADF t-statistic	p-value	Deterministic Terms (5%)	Lag Length p	ADF t-statistic	p-value	Deterministic terms
DAX	0	-2.578071	0.2906	Trend & Intercept	0	-28.22977	0.0000	None
NIKKEI	12	-2.296811	0.4347	Intercept	11	-9.802299	0.0000	Intercept
FTSE	4	-3.329403	0.0623	Intercept	3	-14.27900	0.0000	None
SP500	0	-2.673133	0.2482	Trend & Intercept	3	-15.45636	0.0000	Intercept
CROBEX	12	-2.619871	0.2813	Trend & Intercept	11	-8.701070	0.0000	Intercept
MERV	0	-1.793116	0.7074	None	0	-25.67616	0.0000	None
NSE20	2	-1.874724	0.6666	None	1	-17.38189	0.0000	Trend & Intercept
GEN	5	-1.525626	0.8202	None	4	-14.55675	0.0000	None

Table 6.6 : 2013-2015

In Table 6.2,Table 6.3,Table 6.4,Table 6.5,Table 6.6 we have the results of ADF tests. The first column gives the lags length of time series. The second column gives the results of ADF t-statistics and the third gives the p-values of this test. The Deterministic terms gives the types of models for each index. We start with full model (Trend and intercept) and in the end we choose only the statistical important variables. As we can see all time series are no stationary in levels. The p-values of all are bigger than significant level (a=0.05), so we accept the null hypothesis (time series are no stationary). However, when we take first differences the time series are done stationary I(1) (p-value = 0.000 < 0.05).

The second method is the Philips-Perron test. In Table 6.8,Table 6.9.Table 6.10.Table 6.11 are given the results of this test both in the levels and in the first differences for all four periods of time as are mentioned before.

Table 6.7: 2001-2003

	Level				1rst Difference			
	Bandwidth	PP test stat	p-value	Deterministic terms	Bandwidth	PP test stat	p-value	Deterministic terms
DAX	5	-2.206050	0.4848	Trend & Intercept	7	-24.74029	0.0000	None
NIKKEI	3	-2.645427	0.2602	Trend & Intercept	7	-24.60465	0.0000	None
CROBEX	3	-2.630377	0.2669	Trend & Intercept	7	-24.60167	0.0000	None
MERV	5	-1.500046	0.8288	None	2	-21.09347	0.0000	None
NSE20	12	0.534803	0.9994	Intecept	11	-18.25091	0.0000	Trend & Intercept
GEN	9	-2.819111	0.1909	Trend & Intercept	8	-21.96614	0.0000	None

Table 6.8: 2003-2006

	Level				1rst Difference			
	Bandwidth	PP test stat	p-value	Deterministic terms	Bandwidth	PP test stat	p-value	Deterministic terms
DAX	1	-3.406028	0.0560	Trend & Intercept	8	-33.590411	0.0000	Intercept
FTSE	6	-2.456918	0.3498	Intercept	3	-32.81834	0.0000	None
CROBEX	6	-1.817645	0.6956	None	3	-30.82011	0.0000	None
MERV	6	-2.128187	0.5288	Intercept	4	-30.54334	0.0000	Intercept
NSE20	9	-2.199785	0.4886	None	7	-29.67069	0.0000	Intercept
GEN	7	-1.872991	0.6677	None	1	-30.40517	0.0000	Trend & Intercept

Table 6.9: 2007-2008

	Level				1rst Difference			
	Bandwidth	PP test stat	p-value	Deterministic terms	Bandwidth	PP test stat	p-value	Deterministic terms
DAX	10	-1.742164	0.7311	Trend & Intercept	10	-24.02575	0.0000	None
FTSE	4	-2.514109	0.3211	Intercept	6	-23.86429	0.0000	None
CROBEX	2	-2.269415	0.4495	Intercept	6	-22.76938	0.0000	None
SP	2	-2.440628	0.3580	Intercept	5	-24.10109	0.0000	None
MERV	0	-1.968599	0.6165	None	4	-21.76643	0.0000	None
NSE20	4	-2.560874	0.2987	None	4	-17.64804	0.0000	None

Table 6.10 :2009-2012

	Level				1rst Difference			
	Bandwidth	PP test stat	p-value	Deterministic terms	Bandwidth	PP test stat	p-value	Deterministic terms
DAX	4	-2.375881	0.3920	Intercept	8	-30.13109	0.0000	None
FTSE	1	-2.181819	0.4987	Intercept	5	-31.29888	0.0000	None
CROBEX	8	-2.821725	0.1897	Intercept	6	-32.45105	0.0000	None
SP	1	-2.037577	0.5794	Intercept	3	-34.84780	0.0000	None
MERV	7	-1.555131	0.8098	None	7	-31.64688	0.0000	Trend & Intercept
NSE20	13	-1.447673	0.8464	None	8	-23.10319	0.0000	None
GEN	4	-0.792511	0.964	None	2	-30.800083	0.0000	None

Table 6.11:2013-2015

	Level				1rst Difference			
	Bandwidth	PP test stat	p-value	Deterministic terms	Bandwidth	PP test stat	p-value	Deterministic terms
DAX	6	-2.581452	0.2890	Trend & Intercept	2	-28.23189	0.0000	None
NIKKEI	8	-2.327853	0.4178	Intercept	9	-31.83949	0.0000	None
FTSE	6	-3.439243	0.0470	Intercept	1	-27.69092	0.0000	None
SP500	10	-2.455117	0.3506	Trend & Intercept	15	-27.88297	0.0000	Intercept
CROBEX	4	-3.127738	0.1006	Trend & Intercept	8	-29.32105	0.0000	None
MERV	3	-1.868962	0.6695	None	2	-25.66777	0.0000	None
NSE20	3	-1.914581	0.6458	Trend & Intercept	5	-2659366	0.0000	None
GEN	25	-1.801114	0.7035	Trend & Intercept	31	-24.72608	0.0000	None

In Table 6.7,Table 6.8,Table 6.9,Table 6.10,Table 6.11 we have the results of PP tests. The first column gives the bandwidth of time series. The second column gives the results PP test statistics and the third gives the p-values of this test. The Deterministic terms gives the types of models for each index. As we can see all time series are no stationary in levels. The p-values of all are bigger than 0.05, so we accept the null hypothesis (time series are no stationary). However, when we take first differences the time series are done stationary I(1) (p-value = 0.000 < 0.05).

The above analysis leads to the conclusion that, the results of these two tests are the same. That is, the analyzed time series are stationary when we take first differences I(1) and they have unit root. It is therefore necessary to proceed with cointegration analysis.

6.3 The Cointegration method

The null hypothesis shows is that the time series have not cointegration.

The contrary is assumed for the alternative hypothesis.

First period of time: January 2001 to March 2003

The first step is to find the correct lags (p) for the VAR model that will ne used. We use many selection criteria like LR, AIC, SC, HQ. The ultimate goal is to select the lag with the smallest value of information criteria. The choices of lags are given in Table 6.12and the model is a VAR(2). This is means that the values of time series are affected from changes in the other markets, that happen two days before.

Lag	AIC	SC
0	-29.51198	-29.46549
1	-43.7926	-43.46744
2	-44.09956	-43.49508
3	-44.06850	-43.18503
4	-44.03462	-42.87216
5	-44.00236	-42.56091
6	-43.95443	-42.23399
7	-43.88516	-41.88573
8	-44.07422	-41.79580

Table 6.12: Information criteria (2001-2003)

The second step is to identify a possible trend in the time series. From the relative charts that are included in the attached appendix we can see they have trend and so, it must be added in the model.

The cointegration method is split into two tests. In Table 6.13 we can see the results of the first test and in Table 6.14 the results of the second test (as they are mentioned before). The eigenvalue column gives the estimated values of matrix Π. Also, the Max-eigenvalue Statistic gives the values of this test in the different hypotheses. The last column represents the critical value at 0.01, 0.05 and 0.1 level. Both tests indicate 6 cointegrating equations.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value
None	0.340919	398.1475	40.07757
At most 1	0.276040	308.4837	33.87687
At most 2	0.268931	299.1518	27.58434
At most 3	0.241974	264.5712	21.13162
At most 4	0.234843	255.6288	14.26460
At most 5	0.166209	173.5925	3.841466

Table 6.13:J-Maximum Eigenvalue (2001-2003)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% Critical Value
None	0.340919	1699.576	95.75366
At most 1	0.276040	1301.428	69.81889
At most 2	0.268931	992.9444	47.85613
At most 3	0.241974	693.7926	29.79707
At most 4	0.234843	429.2214	15.49471
At most 5	0.166209	173.5925	3.841466

Table 6.14:J- Trace (2001-2003)

Second period of time: April 2003 to December 2006

The numbers of the lags for the second period are given in Table 6.15 The best model is a VAR(2). This means that the values of time series are affected of changes in the other markets, only if these changes happen one day ago, at most.

Lag	SC	HQ
0	-33.27898	-33.29796
1	-33.05428	-33.18719
2	-33.82091	-34.06772
3	-33.61677	-33.97749
4	-33.40008	-33.87473
5	-33.19202	-33.78058
6	-32.95354	-33.65601
7	-32.72849	-33.54488
8	-32.50754	-33.43784

Table 6.15: Information criteria (2003-2006)

As we can see from the the charts in the attached appendix, they have a trend and so, it must be added in the model.

The next two tables give the results of cointegration tests. In Table 6.16 it is represented the Maximum Eigenvalue test and in Table 6.17 the Trace test. Both tests indicates 6 cointegrating equations.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value
None	0.340919	398.1475	40.07757
At most 1	0.276040	308.4837	33.87687
At most 2	0.268931	299.1518	27.58434
At most 3	0.241974	264.5712	21.13162
At most 4	0.234843	255.6288	14.26460
At most 5	0.166209	173.5925	3.841466

Table 6.16: J-Maximum Eigenvalue (2003-2006)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% Critical Value
None	0.340919	1699.576	95.75366
At most 1	0.276040	1301.428	69.81889
At most 2	0.268931	992.9444	47.85613
At most 3	0.241974	693.7926	29.79707
At most 4	0.234843	429.2214	15.49471
At most 5	0.166209	173.5925	3.841466

Table 6.17: J-Trace (2003-2006)

Third period of time: January 2007 to December 2008

In Table 6.18 shows the numbers of the lags for the third period. It is obvious that the best model is a VAR(3). This is means that the values of time series are affected of changes in the other markets, only if these changes have happened up to three days ago.

Lag	SC	HQ
0	-14.00698	-14.03771
1	-27.66013	-27.87524
2	-27.97027	-28.36976
3	-28.15243	-28.73629
4	-28.00579	-28.77404
5	-27.85573	-28.80835
6	-27.88203	-29.01903
7	-27.78065	-29.10203
8	-27.54347	-29.04922

Table 6.18: Information criterial (2007-2008)

As we can see in the charts which are included in the attached appendix, a trend exists and so, it must be added in the model.

The next two tables give the results of cointegration tests. In Table 6.19 is the values of Maximum Eigenvalue test are included, while in Table 6.20 includes the Trace test values

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value
None	0.187854	104.8697	40.07757
At most 1	0.164750	90.73191	33.87687
At most 2	0.082409	43.34603	27.58434
At most 3	0.036121	18.54212	21.13162
At most 4	0.031789	16.28204	14.26460
At most 5	0.014128	7.171405	3.841466

Table 6.19:J-Maximum Eigenvalue (2007-2008)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% Critical Value
None	0.187854	280.9432	95.75366
At most 1	0.164750	176.0735	69.81889
At most 2	0.082409	85.34159	47.85613
At most 3	0.036121	41.99556	29.79707
At most 4	0.031789	23.45344	15.49471
At most 5	0.014128	7.171405	3.841466

Table 6.20: J-Trace (2007-2008)

The first test indicates 3 cointegrating equations and the second test indicates 6 cointegrating equations. However, we choose the first one because the alternative hypothesis is more specific.

Fourth period of time: January 2009 to December 2012

In Table 6.21 the numbers of the lags are given, for the fourth period under study. The best model is a VAR(2). This means that the values of time series are affected of changes in the other markets, only if these changes have happened at most two days ago.

Lag	SC	HQ
0	-13.34082	-13.36191
1	-39.10474	-39.40916
2	-39.10474	-39.42105
3	-38.93052	-39.9444
4	-38.72714	-39.33867
5	-38.48233	-39.24148
6	-38.22138	-39.12813
7	-37.98631	-39.04068
8	-37.81662	-39.01860

Table 6.21: Information criteria (2009-2012)

Again, looking at the relevant charts in the attached appendix, we can see that they have a trend, which must be added in the model.

The next two tables give the results of cointegration tests. In the first table (Table 6.22) is represented the Maximum Eigenvalue test and in the second (Table 6.23) the Trace test.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value
None	0.090093	96.11221	46.23142
At most 1	0.046096	48.04140	40.07757
At most 2	0.032733	33.87965	33.87687
At most 3	0.17070	17.52693	27.58434
At most 4	0.008903	9.103531	21.13162
At most 5	0.004394	4.483368	14.26460
At most 6	0.002871	2.926473	3.841466

Table 6.22:J-Maximum Eigenvalue (2009-2012)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% Critical Value
None	0.090093	212.0736	125.6154
At most 1	0.046096	115.9614	95.75366
At most 2	0.032733	67.91995	69.81889
At most 3	0.017070	34.04030	47.85613
At most 4	0.008903	16.51337	29.79707
At most 5	0.004394	7.409841	15.49471
At most 6	0.002871	2.926473	3.841466

Table 6.23:J-Trace (2009-2012)

The first test indicates 3 cointegrating equations and the second test indicates 2 cointegrating equations. However, we choose the first one because the alternative hypothesis of test is more specific.

Fifth period of time: January 2013 to December 2015

We begin by choosing the correct number of lags (p) In Table 6.24 are included the results of the relevant analysis, which suggest that. So, the best model is a VAR(1). It means that the values of time series are affected of changes in the other markets, only if these changes have taken place one days ago at most.

Lag	SC	HQ
0	-22.13297	-22.15997
1	-46.97179	-47.21479
2	-46.66485	-47.12385
3	-46.34905	-47.02405
4	-46.04999	-46.94098
5	-45.67497	-46.78196
6	-45.29042	-46.61342
7	-45.09379	-46.63279
8	-45.68572	-46.4407

Table 6.24: Information Criteria (2013-2015)

At a next stage we check the trend of the series. After a visual inspection of the charts included in the attached appendix, we conclude that a trend exist in the data, thus it must be added in the model.

We continue with the cointegration tests. In Table 6.25 the results of the Maximum Eigenvalue are included test and in Table 6.26 the Trace test. Both tests indicate 5 cointegrating equations.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value
None	0.083525	76.66648	52.36261
At most 1	0.067535	61.46325	46.23142
At most 2	0.048576	43.77024	40.07757
At most 3	0.046721	42.05837	33.87687
At most 4	0.038001	34.05398	27.58434
At most 5	0.017422	15.44848	21.13162
At most 6	0.007951	7.017156	14.26460
At most 7	0.005703	5.027109	3.841466

Table 6.25:J-Maximum Eigenvalue (2013-2015)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	5% Critical Value
None	0.083525	285.5051	159.5297
At most 1	0.067535	208.8386	125.6154
At most 2	0.048576	147.3753	95.75366
At most 3	0.046721	103.6051	69.81889
At most 4	0.038001	61.54673	47.85613
At most 5	0.017422	27.49275	29.79707
At most 6	0.007951	12.04427	15.49471
At most 7	0.005703	5.027109	3.841466

Table 6.26:J-Trace (2013-2015)

6.4 Innovation accounting

6.4.1 Variance decomposition

The first part of innovation accounting is the variance decomposition. This method gives to the analytics important information about how powerful is the effect of each variable.

