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Bu tez içerisindeki bütün bilgilerin akademik kurallar ve etik davranış çerçevesinde elde edilerek sunulduğunu beyan ederim. Ayrıca bu kurallar ve davranışların gerektirdiği gibi bu çalışmada orjinal olmayan her tür kaynak ve sonuçlara tam olarak atıf ve referans yaptığımı da beyan ederim; aksi takdirde tüm yasal sorumluluğu kabul ediyorum.

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İmza :

ABSTRACT

A COMPARATIVE ANALYSIS OF DRIVERS OF SECONDARY MARKET LIQUIDITY IN BOND AND STOCK MARKETS AFTER GLOBAL FINANCIAL CRISIS IN TURKEY

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We argue that the liquidity of financial markets is one of the best indicators of financial development. Yet, the concept of liquidity is a complex one with different features. Moreover, different stakeholders have different perspectives on liquidity which makes the concept much more complex from a policy perspective. In this thesis, we investigated the drivers of secondary bond market and stock market liquidity after global financial crisis in Turkey. The literature in Turkey focused only on return volatility for driving liquidity in both bond and stock markets. However, we argued that other type of volatilities including domestic and international volatilities have also a deteriorating impact on secondary market liquidity in Turkey. In this context, we empirically tested whether the volatility and/or uncertainty that stem from the FED and ECB policies within the last 10 years had a negative impact on liquidity both in government bond and stock markets. Our results reveal that international volatilities measured by MOVE index for bond market and measured by VIX index for stock

market had negative impacts on secondary market liquidity in addition to return volatilities in these markets. Similarly, FX risk which is an indicator of domestic volatilities had a negative impact on secondary market liquidity in bond and stock markets. We further analyzed the impact of non-residents in bond and stock markets on secondary market liquidity by including their holdings in stock and bond market. The results showed that as the share of non-residents increase in bond or stock markets the liquidity in these markets improves.

Keyword: Bond market, stock market, market liquidity, global financial crisis

ÖZET

TÜRKİYE'DE KÜRESEL FİNANSAL KRİZ SONRASI DÖNEMDE DEVLET İÇ BORÇLANMA SENETLERİ İLE HİSSE SENEDİ PİYASALARINDA İKİNCİL LİKİDİTEYİ ETKİLEYEN FAKTÖRLERİN KARŞILAŞTIRMALI ANALİZİ

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Finansal piyasaların likit olması finansal gelişmişliğin göstergelerinden en önemlilerinden biridir. Ancak likidite, çok farklı özelliklere sahip olması bakımından çok karmaşık bir kavramdır. Farklı paydaşların likidite üzerinde farklı perspektifleri bulunması da kavramı politika anlamında daha da karmaşıklaştırmaktadır. Bu çalışmada Türkiye'de küresel kriz sonrası dönemde devlet iç borçlanma senetleri piyasası ile hisse senedi piyasasında ikincil piyasa likiditesini belirleyen etkenler incelenmiştir. Türkiye'deki konuyla ilgili literature bakıldığında her iki piyasa için de sadece getirilerdeki oynaklığın likiditeyi etkilediği görülmektedir. Ancak bize göre, getiri oynaklığı dışında kalan yurtiçi ve yurtdışı kaynaklardan kaynaklanan oynaklıklar da ikincil piyasa likiditesini olumsuz etkilemektedir. Bu çerçevede, son on yılda FED ve ECB politikalarından kaynaklanan oynaklık ve belirsizliklerin ikincil piyasa likiditesine olumsuz etkisi olup olmadığı test edilmiştir. Sonuçlar, getiri oynaklığına ilave olarak uluslararası piyasalarda gözlemlenen ve bono piyasası için MOVE ve hisse senedi piyasası için de VIX endeksleriyle ölçümlenebilen oynaklıkların da ikincil piyasa likiditesini olumsuz etkilediğini göstermektedir. Aynı şekilde yurtiçi finansal

piyasalardaki oynaklığı gösterdiği düşünülen kur oynaklıklarının da hem bono piyasasında hem de hisse senedi piyasasında ikincil piyasa likitesine olumsuz etkisi olduğu görülmektedir. Çalışmada ayrıca, yabancı yatırımcıların devlet iç borçlanma senetleri ve hisse senetleri piyasalarındaki payının da piyasa likiditesine etkisi analiz edilmiş olup, her iki piyasa için de yabancı payının arttığında piyasa likiditesinin de iyileştiği gözlemlenmiştir.

Anahtar Kelimeler: Tahvil piyasası, hisse senedi piyasası, piyasa likiditesi, küresel finansal kriz

İTHAF

Anne ve Babama
Eşim Yeliz'e
Oğullarım Ömer Faruk ile Adem Ertuğrul'a
Kızım Güliz'e

ithaf edilmiştir

TEŞEKKÜR

Tez danışmanım Prof. Dr. Nildağ Başak Ceylan ve tez izleme komitesi üyeleri Prof. Dr. Dilek Demirbaş ve Doç. Dr. Ayhan Kapusuz'a çalışma boyunca göstermiş oldukları rehberlikleri, tavsiyeleri, tenkitleri ve destekleri için sonsuz şükranlarımı sunarım.

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LIST OF ABBREVIATIONS

ABCP	: Asset-Backed Commercial Paper
ABSPP	: Asset Backed Securities Purchase Program
ACF	: Autocorrelation Function
ADR	: American Depositary Receipt
AIG	: American International Group
AMLF	: Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility
ARM	: Adjustable Rate Mortgages
BIS	: Bank for International Settlements
BIST	: Borsaistanbul
BP	: Basis Point
CBPP	: Covered Bond Purchase Program
CBOE	: Chicago Board Options Exchange
CDOs	: Collateral Debt Obligations
CPFF	: Commercial Paper Funding Facility
CPI	: Consumer Price Index
CSPP	: Corporate Sector Purchase Program
DvP	: Delivery vs. Payment
ECB	: European Central Bank
EONIA	: Euro Overnight Index Average
FED	: Federal Reserve
FX	: Foreign Exchange
GDP	: Gross Domestic Product
GDR	: Global Depositary Receipt
IFC	: International Finance Center
IMF	: International Monetary Fund
LIBOR	: London Interbank Offered Rate
LSAP	: Long-term Asset Purchase

LTRO : Long-term Refinancing Operations

MBS : Mortgage Backed Securities

MEC : Market Efficiency Coefficient

MMIFF : Money Market Investor Funding Facility

MOVE : Merrill Lynch Option Volatility Estimate Index

MRO : Main Refinancing Operations

NYMEX : New York Mercantile Exchange

NYSE : New York Stock Exchange

OIS : Overnight Interest Swap

OTC : Over the Counter

PACF : Partial Autocorrelation Function

PD : Primary Dealer

PDCF : Primary Dealer Credit Facility

QE : Quantitative Easing

SEC : Securities Exchange Commission

SIFMA : Securities Industry and Financial Markets Association

SMP : Securities Market Program

SPV : Special Purpose Vehicle

TAF : Term Auction Facility

TALF : Term Asset Backed Securities Loan Facility

TARP : Troubled Asset Relief Program

TSLF : Term Securities Lending Facility

TSPB :Türkiye Sermaye Piyasaları Birliği (Turkish Capital Markets Association)

USD : US Dollars

VAR : Value at Risk

VIX : Volatility Index

VLTROS : Very Long-term Refinancing Operations

1. INTRODUCTION

The Turkish government has prepared a "Strategy and Action Plan for Istanbul International Financial Center (IFC)" to make Istanbul first a regional and then a global financial center in line with 9th Development Plan covering 2009-2013 period. However, since the global financial crisis hit the global financial markets, there has been less improvement regarding the strategies and action plans of the project.

Although there has not been any significant improvement in the IFC project, the project is still on the agenda of the government.

The main motivation behind this thesis is that for making Istanbul one of the financial centers at a global level, we need to have developed financial markets. Moreover, we argue that one of the development indicators of financial markets is the availability and resiliency of high liquidity in these markets.

The global financial crisis has significant effects on the global financial system and on real economies. Specifically, we witnessed a decrease in world output and in international trade and an increase in public debt stocks. To restore economic growth without jeopardizing global financial system and increasing public debts further, Central Banks of advanced economies implemented a wide variety of policy tools since the beginning of the crisis. Just to give some specific examples, they initiated asset purchase programs or decreased policy interest rates; in other words they injected a huge amount of liquidity into the financial system. These policies had significant effects not only on the financial systems of these countries but also on the financial systems of emerging economies as well.

Our aim in this thesis is to assess the impact of these policies and other domestic factors on the secondary market liquidity in bond markets and stock markets in Turkey. More specifically, this study will analyze the drivers of liquidity in secondary bond and stock

markets after global financial crisis in Turkey. By doing so, we will not only focus on global factors but also on domestic factors which may have an effect on the secondary markets.

After analyzing both global and domestic drivers of liquidity in these markets, we will be able to offer policies to enhance secondary market liquidity. The thesis will have two important contributions to the existing literature: First, it will be the first attempt which empirically compares drivers of liquidity in bond and stock markets after global financial crisis. Second, the thesis will discuss measures taken to increase secondary bond market liquidity after global financial crisis and offer policy alternatives for enhancing liquidity in these markets.

The rest of the thesis is organized as follows: In the second chapter we provide a theoretical and conceptual framework of liquidity. Specifically, we provide different types of liquidity, namely, market liquidity, funding liquidity and monetary liquidity and some useful features of secondary market liquidity, which are the main focus of this thesis. One of the problems with working secondary market liquidity is the measurement of the liquidity that will capture all useful features of market liquidity. We discussed alternative liquidity measurement techniques. After discussing the importance of liquidity from various perspectives including central banks, debt managers (In our case Turkish Treasury), financial markets, financial stability and financial market participants we presented a summary of drivers of secondary market liquidity in bond and stock markets based on our literature review analysis.

We devoted the third chapter to global financial crisis. We first discussed the stages of the crisis since the beginning of sub-prime mortgage crisis in the USA and then the structural causes of the crisis. Then we focused our attention to policy responses of the major central banks to the global financial crisis. Specifically, we analyzed the FED's and ECB's policy responses to the crisis in order restore economic activity. Lastly, we discussed the impact of these policies on the secondary market liquidity in bond and stock markets.

In chapter four, we carried our empirical analysis for drivers of secondary market

liquidity in bond and stock markets after global financial crisis in Turkey. Before we started our analysis we first discussed the main features of secondary bond and stock markets in Borsa Istanbul as well as the in OTC markets. Then we presented our theoretical background for our empirical analysis. We argued that secondary market liquidity in bond and stock markets have been driven by two main pillars: i) volatility/uncertainty that stem from global factors such as central bank responses to the global financial crisis as well as domestic sources. ii) The behaviors of foreign investors in secondary bond and stock markets. In other words, we argue that the share of foreigners in government bond market as well as in stock markets and the global and domestic uncertainties are significant drivers of secondary market liquidity in bond and stock markets. In testing our arguments, we used VIX and MOVE indexes as proxies for global uncertainty in stock and bond markets respectively. Moreover, in line with existing literature, we included return volatility for both markets as drivers of secondary market liquidity. Lastly, we incorporated FX volatility both in bond and stock markets as drivers of secondary market liquidity to capture volatilities that stem from domestic markets. To capture the impact of foreigners we included the share of nonresidents in bond and stock markets using weekly data.

In chapter five, we turned our attention to policy alternatives. As we witnessed deterioration in secondary bond market especially after Bernanke's speech in May 2013, the Turkish Treasury had some policy measures to enhance liquidity. After discussing these measures and their impacts on secondary bond market liquidity, we offered other policy alternatives both for bond market and stock market.

In the last chapter, we concluded our thesis with our key findings, policy suggestions and with our future research suggestions.

2. THEORETICAL AND CONCEPTIONAL FRAMEWORK OF LIQUIDITY

A significant number of researchers show that there is a close relation between economic development and financial development (Levine, 1995; Demirguc Kunt et al, 2004; and Levine and Zervos, 1996). One of the indicators of the development of financial sector is its liquidity. However, it is difficult define of liquidity in proper way. This difficulty arises from different reasons. First of all, there is no one single type of liquidity and often different types of liquidities are confused. Second, liquidity has different dimensions and hence a single liquidity measure may not be able to capture all of these different dimensions. Third, although liquidity can be considered as a public good, meaning that each financial actor benefits from the availability of it although they do not voluntarily contribute to it. Another complicating factor is that issuers of assets, policy makers or financial institutions investing in these assets have different perspectives on liquidity.

In this section, we deeply analyze the concept of liquidity from different perspectives. In this regard, we present different kind of definitions of liquidity, present how to measure it and further analyze the importance of it for financial markets, monetary policy and for debt managers. We conclude this section by presenting a snapshot of literature that analyzes drivers of secondary market liquidity in bond and stock markets.

2.1.The Definition of Liquidity

Liquidity has several dimensions such as market liquidity vs. funding liquidity, micro liquidity vs. macro liquidity and endogenous liquidity vs. exogenous liquidity, which make the concept complex. These differences make it hard to define liquidity and to measure it in a straightforward way. Hence, different proxies are used to measure it.

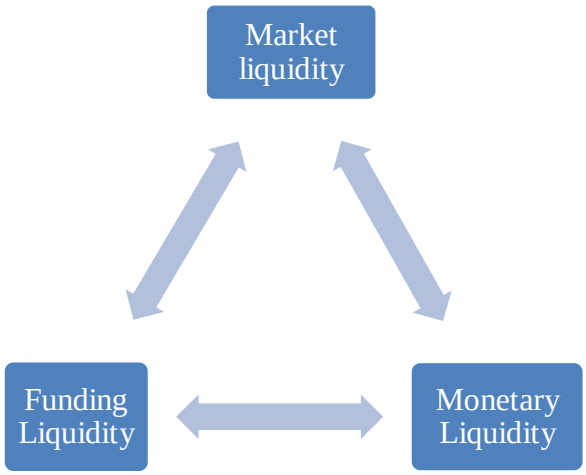
There are three types of liquidity often confused with each other. In this thesis, when we

talk about liquidity our aim is to talk about the liquidity of a financial asset. This type of liquidity is called market liquidity. It is defined as “the ability to rapidly execute sizeable transactions at a low cost and with a limited impact on market price” (IMF, 2015).

Market liquidity funding liquidity and monetary liquidity are three types of liquidity. Funding liquidity refers to the easiness of financial institutions to get funding from financial markets at reasonable conditions whereas monetary liquidity is the liquidity that is provided to financial markets through increase in monetary aggregates by central banks and monetary authorities (IMF, 2015).

Although all these concepts are different from each other, there are close relations among them. First, funding liquidity is usually a prerequisite for market liquidity since market makers, who are the main providers of liquidity also use credit or short term borrowing to maintain their inventories. Second, availability of market liquidity positively affects funding liquidity. Third, increase in monetary aggregates through monetary easing (monetary expansionary policy) ease funding conditions and hence facilitate market-making activities. With the facilitation of market making activities monetary liquidity also helps to get higher market liquidity. However, one should be careful about interpreting these relations among three liquidity concepts, because they are not always one to one and other factors may also play important roles in the relations among these three liquidity concepts.

Figure 1: Three Concepts of Liquidity



After making the distinction among three types of liquidity clear, we now turn to market liquidity which is the main issue of this thesis. According to the traditional definition of market liquidity, a market is liquid if market participants can sell financial securities at the lowest cost and without having any significant impact on the market price. This definition of liquidity incorporates some important features which are worth mentioning to better understand the concept of market liquidity.

Tightness: A market is said to be liquid, when the difference between bid and ask prices (spreads) is narrow. As the liquidity dries up in a financial market, the spread between bid and ask prices increase. Hence, this difference is also used as a proxy for the measurement of liquidity.

Depth: The depth of a financial market illustrates the maximum transaction volume that can be traded without having a significant impact on the market price (IMF, 2004). It can be measured by the volume of transactions of sell orders above market price or by the volume of transactions of buy orders under market price (Kara, 2011). Moreover, sometimes total transaction volume is also used as a measure of depth of a financial market. Another ratio that is used to measure the depth of a financial security is its turnover ratio. This is calculated by dividing total transaction volume in a given period by the total stock of that security.

Breadth: It is similar to depth and many researchers use these terms interchangeably. The measurement of debt takes into account the best ask and bid prices above and below market clearing prices whereas the breadth takes into account all bid and ask prices outside market clearing price. The breadth of a market can be measured by the elasticity of ask and bid prices. The higher the price elasticity of bid and ask, the higher the breadth of the market and hence the liquidity, because in these markets high volume of transactions have a limited impact on prices (Wyss, 2004).

Resiliency: Monitoring and measuring liquidity is easy during normal times. However, sometimes liquidity may dry up due to financial stress or other major distortions. Measuring liquidity in normal times may be not enough in assessing risk that a shock will generate if there is a sudden evaporation of liquidity (IMF, 2015). The resiliency of a market shows the speed of returning back to normal liquidity when normal level liquidity disappears due to major event or financial stress. The more resilient a market, the more liquid is market (Csavas and Szlizard, 2005). Resiliency can be measured by the market efficiency coefficient (MEC) as follows: (Sarr and Laybek, 2002)

(1) MEC= Var (Rt) / (T.Var(rt)) where,

Var (Rt) : Variance of logarithm of long term returns
Var (rt) : Variance of logarithm of short term returns
T : Number of short terms in a long term period

This coefficient tends to be close to 1 in liquid markets. However, as there will be some volatility in financial markets it will be usually under 1.

2.2.The Measurement of Liquidity

Since liquidity has many and diverse features, there is no a single measure of liquidity. In the literature there have been different types of liquidity measures all of which represent a different feature of the liquidity. Below we present some widely used

liquidity measures with their calculation methods and indications which aspect of liquidity they represent.

Bid-Ask Spread: This is the widely used measure of liquidity because of its simplicity and requirements of the data. To calculate this measure one need only data of quotes. Once quotes are obtained, it is calculated as the difference between quoted ask price and quoted bid price.. It shows the difference of prices of a security when a trader pays by buying and then immediately selling a given financial instrument. It reflects transaction costs in secondary market trading The main arguments behind this measure is that there is a premium embedded in prices for quick buying and a concession for quick selling a security. Hence, the difference between bid and ask price is a measure of liquidity, which is the sum of the premium in prices of buying and concession in selling the security (Kumar and Misra, 2015). However, one disadvantage of using the bid-ask spread is that bid and ask quotes are good only for limited quantities and periods of time. The spread therefore only measures the cost of a single trade of limited size (Fleming, 2001). Hence, this measure is usually used together with transaction volume measure.

Volume of Transaction: This is an indirect measure of market liquidity. Theoretically, it is based on the argument that more actively trading markets are more liquid. One limitation of this measure is that it is associated with volatility which usually leads to deterioration in market liquidity (Karpoff, 1987). Koksal (2012) argues that share in stock markets volume and currency volume is different, suggesting that both of these variables should be used in measuring liquidity through volume. The main limitation of using this measure is the problem of double counting involved in measuring trading volume.

Frequency of Trading: It is the number of trades within a time period, without taking into account transaction volume (Fleming, 2001.) Like volume of transaction, high frequency of trading means high market liquidity, but it may also reflect volatility and lower liquidity.

Turnover Ratio: To calculate turnover ratio, one needs only volume data. Once volume data is obtained, turnover ratio is calculated by dividing trade volume by the value of outstanding stock of securities.

The Conventional Liquidity Ratio: This ratio is used to find how much volume of transaction is necessary for a price change of one percent. So, volume and price date are needed for this measure. The mathematical expression of the liquidity ratio can be expressed as follows:

(2) $LR_t = (\sum_{t=1}^{T} Pt * Vt) / (\sum_{1}^{T} Abs(PCt))$

Where P and V represent price and volume, respectively. Abs (PC) is the absolute percentage price change over a fixed time of interval. A higher ratio, indicates higher liquidity.

The Index of Martin (1975): In this index it is assumed that the distribution of price changes is stationary through transaction time. The analytical expression of his proposal is as follows:

(3) $MLI_t = \sum_{t}^{N} ((Pt - P, t-1)^2 / Vt)$

Where P is the closing price and V is the traded volume. The higher the ratio, the lower is the liquidity of the market.

The liquidity Ratio of Hui and Heubel (1984): This index measures only the liquidity of a single asset. It is calculated by taking into account largest price changes and dividing it by the ratio of volume of transactions. Analytically, this can be expressed as follows:

(4) $LR_{HH} = \frac{(Pmax - Pmin)/Pmin}{V/(S * Pavg)}$

Where Pmax is the highest daily price over a 5-day period, Pmin is the lowest daily price over the same horizon, V is the transaction volume, S is the total number of assets, and Pavg is the average price. The higher the index, the lower is the liquidity.

Liquidity Spread: This is the difference between securities that have different liquidity levels and is calculated as the difference between the yields of on-the run and off-the run securities with similar cash flows. Since liquidity has a monetary value, investors are willing to give higher prices for more liquid securities

Roll's (1984) Price Reversal: Roll (1984) used price data to measure of market liquidity. By using price data he calculated covariance between price changes in two subsequent periods. This covariance is interpreted as another kind of bid-ask spread.

Corwin and Schultz's (2012) High-Low Spread: This metric is used to measure transaction costs by estimating a bid-ask spread when quote data are not available. They use price data and estimate a function between high and low prices in two consecutive days

Effective spread: The effective spread is calculated by taking the difference between transaction price and quoted mid-price. Hence, both price and quotes data are needed to calculate it. The main advantage of this calculation is that it captures how far transactions are actually taking place away from the mid-price.

Imputed Round-Trip Cost: To calculate it, one needs both price and volume data of an asset. It is calculated as the difference between highest and lowest prices of an asset with the same transaction size in a particular day. It indirectly calculates cost of transaction by computing how much it costs for a trader to buy and sell the same asset in a particular day and with the same amount of transaction. It is a useful metric when quoted price data is not available.

Price Impact: It is used to measures market depth by estimating the change in price for a given transaction volume and by estimating slope of price change on flow of order

order. In other words, it contains information on the marginal cost of additional transaction . Price and trading volume are needed for the estimation.

Amihud's (2002) Illiquidity Measure: This is also a measure of market depth. One need both price and volume data to calculate this measure. Specifically, it is calculated by dividing absolute value of daily returns by daily volume of transaction. Analytically, it can be expressed as follows:

(5) $\text{Illiq}_t = 1/\text{Dt} * \sum_{t=1}^{Dt} \frac{abs(Rt)}{Vt}$

Where D R and V represent day, return and transaction volume, respectively.. This index is similar to the conventional liquidity ratio that we introduced earlier in the text. The illiquidity index provides a rough measure of impact of price. The main advantage of this index is the availability of data.

The liquidity Ratio of Marsh and Rock (1986): This ratio is based on the assumption that price changes and trade volume are independent, except for large transaction volumes. Their liquidity measure can be expressed as follows:

(6) $\text{LR}_{\text{MR}} = (1/\text{M}) * \sum_{m=1}^{M} \left(abs\left(\frac{(Pm-P,m-1)}{P,m-1}\right)\right) * 100$

Where M represents total number of transactions. The index analyzes the relation between the percentage price change and the absolute number of transactions, instead of the volume of transaction. To better illustrate, let us consider two assets A and B. Suppose that the total transaction volume of asset A is 100 TL and all of the 100 TL is traded in one transaction and asset B is traded for the same total volume (100 TL) as asset A, but in more than 1 transaction. Market sentiment expects that asset B has high liquidity than that of asset A. However, by looking at volume based indices, one cannot conclude this.

Quote Depth: It measures the depth of the order book by numerating the quantity of securities for which traders are willing to supply liquidity. It only requires quotes data

and is calculated as total quantities of securities dealers are willing trade at announced ask and bid prices.

Dealer Count: To get measure one needs providers of quotes. It takes into account only number of dealers that give quotations for the same security. It indirectly measures market depth by providing the number of dealer quotes for a given security.

Markit's liquidity Score: This score includes the following factors: number of dealers and quotes, number of price sources, spreads between bid-ask quotations, maturity for bond markets and whether there is a benchmark yield curve with liquid bond or not . Since it includes different features of liquidity, it provides an approximation of many dimensions of liquidity A smaller value implies higher liquidity (IMF, 2015).

Based on these different types of measures of liquidity we can say that liquidity measures are based on volume of transactions, , price behavior of securities and cost of transaction.

Regarding measures on transaction volume, we can point out three issues (Gabrielsen et all, 2011). First, these indices do not take into account transitory and permanent changes in transaction volume. A transitory change in transaction volume can be interpreted as a temporary lack of liquidity in the market. Price volatility can result from informational asymmetry, rather than from lack of liquidity and these features are not captured by volume-based measures of liquidity. A second issue with measures of transaction volume is that they do not show how a sudden order arrival of an order in order book can affect prices. Trade volumes take into account past relations between prices and transaction volume and this relation may not be stable. The third issue, according to Marsh and Rock (1986), is that conventional liquidity measures have a tendency to overestimate price impact on large transactions and underestimate price changes on small transactions due to the lack of proportionality between prices and volume, a usual characteristic of all volume based measures.

After discussing liquidity measures, we argue that there are three ways to assess these measures. First, since the definition of liquidity includes the trading costs, a measure

that directly calculates trading cost is better measure of liquidity. Second, liquidity measures should be in line with market participants' observations on liquidity. Last, a good liquidity measure should easily be calculated and should be available to market participants on a real time basis. According to the first two criteria, the bid-ask spread and price impact are the best measures of liquidity as both of them directly quantify the costs of trading. Specifically, the bid-ask spread measures the cost of executing a single trade and the price impact measures the price effects of transactions. However, the bid-ask spread is better than the price impact according to last criteria, because it is easy to calculate and understand and also available on a real time basis.

