GARCH MODELLING OF ISE – 100 INDEX

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GARCH MODELLING OF ISE- 100 INDEX
İSTANBUL MENKUL KIYMETLER BORSASI (IMKB) BİLEŞİK 100 ENDEKSİNİN GARCH İLE MODELLENMESİ

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Toplam Sayfa Sayısı:

Anahtar Kelimeler (Türkçe)
1) Risk
2) Getiri
3) Oynaklık
4) GARCH
5) Riske Maruz Değer

Anahtar Kelimeler (İngilizce)
1) Risk
2) Return
3) Volatility
4) GARCH
5) Value at risk

ABSTRACT

In recent years, risk and return concepts has become more important for financial markets. Financial market volatility has a major role in the investment decision taking process. High volatility implies frequent changes in the variables relatively to a certain average in a certain period of time. The notion of increasing volatility in the equity markets became a subject of academic research.

In this study, the volatility of the return series of the ISE-100 index was econometrically analyzed under the independent macro factor variables affecting the ISE return. Additionally, ARCH/GARCH models are evaluated in order to determine the most appropriate model for predicting volatility of ISE

Using monthly historical data from January 2002 to December 2009, it is observed that there exists ARCH effect in the volatility of ISE-100 index. After the existence of the ARCH effect was accepted, it was concluded that GARCH (1.1) is the most appropriate model to forecast volatility of ISE-100.

Key words: Risk, return, volatility, GARCH, value at risk.

ÖZET

Son yıllarda risk ve getiri kavramları finansal piyasalar için önem teşkil etmektedir. Finansal piyasa oynaklığı yatırım kararları almada önemli role sahiptir. Yüksek oynaklık, belirli süre içerisinde değişkenlerin değerinin belirli bir ortalamadan uzak olması anlamına gelir. Hisse senedi piyasasında artan oynaklık kavramı akademik araştırmalar da geniş yer bulmuştur.

Bu çalışmada IMKB-100 endeksinin getiri serilerinin oynaklığı IMKB-100 getirisini etkileyen bağımsız makro ekonomik faktör değişkenleri altında ekonometrik olarak analiz edilmiştir. Bununla birlikte, ARCH/GARCH Modelleri kullanılarak IMKB oynaklık modellemesinde kullanılabilinecek en uygun metot araştırılmıştır.

Ocak 2002 – Aralık 2009 yılları arasında aylık verilerin kullanıldığı çalışmada IMKB oynaklığının ARCH etkisi taşıdığı gözlemlenmiştir. ARCH etkisinin varlığı kabul edildikten sonra, değişkenliğin tahmin edilmesinde kullanılacak en uygun modelin GARCH (1.1) olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Risk, getiri, oynaklık, GARCH, riske maruz değer.

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1. Introduction

In financial markets, identification of the risk and the potential return of an asset can be seen as one of the most helpful input for market players. Market players, who have a determinant role for new investments, determine their investment decisions and the risk appetites according to comparison between risk levels and expected returns. In other words, for the same amount of expected return, an individual prefers to invest in the less risky financial instruments. However, as mentioned by Engle (2003), risk exist in future and knowing about risk, an investor may change his/her behavior to avoid.

Volatility is one of the most important concepts in finance world and modeling and forecasting the volatility of stock markets has been the subject for empirical and theoretical researches for many economists and financial researchers. The volatility of returns in stock exchange market can be seen as a major obstacle for new investments in market.

In terms of stock exchange, an increase in the volatility means a rise, not only in profit but also in loss and this change makes market more risky. Changes of variables in short period result in an excess volatility. This excess volatility causes high percentage increase or decrease in stock prices. In stock exchange markets, high volatility is one of the negative characteristics of market for low level risk-tolerance investors because, in high volatility conditions, the required risk that should be undertaken is also high. In such a high volatility – high risk time periods, low level risk-tolerance investors prefer to stay out of the game and that decreases number of investors in market. Therefore, we can conclude, volatility is one of the main concepts in risk management and finance theory

Volatility can be measured by using the standard deviation and variance returns from the security or market index. Traditional time series and economic models operate under the assumption of constant variance. In contrary, with the increasing importance of risk and uncertainty, modern

finance theory lets us use new econometric models with variable variance and co-variance.

By analyzing the empirical findings which examine the capital market volatility, the results show us that the usage of the non linear conditional variable variance model is more successful than the model which uses the linear time series model. In addition, the studies written for the capital market volatility, let us observe that the ARCH and GARCH models are the best way to explain the conditional variability.

2. Literature Review

2.1 Price

Price is a component of an exchange between buyer and seller. In other words, price is the quantity of payment in order to obtain something.

In finance theory, as also mentioned by Fama (1965), the past market data of the investors let to forecast the stock prices movements, especially the technical analysis is the best known analysis technique. As each discipline has its own assumption, the technical analysis has also some assumptions. Based on these assumptions, to forecast the future movement of a stock price, the past movement of a stock price is endowed with information. Dow Theory, the most popular technical analysis is formulated not only by price action but also by market behavior. The theory accept that the past repeats itself for price action and market behavior so if there is a successfully viewed price chart is created, it helps the investors to predict the future movement of a stock and this prediction allow them increase their expected gains.

In contrast to the chartist theories, random walk claims that the future path of the price level of securities are no more predictable than the path of series of accumulated random numbers. The random walk hypothesis is a financial theory stating that stock market prices evolve according to a random walk and thus the prices of the stock market cannot be predicted. It is consistent with the efficient-market hypothesis. In short, theory claims, price movement series are independent, as a result of this; the past data can not be used in any prediction of future movements.

As I mentioned before price is a component of an exchange between buyer and seller. Price changes, due to market forces i.e. buying and selling of the available goods in the market. Human beings with their both rational and emotional urges are the players of that market. The volatile nature of financial markets makes it sometimes difficult to analyze the exact reasons for various kinds of movements. At those times, in many times, emotional urges overcome rational side and increased volatility times becomes one of the most important circumstances for investors.

Osborne (1959) assumes the independency of prices changes from one transaction to another transaction in individual securities. They are identically independent distributed (iid.) random variables. In addition, as Fama (1965) mentioned, in this model Osborne assumes that the transaction movements of prices are fairly uniformly spread across time and their distributions have finite variance.

In point of fact, there is no, commonly accepted, general price information model for stock exchanges, in the explanation of price levels and distribution of price movements in terms of behavior.

Many articles and researches are examined in order to show factors that affect the prices. The followings are some factors that affect the buying or selling decisions of investors. These factors are chosen with the harmonization of some articles such as; Malhotra (2007) "Factors Affecting Share Prices", Oseni and others (2009) "Determinants of Equity Prices in the Stock Market", Sharma (2008) "Causes for Stock Price Changes".

According to Smith (2008) price is directly affected from the trend of market trading. In other words, the price of the stock of a company is affected, most of the time, by the general market direction. In bullish market, stock prices mostly rise. If there are more people willing to buy the stock, the price of that stock will increase. In bearish market, stock prices mostly decrease. If there are more people willing to sell the stock, the price of that stock will decrease. Analyzing future price movements will help investors to predict the market.

We can add economic growth data to this segment. As Zhang (2004) mentioned, stock prices are positively related with growth of all sectors. In contrary, in an economic recession times, one can buy stocks cheaper than they were in times of market highs.

The performance of sector or industry plays very crucial role in determining the buying or selling decisions of investors. As stated by Draper (1974) the stock prices of companies, which are in same industry,

will move successively. The reason of this is; good or bad market conditions will generally affects companies in same way.

Company performances are also one of the vital factors that affect the stock prices. The main of aim of a company is to create profit. Earnings per share are the profit that the company made per share. For this reason, investors mostly evaluate the company based on its earnings per share revenues and its future earning potentials. The company, which achieves good earnings results, will face with increases in its stock prices because more investors may become more interested in that company. According to Zhang (2004) investor's behaviors against that company may change positively. Moreover that, price/ earnings ratio gives fair idea to investors if the price of company overvalued or undervalued.

As mentioned by Oseni and others (2009) the effect of FII can not be ignored in prices of stocks. These kinds of institutions mostly buy or sell with huge quantities, so these institutions' any buying of stock positively effects prices. In contrast to this, any sell from FII will create downward trend over stock.

One another effect of price changes may be explained by the term insider trading. From the explanation of wikipedia, the term "insider" can be explained by; "a person who has first hand information, about the operations and the financial status of a company, with his/her potential access to non-public information about the company." This kind of traders will buy or sell the stocks before news about company is disclosured and presented. The information asymmetry makes it hard for the investors to get information about the companies before they release public announcements on large events. It can be said that corporate insiders are the ones who take advantage of the information asymmetry. Therefore, according to Chen and others, since the insiders' use the advantage of getting private information about the companies before a public announcement is made; they may have an opportunity to use this information for manipulation for the sake of their own benefits, which is called "insider trading".

Meulbroek (1992) claimed that insider trading causes more rapid price discovery and stronger volatility. Additionally, Cornell and Sirri (1992) and Chakaravarty and McConell (1997) at their studies, supported the conclusions of Meulbroek (1992).

Share buy-back by a company concludes the reduction in the number of shares in the market. According to demand and supply equilibrium; a decrease in the number of shares in the market means decrease in supply. This normally causes an upward shift in share price. Moreover, sometimes share buy-backs used by companies to support and to increase the liquidity of stock.

Stock splits have also effects on price changes. According to study of "Tick Size, Share Price and Stock Splits" by Angel (1997), from the theory, stock splits should not have an impact on stock prices. Because it is a corporate action, that increases the number of corporations' outstanding shares by dividing each share, which also diminishes price. On the other hand, many researches believed that, stock prices increases after stock split. However, some believe that stock split has no real and direct impact on the stock price, as the stock price will increase regardless of stock split.

Moreover, dividend announcements can be seen one of the most important factor that affects price. It is known that shareholders of a company should have the money which is created by that company. Therefore, keeping the money for new investment opportunities or distribution of that profit should not be a matter for that company, because as it is stated in literature, there is no or little effect of the issuance of dividends on the company's capital structure or stock prices. When it is taken into consideration from a different perspective, it is seen that the dividend payments cause a decrease in the re-investment resources of a company.

From the literature, the study conducted by Miller and Modigliani in 1961 and suggests that "dividend payments have no impact on shareholder's value."

The effects of dividend announcements were also investigated by Uddin (2003) in a study in which 137 declared dividends were used between October 2001 and September 2002. His study indicated that investors do not benefit from dividend announcements.

In addition, analyst coverage of a stock is an important factor, which leads to efficient pricing of the stock. The real value of a firm is sometimes overestimated or underestimated by individual investors. Investors therefore need an independent evaluation on the company's fundamentals and its future expectations provided by as many analysts as possible. The coverage of a stock by high number of analysts usually reduces volatility in the market. Analysts also play a key role as an intermediate agent between company management and investors. Managements usually prefer meeting with analysts to share their goals and expectations, which are then forwarded to investors by analysts.

The efficient market hypothesis supposes that prices influence all kinds of information. According to Fama (1970 and 1991), any publicly available information is immediately reflected to prices, which is in accordance with the semi-strong market efficiency. On the other hand, there have been many studies in literature as Kogan and Lochster (2005) mentioned, Huberman and Regev (2001) , Busse and Green (2001), and Meschke (2004) showing some instances in which the re-releases of already available public information can have a significant price effect on individual stocks.

It was indicated by Kogan and Lochstoer (2005) that instantaneous market-level returns have been greatly influenced by the announcements in terms of the direction of the announcement. The trading volume and price volatility were also showed to be influenced by the announcements.

News is regarded as one of the most important and most rapidly affecting factors for stock prices. For example good or bad news creates different impressions on investors in such a way that bad or good news can receive different reactions from the investors.

Similarly, bad stories of stocks can create negative impressions among investors. While there are negative drifts for the stocks having bad public stories, there are fewer drifts for the ones having good stories. This situation is interpreted by Chan (2001) that prices cannot be fast enough to reflect bad public news. Chan added that no news stories in the event month tend to reverse in the subsequent month. According to Chan (2001), this reversal is a statistically significant one even after controlling for size, book-to-market, and liquidity influences. This interpretation complies with the fact that spurious price movements receive overreactions from the investors. Therefore, investors can be a little bit slow to give reactions to the valid information which causes the drift. Investors also overreact to price shocks, which results in excessive trading volume and reversal.

There are also some other researchers such as Erdogan and Yezegel (2009) who investigated the return behavior after large price changes as a result of the announcement of "no news". They indicated that although there is an explanation about the "no news" after large negative price changes, the prices are observed to continue to drift downwards. On the other hand, if the positive sub-sample is taken into consideration, there may be a partial reverse in the prices after the announcement of no news.

The volatile natures of most markets make it sometimes difficult to analyze the exact reasons for various kinds of or down movements. Systematically studying major factors, which affect prices, is very essential for all investors. The volatility of stock price changes is a measure of how much the market is liable to fluctuate.

Black and Scholes (1973) defines that;

> "Volatility is of interest to all traders because it quantifies the risk and is the key input of all pricing models."

Without an efficient volatility estimate, it is difficult for traders to identify situations, in which, prices overvalued or undervalued. That's why

physicists and economists are increasingly interested in time series analyses. According to Liu et all (1999), understanding the statistical properties of the volatility also has practical consequences.

The periods of stock market volatility in developed markets have intensified the debates about the causes of this kind of price movements. Accordingly, several studies have been conducted to investigate the relationship between stock market volatility and macroeconomic variables. The total value of company shares depends on the state of the economy. Therefore, a change in the uncertainty level about the macroeconomic conditions in the future will cause a proportional change in the stock return volatility.

Schwert (1989) shows how macroeconomic variables, precisely inflation, industrial production and money supply, will determine stock market volatility for the U.S.A. Schwert's finding reveals the idea that macroeconomic volatility affects the volatility in a stock market.

Schwert (1989) analyzed the effect of market volatility on various economic variables and tried to examine the effect of time varying volatility among these variables. He concluded that economic downturns have higher rates of market volatility. This result agrees with the result that was obtained by Officer (1973). He also indicated that financial leverage plays an important role in the increase of stock market volatility, as predicted by Black (1976) and Christie (1982). However, financial leverage is responsible for only a small part of the variation in stock volatility.

Morelli (2002) analyzed the relationship between conditional stock market volatility and conditional macroeconomic volatility with data about England. In contrast to Schwert's (1989) defended conclusions, Morelli's finding shows that macroeconomic volatility does not explain stock market volatility.

Davis and Kutan (2003) extended Schwert's (1989) study. It was showed in this study that both movements in inflation and real production and measured macroeconomic volatility have a weak power to explain stock market volatility.

By using monthly data of 1986-2003 periods, Kasman (2006) analyzes the relationship between conditional stock market volatility and macroeconomic volatility for Turkey. The findings indicate that 6 % of the stock market volatility is defined by the change in macroeconomic volatility.

2.2 Volatility

From the glossary statistical terms of OECD, volatility, in financial markets, refers to the amount of uncertainty or risk about the prices changes of determined variable. So we can conclude, the higher the volatility, the riskier the good.

According to Poon S. (2005)

> "a statistical definition of volatility can be given by, as a measure of distribution or dispersion of observations in a data set around the arithmetic average. Statistically, volatility is often measured as the sample standard deviation."

Volatility shows the sensitive part of the total variability against the changes in the market. In other words, volatility is defined as an increase or decrease of any variable according to a certain average value.

In order to explain volatility in financial terms, it is better to refer to the definition given by the ISE. ISE explains volatility as "the feature of fluctuation that the price of a security or the market in general has in a short time interval". It is possible for investors to reduce the risks to be taken if the size and time of these fluctuations are determined beforehand. Since investors face risks in financial markets, they can reduce these risks if they can predict the volatility.

In capital markets, volatility is the statistical measure of the dispersion of returns for a given security or a given market index. Volatility can be measured by using the standard deviation or variance returns from the security or market index. In calculation, standard deviation or variance are squared, so that negative or positive differences are all combined into one quantity. This means volatility does not measure the direction of price changes. On the other hand, this does not mean the price changes of two

compared variables will always go with the same direction. Sometimes, variable will increase more than a compared market index or price difference occurs by negative value of security against market index. As suggested by Mala and Reddy (2007), Krainer (2002), concluded in his study that the developments in an economy can be predicted with the help of the degree of volatility. If the level of risk is higher in volatility, there will be a rise in the cost of capital. As a result, risk- averse investors will decide to decrease investments. The study of Mala and Reddy (2007) showed a similar result in terms of reduced investments and slow economic development according to degree of volatility.

Volatility is used to mean that variability shows higher increases or decreases than its average. It is believed that making a definition of "good" or "bad" for the concept of high volatility in financial markets is not true. Since higher volatility has a possibility of getting higher profits or losses in compare with the low volatility time periods, the liquidity of market will change according to the structure of market players. I mean, if there are more risk-averse investors in the market, the market liquidity may decrease, on the other hand, by the sensation of getting more profits, market liquidity may increase with new investors' attendance in the market. In short, volatility has different effects on different markets.