In Table 6.27 it is represented the percentage of the forecast estimation variance (CROBEX) which can be explained by exogenous shocks to the other variables (DAX, GEN, MERV, NIKKEI, NSE). As we can see, the percentage of the forecast estimation variance is explained by Dax (0.00% to 0.08%) and it is frozen after 8 periods. This is means, that the effect of DAX on the CROBEX is slow. The percentage is explained by NIKKEI (0.00% to 0.55%) and is frozen after 3 periods. This is means, that the effect of NIKKEI in the CROBEX is quick. Finally, the NSE is frozen after 5 periods and the GEN is frozen after 6 periods.

Similar results we can see for the others indices, in the attached appendix.

Period	CROBEX	DAX	GEN	MERV	NIKKEI	NSE
1	100.00	0.00	0.000	0.000	0.000	0.000
2	99.13	0.040	0.316	0.030	0.052	0.426
3	98.90	0.068	0.372	0.075	0.055	0.525
4	98.71	0.071	0.549	0.075	0.055	0.531
5	98.64	0.076	0.613	0.075	0.055	0.532
6	98.64	0.078	0.615	0.076	0.055	0.532
7	9863	0.079	0.615	0.076	0.055	0.532
8	98.63	0.080	0.615	0.076	0.055	0.532
9	98.63	0.080	0.615	0.076	0.055	0.532
10	98.63	0.080	0.615	0.076	0.055	0.532

Table 6.27: Variance decomposition of CROBEX (2001-2003)

In the second period (2003-2006), in Table 6.28 is represented the percentage of the forecast estimation variance (CROBEX) which can be explained by exogenous shocks to the other variables (DAX, FTSE, GEN, MERV, NSE).

As we can see, the maximum percentage of the forecast estimation variance is explained by FTSE (0.00% to 0.338%) and is frozen after 3 periods. This is means, that the effect of FTSE in the CROBEX is quick. The percentage is explained by DAX (0.00% to 0.161%) and is frozen after 5 periods. This is means, that the effect of DAX in the CROBEX is slow. Finally, the NSE (0.00% to 0.161%), GEN (0.00% to 0.063%) and MERV (0.00% to 0.049%) are frozen after 5 periods.

Similar results we can see for the others indices, in the attached appendix.

Period	CROBEX	DAX	FTSE	GEN	MERV	NSE
1	100.00	0.000	0.000	0.000	0.000	0.000
2	99.43	0.158	0.323	0.061	0.018	0.002
3	99.38	0.159	0.338	0.062	0.048	0.005
4	99.23	0.160	0.338	0.062	0.048	0.154
5	99.22	0.161	0.338	0.062	0.048	0.160
6	99.22	0.161	0.338	0.063	0.049	0.161
7	99.22	0.161	0.338	0.063	0.049	0.161
8	99.22	0.161	0.338	0.063	0.049	0.161
9	99.22	0.161	0.338	0.063	0.049	0.161
10	99.22	0.161	0.338	0.063	0.049	0.161

Table 6.28: Variance decomposition of CROBEX (2003-2006)

In the third period (2007-2008), in Table 6.29 is represented the percentage of the forecast estimation variance (CROBEX) which can be explained by exogenous shocks to the other variables (DAX, FTSE, SP, MERV, NSE).

As we can see, the maximum percentage of the forecast estimation variance is explained by FTSE (0.00% to 1.201%) and is frozen after 9 periods. This is means, that the effect of FTSE in the CROBEX is slow. The minimum percentage is explained by NSE (0.00% to 0.012%) and is frozen after 7 periods. This is means, that the effect of NSE in the CROBEX is slow.

Similar results we can see for the others indices, in the attached appendix.

Period	CROBEX	DAX	FTSE	SP	MERV	NSE
1	100.00	0.000	0.000	0.000	0.000	0.000
2	98.70	0.243	0.538	0.489	0.027	2.63-E05
3	97.54	0.946	0.639	0.811	0.048	0.007
4	97.47	0.946	0.702	0.818	0.048	0.009
5	97.00	0.946	1.169	0.817	0.049	0.011
6	96.99	0.946	1.175	0.818	0.054	0.011
7	96.96	0.947	1.196	0.818	0.053	0.012
8	96.96	0.947	1.198	0.818	0.055	0.012
9	96.96	0.948	1.200	0.819	0.055	0.012
10	96.96	0.948	1.201	0.819	0.055	0.012

Table 6.29: Variance decomposition of CROBEX (2007-2008)

The next period depends on the period of time between 2009 and 2012. In table below (Table 6.30) is represented the percentage of the forecast estimation variance (CROBEX) which can be explained by exogenous shocks to the other variables (DAX, FTSE, GEN, MERV, NSE).

As we can see, the maximum percentage of the forecast estimation variance is explained by FTSE (0.00% to 0.335%) and is frozen after 4 periods. This is means, that the effect of FTSE in the CROBEX is little slow. The minimum percentage is explained by NSE (0.00% to 0.073%) and is frozen after 8 periods. This is means, that the effect of NSE in the CROBEX is very slow.

We can see the remaining results for the others indices, in the attached appendix.

Period	CROBEX	DAX	FTSE	SP	GEN	MERV	NSE
1	100.00	0.000	0.000	0.000	0.000	0.000	0.000
2	99.72	0.106	2.94E-05	0.030	0.003	0.096	0.042
3	99.06	0.156	0.347	0.087	0.120	0.168	0.053
4	98.99	0.157	0.353	0.136	0.122	0.169	0.066
5	98.94	0.157	0.355	0.181	0.124	0.169	0.071
6	98.93	0.157	0.355	0.182	0.125	0.169	0.072
7	98.93	0.157	0.355	0.183	0.125	0.169	0.072
8	98.93	0.158	0.355	0.183	0.125	0.169	0.073
9	98.93	0.158	0.355	0.183	0.125	0.169	0.073
10	98.93	0.158	0.355	0.183	0.125	0.169	0.073

Table 6.30: Variance decomposition of CROBEX (2009-2012)

Finally, in the last period (2013-2015), in Table 6.31 is represented the percentage of the forecast estimation variance (CROBEX) which can be explained by exogenous shocks to the other variables (DAX, FTSE, GEN, MERV, NSE).

As we can see, the maximum percentage of the forecast estimation variance is explained by SP (0.00% to 0.101%) and is frozen after 5 periods. This is means, that the effect of this index in the CROBEX is normal. The minimum percentage is explained by NSE and NIKKEI (0.00% to 0.018%) and is frozen after 5 periods for the first and after 3 periods for the second index. This is means that the effect of NSE in the CROBEX is normal but the second is quick. However, neither the percentages of the other indexes are frozen.

Similar results we can see for the others indices, in the attached appendix.

Period	CROBEX	DAX	FTSE	SP	GEN	MERV	NSE	NIKKEI
1	100.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	99.79	0.008	0.040	0.045	0.018	0.008	0.067	0.015
3	99.34	0.009	0.076	0.099	0.049	0.024	0.099	0.018
4	99.33	0.010	0.076	0.100	0.050	0.024	0.100	0.018
5	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018
6	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018
7	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018
8	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018
9	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018
10	99.32	0.011	0.078	0.101	0.053	0.024	0.018	0.018

Table 6.31: Variance decomposition of CROBEX (2013-2015)

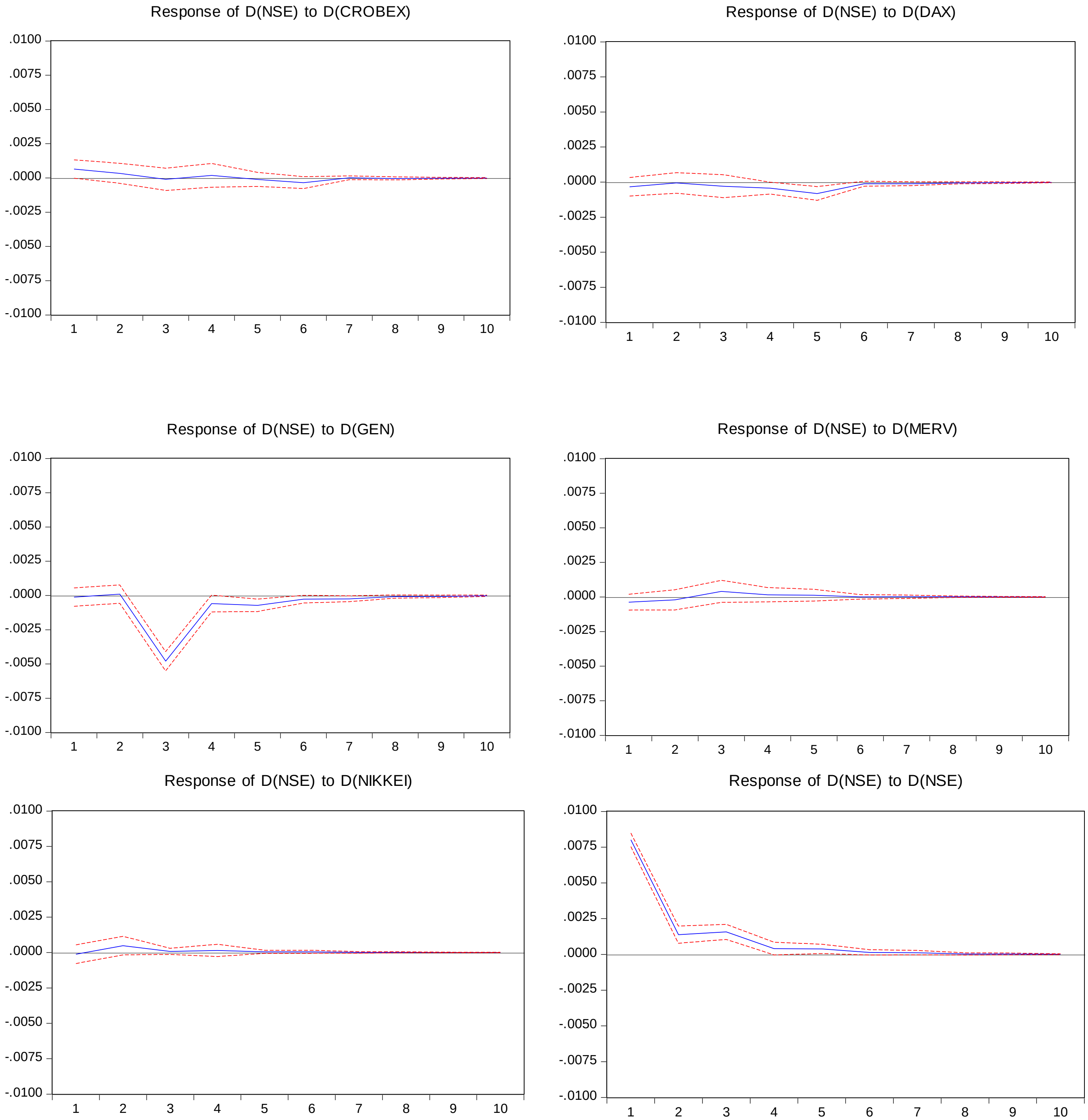
6.4.2 Impulse response functions

The second part of innovation accounting is the impulse response functions. This method examine the effect among the endogenous variables and unexpected disturbance (shock).

We start with the first period of time (2001-2003). In the chart below (Chart 2) is given the response of NSE to the other indexes (CROBEX, DAX, GEN, MERV, NSE). As we can see, one shock in the GEN has an effect to the estimations of NSE. These effects are important (statistical important) and are completed after two days. In the other indexes do not exist important effects.

The corresponding charts we can see for the others indexes in the appendix. So it is not necessary to analyze.

Chart 2 : Responses of NSE (2001-2003)



In the chart below (Chart 3) is given the response of GEN to the other indexes (CROBEX, DAX, FTSE, MERV, NIKKEI) for the second period of time (2003-2006). As we can see, one shock in the NSE has an effect to the estimations of GEN. These effects are important (statistical important) and are completed after three or four days. In the other indexes there are not exist important effects.

The corresponding charts we can see for the others indexes in the appendix.