Hence, based on our analysis of different liquidity measures according to three criteria, for the purposes of this thesis we argue that the bid-ask spread is the best measure of liquidity.

2.3.The Importance of Liquidity

According to Bank for International Settlements (BIS), liquidity in financial markets is a public good so that all the financial market participants benefit from it yet they do not have sufficient motivation to supply liquidity (BIS-CGFS, 1999). Moreover, as we discussed before, market liquidity has close relations with other types of liquidity concepts. Hence, market liquidity has utmost importance from different perspectives.

First of all, a liquid market allows different prices at different maturities so that an efficient yield curve can be established. This is especially valid for fixed income securities such as government bonds and corporate bonds. An efficient yield curve of government bonds with sufficient level of liquidity serves as a benchmark for other financial instruments and help to the formation of pricing of these instruments (Wheller, 2004; Coluzzi et al, 2008). Moreover, due to their risk-free feature, government bonds can be used as collateral by financial institutions. Hence, financial institutions have high tendency to carry government bonds in their balance sheet as source of quick liquidity. In case of an unexpected cash flow, these securities can be easily converted to liquidity.

Hence, the liquidity of these securities has utmost importance for financial institutions carrying these securities in their balance sheets.

The liquidity is a demanded feature of a security not only for the safe functioning of the financial system but also for the issuing part, especially for government debt offices who issue government bonds in primary markets. A liquid government security has high demand from investors compared with the same illiquid security even if all features of both securities such as maturity, cash flows, risk etc. are the same. Hence investors demand extra premium for illiquid assets, called liquidity premium (Diaz and Navarro, 2003). Thus, liquidity of a government security decreases cost of borrowing for governments. Moreover, the presence of a liquid government security markets help governments to obtain funds from domestic markets which in turn help decrease their dependency on foreign markets and hence FX risk they face (Sidaoi et all, 2012).

The liquidity of government securities has also implications for central banks in conducting monetary policy and maintaining financial stability. First, the prices of liquid government securities contain useful information regarding expectations of monetary policies and central banks try to get this formation by monitoring secondary market developments (Gravelle, 1999). For instance, government securities linked to inflation contain useful information regarding inflation expectations (Duran et all, 2011). Hence, liquidity of these markets is a desired feature to reflect true prices of these securities and hence helps central banks to accurately get estimates of market expectations regarding future inflation rates.

The liquidity of government bond market is also important for central banks due to their open market operations. Open market operations are the widely used monetary policy instrument both in developed and emerging countries due to their simplicity, flexibility and easy implementation. Through these operations, central banks can increase money supply by buying back government securities from markets or decrease money supply by selling these securities to the markets. Hence, an illiquid government securities market causes central bank open market operations to either fail or produce negative consequences.

Secondary market liquidity of government bonds is also important for central banks from financial stability perspective. After global financial crisis in 2008, central banks added another variable to their objective functions, the maintenance of financial stability because financial stability is one of the main drivers of price stability. Liquidity in financial markets helps restore investor confidence and increase resiliency of the financial markets against unexpected shocks and decrease systemic risk (BIS, 1999). When there is sufficient liquidity, market participants can obtain the necessary funding from markets and hence there will be less reliance on central bank reserves as lender of last resort.

The liquidity is not only a desirable feature of bond markets but also in stock markets from corporate finance perspective. The concept of liquidity in stock markets was initiated by Amihud in 1986 and then has been subjected to research due to its implications for different perspectives. The liquidity of an individual stock or the stock market has important implications for pricing of the stock, returns, market efficiency, pricing behavior, dividend policy and firm value. Faff et all (2010), for instance, analyzed the effect of liquidity on stock return on Tokyo Stock Exchange. They found that liquidity is taken into account in prices during expansionary period f in business cycle but not taken into account during contractionary period. Spindt et all (2007) analyzed the empirical relation between dividend policy and liquidity. They found that investors prefer cash dividends in illiquid markets. Lipson and Mortal (2009) argue that firms with more liquid shares have lower leverage and they prefer equity financing when they need to raise their capital.

2.4.Drivers of Liquidity: A Snapshot of Literature

The drivers of liquidity have been received great attention form researchers, academicians and policy makers in the recent history. In that regard, drivers of local government bonds, sovereign bonds, corporate bonds and stock markets have been deeply analyzed in the literature. Moreover, some of literature studied commonality in secondary market liquidity in financial markets. In this field of research, drivers of stock

and bond markets have been analyzed together to assess whether there are common factors that drive liquidity in these markets. There have been also researches on how liquidity in bond and stock market are related to each other. Although most of the literature is about the market liquidity, some researchers also analyzed the interlinkages between funding liquidity and market liquidity.

Ui (1999) analyzed the relation between price volatility (as a measure of liquidity) and transparency of the bond market in Italy. He defined transparency of the market as the ability of investors to access information during transactions. He found that as transparency increases, price volatility decreases. A similar analysis has been conducted by Scalia and Vacca (1999) for Italian government securities. They also found that a decrease in transparency has a negative impact on liquidity because investors are waiting for right information before they do any transaction which causes delays in transactions.

Fleming (2002) analyzed whether reopening of a security causes an increase in liquidity or not by studying liquidity patterns of US government securities. He compared the liquidity of 52 weeks government bonds that have been subject to reopening after 26 weeks with that of bonds that have an initial maturity of 26 weeks. He found that's reopening facility has a significant effects on the liquidity of securities.

Chabchitrchaidol and Panyanukul (2005) analyzed the secondary bond market liquidity in Thailand. To measure liquidity they used bid ask spread. They analyzed the effects of price volatility and transaction volume on the liquidity. They found that price volatility has a negative impact on market liquidity and transaction volume has a positive impact on the bond market liquidity. This makes sense, because as the volume of transactions increase, bid-ask spread decreases and hence increases liquidity.

Moser (2007) analyzed the perceptions of investors regarding changes of minister of Economy or Finance in cabinet in 14 Latin American countries. He found that political events may suddenly increase bid and ask spreads and hence decrease liquidity. He argued that the resigning of Ministry of Finance caused an immediate increase in bid-ask spreads and decreased liquidity in government bond markets.

Bloommestein et al (2008) focused on the electronic trading platforms, over the counter transactions, broadening of investor base and availability and effectiveness of primary dealership system in analyzing liquidity. They argued that liquidity increases as the issues of government bonds are transparent and announced according to a pre-determined agenda. Moreover, reopening of the same security, a well-functioning repo market, measures to ease pricing of securities by investors and an effective primary dealership system are important factors in having a liquid bond market.

Bellas et all (2010) analyzed the bid ask spread of emerging countries during 1997-2009. They used EMBI (Emerging Markets Bond Index) spread, financial stress index, volatility index, ratio of short term debt o international reserves, share of external debt in GDP and share of interest payments to international reserves as dependent variables in their model. Moreover, since this was a cross-country analysis, they also added share of foreign trade volume to the model to reflect differences in competition in these countries. They analyzed short term and long term determinants of liquidity and they found that financial variables affect liquidity in short term whereas macroeconomic variables affect in the long-term. Moreover, they observed that crisis years have also a significant effect on liquidity so they incorporate this observation by adding dummy variables for these years. They found that an increase in volatility index increases bid-ask spread meaning that volatility decreases secondary market liquidity. This finding is also consistent with the findings of related literature. They also found that an increase in external debt as shares of GDP, an increase in politic risk or financial stress have deteriorating effects on liquidity in government bond markets.

Goyenko et all (2011) compared the liquidity of the on-the-run and off-the run securities in US government bond market using data from 1967 to 2005. They found that the liquidities of the on-the-run securities have been significantly affected by return volatility. On the other hand, the liquidity of off-the run securities have been affected by not only return volatility but also by macroeconomic variables. According to them the main reason for this difference the high volume of the transactions of on –the run securities that diminishes the effects of macroeconomic variables on the liquidity.

The literature on the liquidity of government bond market in Turkey is rather limited. Kara (2011) analyzed the effects of price volatility and transaction volume on the liquidity which is measured as bid-ask spread of the security during December 2007 to December 2010. He found a positive and significant relation between transaction volume and liquidity of the security. Results also revealed that as price volatility increases, liquidity decreases. A similar analysis has been conducted by Karataş (2015). Like Kara, he also used bid-ask spread to measure secondary market liquidity in government bond market. He found that there is a negative relation between market concentration and bond market liquidity and there is a positive relation between transaction volume and market liquidity.

By utilizing a panel data model, Kilimci et all (2014) analyzed the impact of interest rate risk, interest rate volatility, currency risk, currency volatility and carry trade opportunity variables on the liquidity of government bonds by using transaction volume and bid-ask spreads as measures of liquidity. They found that, the above mentioned explanatory variables have an impact on the secondary market liquidity.

Table 1: Summary of Literature Review on Drivers of Liquidity in Bond Markets

Auhors (Year)	Country	Model	Main Findings
Ui(1999)	Italy	Analyzed the relation between price volatility and transparency	As transparency increases price volatility decreases
Scalia and Vacca (1999)	Italy	Analyzed the relation between liquidity and transparency	Decrease in transparency has a deteriorating effect on liquidity
Fleming (2002)	United States	Analyzed whether reopening of a security causes an increase in liquidity using July 1st 1996-December 31, 2000 data	Availability of reopening facility improves liquidity of securities
Chabchitrchaidol and Panyanukul (2005)	Thailand	Analyzed the effects of price volatility and transaction volume on liquidity	Price volatility has a negative impact and transaction volume has a positive impact on liquidity
Moser (2007)	14 Latin American Countries	Analyzed perceptions of investors regarding changes of Minister of Economy and Finance	Political events may suddenly increase bid-ask spreads and hence decrease liquidity
Bloommestein et all (2008)	OECD Countries	Focused on the role of electronic trading platforms, OTC transactions, broadening of investor base, availability of PD system	Liquidity increases with transparency, reopening, well-functioning repo market affective PD system
Bellas et all(2010)	14 emerging countries	Analyzed liquidity spreads using macro and financial variables (external debt, fiscal balance, short term debt/reserves, external debt amortization/reserves, trade openness, politic risk, financial fragility) during 1997-2009	Financial variables affect liquidity in short term whereas macro variables affect liquidity in long run.

Authors (Year)	Country	Model	Main Findings
Goyenko et all (2011)	United States	Compared liquidity of the on-the run and off-the run securities using data between 1967-2005	Liquidity of the on the run securities have been impacted on return volatility whereas liquidity of the off-the run securities have been affected by not only return volatility but also by macroeconomic variables
Kara (2011)	Turkey	Analyzed the effects of price volatility and transaction volume on liquidity using December 2007-December 2010 data	He found a positive and relation between transaction volume and liquidity and negative relation between volatility and liquidity
Kilimci et all (2011)	Turkey	Analyzed the impacts of interest rate risk and volatility of it currency risk and volatility of and the availability of carry trade opportunity on liquidity using February 2010-September 2014 data	They found that explanatory risk factors have a significant impact on market liquidity

Source: Author based on Literature Review Analysis

Table 2: Drivers of Secondary Bond Market Liquidity in Literature

Macroeconomic Variables	Financial Variables	Volatility/ uncertainty	Events	Market Microstructure
Ratio of short term debt to international reserves	EMBI spread	Price volatility	Political events	Transparency
Share of external debt in GDP	Interest rates	Return volatility	Announcements of news	Reopenings
Share of interest payments to international reserves	Currency	Volatility index		Transaction volume*
Foreign trade volume	Carry trade opportunity	Financial stress index		Electronic Trading Platforms
Monetary Policy Stance		Interest rate volatility		Over the counter transactions
Growth of Industrial Production		Currency risk		Broadening of investor base
Consumer Price Index				Availability and effectiveness of Primary Dealership System
				On the run-off the run discrimination
				Market concentration

Source: Author based on literature review analysis

* Some researchers use transaction volume as the measurement of liquidity instead of a driving factor

As we discussed before, some researchers focused on the covariance of liquidity in bond and stock markets. The main argument behind this is that there the volatilities in these different markets can effect liquidity in both markets. In other words, there may be a comovement of liquidity in different assets (bonds and stocks for instance) and liquidity in these assets can result of common factors such as shocks to volatility, returns and transactions. Tarun et all (2003) analyzed patterns of liquidity, transactions, returns and volatility in stock and bond markets in the US from 1991 to 1998. They found four arguments regarding bond and stock markets liquidity in the US. First, stock and bond market liquidity have similarities such as common regularities in calendar. Second, they found that shocks to spreads in one market increase lead to increase in spreads in both markets. Third, they found that the high correlation between bond and stock market liquidity and volatility is an indication of a common factor that drivers both liquidity and volatility in these two market. Lastly, they argue that flows to both stock government bond securities have and undeniable role in forecasting liquidity in both bond and stock markets. Further, they also analyzed the impacts of monetary policy on the liquidity and found that an expansionary monetary policy has a positive impact on the stock market liquidity during crises. Further, an unexpected increase in FEDs rate has a negative impact on liquidity and both stock and bond volatility decreases upon an unexpected increase in FED's rates.

Bouwman et all (2012) studied the link between bond and stocks and proved that there are links from stock market illiquidity to sovereign bond premia. They also argue that stock market illiquidity is closely related to funding liquidity and are related to flight to quality

Guenon and Urho (2009) analyzed the common dynamics of US stock and Treasury bond market liquidity over a long time. They find that stock and bonds markets are linked not only though volatility but also through liquidity as well. According to their findings, positive shock to stock illiquidity decreases bond illiquidity and vice versa. In other words, illiquidity in the two major markets affects each other. They also analyzed the joint drivers of bond and stock market liquidity in the same paper. Accordingly, returns and return volatility are important drivers of bond and stock market liquidity, a finding consistent with the literature. They also analyzed some key macroeconomic variables in terms of their effects on the liquidity. Specifically, they analyzed the effects

of monetary policy, the growth rate of industrial production and consumer price index. The Granger causality results indicate that shocks to CPI, to monetary policy stance include useful information in predicting stock market liquidity. Shocks to CPI include information in predicting bond liquidity across all maturities and shocks to monetary policy has an effect on medium and short term bonds. Thus, there is evidence that macroeconomic variables are linked to financial market liquidity. Moreover, their results indicate that tightening of monetary policy indicates an increase in stock and bond market illiquidity.

Research in the area of stock market is much more developed compared to government bond markets. According to literature there are two main categories that explain stock market liquidity: i) Firm and sector specific factors and ii) macroeconomic factors (Kumar and Misra, 2015).

Jacoby and Zeng (2010) analyzed the empirical relation between ownership dispersion and market liquidity. They found a positive relation between ownership dispersion and stock market liquidity.

Baber et al (2012) analyzed the impact of availability of institutional investors and liquidity risk on liquidity. They found that the availability of institutional owners has a positive impact on stock market liquidity. A similar analysis has been carried out by Yaghoobnezhadet et al (2011) for Tehran Stock Exchange. They also found that the presence of institutional investors positively impact stock market liquidity. Although Sharma (2005) studied the same relation on Indian Stock Market, contrary to the literature; he found that shareholding is not does not have a meaningful impact stock market of liquidity.

Kim and Verrechia (1994) analyzed the impact of earning announcements on liquidity. They found that earnings announcements increase decrease stock market liquidity by increasing information asymmetry.

Hendershott et all (2011) analyzed the relation between algorithmic trading and liquidity. They used auto quoting on NYSE as an instrumental variable for algorithmic

trading. They found that algorithmic trading enhances liquidity by reducing trading costs.

Kumar et all (2001) analyzed the impact ADR (American Depository Receipts) and GDR (Global Depository Receipt) listings on the liquidity in Indian stock market. They found that GDR listings and ADR listings have different impacts on the liquidity. Specifically, GDR listings refer to high liquidity whereas ADR listings refer to low liquidity.

Chordia et all (2001) analyzed the impact of trading activity, market return and interest rate on the liquidity of stocks in NYSE. They found that liquidity and trading activity is influenced by market returns, its volatility and interest rates. Moreover, macroeconomic news like GDP, inflation etc. also have an impact on liquidity when the news is first publicly announced.

Ding et all (2013) analyzed the impact of the availability of foreign institutional investors on stock market liquidity on Shangai and Shenzen stock exchanges. They found that as the share of foreign institutions increase, the liquidity in stock market increases.

Chordia et all (2005) argued that the predictive power of monetary policy for stock market liquidity is not so strong whereas Goyenko and Ukhov (2009) provided evidence that monetary policy is a good predictor of liquidity for the listed on US markets for the period 1962-2003

Table 3: Summary of Literature Review on Drivers of Liquidity in Stock Markets

Authors (Year)	Country	Model	Main Findings
Jacoby and Zeng (2010)	United States	Analyzed the emprical relation between ownership dispersion and market liquidity using NASDAQ, NYSE and AMEX firms	They found positive relation between ownership dispersion and stock market liquidity
Beber at all (2012)	United States	Analyzed the relation between institutional investors, liquidity and liquidity risk using data form January 1990 until December 2009	Presence of institutional owners positively impacts stock market liquidity
Yaghoobnezhadet et all (2011)	Tehran Stock Exchange	Analyzed the relation between institutional investors and liquidity using 2004-2008 data	Presence of institutional investors positively affects stock liquidity
Sharma (2015)	Indian Stock Market	Analyzed the relation between institutional investors and liquidity using cross-sectional data as of December 2004	Contrary to literature he found that shareholding is not significant in explaining the stock market liquidity
Hendershott et all (2011)	New York Stock Exchange	Analyzed the relation between algorithmic trading and liquidity using data from February 2001 to December 2005	They found that algorithmic trading reduces trading costs and enhances liquidity
Kumar et all (2011)	Indian Stock Market	Studied the impact of ADR and GDR on liquidity using data from January 1st, 1996 to 30th June , 2001	GDR listings positively impacts liquidity while ADR listings do not

Authors (Year)	Country	Model	Main Findings
Chordia et all (2001)	New York Stock Exchange	Analyzed relation between liquidity, trading activity market return and interest rate using data from 1988 to 1998	They found that market returns, its volatility, short term and long term interest rates affect liquidity and . Macroeconomic news like GDP, inflation etc. also impact liquidity when they are first announced
Ding et all (2013)	Shangai Shenzhen Stock Exchanges	Studied the relationship between foreign institutional investors and stock market liquidity using data from April 2004 to end of March 2012	They found that the presence of foreign institutions enhances stock market liquidity
Chordia et all (2005)	United States	Looked at the predictive capacity of monetary policy for stock market liquidity using data from 1988 to 2002	The predictive capacity of monetary policy for stock market liquidity is not strong
Goyenko and Ukhov (2009)	US Stock Market	Analyzed the predictive power of monetary policy for stock market liquidity for 1962-2003 period	Found strong evidence that monetary policy predicts liquidity of the stocks on US markets.

Source: Author based on Literature Review Analysis

Table 4: Drivers of Secondary Stock Market Liquidity in Literature

Firm and sector specific factors	Macroeconomic Factors
Ownership dispersion	Short term interest rates
Institutional Investors	long term interest rates
Earning announcements	Macroeconomic news like GDP, CPI etc.
Algorithmic trading	Monetary Policy
ADR and GDR	
Trading activity	
Market return	
Foreign instituional investors	

Source: Author based on literature review analysis

3. THE GLOBAL FINANCIAL CRISIS AND ITS EFFECT ON SECONDARY MARKET LIQUIDITY

The global financial crisis first began with the subprime mortgage crisis in the US and spread first to other financial market instruments and then to real sector and hampered growth and trade outlook not only in developed economies but also in emerging and less developed economies. Governments, central banks, policy makers and researchers still debate on the root causes and implications of the crisis on the financial system and on the real economy and try to develop policy responses to avert the negative consequences of the crisis on real economy and on the functioning of the financial sector at a global scale.

Specifically, the new international financial architecture after the global financial crisis, the risk management practices of financial institutions, role of credit rating agencies, central bank policies and bank bailout programs are subject to hot debate along with fiscal policies and structural reform programs of governments to restore confidence and achieve higher growth and employment levels.

The different stages of the crisis since the beginning and the policy responses of monetary authorities and governments had significant impact on the functioning of the financial systems, including the market liquidity. Our aim in this chapter is first to identify stages of the global financial crisis with its root causes and then to discuss the impact of the crisis and central bank policies on secondary market liquidity. The first section of this chapter presents an overview of the causes and implications of the global financial crisis. Following the first section, we provide an overview of central bank policies including bail out programs, asset purchase programs and quantitative easing programs in the FED and in European Central Bank. In the last section of this chapter we focus on the impacts of the global financial crisis and central bank policies on the secondary market liquidity.

3.1. The History of Global Financial Crisis

To better understand of what went wrong before and during the crisis, one needs to better analyze the underlying factors of the crisis, the macroeconomic conditions before the crisis, the innovative financial products, the risk management practices of financial institutions and lastly the policy responses of central banks.

The underlying causes of the crisis can be attributed to the global imbalances due to excess global liquidity (savings glut), proliferation of subprime mortgage[1] markets in the US and inadequate risk management practices of financial institutions and credit rating agencies. Regarding the root causes of the subprime mortgage crisis there are two different hypotheses.

According to the first hypothesis, the main culprit behind global imbalances were economic policies of East Asian Economies such as export led growth strategy, the accumulation of international reserves and the Specifically, East Asian Countries' promotion of exports through macroeconomic and microeconomic policies, the desire of these countries' to accumulate international reserves and lastly China's low level of currency to support its export oriented sectors had crucial importance in creating the global imbalances.

The second hypothesis argues that the housing bubble and the subprime mortgage crisis in the US do not have to do with global imbalances. On the contrary, domestic factors in the US such as, the expansion of the mortgage market to low income segments of the population, the expansionary monetary policy of the FED and failures in regulation, incentive, design and structure of the mortgage and financial markets all contributed to the subprime mortgage crisis

[1] Subprime mortgages are mortgage lending that is extended to people with low credit scores and/or with uncertain incomes.

Regardless of which hypothesis best explains the subprime mortgage crisis, the spread of the crisis to other financial markets and financial products can be explained by changeable allocations of the high global savings at a low interest rate environment. When these allocations move from one asset to another, they led to asset-price bubbles. Orlowski (2008) called this process a "wandering asset price bubble". According to Orlowski (2008), there have been five stages since the beginning of the crisis

First, the increase in subprime mortgage lending led to a bubble in housing sector in the US. In the second stage, this bubble spread to other asset classes and had deteriorating impacts not only on mortgage sector but also on banking sector at the global level. Third, it led to the global liquidity crisis when households and financial institutions took their deposits away from the most exposed banks such as Northern Rock, Bear Sterns and Lehman Brothers, banks whose balance sheets are heavily dependent on mortgage loans. This further triggered concerns regarding credit contagion from counterparty risk at the global level. Fourth, the collapse of Collateralized Debt Obligations (CDOs) led the global liquidity to shift in commodity futures market and led to another bubble in this market. Fifth, it reached its peak level in September 2008 with the collapse of Lehman Brothers.

The spillover effects from subprime mortgage markets in the US first to other financial markets in the US and then to financial markets outside US, to commodity future markets and lastly to real economy of developed and developing countries made this crisis one of the most severe crises in the world since the great depression of 1930s.

3.1.1 The Subprime Mortgage Crisis in the US

The roots of the global financial crisis can be explained by three main factors. The first factor is the capital outflows from many emerging economies after the Asian crisis in 1997 and then Russian crisis in 1998 and then the accumulation of savings in the developing countries that have high and persistent current account surpluses (Orlowski, 2008).The second factor is the expansionary monetary policy of the FED and the

extension of mortgage market to low income groups. The third factor is failures in the regulation and design of financial institutions and their risk management practices (Lin, J.Y and Trecihel, V., 2012).

The crisis has stemmed from a combination of macroeconomic processes and micro-level institutional factors that were prevailing before the outbreak of the crisis in 2007. The macroeconomic contributors include monetary expansion in the US, large capital inflows to US securities market from high saving countries, the US housing boom and lastly the rising debt levels of households in the US. The micro- level institutional factors include growing asset securitization practices in line with new financial products, the of hedge funds and investment vehicles, asset valuation and risk models and inadequate supervisory and regulatory framework in banking and financial sector.

The monetary expansion in the US from 2000 until mid-2004 caused higher interest margins for banks and led to housing boom in the US. The cheap and abundant central bank money and the bubble in housing sector in the US encouraged banks to take more risk in lending However, with the FED's tighter monetary policy framework stance since mid-2004, there has been decrease in the profit margins of banks. As a response to this decrease, banks started to use innovative financial institutions and as a result of this, banks converted risky mortgage products into complex derivative instruments to raise funds for new lending. In addition to that, banks did not have concerns regarding default risk since sellers of mortgage securities did not keep these loans on their balance sheets. Hence, there has been an expansion of risky non-traditional mortgage loans. Another contributing factor to higher lending volume was securitization of mortgage loans or the creation of Collateralized Debt Obligations (CDOs)[2] . Banks were able to provide new lending by selling these new products. sold these As a result, the share of subprime mortgages in securitized mortgages reached from 9 percent in 2001 to 40 percent in 2006 (Tilton, 2007). Such a significant increase in subprime mortgage loans could not be possible when the banks were unable to transfer risk to investors who bought CDOs. These financial instruments were attractive for investors due to their higher rate of

[2] CDOs are credit instruments developed from pools of underlying assets such as loans, bonds or mortgage-backed securities. These assets are divided into slices based on their credit ratings. Slices with less cretit rating offer higher returns to compensate for higher credit risk.

return especially when the interest rates are low. The investors who bought CDOs believed that when the market risk increases, they can sell these CDOs when they have investment level credit ratings. One other problem was the underestimation of the risks associated with these complex derivatives by credit rating agencies.