All investors want to have an idea about the stock market risk and return behavior. Because stocks have different levels of volatility, it is not surprising to see that while some stocks are volatile, the others are not volatile that much. Furthermore, some stocks may be more volatile than market volatility. However, the degree of volatility changes from one stock portfolio to another according to the type of the stock it holds. The manner of a portfolio manager against volatility affects stock portfolios. While some stock traders are not afraid of trading in volatility time periods to earn much, the others do not want to take risks and may sell with panic in volatility periods. Since an investor aims to get the highest return against the undertaken risk, it is important for him/her to forecast the volatility in order to determine when to sell or buy by taking the risk into consideration.

The asset return volatility was used by Markowitz (1952) as a measure of risk in modern finance theories and it is also mentioned in the study of Liu, Lee and Lee (2009). Mandelbrot (1963) is the first person who claimed volatility clustering in finance. Mandelbrot show that volatility changes over time and that, for short lags, time series of daily stock index returns exhibit positive correlations. According to observations of Mandelbrot; high amount of changes in the prices of goods tend to be followed by high changes, of either sign, and low amount of changes tend to be followed by low changes. This conclusion feature volatility of financial variables has dynamic structures rather than static. Fama (1965) supported the findings of Mandelbrot in his research.

The importance of stock market volatility is apparent. Therefore, it is necessary to find suitable stocks for an investor's investment or trading style and risk tolerance levels. Since stock prices generally fluctuate, it is not surprising to see higher or lower levels in prices. If the stocks have relatively more volatility, most probably they will have a higher and lower range than less volatile stocks. The moving range of a stock indicates how much volatile it is. In other words, the more a stock moves, the more volatile it is. For this reason, it is especially important for investors to forecast the volatility level of a stock or market in order to determine their investment decisions. Black (1976) argues that corporate leverage affects the long-term volatility of returns of common stocks. According to Black, declines in stock prices increase the debt-equity ratio (financial leverage) of firm subsequently risk (volatility) increases for the firm. The corporate leverage argument is unable to explain variations in volatility for broad market indices.

As a result of rapid changes in financial markets and observed volatility in stock exchange markets, there have been a lot of economists and financial researchers who have been performing many empirical and theoretical studies to model and forecast the volatility of stock markets. It can be said that volatility in financial markets has increased since 1980s. In the last 30 years, many new investment instruments have been introduced to

financial markets in an attempt to decrease the impact of turbulences in global financial markets. Consequently, it has become a necessity to predict the volatility concept and the increased assets in financial markets.

According to many financial market analysts and investors, the volatility of stock returns, interest rates and exchange rates increased very high. If there is a high volatility rate in the financial market, this will have very important effects for policy-makers. According to Becketti and Sellon (1990), the investment decisions may be changed if investors think that high volatility is equal to high risk. On the other hand, the politicians may think that financial market volatility may penetrate into the economy and thus the economic performance may be damaged. Financial volatility can also be considered as a threat to the regularity of the financial market functions and the applicability of financial institutions. However, the difference in the structure of the financial markets can change the nature of volatility, its size and its permanence.

Daly (1999), claimed volatility of stock exchanges can be seen as a sign of price of stock exchanges is not valued as they deserve. And it is also seen as a sign that indicates, capital markets are not functioning as it is needed. Shortly, volatility means that securities are not priced fairly and capital market is not working functional as well as it should.

In terms of stock exchange, increase in the volatility means an increase in both profit and loss, which makes market more risky. In other words, with a high volatility stock price changes may increase or decrease by high percentages. In stock exchange markets, high volatility is one of the bad features of market for risk-averse investors, because, in high volatility conditions, the required risk that should be undertaken is also high. In such a high volatility – high risky time periods, risk-averse investors prefer to stay out of the game and that decreases number of investors in market.

As Kurihara (2006) mentioned in his study for Japan, many factors such as enterprise performance, dividends, stock prices of other countries, gross domestic product, exchange rates, interest rates, current account deficits, money supply, employment etc… have impact on daily stock

prices. The findings of Aydemir and Demirhan (2009) for Turkish economy supported the ideas of Kurihara (2006). According to their conclusion, investors' perception (market reaction) to these indicators with good or bad news, will guide the way of prices.

In financial markets, determination of the risk of an asset and determination of potential return are the biggest helpful inputs for market player. Volatility of returns in market can be major stumbling block for attracting investment because market players determine their investment decisions according to relation between risk and return. By being aware of risks, people may alter their behavior to avoid them. As Engle (2003) mentioned, there are always risks people choose because benefits from taking them exceed the possible costs. This is also determined as central paradigm of finance by Engle. According to his belief in his article, people must take risks to achieve rewards but not all risks are equally rewarded. The difference in risk levels of financial assets exists as a result of differences in their returns. So anyone can conclude that, volatility and determination of volatility is the most crucial thing for traders. Traders are mostly interested in which direction the market is going. In other words, traders are interested in velocity of that direction not interested in the way of direction.

In last 30 years period, the effects o globalization is increasing in global markets. This globalization fact causes an enlargement for uncertainty's zone of influence. With the increasing effect of turbulences in global financial markets in last 30 years, there are many hedging assets exists for protecting risky conditions. Forecasting of volatility concept, gain importance with increased assets in financial markets. Because, in recent years, by developments, there are lots of different assets and derivatives of these assets, which are in market, which are hedge assets of that market and which are hedge of that hedges etc…

According to Figlewski (2004); although the basic Black and Scholes (BS) option pricing formula is composed of five parameters and the returns of volatility of the underlying asset is only one of the components

among them, the volatility seems to play an important role because it is the only one that is not observed directly. It is possible to know or obtain information about the other parameters such as stock price, strike price, time to option expiration and the interest rate from the market easily except for volatility. The only way to get information about volatility is to make predictions about it.

The term volatility can be determined by standard deviation or variance. The relationship between standard deviation and variance shows that volatility and variance bear a resemblance to each other. This feature of volatility makes non linear time series analyses more accurate.

Existence of volatility, its mean reverting behavior, the asymmetric impact of negative versus positive return innovations and possibility to those exogenous or pre-determined variables may have significant influences on volatility. Volatility has a great effect on evolution of real prices and forecasting it, gives crucial benefits to investors. Advances in time series modeling such as ARCH / GARCH models and stochastic volatility models have made it possible to do this. If volatility cannot define successfully or cannot forecast, it will cause very dangerous dimensions for investors. Markets can cope up with normal level volatility. On the other hand, if exaggerated volatility exists in the market, market will face with problems.

Volatility can be defined as a concept that can generally be seen in stocks, exchange rates and inflation in developing countries. The performance of the financial instruments depends mainly on volatility of the share market.

Volatility, which exists in a financial market at a normal level, is believed to be a natural part of the process in allocating the investable funds and providing rivalry. Since the regular functions of financial system might be damaged and the economic performance might be affected negatively due to this volatility, the extreme volatility in share prices could damage the interest rates and exchange rates.

After investors realize the increase of this volatility in share market as the increase in share investments, they are likely to invest their funds in more risky areas. As a result of this reaction, an increase is observed in the cost of exportation deeds. Since small and new companies are affected more by this effect, investors may prefer to buy the shares of much bigger and more experienced companies. Because investors get their funds that they bought from administration by means of the financial markets and associations, these markets and associations play an important role in economy.

The movements in total share market volatility have been the subject of several studies in the literature. For example, Officer (1973) investigated the Great Depression period between 1929-1939 and concluded that share income variability had an extremely high rate. Despite the fact that there is a meaningful correlation between collective leverage power and volatility, it explains only a small part of this movement of volatility. Therefore, it is really difficult to interpret the degree of increase or decrease in total share volatility especially for the Great Depression period by using simple share models. Officer (1973) indicates the variability of volatility in macro economic variables. Black (1976) and Christie (1982) indicated that financial leverage is increased by share volatility. Shiller (1990) indicated that share market volatility is relatively higher than dividend's variables. According to Shiller's value models, the increase in volatility is caused by the proportion of rediscount or each of cash currents. Standard turning can be used to define the concept of volatility.

Because of the abolition of the regime in stable exchange rate in 1971, investors experienced a setting of a definite exchange rate that they had not had before. Then as a result of the petrolium crisis in 1973, huge fluctations in markets increased the inflation and influenced the tendency for rise and fall in interest rates.

The Financial crisis that happened on 19th October 1987 was the date when a rapid fall was observed at an end point in share prices in the U.S.A. and called Blak Monday.[1]

This huge rate of volatility in the share market negatively affected the primary economic transition channels, and as a result the financial markets experienced a severe crisis*. Because of globalism, many countries' stock exchange markets were affected by this crisis in the U.S.A. Particularly the decrease in share prices on19th October was observed to decrease the consumer expenses. It is thought that this factor is likely to lower the consumers'confidence and the consumer expenses in the future again. Both the consumer expenses and the company investment expenses are influenced by this volatility.

Changes in capital investments, consumption and other work period variables are the areas that the level of volatility market influences. It is important to know why the share volatility changes. Therefore, it is necessary that both positive and negative aspects of volatility be investigated well since it can be regarded as positive or negative according to different standpoints. Because the share prices have a very high mobility, there could be high amounts of increase or decrease in share prices. In other words, a high volatility may cause an investor to have either a high profit or a high loss depending on the situation of the prices: in high volatility environments, the higher the increase of prices is, the more the investor will profit and the lower the increase of the prices is, the more the investor will lose. In such a case, if the investor controls a high volume operation, s/he can harm the market especially when manipulation is seen as a way to avoid the risks of volatility. This is the negative side of volatility. However,

[1] Black Monday is the day in which Stock Exchange prices were the most decreased day.

* In October 1987, Black Monday, decrease of stock exchange markets started in Hong Kong. With an effect of time differences, this downward trend of stock prices continued by European Stock Exchange Market. At the end of the day Dow Jones, American Stock Exchange, decreased by % 22.6 (508 point) which was an unnoticed decrease ever happen.

volatility also has a positive side. One of the long term investment instruments, capital market instrument is likely to provide high profit in a short term. Since the volatility gives investors a chance to gain much in a very short time without waiting much, they want to take part in the stock exchange, so this causes the demand to increase.

There are various ways in modeling volatility. There have been many economists and financial researchers who have investigated the concept of modeling and forecasting the volatility of stock market in several empirical and theoretical studies in literature. Therefore, volatility is observed to be one of the most important concepts in finance world. However, the volatility of returns in market may create some problems for new investments.

As it is mentioned by Mazıbaş (2005) there is a volatility parameter in many values at risk models, used in measuring a market risk. It is seen that the volatility of stock market prices is also used in Black-Scholes's formula in order to obtain the prices of traded options.

There are six different models used in modeling volatility, from the book of Introductory Econometrics for Finance by Brooks;

The first one is the historical volatility models. The historical estimate is the simplest model for volatility. It is based on the idea that the values in the past will also continue in the future. As mentioned by Figlewski and Green (1999), it is obtained by calculating the returns of financial asset belonging to the previous period, calculating these returns according to the continuous compounding return and then taking the standard deviations of the continuous compounding returns. The square root of the variance gives the standard deviation, i.e. volatility.

Figlewski and Green (1999) defines that;

> "the historical average variance (or standard deviation) is the traditional volatility input used for options pricing models. However, there has been an ever- increasing indication that proposes the idea that using the volatility obtained from more sophisticated time series models is likely to result in much more accurate option valuations."

Second one is implied volatility models. According to Brooks (2008), it is known that a volatility estimate or forecast is needed as an input for all pricing models used for financial options. Black-Scholes's basic assumption is that the volatility of the asset that the option depends on affects the market price of the option.

Black-Scholes model and other option models are based on standard deviations. Implied Volatility is obtained by placing the standard deviation in the Black-Scholes model.

Third one is exponentially weighted moving average (EWMA) models. Brooks (2008) defines the exponentially weighted moving average (EWMA) is a version of the historical average volatility measure. Since it uses more recent observations, it provides a chance of stronger forecast of volatility than the other data points.

The EWMA is one of the infinite impulse response filters which use exponentially decreasing weighting factors. In the EWMA, the decrease in the weighting for each older data point occurs exponentially, but it does not reach zero. According to Harper (2007), when compared with the Moving Average, the EWMA is more advantageous because of its memory. By using a factor, the EWMA can remember a fraction of its past. For this reason, if the term is chosen wisely, the EWMA can provide a good indicator of the history of the price movement. Therefore, the highest weights can be obtained in the volatility estimate by the latest observations used in the model.

According to Brooks (2002) autoregressive volatility models can be seen as a fourth type of volatility models. Autoregressive volatility models can be defined as a simple example of the class of stochastic volatility specifications. In these models, it is possible to obtain time series of observations on some volatility proxy.

Fifth one is autoregressive conditional heteroskedasticity variance (GARCH) type of volatility models. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) is an improved model of ARCH

by Bollerslev in 1986. Conditional variance is a function of past squared unexpected returns and its own past values. The model is a weighted average of all past squared forecast errors in which weight of old data is decreases. GARCH is also an ARMA (p,q) process in the variance.

According to Brooks (2002) Last type of volatility model is stochastic volatility models. Brooks (2008) states that, the stochastic volatility models are characterized by randomly changing volatility with regard to some stochastic differential equations. In stochastic volatility model, the variance is modeled as a variance that cannot be observed. For that reason, it is also known as latent volatility. In short, the stochastic volatility model assumes that unknown volatility changes stochastically in time.

2.2.1 ARCH/GARCH Model Studies in Literature

In classical standard deviation calculations, the linear time series method is used and it is assumed that variance remain constant over time. In traditional economic models, changes of variance is not depends on time. In other words, it is assumed that, variance is independent from time. On the other hand, changes in variances of time series are mostly denotes dependent to time series, it is also called as, heteroskedasticity. However, today the acceptance of the fact that variance remains constant is not valid anymore. For time periods forecasting errors may be high or low. These changes in the forecast errors are called volatility in financial markets. Time series statistics used for determining the best volatility forecasts in volatility modeling researches. The traditional econometric time series models, generally assume a normal distribution of stock returns.

Mandelbrot (1963) concluded that big changes tend to be followed by big changes and small changes tend to be followed by small changes. In traditional econometric approaches, it is mentioned that the changing variance may appear mostly in models in which horizontal section data are used, whereas time series data are used in models containing the constant variance. The use of conditional variance models allows for a rapid and reliable volatility prediction.

Poon (2005) states that,

> "new characteristic of volatility, time varying nature of returns fluctuations, existed by Engle (1982). Engle succeeded to get Nobel Prize for his achievement in modeling it. The Autoregressive Conditional Heteroscedasticity (ARCH) model is used by Engle (1982) for the first time to explain this type of volatility persistence: since high/low volatility tends to persist, it is called *"autoregressive"*, since it varies with time or with respect to a point in time, it is called *"conditional"*. It is heteroskedasticity because non-constant volatility is expressed by a technical jargon *"heteroskedasticity"*."

Engle (1982) introduced the Autoregressive Conditional Heteroskedasticity (ARCH) in order to find a more convenient way to determine the dynamic characteristics of financial assets and forecast of the changes of variance in time periods. The Autoregressive Conditional Heteroskedasticity (ARCH model), which was put forward by Engle in 1982, is based on hypothesizing normal errors for asset returns and capturing a lot of stylized facts of financial assets such as time-varying volatility and volatility clustering.

According to the researches of Engle (1982) and Cragg (1982), in the macroeconomic data's time series analyses models, by some kind of economic researches, they proved variable variance is not stable as its assumed in previous traditional economic researches. Because of this reason, in forecast of financial market volatility, it is better to use ARCH model rather than traditional approaches. Engle (1982), allow the first and second moments of the stock index return to depend on its past realizations. The return and variance of return are modeled as linear functions, which facilities the statistical estimation for parameters. After years Bollerslev improved the ARCH model. Bollerslev (1986) transferred the ARCH model to the, Generalized Autoregressive Conditional Heteroskedasticity (GARCH) by including autoregressive moving average model. Bollerslev (1986) allowed the variance to depend not only on lagged squared deviations from mean return, but also on lagged variances.

French et al. (1987) examine daily and monthly returns on the NYSE stock index or the period between January 1928 and December1984 and found evidence that statistically significant positive relation between expected returns and volatility. Chou (1988) supported French et al. (1987) finding about positive relation between the predictable components of stock returns volatility, by using same data for a different period.

Booth and Hatem (1992) claimed that the accordance with data exhibiting a similar dependency structure increases the success of the GARCH models both in theoretical and empirical applications like this trend in returns.

As Grunbichler and Schwartz (1993) mentioned, Akgiray (1989) indicated that stock returns in the U.S.A on daily basis between 1963 and 1986 did not include serially independent realizations. His conclusions are similar to those of Fama (1965) in terms of price change. According to their views, high price changes are followed by high changes and low price changes are followed by low changes. Akgiray (1989) also stated that there are severe deficiencies of models that are based on linear dependent daily stock index returns. One of the differences between linear dependent models and non-linear models can be seen in the criticism the linear dependent models received. The linear dependent models have been criticized to neglect information about the dependence on the squared values of returns, which is valuable for prediction proposes.

Lamoureux and Lastrapes (1993) found that an Arch model provides superior volatility forecasts than does implied volatility in a sample of 10 stock series. Akgiray (1989), for forecasting monthly US stock index volatility, stated GARCH model superior to ARCH.

