THE REPUBLIC OF TURKEY
BAHÇEŞEHİR UNIVERSITY

THE EFFECT OF US TERM STRUCTURE OF INTEREST RATES ON TURKISH STOCK MARKET VOLATILITY

Master's Thesis

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İSTANBUL, 2019

THE REPUBLIC OF TURKEY

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ABSTRACT

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Saadet Ayça Atalay

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Thesis Supervisor: Prof.Dr. Aslı Yüksel

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Stock market volatility is an important concept for the investors in assessing the risk of their portfolios for either asset pricing or portfolio management purposes. For this reason, researchers and policy makers put significant efforts to understand the dynamics behind the stock market volatility. While discussing the stock market volatility, many researchers studied the effect of macro-economic factors headed by interest rates. As suggested by Fisher Equation, expected inflation rates are an important factor determining interest rates. Studies on the term structure of interest rate or the yield curve revealed that term structure contains information about the future economic conditions such as inflation or the future general state of the economy such as a recession or an expansion period. This characteristics of term structure of interest rates are used by policy makers for a long time in order to provide direction to the economy by utilizing its influencing effect on long term interest rates. Thus as a further assumption, term structure of interest rates may contain information on the stock volatility as well.

In this thesis the effect of term structure of the US interest rates on Turkish Stock Market volatility is investigated by decomposing term structure into two components as Expectation Factor and Maturity Premium. Thus, with this thesis it is aimed to find out whether any change in the US term structure of interest rate affects Turkish stock market volatility and if there is any effect, which component pose more impact on which sectors and at what magnitude. In order to see the effects of the global 2008 subprime crisis the sample period had been chosen to include this period. The effects of the US Term Structure (USTS) on the weekly volatility of Turkish stock market sector index returns are analysed using the Generalize Method of Moments. As a result of the analysis, it has been found that US Term Structure of interest rates especially the Expectation Factor component, affects Turkish Stock Market volatility. However, it is also observed that this effect disappeared in the period right after the 2008 Subprime crisis.

Keywords: US Term Structure, Expectation Factor, Maturity Premium, Turkish Stock Market Volatility

ÖZET

ABD FAİZ ORANLARI VADE YAPISININ TÜRK HİSSE SENEDİ PİYASASI VOLATİLİTESİNE ETKİSİ

Saadet Ayça Atalay

Hafta sonu Göztepe Tezli MBA Programı

Tez Danışmanı: Prof. Dr. Aslı Yüksel

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Hisse senedi piyasasının volatilitesi, gerek portföy yatırımlarının fiyatlamalarını değerlendirebilmek gerekse de etkin portföy yönetimi yapabilmek açısından önemli bir unsurdur. Bu nedenle hem araştırmacılar hem de politika yapıcılar bu dinamikleri anlamak ve açıklayabilmek için önemli çaba sarf etmişlerdir. Hisse senedi volatilitesi kavramını tartışırken, birçok araştırmacı faiz oranlarının başını çektiği makroekonomik faktörlerin etkisini öncelikle araştırmıştır. Fisher denklemi ile önerildiği üzere, beklenen enflasyon oranı, faiz oranını belirleyen önemli bir faktördür. Getiri eğrisi veya faiz oranı vade yapısı üzerine yapılan çalışmalar göstermiştir ki faiz oranı vade yapısı, enflasyon veya resesyon gibi gelecekteki ekonominin genel durumu hakkında bir takım bilgilere sahiptir. Faiz oranı vade yapısının uzun dönemli faiz oranları üzerine etkisi, politika yapıcılar tarafından ekonomiye yön vermek adına oldukça uzun bir süredir kullanılmaktadır. Bu noktadan hareketle faiz oranları vade yapısının hisse senedi volatilitesi üzerinde de bir etkisi olabileceği varsayılmaktadır.

Bu yüksek lisans tezinde, ABD faiz oranları vade yapısının (USTS) Türk Hisse Senedi Piyasası volatilitesi üzerine etkisi, Beklenti Faktörü ve Vade Primi olarak iki ayrı bileşene ayrıştırılması yolu ile araştırılmaktadır. Bu tez ile ABD faiz oranlarının vade yapısındaki bir değişimin, Türk hisse senedi piyasasına olan etkisi ve bunun hangi bileşenden kaynaklı olduğunun ortaya çıkarılması amaçlanmaktadır. 2008 subprime krizinin olası etkilerini görebilmek amacıyla, örneklem periyodu 15 Eylül 2008 öncesini ve sonrasını içerecek şekilde seçilmiştir. İki bileşene ayrılan USTS verilerinin, haftalık olarak hesaplanan Borsa İstanbul sektör endekslerinin volatilitesi ile analizi için Genelleştirilmiş Momentler Yöntemi kullanılmıştır. Bu çalışmanın sonucunda, özellikle Beklenti Faktörü bileşeninin Türk hisse senedi piyasasına bir etkisi olduğuna dair bulgular gözlemlenmiştir. Ancak bu etkinin 2008 subprime krizinin hemen sonrasında kaybolduğu da gözlemlenmektedir.

Anahtar Kelimeler: Türk Hisse Senedi Piyasası, ABD Faiz Oranları Vade Yapısı, Beklenti Faktörü, Vade Primi

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ABREVIATIONS

EF	:	Expectation Factor
ET	:	Expectation Theory
BIST	:	Borsa Istanbul
GMM	:	Generalized Method of Moments
MP	:	Maturity Premium
OLS	:	Ordinary Least Squares

SYMBOLS

Beta coefficient - 1	:	β
Expected future short term rate	:	$E_w i_{3,w+3h}$
Long term interest rate in week w	:	$i_{l,w}$
Number of trading day in week w	:	N_w
Return on day t in week w	:	$r_{t,w}$
Short term (3 months) interest rate in week w	:	$i_{3,w}$
Time varying maturity premium	:	θ
Weekly stock volatilities	:	σ
Weekly average return	:	μ_w

1. INTRODUCTION

Stock market volatility is an important concept for the investors in assessing the risk of their portfolios for either asset pricing or portfolio management purposes. This is a significant factor in option pricing of stocks where Black & Scholes option pricing model takes into account the price volatility. In another context, the policy makers prefer less stock market volatility hence prefer a stable and predictable investment and capital market environment which makes it easier for investors while making long term investment decisions. This predictable environment with minimized risks, enable the investors to provide capital inflow needed for the development of economies especially in the emerging markets. Because of the minimized risks, the cost of capital will be minimized as well. For this reason, researchers and policy makers put significant efforts to understand the dynamics behind the stock market volatility. The main driving factor behind the stock market volatility come from the Dividend Discount Model where the expected returns on the stocks are composed of dividend gains. Thus the stock price changes over time should be related to these components. Dividend Discount Model suggests that the price of the stock is expected to decrease if the expected future discount rate increases in line with the rising interest rates. Another driving factor comes from the Fisher Equation where the current interest rate is a factor of real interest rate and expected inflation. As rising inflation expectations refers to a rising expected interest rate and hence discount rates, interest rates also becomes a factor effecting stock volatility.

Considering interest rates as a factor in valuing the stocks, it can be expected that significant changes in interest rates may cause increased stock volatility. This assumption is supported by the findings of Schwert (1989) and Hamilton and Lin (1996) where they have found out that stock market volatility increases during the recession periods indicating investors' response to uncertainty.

In the finance literature the number of studies analysing stock market volatility in emerging markets are quite limited. (Bekaert and Harvey (1997); Choudhry (2004); Caner and Önder (2005); Balakrishnan et al. (2011); Hacıhasanoglu et.al, (2012)) . One of the reasons is that the data is not available for longer periods enabling the researches to analyse whether global economic changes have any impact on the emerging market stock markets. One of the early studies in this front is the study of Bekaert and Harvey (1997) where they have argued that capital market liberalization is an important factor for the emerging market economies, decreasing the volatility of the stock market. Hence their study supported that among the emerging market economies taken into consideration that had experienced capital market liberalization processes, most of them experienced a decrease in stock market volatility with more than 6% after the market liberalization process.

Also different studies on emerging market volatility such as Caner and Önder (2005) suggested that Dividend Discount Model does not explain the stock market volatility as much as it does in developed markets. According to the study, dividend yield constituted a significant factor with 43% in explaining the volatility in stock returns in 17 emerging market that are examined, whereas this figure increased to almost 90% in the US and Japan stock markets indicating that dividend yield is far most the important factor in developed markets. In this study the effect of interest rates were also analysed however short term interest rates only explained 3,7% of the stock return volatility. This study was however made before the global crisis in 2008, where the researchers believe that after that date the globalization and integration among the emerging markets accelerated.

In one of the studies made following the 2008 subprime crisis, Hacıhasanoglu et.al, (2012) investigated the factors affecting emerging market equity return volatilities in 22 emerging markets (Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand and Turkey). through examining the volatilities

of other asset classes such as equity, treasury (interest rate) and currency markets before, during and after the financial crisis in 2008. They have found out that during low global risk periods, the interaction between the developed markets and emerging market equity classes are closely related.

However during the crisis where extreme volatility is observed, the link between the emerging market equity classes and other asset classes weakens which indicates that a shock in other asset classes may not affect the emerging market equity class. After the crisis, the relationship between these asset classes re-emerge indicating a recovery period. This is somewhat observed in the study of Li (2016) as well where he investigated the effect of the US Term Structure on the stock market volatilities of other international markets such as UK and Japan. The study showed that post crisis period, investors in UK and Japan paid more attention to local factors such as trading volume other than the US term structure.

While discussing the stock market volatility, many researchers studied the effect of macro- economic factors headed by interest rates. As suggested by Fisher Equation, expected inflation rates are an important factor determining interest rates. At this point a number of economists such as Mishkin (1990), Fama (1990), Estrella and Hardouvelis (1991) who studied the term structure of interest rates found out that the term structure of interest rate or the yield curve contains information about the future economic conditions such as inflation or the future general state of the economy such as a recession or an expansion period. This characteristics of term structure of interest rates are used by policy makers for a long time in order to provide direction to the economy by utilizing its influencing effect on long term interest rates. Thus as a further assumption, term structure of interest rates may contain information on the stock volatility as well.

This hypothesis had been tested in a previous research by Li (2014) where he investigated whether the US zero coupon yield spread contains useful information to predict excess stock market volatility. He found out that, changes in the US zero coupon

yield spread indeed contains valuable information as to the stock market volatility not only in US but also in UK and Hong Kong Market as other developed markets in different geographies. Thus this indicates that within an integrated financial markets environment where information flow is fast and continuous, a change in the US term structure might have important impacts to the other economies of the world.

Furthermore in a following study Li (2015) studied the effect of US term structure to the volatility of international stock markets namely UK and Japan stock markets. After the analysis of data, it is found that USTS has more effect on US and UK stock market than Japanese stock market which indicates that at some point local factors are more determinant in stock market volatility.

Following this article, in this thesis, it is investigated whether the US term structure of interest rates (USTS) has any effect on the Turkish stock market volatility and if there is any effect at what magnitude and to which sectors it is more significant than others. The data set of thesis cover the period between 1999 and 2013 which had been selected to include the before and after period of subprime crisis in US to understand whether the global crisis had any changing impact on the magnitude of the effect. The crisis period is assumed to start with the bankruptcy of Lehman Brothers in September 15, 2008.

This is the first study to investigate the effects of the US term structure on the Turkish stock market volatility with a perspective of decomposing components. Decomposing term structure into two components as Expectation Factor (EF) and time varying Maturity Premium (MP) had been first introduced by Hamilton and Kim (2000). They have investigated the contribution of expectation factor which can be defined as the yield spread between the current long term rates and short term rates and the term premium which can be defined as the excess yield of holding long term bonds, to the predictability of future economic activity.

The results showed that although these two factors were both significant statistically to predict the GDP growth, expectation factor (EF) is s slightly more important quantitatively and statistically compared to the term premium.

In this thesis, by decomposing term structure into two components, it is intended to understand which component, Expectation Factor or Maturity Premium of USTS, pose more impact on investor perception and behaviour indicated by stock return volatilities in an emerging market like Borsa İstanbul.

The rest of this master thesis is organized as follows: Section 2 describes the Literature Review of the studies on term structure, stock market volatility and the possible relation between term structure and stock market volatility together with the theoretical framework. Section 3 presents the data and methodology. Section 4 discusses the empirical findings and Section 5 concludes.

2. LITERATURE REVIEW & THEORITICAL FRAMEWORK

This thesis is investigating the effect of the US term structure of interest rates (USTS) on the Turkish Stock Market volatility. For this reason, starting with the Expectation Theory which is the basis of the theoretical framework for this thesis, the literature related to the predictive power of USTS and its components, the dynamics of stock market volatility in particular emerging stock market volatility and the effect of the USTS on international stock markets were reviewed.

2.1 WHAT DOES EXPECTATION THEORY SUGGESTS?

Expectation Theory (ET) says that long term rate is the sum of expected future short term rates over the life of the long term bond with an addition of term premium. This theory at the same time suggests that yield spread which is the difference between the long term rate and short term rate is a factor of the sum of expected future short term rates and the associated term premium. Thus, yield spread is largely investigated by the economists about the information that it contains and whether it can be used as an indicator for predicting the future inflation, industrial output or even stock volatility.

2.1.1 Understanding the Predictive Power of the US Term Structure of Interest Rate

Dotsey (1998) executed a study on the predictive power of USTS on the future economic growth where Estralla and Hardouvelis's (1991) findings suggest that there is a strong evidence that the slope of the yield curve can predict the cumulative changes in real output for up to 4 years in to the future and up to 18 months for the successive marginal changes in real output. In another study, Mishkin (1990); found that there is significant information in the longer maturity term structure about the future inflation. Furthermore, the slope of the yield curve (terms structure) contains useful information on the predictability of the future changes in inflation. These results support the findings

of Fama (1990) who also found out that longer term maturity term structure forecasts future inflation.

Thus, when the slope of the yield curve steepens, it is a sign that the inflation rate will rise and when the slope shows a downward trend, it is a sign of decreasing inflation rate. Estrella (2004) further studied that empirical results of the period following the US inflationary targeting policy since 1987 confirmed the theoretical base that yield spread can be used to predict inflation. Recent country specific studies by Carstansen and Hawalek (2003) and Konstantinou (2005) tested and verified this hypothesis for Germany and Poland respectively.

2.1.2 Decomposition of Term Structure into Components

Although there are many studies supporting ET, most empirical studies like Fama (1984) and Campbell and Shiller (1987) reject ET where the common points of them are using linear regression models for the excess return on the yield spread. This will further lead researchers to put more emphasis on non-linear models in explaining ET.

In an attempt to explain the effect of yield spread for predicting GDP growth, Hamilton and Kim (2000) decomposed term structure into two components namely Expectation Factor (EF) and Maturity Premium (MP). The study confirmed earlier results that the yield spread between the long term and short term interest rates contains useful information for forecasting GDP growth. They have argued that both factors are statistically significant where EF is slightly more important quantitatively and statistically compared to the term premium**.** Following Hamilton and Kim, Ang et al. (2007) found that EF component is the only factor having predictive power of future economic activity. However, Crump et al. (2016), highlighted MP's long term predictive power but at the same time accepts that expected real rates and expected inflation explains almost 90% of the change in short term bond yields.