The increase in expensive mortgages has also contributed to the massive increase in the household debt as a share of their income. The total debt stock of the household sector exceeded their income by one-third in 2006 and remained flat at that level during 2007. Thus, the borrowing capacity of US households' decreased concerns regarding the default risk of the household sector, which is the largest contributor to US GDP, became a serious problem.

As a result of rising interest rates, there has been an increase in defaults in mortgage sector. Therefore, the early warning signs regarding the crisis were already available in these years and expectations regarding growth of mortgages, house prices and profit margins of banks from mortgage loans and CDOs were not rational.

If we summarize so far we can say that, the subprime mortgage crisis in the US has been result of macroeconomic conditions and microeconomic failures. Claessens et all (2010) identified four features of the crisis that are in common with other crises: i) unsustainable asset price increases ii) credit boom and excessive debt burden iii) building up of systemic risk and iv) the deficiencies in regulation and supervision of financial sectors. They also identified four new features of this crisis: i) The use of complex financial derivative instruments ii) the increased interrelation between financial institutions both at a global and national level iii) the high degree of financial leverage of iv) the role of the household sector.

3.1.2 The Stages of the Crisis Following Subprime Mortgage Crisis in the US

When the Fed started tightening monetary policy by increasing interest rates, the spread of CDOs over government securities declined which gradually decreased the attractiveness of these securities. Moreover, the sharp increase in interest rates of Adjustable Rate Mortgages (ARMs) led to increase in defaults and foreclosures in housing market in the US. Foreclosures rose nearly 79 percent from 2006 to 2007 and reached almost 1.3 million (Orlowski, 2008). As a result, banks significantly reduced extending credits in. The problems in the mortgage market spread to short term money markets in which banks and other financial institutions borrow short term funds. As a result of this, banks started to hoard cash and became unwilling to give loans to each other, which first led to increase in LIBOR rates and resulted in credit crunch trust erosion.

The spread between LIBOR and Overnight Interest Swap (OIS) with corresponding maturities is the best indicator to observe tension on the inter-bank lending market. An increase in this spread means that banks are reluctant to each other.

During 2007-2008 this spread exhibited three sharp increases. The first increase is observed with the beginning of the subprime mortgage crisis on August 17, 2007. At that date, two hedge funds owned by Bear Sterns collapsed due to losses on mortgage backed securities that they keep in their portfolios. At the same time, three European Investment Funds had difficulties in pricing assets linked to subprime mortgages due to the sudden drop in liquidity in these markets (DiMartimo et all, 2007). The second sharp increase in this spread is observed in December 2007, when the financial crisis was spreading to other financial institutions. The effects of this were especially damaging for financial markets that have high exposures to subprime mortgage market; especially those that had failed in raising capital and in reducing excessive leverage. The losses in mortgage derivative market and the increased counterparty risk led to severe liquidity problems for banks. In particular, they triggered run to liabilities of

Bear Stern and in just two days, the bank's liabilities fell by 17 billion USD. The collapse of Bear Sterns further increased the spread to 204 bps on March 19, 2008.

Figure 2: LIBOR-OIS Spread (%)

Source: Federal Reserve Bank of St. Louis

On September 15, 2008, Lehman Brothers filed for bankruptcy due to large losses in the subprime mortgage market. This was also the main milestone in the spread of the mortgage crisis into a global financial crisis. This led to a large increase in uncertainty and selling of securities that caused a collapse of asset prices and drying up liquidity.

In sum, different and complex factors caused the three sharp increases in the LIBOR-OIS Spread. This complexity is an indicator of the spillover effects of the subprime mortgage crisis into other financial markets and global financial institutions.

There have been three significant events following the collapse of Lehman Brothers; the collapse of American International Group (AIG) and the run on Reserve Primary Fund on September 16, 2008and the Troubled Asset Relief Plan (TARP) approved by the congress in the following couple of weeks.

The AIG had written over $400 billion dollars of credit default swaps, to make payments in case of a loss in subprime mortgage securities. With the collapse of Lehman brothers, short term funding to AIG dried up due to concerns that AIG will make enormous payments based on these contracts.

The same day of when the AIG collapsed, there was also a run on the Reserve Primary Fund, a large money market fund in the US. The Reserve Primary Fund held $85 million of Lehman paper and with the collapse of Lehman the fund could no longer keeps its shares at par value of $1 and shareholders took their money out, letting the fund losing 90 percent of its assets (Mishkin, 2011). In turn, this put further pressure on the banks, as their funding was heavily dependent on commercial paper and certificates of deposits held by mutual funds.

During these events, the US Treasury proposed the Troubled Asset Relief Program (TARP) on September 19, 2008. It gave the US Treasury the authorization to purchase subprime mortgage assets worth of $700 billion from troubled financial institutions, and then to use this money to inject capital into banking institutions. However, just after ten days the bailout of financial institutions proposed by the Treasury has been rejected. In response to that, the Dow Jones Industrial Average fell by 778 bps, the US dollar appreciated, gold prices rose by 3.3 percent and the spread between LIBOR and US treasuries reached its peak level of 464 bps on October, 2008.Eventually, the bill was passed on October 3, 2008.

These events that we have seen during September 2008 showed that risk taking was much higher than markets have thought and the fragility of the financial system was much greater than most markets could have anticipated. Moreover, there have been also doubts of the markets on the role of government agencies in managing the crisis.

The next stage of the crisis began at the beginning of 2008. After the huge losses on CDOs and other derivatives, investors started to invest some of their funds in commodity futures with the anticipation that future prices of the underlying commodity will be below the expected price. As a result, oil futures prices in New York Mercantile Exchane (NYMEX) almost doubled from 75 USD in the beginning of October 2007 to

147 USD on July, 11, 2008. Since then, investors stopped in investing in oil futures markets which contributed to declining trend of prices in commodity futures markets.

The increase in market risk and the decrease in liquidity in the banking sector at global level led to the next stage of the crisis, the freeze of liquidity in banking sector accompanied with flight to safety (Orlowski, 2008). In this last stage, the asset bubble moved to US treasuries and to gold markets, the two main safe financial products according to global investors.

In sum, there have been five stages of the global financial crisis (Orlowski, 2008):

i) The subprime mortgage crisis
ii) The spread of credit risk to global banks and increasing losses of financial institutions
iii) The liquidity with the run on Bear Sterns and Lehman Brothers
iv) The commodity price bubble
v) The ultimate freeze of credit markets and flight to safety.

The global financial crisis did not only have impacts on financial sector but also in the real economy in the following stages. The increased debt of US households caused a gradual decline in consumer spending, which further triggered slowdown in US economy and delayed the recovery in the housing market.

3.1.3 The Structural Financial Causes of the Global Financial crisis

After the great depression in 1929, The USA started to implement strict financial regulatory framework until 1960s. The main argument behind this policy shift was based on the belief that unregulated financial markets were the main culprit behind the Great Depression. However, economic and financial conditions in the 1970s and early 1980s led to another policy shift in which financial markets are globally integrated with light regulations.

Although global financial crisis first started with the troubles in subprime mortgage, its root causes can be found in this new financial system. Crotty (2008) identified eight main reasons for the contribution of the new financial system to the global financial crisis.

First, the new financial system is based on light regulation of commercial banks even lighter regulation of investment banks and little regulation of shadow banking system and hedge funds and special investment vehicles created by banks.

Second, in the new financial system there have been lots of incentives and bonuses to traders and top managers of banks that created excessive risks. For example, the growth of mortgage securitization generated fee incomes for banks and mortgage brokers who sold the loans, for investment bankers who packaged the loans into securities, for banks who serviced the securities and for rating agencies who gave these institutions high credit ratings. Evidently, since these fee incomes have not been returned if the securities suffered from losses, everyone in the system had strong incentives to maximize flow of loans. This led to an increase in profits and bonuses during boom period by increasing leverage. In 2006, Goldman Sachs' bonus payments increased to total 16 billion USD, indicating an average bonus payment of 650,000USD across Goldman's 25,000 employees (Crotty, 2009). Similarly, Wall Street's top traders received bonuses up to 50 million USD in that year. These examples reveal that, it is a rational and profit maximizing behavior for financial institutions, to take excessive risk. The same argument is valid for rating agencies as well. These agencies generate revenues through investment banks whose products they rate. For example, in 2005, more than 40 percent of Moody's revenues are generated through mortgage backed securities and Collateralized Debt Obligations, for which they gave high credit ratings. If Moody's gave a below investment rating for these financial instruments their revenues would plummet.

Third, financial innovation produced complex financial instruments that they could not be properly priced and hence they lost liquidity when the boom period came to an end. The rising issuances of Mortgage Backed Securities (MBS) and Collateral Debt

Obligations (CDOs) constitute the best examples of these new financial instruments. According to the Securities Industry and Financial Markets Association (SIFMA), the total value of MBS increased to 7.4 billion USD as of first quarter of 2008, more than double compared to the stock in 2001. Moreover, the CDOs issuances rose from 157 million USD in 2004 to 500 million USD in 2006 and 2007. The explosion of these securities created huge profits for financial institutions at the expense of destroying transparency. Roubini (2008) argued that due to their complex features, these instruments were illiquid and marked to model rather than marked to market and hence are usually rated improperly by rating agencies. When the crisis hit, investors could sell CDOs in their portfolios with a significant loss of revenues. It is estimated that as of February 2009, there have been defaults in almost half of the CDOs these defaults led to a 32 percent drop in the value of AAA rated CDOs (Financial Times, 2009).

Fourth the conventional view was that banks were not as risky as thought, because they removed their risky loans from their balance sheet through securitization in the new banking model. However, banks retained these risky securities in their balance sheets for five reasons. First, banks kept these securities in their balance sheets to convince potential investors. Second, banks hold CDOs in their portfolios since they could be held off-balance sheet with no additional capital requirement. Third, the rate of return of these securities through banks was high. Fourth, when banks had difficulties in selling some of the slices of mortgage backed securities because of their low return, they hold them for themselves so that they could sustain the high rate of CDO sales that kept bonuses rising. Last, banks kept some of the risky securities they created in their portfolios on purpose because of the incentives to generate high profits and bonuses through getting higher risk.

Fifth, regulators allowed banks to hold assets off-balance sheet with no additional capital requirement. Just to cite an example, JP Morgan Chase &Co and Citigroup each had nearly 1 trillion $ in assets held off the balance sheets as of end of 2007. For Citigroup this represented almost half of the bank's total assets.

Sixth, the regulatory system provided incentives to big banks to measure their own risk and set their own capital requirements based on their own risk measurement. This

encouraged banks to take excessive risks. These banks usually used a model called Value at Risk for measuring their risk levels. VAR is an estimate of the possible loss in the value of a portfolio over a fixed time interval with a specific confidence level. Crotty (2008) identified four fundamental flows in this type of risk assessment. First, the time interval that is used to assess current risks may not be adequate. For instance, when firms use data from the past year, during boom periods VAR analysis will produce results supporting that risk is low due to low and losses. On the other hand, if data from past decades instead of past years are used, the VAR analysis will produce results supporting higher risk due to past crises or defaults in that decade.. Second, in VAR models it is assumed that security prices are normally distributed. Although this assumption is usually a valid assumption, in every decade there may be observations that may violate the assumption of a normal distribution. Third, asset-price correlation matrix is a key ingredient of VAR analysis. The lower the correlation among security prices, the lower the portfolio's risk. VAR models implicitly assume that future asset price correlations will be approximately the same with the past price correlations, which may not be a valid assumption. Last, VAR analysis does not take into account assets held off balance sheet and as we discussed before, there have been significant amount of assets held off-balance sheets by most of financial institutions

Seventh, securitization and funding from integrated global capital markets simultaneously created channels of contagion in which a crisis in one financial market in one location (US subprime mortgage markets) quickly spread to other markets in other locations and throughout the world.

Eighth, the new financial system created dangerous leverage throughout the financial system. For instance, although the US Securities and Exchange Commission (SEC) limited the leverage of investment banks to 12 times capital between from 1975 to 2003, it raised the limit to 40 times capital in 2004 (Wall Street Watch, 2009). This led large investment banks to increase asset-to equity ratios to upper 30s before the crisis started (Crotty, 2008). Moreover, expansionary monetary policies of the FED also contributed to the rising leverage

3.2. Policy Responses to the Global Financial Crisis

The crisis has prompted large government interventions to restore confidence in financial system and to limit the impact of the crisis on the real economy. The main mechanisms of the intervention were i) liquidity provision ii) support for short term whole sale funding markets iii) guarantees of retail deposits iv) asset purchases and v) capital injections into troubled banks.

The government intervention had been materialized through monetary and fiscal policies. From the perspectives of this thesis, in this section we will concentrate on the monetary policies since they had the greatest impact on financial markets, including market liquidity, which is the central concept of this thesis. Specifically, we will analyze the policies of the FED and European Central Bank (ECB).

3.2.1 The FED Policies

The FED took a number of measures to avert negative consequences of the global financial crisis that started in August 2007. In addition to losing the monetary policy stance using its conventional tools such as policy interest rates, Fed also eased the conditions in providing liquidity to depository institutions and also introduced new programs to provide liquidity to corporations in addition to depository institutions. Moreover, after the initial effects of the global financial crisis have been eliminated, Fed started to use unconventional monetary easing programs known as quantitative easing programs to boost economic activity and employment and to combat inflation with the ultimate aim of helping the economy recover quickly.

3.2.1.1 August 2007- December 2008 Period

Federal Reserve Liquidity Provision Policies

As we discussed in the previous chapter, the global financial crisis started on August 9, 2007, with the announcement of the Paribas' on its difficulties in determining net values of some of its hedge funds because of the illiquidity in these markets and suspended payments from those funds. This announcement led other financial institutions to reevaluate their credit risk, and increased concerns in the subprime mortgage markets.

On August 10, 2007, the Fed announced liquidity provision to financial markets through open market operations and the discount window. One week later, the Fed changed its credit discount window facility to reduce depository institutions' uncertainty regarding the cost of funding. Particularly, it reduced the primary credit rate and extended the allowable term of lending to 30 days (Fleming, 2012).

On December 12, 2007, Fed announced Term Auction Facility (TAF) program to decrease funding pressures in short term money markets. Through this facility, FED extended loans to depository institutions typically for 28 or 84 days (Armantier, Krieger and McAndrews (2008). On December 12, 2007, Fed also established swap lines with the European central Bank and Swiss National Bank.

At the beginning of 2008, lenders of funds concerned about losing money because of concerns regarding the value of the collateral behind their loans and credit risk of their counterparties. With increasing concerns, they increased haircuts, by asking higher compensation for giving loans whose collateral are riskier and by stopping giving loans against certain collaterals (Gorton and Metrick, 2012).

To decrease liquidity pressures in the term funding markets, the Fed announced initiation of a series of open market operations. These operations led primary dealers to borrow funds through repos for 28 days (Fleming, 2012). On March 11, 2008, the Fed

further announced the introduction of the Term Securities Lending Facility (TSLF) through which Fed auctioned Treasury securities to primary dealers for 28 days.

On March 16, 2008, the Fed introduced the Primary Dealer Credit Facility (PDCF). Through this facility, Fed extended overnight loans to primary dealers at the discount window's primary credit rate (Fleming, 2012).

The collapse of Lehman Brothers on September 15, 2008 led to intensification of money market disruptions. Just after one day, the Reserve Primary Fund's net asset value fell below 1 dollar per share, due to its high exposure to Lehman Brothers. This led to a flight from money market mutual funds to Treasury securities (Fleming, 2012). The Fed launched several new facilities to address the new disruptions in the money markets. On September 18, 2008, the Fed announced the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF). Through this program, the Fed extended loan at the primary credit rate to depository institutions and bank holding companies in order to finance their purchases of Asset-Backed Commercial Paper (ABCP) from money market mutual funds (Fleming, 2012).

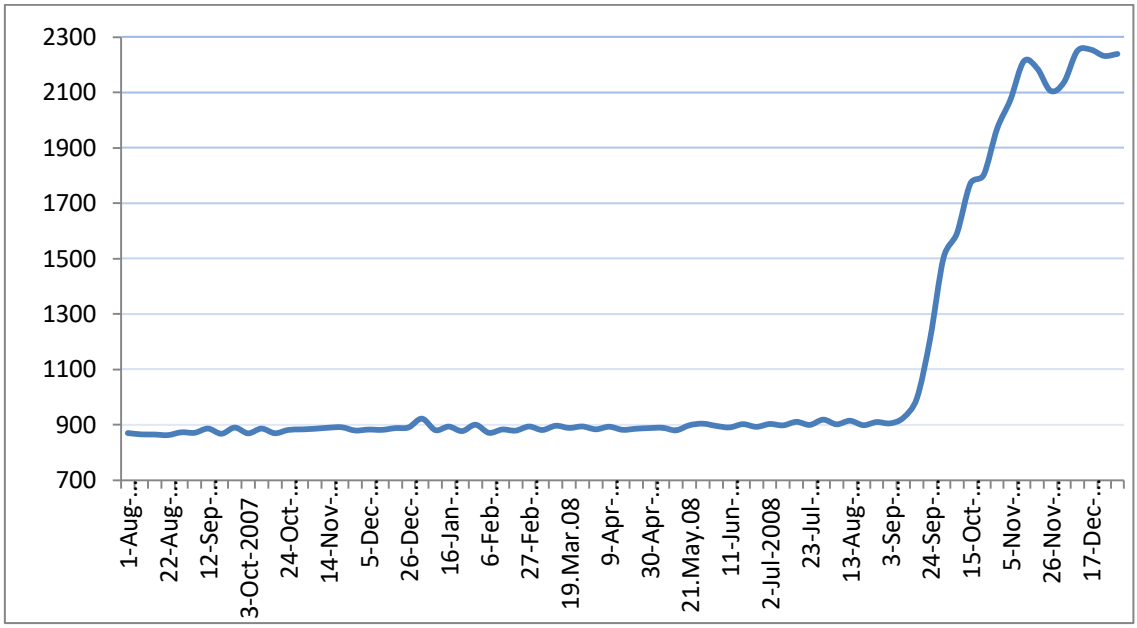
On October 7, 2008 Fed announced the Commercial Paper Funding Facility (CPFF) to decrease tensions in commercial paper market. This facility provided credit to a Special-Purpose Vehicle (SPV) which bought newly issued three month commercial paper from eligible issuers.

On October 21, 2008, the Fed introduced the new Money Market Investor Funding Facility (MMIFF), through which it extended loans to private sector SPVs to finance their purchase of certain money market instruments (Fleming, 2012).

Lastly, on November 25, 2008, The Fed introduced Term Asset Backed Securities Loan Facility (TALF). Though this facility, the Fed provided loans to owners of certain asset-backed securities. This facility has been useful in supporting the issuance of asset-backed securities and hence increased availability of credits and helped economy recover (Fleming, 2012).

As a natural result of these policies, the FED's balance sheet remained almost flat around $ 870-890 million during August-June 2008. It first exceeded 900 million on 18th of June in 2008 and reached $ 995 million as of September 17, 2008. After the Lehman's Collapse, the FED's balance sheet exhibited a significant hike from $ 995 million to $ 1.2 billion on September 24 and $ 1.5 billion on 1st of October. It ended the year with $ 2.2 billion.

Figure 3: FED's Total Assets (Million USD, August 2007- December 2008)



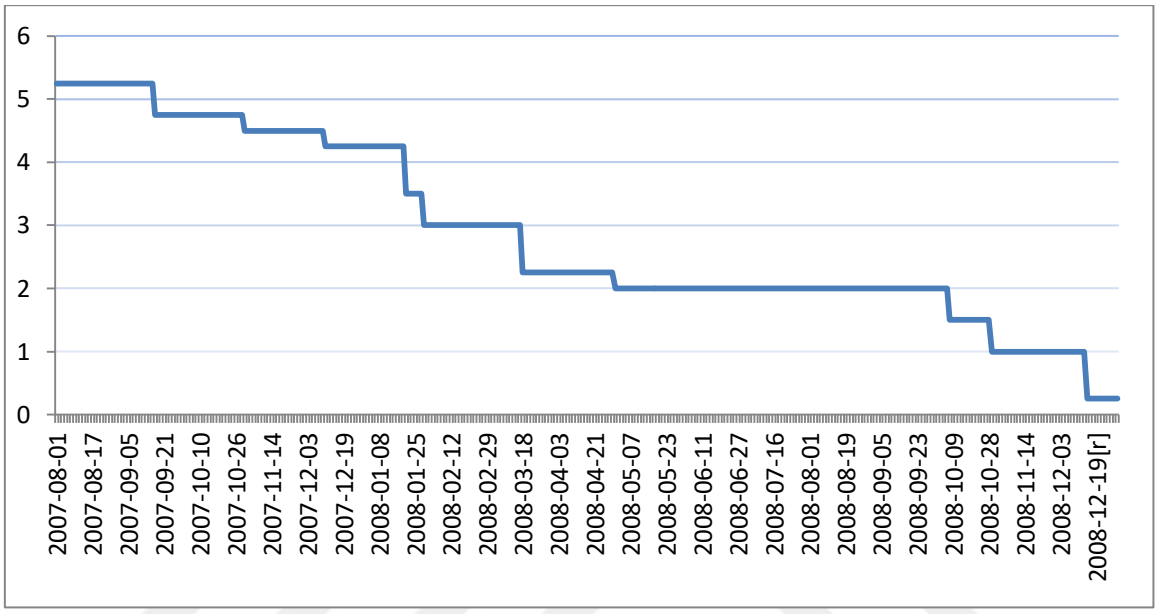
Source: FED (www.federalreserve.gov)

Federal Reserve Policy Rate Policies:

After on the beginning of the crisis August 9, 2007, the Federal Reserve reduced its discount rate 6.25 percent to 5.75 percent. However, this policy did not have any meaningful impact on financial markets because it was only a small subsidy for banks that were already willing to borrow at 6.25 percent. The FED cut the policy rate by 50 basis points on September 18, and cut another 25 basis points on October 31, 2007 and reduced the discount rates by the same amount of policy rate. The Fed also extended maturity of loans at the discount window from overnight to one month and injected liquidity into the markets at maturities from overnight to 3 months. The Fed continued to reduce policy rate in 2008. As a result, the rate which was at 4.75 percent at the end

of 2007, decreased gradually to 0.25 percent, which are historically low level and the lowest FED funds rate possible at the end of December 2008.

Figure 4: FED Policy Rate (August 2007-December 2008)



Source: FED

3.2.1.2 December 2008- December 2013 Period

On November 25, 2008, the FED announced that it would initiate a program to purchase up to 500 billion Dollars agency MBS and 100 billion Dollars of agency debt. In March 2009, these amounts have been increased to 1.25 trillion and 200 billion dollars respectively and purchases of Treasury Securities were also announced. Later in 2009, the FED committed to purchase the full 1.25 trillion dollars of agency MBS and explained that the purchase program, which is called quantitative easing (QE) would be completed in March of 2010.

Although market liquidity is normalized at the end of 2010, the slow economic recovery promoted the FED to announce an additional Large-Scale Asset Purchase (LSAP) program known as QE2, which included only Treasury Securities purchases.

In September 2011, FED announced further balance sheet actions to help stimulate economic activity. First, it decided to extend the average maturity of its Treasury Securities holdings, a different kind of QE program known as the maturity extension program or operation twist. Second, in October 2011, the FED decided to reinvest principal payments from its holdings of agency MBS and agency debt into agency MBS to further support conditions in mortgage markets and to further strong economic recovery.

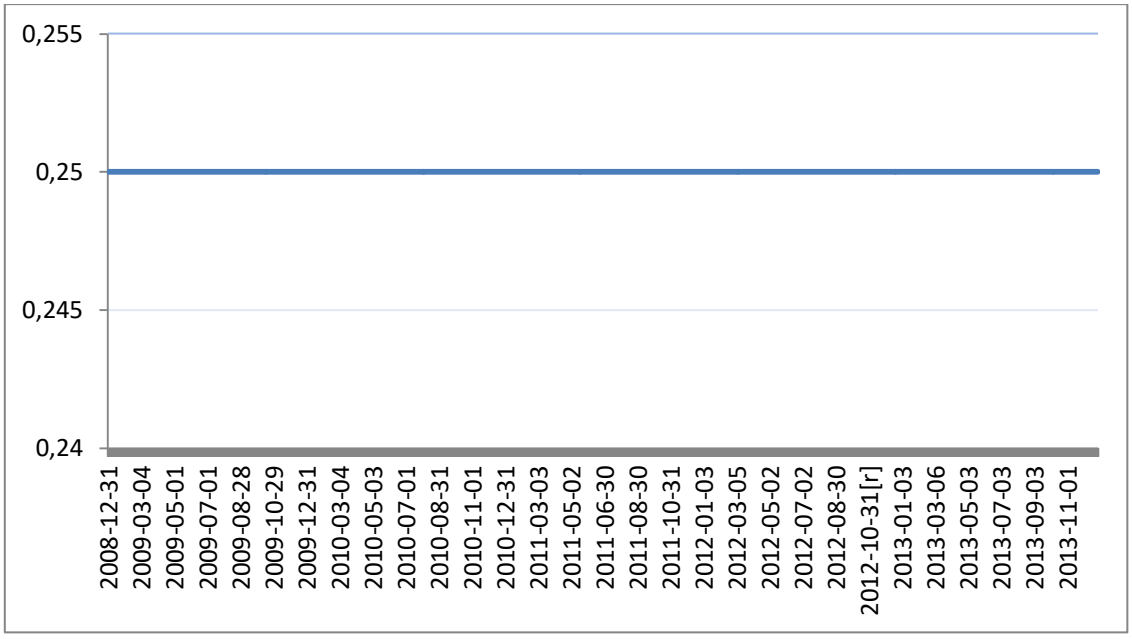
In September 2012, the FED agreed to purchase an additional 40 billion dollars of agency MBS per month and to continue these purchases until the outlook for labor market substantially improve. Three months later, the FED announced additional outright purchases of Treasury securities of 45 billion dollars per month to continue after the completion of maturity extension program. Both MBS and Treasury Security purchases, known as QE 3, continued until December 2013, when the FED first agreed to decrease monthly purchases to get back to normalization of the monetary policy.