Grunbichler and Schwartz (1993) studied the volatility of the German and Swiss equity markets for a recent time period and look at its time series properties. It is significant that they observe a higher correlation between the volatilities in these two markets than between the returns.

Corhay and Rad (1994) investigated whether autoregressive conditional heteroskedastic models could adequately describe stock price

behavior in European capital markets. In previous researches, there are lots of work has been applied to American markets. That's why Corhay and Rad preferred to analyze European markets, in order to analyze autoregressive conditional heteroskedastic model suitable or not in which markets "generally much smaller and thinner" than American markets. The market looked at France, Germany, Italy, the Netherlands and the U.K, estimating ARCH and GARCH models of various orders they found that the Garch (1.1) model generally outperformed other Arch and Garch models.

According to Cromwell at all (1994), the GARCH model can be preferred to the ARCH model in some cases. If the values of variance belonging to the past period are efficient in determining the current value, in other words the changes happening in the variant are internal, the use of the GARCH is more appropriate. Additionally, in cases where the delay structure of the ARCH model is very long, the delay structure can be shortened by using the GARCH model. In other words, the GARCH model allows for the existence of a more economic delay structure.

As long as the prediction horizon increases, most time-series models like the GARCH will predict an unconditional variance of the series. This is regarded to be one of the best features of a volatility prediction model because volatility series are 'mean-reverting'. This state suggests that if they have a higher level now than the average in the past, they are likely to have a tendency to fall back towards their average level, whereas if they have a lower level now than the average in the past, they are likely to have a tendency to rise back towards their average level. Therefore, this is the property that makes the GARCH volatility forecasting models different from the EWMAs.

According to Saganuma (2000), volatility estimates are strongly connected with asset allocation decisions and value at risk calculations. Rolling window, EWMA, GARCH and stochastic volatility are some of the volatility measures used in practice. Because of their capability of incorporating the dynamic structure of volatility and forecasting future

behavior of risk, the GARCH and EWMA models are believed to have better results than constant, rolling window volatility models.

Mc Millan, Speight and Gwilym (2000) analyze the predictive power of several GARCH models in evidence of U.K. By using symmetric and asymmetric error statistics they conclude, the GARCH model outperforms smoothing and moving average techniques which have been previously identified as providing superior volatility.

In an attempt to determine certain qualitative features of volatility, Engle and Patton (2001) examined what a good volatility should have. They concluded that some factors such as mean reverting behavior of volatility, asymmetric impacts against positive or negative periods and possibility of exogenous and unpredictable circumstances could have significant effects on volatility in the ongoing volatility. Working on the daily data of Dow Jones for twelve years, Engle and Patton obtained some findings that comply with the theoretical results, in which the obtained empirical data depend on the sampling frequency.

The use of the GARCH models in measuring volatility is beneficial for its assuming a conditional heteroscedasticity and homoscedasticity unconditional error. In other words, there is an assumption in the model that the realizations of the preceding errors function as changes in variance, and thus these changes facilitate both temporary and random departures from constant unconditional variance. This situation is also true for daily data. The fact that the GARCH model holds the property in data for volatility clustering is its major benefit.

Volatility and market efficiency is one of the popular research topics for finance literature. Fama (1965) analyzed stock market prices and random walk behavior of stock prices and he used the term “efficient market” for the first time. According to the random walk theory, no trends have an effect on the existence of the movements in prices, and past prices are not effective in predicting the future prices.

In Efficient Market Hypothesis, all kinds of information are influenced by prices. In other words, if a market is efficient, the price of any kind of information should increase rapidly and correctively.

Nowadays, real markets and capital markets have become to be affected more from each other. Therefore, effective functioning of capital markets has been one of the most widely debated issues. The effectiveness of capital markets means that securities that are subject to the capital market should reflect their real values.

Volatility in financial markets, Price Bubble, Noise Traders in financial markets, Insider Trading, and Free Rider problem can be cited as the factors that emerge in ineffective financial markets and that remove the market from the effective balances.

There are 3 forms of Efficient Market Hypothesis,

First one is weak form. This form claims, historical market prices and historical data are observed to be reflected in prices. However, Efficient Market Hypothesis also claims that price changes of any period are fully independent from previous changes.

Another form is semi- strong form. This form claims, both past data of price movements and all publicly available information of market contribute to price formation. According to this view, it is possible for an investor to obtain higher returns from benchmark because all investors shared all of their new information, and as a result the effects of this information are simultaneously reflected in the market.

The third and the last form, strong form. This form claims, any kind of information, even the insider trader information is reflected in prices.

Rational expectations theory is criticized by many economists, and it is claimed that not all of the investors in the market move with rational motivations.

Wallace (2010) denotes that,

> "Shiller is strongly disagree with Efficient Market Hypothesis and said, The Efficient market Hypothesis is one of the most egregious errors in the history of economic though."

Robert Shiller, is one of the defender about behaviors' of investors' affects markets in high rate. He said "We are talking about playing game against other people. How do you ever play a game without thinking about their psychology?"

Shiller (2008) emphasizes that an investor who takes part in capital markets is not "a smart investor who knows what she/he wants" and claims that most of the investors taking part in the market just follow trends and tendencies. Such transactions increase the volatility in stock markets. In short, social and psychological factors (Behavioral Finance) are emphasized to be important in behaviors of the investors taking part in the market.

Herd psychology has revealed that investors who do not behave rationally have developed behaviors that are entirely based on their instincts. In this type of behavior, the notion of adapting to the general behavior and moving away from the rational behavior are dominant. Therefore, it is clear that a financial system, which is based on herd psychology and in which the investment decisions are taken according to herd psychology, is not an effective market.

2.3 General View of Istanbul Stock Exchange

2.3.1 Historical Background

The Istanbul Stock Exchange was established on December 26, 1985 for the purpose of ensuring that securities are traded in a secure and stable environment, including buying and selling of stocks treasury bills, government bonds, revenue sharing certificates, private sector bonds, foreign securities, real estate certificates. ISE commenced to operate on January 3, 1986 and ISE has contributed to the development of Turkish capital markets and Turkish economy since its establishment. In the establishment year, ISE had 40 companies and this reached to 323 companies in 2009. Market cap of ISE was 938 million dollar in 1986 and increased to 288 billion dollar. With 2008 crisis, market cap decreased to 119 billion dollar and then, after a year later, reached to 238 billion dollar.

Moreover that, in the establishment year of ISE, trading volume was just 50 thousand dollar and, in 2009, increased to 316 billion dollar levels.

In 2009, ISE's stock market was 10th in terms of market cap and was 7th among emerging markets in terms of volume. ISE was the 3rd stock market that provided the highest return in same year.

According to data of ISE, between 1986 and 2009, 45 billion dollar fund was released through the stock market. And 21.8 billion dollar of this fund was released between 2004 and 2009.

With the effect of globalization, both the volume and the velocity of capital flows have increased. Moreover, with the increase of depth in Turkish capital markets and political stability, interests of foreign investments rose.

2.3.2 Foreign Portfolio Investments

With the effect of globalization, both the volume and the velocity of capital flows have increased. Capital starts to move from abundant regions to scarce regions, because, returns from scarce regions are much more than abundant regions. This is a kind of win-win game. By this transaction of capital, capital will get the benefit of high return, and countries with scarce capital will get the benefits of extra capital. There are two kinds of capital investment, foreign direct investment and portfolio investment.

According to ISE Review (1998:8)

> "Portfolio investment is the purchase of stocks - bonds and money market instruments by foreigners, by taking the risks of political risk- country risk- foreign exchange risk etc., for the purpose of realizing a financial return, which does not result in foreign management, ownership or legal control."

Portfolio theory has a crucial role in the explanation of international portfolio instruments. According to this theory, investors distribute their money funds to obtain the highest return. By this diversification, investors become willing to buy not only local securities, but also foreign securities.

Since 1980s to today, when we analyze the portfolios of investors, it is clear to see that, total share of foreign securities in portfolio is increased.

According to researches of French and Poterba (1991), between 1980s and 1990s for American Investors, share of local stocks for American investors decrease from 94% to 83 %, from year 1980s to 1990s. French and Poterba (1991) also concluded that, this downward trend is also same in Japan. For Japanese investors, in same year period, share of local stocks against total value of stocks, decreased to 83% from 91%.

Increase in liquidity and with sharing risks, existed prices of stocks in emerging countries can be concluding as a nature of portfolio diversification. The effects of internationally diversified portfolio investments over prices are also studied by many other researchers.

By foreign portfolio investments, emerging markets affected more than developed countries, because of their low volume. As it is mentioned by Bodnaruk and Östberg (2008); Merton (1987) and Errunza-Losq (1985) concluded that, foreign purchases have positive effects in Mexican stocks. Moreover, Allan and Gale (1991) also concluded foreign portfolio investments have positive effects over local stock prices and this is seen as a reason of diminishing liquidity risk.

As it is mentioned by Stulz and others (1998), there are many studies in literature that determined positive effects of foreign purchases over local stock prices, such as; Bohn and Tesar (1996), Clark and Berko (1996) and Henry (1997). According to Clark and Berko (1996) any 1% increase in foreign portfolio investments causes 13 % increase in Mexican stock prices. This is also seen as a consequence of sharing risks and increasing liquidity.

A research about South Korean capital market also supported the positive effects of foreign portfolio investments over local stock prices. Conclusion of the research was; 1 billion $ foreign purchase causes 24% increase in prices of Korean local stocks. In the article of “Cross – Border Equity Flows: Hot or Cold?’’ by Cozzini and Howell (1994), 1 billion $ foreign portfolio investment increased the stock exchange prices by 1.4%.

There are many hypotheses about explaining foreign portfolio investments' positive or negative effects on stock exchange returns. Base Broadening hypothesis, Expected / Unexpected Flow hypothesis, Feedback hypothesis, Prices pressure hypothesis are many of them. When we generalize all those researches, we can conclude that increase in foreign portfolio investments causes an increase in liquidity. And this also creates downward shift in risks and cost of capital. At least the price goes up.

Foreign Portfolio Inv. → Liquidity ↑ → Risk ↓ → Cost of Capital ↓ → Prices ↑

2.3.2.1 Portfolio Investments over ISE

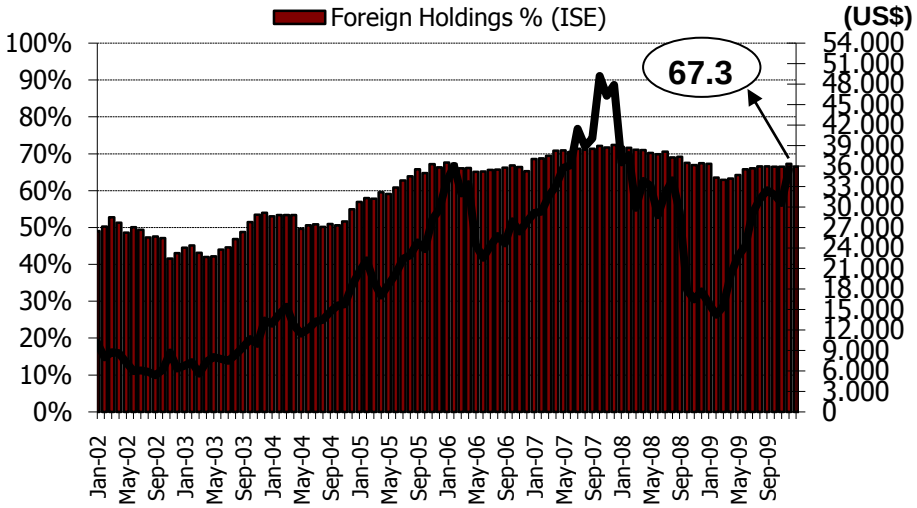
Portfolio investments have changeable characteristics. This kind of capital movements mostly speculative and permanence of that money is very short. That's why this is also called as Hot Money[2]. Capital movements, which called as Hot money, mostly come to country for short term period. With transaction of foreign exchange to local currency, the aim of foreign investment becomes to create positive added- value by using possibilities of arbitrage. At this section of my thesis, I will try to analyze the effects of foreign capital movements over Istanbul Stock Exchange.

With the increase of depth in Turkish capital markets and political stability, interests of foreign investment raised. Since 2005, foreign holding share in Turkish equity market hadn't decreased below % 50. The highest foreign holding share belongs to December 2007 by share of %72.4 and the lowest foreign holding share was %41.6 which was in Nov. 2002

As we see from the graph, increases in the foreign holding share positively affects Istanbul Stock Exchange – 100 index level and decreases in foreign holdings share has downward shift over Istanbul Exchange – 100 index. For example, in January 2002, foreign holding of ISE was 49% levels and in 12 months period, foreign holding's share decreased to 43.1%levels.

[2] Hot Money: Large quantities of money that move quickly in international currency exchanges due to speculative activity. Foreign funds temporarily transferred to a financial center and subject to withdrawal at any moment. Borrowers enticing hot money should be ready to lose it when another borrower offers a higher rate.

Figure 1: Foreign Holdings and ISE – 100



Source: ISE, Oyak Securities Research

Foreign investors' sell ISE buy Dollar strategy causes 47% decrease in ISE-100 index, from 10,152$ to 6,324$[3]. In the analyze of foreign holdings share and ISE-100 index between November 2002 and December 2007, which is lowest to highest foreign holding share period, positive correlation also can be seen. In that period, foreign holdings' share increased by 30.8% percentage from 41.6% to 72.4% levels. In same time period, ISE-100 index close value reached to 47,906$ from 8,662$[4]. Increase in foreign portfolio investments in country raises the liquidity of local capital markets which also increases the market efficiency.

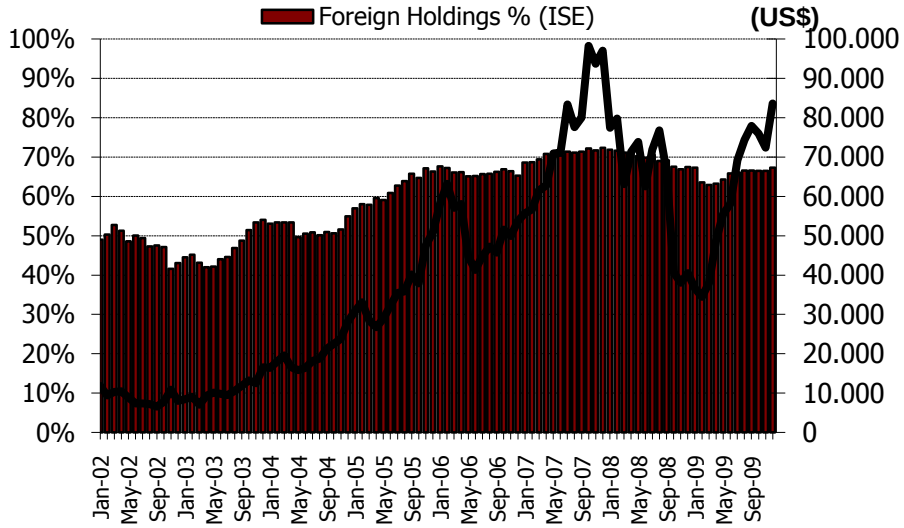
When we analyze data's of total market cap of Turkish stocks between years 2002 and 2009, the highest market cap value reached to 98,293 million $ which belongs to October 2007. And the lowest market cap value was 6,568 million $ in September 2002. Foreign holdings' share in ISE – 100 was 72.1% in October 2007, which is second highest foreign share in Turkish stock market and in September 2002, foreign holdings' share in ISE – 100 was 47.6%[5].

[3] Dollar / Turkish Lira; 1.3053 (Jan. 2002) and 1,6397 (Dec. 2002).

[4] Dollar / Turkish Lira; 1.5353 (Nov. 2002) and 1,1593 (Dec. 2007)

[5] Dollar / Turkish Lira; 1,6505 (Sep. 2002) and 1,1716 (Oct. 2007)

Figure 2: Foreign Holdings and ISE – 100 Market Cap.



Source: ISE, Oyak Securities Research

Foreign holdings in ISE – 100 decreased between January 2002 and December 2002. As it is seen from the graph, in 2002 crisis, foreigners sold their equities market cap of Istanbul Stock Exchange was 11,858 million $ in January 2002. At the end of the year 2002 total market cap was 8,007 million $ and the share of foreign holdings' was 43.1%. On the other hand, by the year 2003 foreign investors, again, started to increase their portfolios in ISE. In October 2007, foreign holdings' market cap reached to 70,911 million $ which is also the highest total market cap of foreigners in Turkish Stocks market.