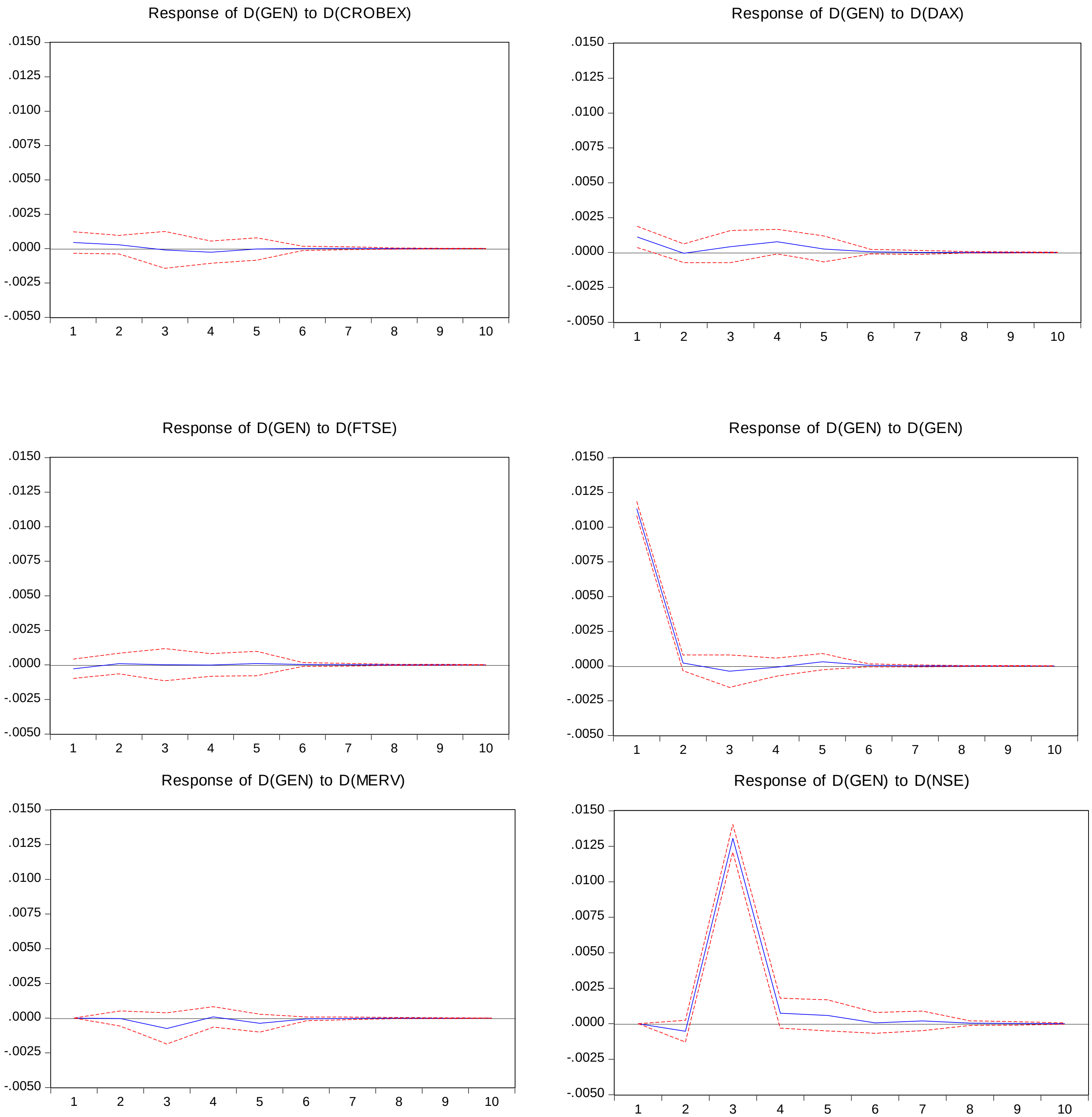
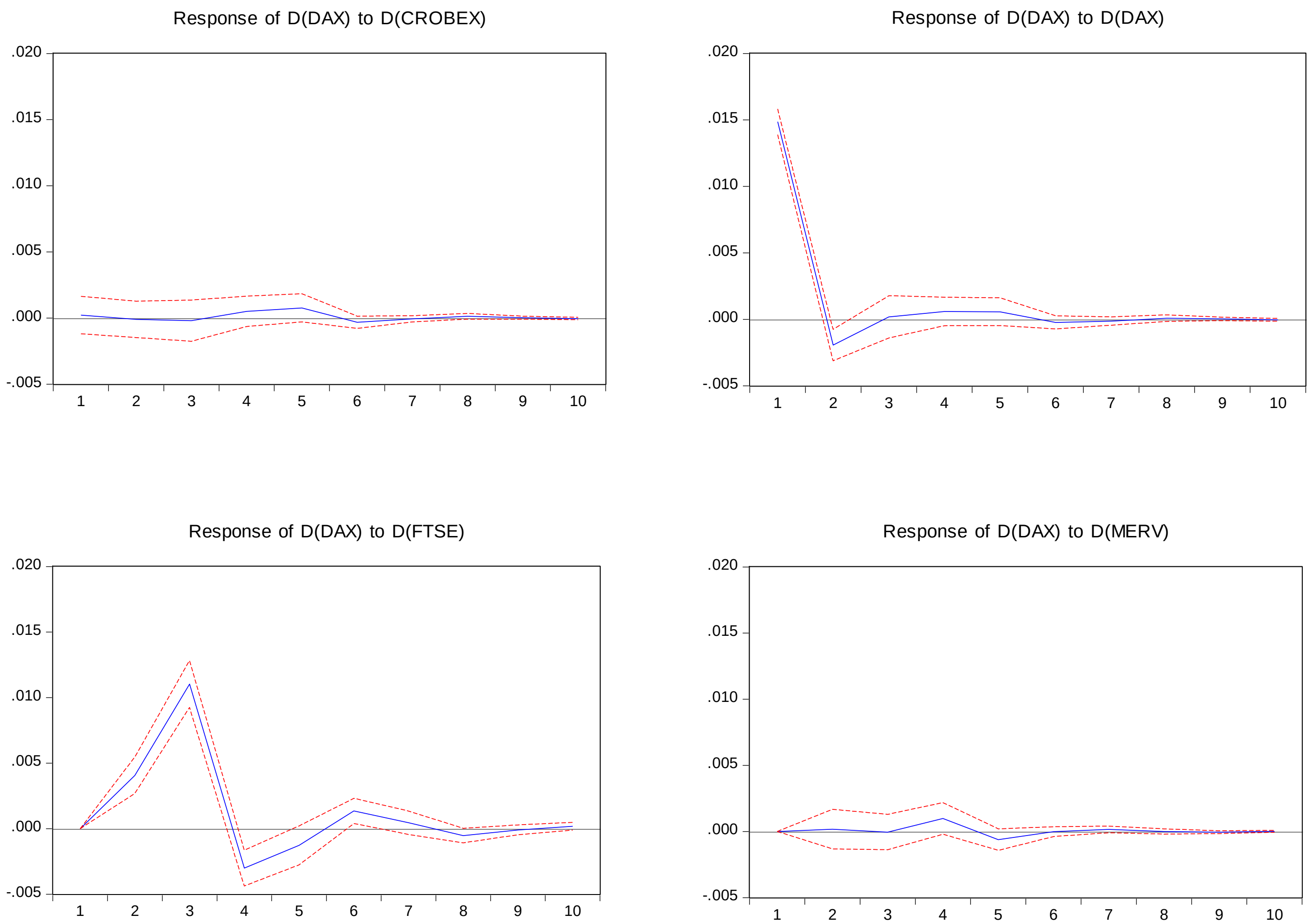


Chart 3: Responses of GEN (2003-2006)

In the chart below (Chart 4) is given the response of DAX to the other indexes (CROBEX, FTSE, SP, MERV, NSE) for the third period of time (2007-2008). As we can see, one shock in the DAX has an effect to the estimations of FTSE. This effect is important (statistical important) and is completed after three days. In the other indexes there are not exist important effects.

The corresponding charts we can see for the others indexes in the appendix.



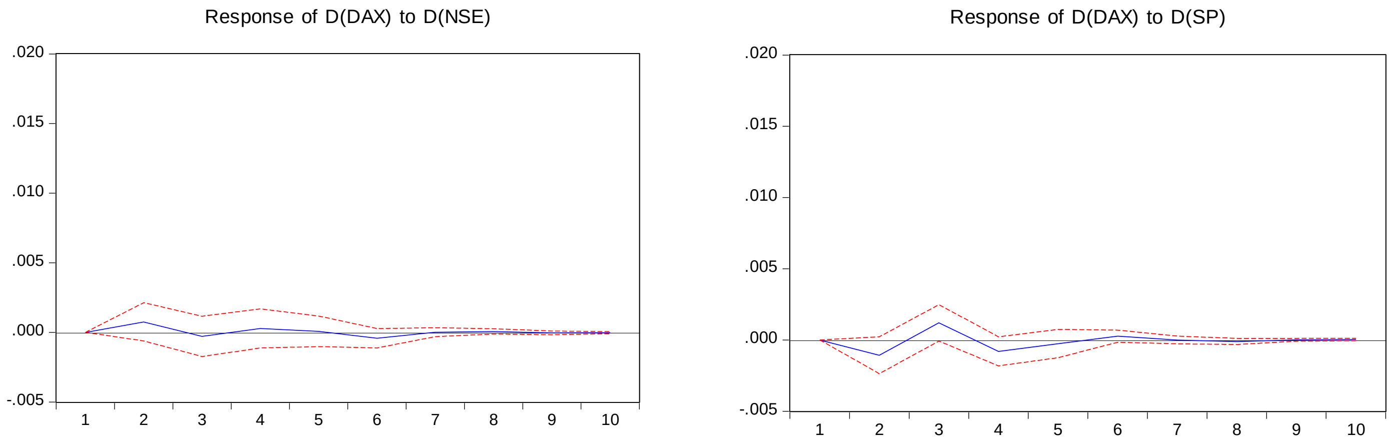
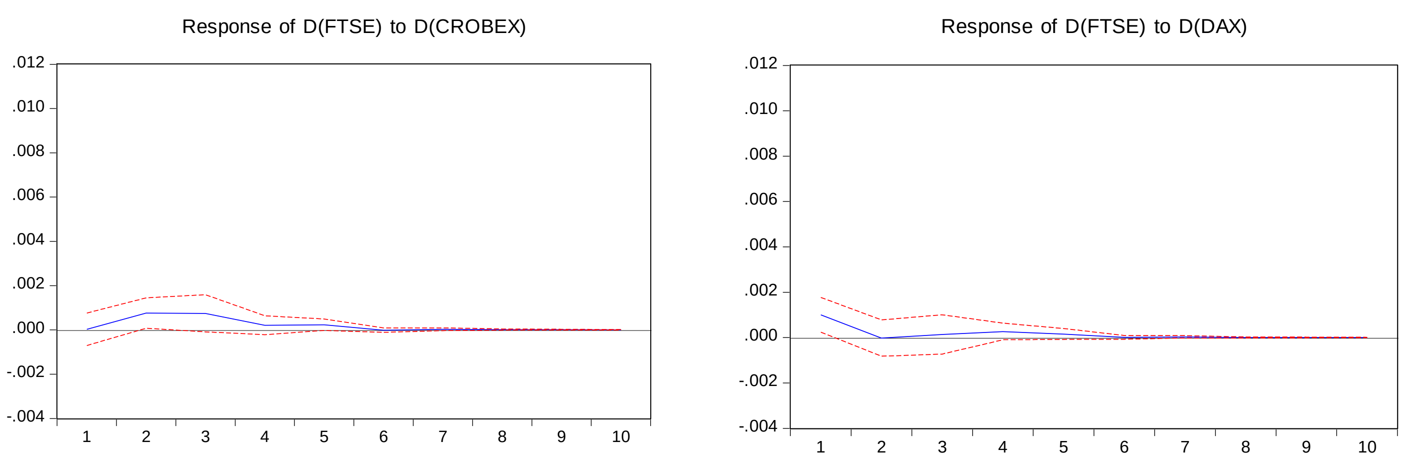


Chart 4: Responses of DAX (2007-2008)

In the chart below (Chart 5) is given the response of FTSE to the other indexes (CROBEX, DAX, SP, MERV, GEN, NSE) for the second period of time (2009-2012). As we can see, one shock in the FTSE has an effect to the estimations of SP. These effects are important (statistical important) and are completed after three days. Also, one shock in the FTSE has a small effect to the estimations of NSE. These effects are statistical important and are completed after 4 days. In the other indexes there are not exist important effects.

The corresponding charts we can see for the others indexes in the appendix.



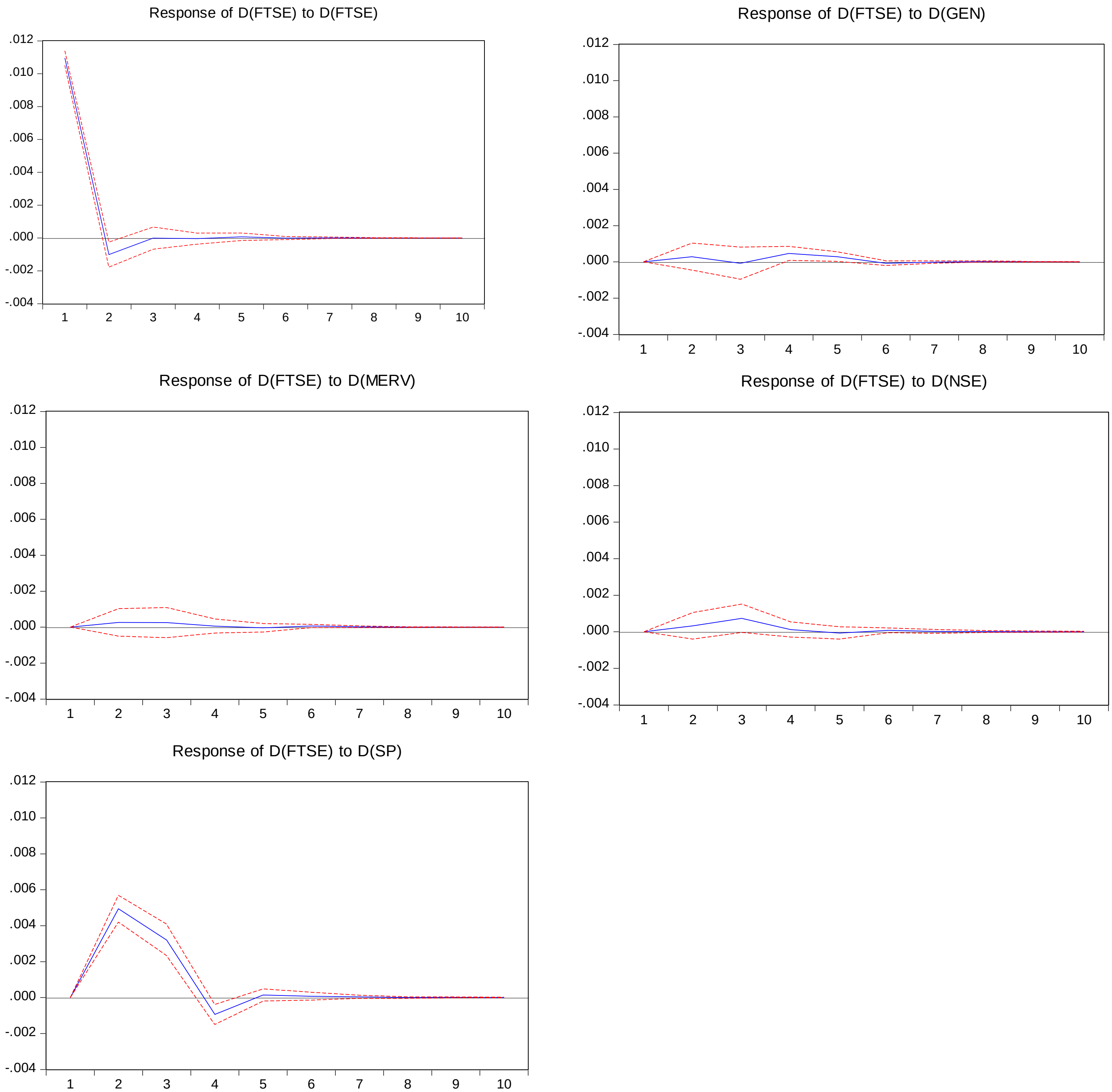
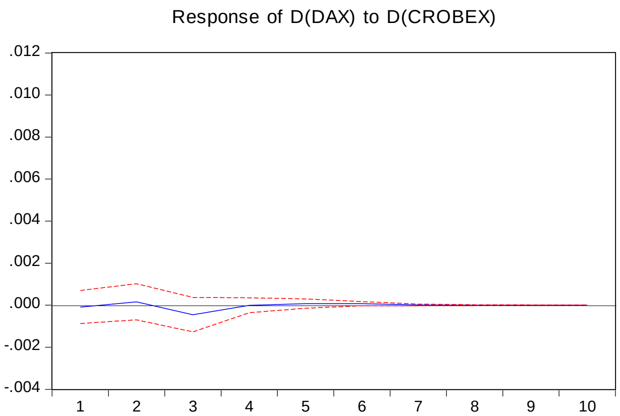
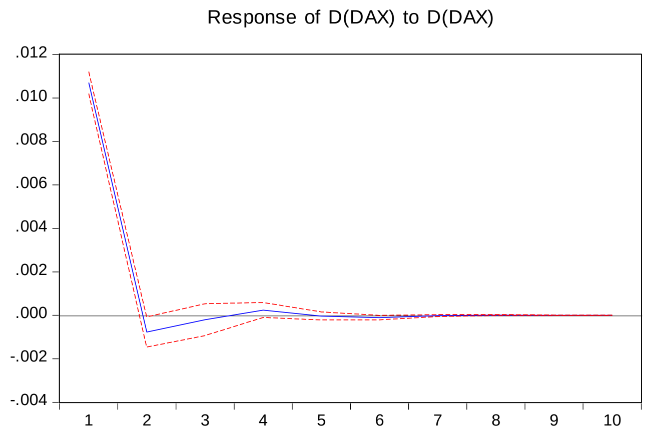


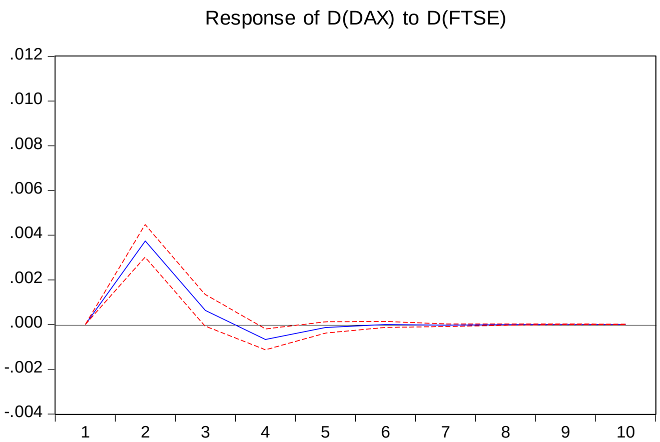
Chart 5: Responses of FTSE (2009-2012)

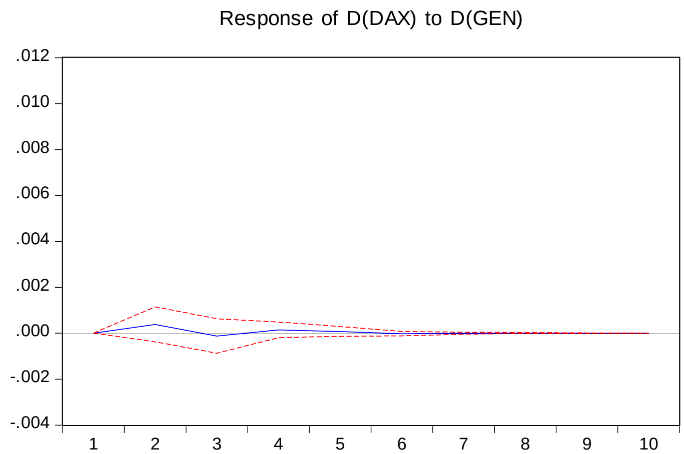
Finally, in the chart below (Chart 6) is given the response of DAX to the other indexes (CROBEX, DAX, FTSE, MERV, NIKKEI) for the last period of time (2013-2016). As we can see, one shock in the DAX has an effect to the estimations of FTSE. This effect is important (statistical important) and it is completed after 2 periods. Also, one shock in the DAX has an effect to the estimations of SP500. This effect is not so important (statistical important) like FTSE and is completed after 3 periods. In the other indexes there are not exist important effects.