Table 5: Summary of the FED's Asset Purchase Programs

Program	Assets Purchased	Announcement Date of the Program	Purchased Amouns (Billions of US Dollars)	Purchased Date Range
QE1	* Agency Debt * MBS * Treasury securities	* 11/25/2008 * 11/25/2008 * 03/18/2009	172 1,250 300	12/05/2008-03/24/2010 01/05/2009-03/31/2010 03/25/2009-10/29/2009
Treasury Reinvestment	* Treasury securities	* 8/10/2010	283	08/17/2010-09-30/2011
QE2	* Treasury securities	* 11/03/2010	600	11/12/2010-06/30/2011
Maturity Extension Program	* Treasury securities	* 09/21/2011	667	10/03/2011-12/28/2012
MBS Reinvestmnet Program	* MBS	* 9/21/2011	1,2	10/3/2011-ongoing
QE3	* MBS * Treasury Securities	* 09/03/2012 * 12/12/2012	823 790	09/14/2012-10/31/2014 01/06/2013-10/27/2014

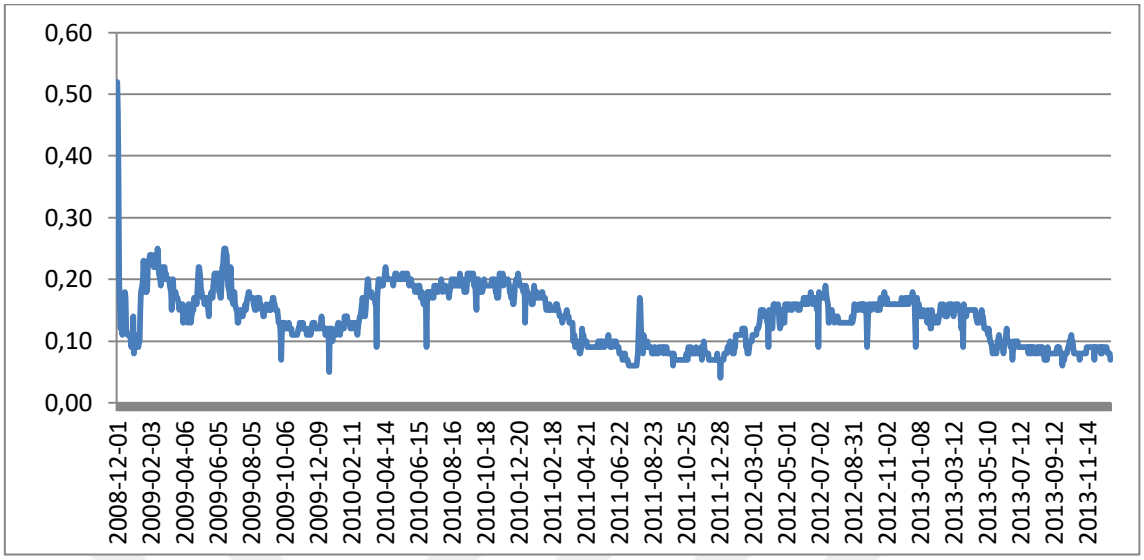
Source: Kandrac (2015)

Figure 5: FED Policy Rate (December 2008-December 2013)



Source: FED

Figure 6: Effective Fed Funds Rate (December 2008-December 2013)[3]



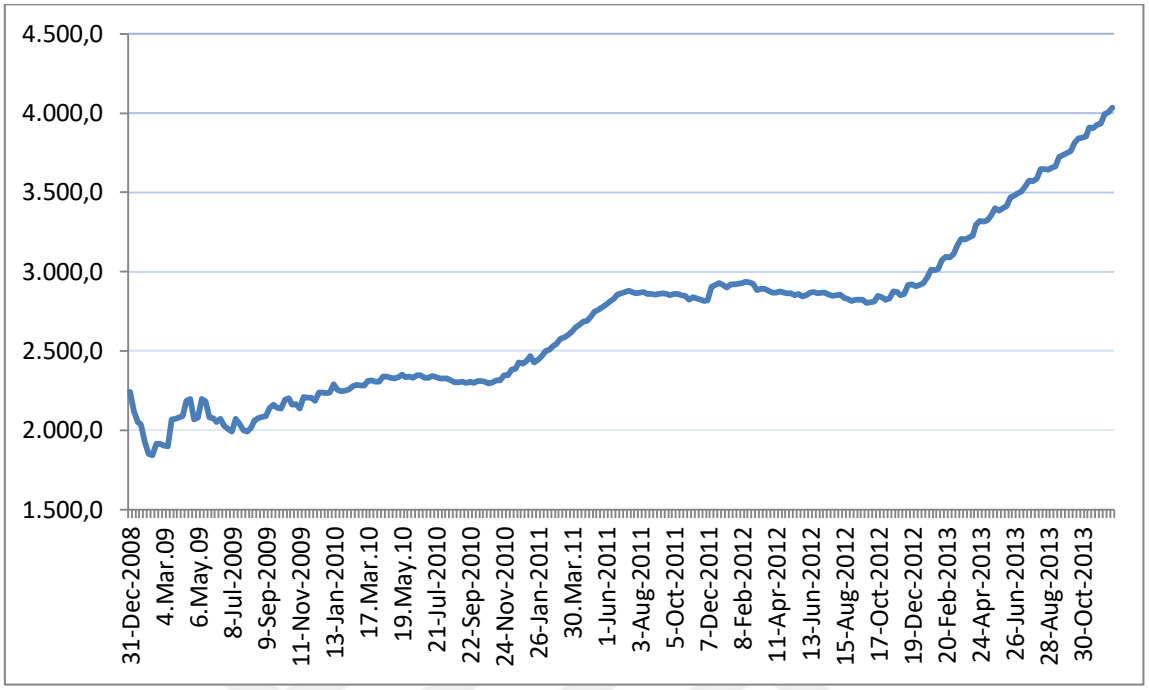
Source: FED

In conclusion, The FED's response to global financial crisis can be categorized in three main stages (Bernanke, 2009). The first stage involves the provision of short term liquidity to sound financial institutions. The second stage involves provision of liquidity directly to borrowers and investors in key credit markets. The final stage involves the purchase of long-term securities for the Fed's portfolio.

As a result of these policies FED's balance sheet exhibited a significant increase from $ 2.2 billion at the end of 2008 to $ 4.0 billion at the end of 2013.

[3] Altough we used FED Funds rate as an indicator of monetary policy stance of the FED until now, during December 2008-December 2013 period, in line with the literature, we used Effective Fed Funds Rate becuase we believed that it is much more informative in predicting monetary policy stance of the FED.

Figure 7: FED's Total Assets (Million USD, August 2008- December 2013)



Source: FED

Table 6: Quantitative Easing: Changes in Asset Holdings on the FED's Balance Sheet (Billion of Dollar)

	Treasury Security Holdings	Agency MBS Holdings	Agency Debt Holdings	Total Assets
QE1	+302	+1129	+168	+451
QE2	+788	-142	-35	+578
QE3	+810	+874	-48	+1663
Total	+1987	+1718	+40	+2587

Source: Congressional Research Service

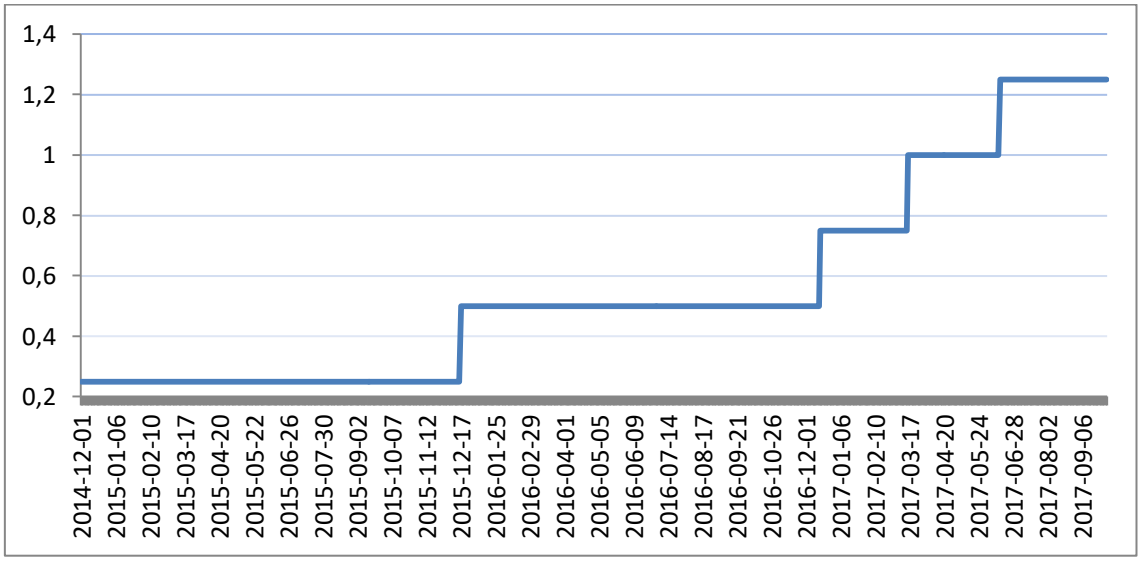
3.2.1.3 Recent Developments in the FED Policies

On October 29, 2014, the FED announced that it would stop making large scale asset purchases and would start normalization of the monetary policy. This means that, QE programs are completed and the attention will be turned to the FED's "exit strategy" from QE programs and zero interest rates in order to avoid any inflationary pressures in the economy.

There are two ways for the FED to return to normal policy: to increase FED Policy rate and to remove excess reserves of banks by reducing balance sheet through asset sales. The FED's intention is to gradually reduce the balance sheet by ceasing to roll over securities as they mature and to gradually increase FED policy rate by monitoring mainly inflationary and employment outlook in the economy (Labonte, 2017).

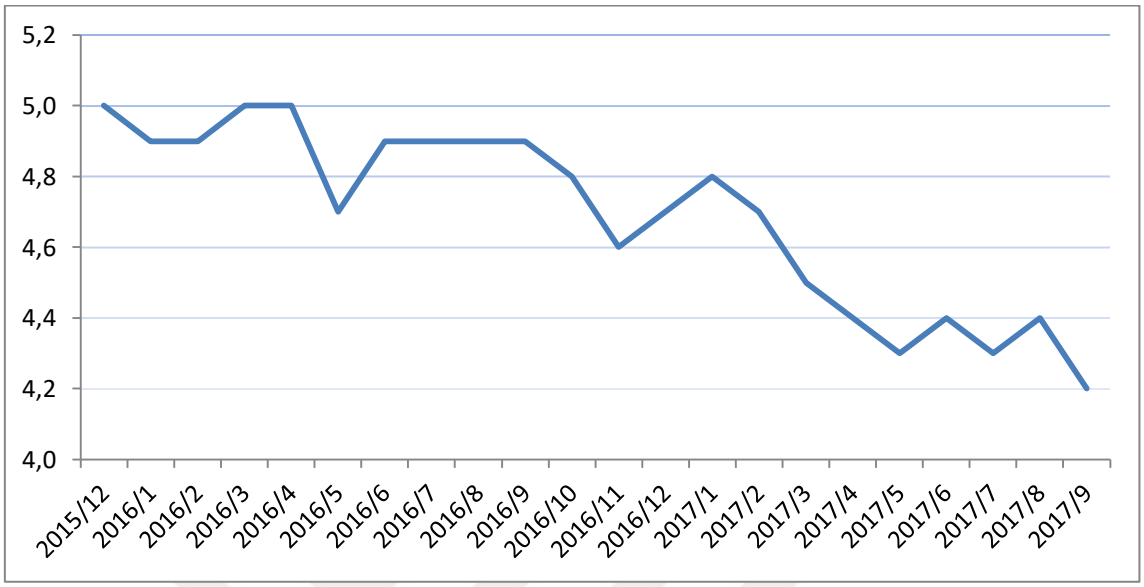
Based on this strategy, the FED gradually increased policy rate from 0.25 percent to 0.50 percent on December 17, 2015, to 0.75 percent on December 15, 2016, to 1 percent on March, 16, 2017 and lastly to 1.25 percent on June 15, 2017 based on the improvements in labor market and decline in unemployment rate.

Figure 8: FED Policy Rate (December 2014-September 2017)



Source: FED

Figure 9: US Unemployment Rate (%, January 2015, September 2017)



Source: US Bureau of Labor Statistics

In June 2017, the FED announced that it would slowly decrease its balance sheet towards the end of the year by allowing some securities to run off when they mature. According to announcement[4], the FED would only allow $6 billion Treasuries and $4 billion MBS to run off each month, and gradually increasing to $30 billion of Treasuries and $20 billion of MBS per month.

Although the normalization period has started there is no official announcement from the Fed when it will end at the time of ending, what will be the new level of the balance sheet and the policy rates. Hence, all the announcement and speeches of the FED members are closely monitored by market participants to anticipate the future of monetary policy stance of the FED.

[4] FED, "FOMC ıssues Addendum to the Policy Normalization Principles and Plans", Press Release, June 2014, 2017 at https://www.federalreserve.gov/newsevents/pressreleases//monetary20170617c.htm

3.2.2 The European Central Bank Policies

Until 2008, the ECB provided liquidity to the system on a weekly basis through open market operation at an interest rate, the Main Refinancing Operations MRO, set by the ECB. (ECB, 2002) However, since the beginning of the financial crisis ECB started to implement unconventional monetary policies that we will analyze in this section by dividing the whole period into four phases.

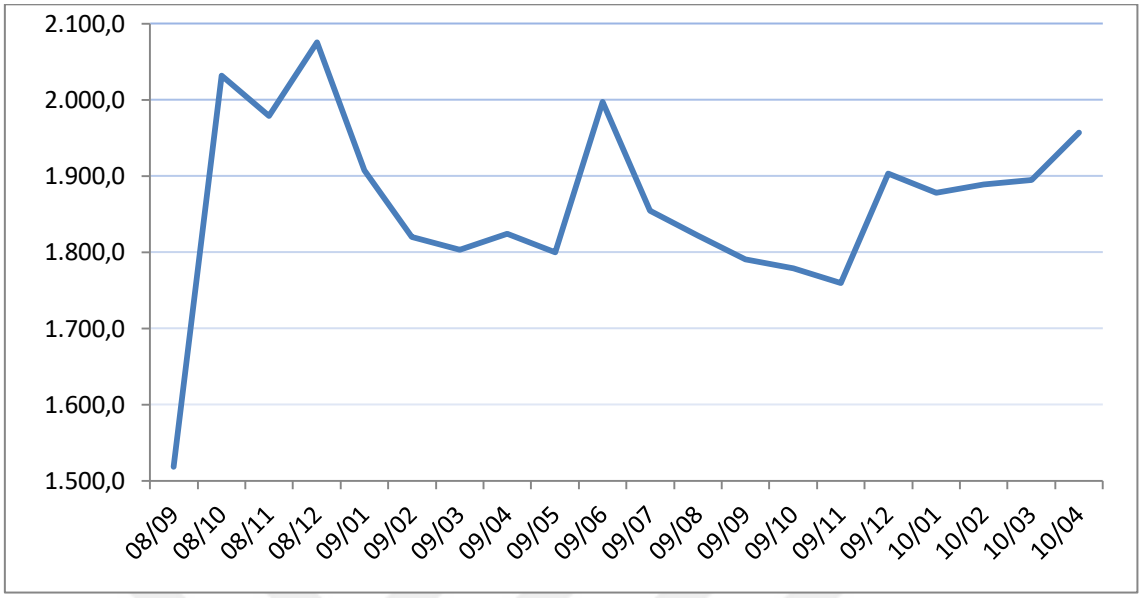
3.2.2.1 September 2008-April 2010 Period

During this period, ECB mainly gave credit support (ECB, 2010). In the first part of this period, namely until December 2009, there was instability in the demand for demand for central bank money due to a banking crisis. Hence, money market rates increased due to insufficient ECB money. In September 2008, the ECB switched to fixed rate system, in which it assured that if banks face unexpected shortages of liquidity, they could get refinancing through the ECB.

ECB cut Main Refinancing Operations (MRO) interest rate from 4.25 percent to 1.0 percent and reduced corridor from 200 basis points to 100 basis points until January 2009. Moreover, ECB implemented and Long Term Refinancing Operations (LTROs) in November 2008 that are worth of 300 billion Euros and 12 months LTROS in June 2009 that has worth of 442 billion Euros. Finally, the ECB implemented the Covered Bond Purchase Program 1 (CBPP 1) to support the decline in the money market rates, to ease funding conditions and to enhance market liquidity in private debt securities markets (Fessud, 2014).

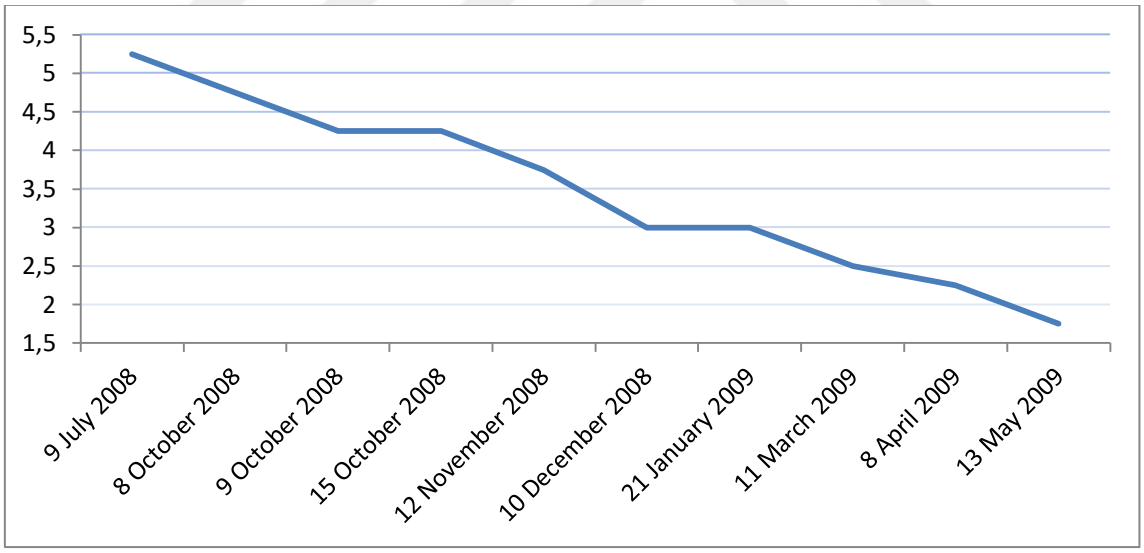
As a result of liquidity injections during this period, there has been a massive increase in the size of the balance sheet of the ECB. Although, in normal years yearly growth rate of the balance sheet of the ECB was roughly 4 percent, it increased by 30 percent in less than a year (Fessud, 2014).

Figure 10: ECB Balance Sheet (Million Euro, September 2008-April 2010)



Source: ECB

Figure 11: ECB Marginal Lending Facility (%, September 2008-April 2010)



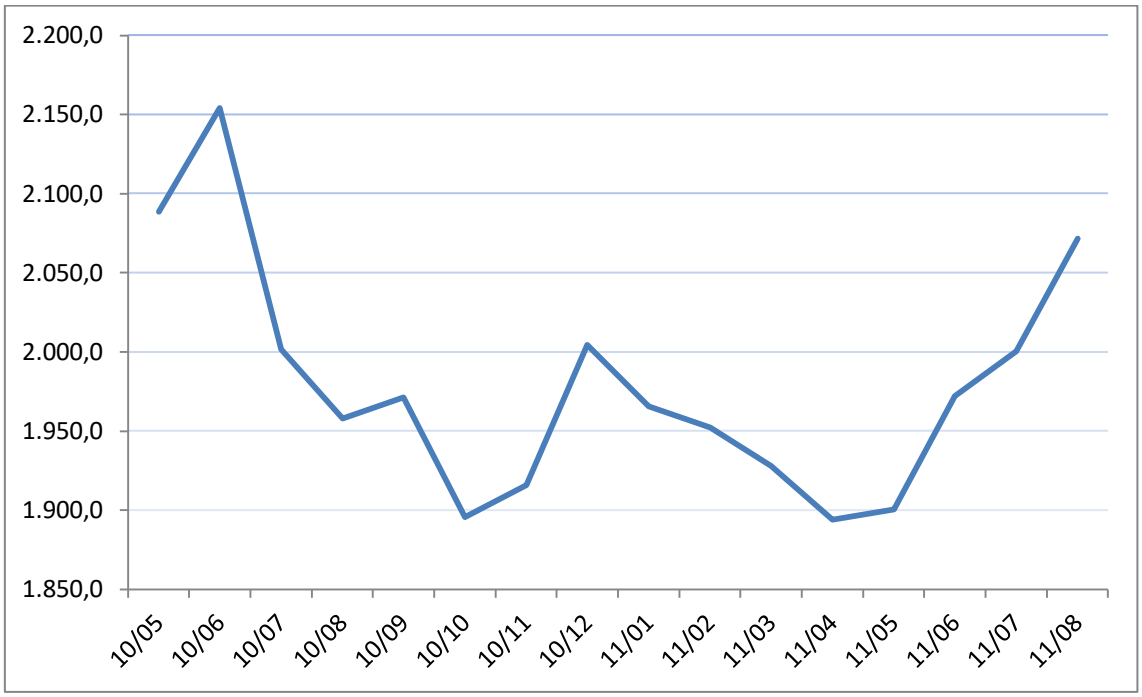
Source: ECB

3.2.2.2 May 2010-August 2011 Period

This period corresponds to the sovereign debt crisis in Euro area. During this period, ECB has been criticized by not taking the necessary measures. The main point in this

period was that, the ECB did not act as a lender of last resort for sovereigns although Greece, Ireland and Portugal were bailed out in less than a year. The only measure of the ECB in this period was the introduction of Securities Markets Programme (SMP) of which whose value reached 100 billion euros at the end of this period.

Figure 12: ECB Balance Sheet (Million Euro, May 2010-August 2011)



Soruce: ECB

In April 2011-August 2011 period conditions seemed relatively stable again and the ECB decided to raise marginal lending facility from 1.75 percent to 2.0 percent in April 2011 and to 2.25 percent in July 2011 due to concerns of price stability. Moreover, the SMP was renewed (Fessud, 2014).

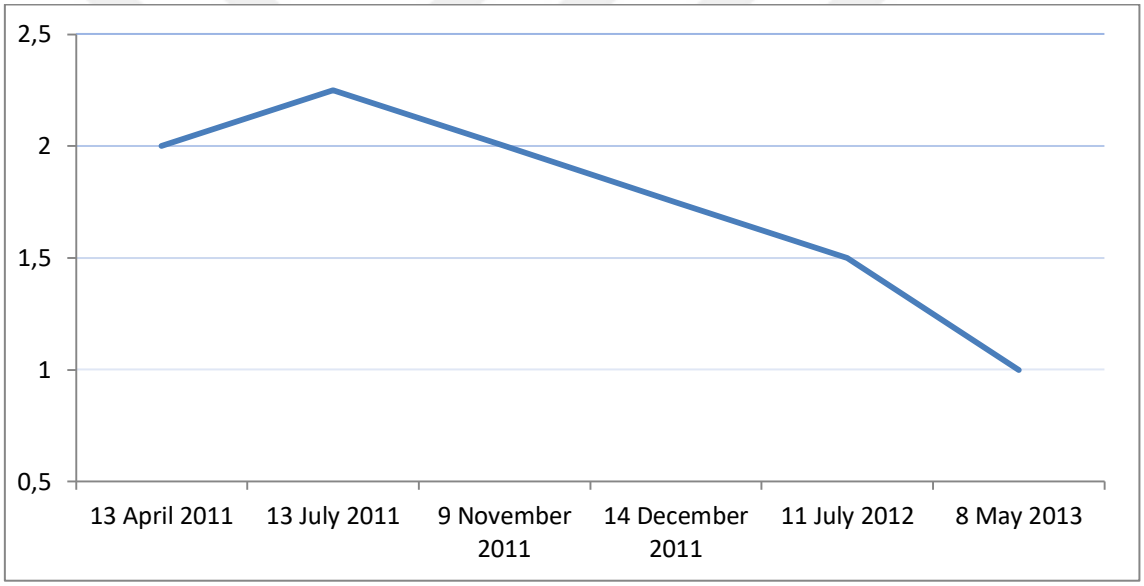
3.2.2.3 August 2011-May 2013 Period

From the beginning of this period until January 2013, there was a re-identification of both financial and sovereign debt crisis, which forced ECB to become lender of last resort. The ECB announced that nonstandard measures would be there as long as

deemed necessary. This announcement cause anxiety in the markets and increased uncertainty among banks and led to an increase in the demand of central bank money for precautionary reasons and led to a rapid deleveraging that generated credit crunch. Finally, the ECB decided to extend the maturities of LTROs.