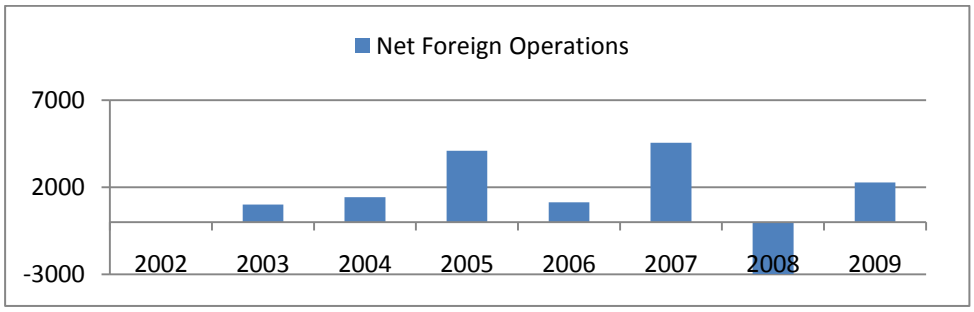
Foreign operations between years 2002 to 2009, the highest net sale was 2,972 million $ in 2002, which cause 63.15% decrease in ISE – 100 index. The second net sale belongs to year 2002 and which cause 33 % decrease in ISE – 100 index. By the year 2003, net foreign operations turns to positive to the year 2008. In 2005 net foreign purchases was 4.087 million $, which was the second highest net purchase, causes 60.56% increase. In 2007, net foreign purchases reached to 4.533 million $, which was the highest net foreign purchase of Turkish stock market, causes 72.14% increase.

Table 1: Net Foreign Operations.

Year	Million ($)	ISE-100 close ($)	Change ISE – 100 ($)
2002	-15	6324	-33,95%
2003	1010	13368	111,39%
2004	1430	18463	38,11%
2005	4087	29645	60,56%
2006	1145	27830	-6,12%
2007	4557	47907	72,14%
2008	-2972	17653	-63,15%
2009	2269	35517	101,20%

Source: HSBC Research Report 2010

Figure 3 : Net Foreign Operations.



Source: ISE, Oyak Securities Research

2.3.3 Investor Profiles of ISE

With the effect of globalization, both the volume and the velocity of capital flows have increased. Moreover, with the increase of depth in Turkish capital markets and political stability, interests of foreign investments rose.

Table 2 and table 3 are the detailed investors' profiles of Istanbul Stock Exchange for the years 2002 and 2009. In those tables, types of investors, shares of each investor types are given. In the analyses of table 2 and table 3, great differences are observed when comparing the year 2002 and 2009. The share of domestic investments in the share of total investment has declined, and the share of foreign investment in the share of total investments has increased.

Table 2 : Equities-Number of investors and Portfolio Sizes Categorized by Portfolio Sizes , 2002

Investor Category	Investor Type	Identified Active Acconts	Share in Total Identified Acvite Accounts	Number of Stocks in Identified Acvtive Accounts	Share in Total Number of Stocks in Identified Active Accounts	Portfolio Size of Identified Active Accounts (TL	Share in Total Portfolio Size of Identified Active Accounts
Domestic	Investment Fund	126	0,01%	31.224.730	0,97%	175.363.806.725	1,25%
	Corporate	2.496	0,22%	345.744.963	1,57%	905.830.661.820	1,20%
	Other	188	0,02%	50.432.958	10,75%	167.674.118.404	6,48%
	Individual	1.131.633	99,35%	1.618.913.933	50,33%	6.009.485.954.386	42,99%
	Toplam	**1.134.443**	**99,60%**	**2.046.316.584**	**63,62%**	**7.258.354.541.335**	**51,92%**
Foreign	Investment Fund	71	0,01%	532.297.927	16,55%	3.100.362.983.722	22,18%
	Corporate	418	0,04%	601.006.402	0,55%	3.478.988.236.492	0,56%
	Other	8	0,00%	17.661.873	18,68%	77.790.230.905	24,88%
	Individual	4.099	0,36%	19.178.143	0,60%	64.697.123.961	0,46%
	Total	**4.596**	**0,41%**	**1.170.144.345**	**36,38%**	**6.721.838.575.080**	**48,08%**
Total		**1.139.039**	**100,00%**	**3.216.460.929**	**100,00%**	**13.980.193.116.415**	**100,00%**

Source: MKK

Table 3 : Equities-Number of investors and Portfolio Sizes Categorized by Portfolio Sizes , 2009

Investor Category	Investor Type	Identified Active Acconts	Share in Total Identified Acvite Accounts	Number of Stocks in Identified Acvtive Accounts	Share in Total Number of Stocks in Identified Active Accounts	Portfolio Size of Identified Active Accounts (TL)	Share in Total Portfolio Size of Identified Active Accounts
Domestic	Investment Fund	227	0,02%	391.443.020	1,45%	1.717.150.625,63	1,38%
	Corporate	3.248	0,29%	3.184.394.451	11,80%	11.469.681.656,89	9,23%
	Other	274	0,02%	602.287.281	2,23%	2.640.818.832,88	2,12%
	GERÇEK	1.104.071	98,99%	8.252.841.275	30,59%	24.504.644.426,18	19,72%
	Investment Trusts	40	0,00%	64.307.625	0,24%	259.100.026,15	0,21%
	Toplam	**1.107.860**	**99,33%**	**12.495.273.653**	**46,31%**	**40.591.395.567,72**	**32,66%**
Foreign	Investment Fund	2.389	0,21%	10.082.564.460	37,37%	59.576.148.220,54	47,93%
	Corporate	937	0,08%	4.304.343.002	15,95%	23.667.259.473,08	19,04%
	Other	5	0,00%	2.487.378	0,01%	12.387.345,32	0,01%
	Individual	4.123	0,37%	97.660.381	0,36%	440.567.540,79	0,35%
	Total	**7.454**	**0,67%**	**14.487.055.221**	**53,69%**	**83.696.362.579,72**	**67,34%**
Total		**1.115.314**	**100,00%**	**26.982.328.874**	**100,00%**	**124.287.758.147,45**	**100,00%**

Source: MKK

In 2002, the ratio of domestic investments and foreign investments were 51.92% and 48.08% respectively. In 2009, the ratio of domestic investments and foreign investments existed as 32.66% and 67.34% respectively. In addition to that, in 2002, real domestic investments' share

was 42.99% of total investments and foreign fund investments' share was 22.18% and real foreign investments' share was 24.89% of total investments. In 2009, real domestic investments' share decreased to 19.72% and real foreign investments' share decreased to 19.04%. On the other hand, foreign fund investments' share increased to 47.93% of total investments.

In summary, as stated above, foreign investments' share in ISE is increased between2002 and 2009. In addition, fund investments' share in total foreign investments is more than real foreign investments.

Moreover, the increase in the share of institutional investor in the market brings along stability in the market and intensity of the institutional investors in the market as well as the increase in the share of stocks included in their portfolio lead to a decrease in volatility in the markets.

When such issues as the increase of the share of foreigners in ISE, foreign investors' greater weight than institutional investors, institutional investors' investment decisions having a say in determining the extent of important issues such as macroeconomic factors are evaluated together, it is expected that ISE will be affected by changes in macroeconomics.

2.3.4 Macroeconomic Factors' Effects on ISE – 100

The relationship between stock exchange prices and general situation has been a research subject for both economic and finance specialists. According to Barro (1989) sometimes, capital markets overreacts developments in economy, moreover that, stock exchanges are the most risky instrument and stock prices may give rapid reactions over any economic developments. Macroeconomic developments and stock prices, sometimes moves in same direction, sometimes moves in opposite directions. Determining the possible causes of stock market volatility is very crucial for stock market investors and these circumstances make harder to measure macroeconomic factors' affects over stock exchange prices.

Burgstaller (2002) analyzed whether or not returns on stock exchange markets are leading indicator for real macroeconomic developments in Austria, Japan and America. He found causality between

stock markets and macroeconomic developments. In consequence, from one point of view, stock exchange index movements are assume as the most important leading indicator of changes in economic conjuncture. In contrary, some researchers support that, like Zügül and Şahin (2009); stock exchange prices represent the all expectations for future developments. And because of this reason, looking at past data, it is not possible to estimate future stock price movements. In other words, from the efficient market hypothesis, no investors can get higher return than average market return, by analyzing past price movements**.**

2.3.4.1 Relationship between Money Supply and Stock Exchange

Money in circulation can be seen as one of the most important macro factor that affects stock exchange markets. From monetarist approach by Meltzer in 1995, increase in money in circulation effects general price levels and also marginal utility of money affected. According to quantity theory of money, there is a direct relationship between quantity of money in an economy and the level of prices of goods and services sold. In its simplest form, the theory is expressed as:

M * V = P * T where;

M ; is Money supply , the amount of Money available in economy for transactions.

V ; is the velocity of Money, the number of times money changes hands

P ; is the price level

T ; is the number of transactions.

Fisher and other economists, who follow quantity theory of money, assumes the parameters of "V" and "T "will not change for part time. At this point, "M" is the only changeable parameter for the left side of the equation because money supply determined by Central Banks. And "P" is the only sensible parameter for the right side of equation for part time. So, with the increase in money for investors, investors become more willing to invest. This willingness causes increases in stock prices.

Now, we are interested in correlation between money supply and stock exchange market. There is a Tobin's Q[6] terminology in economic literature, it is the ratio between current market value of the investment and reproduction cost f a new investment. According to this, with the increase in stock exchange prices, "q" will increase and increased "q" encourages firms to make new investments. Because of those circumstances firms will sell their investment by higher prices. So, macroeconomic portfolio theory creates new relationship between money supply and real sector.

Money Supply ↑ → Stock Prices ↑ → Tobin's Q ↑ → Investments ↑ → National Income ↑

Fama (1981) determined that there is a strong correlation between money supply and stock exchange returns. Wongbangpo and Sharma (2002) investigate money supply's causality relation over stock exchanges in Indonesia, Malaysia, Singapore, Philippines and Thailand. They concluded money supplies' positive effects over stock exchange markets.

Even though delayed, changes in money supply affect returns from stock exchanges. According to literature of finance, money supply, created by Central Bank, affects stock exchange market in two ways. Firstly, increase in supply, brings positive energy to stock exchange market in short term. On the other hand, for long term period, it is also causes increase in general price levels. Continuous money supply to economy creates increasing inflationary expectations. Secondly, increase in volume of money supply will tend to foreign exchange. That will also cause an increase in volatility of foreign exchange. Foreign investors in host country may disturb from this volatility and may left their investments.

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[6] "*Tobin's Q is a ratio devised by James Tobin of Yale University. The Q ratio is calculated as the market value of a company divided by the replacement value of the firm's assets. A low Q (between 0 and 1) means that the cost to replace a firm's assets is greater than the value of its stock. This implies that stock is undervalued. Conversely, a high Q (greater than 1) implies that a firm's stock is more expensive than the replacement cost of its assets, which implies that the stock is overvalued*." [www.investopedia.com]

2.3.4.2 Relationship between Inflation and Stock Exchange

The relationship between inflation and stock returns is one of the most interested issues for both economic and finance literature. According to "Proxy Effect Hypothesis" there is no negative correlation between stock exchange returns and inflation. Fisher claims nominal rates and inflation are in one-to-one correlation. For this reason, returns from stock exchanges and inflation rates should move in same way. In consequence, because of a belief that returns from stock exchanges will compensate the changes in inflation and it will no effect over investors' purchasing powers.

In contrary, many researchers documented negative relationship between stock returns and expected, unexpected changes in the inflation. According to point of view, in a competitive economy, inflation increases firms' production costs and will reduce cash- flow statements. Thus, there is a negative correlation between inflation and stock exchange prices. Many researchers supported negative effects of inflation over stock exchange prices by focusing to the behaviors of investors. They claims, with the effect of inflation, interest rates will move up and as a result of that, some investors become more willing to invest in risk-free instruments rather than stock exchanges.

Gallagher and Taylor (2002) established a new model to test correlation between stock exchange returns and inflation. In contrary to Fisher, they concluded that there is a strong negative correlation between those two variables.

Moreover that, Chopin and Zhong (2001), at their researches about inflation and stock exchanges, concluded negatively strong correlation between inflation and stock exchanges.

As Unro (1998) mentioned, the proxy-effect hypothesis was first presented by Fama (1981). The phenomenon of the prevalence of negative stock return-inflation can be explained by this hypothesis. The main principle of this version of the proxy-effect hypothesis is that there is an observed negative relationship between inflation and stock returns, and this relationship is spurious since it is caused by a positive relationship between stock returns and expected economic activity and an inverse relationship

between expected economic activity and inflation. In a statistical relationship between stock returns and inflation, inflation is regarded to have only a proxy function for expected economic activity

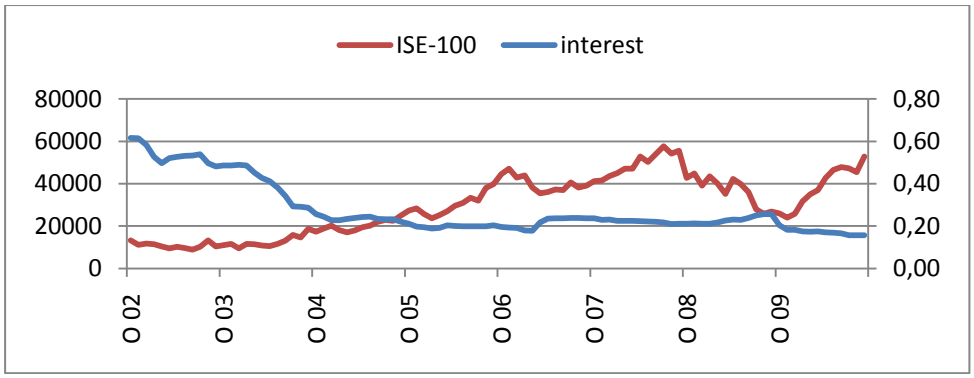
Like Fama, In and Sangbae (2004) supported Fisher's findings in their conclusions. They mentioned positive relationship between stock exchanges and inflation.

2.3.4.3 Relationship between Interest Rates and Stock Exchanges

Interest rates are the ratio which equilibrates money market and capital market relations. A fund usually goes from country in which interest rates in equilibrium to the countries in which interest rates relatively higher than equilibrium level. Changes in demand and supply equilibrium of funds, activates interest rates. In other words, if there is a funding gap in an economy, interest rates moves upward to get the essential fund level. In contrast, when there is an excess in an economy, interest rates moves in downward way. Investment in bank deposits is an alternative investment instrument against investing to stock exchanges. This upward way of interest rates causes a decrease in investment of stock exchange market because; perceptions of investors' will change against this interest rate action. In other words, return from investing to bank deposit will increase by same risk level, so, investors will leave investing in stock exchange market. In short, we can conclude that, there is a negative relationship between interest rates and stock composite indexes, any increase in policy rate leads to a decline in stock prices.

"Figure 4" shows data set of both interests and ISE- 100 between 2002 and 2009. As we see from the graph, since 2002 interest is in a downward trend. At the beginning of 2002, interest rates was at % 60 level, on the other hand, at the end of 2009 interest rates decreased to % 15 level. In same time period, ISE- 100 increased to 52000 from 13000.

Figure 4 : Relationship between ISE-100 and Interest Rate.



Source: Central Bank of Republic of Turkey

In first quarter of 2006, ISE-100 decreased nearly %20, from 46000 to 37000. In the mean time interest rates increased by 4 points, it reached to % 23 levels from % 19 levels. Likewise this inverse correlation, with the effect of 2008 world-wide crisis, ISE- 100 loses in value by nearly 30000 points in one year. Indexes decreased from 55000 point levels to 25000 point levels and interests increased to % 25 levels from % 21 levels. Again, by the loss of 2008 crisis effect, ISE-100 index reached to 52000 point levels in one year period and interests decline to % 15 levels from %20.

Interest rate is the most important factor that effects competition between stock exchange and bonds. If we assume there are only two markets; stock exchange market and bond market, an increase in bond interest rates causes an increase in return from bonds and bond prices will decrease. At that time, investors moves their investments from stock exchange market to bond market. This sale in stock exchange market decreases prices of stocks. In contrast, by any decrease in bond interest rates, return from bond will decrease and prices of bonds will increase. As a result, bonds can be seen as an alternative instrument against stock exchange investments. Basically interest is one of the most popular and the best reflect the general view of the economy.

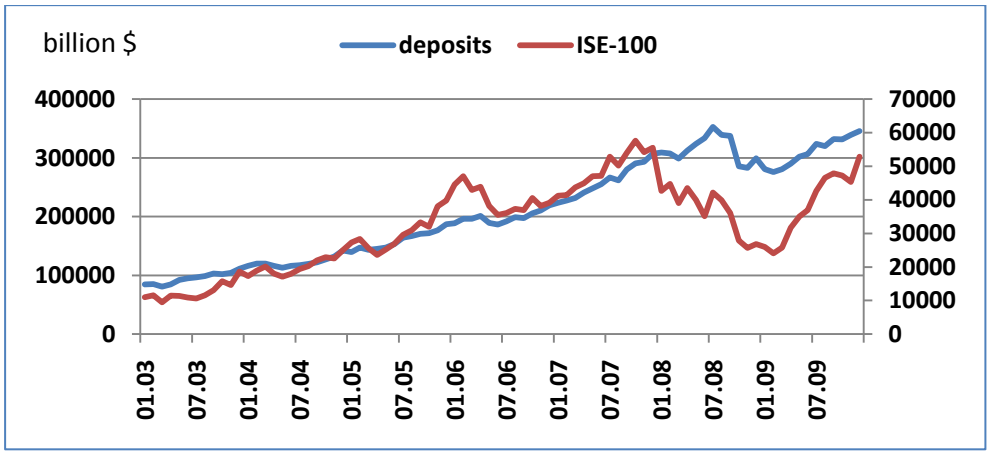
By the effect of globalization, portfolio diversification between countries becomes widened; this is one of the other reasons why banking deposits and stock exchanges increased. For taking the relatively higher

return from interests' foreign capital moved to Turkey. That foreign capital comes to host country for both interest investments and stock exchange investments.