Besides the argument of MP having predictive power, the sign of the MP is also argumentative. According to Bernanke (2005) and market practitioners, when MP is negative, a positive reaction for future economic activity should be expected whereas Neo-Keynesians proposed the opposite.

In another study, following the approach of Hamilton and Kim (2000), Mili et. al. (2012) found out that a non-linear relationship exists between changes in the interest rate and the spread of long term – short term interest rates. The results imply that taking nonlinearity into account shall allow for better explanations of the risk premium thus further studies can be made to deepen the nonlinear characteristics of the risk premium.

2.2 THE DYNAMICS OF STOCK MARKET VOLATILITY

In the literature, many studies analysed stock market volatility of developed markets. Campbell (1987), Glosten et al. (1993) found evidence on the higher short term interest leading to higher stock market volatility in US stock market whereas Schwert (1989) investigated the relation of multiple macroeconomic factors with stock market volatility through time. Particularly the study tries to find whether there is any relation with regards to the time specific changes in a number of macroeconomic variables and corresponding stock market volatility. Schwert (1989) found that among the dependent variables namely; economic activity, financial leverage, stock trading activity, real and nominal macroeconomic activity, general economic conditions of the economy relate most to stock market volatility with a factor of two to or three considering the Great Depression period between the years 1929 – 1939. This is also valid for all other macroeconomic variables where the series are more volatile during these periods.

These findings are in line with previous studies of Officer (1973) and later studies of Campbell et. al. (1993) and Hamilton and Lin (1996) where they have found a strong relation with the business cycle and stock market volatility. According to the studies; economic recessions are the single largest factor almost explaining 60% of the variance in stock returns.

2.2.1 Does Emerging Stock Market Volatility Displays the Same Characteristics?

Stock market volatility studies covering the emerging markets provides a different path. Bekaert and Harvey (1997) investigated 20 emerging market economies all over the world to understand the dynamics behind the emerging market stock market volatility. They had followed a different approach that allows examining the effect of world and local information in explaining the emerging market stock market volatility, particularly after the capital market liberalization processes. The main finding of the study suggests that the stock market volatility decreases in most of the cases of emerging markets after the liberalization processes. This indicates that globalization is a factor decreasing volatility in emerging markets. With regards to globalization, further studies investigating the spill over effect of developed markets to the emerging markets were made. Balakrishnan et. al. (2011), Chancharoenchai and Dibooglu (2006), Claessens et al. (2001); Dungey et al. (2004) Karolyi (2003), Pericoli and Sbracia (2003) are some of them conducting studies in this front. Choudhry (2004) investigated the volatility spill over effect from the US stock market to three pair of emerging market countries (namely Israel–Jordan, India–Pakistan, and Greece–Turkey) and found evidence of a spill over effect from the US stock markets to emerging markets considered. In a similar study Balakrishnan et al. (2011) investigated whether the financial stress of developed markets can be transferred to emerging markets. It is found that although there is a relation, the magnitude of the effect depends on how deep the financial links between the developed and emerging markets.

In a recent study, Hacıhasanoglu et al. (2012) supported these findings where they have investigated the effect of 2008 subprime crisis on emerging market stock markets before, during and after the financial crisis in 2008. Interestingly, the results indicate that during low global risk periods, the interaction between the developed markets and emerging market equity classes are closely related. However, during the crisis where extreme volatility is observed, the link between the emerging market equity classes and other asset classes weakens which indicates that a shock in other asset classes may not affect the emerging market equity class. After the crisis, the relationship between these asset classes re-emerge indicating a recovery period.

2.2.2 Is It Possible to Predict Stock Market Volatility and Economic Activity by Investigating Term Structure of Interest Rate?

In other works, studying the relation of term structure of interest rates with stock market volatility, Zhou (1996) provided evidence that term structure of interest rates has information on stock returns specifically in the long run suggesting that high stock market volatility is associated with the high volatility of the longer maturity bond yields. Later Paye (2012) investigated the relation of stock market volatility with the term spread between the long and short term rates and found that high stock market volatility is closely associated with recessions. In another study Aburachis and Kish (1999) provided country difference for stock and bond returns. In a more recent study, Li (2014) explored the relationship between the changes in US interest rate and stock market movements in international markets of US, UK and Hong Kong.

The findings suggested that the changes in values of US yield spread have some valuable information that can be used to predict the excess stock market volatility in all of the three markets where excess stock market volatility is calculated as 21-day rolling daily deviations from monthly mean return from the daily indices. In an attempt to further explain the effect of term structure of interest rates, Li (2016) decomposed term structure into its components of expectation factor and maturity premium as introduced by Hamilton and Kim (2000). With this study Li would like to explain whether the US term structure of interest rates (USTS) has any effect on the international stock markets like UK and Japan as it had in the US stock market and if had any effect, which component has the largest significance. After the analysis of data, it is found that USTS has more effect on the US and UK stock market than Japanese stock market. As for the components of USTS, both EF and MP of USTS have information on stock market volatility especially for the longer maturities of 36-3 and 60-3. This implies that the reactions of stock market players in short term periods could be varying significantly than in long term periods.

As a last remark, Expectation Factor (EF), which can be used to predict future economic conditions, through the information that it contains about future inflation paths and discount rate adjustments, has more explanatory power than Maturity Premium (MP)

about the future stock market volatility in all of the US, UK and Japanese stock market. This means that stock market players are more sensitive to changes in expected future short term rates. This effect had been observed clearly during the post crisis period of December 2007, where stock market players reacted more to macro factors such as inflation and economic performance than liquidity or maturity factors.

EF, which can be used as an indicator of future economic conditions, working through information about future inflation paths and discount rate adjustments, is an important consideration in the pricing kernel of stocks. Similar to previous studies of the term structure, the negative EF estimated coefficients captured, show that stock market volatility is adversely responding to downward changes in the future economic environment and inflation rates. As for the MP coefficient, when variations in interest rates increase, investors might amend their demands for risk compensations, thus we should see a positive reaction in stock market volatility. Estimated negative MP coefficients highlight the fact that variations in long term rates might not be a strong enough reason to induce such an effect. However, the markets are once again paying more attention to information about expected future short term rates, an indicator of future inflation rates.

3. DATA AND METHODOLOGY

The stock data used in this study contains weekly stock returns that are calculated from daily closing values of BIST indexes between the dates January 8, 1999 and February 8, 2013. The sample period is 14 years covering the subprime crisis period in 2008.

The term structure of interest rate data, were calculated as continuously compounded spot yields of the US zero coupon treasury bonds with different maturities varying from 60 months, 36 months, 12 months and 3 months. Although the sample data for the US zero coupon bonds were available until 2017, due to the proposed model in this study which requires a comparison of real rates with the model produced variables, the data shrunk and the sample period need to be cut at 2013. The stock data were retrieved from Datastream and US zero coupon bond yields data were retrieved from Bloomberg.

For each sector index, daily stock index returns are computed by taking the logarithmic first differences of previous day closing prices with current day closing prices. As a second step, weekly volatilities of indexes are computed by using the following equation (3.1):

$$\sigma_w = \left[\frac{1}{N_w - 1} \sum_{t=1}^{N_w} (r_{t,w} - \mu_w)^2 \right]^{0.5} \quad \textbf{(3.1)}$$

where $r_{t,w}$ denotes the return on day t in week w. μ_w is the weekly average return and N_w is number of trading days in week w. The weeks with less than three trading days are removed from the sample.

For the calculation of term structure of interest rates, the following methodology had been applied. According to the expectation theory, the yield spread between long-term and short-term interest rates is defined as

$$Spread_w = i_{l,w} - i_{3,w} \quad \textbf{(3.2)}$$

where $i_{l,w}$ and $i_{3,w}$ are the long-term and short-term (3-month) interest rates in week *w*, respectively. At this point, the long term maturity may consist of 1-year, 3-year or 5-year periods defined by the 12-month, 36-month or 60-month bond yields.

Although expectation theory suggests that maturity premium is constant, a time varying maturity premium explains expectation theory better as put forward by many researchers, such as Campbell and Shiller (1987) and Bliss and Fama (1987). For this reason in order to understand the effect of the time varying maturity premium, Hamilton and Kim's (2000) approach has been adopted in this study and yield spread is decomposed into two components, as Expectation Factor (EF) and time varying maturity premium (MP).

For the decomposition of term structure, as suggested by the expectation theory, the long term interest rate is defined as the sum of expected future short term rate during the life of the bond plus the time varying maturity premium as put forward by equation (3.3).

$$i_{l,w} = \frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E}_w i_{3,w+3h}) + \theta_w, \qquad k = \frac{l}{3} \qquad l = 12, 36 \text{ or } 60 \quad \textbf{(3.3)}$$

where $\mathrm{E}_w i_{3,w+3h}$ is the future short term rate (3 months) expectation yield made at week *w*, θ_w is time-varying maturity premium and *h* is an integer. With this equation θ_w can be defined as

$$\theta_w = i_{l,w} - \frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h}) \quad \textbf{(3.4)}$$

As a third step, subtract $i_{3,w}$ from both sides of equation (3.3) to reach spread equation provided above.

$$i_{l,w} - i_{3,w} = \left(\frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h}) - i_{3,w}\right) + \theta_w, \quad k = \frac{l}{3} \quad l = 12, 36 \text{ or } 60 \quad \textbf{(3.5)}$$

and substitute θ_w from equation (3.4) into equation (3.5), to arrive spread formula.

$$i_{l,w} - i_{3,w} = \left(\frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h}) - i_{3,w}\right) + \left(i_{l,w} - \frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h})\right), \quad k = \frac{l}{3} \quad l = 12, 36 \text{ or } 60 \quad \textbf{(3.6)}$$

With this composition of spread, the first term in equation (3.6) can be identified as EF which is the variance of average expected future short-term interest rates with the spot short-term rate, while the second term can be identified as the maturity premium (MP).

$$EF_w = \frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h}) - i_{3,w}, \quad k = 4,12 \text{ or } 20 \quad (3.7)$$

$$MP_w = i_{l,w} - \frac{1}{k}\sum_{h=0}^{k-1}(\mathrm{E_w} i_{3,w+3h}), \quad k = \frac{l}{3} \quad l = 12, 36 \text{ or } 60 \quad (3.8)$$

After the decomposition of USTS, the relationship between the BIST stock volatility and USTS are investigated by utilizing the following empirical model.

$$Volatilty_w = \alpha + \beta \cdot EF_w + \gamma \cdot MP_w + \delta \cdot Turnover_w + \varepsilon_w \quad (3.9)$$

where the dependent variable is the weekly standard deviation of BIST stock indexes return (Volatility).

The explanatory variables include the two components of the US yield spread, namely expectation factor (EF) and maturity premium (MP). In order to add a control variable into the model, the turnover data, which is defined as the trading volume divided by the number of shares outstanding, is used. In the literature, there is a growing tendency to see volume or scaled turnover data as an important driver for the increasing volatility. Lamoureux and Lastrapes (1990) explained that trading volume of stocks reflects the dependence in information flows to the market that feeds directly into price volatility. Schwert (1989) finds some evidence on relation between trading activity and stock market volatility which supports the findings of French and Roll (1986). Thus it can be said that volume or turnover data being a proxy for the mixing variable can explain time-series properties of the return.

As the empirical model suggests, the components of yield spread namely EF and MP are not directly observable but rather computed based on expectations. Because of the errors-in-variables problem, the coefficient estimates under the use of ordinary least squares (OLS) will not be unbiased and consistent. The rational expectations states that the error term εw should not have any correlation with any variable that are known in week w. Thus the estimates of the model can be made by using the instrumental variable (IV) method by applying any variable in week w or before as the instruments. For this reason, long-term interest rate ($i_{l,w}$), 3-month interest rate ($i_{3,w}$), share turnover all dated in week w, and a constant are chosen as instruments. The generalized method of moments (GMM) estimator is used since the model is just-identified where GMM estimator is identical to the two stage least squares estimator.

Before the empirical analysis, the variables are tested for stationarity. The results shows that the first difference of EF, MP, $i_{l,w}$ and $i_{3,w}$ should be selected to ensure stationarity. For this reason, the first differences rather than the levels of these variables are used in the remainder of the thesis.

4. DISCUSSION OF FINDINGS

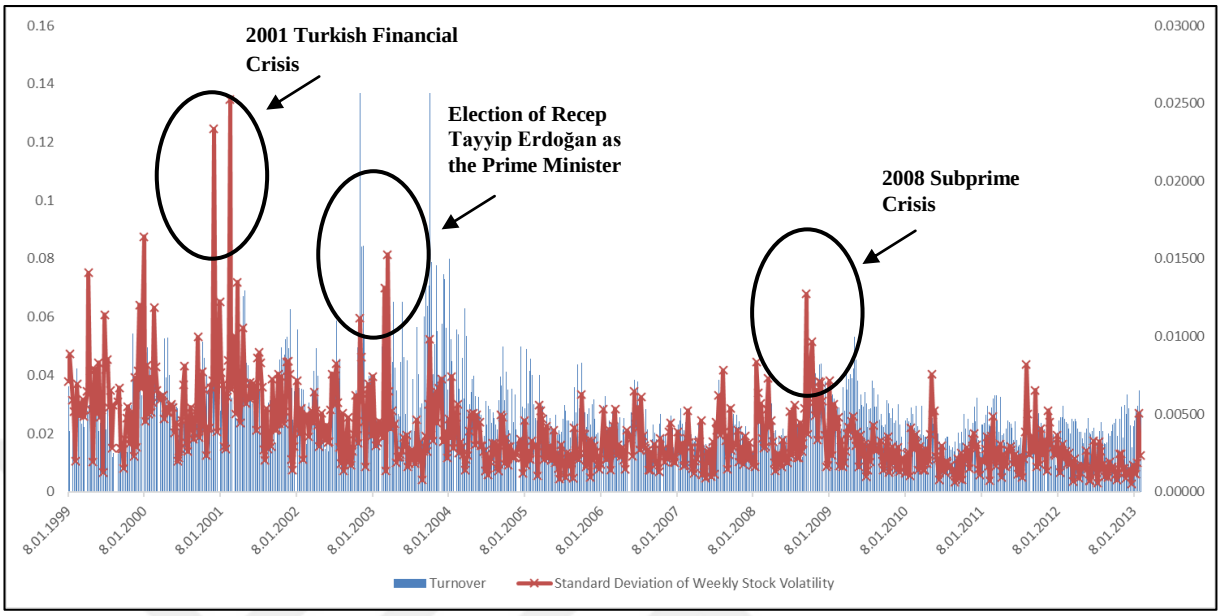
4.1 DESCRIPTIVE STATICS

Before the thorough analysis, the data used were examined separately. First of all, the standard deviation of weekly stock market index returns, representing stock market volatility, together with turnover are viewed through the sample period in order to observe the dates where the stock market volatility reaches its peak. In the second part, the USTS decomposed into EF and MP compared with corresponding US zero coupon yields, were viewed to observe if there is any pattern. As a last point, the data were analysed for normality.