The charts for the other indexes are presented in the appendix.









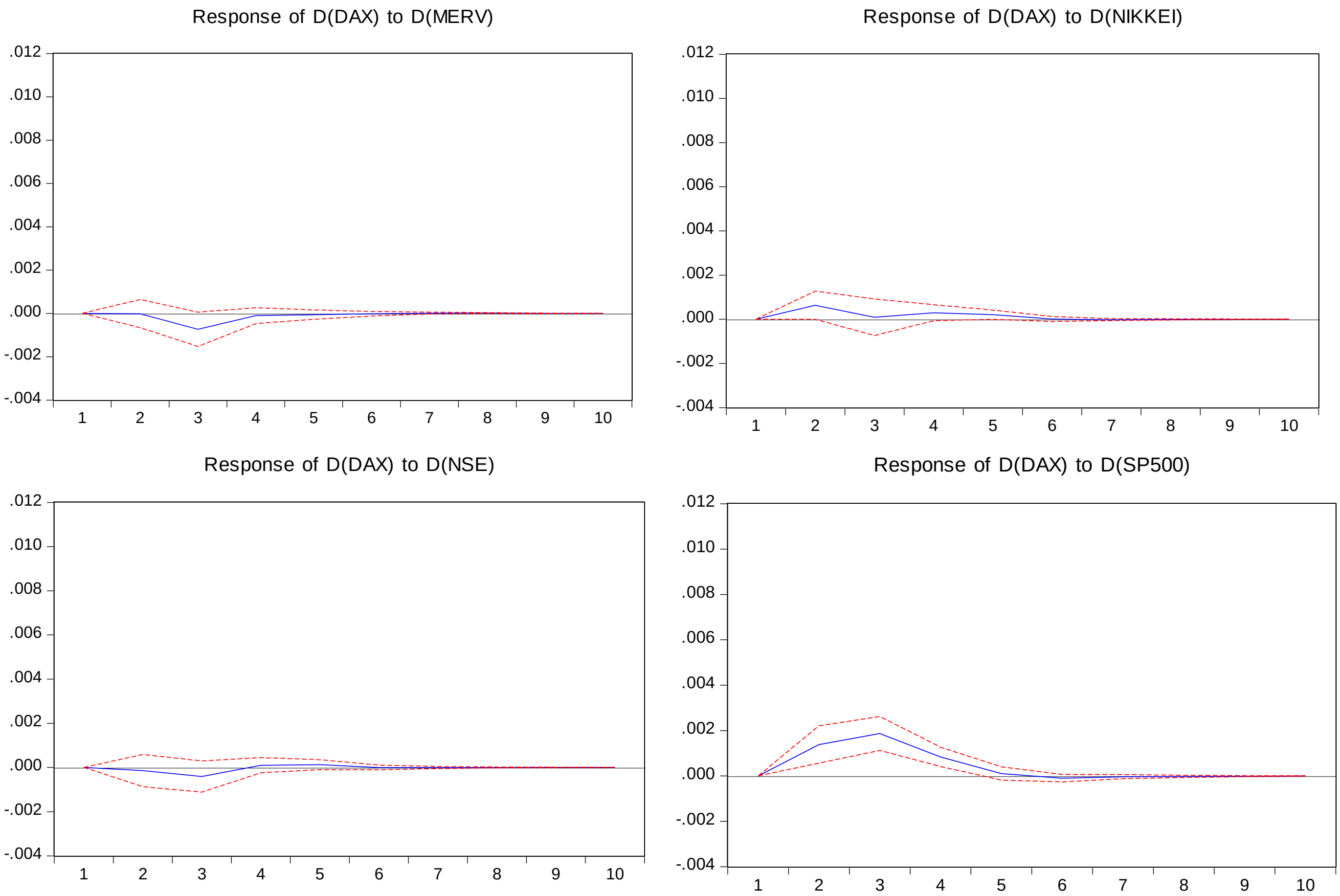


Chart 6: Rersponses of DAX (2013-2015)

CHAPTER 7

CONCLUSIONS

The ultimate goal of these theses is to examine the interdependence among the capital markets of certain developed and developing stock markets. Particularly the relationship among the capital markets of Argentina, Croatia, German, Greece, Japan, Kenya, UK and US was studied.

The sample period includes data from the above markets, covering the period January 2001 to December 2015. To enhance the effectiveness of the analysis, the total period was divided in the following 5 sub- periods:

- January 2001 to March 2003.
- April 2003 to December 2006 (the last period before the economic crisis).
- January 2007 to December 2008.
- January 2009 and December 2012.
- January 2013 and December 2015.

The findings of the performed analysis differ from period to period. Moreover, some of them are explained in real terms and some other not.

Overall, the results support the obvious argument that developed markets affect the developing ones. Moreover, the stock markets of USA, Japan and Germany exert a strong dominance to the other markets. Particularly, a shock in a developed market affected the other markets in sample within a few days. The above findings are in line with the corresponding ones of the majority of similar studies.

However, in certain sub periods it is provided evidence that developing markets affect some of the developed ones. Such findings are obviously due to methodological weaknesses.

A more analytical description of the results of our study is the following:

In the first sub period (January 2001 to March 2003), a long-run interdependence among Argentina, Croatia, German, Kenya and UK was identified. Specifically, one shock in the markets of German and UK had an immediate effect on the other markets. Also, the effects among the markets and unexpected shocks were fading out after one day. Another finding which doesn't make sense is a shock in the Greek stock market or in the market of Argentina affected the market of Kenya.

The results of the second period (April 2003 to December 2006) provide support to the previously stated findings. Particularly, they depict that there exists an interdependence among Argentina, Croatia, German, Kenya and UK. The direction of this dependence is mainly from German and UK markets to the markets of Argentina, Croatia and Kenya. The results of analysis showed that, there were these markets. Specifically, one shock in the markets of German nad UK had an important and quick effect on the other markets.

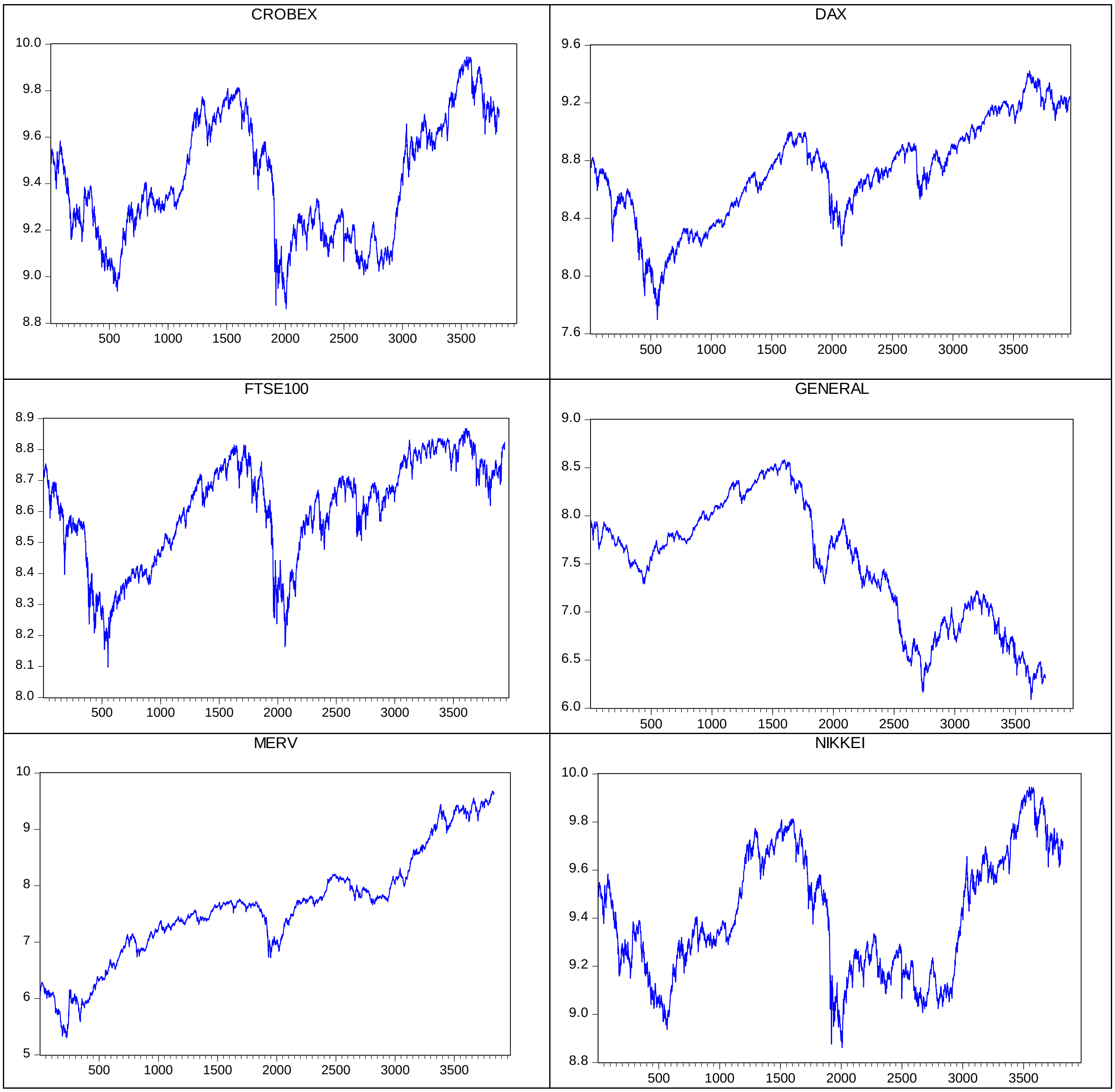
The analysis of the data of the next period (January 2007 to December 2008) reveals a long-term interdependence among Argentina, Croatia, German, Kenya, UK and USA. The interdependence was weak in most cases, with the exception of the USA stock market, which strongly affected the other markets. Another result, which cannot be explained in real terms, was the identified effect of the capital market of Argentina on the stock markets of Kenya and Germany. Possibly such a finding is due to methodological errors.

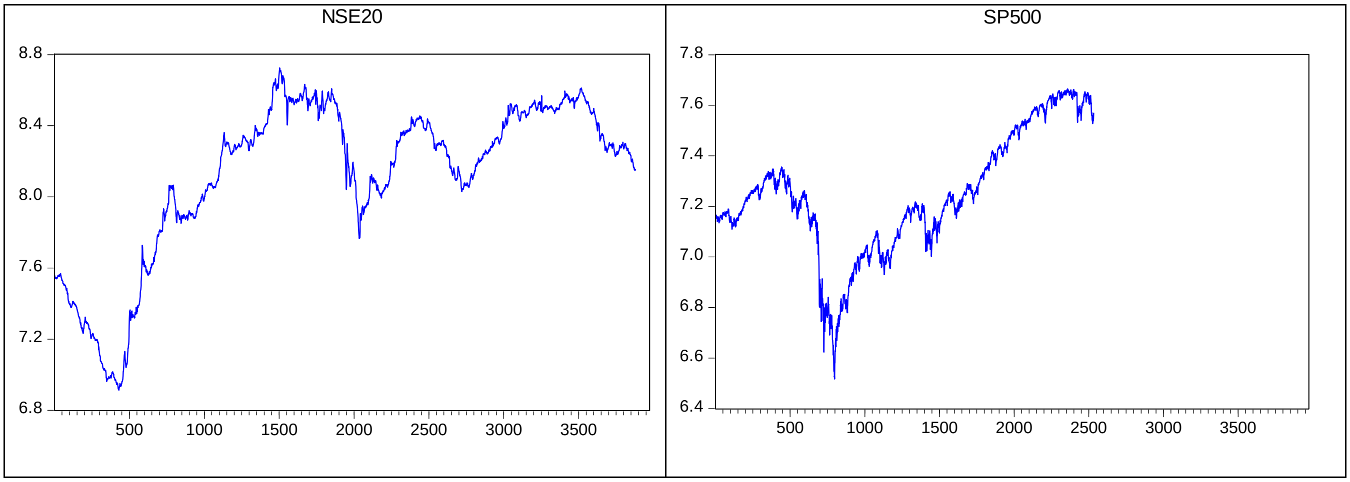
The results of the sub period which followed (January 2009 to December 2012) do not suggest a clear interdependence among the markets of the sample. The markets of Argentina, Croatia, Greece, German, Kenya, UK and USA, slightly and slowly affected each other.

The last period (January 2013 and December 2015) supported more strongly the assertion that the direction of influence is from developed to developing markets. Particularly, it was found that a shock in the markets of Germany, Japan, Kenya, UK and USA affected the stock markets Argentina, Croatia, Greece, and Kenya. However, the results of such a shock affected the developing markets after five periods.