Stock exchange index and deposit accounts, especially in crisis periods, are inversely proportional. An increase in index causes a decrease in rates because of the characteristics of money. Investors' decisions, with same risk level, always move to the highest return. From that point; money will go to capital market if there is a decrease in interest rates. With this movement of money between markets, demand for stock exchanges will rise. Similarly, stock exchange prices may decrease by the effect of an increase in interest rates. In crisis time periods, volatility increases and that uncertainty disturbs both local and foreign investors. Investors become unwilling to invest in stock exchanges because of high volatility and they mostly prefer to invest in risk free investment instruments.

"Figure 5" is monthly time period for both banking deposits and ISE-100 index. At the end of 2002, deposits in banks were 84575 billion dollar.

Figure 5 : Relationship between ISE-100 and Banking Deposits.



Source: BRSA (http://ebulten.bddk.org.tr/AylikBulten/Gelismis.aspx)

As we see from the graph, since 2003, banking deposits in a raising slope. In 7 years period, banking deposits increased nearly 4 times more and reached to 345588 billion dollar. In same year period, ISE- 100 index

increased nearly five times. Strong inverse correlation can be seen 3rd quarter of 2007. With an effect of 2008 crisis, interest rates moved up and ISE-100 index decreased. By the effect of globalization, portfolio diversification between countries becomes widened; this is one of the other reasons why banking deposits and stock exchanges increased. For taking the relatively higher return from interests' foreign capital moved to Turkey. That foreign capital comes to host country for both interest investments and stock exchange investments.

Apergis and Eleftheriou (2002) analyzed correlation between stock exchange returns and inflation and interest rates. According to their conclusion, in Athens, stock exchange prices are more correlated with inflation rather than interest rates. In other words, there are no empirically correlation results between stock prices and interest rates.

Rigobon and Sack (2004) for Unites States, Rigobon and others (2005) for United States and European zone, analyzed the relation between policy rates and stock exchange market. In both two researches, negative correlation between policy rates and stock exchange market concluded.

2.3.4.4 Relationship between Exchange Rate and Stock Exchanges

Foreign exchange transaction is the exchange of domestic country's money for another country's money. In short, exchange rate is the price of one country's money in terms of another's.

Exchange rate can be seen as a key element of balancing the demand for and supply of assets. For individuals, an increase in the domestic stock prices causes an upward shift for domestic assets. For buying more domestic assets, domestic investors will sell foreign assets, which will cause appreciation in domestic currency and increase in stock prices.

According to researches of Kim (2003) it is believed that the major function of financial markets in open market economies is to transfer the savings to investment. In recent years, this has been the most important function of financial markets due to globalization. As a result, the number of investors dealing with the international portfolios is increasing day by day, and market approach is becoming a dominant model. The effect of

globalization is reflected to international trade and capital investments as an increase. Thus, it is clear that globalization increases demand and supply of foreign exchange as well. The ongoing increases in the world trade and capital movements are known to play an important role in making the exchange rates one of the main determinants of business profitability and equity prices.

Today there are highly integrated financial markets that provide international portfolio investors with reasonable close substitutes in domestics and foreign assets (stocks). They can have domestic and international securities from expected returns and risks. According to the portfolio theory, as mentioned by Fang and Miller (2002), investors will hold bigger rates of an asset if the return of that asset is higher and the return of that asset is lower on competing assets when the other factors such as riskiness are equal. Both the rate of return of foreign investors in domestic assets and the rate of return on domestic investors that hold of foreign investment are affected by the rate of depreciation of the domestic currency.

Many economists searched the relationship between stock prices and exchange rates and the direction of this relation. But there is no empirical or theoretical consensus about the relationship and exchange rates either.

According to the most researches, the results show that the depreciation in currency have a negative effect on stock market prices. That means exchange rates have a crucial role in determining investments. In other words, a movement in exchange rate importantly changes the evaluation of stock market investment decisions.

In contrast, positive relationship between stock prices and exchange rate can be explained by; appreciation in domestic currency makes local firms more competitive, which will cause an increase in their exports. An Increase in firms' investments, the value of the firms will be higher. This raises the stock prices of that firm.

Franck and Young (1972) accepted as the first study about relationship between stock prices and exchange rates, by using six different

exchange rates. The conclusion was there is no correlation between these two variables.

Aggarwal(1981) analyzed the effect of exchange rate on U.S. stock prices. His result showed that stock prices and exchange rates are positively correlated.

It is commonly accepted in literature that an increase in the real balances will result in an increase in the interest rates, thereby ensuring financial assets more attractive. They examined long run relationship between stock prices and exchange rate, by using Granger causality test. According to them, there is no long run relationship between these two variables, but they found dual casual relationship in short run. Consequently, portfolio adjustment of investors will lead to appreciation of the domestic currency, in other words stock prices cause's exchange rates. And this is supported by finding of Nieh and Lee (2001) who report no long run equilibrium for G-7 countries.

Bartov and Bodnar (1994) concluded synchronous changes in dollar have little power in explaining abnormal stocks returns.

Markurgee and Noka (1995) found that stock market prices are co-integrated with the exchange rate in eight industrial economies.

Ong and Izan (1999), by using Non Linear Least Square Method, examine the relation between stock prices and exchange rates. They conclude very weak relationship between U.S equity market and exchange rates.

Nieh and Lee (2001), searches the relationship between stock prices and exchange rate for G-7 countries, by daily prices. They conclude there is no long run equilibrium relationship between stock prices and exchange rates for G-7 countries.

Kim (2003), by using monthly data, searches the relationship between common stock prices of S&P and exchange rate. Conclusion of the study shows that S&P common stock price is negatively completed to exchange rate.

Kasman (2003) examined the relationship between Istanbul stock exchange and exchange rate, by using daily data. According to conclusion, there is dual way causality relationship between stock prices and exchange rates.

Erbaykal and Okuyan (2007) examine stock prices and exchange rate relations for 13 developing countries include TURKEY, using different time periods for each country. They found no causality for these variables in Turkey.

Sevuktekin and Nargelecenkenler (2007) they found positive and bidirectional causality between stock prices and exchange rate for Turkey, by using monthly data.

2.4 Researches about Volatility of ISE

Since volatility is perceived as an explicit measure of risk, financial economists interested with accurate measures and forecasts of future volatility and, undoubtedly, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model has been widely used for doing so. Increasing interest for volatility of stock exchanges began with mid 1990s for Turkish economists and financial researchers.

Dağlı (1996) investigate risk and return structure of ISE, by comparing Emerging stock markets between the periods of 1976 and 1992. He concluded that Argentina 1st and Turkey was the 4th country in terms of highest return. In analyze of risk levels of countries, Argentina had the highest standard deviation, which supports correlation between return and risk. How higher the return, the riskier the market. On the other hand, Turkey observed as 2nd highest risk level country, which means return from ISE did not compensate the undertaken risk.

Balaban, Candemir and Kunter (1996) in their research, analyze the volatility of ISE Composite Index by Box-Jenkis method. They use monthly data between 1988 and 1995 and they concluded Arma method's success in modeling volatility of ISE Composite Index.

Yavan and Aybar (1998) become the first people who give voice to negative asymmetry and volatility clustering in Istanbul Stock Exchange. Yavan and Aybar tried to model the variability of Istanbul Stock Exchange composite index via ARCH models. GARCH (1.1) is a successful prescience for volatility of ISE return, concluded by them. Moreover, Yavan and Aybar claimed, conditional variance of return from ISE affected from lagged shocks.

Balaban (1999) verified volatility performances of 17 different models and his research was the first research about forecasting performance of volatility in Turkish Equity Market.

According to Gökçe (2001), forecasting the time series analyses, like stock exchange prices and foreign exchange rates have great importance for investors. Especially because of their compatibility with high frequency financial data, the ARCH and GARCH models are the prominent modeling techniques in comparison with the other models. Gökçe (2001) concluded that the volatility calculated by use of the ARCH models can be interpreted as "*leading indicator*". Gökçe (2001) researched the best model for the explanation of volatility of ISE, by using ARCH models. In his research for Turkish stock exchange market, he conducted by testing 6 different changed variance models with various delay lengths for modeling the return equation According to his results, by using 2245 daily observations, GARCH (1,1) is the best model in explaining volatility of ISE-100 index. Moreover, he also claimed, there is a positively strong correlation between trading volume and daily return.

Aydin (2003) analyzed movements and volatility of ISE – 30 index and verify there is no normal distribution in returns of stock exchanges. He compared Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and Exponential Weighted Moving Average (EWMA) models in explanation of volatility of ISE and concluded GARCH (1.1) is better than EWMA.

Özer and Türkyilmaz (2004) studied the effects of 2001 crisis in Turkish Capital Markets. They founded ARCH effect on ISE – 100 index but no effect on exchange rate.

Mazıbaş (2005) analyzed volatility of ISE services, financial, industrial and technology indexes by using 15 different symmetric and asymmetric models. In his research, daily, weekly and monthly data were used and in forecasting volatility. He concluded, weekly and monthly data were more prophetic in compare to daily data set.

Turanlı, Özden and Vural (2007) researched ISE volatility between January 2002 and December 2006 in daily returns. According to their conclusion, ARCH (1) and GARCH (1,1) gives satisfactory results in determination of return volatility of ISE.

Atakan (2009), examined modeling volatility by ARCH and GARCH for Istanbul Stock Exchange, in which especially high-frequency financial data are used, she indicates that instead of linear time series models, the use of nonlinear conditional variance model is a necessity. When studies in literature conducted on volatility are investigated, it is seen that the most successful results are obtained from the ARCH/GARCH type models in explaining the conditional variability.

3. Methodology and Data

3.1 Data

In the study, monthly data of ISE-100 index were analyzed. The data obtained from the official site of the ISE are the observations logarithmic transformation of monthly 95 closing values belonging to 2002-2009 period was made. As independent variables that can have effect on the ISE, consumer price index (cpi) – interest rates (interest) – Exchange rate (exchange) and money supply (money) were put in the model and they were exposed to the test. The macroeconomic variables used are also the monthly data belonging to the same period and they were obtained from the CBT, Matrix program and the TurkStat databases. While the logarithmic analyses of the values used in the study were performed in the computer environment, the E views 6.0[7] econometrics program was used.

3.2 Methodology

Time series are the expressibility of economic variables with values they have gained at a certain time interval. In order to achieve significant results in these series, it is necessary that the series be stationary.

Stationary process is defined to be a stochastic process, in which joint probability distribution does not change when there is a shift in time or space. Therefore, it is stated that stationary series have constant mean, constant variance and constant auto co-variances for each defined lag. Consequently, it is also known that parameters such as mean and variance do not change according to time or position. As a result, stationary is a tool used in time series analysis, in which the raw data experience a transformation process to be stationary.

As a view of Gujarati (2005), stationary expresses the statistical balance based on the basic idea that probability positions that are dominant in the process do not change with time. In other words, it means that mean and variance are constant in time and that the co-variance of the variables in

[7] E views 6.0 provided by Istanbul Bilgi University

the two delayed time periods depends on delay between variables but does not depend on time.

The reason why the series are fixed is to get assumptions belonging to error term. By this way, errors whose mean is zero, whose variance is constant and which is evenly distributed around the mean are obtained.

Although, in reality there is not a relationship between variables in analyses, in which stationary series are used in non-stationary series, it is possible to meet spurious regression due to the trend in series.

In order to apply analyses in time series and get accurate results, there should not be a trend in the serial and it should be constant. However, since variables in time series analysis generally have a trend for either an increase or a decrease, the conducted analyses generate spurious regression results. Therefore, it is necessary that the time serial be fixed and the trend be eliminated.

In order to test whether or not a time series variable is non-stationary, a unit root test uses an autoregressive model. In literature, Dickey and Fuller test is believed to be the pioneers of testing a unit root in time series. Their augmented test is regarded as a valid test especially in large samples. Another instrument used for unit root test is the Phillips-Perron test. Both tests are based on the fact that a unit root is used as the null hypothesis.

The Dickey-Fuller (DF) test is a test used in determining whether the observed serial is constant or not. The DF test is based on the assumption that error terms are independent and the distributions are in the same way. In order to overcome the problem of autocorrelation encountered in the DF test, the Augmented Dickey-Fuller (ADF) test emerged.

The Augmented Dickey-Fuller (ADF) test, which is used for a unit root in a time series sample, is another version of the Dickey-Fuller test. It is generally applied to a relatively larger and more complicated set of time series models. The test uses an augmented Dickey-Fuller (ADF) statistic with a negative number. It is believed that according to how much negative this number is, it is strongly possible to reject the hypothesis that there is a

unit root at some level of confidence. The main objective of the test is to see whether the null hypothesis that,

$\varphi = 1$ in

$yt = \varphi yt{-}1 + ut$

against the one-sided alternative $\varphi < 1$. Thus the hypotheses of interest are

H_0: series contains a unit root

H_1: series is stationary.

Although there seem to be some similarities between the Phillips-Perron test and the Augmented Dickey–Fuller test, they are different because the latter contains an automatic correction in order to achieve auto-correlated residuals. However, the results that can be obtained by the Phillips-Perron tests agree with the ones obtained by the Augmented Dickey-Fuller test.

3.2.1 ARCH Model

ARCH stands for Autoregressive Conditional Heteroskedasticity. It is a kind of technique for modeling the volatility of an asset over time. ARCH models are commonly employed in modeling financial time series that exhibit time-varying volatility clustering followed by periods of relative calm. Traditional time series and economic models operate under the assumption of constant variance. Autoregressive Conditional Heteroskedasticity, exists as an alternative against traditional time series models. ARCH allows the conditional variance to change overtime as a function of past errors leaving the unconditional variance constant [Bollerslev 1986]. Because of this reason, as Harvey mentioned in 1991, ARCH model assumed as good acknowledgement in the composition of variability of variance and regression.

From the study of Engle in 1982, first degree autoregressive model is given by;

(1) $Yt \parallel \Psi t\text{-}1 \sim N (X_{t\beta} , h_t)$

(2) $H_t = \varepsilon_{t-1} , \varepsilon_{t-2} , \dots , \varepsilon_{t-q}, \alpha)$

(3) $\varepsilon_t = Y_t - X_{t\beta}$

As Enders (2004) mentioned, conditional variance (ht) is dependent to; Yt-1 actualized information set. This information set is composed of exogenous variable and regarded endogenous variable and their β vectors.

Ht; Conditional Variance used in ARCH model

∞; Vector of unknown parameters, defined by (ENGLE, 1982)

Moreover that,

$X_{t\beta}$; conditional average of Yt

α and β; parameter vectors

Xt; vector of exogenous and lagged endogenous variable

Both Ytβ and Ht components are the function of Ψt information set.

Equation (3), showed us, $\varepsilon_t = Yt - Xt\beta$, from there, with the use of residual squares AR (q) process,

(4) $h_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 \varepsilon^2_{t-2} + \dots + \alpha_q \varepsilon^2_{t-q} + Vt$

can be expressed if parameters of $\alpha_1, \alpha_2 , \dots \alpha_n$ equals to the value of zero, forecasted variance equals to α_0 constant. Otherwise, Yt's conditional variance exists slowly when compared with autoregressive process. At the equation (4) Vt is white noise process and Vt is independent from ε_{t-q} [8]*. So we can rewrite the equation as;

$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-i} V_t$

[8] White noise process, is a random process of random variables that are uncorrelated, have mean zero and a finite variance.

* According to Papoulis, we shall say that a process Vt is white noise, if its values V (ti) and V (tj) are uncorrelated for every ti and tj ≠ ti; C (ti , tj) = 0 and ti ≠ tj.

This model can be named as q^{th} rank of ARCH model. The residuals of Arch (q) model comes from; autoregression, ARMA model or standard regression model.

Enders (2004) defines that, for {Yt} and conditional variance forecasts likelihood models usable. For that that reason; equation (4) linear specification is commonly useful. From there, with the new identification of V_t's multiplicative residuals, equation may become more useful. As Enders (2004) mentioned, the most understandable and useful example suggested by Engle. This is defined as;

$$\varepsilon_t = V_t H_t^{1/2} \text{ or } \varepsilon_t = V_t [\, \alpha_0 + \alpha_1 \varepsilon^2_{t-1} \,]^{1/2}$$

V_t is the white noise process $\sigma^2 V_t = 1$ and ε_{t-1} are independent from each other. Moreover that, α_0 and α_1 are constant and $\alpha_0 > 0$, $0 < \alpha_1 < 1$.

V_t has white noise process and independent from ε_{t-1}. As a result of those the proof of $\{\varepsilon_t\}$ series' zero average and uncorrelated is easy.