4.1.1 Weekly Stock Volatility and Turnover During the Sample Period

As presented in the Figure 4.1 standard deviation of weekly stock volatility peaks in three points in time which are also associated with jumps in turnover. The largest peak is observed in February 2001 which is in line with the financial crisis that Turkish markets experienced. The second peak is observed in March 2003 which is the date Mr. Recep Tayyip Erdogan was elected as the Prime Minister leading the ruling AK Party. Among these peaks the third peak and the weakest one is observed in September 2008 (bankruptcy of Lehman Brothers) during the subprime crisis first started in US and spread throughout the world. This development through time revealed that local factors such as local crisis and events are much more effective in terms of stock volatility.

Figure 4.1: Standard Deviation of Weekly Stock Market Index Returns in Comparison with Turnover (1999 – 2013)



Source: DataStream

4.1.2 The Descriptive Analysis of Weekly Stock Volatility and Turnover Data During the Pre-Crisis and Post-Crisis Periods.

A descriptive analysis is made for the standard deviation of weekly stock volatility and turnover data for every sector indexes before and after the global crisis period first to test whether the data is normally distributed or not. As the beginning date for the crisis, September 15, 2008 - the bankruptcy date of Lehman Brothers - has been accepted.

As observed in Table 4.1. in the pre-crisis period it has been observed that the mean standard deviation of weekly stock volatility in the pre-crisis period is 45% higher than the mean standard deviation in post-crisis period. This result may be the effect of the major financial crisis that was experienced in Turkey in 2001 where the sample data includes this period as well. Thus, it is another indication that local factors are more effective in the case of stock volatility.

In the pre-crisis period, mean standard deviation of weekly stock volatility for all of the sectors were in the range of 0.0190 and 0.0330, where the lowest volatility has been observed in the construction related sectors such as building material and construction materials and highest volatility has been observed in sectors dependent in international trade such as Chemicals, Airlines, Travel and Technology sector.

In the post-crisis period this range changed to 0.0113 and 0.0291 together with the sector behaviours where the highest volatility has been observed in Non-Financials sector and the lowest volatility has been observed in Food Products sector implying that Food Products sector is the least sensitive sector to changes in macroeconomic factors.

Secondly, skewness and kurtosis figures for the standard deviation of weekly stock volatility data ranged between 1.5748 - 3.4073 and 6.0338 - 28.6806 respectively. Also the JB data ranged between 390.8837 to 14324.5300 in the pre-crisis period rejecting that the data is normally distributed. For the post-crisis period a similar pattern has been observed. The skewness and kurtosis figures for standard deviation of weekly stock volatility data ranged between 1.0817 - 4.3279 and 4.8649 - 29.5553 respectively. Also the Jarque-Bera (JB) test statistics ranged between 76.4831 and 7313.5330 rejecting the hypothesis that the data is normally distributed in the post-crisis period as well.

For the turnover data a similar pattern is observed in comparison of the pre-crisis and post-crisis periods. The mean turnover figure for the pre-crisis period for all of the sectors is 22% higher than the mean turnover figure for the post-crisis period. It is also observed that the mean standard deviation of turnover for all of the sector indexes are below that of standard deviation of weekly stock volatility.

Similarly, normality of the turnover data had been rejected where JB data ranges from 235.5899 to 21457.9800 in the pre-crisis and in between 16.0471 - 24685.9000 for all of the sector indexes in the post crisis period.

Table 4.1: Descriptive Statistics for Standard Deviation of Weekly Stock Volatility and Turnover used in Analysis

		Pre-Crisis						Post-Crisis					
Industry Name		**Mean**	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**		**Mean**	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**	
Airlines	Week. Vol. Std. Dev.	0.0304	0.0194	1.5748	6.1118	397.7961	***	0.0209	0.0105	1.0817	4.8649	76.483	***
	Turnover	0.0044	0.0055	2.5503	1.4314	2332.8690	***	0.0162	0.0094	3.6092	26.7646	5783.063	***
Automobiles	Week. Vol. Std. Dev.	0.0265	0.0169	2.0551	10.5782	1508.1290	***	0.0188	0.0126	1.8086	6.8464	261.370	***
	Turnover	0.0047	0.0040	1.8919	7.3657	677.2617	***	0.0025	0.0019	2.4235	11.2766	862.456	***
Auto parts	Week. Vol. Std. Dev.	0.0253	0.0161	2.1970	12.2402	2124.2960	***	0.0168	0.0118	2.0496	7.8689	379.771	***
	Turnover	0.0042	0.0034	1.8392	7.2477	640.6691	***	0.0023	0.0015	2.1787	9.1235	529.542	***
Banks	Week. Vol. Std. Dev.	0.0268	0.0160	2.1310	11.0105	1670.6580	***	0.0186	0.0112	2.1209	10.3311	672.536	***
	Turnover	0.0066	0.0041	3.5109	25.2838	11076.6900	***	0.0068	0.0028	1.1552	4.5701	73.155	***
Basic Materials	Week. Vol. Std. Dev.	0.0235	0.0155	2.6680	17.4210	4778.0470	***	0.0174	0.0120	2.3914	10.7882	783.100	***
	Turnover	0.0059	0.0042	2.0208	10.6564	1514.7240	***	0.0073	0.0035	0.6170	2.5652	16.047	***
Beverages	Week. Vol. Std. Dev.	0.0296	0.0182	2.0529	11.6211	1842.6010	***	0.0187	0.0125	2.2342	10.0497	653.107	***
	Turnover	0.0115	0.0097	1.9246	10.2160	1348.8710	***	0.0058	0.0031	1.0342	4.4184	58.972	***
Brewers	Week. Vol. Std. Dev.	0.0255	0.0174	1.7356	9.4226	1081.5420	***	0.0185	0.0111	1.9461	9.7907	574.331	***
	Turnover	0.0015	0.0018	4.5106	34.2425	21457.9800	***	0.0008	0.0005	1.3658	4.4091	88.566	***
Broad line	Week. Vol. Std. Dev.	0.0251	0.0186	2.0729	12.0542	1999.8470	***	0.0174	0.0118	1.9848	9.2898	518.623	***
	Turnover	0.0106	0.0164	3.1720	20.6550	7097.5930	***	0.0017	0.0019	2.7717	13.3127	1279.424	***
Building Materials	Week. Vol. Std. Dev.	0.0190	0.0145	3.3536	23.2342	9220.7630	***	0.0195	0.0172	2.3823	9.6621	628.919	***
	Turnover	0.0022	0.0017	2.0225	8.8994	1038.1990	***	0.0024	0.0038	5.3314	38.3651	12791.100	***
Chemicals	Week. Vol. Std. Dev.	0.0330	0.0213	1.6181	7.3358	593.9632	***	0.0198	0.0150	2.5447	10.6668	793.889	***
	Turnover	0.0068	0.0065	2.1801	8.9899	1113.8290	***	0.0150	0.0109	1.7351	6.4359	223.576	***

Industry Name		Pre-Crisis						Post-Crisis					
		Mean	Std. Dev.	Skewness	Kurtosis	JB		Mean	Std. Dev.	Skewness	Kurtosis	JB	
Commercial Chemicals	Week. Vol. Std. Dev.	0.0301	0.0201	1.7155	7.2381	598.3754	***	0.0186	0.0113	1.6522	6.6413	226.666	***
	Turnover	0.0063	0.0089	3.7378	23.5143	9593.9940	***	0.0136	0.0105	1.7134	6.0695	198.419	***
Construction Materials	Week. Vol. Std. Dev.	0.0198	0.0141	3.2045	22.8057	8793.2160	***	0.0183	0.0117	1.8734	7.8322	350.515	***
	Turnover	0.0022	0.0021	2.0075	7.5858	753.8515	***	0.0016	0.0010	3.0659	17.8342	2415.492	***
Consumer Discretionary.	Week. Vol. Std. Dev.	0.0217	0.0147	3.0209	20.2601	6785.7930	***	0.0136	0.0088	1.6424	6.1483	194.077	***
	Turnover	0.0058	0.0038	1.8643	7.9683	782.9721	***	0.0037	0.0020	1.6230	6.4363	209.481	***
Consumer Goods	Week. Vol. Std. Dev.	0.0220	0.0153	2.7903	18.1532	5291.2710	***	0.0129	0.0085	1.6075	6.5281	213.595	***
	Turnover	0.0045	0.0033	2.0589	10.9666	1631.9160	***	0.0020	0.0014	1.7162	6.4718	223.448	***
Consumer Services	Week. Vol. Std. Dev.	0.0247	0.0167	1.8297	8.3145	844.8505	***	0.0140	0.0083	1.9518	8.7260	450.233	***
	Turnover	0.0052	0.0031	2.3451	13.9091	2861.2530	***	0.0063	0.0030	1.0700	4.5059	64.195	***
Consumer Staples	Week. Vol. Std. Dev.	0.0211	0.0141	2.5798	16.0440	3992.7680	***	0.0137	0.0093	2.1865	10.2587	673.236	***
	Turnover	0.0034	0.0025	1.8154	8.8195	954.6975	***	0.0012	0.0007	1.4578	5.3500	131.473	***
Durable Products	Week. Vol. Std. Dev.	0.0257	0.0177	2.1752	11.5697	1874.2800	***	0.0171	0.0118	1.8456	7.3764	307.299	***
	Turnover	0.0039	0.0028	1.9395	8.2447	863.4763	***	0.0036	0.0036	2.4675	10.8998	813.371	***
Explore Products	Week. Vol. Std. Dev.	0.0281	0.0040	2.5066	15.9765	3862.3770	***	0.0190	0.0123	2.3147	10.9137	788.040	***
	Turnover	0.0057	0.0040	2.4310	13.5817	2706.5840	***	0.0056	0.0027	1.4394	5.5360	137.994	***
Financial	Week. Vol. Std. Dev.	0.0261	0.0153	2.3968	15.0068	3391.5970	***	0.0180	0.0111	1.9725	8.6531	445.504	***
	Turnover	0.0045	0.0024	1.8585	8.3415	859.3038	***	0.0029	0.0018	1.3619	4.2489	84.181	***
Financial Services	Week. Vol. Std. Dev.	0.0258	0.0152	2.3948	14.9890	3382.1110	***	0.0180	0.0111	1.9725	8.6531	445.499	***
	Turnover	0.0047	0.0026	1.7389	7.6114	676.9307	***	0.0029	0.0018	1.3619	4.2489	84.181	***
Food & Beverage	Week. Vol. Std. Dev.	0.0222	0.0152	2.3880	13.8891	2868.9160	***	0.0163	0.0107	1.9178	7.7590	350.247	***
	Turnover	0.0019	0.0016	2.7342	14.0337	3077.1520	***	0.0009	0.0007	2.5553	12.9676	1176.284	***

Industry Name		Pre-Crisis						Post-Crisis					
		Mean	Std. Dev.	Skewness	Kurtosis	JB		Mean	Std. Dev.	Skewness	Kurtosis	JB	
Food Products	Week. Vol. Std. Dev.	0.0275	0.0206	2.1339	9.6278	1260.9630	***	0.0291	0.0276	2.4116	10.3041	718.237	***
	Turnover	0.0016	0.0034	4.4454	31.2505	17798.6000	***	0.0008	0.0014	4.3329	25.1226	5292.233	***
Food Retailer	Week. Vol. Std. Dev.	0.0278	0.0192	1.8531	9.6090	1165.0330	***	0.0184	0.0148	4.2809	29.2160	7130.459	***
	Turnover	0.0117	0.0128	2.3350	11.3096	1843.6610	***	0.0018	0.0011	4.4368	36.5563	11294.670	***
Gas Distribution	Week. Vol. Std. Dev.	0.0268	0.0169	2.5225	16.1296	3989.7490	***	0.0184	0.0110	1.6624	7.2845	275.726	***
	Turnover	0.0031	0.0032	3.8099	23.7593	9861.7090	***	0.0027	0.0025	2.8105	14.4723	1530.079	***
General Retailing	Week. Vol. Std. Dev.	0.0251	0.0186	2.0727	12.0517	1998.8610	***	0.0173	0.0118	2.0231	9.5551	553.855	***
	Turnover	0.0106	0.0164	3.1720	20.6550	7097.5930	***	0.0017	0.0019	2.7717	13.3127	1279.424	***
Healthcare	Week. Vol. Std. Dev.	0.0291	0.0186	1.7889	8.4020	851.9012	***	0.0197	0.0126	1.5900	5.9171	173.799	***
	Turnover	0.0075	0.0065	2.5853	13.0537	2593.4860	***	0.0104	0.0133	6.1507	52.9359	24685.900	***
Heavy Construction	Week. Vol. Std. Dev.	0.0273	0.0174	2.6674	17.9273	5098.9910	***	0.0201	0.0134	2.1022	9.6354	578.496	***
	Turnover	0.0034	0.0043	1.9048	7.4932	704.1514	***	0.0012	0.0007	1.0970	4.3405	61.977	***
Industrial Goods & Services	Week. Vol. Std. Dev.	0.0239	0.0159	2.3518	13.9337	2874.7300	***	0.0180	0.0111	1.4544	5.1993	124.674	***
	Turnover	0.0068	0.0056	1.3664	5.9554	328.7739	***	0.0069	0.0068	2.2143	8.8445	504.099	***
Industrials	Week. Vol. Std. Dev.	0.0233	0.0157	2.4286	14.3162	3077.2300	***	0.0166	0.0104	1.6085	6.1318	188.981	***
	Turnover	0.0071	0.0059	1.2251	5.3679	235.5899	***	0.0023	0.0014	1.6754	6.4592	217.439	***
International Oil & Gas	Week. Vol. Std. Dev.	0.0266	0.0174	2.1670	11.5720	1872.1580	***	0.0199	0.0156	1.8162	7.9792	356.134	***
	Turnover	0.0054	0.0039	1.7220	7.2710	610.8374	***	0.0028	0.0038	2.9915	15.2338	1738.699	***
Iron & Steel	Week. Vol. Std. Dev.	0.0295	0.0182	2.0657	11.7016	1871.2010	***	0.0197	0.0130	1.9665	8.5421	432.970	***
	Turnover	0.0115	0.0097	1.9246	10.2160	1348.8700	***	0.0062	0.0035	1.7451	11.2778	756.594	***
Market	Week. Vol. Std. Dev.	0.0224	0.0144	2.6772	16.7208	4401.8390	***	0.0140	0.0089	2.2070	10.5337	714.751	***
	Turnover	0.0057	0.0028	2.5838	15.5802	3753.2390	***	0.0047	0.0014	0.8172	3.8693	32.129	***