APPENDIX

Traces charts





<u>Cointegration method</u>

2001-2003

VAR Lag Order Selection Criteria
Endogenous variables: D(CROBEC) D(DAX) D(GEN) D(MERV) D(NIKKEI) D(NSE)
Exogenous variables: C
Date: 09/17/16   Time: 17:54
Sample: 1 567
Included observations: 558

Lag	LogL	LR	FPE	AIC	SC	HQ
0	8239.844	NA	6.14e-21	-29.51198	-29.46549	-29.49383
1	12260.23	7939.899	3.86e-27	-43.79293	-43.46744	-43.66582
2	12381.78	237.4370	2.84e-27*	-44.09956*	-43.49508*	-43.86349*
3	12409.11	52.80661	2.93e-27	-44.06850	-43.18503	-43.72348
4	12435.66	50.71304	3.03e-27	-44.03462	-42.87216	-43.58064
5	12462.66	50.99984	3.13e-27	-44.00236	-42.56091	-43.43942
6	12485.29	42.25505	3.28e-27	-43.95443	-42.23399	-43.28254
7	12501.96	30.77688	3.52e-27	-43.88516	-41.88573	-43.10431
8	12590.71	161.9103*	2.92e-27	-44.07422	-41.79580	-43.18442

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Date: 09/17/16 Time: 18:21
Sample (adjusted): 5 567
Included observations: 563 after adjustments
Trend assumption: Linear deterministic trend
Series: D(CROBEC) D(DAX) D(GEN) D(MERV) D(NIKKEI) D(NSE)
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.335615	982.0230	95.75366	0.0001
At most 1 *	0.318778	751.8160	69.81889	0.0001
At most 2 *	0.252477	535.6992	47.85613	0.0001
At most 3 *	0.236648	371.8714	29.79707	0.0001
At most 4 *	0.217797	219.8413	15.49471	0.0001
At most 5 *	0.134840	81.54566	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.335615	230.2070	40.07757	0.0001
At most 1 *	0.318778	216.1168	33.87687	0.0001
At most 2 *	0.252477	163.8278	27.58434	0.0001
At most 3 *	0.236648	152.0301	21.13162	0.0001
At most 4 *	0.217797	138.2957	14.26460	0.0001
At most 5 *	0.134840	81.54566	3.841466	0.0000

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2003-2006

Date: 09/18/16 Time: 20:32
Sample (adjusted): 5 959
Included observations: 955 after adjustments
Trend assumption: Linear deterministic trend
Series: D(CROBEX) D(DAX) D(FTSE) D(GEN) D(MERV) D(NSE)
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.340919	1699.576	95.75366	1.0000
At most 1 *	0.276040	1301.428	69.81889	1.0000
At most 2 *	0.268931	992.9444	47.85613	0.0001
At most 3 *	0.241974	693.7926	29.79707	0.0001
At most 4 *	0.234843	429.2214	15.49471	0.0001
At most 5 *	0.166209	173.5925	3.841466	0.0000

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.340919	398.1475	40.07757	0.0001
At most 1 *	0.276040	308.4837	33.87687	0.0001
At most 2 *	0.268931	299.1518	27.58434	0.0001
At most 3 *	0.241974	264.5712	21.13162	0.0001
At most 4 *	0.234843	255.6288	14.26460	0.0001
At most 5 *	0.166209	173.5925	3.841466	0.0000

Max-eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2007-2008

VAR Lag Order Selection Criteria
Endogenous variables: CROBEX DAX FTSE SP MERV NSE
Exogenous variables: C
Date: 09/19/16 Time: 20:56
Sample: 1 508
Included observations: 500

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3520.388	NA	3.16e-14	-14.05755	-14.00698	-14.03771
1	7045.539	6951.597	2.75e-20	-28.01416	-27.66013	-27.87524
2	7234.937	368.9477	1.49e-20	-28.62775	-27.97027	-28.36976
3	7392.340	302.8435	9.15e-21	-29.11336	-28.15243*	-28.73629
4	7467.544	142.8874	7.83e-21	-29.27018	-28.00579	-28.77404
5	7541.891	139.4741	6.72e-21	-29.42356	-27.85573	-28.80835
6	7660.330	219.3489	4.83e-21	-29.75332	-27.88203	-29.01903
7	7746.848	158.1550	3.95e-21	-29.95539	-27.78065	-29.10203*
8	7799.414	94.83030*	3.70e-21*	-30.02166*	-27.54347	-29.04922

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Date: 09/19/16 Time: 21:16
Sample (adjusted): 5 508
Included observations: 504 after adjustments
Trend assumption: Linear deterministic trend
Series: CROBEX DAX FTSE SP MERV NSE
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.187854	280.9432	95.75366	0.0000
At most 1 *	0.164750	176.0735	69.81889	0.0000
At most 2 *	0.082409	85.34159	47.85613	0.0000
At most 3 *	0.036121	41.99556	29.79707	0.0012
At most 4 *	0.031789	23.45344	15.49471	0.0026
At most 5 *	0.014128	7.171405	3.841466	0.0074

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.187854	104.8697	40.07757	0.0000
At most 1 *	0.164750	90.73191	33.87687	0.0000
At most 2 *	0.082409	43.34603	27.58434	0.0002
At most 3	0.036121	18.54212	21.13162	0.1109
At most 4 *	0.031789	16.28204	14.26460	0.0237
At most 5 *	0.014128	7.171405	3.841466	0.0074

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2009-2012

VAR Lag Order Selection Criteria
Endogenous variables: CROBEX DAX FTSE MERV NSE GEN SP
Exogenous variables: C
Date: 09/19/16 Time: 22:39
Sample: 1 1021
Included observations: 1013

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6781.347	NA	3.66e-15	-13.37482	-13.34082	-13.36191
1	20069.07	26365.57	1.63e-26	-39.51248	-39.24046*	-39.40916
2	20169.89	198.6461	1.47e-26	-39.61478	-39.10474	-39.42105*
3	20251.20	159.0978	1.38e-26	-39.67858	-38.93052	-39.39444
4	20317.74	129.2722	1.34e-26	-39.71321	-38.72714	-39.33867
5	20363.31	87.88872	1.34e-26	-39.70643	-38.48233	-39.24148
6	20400.69	71.59186	1.38e-26	-39.68349	-38.22138	-39.12813
7	20451.18	96.00394	1.37e-26	-39.68644	-37.98631	-39.04068
8	20534.79	157.8054*	1.28e-26*	-39.75477*	-37.81662	-39.01860

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Date: 09/19/16 Time: 22:39
Sample (adjusted): 4 1021
Included observations: 1018 after adjustments
Trend assumption: Linear deterministic trend
Series: CROBEX DAX FTSE MERV NSE GEN SP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.090093	212.0736	125.6154	0.0000
At most 1 *	0.046096	115.9614	95.75366	0.0010
At most 2	0.032733	67.91995	69.81889	0.0702
At most 3	0.017070	34.04030	47.85613	0.4997
At most 4	0.008903	16.51337	29.79707	0.6757
At most 5	0.004394	7.409841	15.49471	0.5305
At most 6	0.002871	2.926473	3.841466	0.0871

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.090093	96.11221	46.23142	0.0000
At most 1 *	0.046096	48.04140	40.07757	0.0052
At most 2 *	0.032733	33.87965	33.87687	0.0500
At most 3	0.017070	17.52693	27.58434	0.5349
At most 4	0.008903	9.103531	21.13162	0.8240
At most 5	0.004394	4.483368	14.26460	0.8051
At most 6	0.002871	2.926473	3.841466	0.0871

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

2013-2015

VAR Lag Order Selection Criteria
Endogenous variables: CRO DAX1 FTSE100 GENI MERVI NIKKEI2 NSE20 SP500
Exogenous variables: C
Date: 09/17/16 Time: 19:48
Sample: 1 881
Included observations: 873

Lag	LogL	LR	FPE	AIC	SC	HQ
0	9688.131	NA	3.23e-20	-22.17670	-22.13297	-22.15997
1	20746.98	21889.67	3.71e-31	-47.36535	-46.97179*	-47.21479*
2	20829.70	162.2240	3.56e-31	-47.40824	-46.66485	-47.12385
3	20908.55	153.1962	3.44e-31	-47.44228	-46.34905	-47.02405
4	20994.72	165.8073	3.27e-31	-47.49305	-46.04999	-46.94098
5	21047.72	101.0324	3.35e-31	-47.46786	-45.67497	-46.78196
6	21096.57	92.21153	3.47e-31	-47.43315	-45.29042	-46.61342
7	21227.44	244.6571*	2.98e-31*	-47.58635*	-45.09379	-46.63279
8	21266.02	71.41359	3.16e-31	-47.52811	-44.68572	-46.44071

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Date: 09/17/16 Time: 22:16
Sample (adjusted): 3 881
Included observations: 879 after adjustments
Trend assumption: Linear deterministic trend
Series: CRO DAX1 FTSE100 GENI MERVI NIKKEI2 NSE20 SP500
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.083525	285.5051	159.5297	0.0000
At most 1 *	0.067535	208.8386	125.6154	0.0000
At most 2 *	0.048576	147.3753	95.75366	0.0000
At most 3 *	0.046721	103.6051	69.81889	0.0000
At most 4 *	0.038001	61.54673	47.85613	0.0016
At most 5	0.017422	27.49275	29.79707	0.0901
At most 6	0.007951	12.04427	15.49471	0.1548
At most 7 *	0.005703	5.027109	3.841466	0.0249

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.083525	76.66648	52.36261	0.0000
At most 1 *	0.067535	61.46325	46.23142	0.0006
At most 2 *	0.048576	43.77024	40.07757	0.0184
At most 3 *	0.046721	42.05837	33.87687	0.0043
At most 4 *	0.038001	34.05398	27.58434	0.0064
At most 5	0.017422	15.44848	21.13162	0.2587
At most 6	0.007951	7.017156	14.26460	0.4871
At most 7 *	0.005703	5.027109	3.841466	0.0249

Max-eigenvalue test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Innovation accounting

Variance decomposition

2001-2003

Variance Decomposition of D(CROBEC): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	0.020856	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.021013	99.13337	0.040087	0.316184	0.030972	0.052577	0.426806
3	0.021043	98.90217	0.068968	0.372013	0.075117	0.055739	0.525995
4	0.021065	98.71530	0.071691	0.549975	0.075816	0.055819	0.531394
5	0.021074	98.64529	0.076547	0.613811	0.075871	0.055799	0.532685
6	0.021074	98.64131	0.078387	0.615909	0.075892	0.055798	0.532705
7	0.021074	98.63965	0.079957	0.615934	0.075945	0.055799	0.532711
8	0.021074	98.63960	0.080012	0.615933	0.075946	0.055803	0.532712
9	0.021074	98.63957	0.080012	0.615945	0.075947	0.055803	0.532725
10	0.021074	98.63956	0.080012	0.615947	0.075947	0.055803	0.532727

Variance Decomposition of D(DAX): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	0.022806	0.424168	99.57583	0.000000	0.000000	0.000000	0.000000
2	0.022952	0.450081	98.53241	0.853560	0.073520	0.090416	1.17E-05
3	0.023060	0.584566	97.65613	1.486512	0.123293	0.089621	0.059880
4	0.023069	0.584161	97.63739	1.503915	0.123764	0.090092	0.060683
5	0.023075	0.602424	97.60301	1.513611	0.123983	0.090055	0.066920
6	0.023075	0.604074	97.60096	1.513653	0.124040	0.090096	0.067175
7	0.023075	0.604499	97.59774	1.516158	0.124076	0.090093	0.067430
8	0.023075	0.604573	97.59760	1.516209	0.124085	0.090099	0.067431
9	0.023075	0.604577	97.59751	1.516265	0.124085	0.090098	0.067460
10	0.023075	0.604585	97.59750	1.516266	0.124085	0.090099	0.067461

Variance Decomposition of D(GEN): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	0.024321	0.218925	0.937906	98.84317	0.000000	0.000000	0.000000
2	0.024414	0.217933	1.479878	98.24535	0.023417	0.013591	0.019828
3	0.024697	0.263304	3.499267	96.13473	0.028032	0.013392	0.061277
4	0.024775	0.837395	3.507600	95.54517	0.032581	0.015414	0.061838
5	0.024786	0.864483	3.508385	95.50806	0.032579	0.015779	0.070715
6	0.024786	0.866152	3.509696	95.50347	0.033334	0.015870	0.071476
7	0.024787	0.867769	3.510861	95.50021	0.033365	0.015869	0.071930
8	0.024787	0.867862	3.510849	95.50011	0.033377	0.015873	0.071932
9	0.024787	0.867869	3.510863	95.50007	0.033379	0.015873	0.071950
10	0.024787	0.867876	3.510864	95.50006	0.033379	0.015873	0.071950

Variance Decomposition of D(MERV): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	0.033386	0.029665	0.370345	0.000541	99.59945	0.000000	0.000000
2	0.033525	0.029425	0.368473	0.015797	99.40713	0.005527	0.173652
3	0.033573	0.030027	0.413161	0.022133	99.15216	0.007299	0.375217
4	0.033606	0.154477	0.412444	0.086684	98.95764	0.008364	0.380389
5	0.033622	0.154554	0.412463	0.167929	98.86370	0.008393	0.392962
6	0.033623	0.156569	0.412683	0.170220	98.85908	0.008469	0.392975
7	0.033624	0.156590	0.415386	0.172678	98.85348	0.008471	0.393394
8	0.033624	0.157182	0.415486	0.172677	98.85276	0.008483	0.393412
9	0.033624	0.157182	0.415532	0.172874	98.85246	0.008483	0.393468
10	0.033624	0.157185	0.415533	0.172888	98.85244	0.008484	0.393468

Variance Decomposition of D(NIKKEI): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	1.61E-05	0.504090	0.029921	0.005798	0.015935	99.44426	0.000000
2	0.020868	99.99994	2.80E-08	8.80E-08	3.75E-08	5.94E-05	1.47E-07
3	0.021025	99.13232	0.040018	0.316076	0.030939	0.052652	0.427997
4	0.021055	98.90134	0.068884	0.371784	0.075064	0.055821	0.527103
5	0.021077	98.71401	0.071603	0.550194	0.075765	0.055900	0.532528
6	0.021086	98.64403	0.076460	0.613998	0.075819	0.055880	0.533815
7	0.021086	98.64003	0.078308	0.616104	0.075841	0.055879	0.533835
8	0.021086	98.63838	0.079877	0.616128	0.075894	0.055880	0.533841
9	0.021086	98.63832	0.079932	0.616127	0.075895	0.055884	0.533842
10	0.021086	98.63829	0.079932	0.616140	0.075896	0.055884	0.533855

Variance Decomposition of D(NSE): Period	S.E.	D(CROBEC)	D(DAX)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)
1	0.008054	0.648819	0.171665	0.021057	0.214408	0.021459	98.92259
2	0.008197	0.791956	0.171686	0.035936	0.269791	0.374110	98.35652
3	0.009639	0.583666	0.219631	24.75197	0.370990	0.277639	73.79611
4	0.009679	0.616203	0.416186	24.91836	0.395062	0.299315	73.35487
5	0.009749	0.620113	1.109458	25.10998	0.405968	0.297330	72.45715
6	0.009761	0.744107	1.122162	25.12597	0.405072	0.299465	72.30322
7	0.009766	0.743488	1.136928	25.16411	0.405000	0.299231	72.25124
8	0.009766	0.744874	1.139968	25.16784	0.405234	0.299384	72.24270
9	0.009767	0.745368	1.141833	25.17068	0.405259	0.299369	72.23749
10	0.009767	0.745544	1.142088	25.17074	0.405261	0.299379	72.23698

Cholesky Ordering: D(CROBEC) D(DAX) D(GEN) D(MERV) D(NIKKEI) D(NSE)