Firstly, take the unconditional expectation of ε_t and because of $E(V_t) = 0$;

$$E(\varepsilon_t) = E[\, V_t (\alpha_0 + \alpha_1 \varepsilon^2_{t-1} - 1)^{1/2} \,]$$

$$\Rightarrow \quad E(V_t)\, E(\alpha_0 + \alpha_1 \varepsilon^2_{t-1} - 1)^{1/2} = 0$$

$$\Rightarrow \quad E(V_t, V_{ti}) = 0 \text{ , therefore;}$$

$$\Rightarrow \quad E(\varepsilon_t, \varepsilon_{t-i}) = 0 \text{ and } i \neq 0 \text{ .}$$

When we take ε_t ' s square and unconditional expectation;

$$E(\varepsilon_t^2) = E[\, V_t^2 (\alpha_0 + \alpha_1 \varepsilon^2_{t-1} - 1) \,]$$

$$\Rightarrow \quad E(V_t^2)\, E(\alpha_0 + \alpha_1 \varepsilon^2_{t-1} - 1) = 0$$

$\sigma^2 V_t = 1$ and ε_t conditional variance and ε_{t-1} conditional variance are coincide. I mean;

$E(\varepsilon_t^2) = E(\varepsilon_{t-1}^2)$. So, unconditional variance equation can be modifying as;

$$E(\varepsilon_t^2) = \alpha_0 / (1 - \alpha_1)$$

By this modification, unconditional averages and variances not affected from error process. In a similar vein, it is possible to show ε_t

conditional average is equal to zero. V_t and ε_{t-1} variables are independent and $E(V_t) = 0$. So, ε_t's conditional average calculate;

$$E(\varepsilon_t \setminus \varepsilon_{t-1}, \varepsilon_{t-2}, \ldots) = E_{t-1}(V_t)\, E_{t-1}(\alpha_0 + \alpha_1 \varepsilon^2_{t-1})^{1/2} = 0$$

In conclusion, according to Enders (2004), average is zero and variance is constant and auto covariance is zero. That shows us, $\{\varepsilon_t\}$ series not affected from $\varepsilon_t = V_t\ h_t^{1/2}$ process. On the other hand, in conditional variance cases, the effects of the process will decrease. Because, $E(V_t)^2 = 1$ and the variance of ε_t is effected from ε_t's previous actualized values (i.e $\varepsilon_{t-1}, \varepsilon_{t-2}, \ldots$)

$$E(\varepsilon_t^2 \| \varepsilon_{t-1}, \varepsilon_{t-2}, \ldots) = \alpha_0 + \alpha_1 \varepsilon^2_{t-1}.$$

The variance of ε_t dependent to actualized value of ε^2_{t-1}. If ε^2_{t-1}'s actualized value is large at the time of "t", conditional variance is also large.

3.2.1.1 Constraints of ARCH Model

Conditional Variance (ht) should be positive for all actualized values of ε_t's. So;

$\alpha_0 > 0$ and

$\alpha_1 > 0$, i = 1, 2, 3, … , q

Another constraint;

To make the dynamic stabilization of the equation, all α parameters, except constant term or the summation of all parameters should be less than one.

$$\sum_{i=1}^{q} \alpha_i < 1$$

Engle (1982) defines that, this constraint is important for reaching stabilization. If this constraint is transgressed, in other words, if summation of α_i comes more than 1, process will face with an endless variance.

3.2.1.2 Weak Sides of ARCH Model

ARCH model assumes that, both positive and negative shocks have similar effects on volatility, because it is correlated with squares of previous shocks. On the other hand, in practice, the response of an asset is different

against positive and negative shocks. In short, ARCH model assumes symmetric responses.

Tsay (2002) assumes that, ARCH model is restrictive in parameters and the higher the degree of ARCH causes more restriction complexity.

Moreover that, Tsay (2002) also states, ARCH model provides a mechanic way to understand the behavior of the conditional variance. ARCH model does not show new insights for understanding the sources of financial time series. Moreover, ARCH model is not enough in forecasting.

3.2.2 GARCH Model

After Autoregressive Conditional Heteroskedasticity (ARCH) model created in 1982, its uses increased in both macroeconomic models and financial data modeling. In other words, ARCH assumed the difference between changing variance overtime and unchanging unconditional variance, as a function of residuals. Lagged structure is included in ARCH model, that's the biggest problem faced in ARCH models. By setting constraints in to lag structure of model, model may shorten linearly. To solve those kinds of problems, improved types of ARCH models existed. Bollerslev (1986) Generalizad Autoregressive Conditional Heteroskedasticity (GARCH) is also one of improved model of ARCH.

GARCH is one of the most preferable methods in volatility modeling systems. This model is not only criterion of volatility; it is also an instrument that shows continuity of shocks over volatility.

GARCH is a model, in which more information based on past and has more flexible lagged structure. Moreover that, in ARCH (p) process, conditional variance is just linear function of past sample variance. On the other hand, GARCH (p,q) process, conditional variances' lagged values included to model. Cromwell, Labys and Terraza (1994: p.56) states that;

> "if changes of variance are external, GARCH model may preferable compared to ARCH model. Besides, in ARCH (q) model, lagged structure is too long. By use of GARCH model, lagged structure may shorten and model becomes more useful."

$$Yt \parallel \Psi_{t-i} \sim N(X_{t\beta}, h_t)$$

$$H_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-i} + \sum_{j=1}^{p} \beta_j h_{t-j}$$

$$\Rightarrow H_t = \alpha_0 + \alpha(L)\, \varepsilon_t^2 + \beta(L)\, h_t$$

$$\varepsilon_t = Y_t - X_t\beta$$

Conditional variance, in GARCH model, changes dependently with p and q parameters.

ε_t ; is a stochastic process acquired by least squares.

Ψ_t ; data information at time t.

Y_t range has 0 conditional variance which depend upon Ψ_{t-i} data information set. Moreover that, Y_t range has normal distribution with h_t conditional variance. ε_t's conditional variance is illustrated ARMA process by h_t and it is named as GARCH (p,q).

GARCH (p,q) model takes the notice of both autoregressive and moving average variables, If we take p = 0 and q = 1 first degree of ARCH models turns into GARCH (0,1) . So, if all β_j parameters are equal to zero, we can conclude that GARCH (p,q) model is equal to ARCH (p) model. At this point, it's easy to understand the benefits of GARCH (p,q) model; the higher degree ARCH model, shows more parsimonious GARCH model in terms of number of parameters.

> Enders (2004: p.118) mentioned "all coefficients of h_t equation should be positive.

So, parsimonious model's benefits and success in forecasting stage exists once again. If; p = q =0, ε_t will have white noise process.

3.2.2.1 Constraints of GARCH Model

All parameter restrictions of ARCH model hold true for GARCH model. To get positivity, also for GARCH model, negativity provision for parameter should be procured. GARCH (p,q) ;

$p \geq 0$, $q \geq 0$

$\alpha_0 > 0$, $\alpha_i > 0$, $\beta_j \geq 0$

i = 1, 2, 3… p

j = 1, 2, 3 …, q

3.2.2.2 Stationary Conditions of GARCH Model

$$H_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon^2_{t-i} + \sum_{j=1}^{p} \beta_j h_{t-j}$$

In order to obtain the stationary condition of the model, the conditional heteroskedasticity (h_t) equation can be written as follows, by using lag processor (L);

$$H_t = \alpha_0 + \alpha (L)\, \varepsilon_t^{\,2} + \beta (L)\, h_t$$

The constraints belonging to the GARCH (p.q) process defined in the previous expressions can be shown all together as:

- $E(\varepsilon_t) = 0$
- $VAR(\varepsilon_t) = \alpha_0 / 1 - \alpha(1) - \beta(1)$
  - $\alpha / 1 - \sum_{i=1}^{p} \alpha_i - \sum_{j=1}^{p} \beta_{ji}$
- $Cov(\varepsilon_t, \varepsilon_j) = 0 \;, t \neq 0$
- $\alpha_1 + \beta_1 < 1$ or $\sum_{i=1}^{p} \alpha_i + \sum_{j=1}^{p} \beta_j < 1$

Bollerslev (1986) stated that when these conditions are met, the process will have a co-variance stationary and finite variance. According to Greene (1993) the last conditions above implies the necessity of the fact that the sum of the parameter values of the conditional heteroskedasticity equation in the GARCH model should be lower than 1. This condition is very important to obtain the finite variance belonging to the model. When it is taken into consideration, the unconditional model is seen to be equal to classical regression.

3.2.2.3 Weak Sides of GARCH Model

According to Tsay (2002) GARCH model has the same weakness sides as ARCH model. For an example, model gives the same reactions to both positive and negative shocks. Moreover that, according to high frequency financial time series empirical analyses, it can be easily observed that, GARCH model Tail behavior is even shorter than student – t distributions. And also there are many restrictions in parameters.

3.2.3 Value at Risk

The crises experienced in the globalized world in recent years have revealed the necessity of an effective risk management system. The lack of an effective mechanism of risk measurement has been demonstrated to be the main factor for many crises experienced in the market. Therefore, there has appeared a need for a system revealing with a single figure the statement of the loss, in other words the size of risk that may occur in the value of financial assets that have been invested in a certain time period.

According to Kiam (1997) *"risk"* is generally used with the concept of *"uncertainty"*. In other words, risk is exposed to uncertainty.

Value at Risk (VaR) is a new concept which was first initiated by JP Morgan in 1994. The VaR is used to measure market risks and record the results in a standard way.

According to JP Morgan (1996:6), the VaR is defined as a method expressing the maximum loss that may occur in financial markets at a certain confidence interval and in a certain time period from a prospective point of view and with a term-as money value- that can easily be understood by everybody.

The exploration of financial risk management has been stimulated by two important studies. The first study was conducted by Engle (1982) to analyze volatility estimation models. The other study, including the Risk Metric Methods, was conducted by JP Morgan on the Wall Street. It is based on a mathematical and statistical methodology which measures the portfolio's market risk.

The demand of accurate portfolio risk measurement is believed to be increased by volatility in returns. Investors behave more perceptively about their return and loss on their investments. The VaR method gives investors a possibility of measuring the risk they have with a single figure. The simplicity of its calculation method and ease of interpreting have made it popular among financial institutions. Financial institutions and other firms prefer the VaR method because it gives them an opportunity to evaluate the risks and cash flow in their institutions and in other firms to derive at the hedging decisions.

Despite its being accepted as one of the most effective risk management tools, the VaR method is criticized by many for not being sufficient enough to monitor all risks. Therefore, by using the VaR method, it is not possible to assess all risk management challenges.

Volatility is defined as a statistical measurement of an asset price movement. If the volatility is high, then there is a high possibility of return or loss. According to Culp, Mensink and Neves (1999:3), the VaR statistically defines one number of maximum loss per day- week- month etc. In other words, it is a statistical summary of a financial asset or portfolio in terms of market risk. Since the VaR is used to measure risks, it estimates the accurate loss number volatility.

VaR is used to measure the maximum effect that risk factors may have on portfolio values. In other words, the aim is to determine the acceptable maximum loss and to be protected from the possible risks.

Traditional measurements of VaR relied on the assumption, that standard deviation does not change over time (homoskedasticity), Engle (2001) argues that *"we get much better estimates by using models that explicitly allow the standard deviation to change of time (heteroskedasticity)."* He recommends ARCH and GARCH which obtains better variance forecasts and better measures of Value at Risk.

Korkmaz and Aydin (2002) analyzed ISE – 30 Index return volatility by using EWMA and GARCH methods. VaR numbers calculated by using both methods and they concluded results were satisfactory for forecasting volatility at 95% and 99% levels. In comparison, they concluded GARCH provides more accurate analyses than EWMA.

The effectiveness of the VaR models was also tested by Hendricks (1996). He wanted to compare and demonstrate the similarity of the risk number measured by the VaR and the real risk. Although he used different VaR models, he could not find a method superior to others.

According to Simons (1996), there are two main restrictions of the Value at Risk. The first restriction is that the VaR focuses on only one point in distribution of profit and loss. The second restriction is that the VaR may

be so weak that it cannot be possible to measure the accurate risk number in extreme market conditions.

Jorion (1997) stated that the VaR cannot be a perfect measurement tool. Moreover, the weak sides of the VaR are also mentioned in Jorion (2000). He states that because of its disadvantages, it cannot be a perfect measurement tool.

The use of filtered historical simulation techniques was suggested by Barone, Adesi and Giannopoulos (2000) in a study in which they analyzed the VaR number by variance – covariance and simulation techniques.

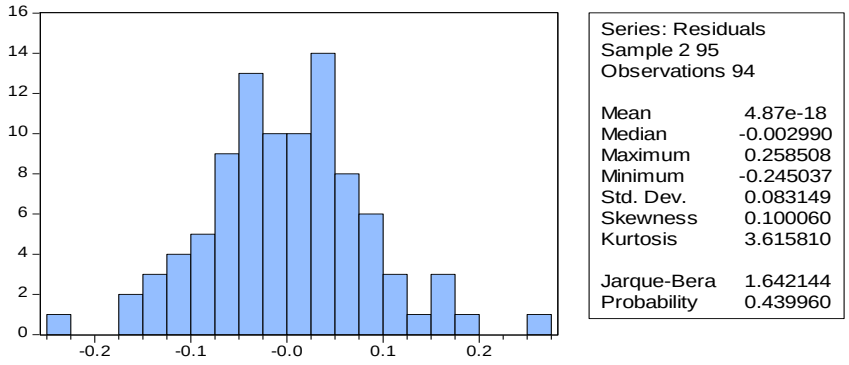
4. Findings and Results

4.1 Descriptive Statistics and Preliminary Tests

In order to find out whether the return series of the dependent and independent variable values, whose logarithmic transformations were made, used in the study were constant, the unit root tests were implemented.

In order to test the constancy of the series, first of all the first differences of the series were taken and then the augmented Dickey Fuller Unit Root test was applied to each variable serial. According to the data in the *"Table 4",* the test statistics were found to be more negative than the critical values. For that reason, it is believed that the null hypotheses of a unit root test are rejected. Therefore, the variables are observed to be first order stationary.

Figure 6 : ISE-100 Index Return Distribution Statistics



From the *"Figure 6",* skewness (0.10006) is slightly positive, and there is skewed distribution to the right.

There should be values around Kurtosis (3,6158) ➔ kurtosis for a normal distribution =3 and skewness=0.

Jarque- Bera test is used in calculating the skewness and kurtosis values and it serves to explain whether the error term is normally distributed. When JB value is compared to Chi square with 2 degree of freedom (5%):

Chi square = 5,99 & jarque-bera =1,6421

H_0: error term distribution is normal

H_1: error term distribution is not normal

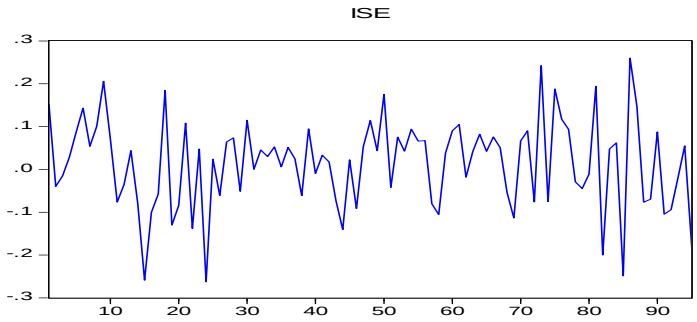
- JB<K^2, H_0 cannot be rejected. As a result,

  Error term distribution is normal and therefore the t and F values are reliable.

  In other words, the parameters are statistically significant.

From the *"Figure 7"* the volatility clustering in the ISE return series are clearly observed. In other words, as Mandelbrot (1963) mentioned, high changes are followed by high movements, whereas low changes are followed by small movements.

Figure 7: ISE-100 Log Return.



As is seen in *"Table 5"*, according to the results obtained from the ISE-100 return index correlogram, the ISE – 100 is not affected from its own previous monthly values. In other words, this result means that an auto correlogram does not exist.

4.2 Economic Indicators and Their Effect on ISE

A model was created with the macro factors with 4 independent variables (cpi, interest, money, exchange), which are thought to affect the ISE return *"Table 6"*. Results demonstrate the findings of the regressed variables. Coefficient values of variables' statistical significance are tested by "*probability*" values. In equation, probability values changes between 0.0 and 0.4974 and values under %1, %5 and %10 can be interpret as significant. As it seen from the table only exchange rate probability is significant. *R-squared* value is 0.35070, which means changes in dependent variable can be explained by only %35 of independent variables. The

remaining %65 shares can be explained by other un-used dependent variables. From the point of *F statistics*, the value is 12.15274 and this is bigger than F statistics table value at 0.05 confidence level.

$H_0 = p^2 = 0$; There is no linear relationship between dependent variable and independent variables and regression is not significant.

$H_1 = p^2 > 0$; There is linear relationship between dependent variable and independent variables and regression is significant.

⇨ $12.15274 > 2.70$; H_0 is rejected.

Heteroskedasticity analyze of data are shown in the *"Table 7"*

H_0: There is no variable variance.
H_1: There is variable variance.
According to 0.05 confidence level, 2.70 and 1.103 values;

⇨ $2.70 > 1.103$, H_0 accepted. So it's concluded that there is no variable variance.

Interpretation of Return relationship between ISE – 100 index and selected macroeconomic variables;

Stock exchange market is affected from inflation like any other money markets. With high inflation, purchasing power decreases, this as a result causes a decrease in demand for goods and services. As a result of this, stock exchange values also decreases. Research results go parallel with that point of view, because findings from equation, there is a negative correlation between ISE-100 index and inflation.