Industry Name		Pre-Crisis						Post- Crisis					
		Mean	Std. Dev.	Skewness	Kurtosis	JB		Mean	Std. Dev.	Skewness	Kurtosis	JB	
Multi Utility	Week. Vol. Std. Dev.	0.0268	0.0169	2.5225	16.1297	3989.7700	***	0.0184	0.0110	1.6624	7.2845	275.725	***
	Turnover	0.0031	0.0032	3.8100	23.7604	9862.6890	***	0.0027	0.0025	2.8105	14.4723	1530.079	***
Non Financials	Week. Vol. Std. Dev.	0.0209	0.0144	2.9358	19.5628	6266.0860	***	0.0113	0.0074	2.0398	9.2952	527.566	***
	Turnover	0.0052	0.0028	1.5521	7.5708	619.4579	***	0.0031	0.0011	0.9053	4.0035	40.172	***
Oil & Gas	Week. Vol. Std. Dev.	0.0250	0.0166	2.5181	14.6090	3249.3480	***	0.0165	0.0100	1.4958	5.6621	150.338	***
	Turnover	0.0054	0.0037	1.9600	8.5057	926.8914	***	0.0050	0.0025	1.8588	8.3399	396.897	***
Personal Goods	Week. Vol. Std. Dev.	0.0243	0.0165	2.5459	15.7186	3808.5240	***	0.0171	0.0118	1.8456	7.3765	307.306	***
	Turnover	0.0044	0.0033	2.7166	14.8853	3465.3960	***	0.0036	0.0036	2.4675	10.8997	813.362	***
Retail	Week. Vol. Std. Dev.	0.0237	0.0160	3.4073	28.6806	14324.5300	***	0.0151	0.0104	2.5815	13.2253	1230.114	***
	Turnover	0.0043	0.0031	2.3164	11.3658	1855.6550	***	0.0026	0.0020	2.9958	16.2381	1979.496	***
Technology	Week. Vol. Std. Dev.	0.0312	0.0210	1.8585	8.0002	787.6839	***	0.0197	0.0119	1.4634	6.0714	168.753	***
	Turnover	0.0101	0.0102	3.7480	24.6097	10615.9600	***	0.0061	0.0061	2.7846	14.3571	1500.001	***
TMT	Week. Vol. Std. Dev.	0.0286	0.0180	2.1907	11.3524	1805.1180	***	0.0142	0.0088	1.9601	8.3364	411.059	***
	Turnover	0.0066	0.0059	1.9026	6.8990	602.2979	***	0.0020	0.0011	1.2690	4.8738	93.305	***
Travel	Week. Vol. Std. Dev.	0.0301	0.0197	1.5858	6.0338	390.8837	***	0.0188	0.0093	1.3274	6.8008	201.505	***
	Turnover	0.0042	0.0054	2.7462	13.6904	2931.1330	***	0.0146	0.0079	1.5498	6.7638	222.880	***
Utilities	Week. Vol. Std. Dev.	0.0233	0.0143	2.7029	18.5523	5467.1490	***	0.0180	0.0109	1.6595	7.1506	264.780	***
	Turnover	0.0039	0.0036	3.0283	15.7508	4018.5140	***	0.0029	0.0026	2.6976	13.3516	1277.463	***

		Pre-Crisis					Post- Crisis				
		Mean	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**	**Mean**	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**
Standard Deviation of Weekly Stock Volatilities	MIN	0.0190	0.0040	1.5748	6.0338	390.8837	0.0113	0.0074	1.0817	4.8649	76.4831
	MAX	0.0330	0.0213	3.4073	28.6806	14324.5300	0.0291	0.0276	4.3279	29.5553	7313.5330
	Average	0.0258	0.0167	2.3123	13.6364	3237.4792	0.0177	0.0118	2.0230	9.3025	759.1857
Turnover	MIN	0.0015	0.0016	1.2251	1.4314	235.5899	0.0008	0.0005	0.6170	2.5652	16.0471
	MAX	0.0117	0.0164	4.5106	34.2425	21457.9800	0.0162	0.0133	6.1507	52.9359	24685.9000
	Average	0.0056	0.0051	2.4636	13.1345	3759.3981	0.0046	0.0033	2.2545	11.9887	2011.9833

*: Represents 10% significance level Std. Dev.: Standard Deviation Week. Vol. Std. Dev.: Standard Deviation of Weekly Stock Volatility

**: Represents 5% significance level TMT: Technology Media Telecom JB: Jarque-Bera

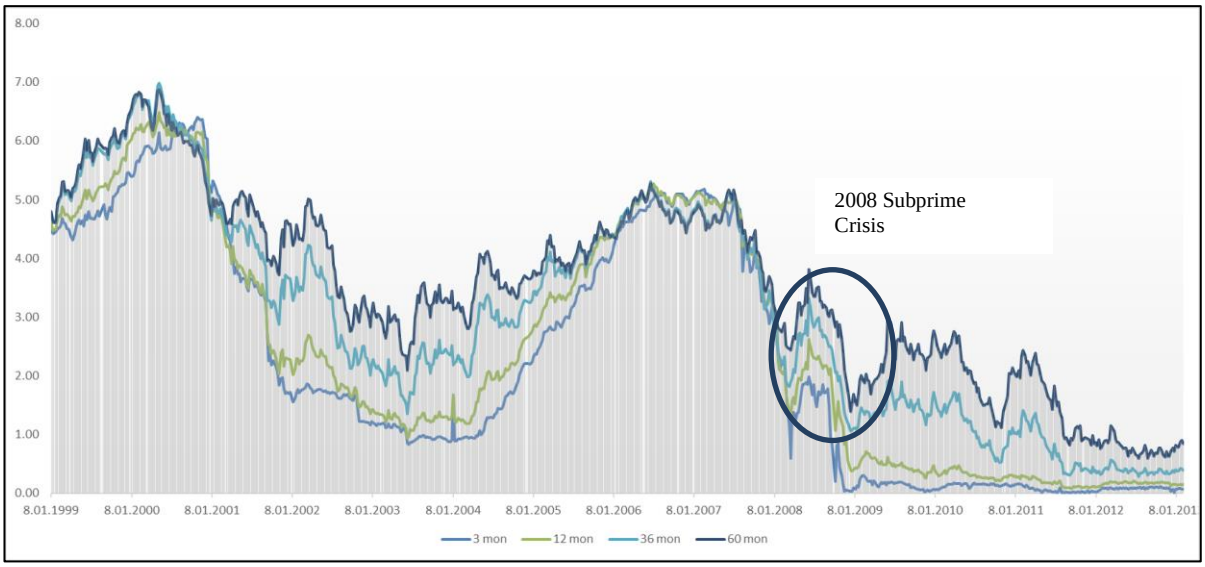
***: Represents 1% significance level

4.1.3 The Descriptive Analysis of US Term Structure of Interest Rates Decomposed into EF and MP with Various Maturities

As can be observed from the Figure 4.2 the interest rates declined sharply in September 2008, due to the effect of subprime crisis. When compared with Figure 4.3, it has been observed that the movement of interest rates are linked to the movement of MP and EF components which move inversely with each other. MP having a positive sign most of the time is associated with negative values of EF. This indicates that when EF is negative implying that the interest rates are expected to fall and an economic downturn is probable. This effect has been clearly observed in Figure 4.3 where the EF was negative before the crisis and stays flat afterwards.

On the other hand, short term MP moves in the same direction with the current short term rate. This was one of the findings of Li (2016) where the behaviours of MP and EF were compared with S&P 500 volatility.

Figure 4.2: US Interest Rates with Maturities Ranging from 3 Months to 60 Months (%, 1999 – 2013)



Source: Bloomberg

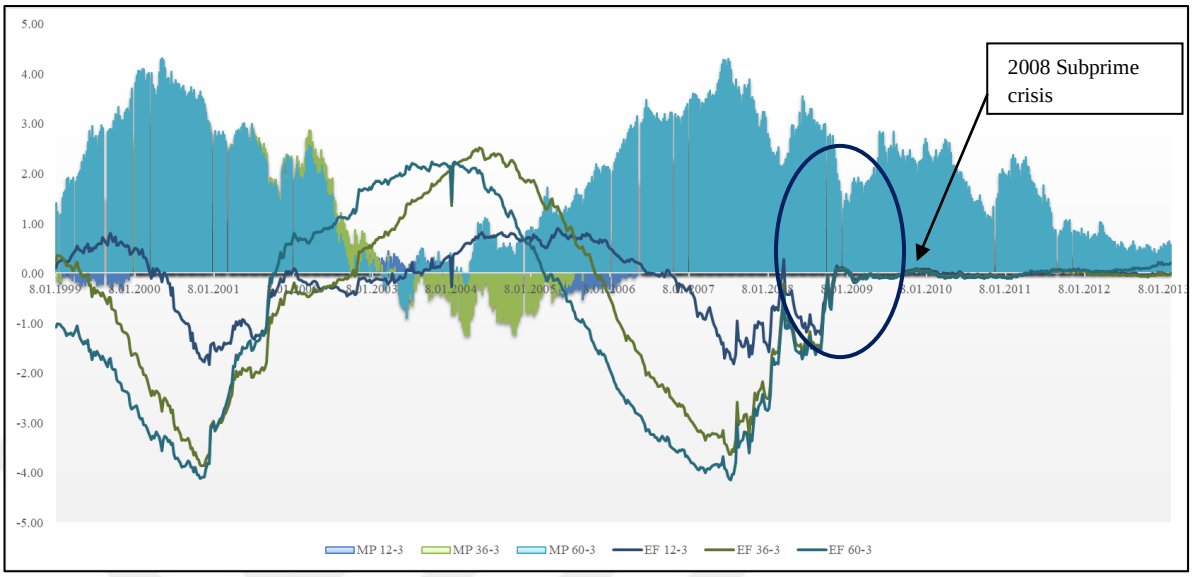
m3: 3-month US zero coupon bond yield

m12: 12-month US zero coupon bond yield

m36: 36-month US zero coupon bond yield

m60: 60-month US zero coupon bond yield

Figure 4.3: The Development of MP and EF Components Before and After the Subprime Crisis (%, 1999 – 2013)



Source: Bloomberg

mp123: Maturity Premium component of yield spread between 12 months and 3 months US zero coupon bond

mp363: Maturity Premium component of yield spread between 36 months and 3 months US zero coupon bond

mp603: Maturity Premium component of yield spread between 60 months and 3 months US zero coupon bond

ef123: Expectation Factor component of yield spread between 12 months and 3 months US zero coupon bond

ef363: Expectation Factor component of yield spread between 36 months and 3 months US zero coupon bond

ef603: Expectation Factor component of yield spread between 60 months and 3 months US zero coupon bond

The USTS data has been tested for normality and as observed from the values of JB presented in Table 4.2 ranging from 14.7081 to 41.9564 in the pre-crisis period and 11.4798 to 7952.2850 in the post crisis period, normality distribution of the USTS data was rejected.

Similar to the weekly stock volatility and turnover data, USTS has also been analysed in two parts as the pre-crisis and post-crisis period. The main observation is that, due to the precautions taken after September 15, 2008, the mean US interest rates declined to almost 0% from 3.5% - 4% levels, where the interest rates for maturities of 3 months,

12 months, 36 months and 60 months declined by 96%, 91%, 76% and 62% respectively. The largest decline observed in short term interest rates up to 12 months.

Following the decline in interest rates, the spread between the long term rates and short term rates diminished where majority of the decline came from the EF component. It has been observed that the EF component of USTS having a negative mean value for all the maturities in the pre-crisis period decreased significantly in the post crisis period by 89%, 94% and 98% respectively for the maturities 12-3 months, 36-3 months and 60-3 months where the largest decline observed in the long term maturities. On the other hand, MP component of USTS which has a positive sign pre-crisis period decreased less than EF component with 46%, 37% and 26% for the maturities of 12-3 months, 36-3 months and 60-3 months.

In line with the diminishing spreads, standard deviation for EF component of USTS decreased as well during the post crisis period -88%, -94%, -94% respectively for the maturities 12-3 months, 36-3 months and 60-3 months. Likewise, the standard deviation of MP component showed a similar pattern where the figure decreased by -63%, -65% and -43% respectively for the maturities 12-3 months, 36-3 months and 60-3 months.

Table 4.2: Descriptive Statistics for EF and MP Component of USTS Used in the Analysis.

	Pre-Crisis						Post-Crisis					
Interest Rates	**Mean**	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**		**Mean**	**Std. Dev.**	**Skewness**	**Kurtosis**	**JB**	
m3	3.2740	1.7254	0.0912	1.5737	41.9564	***	0.1181	0.1206	4.5292	28.8986	7057.4200	***
m12	3.5270	1.6301	0.0648	1.6470	37.4886	***	0.3308	0.2713	3.3387	17.9827	2522.4960	***
m36	3.9957	1.3602	0.1876	2.1163	18.7027	***	0.9620	0.5197	0.3191	2.0959	11.4798	***
m60	4.3562	1.0731	0.3179	2.4337	14.7081	***	1.6655	0.7207	0.0132	1.6507	17.0739	***
ef123	-0.1745	0.7361	-0.4996	2.1320	35.5460	***	-0.0195	0.0866	-4.1601	27.1950	6137.1010	***
ef363	-0.6965	1.8043	0.1029	1.8794	26.3426	***	-0.0441	0.1031	-4.6358	30.6095	7952.2850	***
ef603	-1.0246	2.0592	0.1529	1.6591	38.3837	***	-0.0214	0.1296	-3.0152	18.5151	2597.6780	***
mp123	0.4275	0.6184	0.5650	2.1941	39.0942	***	0.2322	0.2296	3.4350	18.7784	2776.4690	***
mp363	1.4183	1.4239	-0.2688	1.7043	39.9314	***	0.8879	0.4970	0.3038	2.0327	12.2327	***
mp603	2.1068	1.3205	-0.3465	1.9353	32.7478	***	1.5688	0.7500	-0.0735	1.6520	17.2384	***

**: Represents 10% significance level*

***: Represents 5% significance level*

****: Represents 1% significance level*

Std. Dev: Standard Deviation

m3: 3-months US zero coupon bond interest rate

m12: 12-months US zero coupon bond interest rate

m36: 36-months US zero coupon bond interest rate

m60: 60-months US zero coupon bond interest rate

ef123: Expectation Factor component of yield spread between 12 months and 3 months US zero coupon bond

ef363: Expectation Factor component of yield spread between 36 months and 3 months US zero coupon bond

ef603: Expectation Factor component of yield spread between 60 months and 3 months US zero coupon bond

mp123: Maturity Premium component of yield spread between 12 months and 3 months US zero coupon bond

mp363: Maturity Premium component of yield spread between 36 months and 3 months US zero coupon bond

mp603: Maturity Premium component of yield spread between 60 months and 3 months US zero coupon bond

4.2 RESULTS

4.2.1 Whole Period Analysis by Sectors

The analysis of the data had been made in two parts. In the first part, the whole sample period is considered where around 710 observations are included. In the second part the pre-crisis period ending in September 15, 2008 and post-crisis period starting from that point had been analysed separately to see whether any change in the behaviour of the explanatory variables are observed.

As presented in Table 4.3, during the analysis of the whole sample period, it has been observed that Durable Products, Food Products and Personal Goods sectors having an EF Coefficient ranging from 0.004 – 0.012 are not statistically significant. On the other hand, EF is a slightly significant factor in the long term maturities of 36 and 60 months in Banks, Chemicals, Consumer Discretionary, Consumer Services and Retail sectors.

Another finding is that MP is not significant almost for all of the sectors except for Beverages, Chemicals, Consumer Discretionary, Healthcare and Iron & Steel. Among these sectors the consistently highest significance level is observed in the healthcare sectors together with Iron & Steel which can be an indication of the investors trading in these sectors are have a long term horizon. Turnover is the most explanatory variable in the model for all of the sectors except for the Brewers and Commercial Chemicals sector where turnover is not significant at all and in Oil & Gas industry where turnover is slightly significant within 10% range. This finding is very much in line with the previous studies of Lamoureux and Lastrapes (1990) which indicates that trading volume of stocks reflects the dependence in information flows to the market that feeds directly into price volatility.