2003-2006

Variance Decomposition of D(CROBEX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.016047	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.016093	99.43563	0.158855	0.323562	0.061165	0.018619	0.002171
3	0.016100	99.38418	0.159461	0.338857	0.062978	0.048886	0.005633
4	0.016112	99.23440	0.160397	0.338691	0.062944	0.048928	0.154645
5	0.016112	99.22725	0.161557	0.338666	0.062952	0.048945	0.160629
6	0.016112	99.22594	0.161700	0.338677	0.063041	0.049103	0.161536
7	0.016112	99.22579	0.161712	0.338678	0.063048	0.049116	0.161660
8	0.016113	99.22573	0.161713	0.338678	0.063049	0.049117	0.161711
9	0.016113	99.22573	0.161713	0.338678	0.063049	0.049117	0.161717
10	0.016113	99.22573	0.161713	0.338678	0.063049	0.049117	0.161718

Variance Decomposition of D(DAX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.010742	0.044563	99.95544	0.000000	0.000000	0.000000	0.000000
2	0.010780	0.098541	99.66389	0.074997	0.090304	0.004344	0.067925
3	0.010800	0.152342	99.46505	0.086905	0.110442	0.071894	0.113370
4	0.010806	0.152213	99.34806	0.087391	0.110311	0.072183	0.229842
5	0.010806	0.152378	99.34471	0.087420	0.110307	0.072184	0.233001
6	0.010807	0.152384	99.34204	0.087427	0.110368	0.072286	0.235494
7	0.010807	0.152384	99.34195	0.087428	0.110372	0.072291	0.235573
8	0.010807	0.152384	99.34187	0.087428	0.110373	0.072294	0.235653
9	0.010807	0.152384	99.34186	0.087428	0.110373	0.072294	0.235658
10	0.010807	0.152384	99.34186	0.087428	0.110373	0.072294	0.235660

Variance Decomposition of D(FTSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.010325	0.073951	0.595911	99.33014	0.000000	0.000000	0.000000
2	0.010350	0.077743	0.598936	99.17968	0.087262	0.048640	0.007743
3	0.010375	0.297775	0.619236	98.71694	0.086849	0.267098	0.012102
4	0.010377	0.297802	0.622401	98.67550	0.086927	0.267412	0.049954
5	0.010382	0.298726	0.623220	98.58149	0.086846	0.267354	0.142362
6	0.010382	0.298745	0.623638	98.58092	0.086863	0.267385	0.142453
7	0.010382	0.298744	0.623674	98.58015	0.086927	0.267489	0.143012
8	0.010382	0.298744	0.623675	98.58014	0.086927	0.267490	0.143025
9	0.010382	0.298744	0.623675	98.58010	0.086928	0.267490	0.143058
10	0.010382	0.298744	0.623676	98.58010	0.086928	0.267490	0.143060

Variance Decomposition of D(GEN): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.011418	0.150828	0.960958	0.060342	98.82787	0.000000	0.000000
2	0.011436	0.211149	0.960302	0.067138	98.54561	0.000762	0.215036
3	0.017387	0.094401	0.473360	0.029108	42.68174	0.183957	56.53743
4	0.017423	0.117251	0.669082	0.029013	42.51021	0.185696	56.48875
5	0.017441	0.117285	0.688561	0.032124	42.45182	0.229962	56.48025
6	0.017441	0.117323	0.689538	0.032370	42.45085	0.230951	56.47897
7	0.017443	0.117488	0.689446	0.032398	42.44511	0.231016	56.48454
8	0.017443	0.117487	0.689503	0.032400	42.44485	0.231014	56.48475
9	0.017443	0.117487	0.689512	0.032401	42.44478	0.231022	56.48480
10	0.017443	0.117487	0.689513	0.032401	42.44477	0.231023	56.48480

Variance Decomposition of D(MERV): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.018647	0.019946	0.278198	0.079173	3.452300	96.17038	0.000000
2	0.018695	0.046899	0.456610	0.278380	3.454452	95.71028	0.053378
3	0.024164	0.179979	0.682655	0.168131	2.067645	57.65057	39.25102
4	0.024184	0.196899	0.798093	0.167849	2.064322	57.55303	39.21980
5	0.024207	0.196871	0.809409	0.169863	2.083101	57.48211	39.25864
6	0.024207	0.196907	0.809989	0.170039	2.083437	57.48126	39.25837
7	0.024208	0.197003	0.809912	0.170050	2.083252	57.47575	39.26404
8	0.024208	0.197003	0.809955	0.170051	2.083244	57.47553	39.26422
9	0.024208	0.197002	0.809961	0.170051	2.083245	57.47545	39.26429
10	0.024208	0.197002	0.809962	0.170051	2.083245	57.47545	39.26429

Variance Decomposition of D(NSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NSE)
1	0.019793	0.003738	0.005379	0.025529	0.146252	0.227617	99.59148
2	0.019855	0.046885	0.387053	0.025413	0.149387	0.229488	99.16177
3	0.019886	0.048082	0.417674	0.030546	0.205103	0.308719	98.98988
4	0.019887	0.048217	0.418889	0.030928	0.206372	0.310207	98.98539
5	0.019889	0.048546	0.418801	0.030966	0.206343	0.310256	98.98509
6	0.019889	0.048545	0.418890	0.030968	0.206341	0.310254	98.98500
7	0.019889	0.048546	0.418904	0.030970	0.206349	0.310265	98.98497
8	0.019889	0.048546	0.418906	0.030970	0.206350	0.310266	98.98496
9	0.019889	0.048546	0.418906	0.030970	0.206350	0.310267	98.98496
10	0.019889	0.048546	0.418906	0.030970	0.206350	0.310267	98.98496
Cholesky Ordering: D(CROBEX) D(DAX) D(FTSE) D(GEN) D(MERV) D(NSE)							

2007-2008

Variance Decomposition of D(CROBEX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.030408	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.030607	98.70144	0.243336	0.538771	0.027201	2.63E-05	0.489226
3	0.030796	97.54762	0.946158	0.639039	0.048798	0.007220	0.811169
4	0.030808	97.47155	0.949406	0.702279	0.048829	0.009889	0.818049
5	0.030882	97.00536	0.946874	1.169002	0.049467	0.011735	0.817565
6	0.030884	96.99281	0.946767	1.175699	0.054546	0.011832	0.818343
7	0.030888	96.96904	0.947892	1.196748	0.055341	0.012139	0.818837
8	0.030888	96.96664	0.947904	1.198362	0.055439	0.012657	0.818995
9	0.030889	96.96411	0.948031	1.200687	0.055500	0.012669	0.819005
10	0.030889	96.96356	0.948031	1.201176	0.055506	0.012695	0.819037

Variance Decomposition of D(DAX):

Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.014866	0.022083	99.97792	0.000000	0.000000	0.000000	0.000000
2	0.015591	0.024757	92.44826	6.807888	0.012192	0.233232	0.473668
3	0.019144	0.027482	61.32498	37.75493	0.008727	0.177712	0.706177
4	0.019438	0.092863	59.57773	39.01569	0.264798	0.192645	0.856273
5	0.019514	0.245695	59.19501	39.13750	0.362436	0.192437	0.866920
6	0.019572	0.272488	58.86377	39.38471	0.360386	0.238820	0.879830
7	0.019578	0.273467	58.83059	39.41176	0.366239	0.238686	0.879265
8	0.019586	0.277366	58.78360	39.45183	0.365947	0.239495	0.881757
9	0.019586	0.277441	58.78141	39.45268	0.366823	0.239900	0.881747
10	0.019587	0.277985	58.77616	39.45696	0.366802	0.240145	0.881948

Variance Decomposition of D(FTSE):

Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.021966	0.037851	0.871028	99.09112	0.000000	0.000000	0.000000
2	0.022166	0.078720	0.875905	97.70999	0.819566	0.229099	0.286721
3	0.022332	0.478014	1.230357	96.75934	0.948452	0.264800	0.319039
4	0.022381	0.491321	1.225747	96.66800	0.944867	0.338951	0.331117
5	0.022415	0.492242	1.230525	96.66067	0.946518	0.338823	0.331222
6	0.022421	0.495529	1.230689	96.65225	0.946670	0.339432	0.335429
7	0.022423	0.496640	1.231522	96.64913	0.947658	0.339540	0.335512
8	0.022424	0.497118	1.231823	96.64743	0.947592	0.340185	0.335857
9	0.022424	0.497168	1.231955	96.64715	0.947696	0.340181	0.335853
10	0.022425	0.497231	1.231968	96.64702	0.947680	0.340202	0.335904

Variance Decomposition of D(MERV):

Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.026382	0.001075	0.071248	0.153351	99.77433	0.000000	0.000000
2	0.033940	0.372760	0.043698	0.174943	60.47062	38.80167	0.136307
3	0.034249	0.635377	0.312002	0.769868	59.39840	38.69990	0.184459
4	0.034495	0.628263	0.925200	1.074691	58.57290	38.47682	0.322133
5	0.034558	0.626406	0.937270	1.332614	58.35887	38.42381	0.321025
6	0.034616	0.626131	0.946294	1.641089	58.16465	38.30148	0.320358
7	0.034618	0.627775	0.951609	1.641413	58.15954	38.29887	0.320799
8	0.034619	0.628998	0.952923	1.641945	58.15764	38.29759	0.320900
9	0.034620	0.628973	0.952877	1.646855	58.15461	38.29577	0.320918
10	0.034620	0.628974	0.952873	1.647254	58.15438	38.29560	0.320921

Variance Decomposition of D(NSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.018988	0.073696	0.000883	0.048846	0.620067	99.25651	0.000000
2	0.019469	0.076608	0.588277	0.092990	0.662084	98.55648	0.023560
3	0.019885	0.073438	2.161258	0.873551	0.661309	95.76730	0.463143
4	0.020019	0.074565	2.168133	1.836615	0.671078	94.79161	0.458003
5	0.020109	0.079220	2.194194	2.608167	0.668995	93.99417	0.455251
6	0.020113	0.084860	2.214441	2.607520	0.672574	93.96419	0.456412
7	0.020114	0.087764	2.218567	2.614409	0.672946	93.94989	0.456424
8	0.020116	0.087774	2.218157	2.632784	0.672881	93.93196	0.456442
9	0.020117	0.087825	2.218146	2.633627	0.672966	93.93096	0.456470
10	0.020117	0.087932	2.218191	2.634057	0.672965	93.93034	0.456513

Variance Decomposition of D(SP): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(SP)
1	0.026249	0.005811	0.758362	0.362912	0.014213	0.345716	98.51299
2	0.026385	0.028168	0.955977	0.428722	0.250428	0.391380	97.94532
3	0.026483	0.328414	0.951735	0.439565	0.250100	0.407839	97.62235
4	0.026494	0.332388	0.961624	0.493298	0.250210	0.407513	97.55497
5	0.026496	0.335636	0.964136	0.499600	0.250189	0.407463	97.54298
6	0.026497	0.335673	0.964098	0.507821	0.250269	0.407495	97.53464
7	0.026498	0.335762	0.964219	0.512095	0.250296	0.407643	97.52998
8	0.026498	0.335785	0.964251	0.512183	0.250364	0.407643	97.52977
9	0.026498	0.335817	0.964260	0.512815	0.250364	0.407653	97.52909
10	0.026498	0.335817	0.964260	0.512820	0.250370	0.407656	97.52908

Cholesky Ordering: D(CROBEX) D(DAX) D(FTSE) D(MERV) D(NSE) D(SP)

2009-2012

Variance Decomposition of D(CROBEX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.014179	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.014201	99.72054	0.106006	2.94E-05	0.096436	0.042776	0.003664	0.030549
3	0.014254	99.06555	0.156823	0.347554	0.168241	0.053663	0.120820	0.087346
4	0.014260	98.99467	0.157352	0.353654	0.169235	0.066436	0.122521	0.136134
5	0.014264	98.94065	0.157320	0.355294	0.169267	0.071614	0.124415	0.181437
6	0.014265	98.93697	0.157661	0.355303	0.169351	0.072827	0.125045	0.182845
7	0.014265	98.93564	0.157999	0.355344	0.169355	0.072939	0.125248	0.183477
8	0.014265	98.93545	0.158012	0.355344	0.169373	0.073073	0.125250	0.183497
9	0.014265	98.93539	0.158021	0.355346	0.169375	0.073092	0.125251	0.183530
10	0.014265	98.93537	0.158022	0.355346	0.169375	0.073101	0.125253	0.183531

Variance Decomposition of D(DAX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.014912	0.069391	99.93061	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.015048	0.094568	98.39848	0.342598	0.044273	0.238351	0.515994	0.365738
3	0.015213	0.718745	96.34691	0.464865	0.044694	0.252031	0.512571	1.660189
4	0.015217	0.720908	96.29614	0.464898	0.051095	0.266654	0.513631	1.686671
5	0.015220	0.728813	96.26744	0.465937	0.051274	0.266764	0.517642	1.702126
6	0.015220	0.728866	96.26534	0.465936	0.051550	0.268307	0.517631	1.702371
7	0.015220	0.729252	96.26412	0.465974	0.051589	0.268416	0.517655	1.702996
8	0.015220	0.729265	96.26399	0.465973	0.051593	0.268505	0.517673	1.702997
9	0.015220	0.729281	96.26393	0.465975	0.051594	0.268518	0.517677	1.703023
10	0.015220	0.729282	96.26392	0.465975	0.051595	0.268525	0.517677	1.703024

Variance Decomposition of D(FTSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.011001	0.000494	0.834947	99.16456	0.000000	0.000000	0.000000	0.000000
2	0.012137	0.390717	0.686382	82.16309	0.046102	0.082725	0.044420	16.58657
3	0.012600	0.713160	0.648634	76.23856	0.083241	0.410117	0.054447	21.85184
4	0.012649	0.734985	0.687447	75.65041	0.084768	0.424211	0.182522	22.23566
5	0.012656	0.767236	0.701321	75.56334	0.085644	0.424621	0.236217	22.22162
6	0.012657	0.767256	0.701252	75.55322	0.088056	0.427721	0.240225	22.22227
7	0.012657	0.767660	0.701752	75.55118	0.088324	0.427899	0.240391	22.22279
8	0.012657	0.767731	0.701761	75.55084	0.088326	0.428034	0.240624	22.22269
9	0.012657	0.767774	0.701761	75.55073	0.088326	0.428052	0.240646	22.22271
10	0.012658	0.767774	0.701765	75.55071	0.088328	0.428063	0.240646	22.22271

Variance Decomposition of D(MERV): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.018906	0.069417	0.125472	1.130398	98.67471	0.000000	0.000000	0.000000
2	0.019047	0.587222	0.127817	1.440376	97.22566	0.112475	0.066689	0.439762
3	0.019218	1.295773	0.157893	1.490501	95.69240	0.152211	0.483620	0.727602
4	0.019224	1.299645	0.157835	1.493621	95.64503	0.152125	0.488798	0.762944
5	0.019230	1.311490	0.167559	1.496068	95.59034	0.152359	0.488588	0.793595
6	0.019230	1.311476	0.167581	1.496232	95.58929	0.153177	0.488589	0.793653
7	0.019230	1.312322	0.167680	1.496348	95.58671	0.153207	0.488782	0.794953
8	0.019230	1.312325	0.167682	1.496348	95.58662	0.153275	0.488794	0.794956
9	0.019230	1.312347	0.167693	1.496350	95.58653	0.153279	0.488796	0.795003
10	0.019230	1.312347	0.167694	1.496350	95.58653	0.153284	0.488796	0.795003