There are two different views about correlations between exchange rate and stock exchange market. According to findings from equation, there is a positive correlation between stock exchange market and exchange rates.

Interest rate is the most important factor that affects competition between stock exchange and bonds. If we assume there are only two markets; stock exchange market and bond market, an increase in bond interest rates causes an increase in return from bonds and bond prices will decrease. At that time, investors moves their investments from stock

exchange market to bond market. This sale in stock exchange market decreases prices of stocks. In contrast, by any decrease in bond interest rates, return from bond will decrease and prices of bonds will increase. As a result, bonds can be seen as an alternative instrument against stock exchange investments. Findings in this paper exhibits are different results from this expectation. The results show that there is a positive correlation between interest rates and ISE-100 index.

Money in circulation is one of the most important macro factors that affect stock exchange markets. For short term, increase in money supply causes an increase in general price levels. As a result of that, prices of stock exchanges will increase. In contrary to this, in monthly time analysis, there is a negative correlation between money supply and stock exchanges. The equation results can be explained by the premise of; increase in supply stimulates stock exchange market in short term. On the other hand, for long term, it is also causes increase in general price levels. Continuous money supply to economy creates increasing inflationary expectations. As a result of this expectation both local and foreign investors may disturb and become unwilling to invest.

In addition, because of the possibility that the created equation can be affected by the previous period's values in the independent variables in the ISE, the created model was taken 4 lag back *"Table 8"*. Then in order to find out the changes among the observation values highly affecting one another, the correlogram structures were investigated. The model was run again by analyzing the covariance matrix tables and its significance was investigated in "*table 9 and 10*". After the necessary covariance matrix analyses were made, the equation was set up again. After the model was analyzed, it was investigated whether there was a heteroscedasticity problem. Since no heteroscedasticity problem was observed, the White correction was not added to the model.

4.3 Volatility Structure

As a result, in the role model created for explaining the ISE return volatility, the mean equation structure was found to be as ISE = C + EXCHANGE + INTEREST + MONEY (-1) and it is shown in *"Table 11"*.

While the R-squared value of the established model is 0.36914, the Adjusted R-squared value is 0.34811. Although the obtained values do not economically bear sufficient meanings at this level, the model Prob. (F-statistic) < 0.05 value indicates that the coefficients are significant, in other words, the model is statistically significant. According to the results obtained from the model, it was observed that a 1% increase experienced in the exchange return was reflected to the ISE as a 1.292 increase, whereas a 1% increase experienced in interest made a 0.261 positive contribution to the ISE. On the other hand a 1% increase experienced in money supply [Money (-1)] of the previous period affected the ISE at the rate of 0.583. Residual square correlogram can be seen in *"table 12"*.

In the determination of the volatility structure of financial return series, the residuals of the related series are used. In order to decide the ARCH or the GARCH structure, the ARCH-LM tests are performed. In order to find out the existence of the ARCH effect, the ARCH-LM test suggested by Engle (1982) was used in the study. Both the hypotheses that support and the ones that do not support the idea that error in the ARCH-LM test have variance effect are listed below:

$H_o = \alpha_1 = \alpha_2 = \alpha_3 \ldots = \alpha_q$ there is not an ARCH effect in the model

H_a = at least one $\alpha_i > 0$ (i = 1,2, … , q) there is an ARCH effect in the model

According to the result obtained from the ARCH-LM test shown in *"Table 13"*, the Obs*R-squared value was found as 18.001, whereas its probability value was found as 0.1797. This value is higher than chi-square 3.841 table value, which is the degree of freedom at 0.05 error level.

For 5% confidence interval, chi-square 3,841, R squared 18.001551 ➔ $R^2 > 3{,}841$.

This situation reveals the existence of the ARCH effect in the return series. In other words, the ARCH effect is available and it should be removed. After the existence of the ARCH effect was accepted, the process of choosing a suitable ARCH type model was initiated.

When lagging levels of only one period ago is used both for error and volatility values in the model, it is called GARCH (1.1).

Accordingly, various ARCH and GARCH models have been tried and they are shown in *"Table 14"* with their detailed values. In the selection of the model suitable for the ISE-100 monthly returns, the selection will be made according to the Akaike Information Criterion (AIC). It is a criterion which is also used in grading multivariate auto regression models and in which a selection is made according to the smallest value. Brief results for various GARCH model are shown in *"table 15"* After various trials, the most suitable ARCH-GARCH model, meeting the requirements such that the parameters providing the equation should have positive values and the sum of the parameters should be lower than 1, was obtained as GARCH (1.1) and it was shown in *"Table 16"*. The R-squared value of the GARCH (1.1) model was found as 0.3677. The estimation of the volatility of the return equation estimated by the GARCH (1.1) model is calculated by the equation;

$$h_t = \alpha_0 + \alpha_1 u^2_{t-1} + \gamma\, h_{t-1}$$

As shown in *"Table 17"*, the ARCH-LM test was performed again to the residues of the model in order to test the suitability of the GARCH (1.1) model. While the Obs*R-squared value was found as 0.0003, the Probability Chi-square value was found as 0.9853. In addition, since the F-statistics probability value was greater than 5%, it was concluded that the ARCH effect disappeared among the error terms in the GARCH (1.1) model. To sum up, with the ARCH-LM test applied, the ARCH effect in the residues was observed to have disappeared in the residues in all of the logs. Therefore, it is possible to analyze the volatility of the monthly return series of the ISE-100 index by using the GARCH (1.1) model.

Monthly VaR number calculated by using GARCH model and as from the recommendations of Engle (2001). The results support the conclusions of Korkmaz and Aydın (2002), VaR application on ISE – 30 Index. From *"Table 18",* VaR analyze provides satisfactory results in the forecasting of volatility at both 95% and 99% confidence levels.

Sevüktekin and Nargelecekenler's (2006) hypothesis in their analysis results that *"as it was determined in studies of various researchers such as Akgiray (1989), Pagan and Schwert (1990), Brailsford and Faff (1996), Brooks (1996) and Gökçe (2001), when Stock Exchange Market is in question, the suitable model is a model belonging to the GARCH (1.1) or at least the GARCH (p,q)"* was also supported in this study.

5. Conclusion

According to the modern portfolio theory, investors make their decisions about their investment preferences by taking their risk - return profiles into consideration. In this case, some of the investors accept low returns for the sake of keeping the risk they are exposed to lower, whereas the others prefer to invest in high risk assets in order to increase their profits.

The volatility of the return series of the ISE-100 index was econometrically analyzed under the independent macro factor variables affecting the ISE return. One of the main interests of finance literature has become the risk measurement. It is stated that the increasing trend in risk measurement of the world financial markets is due to two reasons such as the developments in the financial markets and globalization. Therefore, the concept of volatility has become popular as a risk measure among investors since the price movements affect their expected profits. In traditional methods, variance is used constantly. However, according to the results obtained from the recent studies, variance is not observed to be constant over time for the high frequency data. While the ARCH was provided by Engle (1982), the GARCH was provided by Bollerslev (1986). These two means consist of the variance as a function of moving averages of past squared residuals and lagged values of the variances added to model.

With the ARCH and GARCH methods, having taken place with their success on modeling the financial data in many studies in literature, the ISE-100 return volatility was modeled. It was determined that the ARCH had an effect in the ISE-100 return series and therefore it was aimed to determine the best model by estimating alternative conditional variance models . In order to estimate volatility and give more weights to recent events as opposed to older events, time series have been used. The limitations of all GARCH parameters are eliminated, and as a result a more accurate analysis is obtained by the GARCH. As it was expected, among all model results, the GARCH (1.1) model was determined to be the most suitable model for the ISE-100 monthly return series. It was concluded in this study that advanced

volatility techniques such as the ARCH-GARCH are sufficient for modeling the volatility effect in return series. Moreover, the squares of error terms of the GARCH (1.1) model were observed to have better results than the ARCH (1) model in terms of autocorrelation effect. At the end of estimating the GARCH (1.1) model for the ISE-100 return series, the ARCH effect that was observed in the model before was eliminated. It was determined in this study that the stock exchange market in Turkey has time varying volatility and long memory behavior. Because of this feature of the market, the GARCH (1.1) model indicates the tendencies in the stock returns quite well. The GARCH (1.1) model was observed to support the studies conducted on stock exchange markets in literature.

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7. Appendices

Table 4 : Unit Root Tests.

Table 4.1 Augmented Dickey Fuller Unit Root Test on D (ISE)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.039.991	0.0000
Test critical values:	1% level	-3.501.445	
	5% level	-2.892.536	
	10% level	-2.583.371	

Table 4.2 Augmented Dickey Fuller Unit Root Test on D (CPI)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.149.633	0.0000
Test critical values:	1% level	-3.505.595	
	5% level	-2.894.332	
	10% level	-2.584.325	

Table 4.3 Augmented Dickey Fuller Unit Root Test on D (EXCHANGE)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.260.888	0.0000
Test critical values:	1% level	-3.501.445	
	5% level	-2.892.536	
	10% level	-2.583.371	

Table 4.4 Augmented Dickey Fuller Unit Root Test on D (MONEY)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.703.837	0.0000
Test critical values:	1% level	-3.501.445	
	5% level	-2.892.536	
	10% level	-2.583.371	

Table 4.5 Augmented Dickey Fuller Unit Root Test on D (INTEREST)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.292.262	0.0000
Test critical values:	1% level	-3.501.445	
	5% level	-2.892.536	
	10% level	-2.583.371	

Table 5 : ISE-100 Correlogram.

Date: 04/21/11 Time: 21:54

Sample: 1 95

Included observations: 95

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*|. |	.*|. |	1	-0.087	-0.087	0.7470	0.387
. |. |	. |. |	2	0.054	0.047	10.375	0.595
. |* |	. |* |	3	0.119	0.129	24.653	0.482
. |. |	. |. |	4	0.002	0.021	24.655	0.651
. |. |	. |. |	5	0.021	0.009	25.091	0.775
.*|. |	.*|. |	6	-0.084	-0.101	32.342	0.779
. |. |	. |. |	7	-0.019	-0.042	32.739	0.859
.*|. |	.*|. |	8	-0.090	-0.092	41.267	0.846
. |. |	. |. |	9	-0.005	0.005	41.292	0.903
. |. |	. |. |	10	0.025	0.049	41.984	0.938
. |* |	. |* |	11	0.075	0.115	48.101	0.940
. |. |	. |. |	12	-0.059	-0.051	52.016	0.951
. |* |	. |. |	13	0.102	0.072	63.687	0.932
. |. |	.*|. |	14	-0.045	-0.074	65.952	0.949
.*|. |	.*|. |	15	-0.132	-0.161	86.149	0.897
. |. |	.*|. |	16	-0.051	-0.112	89.135	0.917
. |. |	. |. |	17	-0.011	0.025	89.271	0.943
.*|. |	.*|. |	18	-0.150	-0.105	11.632	0.866
.*|. |	. |. |	19	-0.089	-0.054	12.591	0.859
. |. |	. |. |	20	0.060	0.066	13.038	0.876
. |. |	. |* |	21	0.036	0.091	13.196	0.902
. |. |	. |. |	22	0.019	0.013	13.243	0.926
. |. |	. |. |	23	0.061	0.027	13.720	0.935
. |. |	.*|. |	24	-0.024	-0.100	13.792	0.951
. |. |	. |. |	25	0.036	0.002	13.960	0.962
. |. |	. |. |	26	0.002	-0.020	13.961	0.974
. |* |	. |* |	27	0.111	0.150	15.633	0.960
. |. |	. |. |	28	-0.057	0.012	16.075	0.965
. |. |	. |. |	29	-0.023	0.026	16.151	0.974
.*|. |	.*|. |	30	-0.072	-0.164	16.895	0.974
. |. |	. |. |	31	0.019	-0.009	16.949	0.981
. |. |	.*|. |	32	-0.046	-0.093	17.260	0.984
. |. |	. |. |	33	-0.029	-0.043	17.387	0.988
. |. |	. |. |	34	0.039	-0.012	17.614	0.991
.*|. |	.*|. |	35	-0.166	-0.092	21.852	0.959
. |. |	. |. |	36	0.028	-0.028	21.972	0.968

Table 6 : Analayses Values of Data Whose Logarithm was Taken.

Model: ISE = C INTEREST EXCHANGE MONEY CPI

Dependent Variable: ISE
Method: Least Squares
Date: 04/03/11 Time: 12:19
Sample: 1 95
Included observations: 95

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.033496	0.013894	2.410924	0.0179
INTEREST	0.294198	0.183753	1.601051	0.1129
EXCHANGE	1.180900	0.237680	4.968442	0.0000
MONEY	-0.290956	0.427061	-0.681300	0.4974
CPI	-0.008010	0.009144	-0.875976	0.3834

R-squared	0.350701	Mean dependent var	0.014556
Adjusted R-squared	0.321843	S.D. dependent var	0.105108
S.E. of regression	0.086557	Akaike info criterion	-2.004843
Sum squared resid	0.674283	Schwarz criterion	-1.870428
Log likelihood	100.2300	Hannan-Quinn criter.	-1.950529
F-statistic	12.15274	Durbin-Watson stat	2.300311
Prob(F-statistic)	0.000000		

Table 7 : Heteroskedasticity Analyze

Heteroskedasticity Test: White

F-statistic	1.103490	Prob. F(14,80)	0.3678
Obs*R-squared	15.37621	Prob. Chi-Square(14)	0.3529
Scaled explained SS	20.28870	Prob. Chi-Square(14)	0.1213

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/09/11 Time: 04:27
Sample: 1 95
Included observations: 95

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001612	0.002781	0.579777	0.5637
CPI	0.004046	0.002906	1.392038	0.1678
CPI^2	0.000368	0.001093	0.336523	0.7374
CPI*EXCHANGE	-0.057479	0.049688	-1.156786	0.2508
CPI*INTEREST	0.017944	0.037259	0.481601	0.6314
CPI*MONEY	-0.088261	0.076650	-1.151492	0.2530
EXCHANGE	0.066526	0.073556	0.904429	0.3685
EXCHANGE^2	0.252134	0.529513	0.476161	0.6353
EXCHANGE*INTEREST	2.881868	1.598215	1.803179	0.0751
EXCHANGE*MONEY	0.507766	1.447385	0.350816	0.7266
INTEREST	-0.120382	0.050167	-2.399642	0.0187
INTEREST^2	-0.224643	0.371325	-0.604977	0.5469
INTEREST*MONEY	5.781696	2.833873	2.040210	0.0446
MONEY	0.115804	0.146624	0.789801	0.4320
MONEY^2	0.346471	0.921444	0.376009	0.7079

R-squared	0.161855	Mean dependent var	0.007098
Adjusted R-squared	0.015179	S.D. dependent var	0.012235
S.E. of regression	0.012142	Akaike info criterion	-5.840339
Sum squared resid	0.011794	Schwarz criterion	-5.437096
Log likelihood	292.4161	Hannan-Quinn criter.	-5.677399
F-statistic	1.103490	Durbin-Watson stat	1.437877
Prob(F-statistic)	0.367812		

Table 8 : Lag Advanced Model.

Dependent Variable: ISE
Method: Least Squares
Date: 04/24/11 Time: 02:33
Sample (adjusted): 5 95
Included observations: 91 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001612	0.026082	0.061820	0.9509
EXCHANGE	1.217.437	0.239282	5.087.874	0.0000
EXCHANGE(-1)	0.502693	0.249110	2.017.956	0.0474
EXCHANGE(-2)	0.046908	0.261746	0.179211	0.8583
EXCHANGE(-3)	0.325013	0.261794	1.241.483	0.2186
EXCHANGE(-4)	0.104857	0.270109	0.388204	0.6990
CPI	-0.012629	0.011790	-1.071.208	0.2878
CPI(-1)	0.005595	0.014738	0.379601	0.7054
CPI(-2)	0.007240	0.014637	0.494617	0.6224
CPI(-3)	-0.026067	0.014311	-1.821.456	0.0728
CPI(-4)	0.030536	0.012232	2.496.385	0.0149
INTEREST	0.148241	0.232524	0.637530	0.5259
INTEREST(-1)	0.429189	0.239999	1.788.294	0.0781
INTEREST(-2)	-0.671190	0.245905	-2.729.473	0.0080
INTEREST(-3)	0.357682	0.237324	1.507.148	0.1363
INTEREST(-4)	0.087996	0.208377	0.422292	0.6741
MONEY	0.101948	0.458471	0.222366	0.8247
MONEY(-1)	0.904476	0.471114	1.919.865	0.0590
MONEY(-2)	-0.135261	0.479186	-0.282273	0.7786
MONEY(-3)	0.787516	0.487985	1.613.813	0.1111
MONEY(-4)	-0.745695	0.497092	-1.500.115	0.1381

R-squared	0.530840	Mean dependent var	0.013806
Adjusted R-squared	0.396794	S.D. dependent var	0.106215
S.E. of regression	0.082493	Akaike info criterion	-1.953.024
Sum squared resid	0.476361	Schwarz criterion	-1.373.595
Log likelihood	1.098626	Hannan-Quinn criter.	-1.719261
F-statistic	3.960141	Durbin-Watson stat	2.374941
Prob(F-statistic)	0.000009		

Table 9 : Covariance Matrix.