Table 4.3: The Analysis of EF, MP and Turnover with the Turkish stock market volatility by sector (Whole Period)

Whole Period		C		EF		MP		TURN		R2%
Airlines	**123**	0.030		0.022		-0.012		-0.265		2%
		(17.367)	***	(2.230)	***	-(1.042)		-(2.369)	**	
	363	0.029		0.021		-0.001		-0.258		3%
		(17.530)	***	(2.887)	***	-(0.091)		-(2.337)	**	
	603	0.029		0.021		0.002		-0.258		4%
		(17.705)	***	(2.965)	***	(0.380)		-(2.339)	**	
Automobiles	**123**	0.016		0.019		-0.024		2.148		21%
		(14.759)	***	(2.685)	***	-(1.951)	*	(7.944)	***	
	363	0.015		0.021		-0.007		2.193		24%
		(14.598)	***	(3.942)	***	-(1.397)		(7.915)	***	
	603	0.015		0.020		-0.005		2.170		25%
		(14.628)	***	(3.956)	***	-(1.068)		(7.933)	***	
Auto parts	**123**	0.015	***	0.022	***	-0.022	**	2.200	***	17%
		(14.241)		(2.993)		-(1.968)		(7.959)		
	363	0.014	***	0.022	***	-0.007		2.262	***	21%
		(14.037)		(4.103)		-(1.418)		(7.941)		
	603	0.015	***	0.022	***	-0.004		2.237	***	22%
		(14.064)		(4.114)		-(1.039)		(7.988)		
Banks	**123**	0.015		0.012		-0.014		1.438		14%
		(9.596)	***	(1.595)		-(1.246)		(7.521)	***	
	363	0.015		0.013		-0.003		1.434		14%
		(9.611)	***	(2.545)	**	-(0.579)		(7.475)	***	
	603	0.014		0.013		0.000		1.454		15%
		(9.596)	***	(2.582)	***	-(0.081)		(7.605)	***	
Basic Materials	**123**	0.016		0.029		-0.015		0.900		5%
		(8.695)	***	(3.089)	***	-(1.528)		(2.965)	***	
	363	0.016		0.026		-0.006		0.924		9%
		(8.614)	***	(3.971)	***	-(1.187)		(3.032)	***	
	603	0.016		0.026		-0.003		0.926		10%
		(8.598)	***	(4.025)	***	-(0.709)		(3.055)	***	
Beverages	**123**	0.016		0.029		-0.020		1.009		26%
		(11.606)	***	(2.896)	***	-(2.199)	**	(7.838)	***	
	363	0.016		0.026		-0.010		1.020		28%
		(11.599)	***	(3.892)	***	-(2.301)	**	(7.817)	***	
	603	0.016		0.026		-0.007		1.022		29%
		(11.540)	***	(3.941)	***	-(1.657)	*	(7.886)	***	

Whole Period		C		EF		MP		TURN		R2%
Brewers	**123**	0.023		0.015		-0.008		-0.041		1%
		(19.480)	***	(1.831)	*	-(0.729)		-(0.039)		
	363	0.023		0.014		-0.001		-0.058		0%
		(19.397)	***	(2.172)	**	-(0.148)		-(0.055)		
	603	0.023		0.013		-0.001		-0.072		1%
		(19.346)	***	(2.120)	**	-(0.246)		-(0.069)		
Broad line	**123**	0.019		0.023		-0.015		0.510		17%
		(18.230)	***	(2.904)	***	-(1.496)		(4.583)	***	
	363	0.019		0.020		-0.010		0.516		20%
		(18.304)	***	(3.409)	***	-(2.088)	**	(4.591)	***	
	603	0.019		0.020		-0.009		0.511		21%
		(18.547)	***	(3.444)	***	-(1.899)	*	(4.590)	***	
Building Materials	**123**	0.016		0.013		-0.013		1.416		6%
		(11.853)	***	(2.090)	**	-(1.485)		(2.835)	***	
	363	0.016		0.013		-0.004		1.419		6%
		(11.861)	***	(2.776)	***	-(0.751)		(2.836)	***	
	603	0.016		0.013		-0.002		1.403		6%
		(11.933)	***	(2.822)	***	-(0.517)		(2.844)	***	
Chemicals	**123**	0.025		0.026		-0.031		0.429		4%
		(15.458)	***	(1.560)		-(2.584)	***	(2.510)	***	
	363	0.025		0.026		-0.015		0.424		6%
		(16.007)	***	(2.037)	**	(1.867)	*	(2.534)	**	
	603	0.025		0.026		-0.012		0.425		6%
		(16.301)	***	(2.097)	**	-(1.671)	*	(2.558)	**	
Commercial Chemicals	**123**	0.028		0.025		-0.011		-0.145		0%
		(15.693)	***	(2.748)	***	-(0.889)		-(1.373)		
	363	0.028		0.021		-0.006		-0.150		2%
		(15.824)	***	(3.232)	***	-(0.972)		-(1.455)		
	603	0.028		0.021		-0.004		-0.153		3%
		(16.021)	***	(3.270)	***	-(0.702)		-(1.487)		
Consumer Discretionary	**123**	0.009		0.008		-0.021		2.001		26%
		(6.965)	***	(1.501)		-(2.302)	**	(6.573)	***	
	363	0.009		0.011		-0.009		1.993		27%
		(7.121)	***	(2.598)	***	-(2.077)	**	(6.641)	***	
	603	0.009		0.011		-0.007		1.994		27%
		(7.087)	***	(2.652)	***	-(1.813)	*	(6.697)	***	
Consumer Goods	**123**	0.012		0.020		-0.018		1.968		17%
		(9.869)	***	(2.779)	***	-(1.687)	*	(5.082)	***	
	363	0.012		0.019		0.019		1.983		20%
		(9.902)	***	(3.559)	***	-(1.504)		(5.088)	***	
	603	0.012		0.019		-0.004		1.997		21%
		(9.810)	***	(3.562)	***	-(1.117)		(5.183)	***	

Whole Period		C		EF		MP		TURN		R2%
Construction Materials	**123**	0.014		0.025		-0.016		2.499		12%
		(15.322)	***	(2.939)	***	-(1.473)		(5.925)	***	
	363	0.014		0.022		-0.006		2.615		15%
		(15.506)	***	(4.047)	***	-(1.324)		(6.253)	***	
	603	0.014		0.022		-0.005		2.567		16%
		(15.785)	***	(4.035)	***	-(1.018)		(6.308)	***	
Consumer Services	**123**	0.016		0.011		-0.021		0.915		4%
		(8.171)	***	(1.408)		-(1.996)	**	(2.801)	***	
	363	0.016		0.013		-0.006		0.904		4%
		(8.222)	***	(2.269)	**	-(1.129)		(2.777)	***	
	603	0.016		0.014		-0.002		0.910		5%
		(8.275)	***	(2.307)	**	-(0.568)		(2.824)	***	
Consumer Staples	**123**	0.013		0.018		-0.008		2.007		13%
		(14.579)	***	(2.497)	**	-(0.931)		(5.160)	***	
	363	0.013		0.016		-0.004		2.050		14%
		(14.427)	***	(2.903)	***	-(1.075)		(5.216)	***	
	603	0.013		0.015		-0.003		2.054		15%
		(14.519)	***	(2.884)	***	-(0.903)		(5.334)	***	
Durable Products	**123**	0.013		0.004		-0.017		2.560		23%
		(9.655)	***	(0.603)		-(1.418)		(5.728)	***	
	363	0.013		0.007		-0.007		2.569		23%
		(9.611)	***	(1.344)		-(1.390)		(5.728)	***	
	603	0.013		0.007		-0.005		2.567		23%
		(9.561)	***	(1.395)		-(1.109)		(5.735)	***	
Explore Products	**123**	0.016		0.016		-0.015		1.687		15%
		(7.790)	***	(2.455)	**	-(1.314)		(4.857)	***	
	363	0.016		0.017		-0.002		1.692		15%
		(7.523)	***	(3.857)	***	-(0.346)		(4.736)	***	
	603	0.016		0.016		-0.003		1.696		15%
		(7.471)	***	(3.686)	***	-(0.596)		(4.741)	***	
Financials	**123**	0.011		0.018		-0.015		3.105		26%
		(7.386)	***	(2.504)	**	-(1.771)	*	(6.908)	***	
	363	0.011		0.017		-0.005		3.123		27%
		(7.236)	***	(3.583)	***	-(1.271)		(6.917)	***	
	603	0.011		0.017		-0.003		3.136		28%
		(7.209)	***	(3.606)	***	-(0.868)		(7.022)	***	
Financial Services	**123**	0.012		0.019		-0.016		2.695		23%
		(8.161)	***	(2.521)	**	-(1.867)	*	(6.301)	***	
	363	0.012		0.018		-0.006		2.717		24%
		(7.957)	***	(3.603)	***	-(1.335)		(6.311)	***	
	603	0.012		0.018		-0.003		2.736		25%
		(7.919)	***	(3.627)	***	-(0.917)		(6.441)	***	

Whole Period		C		EF		MP		TURN		R2%
Food & Beverage	123	0.018		0.017		-0.005		1.742		4%
		(15.923)	***	(2.353)	**	-(0.545)		(2.280)	**	
	363	0.018		0.014		-0.001		1.754		4%
		(15.760)	***	(2.547)	**	-(0.319)		(2.274)	**	
	603	0.018		0.014		-0.001		1.732		4%
		(15.764)	***	(2.510)	**	-(0.325)		(2.254)	**	
Food Products	123	0.026		-0.002		0.001		1.655		4%
		(22.210)	***	-(0.172)		(0.135)		(3.664)	***	
	363	0.026		-0.001		0.003		1.650		5%
		(22.249)	***	-(0.127)		(0.448)		(3.648)	***	
	603	0.026		-0.001		0.001		1.655		4%
		(22.239)	***	-(0.179)		(0.199)		(3.656)	***	
Food Retailer	123	0.020		0.036		-0.019		0.591		15%
		(17.220)	***	(2.367)	**	-(1.473)		(7.972)	***	
	363	0.020		0.032		-0.009		0.607		18%
		(17.499)	***	(3.233)	***	-(1.576)		(8.268)	***	
	603	0.019		0.031		-0.005		0.615		20%
		(17.769)	***	(3.255)	***	-(1.033)		(8.481)	***	
Gas Distribution	123	0.023		0.021		-0.015		0.518		1%
		(16.625)	***	(2.515)	**	-(1.369)		(2.009)	**	
	363	0.023		0.020		-0.006		0.508		2%
		(16.854)	***	(3.016)	***	-(1.104)		(1.993)	**	
	603	0.023		0.020		-0.003		0.503		3%
		(16.981)	***	(3.060)	***	-(0.675)		(1.969)	**	
General Retailer	123	0.019		0.023		-0.016		0.510		17%
		(18.233)	***	(2.885)	***	-(1.509)		(4.583)	***	
	363	0.019		0.020		-0.011		0.516		20%
		(18.306)	***	(3.397)	***	-(2.094)	**	(4.591)	***	
	603	0.019		0.020		-0.009		0.511		21%
		(18.550)	***	(3.434)	***	-(1.882)	*	(4.590)	***	
Healthcare	123	0.023		0.023		-0.027		0.404		5%
		(15.575)	***	(3.033)	***	-(2.570)	**	(3.750)	***	
	363	0.023		0.023		-0.012		0.418		6%
		(15.601)	***	(4.157)	***	-(2.345)	**	(3.680)	***	
	603	0.023		0.023		-0.009		0.417		8%
		(15.787)	***	(4.200)	***	-(1.899)	*	(3.706)	***	
Heavy Construction	123	0.018		0.021		-0.019		2.477		31%
		(19.615)	***	(2.110)	**	-(1.682)	*	(7.064)	***	
	363	0.018		0.020		-0.010		2.528		34%
		(19.671)	***	(3.118)	***	-(1.988)	**	(7.265)	***	
	603	0.018		0.019		-0.008		2.497		34%
		(19.803)	***	(3.125)	***	-(1.513)		(7.270)	***	

Whole Period		C		EF		MP		TURN		R2%
Industrial Goods & Services	**123**	0.017		0.013		-0.021		0.791		10%
		(14.927)	***	(2.034)	**	-(2.118)	**	(3.946)	***	
	363	0.017		0.016		-0.005		0.800		11%
		(14.676)	***	(3.106)	***	-(1.097)		(3.947)	***	
	603	0.016		0.016		-0.003		0.811		12%
		(14.482)	***	(3.138)	***	-(0.711)		(4.000)	***	
Industrials	**123**	0.015		0.020		-0.019		1.156		19%
		(14.587)	***	(2.822)	***	-(1.856)	*	(5.254)	***	
	363	0.015		0.020		-0.006		1.163		20%
		(14.438)	***	(4.273)	***	-(1.224)		(5.272)	***	
	603	0.014		0.019		-0.003		1.179		22%
		(14.350)	***	(4.294)	***	-(0.828)		(5.450)	***	
International Oil & Gas	**123**	0.021		0.018		-0.008		0.694		3%
		(13.325)	***	(2.621)	***	-(0.768)		(2.696)	***	
	363	0.021		0.016		0.000		0.691		4%
		(13.281)	***	(3.039)	***	-(0.031)		(2.674)	***	
	603	0.021		0.016		0.001		0.691		4%
		(13.376)	***	(3.037)	***	(0.237)		(2.678)	***	
Iron & Steel	**123**	0.017		0.029		-0.020		0.978		24%
		(11.991)	***	(2.889)	***	-(2.220)	**	(7.605)	***	
	363	0.017		0.026		-0.010		0.989		27%
		(11.984)	***	(3.888)	***	-(2.384)	**	(7.591)	***	
	603	0.017		0.025		-0.008		0.991		28%
		(11.923)	***	(3.925)	***	-(1.821)	*	(7.670)	***	
Market	**123**	0.006		0.014		-0.016		2.503		23%
		(3.407)	***	(2.237)	**	-(1.711)	*	(6.332)	***	
	363	0.006		0.015		-0.006		2.513		24%
		(3.335)	***	(3.389)	***	-(1.534)		(6.275)	***	
	603	0.006		0.015		-0.003		2.537		25%
		(3.252)	***	(3.442)	***	-(1.022)		(6.376)	***	
Multi Utility	**123**	0.023		0.021		-0.015		0.518		1%
		(16.625)	***	(2.515)	***	-(1.369)		(2.009)	**	
	363	0.023		0.020		-0.006		0.508		2%
		(16.853)	***	(3.016)	***	-(1.104)		(1.993)	**	
	603	0.023		0.020		-0.003		0.504		3%
		(16.981)	***	(3.060)	***	-(0.675)		(1.970)	**	
Non Financials	**123**	0.006		0.018		-0.017		2.589		25%
		(4.147)	***	(2.902)	***	-(1.898)	*	(6.800)	***	
	363	0.006		0.018		-0.007		2.604		27%
		(4.090)	***	(3.935)	**	-(1.765)	*	(6.816)	***	
	603	0.006		0.018		-0.004		2.617		28%
		(4.034)	***	(3.955)	***	-(1.301)		(6.975)	***	