When bond market returns to negative levels in Italy and Spain in July 2011, ECB decided to cut marginal lending facility to 2.0 percent. Moreover, ECB reintroduced SMP in July 2011, and implemented Covered Bond Purchased Programme 2, which reached 16 billion euros.

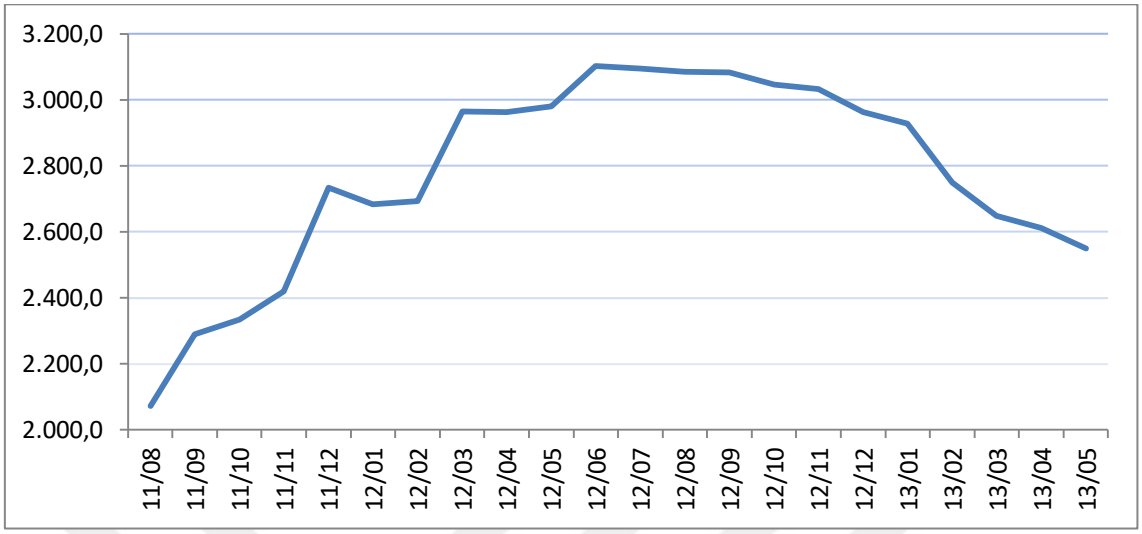
Figure 13: ECB Marginal Lending Facility (%, August 2011 – May 2013)



Source: ECB

The main factor behind the increase in the size of the ECB balance sheet can be explained by two Very Long-Term Refinancing Operations (VLTROS) the first one in December 2011 with an amount of 489 billion Euros and the second in February 2012 with an amount of 529 billion Euros. In addition to them, ECB reduced reserve requirement ratio from 2 percent to 1 percent in the middle of 2012. The sum of all those measures caused the balance sheet to reach its peak level with 3 trillion (FESSUD, 2014).

Figure 14: ECB Balance Sheet (Million Euro, August 2011-May 2013)



Source: ECB

During first five months of 2013, tensions in money markets and bond markets slowed down and banks restarted loans repayments, which decreased the ECB balance sheet and excess liquidity.

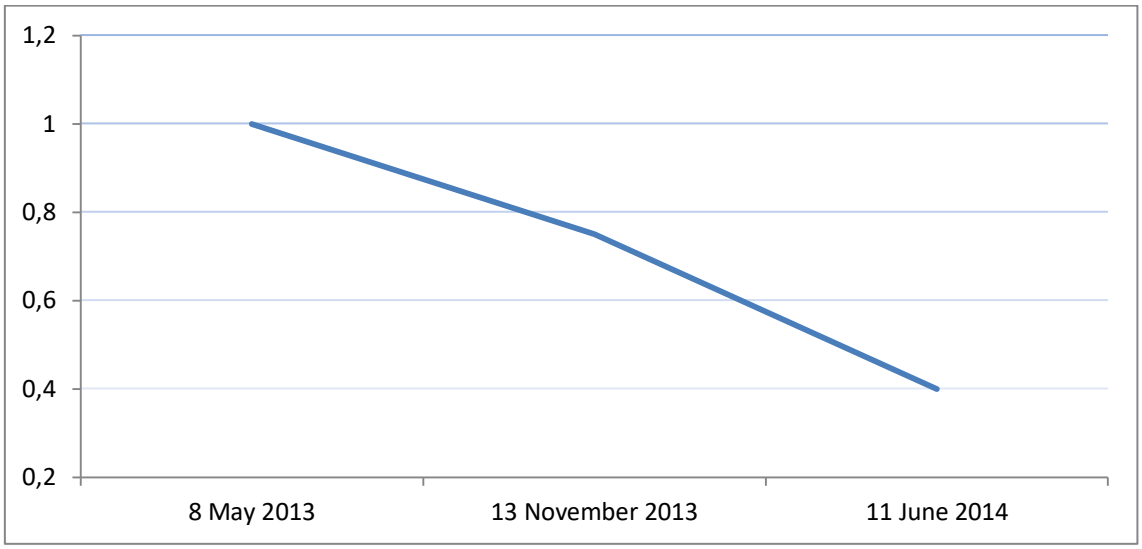
3.2.2.4 June 2013-June 2014 Period

In this period, the size of the balance sheet of the ECB sharply decreased due to the early repayment of the 1 trillion VLTROs. There are different arguments regarding this early repayment. One argument is that banks are not so dependent on the liquidity provision of the ECB to obtain funds. The other argument is that banks do not use excess reserves to extend loans or they prefer deleverage.

In this period, money market interest rates exhibited significant volatility which can be observed from Euro Overnight Index Average (EONIA) rates. The response of the ECB to this was to cut the MRO rate by 25 basis points to 0.25 percent, to cut marginal lending facility to 0.75 percent and deposit rate to 0.0 percent and to reduce the corridor band from 150 basis points to 75 basis points.in November 2013.

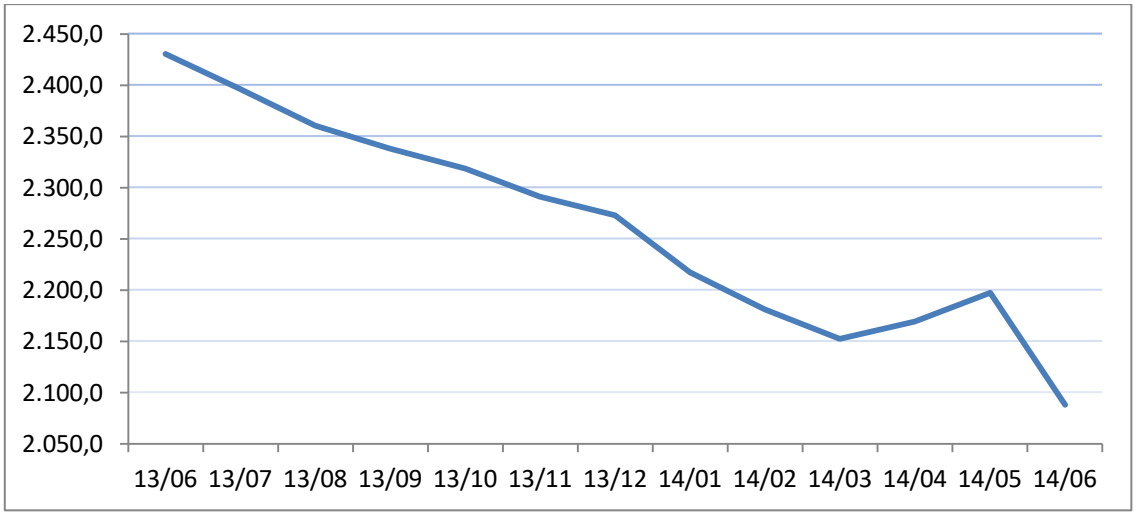
In June 2014, ECB announced additional measures for deflationary risks that can be seen in Eurozone since late 2013 (Claeys et all, 2014). Accordingly, ECB cut interest rate by 10 basis points to 0.15 percent, the marginal lending facility rate to 0.40 percent and the deposit rate to -0.10 percent and reduced the corridor band from 75 basis points to 50 basis points. Moreover, it also suspended the SMP sterilization.

Figure 15: ECB Marginal Lending Facility (%, June 2013 – June 2014)



Source: ECB

Figure 16: ECB Balance Sheet (Million Euro, June 2013-June 2014)

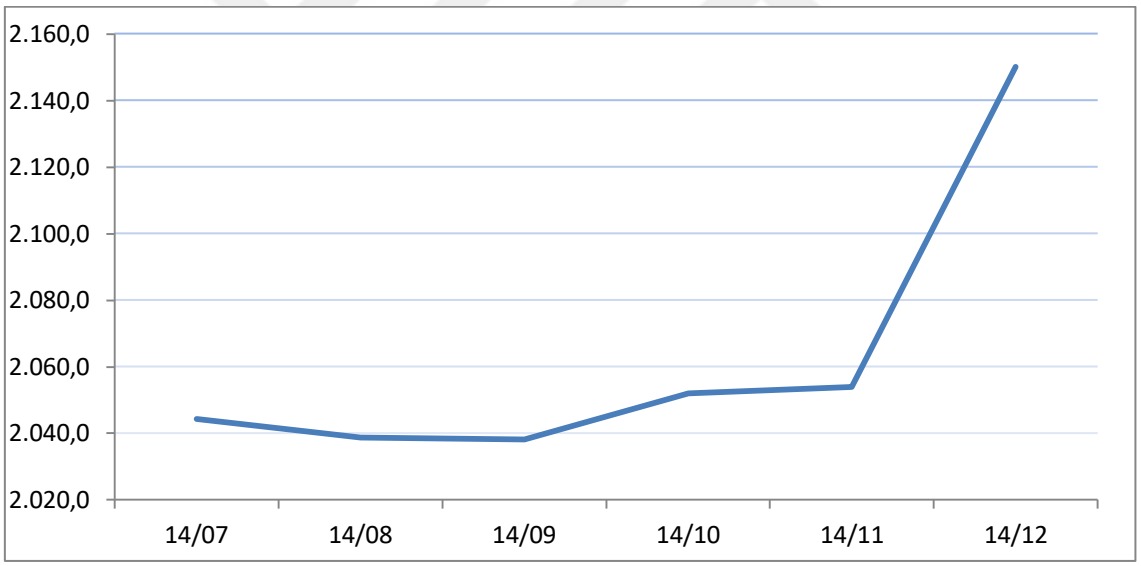


Source: ECB

3.2.2.5 Recent Developments in ECB Policies

The ECB has implemented other major additional monetary policy measures since June 2014 to combat deflationary and weak growth momentum. This new policy package included three main elements (ECB, 2014): reducing the key interest rates, introducing longer term refinancing operations (TLTROs) and launching two purchase programs, an Asset Backed Securities Purchase Program (ABSPP) and a new Covered Bond Purchase Program (CBPP 3), for selected private sector assets. During 2014, ECB purchased 1.7 billion Euros under ABSPP and 29.6 billion Euros under CBPP3 (ECB, 2014) after November 2014 and these programs led to a significant increase in ECB balance sheet.

Figure 17: ECB Balance Sheet (Million Euro, June 2014-December 2014)



Source: ECB

At the beginning of 2015, the Governing Council of the ECB conducted a comprehensive assessment of the stance economy to assess the impact of the monetary stimulus packages implemented especially since mid-2014. Their findings revealed that inflation had been weaker than expected and economic recession remained as an issue, money and credit developments continued to be insufficient and the monetary policy stance was also insufficient to bring inflation close to 2 percent over the medium term

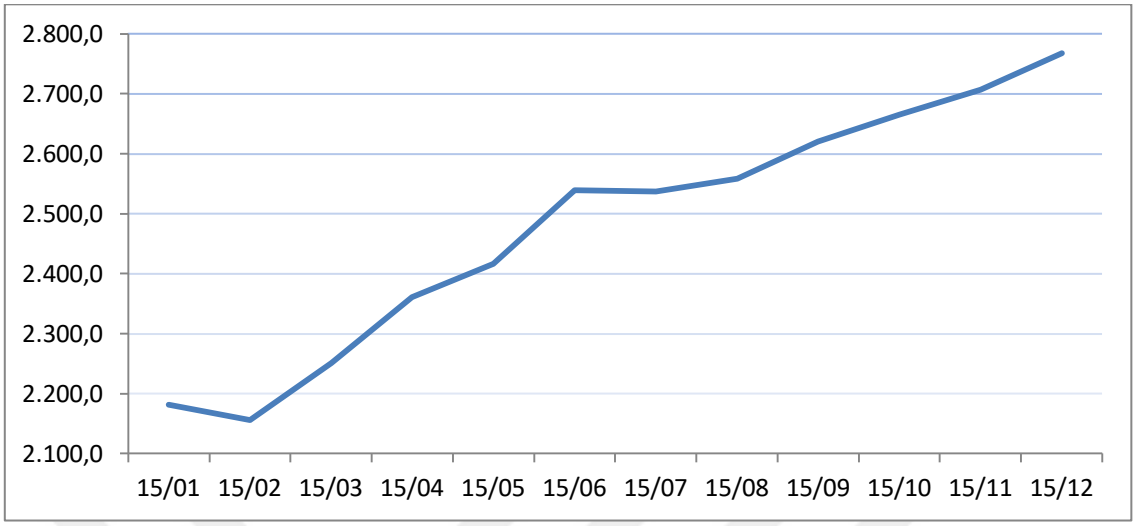
(ECB, 2015). Hence, on January 22, 2015, the ECB decided to enlarge the asset purchase program which started in October 2014 by including euro-dominated investment grade securities issued by governments and European institutions. Under this Asset Purchase Program (APP), ECP monthly purchased public and private securities amounting 60 billion Euros (ECB, 2015).

Thanks to monetary stimulus, increased confidence and with the help of low energy prices, the economic recovery gained momentum in the first half of the 2015 in euro-area. However, starting in summer and mostly in the third quarter of 2015, financing conditions and economic outlook deteriorated again with the difficulties in negotiations over the assistance package for Greece and with growing concerns regarding the outlook of the global economy. Based on these observations ECB has taken the following decisions in its December, 2015 meeting (ECB, 2015):

i) To lower interest rate on depository facility by 10 basis points to -0.30 percent
ii) To extend the intended end-date for the monthly purchases of 60 billion Euros under APP until the end of March 2017.
iii) To Reinvest the principal payments on the securities purchased under the APP as they matured
iv) To include euro-dominated marketable debt instruments issued by regional and local governments located in the euro area in the list of assets that were eligible for regular purchases by the respective national central banks.

With these new measures, the ECB aimed to further strengthen the easing impact of the measures taken since June 2014. Based on these measures, the ECB balance sheet increased from 2.2 billion Euros to 2.8 billion euros during 2015.

Figure 18: ECB Balance Sheet (Million Euro, January 2015-December 2015)



Source: ECB

At the beginning of 2016, there has been deterioration in economic and financial conditions in Euro area due to increasing uncertainty, geopolitical risks volatility in financial and commodity markets (ECB, 2016). Moreover, inflation dynamics continued to be weaker than expected, mainly due to sharp fall in oil prices and low wage growth. So, the ECB announced that it expected key interest rates to remain at present or lower levels for an extended period of time. Consequently, the ECB introduced the following package of monetary policy measures in March 2016 (ECB, 2016):

i) To lower key policy interest rates and in particular cut the rate on the deposit facility to -0.40 percent

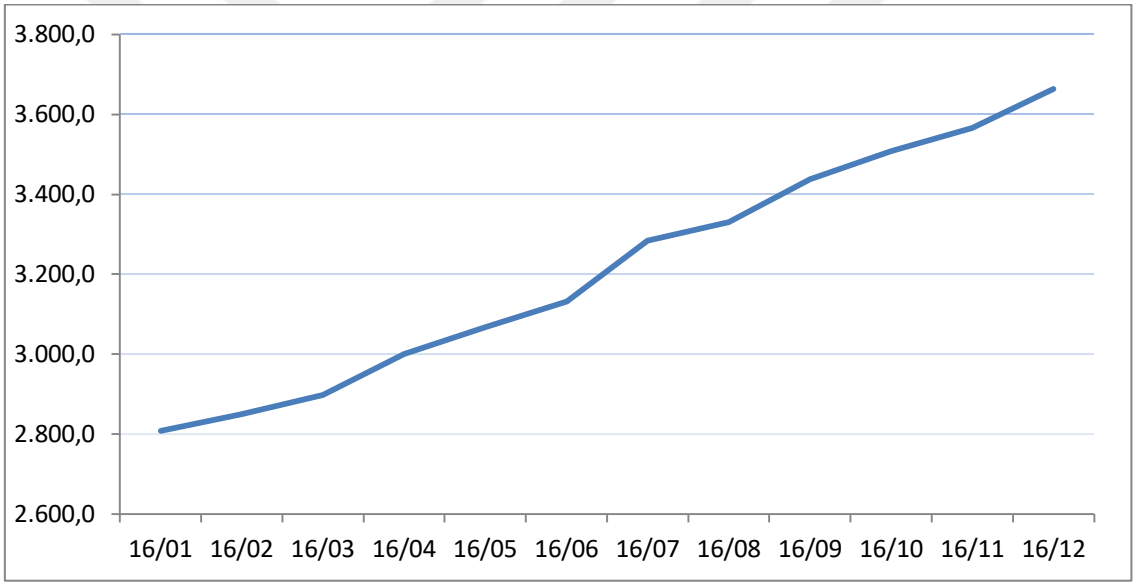
ii) To increase the monthly asset purchases from 60 billion euros to 80 billion euros starting in April 2016

iii) To include a new Corporate Sector Purchase Program (CSPP) in the APP for purchasing investment grade euro denominated bonds issued by non-bank corporations

iv) To launch a new targeted long term refinancing operations (TLTRO-II) starting in June 2016.

The policy package launched in March 2016 together with the monetary policy already in place helped supporting the resilience of the euro economy. After the UK referendum on Brexit in mid-2016, first financial market volatility increased, but then markets calmed down quickly. Hence, the ECB continued to monitor market developments and underlined its commitment to implement expansionary monetary policy until reaching 2 percent level of inflation over the medium term. In its December meeting, ECB decided to extend the horizon of asset purchase program beyond March 2017. Based on these measures, during 2016 the ECB's balance sheet increased from 2.8 billion euros to 3.6 billion euros.

Figure 19: ECB Balance Sheet (Million Euro, January 2016-December 2016)

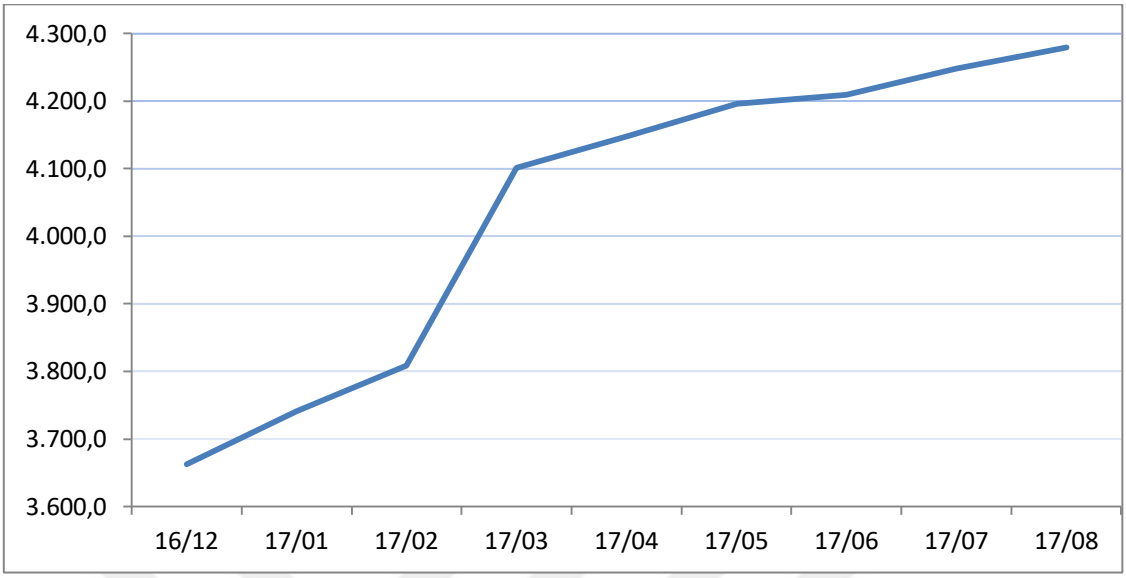


Source: ECB

During 2017 meetings, the ECB kept interest rates unchanged and reaffirmed that the interest rates will be at present or lower levels for an extended period of time (ECB, 2017). Moreover, the ECB confirmed that the Euro system will continue to make 80 billion euros monthly purchases under the APP until March 2017 then reduce monthly purchases to 60 billion euros beginning from April 2017.

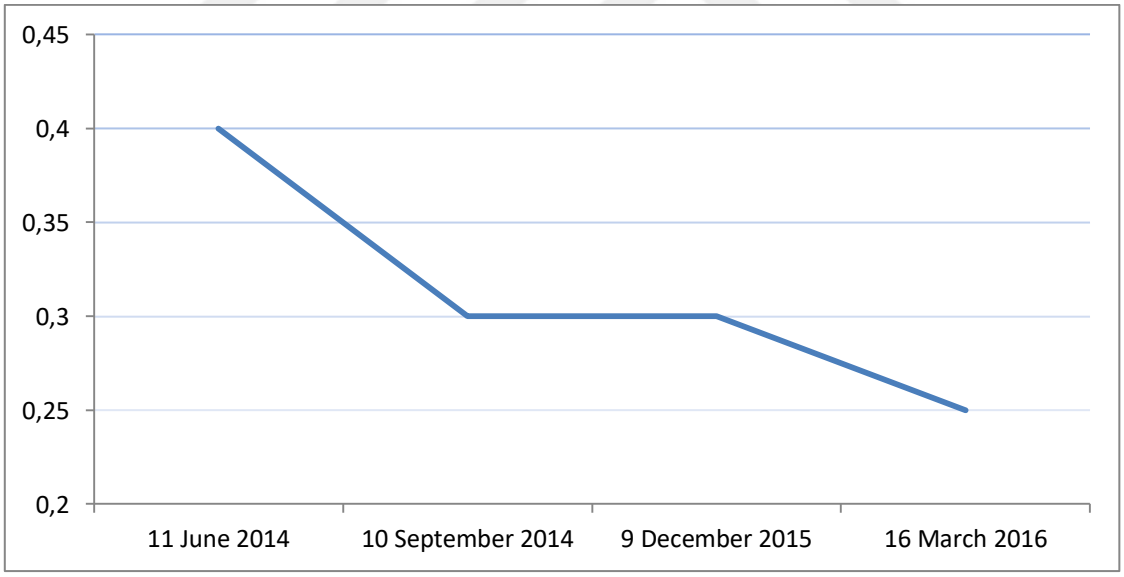
Owing to these policies the size of the balance sheet of the ECB increased from 3.6 billion euros in December 2016 to 4.3 billion euros as of August 2017.

Figure 20: ECB Balance Sheet (Million Euro, December 2016-August 2017)



Source: ECB

Figure 21: ECB Marginal Lending Facility (%, June 2014 – August 2017)



Source: ECB

3.2.3. Comparison of Monetary Policy Responses of the FED and ECB

The Monetary Policy Responses of Fed and ECB have been different due to temporary and structural differences between these two monetary authorities (European Parliament, 2012).

First, global financial crisis began in the US during 2007-2009 and then spread to Euro area at the end of 2009. Thus, monetary policy responses of the FED and ECB have been done at different times.

Second, in the US, the subprime assets were the center of the crisis whereas in the Euro area it was mainly sovereign debt.

Third, although the US financial system is dependent on capital markets the Euro area is dependent on banking sector. Specifically, in the US, 25 percent of corporates use banking system to raise external financing whereas in the euro area 75 percent of corporates use banking system to raise external financing (European Parliament, 2012). This difference also affects the monetary transmission mechanisms of central banks.

Fourth, although the US has single Treasury bond market and a single fiscal policy, the European area has 17 government bond markets and 17 different fiscal policy implementations. Hence, the coordination of monetary policy with fiscal policy is much easier for the Fed compared to the ECB.

Fifth, although ECB has only one primary objective, the FED has more than one objective. Article 127 of the "Treaty of the Functioning of the European Union" states that "the primary objective of the European System of Central Banks shall be to maintain price stability" (De la Dehesa, 2006). On the other hand, the mandate of the Fed which it received from Congress (Section 2A of the Federal Reserve Act) is "to maintain long run growth of the monetary and credit aggregates commensurate with the

economy's long run potential to increase production, so as to promote maximum employment, stable prices and moderate long term interest rates."