Variance Decomposition of D(NSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.007759	0.015484	0.008790	0.029545	0.002669	99.94351	0.000000	0.000000
2	0.008090	0.092713	0.059819	0.046155	0.080156	99.46162	9.32E-05	0.259445
3	0.008292	0.095537	0.607349	0.120021	0.080700	98.55907	0.026807	0.510513
4	0.008341	0.119370	0.689278	0.121953	0.083079	98.29795	0.051457	0.636909
5	0.008359	0.136472	0.719890	0.125282	0.083000	98.15050	0.058345	0.726509
6	0.008364	0.141551	0.730584	0.125874	0.083507	98.11858	0.061228	0.738670
7	0.008366	0.143933	0.734242	0.126178	0.083603	98.10461	0.062488	0.744943
8	0.008366	0.144576	0.735221	0.126251	0.083673	98.10081	0.062758	0.746707
9	0.008366	0.144814	0.735538	0.126277	0.083696	98.09953	0.062845	0.747300
10	0.008366	0.144884	0.735629	0.126284	0.083703	98.09916	0.062876	0.747463

Variance Decomposition of D(GEN): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.025248	0.665507	0.197843	0.016824	0.000354	0.848490	98.27098	0.000000
2	0.025298	0.775080	0.233348	0.106900	0.050497	0.846307	97.98624	0.001625
3	0.025451	0.773452	0.789603	0.129028	0.304744	0.858446	97.14151	0.003213
4	0.025456	0.773233	0.798370	0.129709	0.306100	0.863926	97.10854	0.020127
5	0.025460	0.783736	0.799742	0.132667	0.306193	0.864917	97.08473	0.028016
6	0.025460	0.783760	0.799746	0.132665	0.306330	0.865780	97.08334	0.028383
7	0.025460	0.783794	0.800003	0.132670	0.306369	0.865933	97.08260	0.028629
8	0.025460	0.783801	0.800017	0.132670	0.306369	0.866001	97.08251	0.028630
9	0.025460	0.783812	0.800019	0.132672	0.306369	0.866014	97.08247	0.028648
10	0.025460	0.783812	0.800020	0.132672	0.306370	0.866019	97.08246	0.028649

Variance Decomposition of D(SP): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(MERV)	D(NSE)	D(GEN)	D(SP)
1	0.014471	1.193918	0.012108	2.413141	0.066571	0.055885	0.000135	96.25824
2	0.014566	1.181914	0.019442	2.528091	0.146944	0.380801	0.020489	95.72232
3	0.014664	1.555856	0.168278	2.503784	0.157492	0.430330	0.577100	94.60716
4	0.014665	1.556291	0.168290	2.504369	0.161520	0.435524	0.577037	94.59697
5	0.014667	1.559505	0.171085	2.504418	0.163805	0.436032	0.578740	94.58641
6	0.014667	1.559499	0.171105	2.504454	0.163847	0.436255	0.578749	94.58609
7	0.014667	1.559790	0.171104	2.504488	0.163847	0.436254	0.578878	94.58564
8	0.014667	1.559790	0.171104	2.504488	0.163849	0.436261	0.578879	94.58563
9	0.014667	1.559793	0.171107	2.504488	0.163850	0.436261	0.578878	94.58562
10	0.014667	1.559793	0.171107	2.504488	0.163850	0.436261	0.578879	94.58562

Cholesky Ordering: D(CROBEX) D(DAX) D(FTSE) D(MERV) D(NSE) D(GEN) D(SP)

2013-2015

Variance Decomposition of D(CROBEX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.014648	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.014694	99.79637	0.008293	0.040579	0.018661	0.008240	0.015184	0.067454	0.045216
3	0.014735	99.34261	0.009388	0.076246	0.049618	0.242485	0.018263	0.162344	0.099047
4	0.014736	99.33209	0.010408	0.076311	0.050654	0.242883	0.018560	0.168237	0.100862
5	0.014737	99.32217	0.011453	0.078569	0.053338	0.242862	0.018620	0.171464	0.101526
6	0.014737	99.32196	0.011471	0.078587	0.053361	0.242874	0.018730	0.171486	0.101532
7	0.014737	99.32179	0.011517	0.078594	0.053362	0.242884	0.018769	0.171497	0.101586
8	0.014737	99.32178	0.011517	0.078601	0.053363	0.242884	0.018769	0.171499	0.101587
9	0.014737	99.32178	0.011518	0.078601	0.053363	0.242884	0.018770	0.171499	0.101589
10	0.014737	99.32178	0.011519	0.078601	0.053363	0.242884	0.018770	0.171499	0.101589

Variance Decomposition of D(DAX): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.010709	0.006927	99.99307	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.011480	0.025053	87.45820	10.63421	0.110945	9.31E-05	0.302501	0.015378	1.453627
3	0.011691	0.175722	84.36812	10.54837	0.118429	0.394071	0.297410	0.138638	3.959248
4	0.011748	0.174059	83.59281	10.77084	0.132613	0.397991	0.357094	0.144361	4.430233
5	0.011752	0.177674	83.53285	10.77607	0.136409	0.400219	0.386836	0.155438	4.434495
6	0.011753	0.181158	83.52476	10.77398	0.136695	0.400367	0.386795	0.155428	4.440812
7	0.011753	0.181199	83.52306	10.77454	0.136692	0.400476	0.387054	0.155443	4.441532
8	0.011753	0.181199	83.52256	10.77450	0.136700	0.400624	0.387089	0.155450	4.441881
9	0.011753	0.181199	83.52242	10.77452	0.136701	0.400629	0.387095	0.155452	4.441989
10	0.011753	0.181200	83.52241	10.77452	0.136704	0.400629	0.387096	0.155453	4.441988

Variance Decomposition of D(FTSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.007950	0.279794	2.222998	97.49721	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.008021	0.329032	2.563420	95.91638	0.000531	0.065918	0.107994	0.517245	0.499479
3	0.008336	0.654494	2.608454	88.91332	0.225751	0.095664	0.477486	0.826945	6.197888
4	0.008339	0.663033	2.616702	88.85339	0.225714	0.103791	0.495111	0.842280	6.199976
5	0.008343	0.673848	2.637689	88.80283	0.225571	0.112093	0.501568	0.850130	6.196269
6	0.008343	0.673811	2.637610	88.80315	0.225559	0.112125	0.501593	0.850217	6.195933
7	0.008343	0.673975	2.637646	88.79898	0.225611	0.112713	0.501757	0.850209	6.199110
8	0.008343	0.673977	2.637659	88.79860	0.225615	0.112720	0.501784	0.850208	6.199439
9	0.008343	0.673982	2.637664	88.79855	0.225619	0.112723	0.501800	0.850212	6.199451
10	0.008343	0.673983	2.637666	88.79855	0.225619	0.112723	0.501800	0.850212	6.199451

Variance Decomposition of D(GEN): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.025891	0.117507	0.164904	0.385055	99.33254	0.000000	0.000000	0.000000	0.000000
2	0.026078	0.131835	0.170467	0.921648	98.75517	0.002428	1.05E-05	0.004989	0.013450
3	0.026146	0.214426	0.319951	0.934264	98.25139	0.228936	0.001687	0.007184	0.042162
4	0.026153	0.215266	0.325873	0.939938	98.19840	0.231305	0.004137	0.014420	0.070662
5	0.026156	0.215290	0.326688	0.945310	98.17707	0.231390	0.004269	0.014763	0.085223
6	0.026157	0.215288	0.326717	0.945987	98.17472	0.231558	0.004339	0.014775	0.086614
7	0.026157	0.215317	0.326718	0.946367	98.17392	0.231561	0.004504	0.014882	0.086727
8	0.026157	0.215326	0.326733	0.946367	98.17384	0.231562	0.004505	0.014884	0.086781
9	0.026157	0.215328	0.326738	0.946366	98.17382	0.231563	0.004507	0.014884	0.086795
10	0.026157	0.215328	0.326739	0.946367	98.17382	0.231563	0.004507	0.014884	0.086796

Variance Decomposition of D(MERV): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.027409	0.034498	0.091284	0.094628	0.124817	99.65477	0.000000	0.000000	0.000000
2	0.027508	0.038924	0.099494	0.314895	0.133964	99.06068	0.002412	0.003928	0.345706
3	0.027650	0.221569	0.251875	0.450071	0.613493	98.05715	0.022517	0.011791	0.371535
4	0.027657	0.228917	0.257571	0.456537	0.622868	98.00838	0.025166	0.011900	0.388663
5	0.027659	0.230280	0.259278	0.458236	0.624875	97.99860	0.026604	0.012474	0.389649
6	0.027659	0.230296	0.259366	0.458664	0.624874	97.99769	0.026667	0.012589	0.389851
7	0.027659	0.230325	0.259482	0.458669	0.624917	97.99748	0.026671	0.012600	0.389854
8	0.027659	0.230331	0.259488	0.458692	0.624917	97.99744	0.026673	0.012601	0.389862
9	0.027659	0.230332	0.259488	0.458693	0.624918	97.99743	0.026674	0.012601	0.389864
10	0.027659	0.230332	0.259489	0.458693	0.624918	97.99743	0.026674	0.012601	0.389865

Variance Decomposition of D(NIKKEI): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.015496	64.75786	0.095081	0.230915	0.006383	0.001869	34.90789	0.000000	0.000000
2	0.015552	64.56997	0.103434	0.232846	0.012903	0.012636	34.74929	0.244889	0.074036
3	0.015663	63.84944	0.290079	0.276853	0.035718	0.240464	34.27376	0.747578	0.286113
4	0.015667	63.82183	0.293497	0.297685	0.035753	0.240500	34.25797	0.747179	0.305586
5	0.015670	63.81491	0.293718	0.301605	0.037471	0.240531	34.25890	0.747182	0.305688
6	0.015670	63.81334	0.293755	0.302383	0.037717	0.240526	34.25827	0.747162	0.306844
7	0.015670	63.81308	0.293781	0.302393	0.037717	0.240616	34.25805	0.747486	0.306883
8	0.015670	63.81306	0.293814	0.302397	0.037719	0.240617	34.25802	0.747491	0.306885
9	0.015670	63.81305	0.293814	0.302400	0.037720	0.240617	34.25802	0.747493	0.306886
10	0.015670	63.81305	0.293814	0.302400	0.037720	0.240617	34.25802	0.747493	0.306886

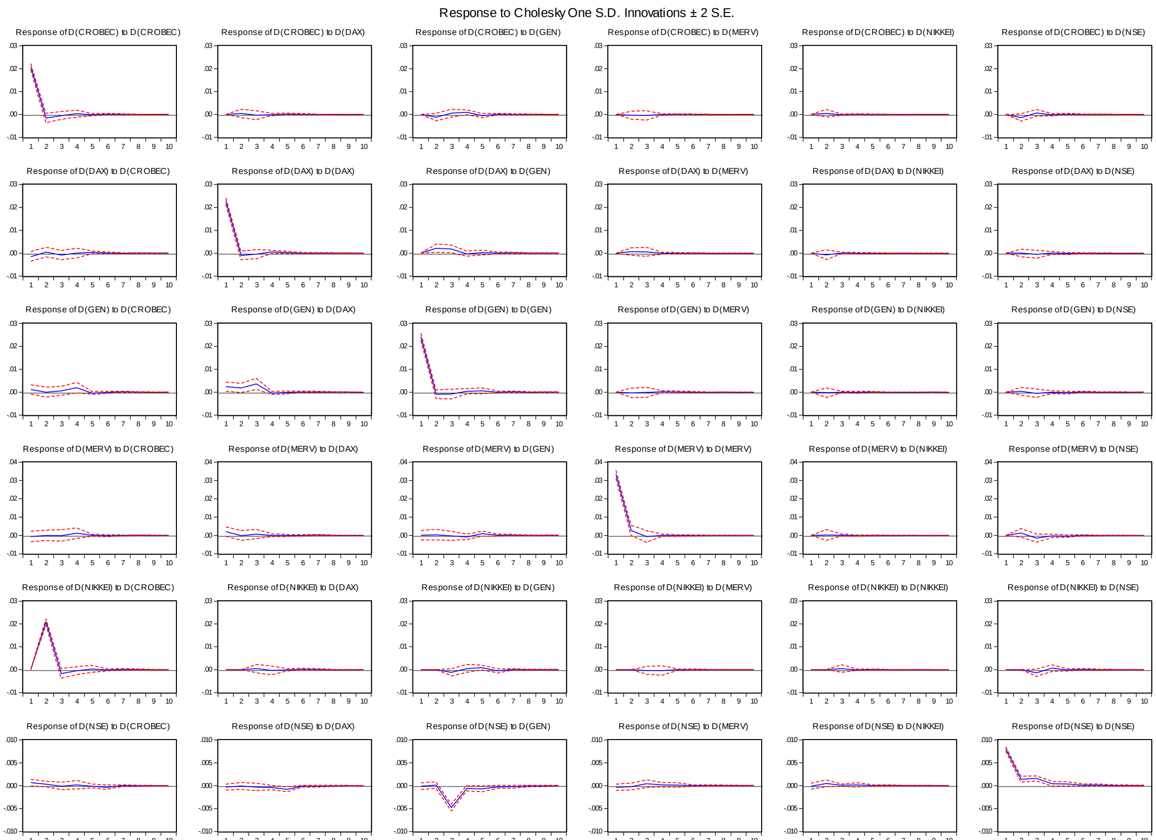
Variance Decomposition of D(NSE): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.009150	0.003359	0.054607	0.021280	0.210653	0.062993	1.326243	98.32087	0.000000
2	0.009195	0.013739	0.061784	0.021076	0.229464	0.062386	1.702100	97.61650	0.292952
3	0.009274	0.207864	0.110753	0.034001	0.448452	0.347512	2.275968	96.28395	0.291502
4	0.009275	0.208037	0.111322	0.045861	0.451367	0.347575	2.275809	96.26345	0.296583
5	0.009277	0.210163	0.111359	0.046847	0.451469	0.347699	2.277838	96.25108	0.303546
6	0.009277	0.210174	0.111506	0.047679	0.451493	0.347708	2.278274	96.24947	0.303700
7	0.009277	0.210362	0.111532	0.047701	0.451510	0.347748	2.278679	96.24867	0.303799
8	0.009277	0.210364	0.111547	0.047701	0.451515	0.347748	2.278678	96.24863	0.303812
9	0.009277	0.210369	0.111548	0.047705	0.451515	0.347749	2.278678	96.24862	0.303813
10	0.009277	0.210369	0.111548	0.047705	0.451515	0.347749	2.278678	96.24862	0.303814

Variance Decomposition of D(SP500): Period	S.E.	D(CROBEX)	D(DAX)	D(FTSE)	D(GEN)	D(MERV)	D(NIKKEI)	D(NSE)	D(SP500)
1	0.008006	0.063177	0.009604	0.085777	0.106851	0.156585	0.000329	0.001683	99.57599
2	0.008029	0.063644	0.020712	0.132184	0.119635	0.164229	0.051468	0.393148	99.05498
3	0.008111	0.447807	0.103173	0.935428	0.119886	0.218171	0.446009	0.648589	97.08094
4	0.008112	0.447704	0.104712	0.938042	0.122258	0.218168	0.445913	0.654802	97.06840
5	0.008116	0.449855	0.110966	0.939621	0.122249	0.228547	0.455859	0.662092	97.03081
6	0.008116	0.449906	0.111083	0.939744	0.122265	0.228794	0.456204	0.662076	97.02993
7	0.008116	0.449934	0.111283	0.939810	0.122316	0.228812	0.456212	0.662085	97.02955
8	0.008116	0.449937	0.111283	0.939917	0.122321	0.228812	0.456215	0.662087	97.02943
9	0.008116	0.449938	0.111284	0.939919	0.122321	0.228814	0.456215	0.662087	97.02942
10	0.008116	0.449939	0.111285	0.939919	0.122321	0.228814	0.456216	0.662087	97.02942