Whole Period		C		EF		MP		TURN		R2%
Oil & Gas	**123**	0.020		0.017		-0.015		0.463		2%
		(11.350)	***	(2.576)	**	-(1.473)		(1.850)	*	
	363	0.020		0.017		-0.001		0.455		2%
		(11.207)	***	(3.384)	***	-(0.261)		(1.788)	*	
	603	0.020		0.017		-0.001		0.446		3%
		(11.305)	***	(3.325)	***	-(0.179)		(1.763)	*	
Pers Goods	**123**	0.015		0.007		-0.019		1.681		14%
		(11.418)	***	(0.977)		-(1.635)		(4.569)	***	
	363	0.015		0.009		-0.007		1.686		14%
		(11.437)	***	(1.685)	*	-(1.477)		(4.579)	***	
	603	0.015		0.009		-0.005		1.695		15%
		(11.317)	***	(1.730)	*	-(1.094)		(4.597)	***	
Retail	**123**	0.013		0.009		-0.014		2.010		17%
		(11.000)	***	(1.360)		-(1.407)		(5.205)	***	
	363	0.013		0.010		-0.004		2.016		17%
		(10.872)	***	(2.100)	**	-(0.797)		(5.216)	***	
	603	0.013		0.010		-0.002		2.014		17%
		(10.859)	***	(2.125)	**	-(0.461)	*	(5.241)	***	
Technology	**123**	0.020		0.022		-0.023		0.890		17%
		(14.032)	***	(2.384)	**	-(1.986)	**	(8.061)	***	
	363	0.020		0.023		-0.007		0.899		19%
		(14.131)	***	(3.165)	***	-(1.197)		(8.285)	***	
	603	0.019		0.023		-0.004		0.902		20%
		(14.258)	***	(3.224)	***	-(0.666)		(8.436)	***	
TMT	**123**	0.016		0.014		-0.024		1.658		27%
		(14.307)	***	(2.075)	**	-(2.358)	**	(8.324)	***	
	363	0.015		0.016		-0.008		1.671		28%
		(14.510)	***	(3.202)	***	-(1.632)		(8.574)	***	
	603	0.016		0.017		-0.004		1.653		28%
		(14.570)	***	(3.284)	***	-(0.955)		(8.559)	***	
Travel	**123**	0.029		0.022		-0.015		-0.396		3%
		(17.668)	***	(2.183)	**	-(1.338)		-(3.855)	***	
	363	0.029		0.021		-0.001		-0.390		4%
		(17.790)	***	(2.937)	***	-(0.227)		-(3.829)	***	
	603	0.029		0.021		0.001		-0.391		5%
		(18.024)	***	(3.016)	***	(0.176)		-(3.888)	***	

Whole Period		C		EF		MP		TURN		R2%
Utilities	**123**	0.018		0.020		-0.006		0.950		7%
		(17.132)	***	(2.565)	**	-(0.712)		(3.520)	***	
	363	0.018		0.017		-0.002		0.941		7%
		(17.329)	***	(2.932)	***	-(0.416)		(3.521)	***	
	603	0.018		0.017		0.000		0.934		8%
		(17.433)	***	(2.983)	***	(0.093)		(3.502)	***	

T-statistics are provided in parenthesis
**: represents significance level at 10%*
***: represents significance level at 5%*
****: represents significance level at 1%*
TMT: Technology-Media-Telecomm sectors
C: Coefficient
EF: Expectation Factor
MP: Maturity Premium
TURN: Turnover
123: 12 months vs 3 months
363: 36 months vs 3 months
603: 60 months vs 3 months

4.2.2 Pre-Crisis Period Analysis by Sectors

In the second part of the study, in order to observe if there is any change in the behaviours of the variables, the pre-crisis situation until (15/09/2008) had been analysed. There are a total of 487 weekly observations in the data starting from 8/01/1999.

When analysing the pre-crisis period, the main finding is that in almost all of the sectors, EF is a statistically significant factor with 1% significance level in all of the maturities with a positive sign except for Durable Products, Food Products, where EF is not significant at all. Interestingly for the banking sector EF is not significant in short term but significant at the level 1% in other maturities. The magnitude of the EF coefficient ranges from 0.010 – 0.026 at sectors where significance level is 10% or less.[1] Another finding is that MP is not significant almost for all of the sectors except for Beverages, Chemicals and Iron & Steel where it is statistically significant at 1% level for 12 month maturities and statistically significant at 5% level for 36 month maturities. The sign is negative implying an inverse relationship with stock volatility.

[1] The analysis results for the pre-crisis sample period for all of the sectors are presented in the Table 4.4 in the appendix of this thesis

This can be interpreted as when the maturity premium increases volatility decreases and vice versa. Hence it can also be said that the investors trading in these sectors use maturity premium as factor in their decision making process up to 12 months at most in general.

Turnover is statistically significant at 1% level in most of the sectors except for Brewers, Commercial Chemicals, Food & Beverage, Oil & Gas Distribution and Multi Utility where in the pre-crisis period turnover is not significant at all.

4.2.3 Post-Crisis Period Analysis by Sectors

In the post crisis period, the most important observation is that the correlation with EF and stock market volatility disappears in all of the sectors for 12 month maturities. [2]For the longer term maturities, the correlation builds but with less significance level such as 10%. The two sectors that kept 5% significance level in 36 months and 60 months maturities are Explore Product Producers and Heavy Construction sector. This is in line with the findings of Hacıhasanoglu et al. (2012) where they have investigated the effect 2008 subprime crisis to emerging market macroeconomic variables including equity volatility. After the analysis, they have found out that there is a relatively strong correlation between the equity class volatility and US interest rate volatility which disappears right after the crisis and as restores again as time passes.

The weak link between MP and volatility loosens post crisis period where the correlation of MP with stock volatility disappears in the short term maturities following the same pattern with EF. For example, the correlation of Beverages and Iron & Steel sectors which are significant at 1% level in pre-crisis period is lost in post-crisis period.

In a similar context, the effect of MP on the stock volatility of Healthcare sector are lost for 12 months maturities but restored at 36 months with 5% significance level and with

[2] The regression analysis results for the post-crisis sample period for all of the sectors are presented in the Table 4.5 in the appendix of this thesis

10% significance level at 60 months maturities. There are only two sectors namely Travel & Leisure and Chemicals sectors which keep MP significant at 10% level in 12 month maturities. Chemicals is the only sector keeping its MP correlation for all of the maturities with loosened significance.

Another finding is that in the post crisis period, although turnover keeps its significance level in most of the sectors, the effect of turnover had either been lost or weakened its significance level mostly in construction and retail based industries such as Building Materials, Industrials, Basic Materials, Iron & Steel, Retail, Consumer Services which were significant at 1% level. With the lost connection the explaining power is also lost for these sectors.

5. CONCLUSION

Understanding and predicting stock market volatility has always been one of the consideration of policy makers and investors especially for the emerging market economies where long term investments are encouraged with lower stock volatility environment.

In a global environment where the information flow is fast and the economies are linked, the global macroeconomic factors such as USTS of interest rates may have some effect on the stock market volatility of emerging markets as well. Following the study of Li (2016) who made a similar investigation to understand the effect of two components of USTS namely Expectation Factor (EF) and Maturity Premium (MP) on volatility of the developed international markets (UK and Japan), this master thesis aims to investigate whether there is a relation between the EF and MP component of USTS and Turkish Stock Market volatility and if there is an effect, what is the magnitude and direction of this effect.

The main finding of this thesis is that Turkish stock market volatility is affected by the Expectation Factor component of USTS of interest rate with a positive sign although the magnitude is not very high. That means when the EF increases, stock volatility in Turkey increases as well. Combining this finding with US economy, where an inverse correlation with the sign of EF exists, it can be said that when the US economy grows causing US stock volatility to decrease, Turkish stock market volatility increases.

As a second finding, MP having a negative sign, has a very weak correlation linked to some special sectors such as Healthcare and Iron & Steel. That means a decrease in MP shall be associated with an increase in stock volatility. Not surprisingly this relation is inversely correlated with US market behaviour where MP have a positive sign.

Finally, and most importantly, the results of the analysis showed that in Turkey local factors and events are much more effective on the stock market volatility than the global factors. This finding can be linked to the Schwerts (1989) and later Hamilton & Lin (1996) findings that stock market volatility is closely related with economic downturns, implying that investors activities increase at times of economic uncertainties.

However, in case of uncertainties triggered by global factors, such as 2008 subprime crisis, the emerging market, in this case Turkish market, loosens its tie with the global markets right after the crisis to protect itself from unnecessary volatilities. This conclusion is supported by the finding that the effect of EF and MP weakens and almost disappears in almost all of the sectors during the post crisis period when compared with pre-crisis period data. This is in fact in line with the previous studies of Hacıhasanoglu et al. (2012) also where they have found that during the crisis periods, the link with the global markets are lost in emerging markets in the short term maturities and then the link is then restored for longer maturities.

As a last remark supporting local factors being more effective in the stock volatility, it is concluded that turnover is the most explanatory variable in comparison with EF and MP where both during the pre-crisis and post crisis period, it is statistically significant with 1% significance level for most of the sectors. This finding is very much in line with the previous studies of Lamoureux and Lastrapes (1990) which indicates that trading volume of stocks reflects the dependence in information flows to the market that feeds directly into price volatility.

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APPENDIX

Table 4.4: The Analysis of EF, MP and Turnover and the Turkish stock market volatility by sector (Pre Crisis Period)

PRE		C		EF		MP		TURN		R2%
Airlines	**123**	0.032		0.020		-0.016		-0.267		1%
		(18.130)	***	(1.788)	*	-(1.130)		-(1.754)	*	
	363	0.032		0.020		0.001		-0.263		2%
		(18.306)	***	(2.465)	**	(0.181)		-(1.765)	*	
	603	0.032		0.021		0.006		-0.277		3%
		(18.544)	***	(2.532)	**	(0.814)		-(1.879)	*	
Automobiles	**123**	0.018		0.019		-0.027		1.895		17%
		(14.144)	***	(2.598)	***	-(1.922)	*	(7.061)	***	
	363	0.018		0.021		-0.005		1.941		21%
		(14.182)	***	(3.879)	***	-(0.906)		(7.024)	***	
	603	0.018		0.021		-0.002		1.916		22%
		(14.262)	***	(3.882)	***	-(0.341)		(7.062)	***	
Auto parts	**123**	0.018		0.021		-0.024		1.854		12%
		(14.749)	***	(2.850)	***	-(1.878)	*	(6.885)	***	
	363	0.017		0.022		-0.005		1.916		17%
		(14.763)	***	(3.918)	***	-(0.844)		(6.865)	***	
	603	0.017		0.022		-0.001		1.891		18%
		(14.819)	***	(3.917)	***	-(0.239)		(6.923)	***	
Banks	**123**	0.019		0.010		-0.019		1.219		11%
		(12.110)	***	(1.577)		-(1.567)		(6.318)	***	
	363	0.019		0.012		-0.003		1.213		11%
		(12.140)	***	(2.615)	***	-(0.649)		(6.251)	***	
	603	0.019		0.013		0.000		1.235		12%
		(12.147)	***	(2.677)	***	-(0.050)		(6.418)	***	
Basic Materials	**123**	0.016		0.026		-0.018		1.273		10%
		(8.414)	***	(2.897)	***	-(1.796)	*	(3.713)	***	
	363	0.016		0.023		-0.006		1.309		14%
		(8.281)	***	(3.642)	***	-(1.148)		(3.790)	***	
	603	0.016		0.023		-0.004		1.307		16%
		(8.244)	***	(3.684)	***	-(0.683)		(3.794)	***	
Beverages	**123**	0.019		0.025		-0.024		0.917		25%
		(12.125)	***	(2.620)	***	-(2.824)	***	(6.925)	***	
	363	0.019		0.023		-0.010		0.932		28%
		(12.084)	***	(3.552)	***	-(2.099)	**	(6.872)	***	
	603	0.019		0.023		-0.008		0.935		29%
		(11.975)	***	(3.585)	***	-(1.550)		(6.903)	***	

PRE		C		EF		MP		TURN		R2%
Brewers	**123**	0.027		0.018		-0.006		-0.899		2%
		(22.184)	***	(2.159)	**	-(0.450)		-(1.022)		
	363	0.027		0.016		0.001		-0.918		2%
		(22.088)	***	(2.374)	**	(0.223)		-(1.033)		
	603	0.027		0.016		0.002		-0.933		2%
		(22.123)	***	(2.345)	**	(0.387)		-(1.049)		
Broad line	**123**	0.020		0.023		-0.022		0.457		15%
		(14.776)	***	(2.859)	***	-(1.984)	**	(4.221)	***	
	363	0.020		0.021		-0.010		0.465		19%
		(15.071)	***	(3.552)	***	-(1.785)	*	(4.244)	***	
	603	0.020		0.020		-0.009		0.461		21%
		(15.396)	***	(3.552)	**	-(1.577)		(4.239)	***	
Building Materials	**123**	0.011		0.017		-0.015		3.773		19%
		(9.839)	***	(2.633)	***	-(1.433)		(6.671)	***	
	363	0.011		0.016		-0.004		3.797		20%
		(9.911)	***	(3.151)	***	-(0.838)		(6.750)	***	
	603	0.011		0.016		-0.002		3.722		21%
		(10.057)	***	(3.155)	***	-(0.364)		(6.727)	***	
Chemicals	**123**	0.023		0.023		-0.035		1.491		20%
		(13.311)	***	(1.521)		-(3.002)	***	(8.395)	***	
	363	0.023		0.024		-0.015		1.480		22%
		(14.045)	***	(2.037)	**	-(2.009)	**	(8.713)	***	
	603	0.023		0.023		-0.012		1.479		23%
		(14.253)	***	(2.065)	**	(1.551)		(8.666)	***	
Commercial Chemicals	**123**	0.030		0.023		-0.017		-0.044		-1%
		(16.245)	***	(2.321)	**	-(1.342)		-(0.356)		
	363	0.030		0.022		-0.004		-0.054		2%
		(16.428)	***	(3.034)	***	-(0.587)		-(0.462)		
	603	0.030		0.022		-0.001		-0.061		2%
		(16.676)	***	(3.074)	***	-(0.114)		-(0.519)		
Consumer Discretionary	**123**	0.011		0.010		-0.026		1.862		23%
		(7.347)	***	(1.730)	*	-(2.392)	**	(5.661)	***	
	363	0.011		0.013		-0.009		1.853		25%
		(7.495)	***	(3.098)	***	-(1.761)	*	(5.704)	***	
	603	0.011		0.013		-0.006		1.854		25%
		(7.415)	***	(3.092)	***	-(1.244)		(5.731)	***	