Last, the decision making process in the ECB is much more complex compared to the FED's governance. ECB monetary policy decisions are made by its Governing Council which is composed of 23 members, 6 permanent members of the Executive Board and 17 central banks governors of the euro area member states. In the FED, monetary policy decisions are made by the Federal Open Market Committee which is composed of 12 members.

3.3.The Impact of Central Bank Policies on the Market Liquidity

From a theoretical perspective, there are two contrasting views on the impact of the large scale asset purchases on the liquidity. According to first view, large scale asset purchases may have a detrimental effect on the secondary market liquidity because these purchases decrease the available supply of securities to private parties. As the supply of securities reduces, market participants become unwilling to trade securities that they held in their balance sheets. The other view is that asset purchase programs are useful in enhancing liquidity by increasing demand of securities. Hence, such improved trading opportunities could reduce liquidity risk premiums and hence their yields embedded in asset prices.

Gagnon et all (2010) argued that the liquidity has been important in the early stages of the asset purchase programs for certain types of assets in the USA. For instance, older US Treasury securities have usually low liquidity compared to new securities with comparable maturities. However, once the FED began buying these bonds, investors became more willing to hold and trade them and this increased liquidity of these securities. However, Gagnon et all (2010) also noticed that as financial conditions over the programs improved, the programs became an impediment to market liquidity by decreasing the available supply to market participants.

Christansen and Gillan (2017) argue that the QE programs of the FED have also increased liquidity of these securities. According to them, the presence and actions of the Fed increased bargaining power of buyers and reduced bargaining power of sellers in the markets where securities are held through QE programs. As argued by Duffie et all (2007), increased bargaining power of sellers reduced search and bargaining frictions in over-the counter markets and led to reduced illiquidity price distortions. Similarly, Adrian et all (2017) argued that there is no strong evidence of deterioration in Treasury market liquidity in the post-crisis area.

4. EMPRICAL ANALYSIS OF DRIVERS OF SECONDARY MARKET LIQUIDITY IN BOND AND STOCK MARKETS IN TURKEY

The last ten years since the beginning of the outbreak of subprime mortgage crisis in the US witnessed significant challenges for global economy and especially for global financial markets. Market participants closely monitored different stages of the global financial crisis along with the central bank responses to these stages as well as the geopolitical and political developments in search for higher yields. In general, the last ten year witnessed increased geopolitical risks, increased global liquidity thanks to the easing of monetary policies of the FED, ECB and other major central banks and increased volatility and uncertainty due to geopolitical factors. These developments had significant impact on the financial markets both in developed and emerging economies.

The aim of this chapter is to empirically analyze drivers of secondary market liquidity in bond and stock markets during this ten year period. Before starting our analysis we will first briefly describe the functioning of secondary bond and stock markets in Turkey. In the second section we will present our theoretical perspective behind our econometric model. In the third section, we will present a descriptive analysis of the data we used in or empirical model. After presenting the methodology and specification of the model we will conclude this chapter with the main findings of the empirical model.

4.1. Secondary Bond And Stock Markets in Turkey

Both secondary bond market and secondary stock market are organized under Borsaistanbul, an organized market for most of the financial securities in Turkey. Apart from Borsaistanbul, there are also OTC markets, in which securities are traded not in an organized market but on a mutual agreement of financial market participants. Yet, prices in these OTC markets are usually takes into account the prices available in organized markets.

4.1.1 Secondary Bond Markets in Organized Markets

Government bonds are traded in the Debt Securities Market, an organized market which has been established under Borsaistanbul (BIST) in June 1991.The Debt Securities Market is comprised of the flowing sub-markets:

i) **Outright Purchases and Sales Market**: Transactions of debt securities including government bonds are carried out

ii) **Offering Market for Qualified Investors:** In this market, capital market instruments of the corporations whose equities are traded on Borsa Istanbul Equity Market are issued to "qualified investors".

iii) **Repo-Reverse Repo Market**: Market in which repo-reverse repo transactions are executed.

iv) **Interbank Repo-Reverse Repo Market:** Market in which repo-reverse repo transactions are executed only by the banks for their own portfolios.

v) **Repo Market for Specified Securities**: Market in which repo-reverse repo transactions with specified debt securities are executed.

vi) **Equity Repo Market:** Market in which repo- reverse repo transactions are executed with the shares of the companies that are traded on Borsa İstanbul Equity Market and which are included in BIST 30 Index.

vii) **International Bonds Market:** Market in which foreign debt instruments issued by the Turkish Undersecretariat of Treasury and listed at Borsaistanbul are traded.

viii) **Negotiated Repo Deals Market**: This market allows repo-reverse repo transactions to be executed with the preferred counterparties.

The government bond securities issued by Turkish Treasury are traded in the Outright Purchases and Sales Market under Debt Securities Market.

Central Bank, banks and the intermediary institutions, which are members of Borsaistanbul, are entitled to make transactions in the Debt Securities Market. Retail and corporate investors are not allowed to make transactions on their own name but they can make transactions through agencies that are member of Borsaistanbul. Although there are 8 sub-markets of Debt Securities Markets, outright purchases and Sales Market, in which government bond are traded has a significant share in total transaction volume. According to Capital Markets Board, 74 percent of total transactions belong to government bonds transactions. Hence, the secondary market liquidity in bond market is also a significant indicator for total debt securities market.

The settlement process of the securities is carried out in Takasbank Settlement Pool Account with Merkezi Kayıt Istanbul-CSD of Turkey. Merkezi Kayıt Istanbul and Takasbank systems are interconnected with each other which help instantaneous reflection of transfer of securities in Merkezi Kayıt Istanbul. The realization of the settlement is carried out with the details transferred from Merkezi Kayıt Istanbul (TSPAKB, 2017).

One of the main ingredients of the secondary bond market in Borsaistanbul is the availability of Primary Dealership System first introduced by Turkish Treasury in 2000. However, the system has not been implemented in 2001 during financial crisis in Turkey and has been continuously implemented since September 2002. According to this system primary dealers, which are banks in our case, have been given some privileges and obligations regarding both primary government bond market and secondary bond market with the aim of reducing roll-over risk, broadening investor base in primary market and constituting transparent, competitive and more organized secondary market and also increasing liquidity and reducing volatility in secondary government bond market. Turkish Treasury signs an annual protocol with primary dealers and gives some privileges and responsibilities who sign the protocol and who become a primary dealer.

Table 7: Primary Dealers in 2018

Akbank T.A.Ş.	ING Bank A.Ş.	T. İş Bankası A.Ş.
DenizBank A.Ş.	T.Ekonomi Bankası A.Ş.	T. Vakıflar Bankası T.A.O.
Deutche Bank A.Ş.	T.C. Ziraat Bankası A.Ş.	Yapı ve Kredi Bankası A.Ş.
QNB Finansbank A.Ş.	T. Garanti Bankası A.Ş.	
HSBC Bank A.Ş.	T. Halk Bankası A.Ş.	

Source: Turkish Treasury (listed on alphabetical order)

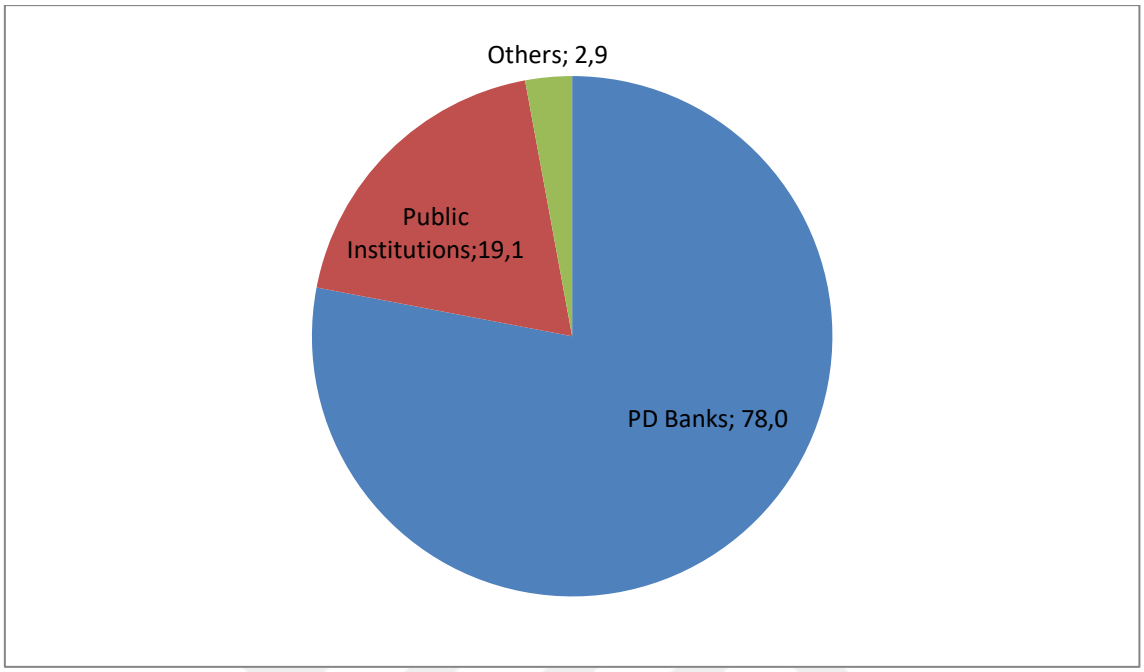
Table 8: Priviliges and Responsibilities of Primary Dealers in 2018

Rights of PDs	Obligations of PDs
Right to use "Turkish Primary Dealer" title	Primary Dealers must purchase pre-determined amount of government securities in auctions on a monthly and quarterly basis
No collateral requirements for participating in auctions	Primary Dealers are obliged to enhance secondary market liquidity by giving bid and ask quotations with PD title
Right to submit non-competitive bids before the auctions	Obligation of research and sharing them with Treasury
Right to submit option bids after auction is closed	The Primary Dealer shall not distort competition in the primary market by negotiating and acting in coordination with other primary dealers and /or participants
Right to involve in cash operations in the money market	
Right to participate in "TAP" sales	
Right to serve as an intermediary in "public offerings"	
Right to participate in buy-back and switching auctions conducted by Turkish Treasury	
Participates in the Primary Dealership Consultation Board meetings	
Right to trade securities at the Securities Lending market at the Central Bank.	

Source: Turkish Treasury

The PD system has significant benefits for Turkish Treasury both in primary market and secondary market. The following graph shows the distributions of sales of government securities in primary market.

Figure 22: Distributions of Domestic Government Securities Sales in Primary Markets (2017)

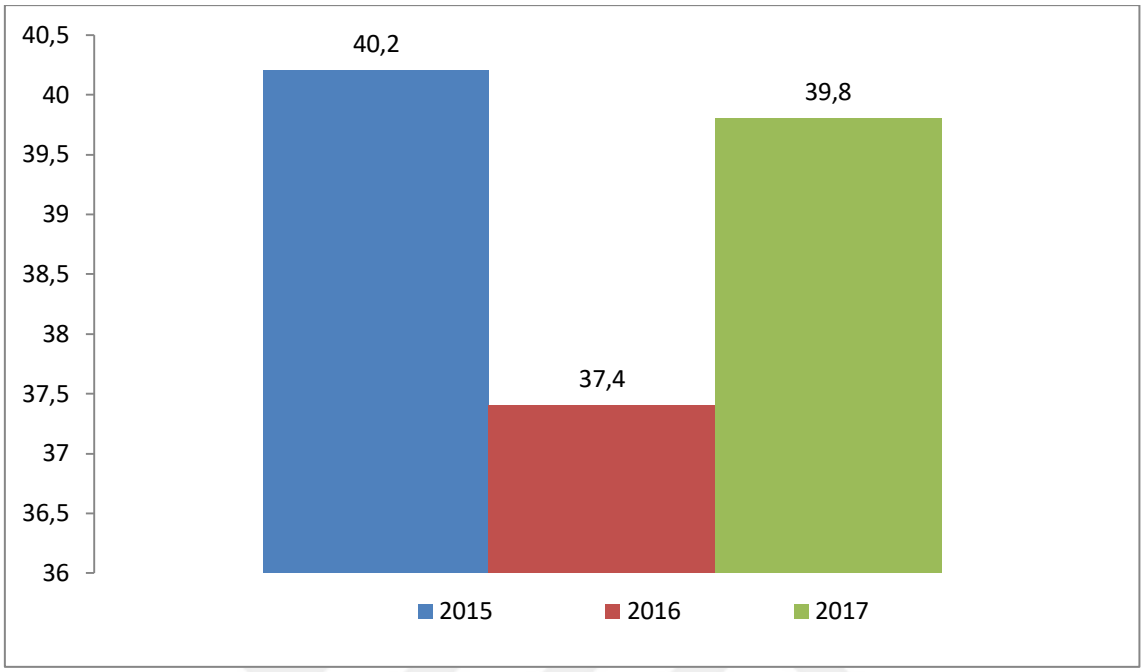


Source: Turkish Treasury

As shown in the figure, 78 percent of total domestic borrowing has been carried out through PD banks in 2017. The PD banks also have significant contributions in the secondary bond market. As we discussed before, PD Banks are entitled to use "Turkish Primary Dealer" title and they use this title in their secondary market operations in Borsa Istanbul. Hence, we can differentiate secondary market transactions on the basis of PD initiated transactions or non-pad initiated transactions.

The following figure shows the share of pad-quoted transactions in total benchmark security transactions in secondary market bond market in Borsaistanbul for the last three years.

Figure 23: Share of PD-Transactions in Total Benchmark Security Transactions (%)



Source: Turkish Treasury

The figure reveals that PD-quoted transactions constitute almost 40 percent of total transactions in benchmark securities in secondary market bond market.

4.1.2 Secondary Bond Markets in OTC Markets

In addition to organized markets, debt securities can also be traded in the Over the Counter (OTC)market. However, transactions in the OTC market must be reported to Borsa Istanbul. The settlement of OTC transactions is conducted through banks' accounts at the Central Bank, or brokerage firms' accounts at Takasbank, or through the system of Merkezi Kayıt Kuruluşu (MKK) of Turkey. Transactions in this market are carried out by banks or agencies that have lines and line limits to other banks and/or other agencies. The prices in this market are usually follow the prices in organized market, namely in Debt Securities Market in Borsaistanbul (TSPAKB, 2017).

4.2.Secondary Stock Market in Borsaistanbul

The equity market under BorsaİstanbuI serves as the market for secondary stock market for equities. In this market, not only equities but also warrants, certificates, rights coupons and exchange traded funds are traded. Only brokerage firms are allowed to trade in equities market.

Multiple price-continuous auction method is used in these markets. According to this system, buy and sell orders are automatically matched on a price and time priority basis. The equity transactions are carried out in a single session. The session begins with an opening auction (single price). Then, orders are entered into the t system without matching. At the end of this period, opening prices are determined and orders are matched. Similarly there is a closing auction at the end of session. .In this market short selling is possible and transactions regarding short selling are done at Borsa Istanbul. The securities, transaction prices and volumes are announced at the end of the day on Borsa Istanbul's website.

The settlement of equities and cash is done on T+2 by Takasbank, through delivery-versus-payment (DVP) system.

4.3. A Theoretical Perspective for Emprical Investigation

Before we proceed with the emprical model, in this section, we present a theoretical perspective that forms the basis of our emprical model.

In Turkey, the main players in secondary bond markets are banks. Banks hold government bond securities for two reasons. First, they make capital gains from buying and selling securities by trying to forecast the direction and magnitude of market interest rates. They keep these bonds in their trading books. Second, they keep some of the government bond securities in their portfolio and held until maturity for

management of their balance sheet or for hedging purposes. From secondary market liquidity perspective, the most important thing is the stock of securities that banks hold in their trading books.

For stock of government securities in their trading book banks use all available information to make an estimate of market interest rates. When they anticipate that market interest rates will increase for some reason, they have a tendency to sell their bond stock as the value of these securities will decline. Similarly, when they anticipate that the market interest rates will decline, they have a tendency to buy government bond securities today as the value of these securities will increase and they will make profit.

Two issues are further important in this simple hypothetical world. First, banks use marked-to market principles in their accounting procedures, meaning that when keeping the accounts regarding their government bond portfolio they use market interest rates in recoding the price of bonds in their portfolios. Hence, market interest rates are crucial important for banks in deciding whether to sell or buy securities in secondary markets. Second, as banks in Turkey are dependent on foreign savings due to lack of enough savings in domestic markets, they always stand on the same side of the markets. That is to say, they always together want to sell their portfolio of securities. In such an environment the demand for securities form other players are important and these players are usually foreign investors.

In the previous paragraph we explained how domestic banks generate capital gains by buying and selling securities by anticipating market interest rate movements. For foreign investors, there is one more factor in generating revenues which is exchange rate. Accordingly, foreign investors generate revenues when TL appreciates (FX depreciates) during the period in which they buy a security and sell at the end of period. Hence, the availability of foreign investors in domestic debt market positively affect secondary market liquidity because Turkish banks, who rely on foreign financing, can sell their portfolio of securities to foreign investors. This positively affects secondary market liquidity as long as the flow of foreign investments is sustainable. However, when the wind turns back and a sell-off of foreign investors starts, the secondary market liquidity deteriorates because Turkish banks must buy all the securities. Moreover, since

they are always on the same side (either all of them buyers or all of them sellers) the secondary market liquidity does not recover after foreigners outflow.

Based on the above discussion regarding the behaviors of Turkish banks and foreign investors we argue that the secondary market liquidity in bond markets depends on two main parameters: i) Volatility (or uncertainty) ii) The availability of foreign investors. Mathematically, we formulate this as follows:

(7) Secondary bond market liquidity = f (Volatility or uncertainty, Investments of Foreign Investors)

We argue that as volatility or uncertainty in financial markets increases, Turkish banks become unwilling to trade the securities in their portfolio. This may occur either because they may not be able to properly price the securities due high uncertainty or they may wait for new information such as Central Bank decision on interest rates or the results of primary market domestic debt auctions. Independent of the reason of uncertainty, Turkish banks become unwilling to trade the securities in their portfolio which negatively affects the secondary market liquidity in bond markets.

We further argue that the availability of foreign investors in domestic debt markets increases volume of transaction, decreases bid-ask spread and increases secondary market liquidity in bonds market. The main reason for increased liquidity is increased demand for the available domestic debt instruments. However, one should be careful in interpreting the relation between secondary market liquidity and investments of foreign investors. When there is an inflow of foreign investments, this increases demand for domestic debt securities, price of it and decreases the interest rate. This improves the secondary market liquidity. However, when there is an outflow of foreign investments we see the opposite movements in markets, the demand decreases, the price decreases and secondary market liquidity deteriorates. However, we should note that when we measure the secondary market liquidity in terms of transaction volume, the inflows of foreigners and outflows of foreigners affect transaction volume in the same direction since the transaction volume includes both selling and buying transactions.

Based on our observations regarding the market we construct the following two hypotheses for bond markets in Turkey:

Hypothesis 1: The secondary bond market is negatively affected by uncertainty or volatility

Hypothesis 2: The secondary bond market is positively affected by the availability of foreign investors in domestic debt market.

The first hypothesis has been investigated in the literature in terms of return or price volatility. However, in our analysis we further extend this analysis and include global uncertainties regarding bond market and include MOVE index as well.

To test the validity of our second hypothesis, we added holdings of the bond market by non-residents, a data which has been published on a weekly basis. Hence, for this part of analysis we used weekly data as opposed to daily data which have been used so far.

Lastly, we applied the same methodology for secondary stock market liquidity. We argue that, secondary markets stock liquidity is also a function of holdings of stocks by non-residents and volatility. To measure global volatility for stock markets we used VIX index.

Hypothesis 3: The secondary stock market is negatively affected by uncertainty or volatility

Hypothesis 4: The secondary stock market is positively affected by the availability of foreign investors in domestic stock market.

4.4. Data and Descriptive Analysis

The main data source for our empirical research is Borsistanbul, in which both stocks and government securities are traded in an organized market. To measure the liquidity of government bonds we used both bid-ask spread of 2 years bond and the transaction volume. To measure the secondary market liquidity in stock markets we used daily transaction volume. The other variables that are used in the model are explained below.

4.4.1 Data

Interest Rate: We used secondary market yield to maturity of the 2-year government bond for measuring the return of the bond. The data has been taken from Borsaistanbul through Bloomberg. Using this data we also calculated the return volatility of the government bond.

BIST 100 Index: We get daily Bist 100 index levels to calculate the return and return volatility of stock markets.

VIX: VIX is a measure of the stock market's expectation of volatility calculated by Chicago Board Options Exchange (CBOE) by taking into account S&P index. It can also be defined as fear index regarding stock markets at global level. The VIX index indicates expected annualized change in S&P 500 index over the next 30 days as computed from options theory and current available options market data. An increase in this index indicates a rising fear in stock markets whereas a decrease in the index indicates a decrease in fear.

MOVE Index: The Merrill Lynch Option Volatility Estimate (MOVE) Index is an index of the normalized implied volatility on 1-month Treasury options which are weighted on the 2, 5, 10, and 30 year maturities. In other words, it is the government securities version of VIX and shows the fear in government securities markets. Similar

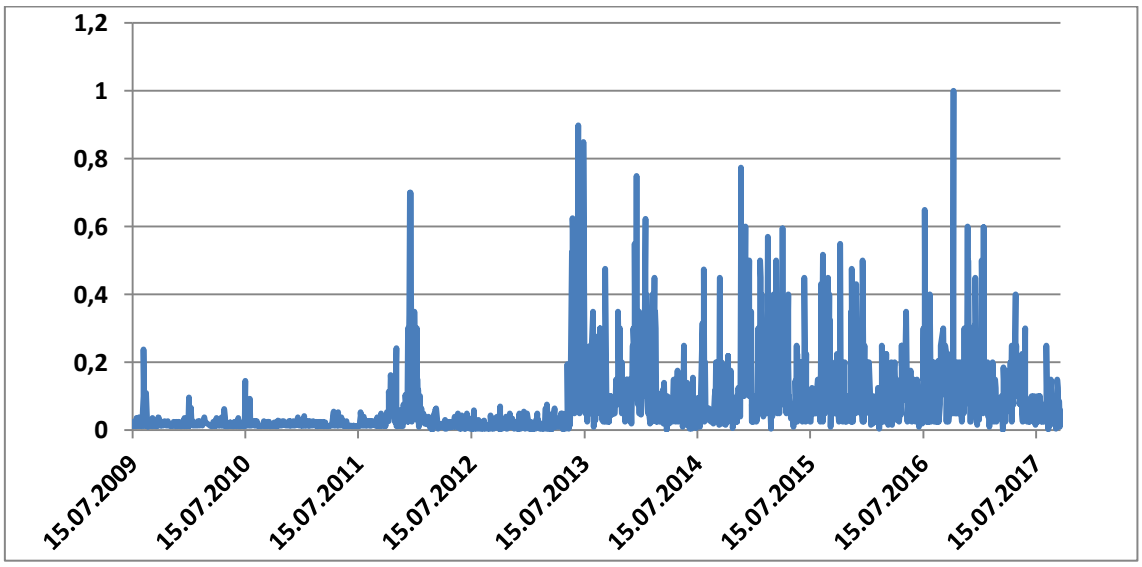
to the VIX index, an increase in this index indicates increasing fear in government securities markets whereas a decrease indicates a decreasing fear level.

Stock of Foreign Portfolio of Government Securities and Stock Markets: The CBRT weekly publishes foreign purchases as well as stock of government securities and stock markets held by foreigners. We use this data to get the information on the interest of foreigners in our government debt and stock markets.

4.4.2 Descriptive Analysis

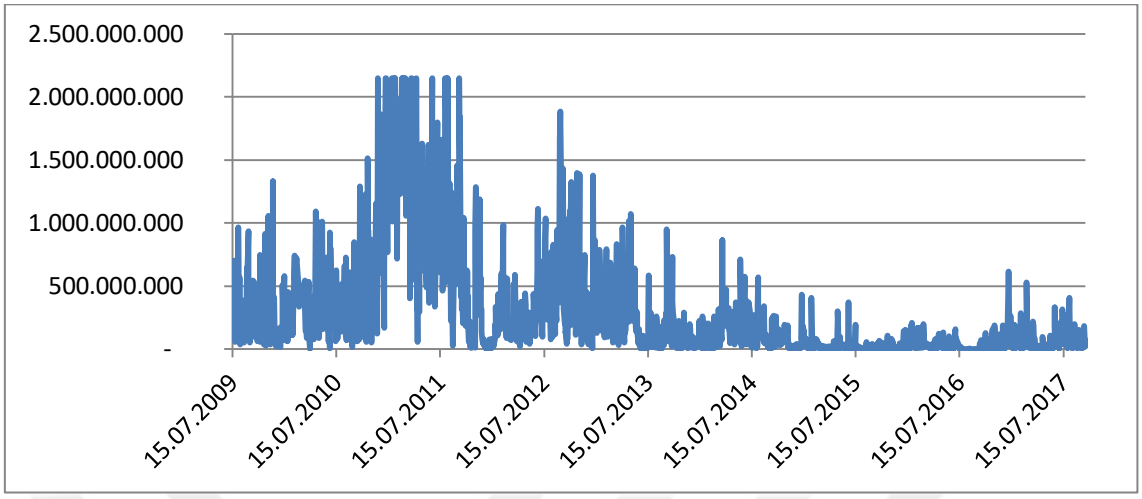
Before constructing our econometric model, we deeply analyze the data at hand to get a clear picture on what happened on secondary market liquidity. The following two graphs show the developments in secondary market liquidity in government bond market in Turkey during June 2009 and September 2017.