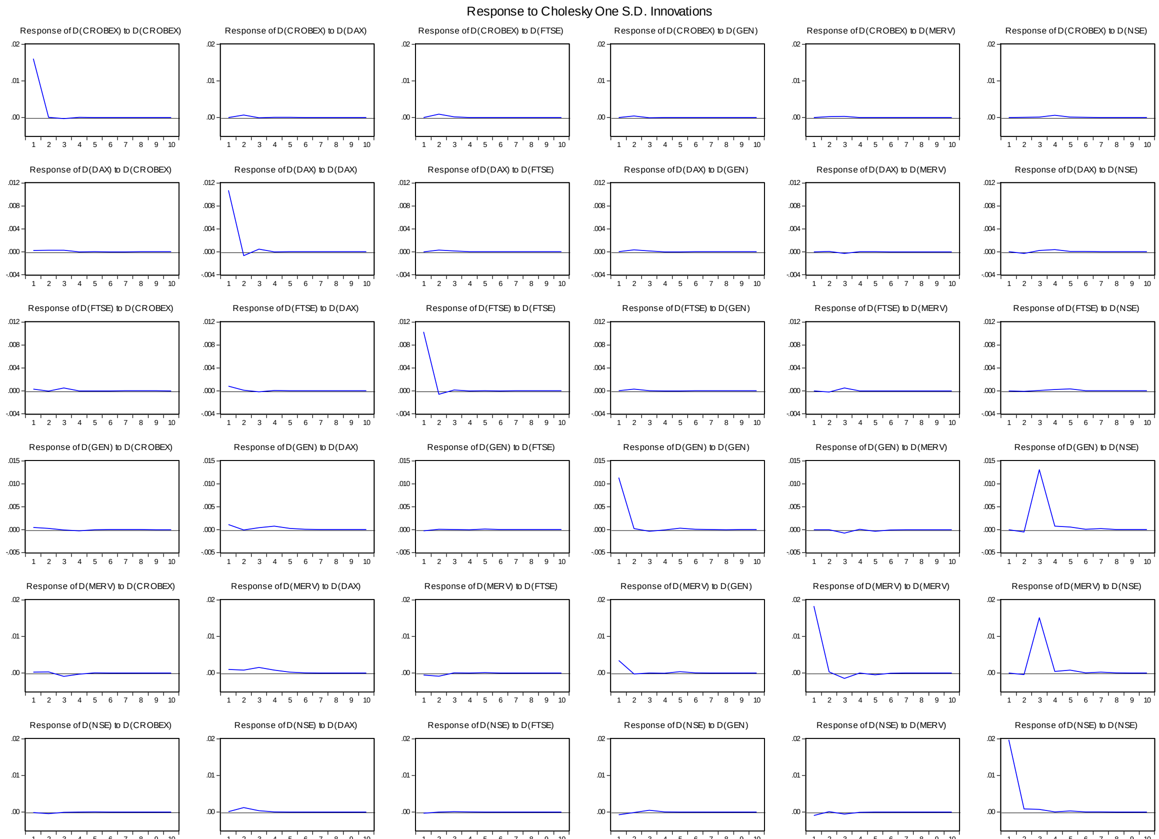
Cholesky Ordering: D(CROBEX) D(DAX) D(FTSE) D(GEN) D(MERV) D(NIKKEI) D(NSE

Impulse response functions

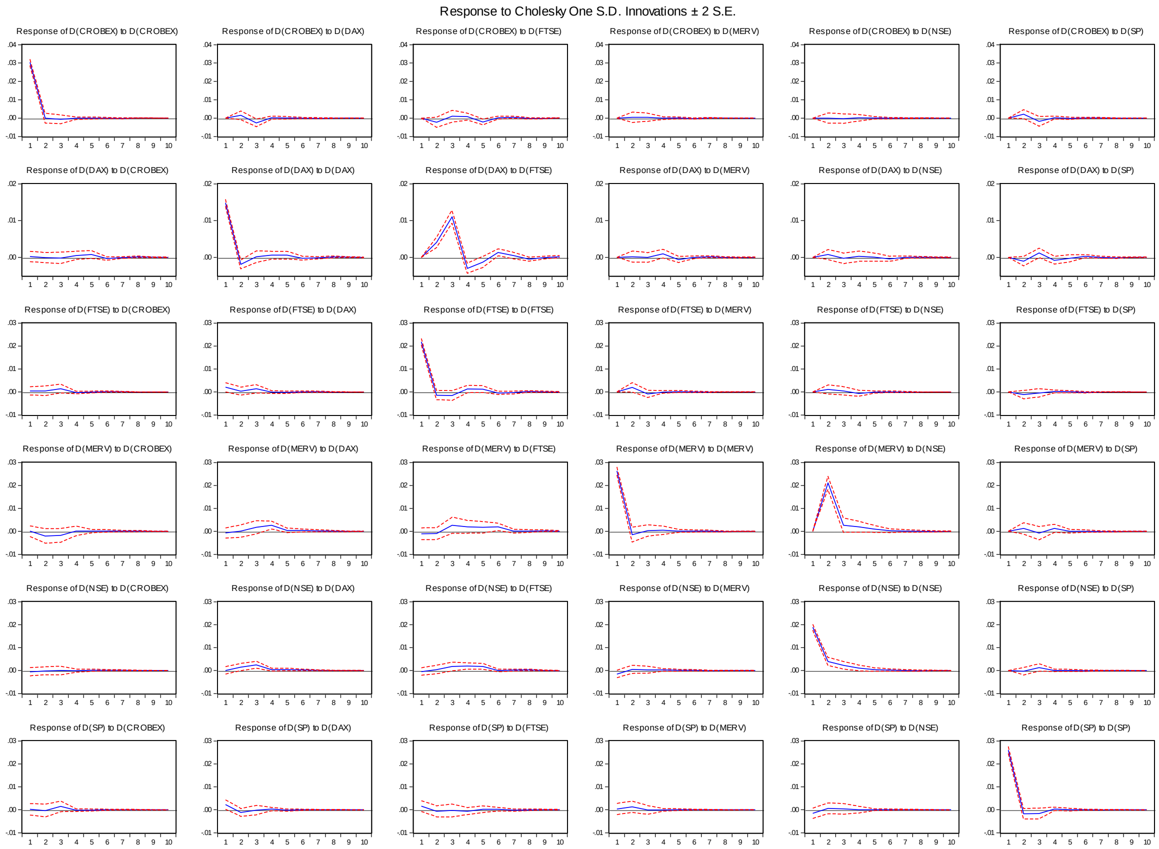
2001-2003



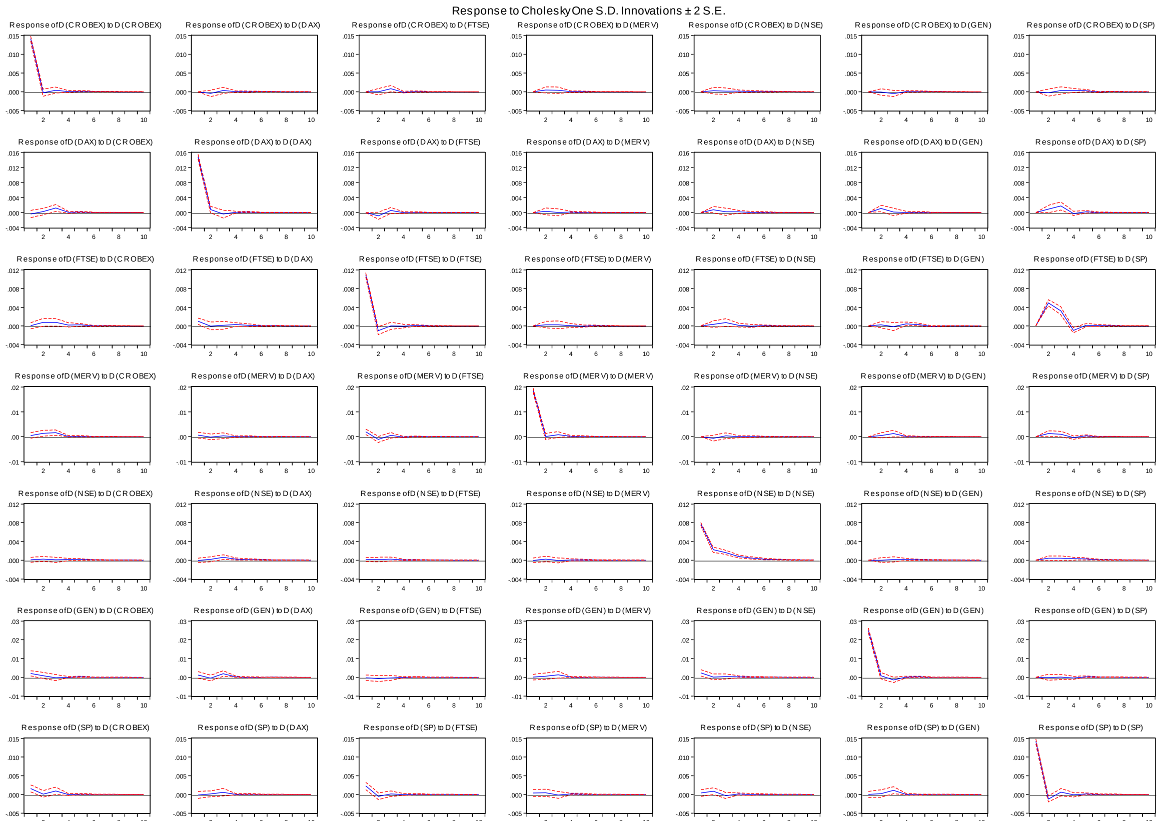
2003-2006



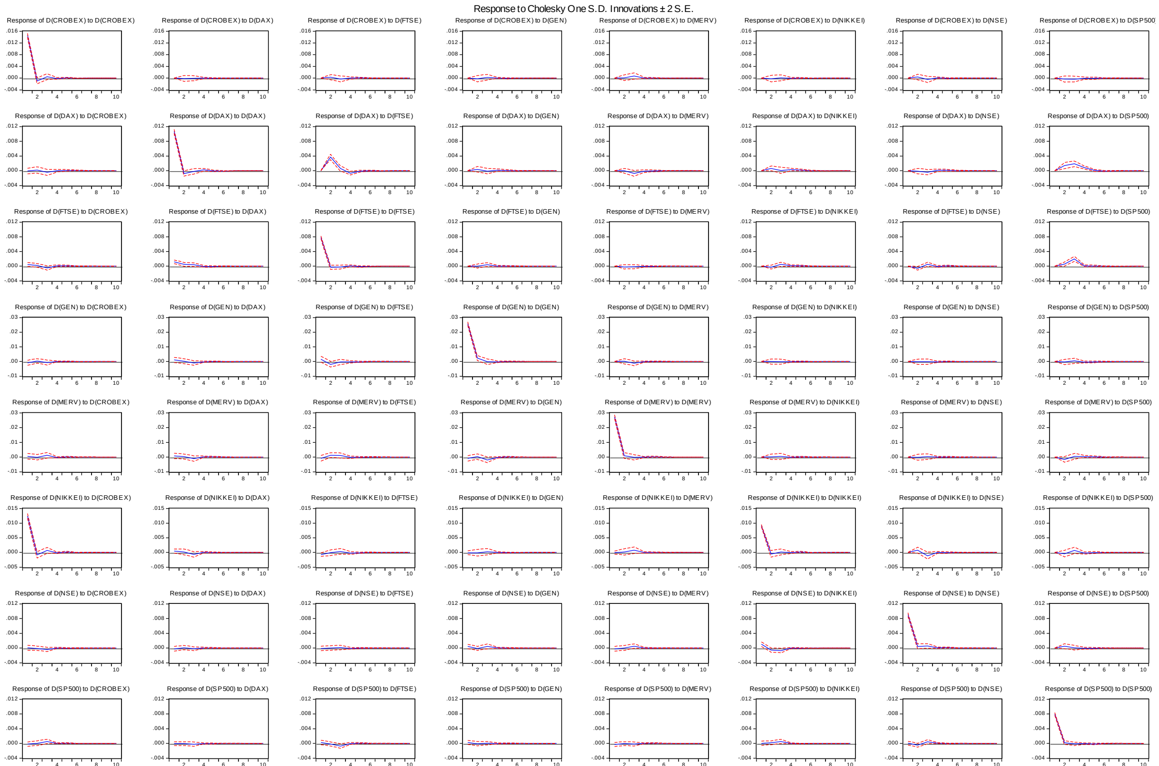
2007-2008


Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of D(CROBEX) to D(CROBEX)
Response of D(CROBEX) to D(DAX)
Response of D(CROBEX) to D(FTSE)
Response of D(CROBEX) to D(MERV)
Response of D(CROBEX) to D(NSE)
Response of D(CROBEX) to D(SP)
Response of D(DAX) to D(CROBEX)
Response of D(DAX) to D(DAX)
Response of D(DAX) to D(FTSE)
Response of D(DAX) to D(MERV)
Response of D(DAX) to D(NSE)
Response of D(DAX) to D(SP)
Response of D(FTSE) to D(CROBEX)
Response of D(FTSE) to D(DAX)
Response of D(FTSE) to D(FTSE)
Response of D(FTSE) to D(MERV)
Response of D(FTSE) to D(NSE)
Response of D(FTSE) to D(SP)
Response of D(MERV) to D(CROBEX)
Response of D(MERV) to D(DAX)
Response of D(MERV) to D(FTSE)
Response of D(MERV) to D(MERV)
Response of D(MERV) to D(NSE)
Response of D(MERV) to D(SP)
Response of D(NSE) to D(CROBEX)
Response of D(NSE) to D(DAX)
Response of D(NSE) to D(FTSE)
Response of D(NSE) to D(MERV)
Response of D(NSE) to D(NSE)
Response of D(NSE) to D(SP)
Response of D(SP) to D(CROBEX)
Response of D(SP) to D(DAX)
Response of D(SP) to D(FTSE)
Response of D(SP) to D(MERV)
Response of D(SP) to D(NSE)
Response of D(SP) to D(SP)

2009-2012



2013-2015


Response to Cholesky One S.D. Innovations ± 2 S.E.
Response of D(CROBEX) to D(CROBEX)
Response of D(CROBEX) to D(DAX)
Response of D(CROBEX) to D(FTSE)
Response of D(CROBEX) to D(GEN)
Response of D(CROBEX) to D(MERV)
Response of D(CROBEX) to D(NIKKEI)
Response of D(CROBEX) to D(NSE)
Response of D(CROBEX) to D(SP500
Response of D(DAX) to D(CROBEX)
Response of D(DAX) to D(DAX)
Response of D(DAX) to D(FTSE)
Response of D(DAX) to D(GEN)
Response of D(DAX) to D(MERV)
Response of D(DAX) to D(NIKKEI)
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Response of D(FTSE) to D(CROBEX)
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Response of D(SP500) to D(GEN)
Response of D(SP500) to D(MERV)
Response of D(SP500) to D(NIKKEI)
Response of D(SP500) to D(NSE)
Response of D(SP500) to D(SP500)

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