PRE		C		EF		MP		TURN		R2%
Consumer Goods	**123**	0.014		0.019		-0.023		1.668		12%
		(9.879)	***	(2.590)	***	-(1.854)	*	(4.356)	***	
	363	0.014		0.020		-0.006		1.688		15%
		(10.025)	***	(3.428)	***	-(1.057)		(4.389)	***	
	603	0.014		0.020		-0.003		1.707		17%
		(9.890)	***	(3.433)	***	-(0.498)		(4.465)	***	
Construction Materials	**123**	0.014		0.022		-0.016		2.685		15%
		(13.876)	***	(3.335)	***	-(1.454)		(6.019)	***	
	363	0.014		0.020		-0.005		2.799		19%
		(14.318)	***	(4.015)	***	-(0.875)		(6.288)	***	
	603	0.014		0.020		-0.002		2.744		20%
		(14.699)	***	(4.019)	***	-(0.352)		(6.352)	***	
Consumer Services	**123**	0.016		0.006		-0.029		1.641		10%
		(8.108)	***	(0.822)		-(2.447)	**	(5.560)	***	
	363	0.016		0.011		-0.009		1.636		10%
		(8.134)	***	(1.833)	*	-(1.718)	*	(5.525)	***	
	603	0.016		0.011		-0.006		1.643		11%
		(8.226)	***	(1.852)	*	-(1.181)		(5.664)	***	
Consumer Staples	**123**	0.016		0.017		-0.010		1.595		8%
		(13.602)	***	(2.599)	***	-(1.000)		(4.069)	***	
	363	0.016		0.015		-0.002		1.644		10%
		(13.437)	***	(2.815)	***	-(0.485)		(4.121)	***	
	603	0.015		0.015		-0.001		1.650		10%
		(13.543)	***	(2.798)	***	-(0.171)		(4.212)	***	
Durable Products	**123**	0.012		0.001		-0.021		3.475		31%
		(7.293)	***	(0.186)		-(1.640)		(6.670)	***	
	363	0.012		0.005		-0.007		3.489		32%
		(7.228)	***	(1.124)		-(1.268)		(6.665)	***	
	603	0.012		0.006		-0.004		3.483		32%
		(7.194)	***	(1.241)		-(0.707)		(6.658)	***	
Explore Products	**123**	0.019		0.017		-0.012		1.655		15%
		(8.269)	***	(2.252)	**	-(0.881)		(4.222)	***	
	363	0.019		0.016		0.000		1.652		15%
		(8.006)	***	(3.399)	***	-(0.017)		(4.113)	***	
	603	0.019		0.016		0.001		1.654		16%
		(7.943)	***	(3.409)	***	(0.177)		(4.102)	***	
Financials	**123**	0.013		0.015		-0.016		2.984		23%
		(6.182)	***	(2.458)	**	-(1.709)	*	(5.457)	***	
	363	0.013		0.015		-0.004		3.005		24%
		(5.976)	***	(3.471)	***	-(0.883)		(5.417)	***	
	603	0.013		0.015		-0.002		3.024		25%
		(5.904)	***	(3.505)	***	-(0.394)		(5.477)	***	

PRE		C		EF		MP		TURN		R2%
Financial Services	123	0.014		0.016		-0.017		2.478		18%
		(7.072)	***	(2.454)	**	-(1.761)	*	(4.874)	***	
	363	0.014		0.016		-0.005		2.504		20%
		(6.780)	***	(3.443)	***	-(0.930)		(4.836)	***	
	603	0.014		0.016		-0.002		2.530		21%
		(6.676)	***	(3.467)	***	-(0.435)		(4.914)	***	
Food & Beverage	123	0.021		0.018		-0.005		0.865		2%
		(15.658)	***	(2.339)	**	-(0.418)		(1.200)		
	363	0.021		0.015		0.002		0.870		2%
		(15.447)	***	(2.499)	**	(0.330)		(1.195)		
	603	0.021		0.015		0.003		0.845		2%
		(15.515)	***	(2.478)	**	(0.566)		(1.169)		
Food Products	123	0.025		-0.003		0.010		1.192		3%
		(20.174)	***	-(0.227)		(0.828)		(3.647)	***	
	363	0.026		-0.001		0.013		1.165		5%
		(20.427)	***	-(0.133)		(1.958)	*	(3.607)	***	
	603	0.026		-0.001		0.013		1.170		5%
		(20.382)	***	-(0.116)		(1.961)	*	(3.608)	***	
Food Retailer	123	0.022		0.025		-0.026		0.516		13%
		(14.111)	***	(2.495)	**	-(2.451)	**	(7.374)	***	
	363	0.022		0.025		-0.008		0.537		16%
		(14.683)	***	(3.273)	***	-(1.399)		(7.884)	***	
	603	0.021		0.024		-0.006		0.546		17%
		(14.924)	***	(3.313)	***	-(0.923)		(8.076)	***	
Gas Distribution	123	0.026		0.018		-0.020		0.153		0%
		(17.162)	***	(2.057)	**	-(1.608)		(0.689)		
	363	0.026		0.019		-0.004		0.130		2%
		(17.567)	***	(2.640)	***	-(0.677)		(0.604)		
	603	0.026		0.019		-0.001		0.120		3%
		(17.812)	***	(2.689)	***	-(0.135)		(0.564)		
General Retailer	123	0.020		0.023		-0.022		0.457		15%
		(14.776)	***	(2.859)	***	-(1.984)	**	(4.221)	***	
	363	0.020		0.021		-0.010		0.465		19%
		(15.071)	***	(3.552)	***	-(1.785)	*	(4.244)	***	
	603	0.020		0.020		-0.009		0.461		21%
		(15.396)	***	(3.552)	***	-(1.577)		(4.239)	***	
Healthcare	123	0.024		0.024		-0.030		0.691		6%
		(12.691)	***	(3.005)	***	-(2.462)	**	(4.417)	***	
	363	0.024		0.024		-0.012		0.735		8%
		(13.203)	***	(3.961)	***	-(1.949)	*	(4.830)	***	
	603	0.024		0.024		-0.009		0.727		10%
		(13.416)	***	(3.958)	***	-(1.526)		(4.786)	***	

PRE		C		EF		MP		TURN		R2%
Heavy Construction	123	0.019		0.015		-0.018		2.376		34%
		(19.993)	***	(2.169)	**	-(1.811)	*	(6.740)	***	
	363	0.019		0.014		-0.008		2.422		37%
		(19.905)	***	(2.993)	***	-(1.574)		(6.802)	***	
	603	0.019		0.014		-0.006		2.396		37%
		(20.105)	***	(3.059)	***	-(1.090)		(6.818)	***	
Industrial Goods & Services	123	0.016		0.014		-0.022		1.184		17%
		(12.275)	***	(2.086)	**	-(1.966)	**	(4.544)	***	
	363	0.016		0.016		-0.004		1.202		19%
		(11.953)	***	(3.105)	***	-(0.777)		(4.525)	***	
	603	0.016		0.016		-0.001		1.219		20%
		(11.773)	***	(3.154)	***	-(0.153)		(4.619)	***	
Industrials	123	0.015		0.017		-0.019		1.134		18%
		(12.942)	***	(2.848)	***	-(1.717)	**	(5.106)	***	
	363	0.015		0.018		-0.003		1.146		20%
		(12.739)	***	(4.010)	***	-(0.676)		(5.102)	***	
	603	0.015		0.018		0.000		1.164		22%
		(12.545)	***	(4.039)	***	-(0.034)		(5.230)	***	
International Oil & Gas	123	0.026		0.019		-0.012		0.040		0%
		(12.066)	***	(2.493)	**	-(0.986)		(0.130)		
	363	0.026		0.018		0.000		0.038		1%
		(12.011)	***	(3.054)	***	-(0.032)		(0.122)		
	603	0.026		0.017		0.002		0.038		2%
		(12.135)	***	(3.049)	***	(0.312)		(0.121)		
Iron & Steel	123	0.019		0.025		-0.024		0.917		25%
		(12.126)	***	(2.630)	***	-(2.827)	***	(6.920)	***	
	363	0.019		0.023		-0.010		0.932		28%
		(12.086)	***	(3.562)	***	-(2.099)	**	(6.868)	***	
	603	0.019		0.023		-0.008		0.935		29%
		(11.978)	***	(3.596)	***	-(1.553)		(6.903)	***	
Market	123	0.010		0.013		-0.022		2.110		18%
		(5.782)	***	(2.332)	**	-(2.079)	**	(5.581)	***	
	363	0.010		0.015		-0.006		2.123		20%
		(5.638)	***	(3.530)	***	-(1.363)		(5.518)	***	
	603	0.010		0.015		-0.003		2.151		21%
		(5.497)	***	(3.559)	***	-(0.698)		(5.607)	***	
Multi Utility	123	0.026		0.018		-0.020		0.154		0%
		(17.161)	***	(2.057)	**	-(1.608)		(0.690)		
	363	0.026		0.019		-0.004		0.130		2%
		(17.567)	***	(2.640)	***	-(0.677)		(0.606)		
	603	0.026		0.019		-0.001		0.120		3%
		(17.812)	***	(2.689)	***	-(0.135)		(0.565)		

PRE		C		EF		MP		TURN		R2%
Non Financials	123	0.009		0.018		-0.022		2.339		21%
		(5.387)	***	(2.871)	***	-(2.267)	**	(6.001)	**	
	363	0.009		0.018		-0.006		2.364		23%
		(5.209)	***	(3.920)	***	-(1.428)		(5.975)	***	
	603	0.008		0.018		-0.003		2.382		25%
		(5.098)	***	(3.905)	***	-(0.739)		(6.090)	***	
Oil & Gas	123	0.024		0.017		-0.014		0.224		1%
		(12.105)	***	(2.392)	**	-(1.161)		(0.798)		
	363	0.024		0.017		0.000		0.213		2%
		(11.955)	***	(3.071)	***	-(0.055)		(0.746)		
	603	0.024		0.017		0.002		0.200		2%
		(12.103)	***	(3.068)	***	(0.383)		(0.706)		
Pers Goods	123	0.017		0.006		-0.024		1.773		13%
		(8.350)	***	(0.832)		-(1.890)	*	(3.392)	***	
	363	0.017		0.010		-0.008		1.781		14%
		(8.388)	***	(1.701)	*	-(1.304)		(3.411)	***	
	603	0.016		0.010		-0.004		1.792		15%
		(8.294)	***	(1.776)	*	-(0.672)		(3.426)	***	
Retail	123	0.015		0.005		-0.018		2.047		18%
		(9.386)	***	(0.899)		-(1.632)		(4.599)	***	
	363	0.015		0.008		-0.005		2.062		17%
		(9.141)	***	(1.621)		-(1.083)		(4.572)	***	
	603	0.015		0.008		-0.004		2.063		18%
		(9.110)	***	(1.628)		-(0.860)		(4.591)	***	
Technology	123	0.023		0.022		-0.025		0.791		13%
		(13.162)	***	(2.377)	**	-(1.975)	**	(7.045)	***	
	363	0.023		0.023		-0.006		0.801		16%
		(13.338)	***	(3.078)	***	-(0.896)		(7.281)	***	
	603	0.023		0.023		-0.003		0.804		17%
		(13.512)	***	(3.110)	***	-(0.359)		(7.446)	***	
PRE	123	0.023		0.022		-0.025		0.791		13%
		(13.162)	***	(2.377)	**	-(1.975)	**	(7.045)	***	
	363	0.023		0.023		-0.006		0.801		16%
		(13.338)	***	(3.078)	***	-(0.896)		(7.281)	***	
	603	0.023		0.023		-0.003		0.804		17%
		(13.512)	***	(3.110)	***	-(0.359)		(7.446)	***	
TMT	123	0.020		0.012		-0.030		1.380		21%
		(14.522)	***	(1.660)	*	-(2.628)	***	(6.970)	***	
	363	0.019		0.016		-0.007		1.395		22%
		(14.907)	***	(2.891)	***	-(1.281)		(7.215)	***	
	603	0.019		0.017		-0.003		1.377		22%
		(15.026)	***	(2.956)	***	-(0.517)		(7.191)	***	

PRE		C		EF		MP		TURN		R2%
Travel	**123**	0.031		0.023		-0.015		-0.254		0%
		(18.009)	***	(1.946)	*	-(1.090)		-(1.647)		
	363	0.031		0.022		0.002		-0.246		2%
		(18.159)	***	(2.593)	***	(0.235)		-(1.635)		
	603	0.031		0.023		0.006		-0.261		3%
		(18.403)	***	(2.658)	***	(0.829)		-(1.755)	*	
Utilities	**123**	0.020		0.017		-0.009		0.736		5%
		(16.796)	***	(2.125)	**	-(0.927)		(2.721)	***	
	363	0.021		0.016		0.001		0.721		5%
		(17.100)	***	(2.527)	**	(0.156)		(2.701)	***	
	603	0.021		0.016		0.004		0.709		6%
		(17.314)	***	(2.601)	***	(0.900)		(2.679)	***	

T-statistics are provided in parenthesis
**: represents significance level at 10%*
***: represents significance level at 5%*
****: represents significance level at 1%*
TMT: Technology-Media-Telecomm sectors
C: Coefficient
EF: Expectation Factor
MP: Maturity Premium
TURN: Turnover
123: 12 months vs 3 months
363: 36 months vs 3 months
603: 60 months vs 3 months

Table 4.5: The Analysis of EF, MP and Turnover with the Turkish stock market volatility by sector (Post Crisis Period)

POST		C		EF		MP		TURN		R2%
Airlines	**123**	0.015		0.037		0.004		0.348		13%
		(9.716)	***	(1.577)		(0.278)		(4.169)	***	
	363	0.015		0.029		-0.005		0.341		14%
		(9.623)	***	(1.711)	*	-(0.624)		(4.033)	***	
	603	0.015		0.028		-0.004		0.341		13%
		(9.597)	***	(1.763)	*	-(0.619)		(4.039)	***	
Automobiles	**123**	0.011		0.016		-0.009		3.262		24%
		(6.602)	***	(0.606)		-(0.513)		(4.530)	***	
	363	0.010		0.015		-0.016		3.314		25%
		(6.503)	***	(0.819)		-(1.575)		(4.555)	***	
	603	0.010		0.015		-0.012		3.337		25%
		(6.456)	***	(0.895)		-(1.765)	*	(4.620)	***	
Auto parts	**123**	0.009		0.020		-0.012		3.361		21%
		(5.678)	***	(0.738)		-(0.641)		(4.028)	***	
	363	0.009		0.019		-0.017		3.406		22%
		(5.545)	***	(1.025)		-(1.807)	*	(4.046)	***	
	603	0.009		0.019		-0.012		3.426		22%
		(5.561)	***	(1.112)		-(1.940)	*	(4.113)	***	