Figure 24: Bid-Ask Spread of 2 Year Government Bond (TL Kurus)



Source: Borsaistanbul

Figure 25: Daily Transaction Volume of 2 Year Government Bond (Million TL)



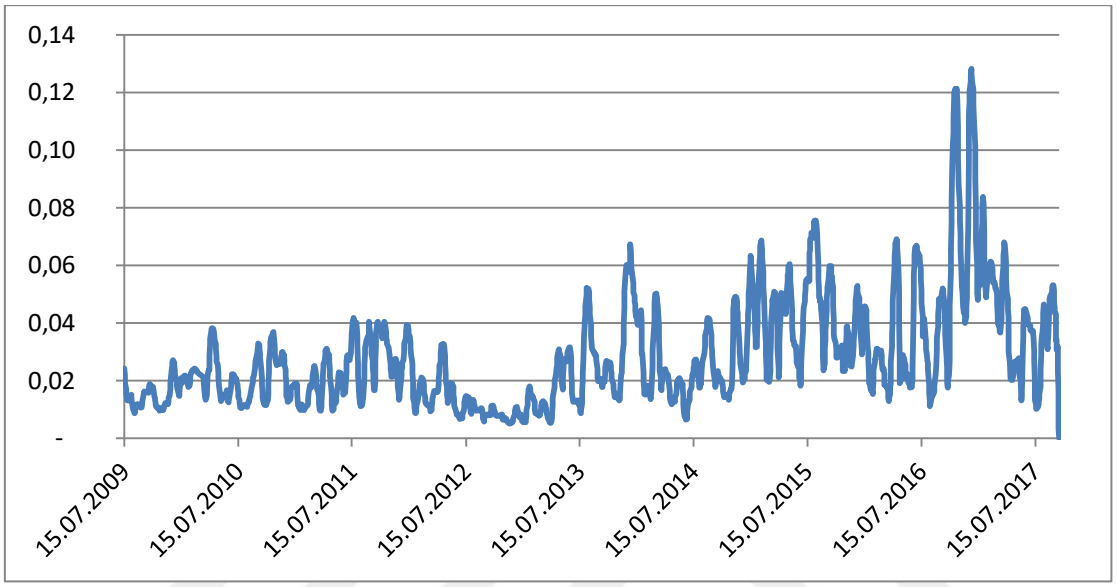
Source: Borsaistanbul

These two graphs show a clear picture regarding the secondary market liquidity in bonds market between June 2009 and September 2017. Accordingly, we see a clear distinction between 2009 and May 2013 and after May 2013. In other words, we see a significant deterioration in secondary market liquidity after May 2013 measured in terms of both bid-ask spread and daily transaction volume. The importance of May 2013 comes from the speech of Bernanke, The FED Chairman, on the tapering of FED policies. In his famous speech on May 22, 2013 on the Congress, Bernanke testifies that the FED would likely start slowing, that is tapering, the pace of its bond purchases later in the year.

This speech has been a turning point in international capital markets as all market participants started to expect the global liquidity would dry up due to tightening of the FED policies. However, the FED has not been urgent in decreasing asset purchasing and increasing interest rates, so the market's expectations have not been materialized immediately. However, market participants closely monitored main central Bank's decisions and speeches of their governors or other monetary policy committee members to get some insights on the timing and pace of normalization of monetary policies.

May 2013 is also a turning point for government securities in Turkey as foreigners decreased their holdings of government debt securities as they expected higher foreign interest rates with the normalization announcement of FED's monetary policies.

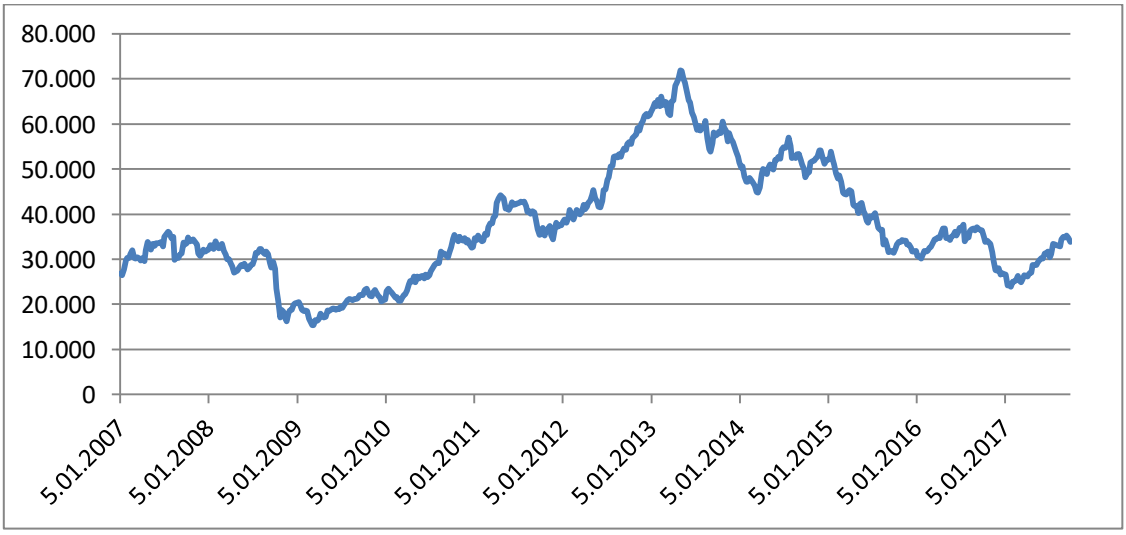
Figure 26: FX (USD/TL) Volatility



Source: CBRT and Author Calculations

The FX volatility, which is measured by the volatility of USD/TL, also witnessed increases and large swings after May 2013.

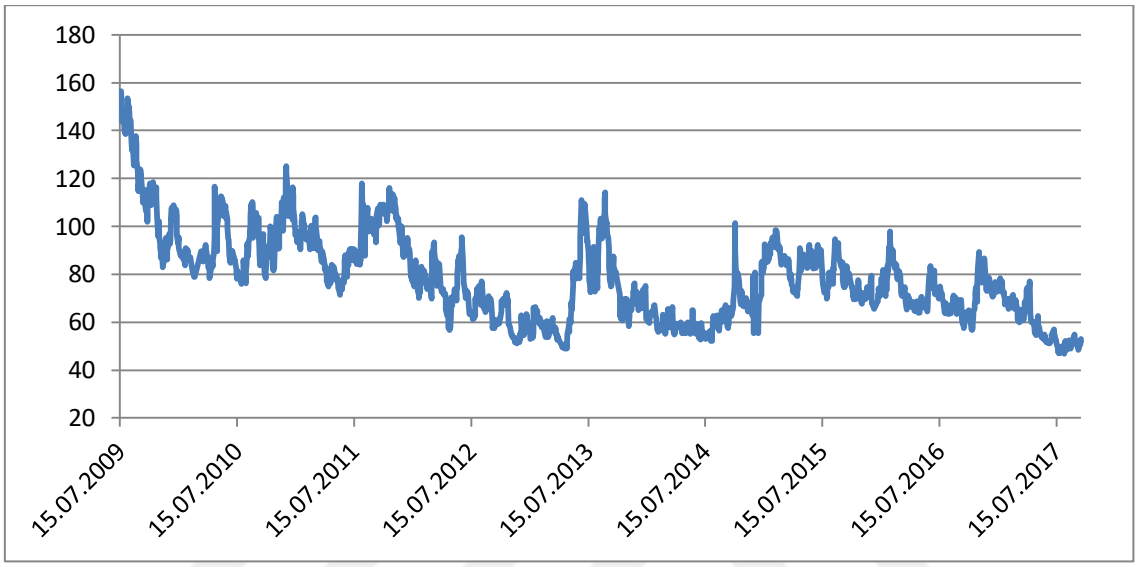
Figure 27: Foreign Holdings of Government Debt in Turkey (Million USD)



Source: CBRT

The stock of government debt hold by foreigners in Turkey increased up to 80 billion TLs at the beginning of May 2013. However, after Bernanke's famous speech on May 2013, foreign holders started to decrease their holdings of government debt securities.

Figure 28: Move Index

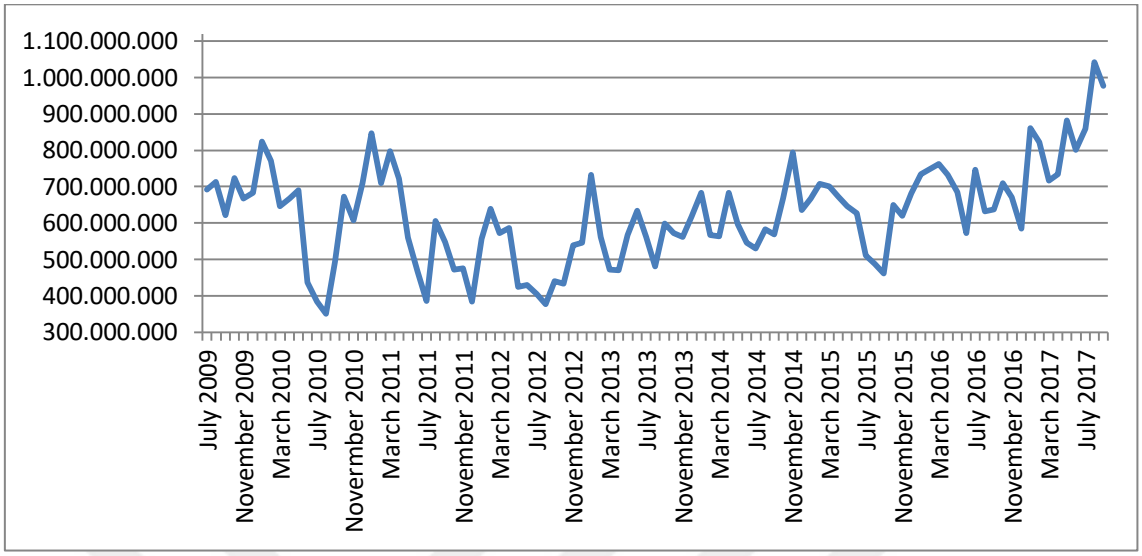


Source: Bloomberg

After Bernanke's speech on May 2013, we have not seen turmoil in Turkish government securities markets but also in global government securities markets which is reflected in the MOVE index which shows global fear in government securities markets. The value of index which was above 150 in the middle of 2019 decreased up to 50 in April 2013 hit a significant increase after May 2013 and increased above 110 as of September 2013. The index oscillated around 60s from September 2013 until the end of 2014 started to oscillate around 80s during 2015 and started to decrease since the beginning of February 2016.

The discussions regarding normalization policy of major central banks after May 2013 had not only affected government securities markets but also stock markets. However, the change in stock markets has not been affected only by central bank decisions but also by discussions regarding the growth of global economy. The following graph shows the monthly averages of transaction volume of BIST 100 index in Borsaistanbul.

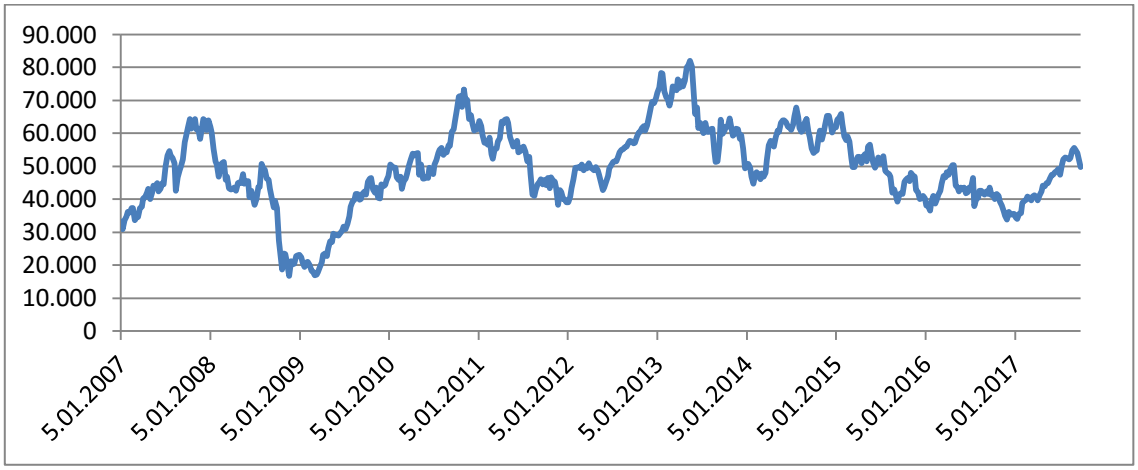
Figure 29: Monthly Averages of Truncation Volume at Borsaistanbul (TL)



Source: Borsaistanbul

The stock market liquidity, which is measured by transaction volume at Borsaistanbul, did not show any significant reaction to Bernanke's famous tapering speech in May 2013. The average volume of transactions showed significant oscillations before May 2013 but in general it declined from 847 million TL in January 2011 to below 400 million as of August 2012. Beginning from the start of 2013, the transaction volume increased until the end of 2014 and showed a sharp decrease during the middle of 2015 and then showed another significant increase after June 2016.

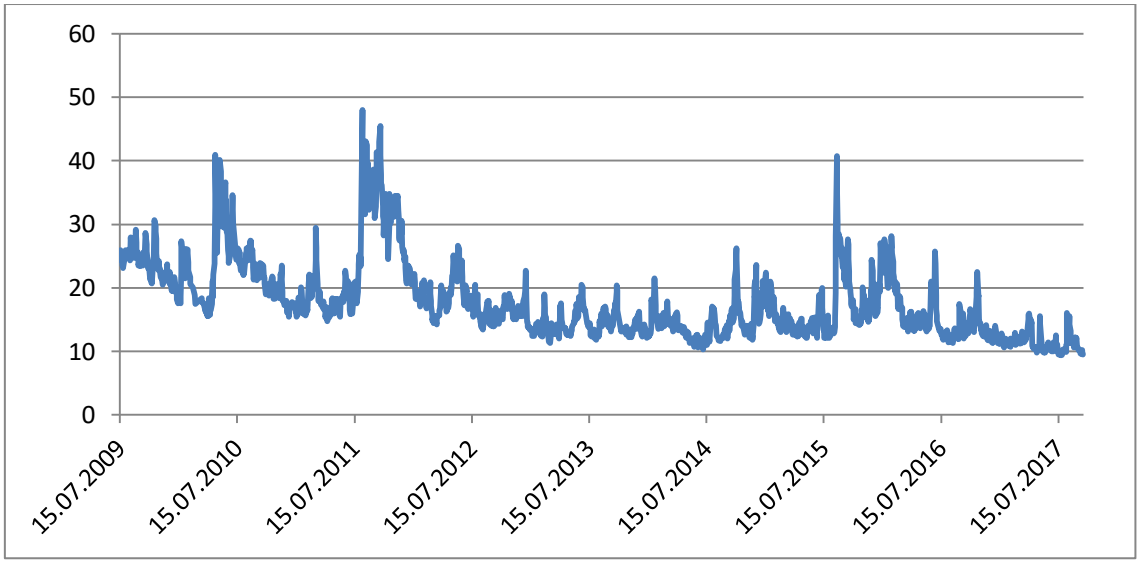
Figure 30: Foreign Holdings of Stock Market in Turkey (Million USD)



Source: CBRT

The Bernanke's speech and the discussions regarding the exit strategies of major central banks thereafter had a significant impact on the holdings of stocks at Borsaistanbul by foreigners. While the value of stock portfolio of foreigners was above 80 billion USD on May 17, 2013 it exhibited a sharp decrease after Bernanke's speech and declined to 47 billion USD in 6 months. Although it increased in the first half of 2014 to some extent, it never reached its pre-Bernanke level and decreased again below 40 billion USD towards the end of 2016 and showed another increasing trend during 2017.

Figure 31: VIX Index



Source: Bloomberg

Similarly, the VIX index, which shows the fear in stock markets did not show any significant reaction to FED's tapering message on May 2013. It showed only temporary and negligible reaction during May-June period in 2013 but oscillated between 10 and 20 during the whole year of 2013. It decreased from 20 until 10 during the first five months of 2014 and showed relatively significant increase in September 2014 and closed the year again below 20. In 2015, it showed a record level on August with a level of above 40 but again declined to its normal levels below 20. Beginning from 2016 the value of the index shows a gradual decreasing trend. During 2016 and 2017, it never exceeded 20 but tested its lowest value below 10.

We provide a summary of descriptive statistics below both for our Daily and weekly data sets.

Table 9: Descriptive Statistics of Daily Data Set

	Mean	Median	Max	Min	Std. Dev.
USD/TL	2.236403	1.9888	3.8848	1.3951	0.682803
FX Volatility	0.035401	0.022914	1.138928	0.004925	0.083796
2Yr Bid-Ask spread	0.076213	0.035	1	0.001	0.105113
2 Yr Volume (Million TL)	2.93E+08	1.13E+08	2.15E+09	100,000	4.29E+08
2 Yr int rate	9.11	9.08	11.93	4.79	1.50
2 Yr int rate Volatility	0.272885	0.213355	3.773212	0.026607	0.293114
Bist 100 index	71,977.13	73,718.71	11,0423.1	37,726.69	13,610.49
Bist 100 Return	0.063816	0.10608	8.397106	-10.4737	1.50139
BIST 100 Return Volatility	1.394829	1.271021	5.515706	0.524008	0.563495
Bist 100 volume (Millon TL)	6.25E+08	6.05E+08	1.67E+09	96,935,496	1.91E+08
VIX index	17.62731	16,04	48	9.36	5.941753
Move index	78.03139	75.3016	156.3	46.9123	18.66684

Table 10: Descriptive Statistics of Weekly Data Set

	Mean	Median	Max	Min	Std. Dev.
FX volatility	0.028232	0.023221	0.125802	0,00516	0.018756
2Yr Bid-Ask spread	0.076003	0.046	0.4975	0.0064	0.078781
2 Yr Volume (Million TL)	2.88E+08	1.41E+08	2.01E+09	100,000	3.78E+08
2 Yr int rate	9.095194	9.05	11.9	4.9125	1.482951
2 Yr int rate Volatility	0.229639	0.181952	0.947766	0.010708	0.161479
Bist 100 index	71,670.44	73,552.54	11,0257.9	37,932.34	13,616.53
BIST 100 Return	0.269564	0.48896	8.943837	-13.5845	2.703779
BIST 100 Return Volatility	2.27273	2.043743	7.815515	0.233886	1.247555
Bist 100 volume (Million TL)	6.21E+08	6.13E+08	1.39E+09	1.58E+08	1.65E+08
VIX index	17.69505	16.292	40.282	9.688	5.83617
Move index	78.2151	75.6	152.3333	48.15994	18.46754
Stock Holdings of Non-residents (Million Dolar)	50,766.08	50,833	82,048	16,683	13,180.61
Gbond Holdings of Non-residents (Million Dolar)	40,515.94	37,911	71,818	19,970	12,449.68

4.5.Methodology and Specification of the Model

In this section, we analyzed the drivers of secondary market liquidity in government bond and stock markets after global financial crisis in Turkey. We followed the following methodology.

First, we tested whether the series are normally distributed or not by using both skewness, curtosis analysis and by applying Jarque Bera test

Second, we tested whether there exists unit root (stationarity) in the data that we used. The existence of unit root may cause our analysis to have serious issues like spurious regressions and errant behavior. Spurious regressions mean that one can have high r-

squared values even if the data is uncorrelated. Errant behavior means that the data may not follow the necessary assumptions. For instance, t-ratios may not be able to follow t-distribution.

Then, we have constructed an OLS regression model and tested our hypotheses regarding drivers of secondary market liquidity in bond and stock markets. Here we also analyzed whether there are heteroscedasticity and autocorrelation problems or not.

4.5.1. Testing for Normality

The assumption of normality has utmost importance in statistics and regression analysis. It is especially critical when constructing reference intervals for variables When the normality assumption does not hold, it is impossible to get accurate and reliable conclusions from the models that we construct. Usually, when the data set is large enough (more than 30) we can conclude that the data is normally distributed according to central limit theorem. As our data set include 1903 observations in daily models and 428 observations in weekly models, the assumption of normality will not cause any major problems.

In this section we used skewness, kurtosis and Jarque Bera tests to test normality of our variables.

Skewness is defined as the asymmetry from the normal distribution Skewness can either be negative or positive depending on the location of data points with regard to the average of the data set. The skewness in a normal distribution is zero.

Kurtosis, on the other hand, measures whether the tails are in line with the tails with a normal distribution. Large kurtosis value indicates that the data in tails in the distributions exceed the data in the tails of a normal distribution. Similarly, a small kurtosis value indicates that the tail of a distribution is like tail of a normal distribution.

The value of the kurtosis of a normal distribution depends on the sample size. Yet, if we

convert the kurtosis into z-normal distribution by dividing standard deviation a rule of thumb is that kurtosis should be between -3 and 3 for normally distributed data sets.

The Jarque Bera test statistics is another way of looking whether the data sets are normally distributed or not. The null hypothesis for this test is that the data is normally distributed and the alternative hypothesis is that it is not normally distributed. If the value of the test statistics is zero, we accept the null hypothesis and conclude that the data is normally distributed. We can also look at the probability of the test statistics. The probability should be greater than 0.05 for accepting normality under 95 percent confidence interval.

Table 11: Skewness, Kurtosis and Jarque Bera Test Values for Daily Data Sets

	Skewness	Kurtosis	Jarque Bera Test Statistics	Probability of Jarque Bera
FX Volatility	0.14	2.17	6.32	0.09***
2Yr Bid-Ask spread	0.24	2.49	4.97	0.082***
2 Yr Volume (Million TL)	-0.97	3.95	3.50	0.093***
2 Yr int rate	-0.36	2.91	2.73	0.082***
2 Yr int rate Volatility	-0.22	2.84	1.48	0.050**
Bist 100 Return	-0.34	2.99	2.54	0.064***
BIST 100 Return Volatility	1.53	1.98	7.38	0.098***
Bist 100 volume (Million TL)	-0.46	3.34	8.25	0.097***
VIX index	0.64	3.07	1.13	0.048**
Move index	0.25	2.71	0.82	0.032**

*** Significant at 95 percent confidence level*

**** Significant at 90 percent confidence level*

Table 12: Skewness, Kurtosis and Jarque Bera Test Values for Weekly Data Sets

	Skewness	Kurtosis	Jarque Bera Test Statistics	Probability of Jarque Bera
FX Volatility	0.04	2.57	3.44	0.18*
2Yr Bid-Ask spread	0.19	1.83	7.34	0.08**
2 Yr Volume (Million TL)	-0.91	3.41	5.75	0.092***
2 Yr int rate	-0.58	3.28	7.50	0.061***
2 Yr int rate Volatility	-0.48	3.66	4.91	0.072***
Bist 100 Return	-0.58	5.28	7.50	0.062***
BIST 100 Return Volatility	-0.48	3.66	4.91	0.068***
Bist 100 volume (Million TL)	-0.67	4.67	3.12	0.09***
VIX index	0.65	3.03	3.68	0.091***
Move index	0.25	2.72	2.91	0.05**
Stock Holdings of Non-residents (Million Dollar)	-0.36	2.99	2.25	0.061***
Gbond Holdings of Non-residents (Million Dollar)	-0.13	2.21	2.24	0.02**

** Significant at 99 percent confidence level*
*** Significant at 95 percent confidence level*
**** Significant at 90 percent confidence level*

4.5.2 Testing for Unit Root

Another test that should be conducted before our analysis is whether the series are stationary or not. A stationary data is defined as the data whose mean, variance and autocorrelation structure do not change over time. When the data is not stationary, it could not be predictable and hence cannot be modeled or forecasted. The results obtained by using non-stationary time series may be spurious meaning that they may indicate a relationship between two variables although in fact there is no such a relation between these variables.

To test whether the series are stationary or not we used both Augmented Dickey Fuller Test (with constant and constant and trend) and Phillip-Perrron Test (with constant and constant and trend) in eviews and the results are summarized in the following tables.