	C	EXCHANGE	EXCHANGE (-1)	EXCHANGE (-2)	EXCHANGE (-3)	EXCHANGE (-4)	CPI	CPI (-1)	CPI (-2)	CPI (-3)	CPI (-4)
C	0.000680	-0.000478	-0.000846	-0.001162	-0.001497	-0.001854	-6.20E-05	-4.91E-05	-3.25E-05	-3.89E-06	-7.42E-05
EXCHANGE	-0.000478	0.057256	2.94E-05	-0.002399	-0.005297	-0.004370	-0.000701	0.000761	-0.000152	0.000149	2.89E-05
EXCHANGE(-1)	-0.000846	2.94E-05	0.062056	-0.004917	-0.002290	-0.006360	-0.000553	-0.000429	0.000865	-0.000300	0.000183
EXCHANGE(-2)	-0.001162	-0.002399	-0.004917	0.068511	-0.006155	0.002088	0.000402	-0.000777	-0.000381	0.001003	-0.000371
EXCHANGE(-3)	-0.001497	-0.005297	-0.002290	-0.006155	0.068536	-0.002378	0.000354	0.000171	-0.000733	-0.000423	0.000730
EXCHANGE(-4)	-0.001854	-0.004370	-0.006360	0.002088	-0.002378	0.072959	0.000788	-0.000158	7.68E-05	-0.000665	-0.000109
CPI	-6.20E-05	-0.000701	-0.000553	0.000402	0.000354	0.000788	0.000139	-8.01E-05	-7.29E-06	1.06E-05	-1.16E-05
CPI(-1)	-4.91E-05	0.000761	-0.000429	-0.000777	0.000171	-0.000158	-8.01E-05	0.000217	-9.22E-05	-1.64E-05	3.35E-05
CPI(-2)	-3.25E-05	-0.000152	0.000865	-0.000381	-0.000733	7.68E-05	-7.29E-06	-9.22E-05	0.000214	-8.12E-05	-7.18E-06
CPI(-3)	-3.89E-06	0.000149	-0.000300	0.001003	-0.000423	-0.000665	1.06E-05	-1.64E-05	-8.12E-05	0.000205	-8.46E-05
CPI(-4)	-7.42E-05	2.89E-05	0.000183	-0.000371	0.000730	-0.000109	-1.16E-05	3.35E-05	-7.18E-06	-8.46E-05	0.000150
INTEREST	0.001618	-0.001532	-0.005799	-0.009600	0.004397	-0.015554	8.40E-05	0.000556	-0.000489	-6.38E-05	0.000313
INTEREST(-1)	-0.000220	-0.001838	-0.000112	-0.005254	-0.008604	0.012276	0.000249	-0.000195	0.000606	-0.000295	-0.000196
INTEREST(-2)	0.000127	0.004835	-0.004582	0.002407	-0.006558	-0.011598	-0.000164	0.000533	-0.000336	0.000700	-0.000113
INTEREST(-3)	0.000234	0.001744	0.007758	-0.007252	0.001482	-0.006909	-9.52E-05	-0.000219	0.000573	-0.000321	0.000311
INTEREST(-4)	0.000133	-0.000138	-0.001674	0.007743	-0.003938	-0.002143	-8.46E-05	0.000123	-0.000252	0.000532	9.62E-05
MONEY	-0.002553	0.062372	0.022315	-0.029377	0.003620	-0.006050	-0.001616	0.001646	-0.000109	-0.000842	0.000550
MONEY(-1)	-0.003961	0.005610	0.063633	0.023210	-0.027742	0.005750	-0.000180	-0.000951	0.001549	-0.000329	-0.000255
MONEY(-2)	-0.004230	-0.011299	0.000800	0.066391	0.024644	-0.020384	0.001089	-0.000998	-0.000897	0.001641	-0.000600
MONEY(-3)	-0.005796	-0.015369	-0.013325	0.008347	0.066085	0.036140	0.000547	0.000882	-0.000749	-0.000948	0.001089
MONEY(-4)	-0.005598	-0.011792	-0.010559	0.000810	0.006360	0.078185	0.000584	-0.000307	0.000959	-0.000709	-0.000319

Table 10: Covariance Matrix (continues).

	INTEREST	INTEREST (-1)	INTEREST (-2)	INTEREST (-3)	INTEREST (-4)	MONEY	MONEY (-1)	MONEY (-2)	MONEY (-3)	MONEY (-4)
C	0.001618	-0.000220	0.000127	0.000234	0.000133	-0.002553	-0.003961	-0.004230	-0.005796	-0.005598
EXCHANGE	-0.001532	-0.001838	0.004835	0.001744	-0.000138	0.062372	0.005610	-0.011299	-0.015369	-0.011792
EXCHANGE(-1)	-0.005799	-0.000112	-0.004582	0.007758	-0.001674	0.022315	0.063633	0.000800	-0.013325	-0.010559
EXCHANGE(-2)	-0.009600	-0.005254	0.002407	-0.007252	0.007743	-0.029377	0.023210	0.066391	0.008347	0.000810
EXCHANGE(-3)	0.004397	-0.008604	-0.006558	0.001482	-0.003938	0.003620	-0.027742	0.024644	0.066085	0.006360
EXCHANGE(-4)	-0.015554	0.012276	-0.011598	-0.006909	-0.002143	-0.006050	0.005750	-0.020384	0.036140	0.078185
CPI	8.40E-05	0.000249	-0.000164	-9.52E-05	-8.46E-05	-0.001616	-0.000180	0.001089	0.000547	0.000584
CPI(-1)	0.000556	-0.000195	0.000533	-0.000219	0.000123	0.001646	-0.000951	-0.000998	0.000882	-0.000307
CPI(-2)	-0.000489	0.000606	-0.000336	0.000573	-0.000252	-0.000109	0.001549	-0.000897	-0.000749	0.000959
CPI(-3)	-6.38E-05	-0.000295	0.000700	-0.000321	0.000532	-0.000842	-0.000329	0.001641	-0.000948	-0.000709
CPI(-4)	0.000313	-0.000196	-0.000113	0.000311	9.62E-05	0.000550	-0.000255	-0.000600	0.001089	-0.000319
INTEREST	0.054067	-0.023127	0.010339	-0.000916	0.000868	-0.008076	-0.019919	0.005759	-0.022619	-0.043053
INTEREST(-1)	-0.023127	0.057600	-0.028385	0.011951	-0.006735	0.013055	-0.002323	-0.019661	0.013802	0.005546
INTEREST(-2)	0.010339	-0.028385	0.060469	-0.028032	0.012983	-0.010718	0.013719	-0.004453	-0.020043	0.004687
INTEREST(-3)	-0.000916	0.011951	-0.028032	0.056323	-0.022778	0.014693	-0.009871	0.014048	-0.010647	-0.022120
INTEREST(-4)	0.000868	-0.006735	0.012983	-0.022778	0.043421	-0.014827	0.005407	-0.007763	0.011685	-0.000455
MONEY	-0.008076	0.013055	-0.010718	0.014693	-0.014827	0.210195	0.017012	-0.021935	-0.027106	-0.012790
MONEY(-1)	-0.019919	-0.002323	0.013719	-0.009871	0.005407	0.017012	0.221949	0.013187	-0.012022	-0.002765
MONEY(-2)	0.005759	-0.019661	-0.004453	0.014048	-0.007763	-0.021935	0.013187	0.229619	0.017764	-0.012783
MONEY(-3)	-0.022619	0.013802	-0.020043	-0.010647	0.011685	-0.027106	-0.012022	0.017764	0.238129	0.059933
MONEY(-4)	-0.043053	0.005546	0.004687	-0.022120	-0.000455	-0.012790	-0.002765	-0.012783	0.059933	0.247101

Table 11 : Equation Descriptvie Statistics.

Dependent Variable: ISE
Method: Least
Squares
Date: 04/29/11 Time: 15:43
Sample (adjusted): 2 95
Included observations: 94 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008596	0.011076	0.776166	0.1397
EXCHANGE	1.292.908	0.189090	6.837.526	0.0000
INTEREST	0.261894	0.176839	1.480.967	0.0421
MONEY(-1)	0.583806	0.356210	1.638.936	0.1047

R-squared	0.369144	Mean dependent var	0.013088
Adjusted R-squared	0.348116	S.D. dependent var	0.104687
S.E. of regression	0.084524	Akaike info criterion	-2.061945
Sum squared resid	0.642985	Schwarz criterion	-1.953720
Log likelihood	1.009114	Hannan-Quinn criter.	-2.018230
F-statistic	1.755445	Durbin-Watson stat	2.343123
Prob(F-statistic)	0.000000		

Table 12 : Correlogram of Residuals Squared.

Date: 04/30/11 Time: 22:22
Sample: 2 95
Included observations: 94

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |* |	. |* |	1	0.139	0.139	1.8676	0.172
. |* |	. |* |	2	0.183	0.167	5.1409	0.076
. |* |	. |* |	3	0.173	0.135	8.1104	0.044
. |. |	. |. |	4	0.049	-0.014	8.3508	0.080
. |* |	. |* |	5	0.142	0.094	10.402	0.065
. |. |	. |. |	6	0.049	-0.002	10.644	0.100
. |. |	. |. |	7	0.020	-0.026	10.684	0.153
. |. |	.*|. |	8	-0.041	-0.086	10.859	0.210
. |. |	. |. |	9	0.006	0.013	10.863	0.285
. |* |	. |* |	10	0.081	0.094	11.565	0.315
. |. |	. |. |	11	0.007	0.003	11.570	0.397
. |* |	. |* |	12	0.119	0.102	13.125	0.360
. |. |	.*|. |	13	-0.036	-0.072	13.271	0.427
. |* |	. |. |	14	0.077	0.062	13.941	0.454
. |* |	. |* |	15	0.147	0.109	16.415	0.355
.*|. |	.*|. |	16	-0.082	-0.138	17.199	0.373
.*|. |	.*|. |	17	-0.085	-0.162	18.043	0.386
. |. |	. |. |	18	-0.021	0.019	18.096	0.449
.*|. |	.*|. |	19	-0.147	-0.103	20.683	0.355
.*|. |	. |. |	20	-0.067	-0.039	21.236	0.383
.*|. |	. |. |	21	-0.096	-0.039	22.379	0.378
. |. |	. |. |	22	-0.046	0.053	22.648	0.422
. |. |	. |. |	23	-0.030	0.055	22.761	0.475
. |. |	. |. |	24	-0.012	0.000	22.780	0.533
. |. |	. |. |	25	-0.007	-0.021	22.786	0.590
. |. |	. |. |	26	-0.028	-0.024	22.891	0.639
. |. |	. |. |	27	-0.013	-0.029	22.915	0.690
. |. |	. |. |	28	-0.032	-0.008	23.052	0.730
. |. |	. |. |	29	-0.031	-0.032	23.189	0.768
. |. |	. |. |	30	-0.023	-0.024	23.261	0.804
.*|. |	. |. |	31	-0.075	0.039	24.076	0.807
. |. |	. |. |	32	-0.061	-0.018	24.620	0.821
. |. |	. |. |	33	-0.018	0.014	24.669	0.852
.*|. |	. |. |	34	-0.070	-0.028	25.402	0.856
.*|. |	.*|. |	35	-0.092	-0.083	26.704	0.842
. |. |	. |. |	36	-0.046	-0.034	27.027	0.860

Table 13 : ARCH-LM Test Results.

Heteroskedasticity Test: ARCH

F-statistic	1.7962111	Prob. F(1,91)	0.1835
Obs*R-squared	18.001551	Prob. Chi-Square(1)	0.1797

Table 14 : Alternative ARCH - GARCH Model Estimation Results.

	ARCH (1)	ARCH (2)	ARCH (3)	ARCH (4)
c	0.005947	0.005047	0.004455	0.004522
α1	0.139232*	0.112772	0.086719	0.088451
α2		- 0.167783	0.150173	0.152085
α3			0.137159*	0.138327
α4				-0.013750
β1				
β2				
R-squared	0.019357	0.046267	0.062835	0.062459
Adjusted R-squared	0.008580	0.024834	0.030519	0.018340
S.E. of regression	0.011124	0.011070	0.011079	0.011208
Sum squared resid	0.011261	0.010907	0.010679	0.010677
Log likelihood	2.874232	2.853039	2.826657	2.790714
F-statistic	1.796211	2.158738	1.944401	1.415678
Prob(F-statistic)	0.183508	0.121479	0.128366	0.235729
Mean dependent var	0.006890	0.006964	0.007034	0.007063
S.D. dependent var	0.011172	0.011210	0.011252	0.011312
Akaike info criterion	-6.138133	-6.137040	-6.124520	-6.090475
Schwarz criterion	-6.083668	-6.054808	-6.014153	-5.951596
Hannan-Quinn criter.	-6.116142	-6.103851	-6.079994	-6.034471
Durbin-Watson stat	2.043738	2.043777	1.990947	1.991691

Table 14 Alternative ARCH - GARCH Model Estimation Results (continues)

	GARCH (1.0)	GARCH (0.1)	GARCH (1.1)	GARCH (2.1)	GARCH (1.2)	GARCH (2.2)
c	0.004340	0.000291	0.000668	0.000571	0.000799	0.000779
α1	0.418398		0.337872	0.384439	0.472409	0.477538
α2				-0.078693		-0.013021
α3						
α4						
β1		0.968116	0.601453	0.646677	0.106464	0.121299
β2					0.367044	0.362656
R-squared	0.369083	0.363618	0.367764	0.367653	0.365759	0.365723
Adjusted R-squared	0.333236	0.327460	0.324162	0.316183	0.314135	0.306027
S.E. of regression	0.085483	0.085853	0.086063	0.086569	0.086699	0.087210
Sum squared resid	0.643047	0.648618	0.644391	0.644505	0.646435	0.646472
Log likelihood	1.043371	1.022459	1.086151	1.086585	1.089877	1.089887
F-statistic	1.029591	1.005633	8.434489	7.143041	7.085036	6.126366
Prob(F-statistic)	0.000000	0.000000	0.000000	0.000001	0.000001	0.000003
Mean dependent var	0.013088	0.013088	0.013088	0.013088	0.013088	0.013088
S.D. dependent var	0.104687	0.104687	0.104687	0.104687	0.104687	0.104687
Akaike info criterion	-2.092278	-2.047785	-2.162022	-2.141671	-2.148674	-2.127419
Schwarz criterion	-1.929940	-1.885447	-1.972628	-1.925220	-1.932223	-1.883912
Hannan-Quinn criter.	-2.026705	-1.982212	-2.085521	-2.054241	-2.061244	-2.029060
Durbin-Watson stat	2.342404	2.355415	2.344821	2.344373	2.339566	2.339436

Table 15 : Akaike Info and Schwarz Criterion Results of GARCH Models.

	GARCH (1.0)	GARCH (0.1)	GARCH (1.1)	GARCH (2.1)	GARCH (1.2)	GARCH (2.2)
Akaike info criterion	-2.092278	-2.047785	-2.162022*	-2.141671	-2.148674	-2.127419
Schwarz criterion	-1.929940	-1.885447	-1.972628*	-1.925220	-1.932223	-1.883912

Table 16 : GARCH (1.1)

Dependent Variable: ISE
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 04/29/11 Time: 02:02
Sample (adjusted): 2 95
Included observations: 94 after adjustments
Convergence achieved after 19 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(5) + C(6)*RESID(-1)^2 +
C(7)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.008100	0.009228	0.877780	0.3801
EXCHANGE	1.274.628	0.178971	7.122.001	0.0000
INTEREST	0.287293	0.144234	1.991.850	0.0464
MONEY(-1)	0.711306	0.292583	2.431.127	0.0151
	Variance Equation			
C	0.000668	0.000614	1.089.170	0.2761
RESID(-1)^2	0.337872	0.213315	1.583.915	0.1132
GARCH(-1)	0.601453	0.158450	3.795.850	0.0001

R-squared	0.367764	Mean dependent var	0.013088
Adjusted R-squared	0.324162	S.D. dependent var	0.104687
S.E. of regression	0.086063	Akaike info criterion	-2.162022
Sum squared resid	0.644391	Schwarz criterion	-1.972628
Log likelihood	1.086151	Hannan-Quinn criter.	-2.085521
F-statistic	8.434489	Durbin-Watson stat	2.344821
Prob(F-statistic)	0.000000		

Table 17 : ARCH-LM Test Results for GARCH (1.1.) Model.

Heteroskedasticity Test: ARCH

F-statistic	0.000333	Prob. F(1,91)		0.9855
Obs*R-squared	0.000340	Prob. Chi-Square(1)		0.9853

Table 18 : Value at Risk for GARCH (1.1)

Formula for GARCH (1.1)

$$\sigma^2_t = \gamma V_L + \alpha u^2_{t-1} + \beta \sigma^2_{t-1}$$

L.R Variance	0,01%
gamma	0,0284
alpha	0,0904
beta	0,8812

GARCH(1,1)	0,0907122

	VaR
% 95 Confidence Level (2,326)	0,2109
% 99 Confidence Level (1,645)	0,1492