POST		C		EF		MP		TURN		R2%
Banks	**123**	0.001		0.016		0.006		2.630		46%
		(0.383)		(0.493)		(0.287)		(7.684)	***	
	363	0.001		0.011		0.001		2.619		46%
		(0.414)		(0.542)		(0.135)		(7.900)	***	
	603	0.001		0.010		-0.001		2.615		46%
		(0.418)		(0.540)		-(0.209)		(7.898)	***	
Basic Materials	**123**	0.014		0.050		-0.009		0.360		9%
		(6.940)	***	(1.363)		-(0.335)		(1.684)	*	
	363	0.015		0.044		-0.011		0.346		10%
		(7.062)	***	(1.735)	*	-(1.106)		(1.607)		
	603	0.014		0.043		-0.007		0.358		9%
		(6.824)	***	(1.801)	*	-(0.804)		(1.643)		
Beverages	**123**	0.014		0.054		-0.005		0.731		11%
		(6.658)	***	(1.444)		-(0.200)		(2.857)	***	
	363	0.014		0.045		-0.010		0.739		11%
		(6.793)	***	(1.764)	*	-(0.993)		(2.870)	***	
	603	0.014		0.045		-0.006		0.753		11%
		(6.556)	***	(1.828)	*	-(0.703)		(2.872)	***	
Brewers	**123**	0.012		-0.011		-0.022		7.752		15%
		(8.466)	***	-(0.592)		-(1.635)		(3.669)	***	
	363	0.012		-0.002		-0.012		7.808		15%
		(8.680)	***	-(0.204)		-(1.351)		(3.761)	***	
	603	0.012		-0.002		-0.011		7.907		16%
		(8.681)	***	-(0.141)		-(1.547)		(3.829)	***	
Broad line	**123**	0.013		0.023		0.004		2.428		16%
		(9.581)	***	(0.707)		(0.194)		(5.150)	***	
	363	0.013		0.015		-0.012		2.438		17%
		(10.108)	***	(0.682)		-(1.347)		(5.169)	***	
	603	0.013		0.016		-0.009		2.456		17%
		(9.811)	***	(0.746)		-(1.345)		(5.162)	***	
Building Materials	**123**	0.018		-0.007		-0.021		0.385		1%
		(8.057)	***	-(0.355)		-(1.351)		(0.938)		
	363	0.019		0.000		-0.017		0.342		2%
		(8.211)	***	-(0.036)		-(1.553)		(0.858)		
	603	0.019		0.001		-0.013		0.341		2%
		(8.185)	***	(0.085)		-(1.743)	*	(0.846)		
Chemicals	**123**	0.013		0.046		-0.042		0.421		20%
		(8.753)	***	(1.063)		-(1.867)	*	(3.590)	***	
	363	0.013		0.051		-0.028		0.398		21%
		(8.756)	***	(1.852)	*	-(1.756)	*	(3.645)	***	
	603	0.013		0.051		-0.020		0.396		21%
		(8.873)	***	(1.958)	*	-(1.872)	*	(3.721)	***	

POST		C		EF		MP		TURN		R2%
Commercial Chemicals	**123**	0.016		0.030		0.007		0.194		5%
		(9.886)	***	(1.048)		(0.294)		(2.552)	**	
	363	0.016		0.020		-0.013		0.186		6%
		(10.196)	***	(0.910)		-(1.306)		(2.488)	**	
	603	0.016		0.020		-0.011		0.186		7%
		(10.164)	***	(0.953)		-(1.516)		(2.495)	**	
Consumer Discretionary	**123**	0.008		-0.002		-0.007		1.527		12%
		(5.707)	***	-(0.091)		-(0.524)		(4.230)	***	
	363	0.008		-0.001		-0.009		1.533		13%
		(5.795)	***	-(0.044)		-(1.219)		(4.181)	***	
	603	0.008		0.000		-0.008		1.543		13%
		(5.733)	***	-(0.002)		-(1.523)		(4.243)	***	
Consumer Goods	**123**	0.009		0.018		-0.001		1.795		10%
		(8.379)	***	(0.757)		-(0.098)		(4.568)	***	
	363	0.009		0.013		-0.011		1.846		11%
		(8.918)	***	(0.878)		-(1.639)		(4.846)	***	
	603	0.009		0.014		-0.008		1.874		12%
		(8.685)	***	(0.943)		-(1.621)		(4.828)	***	
Construction Materials	**123**	0.017		0.041		-0.016		0.673		6%
		(9.226)	***	(1.014)		-(0.526)		(0.754)		
	363	0.017		0.037		-0.018		0.533		8%
		(9.332)	***	(1.511)		-(1.686)	*	(0.600)		
	603	0.017		0.037		-0.014		0.511		9%
		(9.217)	***	(1.597)		-(1.708)	*	(0.574)		
Consumer Services	**123**	0.012		0.018		-0.007		0.251		4%
		(7.229)	***	(0.770)		-(0.454)		(1.167)		
	363	0.012		0.017		-0.004		0.241		3%
		(7.088)	***	(1.133)		-(0.510)		(1.059)		
	603	0.012		0.017		-0.002		0.241		3%
		(7.101)	***	(1.187)		-(0.500)		(1.083)		
Consumer Staples	**123**	0.009		0.023		-0.001		3.975		11%
		(8.139)	***	(0.702)		-(0.041)		(3.458)	***	
	363	0.009		0.018		-0.011		3.956		12%
		(8.181)	***	(0.820)		-(1.428)		(3.486)	***	
	603	0.009		0.018		-0.008		4.032		12%
		(8.099)	***	(0.871)		-(1.476)		(3.568)	***	
Durable Products	**123**	0.013		0.007		0.000		1.227		14%
		(11.032)	***	(0.346)		-(0.028)		(4.062)	***	
	363	0.012		0.005		-0.008		1.246		14%
		(11.631)	***	(0.346)		-(0.870)		(4.154)	***	
	603	0.012		0.005		-0.007		1.258		14%
		(11.591)	***	(0.382)		-(1.173)		(4.198)	***	

POST		C		EF		MP		TURN		R2%
Explore Products	**123**	0.009		0.013		-0.032		1.749		20%
		(3.995)	***	(0.650)		-(1.718)	*	(3.492)	***	
	363	0.009		0.022		-0.013		1.811		19%
		(3.593)	***	(2.097)	**	-(1.008)		(3.407)	***	
	603	0.009		0.021		-0.015		1.811		21%
		(3.678)	***	(2.119)	**	-(1.462)		(3.562)	***	
Financials	**123**	0.011		0.034		-0.012		2.429		22%
		(8.301)	***	(1.153)		-(0.720)		(4.520)	***	
	363	0.011		0.031		-0.011		2.455		23%
		(8.142)	***	(1.634)		-(1.408)		(4.520)	***	
	603	0.011		0.031		-0.007		2.459		23%
		(8.194)	***	(1.711)	*	-(1.394)		(4.576)	***	
Financial Services	**123**	0.011		0.034		-0.012		2.429		22%
		(8.301)	***	(1.153)		-(0.720)		(4.520)	***	
	363	0.011		0.031		-0.011		2.455		23%
		(8.142)	***	(1.634)		-(1.408)		(4.520)	***	
	603	0.011		0.031		-0.007		2.459		23%
		(8.194)	***	(1.711)	*	-(1.394)		(4.576)	***	
Food & Beverage	**123**	0.011		0.008		-0.009		5.800		14%
		(8.555)	***	(0.361)		-(0.599)		(3.266)	***	
	363	0.011		0.008		-0.014		5.783		15%
		(8.647)	***	(0.539)		-(1.759)	*	(3.292)	***	
	603	0.011		0.009		-0.011		5.863		16%
		(8.652)	***	(0.614)		-(1.728)	*	(3.369)	***	
Food Products	**123**	0.021		0.015		-0.028		9.005		20%
		(9.977)	***	(0.457)		-(0.996)		(5.605)	***	
	363	0.021		0.018		-0.033		8.928		21%
		(10.212)	***	(0.888)		-(1.713)	*	(5.681)	***	
	603	0.021		0.021		-0.020		8.899		21%
		(10.124)	***	(1.064)		-(1.411)		(5.713)	***	
Food Retailer	**123**	0.015		0.096		0.009		1.802		17%
		(7.302)	***	(1.503)		(0.201)		(1.436)		
	363	0.015		0.075		-0.011		1.810		18%
		(7.492)	***	(1.793)	*	-(0.878)		(1.493)		
	603	0.014		0.073		-0.007		1.849		17%
		(7.310)	***	(1.853)	*	-(0.733)		(1.500)		
Gas Distribution	**123**	0.014		0.036		0.004		1.431		14%
		(11.483)	***	(1.576)		(0.287)		(4.069)	***	
	363	0.014		0.026		-0.014		1.428		15%
		(11.743)	***	(1.644)		-(1.764)	*	(4.003)	***	
	603	0.014		0.027		-0.009		1.448		15%
		(11.559)	***	(1.738)	*	-(1.912)	*	(4.050)	***	

POST		C		EF		MP		TURN		R2%
General Retailer	**123**	0.013		0.022		0.004		2.431		16%
		(9.578)	***	(0.683)		(0.168)		(5.145)	***	
	363	0.013		0.015		-0.013		2.440		17%
		(10.107)	***	(0.664)		-(1.355)		(5.163)	***	
	603	0.013		0.016		-0.008		2.458		17%
		(9.812)	***	(0.728)		-(1.307)		(5.158)	***	
Healthcare	**123**	0.016		0.016		-0.028		0.379		19%
		(12.395)	***	(0.647)		-(1.349)		(6.251)	***	
	363	0.015		0.021		-0.021		0.382		20%
		(12.934)	***	(1.481)		-(2.379)	**	(6.570)	***	
	603	0.015		0.023		-0.012		0.382		18%
		(12.527)	***	(1.634)		-(1.838)	*	(6.217)	***	
Heavy Construction	**123**	0.014		0.056		-0.020		5.245		17%
		(7.719)	***	(1.309)		-(0.561)		(3.028)	***	
	363	0.013		0.052		-0.020		5.305		19%
		(7.949)	***	(2.049)	**	-(1.634)		(3.164)	***	
	603	0.013		0.052		-0.014		5.364		19%
		(7.801)	***	(2.149)	**	-(1.423)		(3.214)	***	
Industrial Goods & Services	**123**	0.016		0.010		-0.023		0.227		5%
		(10.505)	***	(0.421)		-(1.500)		(1.585)		
	363	0.016		0.015		-0.015		0.233		5%
		(10.752)	***	(0.986)		-(1.671)	*	(1.623)		
	603	0.016		0.016		-0.010		0.237		4%
		(10.545)	***	(1.079)		-(1.469)		(1.639)		
Industrials	**123**	0.017		0.029		-0.016		-0.242		5%
		(8.318)	***	(0.950)		-(0.732)		-(0.350)		
	363	0.017		0.028		-0.016		-0.293		7%
		(8.455)	***	(1.446)		-(1.852)	*	-(0.427)		
	603	0.017		0.028		-0.012		-0.294		7%
		(8.298)	***	(1.539)		-(1.976)	*	-(0.423)		
International Oil & Gas	**123**	0.015		0.019		0.004		1.584		16%
		(10.776)	***	(0.868)		(0.306)		(3.142)	***	
	363	0.015		0.015		0.001		1.588		16%
		(10.720)	***	(0.908)		(0.097)		(3.128)		
	603	0.015		0.014		0.000		1.589		16%
		(10.661)	***	(0.916)		(0.060)		(3.141)	***	
Iron & Steel	**123**	0.016		0.052		-0.005		0.492		8%
		(6.980)	***	(1.424)		-(0.198)		(1.819)	*	
	363	0.016		0.044		-0.012		0.493		9%
		(7.169)	***	(1.739)	*	-(1.185)		(1.843)	*	
	603	0.016		0.043		-0.008		0.505		9%
		(7.040)	***	(1.801)	*	-(0.978)		(1.884)	*	

POST		C		EF		MP		TURN		R2%
Market	123	-0.004		0.015		0.004		3.851		40%
		-(1.418)		(0.556)		(0.244)		(5.626)	***	
	363	-0.004		0.011		-0.003		3.827		40%
		-(1.427)		(0.587)		-(0.604)		(5.772)	***	
	603	-0.004		0.010		-0.004		3.828		40%
		-(1.447)		(0.600)		-(1.070)		(5.791)	***	
Multi Utility	123	0.014		0.036		0.004		1.431		14%
		(11.483)	***	(1.576)		(0.287)		(4.069)	***	
	363	0.014		0.026		-0.014		1.428		15%
		(11.743)	***	(1.644)		-(1.765)	*	(4.003)	***	
	603	0.014		0.027		-0.009		1.448		15%
		(11.559)	***	(1.738)	*	-(1.912)	*	(4.050)	***	
Non Financials	123	0.009		0.020		0.000		0.865		4%
		(4.840)	***	(0.783)		(0.021)		(1.857)	*	
	363	0.009		0.015		-0.008		0.846		5%
		(4.914)	***	(0.890)		-(1.253)		(1.823)	*	
	603	0.008		0.015		-0.007		0.873		6%
		(4.788)	***	(0.939)		-(1.500)		(1.868)	*	
Oil & Gas	123	0.010		0.016		-0.023		1.227		14%
		(7.356)	***	(0.697)		-(1.461)		(3.935)	***	
	363	0.010		0.021		-0.007		1.225		13%
		(7.267)	***	(1.576)		-(0.799)		(3.891)	***	
	603	0.010		0.021		-0.009		1.221		14%
		(7.195)	***	(1.589)		-(1.262)		(3.918)	***	
Pers Goods	123	0.013		0.007		0.000		1.227		14%
		(11.032)	***	(0.346)		-(0.028)		(4.062)	***	
	363	0.012		0.005		-0.008		1.246		14%
		(11.631)	***	(0.346)		-(0.870)		(4.154)	***	
	603	0.012		0.005		-0.007		1.258		14%
		(11.591)	***	(0.382)		-(1.173)		(4.198)	***	
Retail	123	0.014		0.026		0.000		0.332		3%
		(11.996)	***	(0.865)		(0.006)		(1.318)		
	363	0.014		0.021		-0.001		0.337		3%
		(11.898)	***	(1.074)		-(0.086)		(1.320)		
	603	0.014		0.021		0.000		0.333		3%
		(11.842)	***	(1.114)		(0.010)		(1.299)		
Technology	123	0.014		0.018		-0.015		0.884		23%
		(10.188)	***	(0.526)		-(0.631)		(5.211)	***	
	363	0.014		0.019		-0.011		0.887		23%
		(10.431)	***	(0.897)		-(1.270)		(5.180)	***	
	603	0.014		0.020		-0.006		0.894		23%
		(10.180)	***	(0.969)		-(1.061)		(5.223)	***	

POST		C		EF		MP		TURN		R2%
TMT	**123**	0.013		0.023		-0.001		0.723		4%
		(10.245)	***	(1.021)		-(0.044)		(1.475)		
	363	0.013		0.018		-0.009		0.760		5%
		(10.179)	***	(1.120)		-(1.322)		(1.512)		
	603	0.013		0.018		-0.006		0.785		4%
		(10.172)	***	(1.198)		-(1.371)		(1.559)		
Travel	**123**	0.014		0.023		-0.021		0.305		13%
		(8.186)	***	(1.175)		-(1.702)	*	(2.745)	***	
	363	0.014		0.025		-0.013		0.291		12%
		(8.134)	***	(1.846)	*	-(1.649)		(2.560)	***	
	603	0.014		0.026		-0.008		0.290		12%
		(8.080)	***	(1.896)	*	-(1.939)	*	(2.571)	**	
Utilities	**123**	0.014		0.037		0.005		1.383		14%
		(11.080)	***	(1.590)		(0.336)		(3.498)	***	
	363	0.014		0.027		-0.013		1.378		15%
		(11.192)	***	(1.647)		-(1.679)	*	(3.406)	***	
	603	0.014		0.027		-0.009		1.395		15%
		(10.945)	***	(1.736)	*	-(1.911)	*	(3.437)	***	

T-statistics are provided in parenthesis

**: represents significance level at 10%*

***: represents significance level at 5%*

****: represents significance level at 1%*

TMT: Technology-Media-Telecomm sectors

C: Coefficient

EF: Expectation Factor

MP: Maturity Premium

TURN: Turnover

123: 12 months vs 3 months

363: 36 months vs 3 months

603: 60 months vs 3 months

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