Table 13: ADF Test Results in Daily Data

Variables	ADF(I0)		ADF(I1)	
	Constant	Constant+trend	Constant	Constant+trend
FX Volatility	-5.76*	-8.29*	-18.75*	-18.74*
2Yr Bid-Ask spread	-5.55*	-9.30*	-4.43*	-4.42*
2 Yr Volume (Million TL)	-5.78*	-7.85*	-21.62*	-21.61*
2 Yr int rate	-2.29	-3.04	-22.06*	-22.09*
2 Yr int rate Volatility	-7.34*	-7.36*	-16.44*	-16.44*
Bist 100 Return	-4.14*	-4.14*	-19.33*	-19.32*
BIST 100 Return Volatility	-3.81*	-4.19*	-15.48*	-15.48*
Bist 100 volume (Million TL)	-8.25*	-8.77*	-22.23*	-22.22*
VIX index	-5.42*	-7.16*	-45.84*	-45.83*
Move index	-4.38*	-5.22*	-33.57*	-33.56*

**significant at 99 percent confidence level*
***significant at 95 percent confidence level*
****significant at 90 percent confidence level*

Table 14: Phillips-Perron Test Results in Daily Data

Variables	PP(I0)		PP(I1)	
	Constant	Constant+trend	Constant	Constant+trend
FX Volatility	-6.32*	-7.48*	-43.51*	-43.50*
2Yr Bid-Ask spread	-32.60*	-38.59*	-29.12	-30.02*
2 Yr Volume (Million TL)	24.35*	-32.31*	-29.42*	-29.31*
2 Yr int rate	-2.39	-3.54***	-41.94*	-41.93*
2 Yr int rate Volatility	-5.21*	-5.24*	-20.76*	-20.75*
Bist 100 Return	-44.17*	-44.17*	-64.26*	-64.03*
BIST 100 Return Volatility	-5.68*	-5.99*	-40.73*	-40.72*
Bist 100 volume (Million TL)	-26.08*	-27.02*	-27.71*	-23.91*
VIX index	-4.69*	-6.62*	-55.15*	-55.14*
Move index	-3.92*	-4.81*	-47.84*	-47.85*

**significant at 99 percent confidence level*
***significant at 95 percent confidence level*
****significant at 90 percent confidence level*

Table 15: ADF Test Results in Weekly Data

Variables	ADF(I0)		ADF(I1)	
	Constant	Constant+trend	Constant	Constant+trend
FX Volatility	-4.39*	-5.30*	-14.84*	-14.82*
2Yr Bid-Ask spread	-3.77*	-5.31*	-17.12*	-17.10*
2 Yr Volume (Million TL)	-3.36**	-6.50*	-17.10*	-17.08*
2 Yr int rate	-2.56	-3.27***	-14.89*	-14.93*
2 Yr int rate Volatility	-7.28*	-7.24*	-16.26*	-16.25*
Bist 100 Return	-18.37*	-18.38*	-11.39*	-11.38*
BIST 100 Return Volatility	-8.72*	-8.94*	-12.75*	-12.73*
Bist 100 volume (Million TL)	-5.73*	-6.24*	-17.26*	-17.26*
VIX index	-4.01*	-5.42*	-16.77*	-16.75*
Move index	-3.59**	-4.23*	-20.02*	-20.00*
Stock Holdings of Non-residents (Million Dollar)	-3.03***	-3.04***	-19.33*	-19.33*
Gbond Holdings of Non-residents (Million Dollar)	-3.08***	-3.75**	-18.49*	-18.68*

**significant at 99 percent confidence level*
***significant at 95 percent confidence level*
****significant at 90 percent confidence level*

Table 16: PP Test Results in Weekly Data

Variables	PP(I0)		PP(I1)	
	Constant	Constant+trend	Constant	Constant+trend
FX Volatility	-5.67*	-6.29*	-18.63*	-18.48*
2Yr Bid-Ask spread	-6.76*	-10.87*	-60.04*	-60.46*
2 Yr Volume (Million TL)	-5.40*	-8.56*	-51.30*	-51.22*
2 Yr int rate	-2.58***	-3.25***	-14.98*	-15.02*
2 Yr int rate Volatility	-7.27*	-7.26*	-32.20*	-31.92*
Bist 100 Return	-18.39*	-18.40*	-28.23*	-28.91*
BIST 100 Return Volatility	-8.50*	-8.65*	-57.25*	-58.02*
Bist 100 volume (Million TL)	-10.78*	-11.33*	-30.64*	-34.97*
VIX index	-3.68*	-5.52*	-24.02*	-23.98*
Move index	-3.37**	-4.11*	-20.73*	-20.71
Stock Holdings of Non-residents (Million Dollar)	-3.27***	-3.37***	-19.42*	-19.42*
Gbond Holdings of Non-residents (Million Dollar)	-3.07***	-3.77**	-18.71*	-18.74*

**significant at 99 percent confidence level*
***significant at 95 percent confidence level*
****significant at 90 percent confidence level*

4.5.3 Specification of the Model

As we discussed earlier, we try to test the following four hypotheses:

Hypothesis 1: The secondary bond market liquidity is negatively affected by uncertainty or volatility

Hypothesis 2: The secondary bond market liquidity is positively affected by the availability of foreign investors in domestic debt market.

Hypothesis 3: The secondary stock market liquidity is negatively affected by uncertainty or volatility

Hypothesis 4: The secondary stock market liquidity is positively affected by the availability of foreign investors in domestic stock market.

To test the validity of our arguments we used the following OLS regression models using time series data.

Daily Data Models:

M 1: $BAS = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 FXVOLATILITY$

M 2: $GBondvolume = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 FXVOLATILITY$

M3: $BIST100volume = \alpha + \beta 1 BIST100return + \beta BIST100returnvol + \beta 3 VIX + \beta 4 FXVOLATILITY$

Weekly Data Models:

M4: $BAS = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 GBondnonresidents + \beta 5 FXVOLATILITY$

M5: $GBondvolume = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 GBondnonresidents + \beta 5 FXVOLATILITY$

M6: $BIST100volume = \alpha + \beta 1 BIST100return + \beta BIST100returnvol + \beta 3 VIX + \beta 4 Stcoknonresidents + \beta 5 FXVOLATILITY$

In Models 1 and 2, we analyzed the impact of volatility on government bond market using two different dependent variables. In Model 1, we measure the secondary bond market liquidity by the bid-ask-spread and in the Model 2 we use the total transaction volume (Million TL) for the same purpose. To capture the impact of volatility, we do not only include return volatility but also include global volatility regarding bond market which is measured by MOVE Index. The main argument behind this inclusion is that, this period is characterized by uncertainties regarding the policies of the FED and ECB and we argue that these uncertainties are reflected in bond markets. Moreover, we included FX volatility which is measured by standard deviation of USD/TL.

In Model 3, we analyzed the impact of volatility on the secondary stock market and here we only used the stock market transaction volume as a proxy for market liquidity. Similar to what we did for bond market, we do not include only return volatility but also global volatility regarding stock markets which is captured by VIX Index and FX volatility.

In Model 4-6, we did the same analysis by extending our analysis by including the holdings of non-residents in bond and stock markets.

4.6. Results of the Model

Before going forward with our emprical model, we have two investigate two further issues, the availability of autocorrelation and heteroscedasticity in error terms in our regression model. Heteroscedasticity refers to the problem that the variance of the error term is not constant over time, a problem usually encountered in cross-section data. Autocorrelation is another problem related to error terms that need to be addressed before going on with our analysis. It is defined as the correlation of the error term with its past values.

To detect heteroscedasticity we applied both “White test” and “Breusch-Pagan-Godfrey tests in our 6 models and for autocorrelation we applied Breusch Godfrey Serial Correlation LM Test and the results shown in the following tables.

Table 17: Heteroscedasticity Test Results for Daily Models

Model 1: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	10.58555	Prob. F(5,1891)	0.0000
Obs*R-squared	51.65002	Prob. Chi-Square(5)	0.0000
Scaled explained SS	84.68656	Prob. Chi-Square(5)	0.0000

Model 1: Heteroscedasticity Test: White

F-statistic	4.852869	Prob. F(20,1876)	0.0000
Obs*R-squared	93.31602	Prob. Chi-Square(20)	0.0000
Scaled explained SS	153.0031	Prob. Chi-Square(20)	0.0000

Model 2: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	13.59115	Prob. F(4,1892)	0.0000
Obs*R-squared	52.98580	Prob. Chi-Square(4)	0.0000
Scaled explained SS	97.42824	Prob. Chi-Square(4)	0.0000

Model 2: Heteroscedasticity Test: White

F-statistic	7.698224	Prob. F(14,1882)	0.0000
Obs*R-squared	102.7500	Prob. Chi-Square(14)	0.0000
Scaled explained SS	188.9328	Prob. Chi-Square(14)	0.0000

Model 3: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	14.63942	Prob. F(5,1892)	0.0000
Obs*R-squared	70.69422	Prob. Chi-Square(5)	0.0000
Scaled explained SS	201.8834	Prob. Chi-Square(5)	0.0000

Model 3: Heteroscedasticity Test: White

F-statistic	11.37916	Prob. F(20,1877)	0.0000
Obs*R-squared	205.2439	Prob. Chi-Square(20)	0.0000
Scaled explained SS	586.1204	Prob. Chi-Square(20)	0.0000

Table 18: Heteroscedasticity Test Results for Weekly Models

Model 4: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.178702	Prob. F(6,420)	0.0041
Obs*R-squared	12.88892	Prob. Chi-Square(6)	0.0048
Scaled explained SS	14.22727	Prob. Chi-Square(6)	0.0072

Model 4: Heteroscedasticity Test: White

F-statistic	1.956324	Prob. F(27,399)	0.0034
Obs*R-squared	49.91905	Prob. Chi-Square(27)	0.0046
Scaled explained SS	55.10249	Prob. Chi-Square(27)	0.0011

Model 5: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.723384	Prob. F(5,422)	0.0079
Obs*R-squared	8.564556	Prob. Chi-Square(5)	0.0077
Scaled explained SS	22.28047	Prob. Chi-Square(5)	0.0005

Model 5: Heteroscedasticity Test: White

F-statistic	2.874007	Prob. F(20,407)	0.0000
Obs*R-squared	52.96567	Prob. Chi-Square(20)	0.0001
Scaled explained SS	137.7888	Prob. Chi-Square(20)	0.0000

Model 6: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.568564	Prob. F(5,421)	0.0077
Obs*R-squared	7.809119	Prob. Chi-Square(5)	0.0071
Scaled explained SS	13.94012	Prob. Chi-Square(5)	0.0160

Model 6: Heteroscedasticity Test: White

F-statistic	0.938160	Prob. F(20,406)	0.0084
Obs*R-squared	18.86202	Prob. Chi-Square(20)	0.0008
Scaled explained SS	33.67074	Prob. Chi-Square(20)	0.0284

Table 19: Autocorrelation Test Results for Daily and Weekly Models

Daily Models:

Model 1: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	92.40186	Prob. F(2,1889)	0.0000
Obs*R-squared	169.0481	Prob. Chi-Square(2)	0.0000

Model 2: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	882.5825	Prob. F(2,1890)	0.0000
Obs*R-squared	916.1059	Prob. Chi-Square(2)	0.0000

Model 3: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	66.87918	Prob. F(2,1890)	0.0000
Obs*R-squared	125.4465	Prob. Chi-Square(2)	0.0000

Weekly Models:

Model 4: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	23.45249	Prob. F(2,418)	0.0000
Obs*R-squared	43.08068	Prob. Chi-Square(2)	0.0000

Model 5: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	286.8432	Prob. F(2,420)	0.0000
Obs*R-squared	247.0979	Prob. Chi-Square(2)	0.0000

Model 6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	118.6363	Prob. F(2,419)	0.0000
Obs*R-squared	154.3801	Prob. Chi-Square(2)	0.0000

After completing all the tests regarding heteroscedasticity and autocorrelation, we found that the models exhibit an AR(1) process and we have taken this into account in estimating our models by putting another AR(1) variable into the model to correct the serial correlation problem.

The regression models are summarized in the following tables.

Table 20: Regression Results of Model 1

Explanatory Variables	Dependent Variable: BAS		
	Coefficient	P-value	t-Statistics
Government Bond Return	1.997	0.000	8.48
Government Bond Return Volatility	0.408	0.000	6.302
MOVE Index	-0.847	0.000	-4.470
FX Volatility	0.424	0.000	6.664
R-Square	0.480		
Prob(F-Statistic)	0.0000		
Number of Observations	1897		

Table 21: Regression Results of Model 2

Explanatory Variables	Dependent Variable: Bond Volume		
	Coefficient	P-value	t-Statistics
Government Bond Return	-3.448	0.000	-8.264
Government Bond Return Volatility	-0.312	0.001	-3.305
MOVE Index	1.948	0.000	3.510
FX Volatility	-0.822	0.000	-8.566
R-Square	0.371		
Prob(F-Statistic)	0.0000		
Number of Observations	1897		

In models 1 and 2 we estimated the impact of bond return, bond return volatility, FX volatility and MOVE Index on the secondary market liquidity in bond markets. We used two different dependent variables to measure liquidity: bid ask spread and transaction volume. The results are in line with our expectations and with the literature. Specifically, government bond return volatility had a positive impact on bid-ask spread, which means that an increase in volatility causes bid-ask-spread to increase and hence liquidity to decrease. Similarly, FX volatility has a positive impact on bid-ask-spread which means that an increase in this volatility causes bid-ask spread to increase and hence secondary market liquidity to decrease. The only unexpected results come from MOVE Index. An increase in this index decreases bid ask spread and hence improve secondary market liquidity. These results generally confirm our first hypothesis that volatility/uncertainty had a negative impact on secondary market liquidity. We did the same analysis this time using transaction volume as a proxy for secondary market bond liquidity. Again, the results confirm our first hypothesis that volatility/uncertainty had a negative impact on secondary market bond liquidity. Specifically, government bond return and bond return volatility had negative impact on bond transaction volume which means that an increase in volatility decreases transaction volume and hence deteriorate secondary market liquidity. Similarly, an increase in FX volatility has a negative impact on transaction volume and hence on secondary market liquidity. MOVE Index again surprisingly, has a positive impact on transaction volume.

The impact of return volatility on secondary market liquidity had been examined in the past in Turkey. However, we proved that not only return volatility but also volatilities that arise from FX markets and from international markets had also a significant impact on secondary bond market liquidity.

However, we also argue that volatilities that arise from qualitative variables such as from arrivals of political and economic news may also have a deteriorating impact on secondary market bond liquidity. To measure the impact of these qualitative variables one should use intra-day data and should look at the behavior of liquidity when the economic or political news arrive and we leave this for future researchers as we do not have intra-day data at hand.

The regression results of the Model 3 are shown in the following table. Here, we tried to estimate the impact of return volatility and global stock market liquidity on secondary market stock liquidity which is measured by total transaction volume in Borsaistanbul Stock Market.

Table 22: Regression Results of Model 3

Explanatory Variables	Dependent Variable: BIST100Volume		
	Coefficient	P-value	t-Statistics
BIST100 Return	1.001	0.058	2.585
BIST100 Return Volatility	0.035	0.049	1.965
VIX Index	-0.202	0.000	-6.775
FX Volatility	0.041	0.003	2.903
R-Square	0.381		
Prob(F-Statistic)	0.0000		
Number of Observations	1897		

For stock market we used total transaction volume as a proxy for secondary market liquidity. Although the transaction volume is the sum of all transaction volumes of stocks traded at Borsaistanbul, we believe that it is one of the best aggregate liquidity indicators for stock markets.

The global fear index regarding stock markets, which is measured by VIX index, has negative and significant impact on secondary stock market liquidity. The return volatility, produced insignificant results and these are again in line with our hypothesis that volatility and uncertainty had negative impacts on secondary market liquidity in stock markets. However, as we argued for bond market, volatility or uncertainty that arise from qualitative variables such as from news arrivals should also been analyzed in future research using intra-day data.

By using models 1-3, we showed that return volatility as well as global fear factors regarding bond and stock market has significant and negative impacts on secondary market liquidity both in stock markets and bond markets after global financial crisis in Turkey. We argue that these results are in line both with our expectations and with the literature so far although the global fear factors have been firstly used in this thesis as drivers of secondary market liquidity.

If we interpret the regression results from another perspective, what we find is that the secondary market liquidity in bond markets deteriorates after May 2013, which is the time of famous Bernanke's speech. This speech changed the expectations of market participants regarding the availability of global liquidity as Bernanke hinted the exit strategy of monetary policy of the FED and beginning of the normalization of the monetary policy. These explanations had significant negative impacts on global investors and these investors decreased their holdings of bond stock in emerging markets including Turkey.

These interpretations led us to extend our econometric model by incorporating the holdings of nonresidents in bond and stock markets. As we have seen in descriptive analysis, after May 2013, the deterioration in secondary bond market coincided with the decrease of holdings of nonresidents. Based on this, we constructed the following models using weekly data:

M4: $BAS = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 FX\ Volatility + \beta 5 GBondnonresidents$

M5: $GBondvolume = \alpha + \beta 1 GBondreturn + \beta 2 GBondreturnvol + \beta 3 MOVE + \beta 4 FX\ Volatility + \beta 5 GBondnonresidents$

M6: $BIST100volume = \alpha + \beta 1 BIST100return + \beta BIST100returnvol + \beta 3 VIX + \beta 3 FX\ Volatility + \beta 5 Stcoknonresidents$

The regression results of Models 4 and 5 are shown in the following tables.

Table 23: Regression Results of Model 4

Explanatory Variables	Dependent Variable: BAS		
	Coefficient	P-value	t-Statistics
Government Bond Return	2.610	0.000	9.198
Government Bond Return Volatility	0.181	0.005	1.458
MOVE Index	-0.297	0.127	-1.527
FX Volatility	0.631	0.000	9.373
Gbondnondresidents	-1.224	0.000	-7.208
R-Square	0.378		
Prob(F-Statistic)	0.0000		
Number of Observations	428		

Table 24: Regression Results of Model 5

Explanatory Variables	Dependent Variable: Bond Volume		
	Coefficient	P-value	t-Statistics
Government Bond Return	-2.678	0.001	-3.184
Government Bond Return Volatility	-1.124	0.000	-2.411
MOVE Index	-1.575	0.000	-3.332
FX Volatility	-0.831	0.000	-5.023
Gbondnondresidents	-0.289	0.518	-0.646
R-Square	0.286		
Prob(F-Statistic)	0.0000		
Number of Observations	428		

In models 4 and 5 we tested the impact of government bond return volatility, move index, FX volatility and the stock of nonresidents in bond markets on the secondary market liquidity. In model 4 we used bid-ask spread as the dependent variable to measure secondary bond market liquidity and in model 5 we used bond transaction

volume. Return volatility, FX volatility and the stock of nonresidents are three significant drivers of secondary market liquidity when measured by bid ask spread. However, in model 5 we see that return volatility, MOVE index and FX volatility are significant drivers of government bond transaction and bond holdings of foreigners are not significant drivers of liquidity when measured by transaction volume.

Table 25: Regression Results of Model 6

Explanatory Variables	Dependent Variable: BIST100Volume		
	Coefficient	P-value	t-Statistics
BIST100 Return	0.2811	0.450	0.752
BIST100 Return Volatility	0.060	0.010	2.343
VIX Index	-0.179	0.002	-3.011
FX Volatility	0.034	0.233	1.193
Stocknonresidents	0.095	0.0050	1.930
R-Square	0.281		
Prob(F-Statistic)	0.0000		
Number of Observations	428		

In model 6, we tested the impact of return volatility, VIX Index, FX volatility and stock of nonresidents on the transaction volume in stock markets. VIX Index and stock of non- residents have significant impacts on transaction volume of BIST100 at Borsaistanbul. FX volatility, which negatively impacts secondary market liquidity in bond market, does not have significant impact on secondary market liquidity in stock markets. One potential explanation for this may be the fact that nonresidents hold almost 60-65 percent of stock in stock market whereas this ratio is around 20 percent in government bond market.

If we summarize our findings we argue that volatility/uncertainty has a negative impact on secondary market liquidity both in government bond and stock markets. However. the type of volatility or the ways we measure this volatility differ among bond and stock markets. The global uncertainties, which is measured by MOVE index for government bond market has a negative impact on secondary market liquidity measured in terms of

transaction volume but does not have a significant impact on bid-ask spread in government bond market. On the contrary, government bond stock of nonresidents have a negative impact on bond market liquidity measured in terms of bid-ask spread whereas it does not have significant impact on bond market transaction volume. However, FX volatility is a significant driver of secondary market liquidity both in terms of bid-ask spread and bond market transaction volume.

Regarding stock market, the global uncertainties measured by VIX Index, have significant and negative impacts on transaction volume. FX volatility, which has a negative impact on government bond market secondary liquidity does not have a significant impact on transaction volume in stock markets. The stock of non-residents has a negative and significant impact on transaction volume at Borsaistanbul.

In sum, as we argued in our hypotheses, uncertainties that arise from global or domestic financial markets and the behaviors of foreign investors are the key drivers of secondary market liquidity in bond and stock markets in Turkey.

Table 26: A Comparison of our Hypotheses with Our Findings

Hypotheses	Dependent Variable(s)	Explanatory variables	Emprical Findings
1) The secondary bond market liquidity is negatively affected by uncertainty or volatility	- Bid ask spread - Transaction volume in bond markets	- Bond return Volatility - FX Volatility	Both bond return volatility and FX volatility positively impacted bid ask spread which means that an increase in these variables led to an increase in bid ask spread and hence to deterioration in liquidity. These variables also negatively impacted bond transaction volume which supports our hypothesis
2) The secondary bond market liquidity is positively affected by the availability of foreign investors in domestic debt market.	- Bid ask spread - Transaction volume in bond markets	- Return volatility - Bond holdings of non-residents - FX Volatility - MOVE index	Return volatility, FX volatility and bond holdings of nonresidents are significant drivers of liquidity measured by bid ask spread and MOVE index is significant when the liquidity is measured by transaction volume
3) The secondary stock market liquidity is negatively affected by uncertainty or volatility	- BIST100 volume of transactions	- VIX - Return Volatility - FX Volatility	The VIX index, return volatility and FX volatility negatively affected transaction volume of BIST 100 index
4) The secondary stock market liquidity is positively affected by the availability of foreign investors in domestic stock market.	- BIST100 volume of transactions	- VIX - Stock holdings of non-residents	VIX index and holdings of nonresidents at Borsaistanbul are significant drivers of stock market liquidity

5. POLICY CONSIDERATIONS

Formulating and implementing policies to enhance secondary market liquidity is not an easy task because of several reasons.

First, the concept of secondary market liquidity is a complex one, which makes it challenging to define and/or to measure and hence to offer appropriate policy alternatives. For instance, some policy measures may be helpful in increasing transaction volume, yet they may not be able to decrease bid-ask spread, which is another measurement technique of the secondary market liquidity. Moreover, some policies may increase secondary market liquidity yet they may not be able to prevent decreasing liquidity in turmoil's or when the liquidity dries up for some reason, the policies may not be able to bring it back to its normal levels.

Second, although secondary market liquidity is a desirable feature, most of the market participants are not willing to privately provide liquidity and they wait others to provide it. Moreover, although liquidity is not only desirable by governments or public institutions, private market participants usually do not provide liquidity as desired. In other words, secondary market liquidity is considered as a public good and market participants always wait public institutions to formulate policies to enhance it and they wait to reap the benefits of these policies.

Third, as we discussed in the previous chapter, volatility and uncertainty has a detrimental impact on the secondary market liquidity. However, most often it is almost impossible to find appropriate policies for large fluctuations in financial market especially at the global level.

Yet, public institutions have some policy tools to provide secondary market liquidity or to enhance resiliency of the liquidity. In this chapter, we will first discuss liquidity enhancing factors and policy alternatives from a practical perspective.

5.1. Liquidity Enhancing Factors

In this section will present ten factors that we believe are crucial importance for enhancing liquidity in bond and stock markets.

1) **Availability of PD System:** As we discussed before, one of the main advantage of having a PD system is to enhance secondary market liquidity. PDs have the obligations to make transactions in the secondary market in line with the rules of the Treasury. For instance, in Turkey PDs have to give bid and ask quotations every five minute and the spread between these bid and ask quotations are determined by the Treasury. Moreover, since PDs have also an active role in primary markets, they may use this role in providing liquidity in secondary markets, i.e. they may buy large amounts of securities in the primary market and sell in the secondary market to reap the benefits of capital gains.

2) **Nominal Stock of the Security and Reopening**: Market participants buy securities either to keep in their portfolio or for their customers. Hence, the amount of the security must be high enough to meet the demand of market participants both for their portfolios and for their customers. If there are not enough securities, market participants become unwilling to sell their securities in secondary markets. Hence. Treasury has a policy of reopening which means that Treasury increases the nominal stock of a security by reopening, meaning that they sell the same security until the stock of security reaches certain level which is sufficient for secondary market liquidity.

3) **On the Run-Off the Run Distinction:** On the run securities are securities whose reopening still continue and off the run securities are those that the issuer of the security has completed reopening of the security and started to issue another security. For example, if the Treasury issues a government bond with a maturity of 10 year from now on and the Treasury continues to sell the same security in the coming months, this security is said to be on the run security. However, when the Treasury stops issuing that particular security and starts to issue another 10 year government bond, the former

becomes off-the run and the new security becomes the new on the run security. Both the theory and the literature argues that on the run securities are more liquid compared to off-the run securities.

4) Concentration of Securities across Investors: The concentration level of securities across investors is another factor that helps explain secondary market liquidity. When the security is concentrated in the balance sheets of a few investors, we observe a deterioration of market liquidity as these investors keep these securities in their balance sheets until maturity.

5) Buy-back Mechanisms: Sometimes Issuers of securities may initiate buy-back programs to buy their securities in the secondary market before maturity. This is a useful policy for enhancing market liquidity because market participants believe that they can resell these securities to the issuer when they need cash. Turkish Treasury adopted that kind of policy beginning from 2016 onward and this will be discussed in the second section of this chapter.

6) **Distribution and Behaviors of Investors:** Some investors purchase securities for managing their balance sheet and they keep these securities in their balance sheet until maturity which is not a desirable feature from market liquidity perspective. Others on the other hand, purchase securities bot for managing their balance sheet and for trading. These investors (especially banks in Turkey) keep some of the securities in their balance sheet until maturity and some of the securities in their trading book to buy and sell in the secondary market and to make profits from these transactions. In Turkey, insurance companies and public institutions constitute the first type, whereas banks and nonresidents constitute the second type of investors. The liabilities of insurance companies are usually long term and to manage these long-term liabilities they keep securities until maturity which is not desirable from market liquidity perspective. Public institutions on the other hand keep securities until maturity because they lack the necessary financial and institutional capacity to make transactions in the secondary market.

7) Short Selling of Securities: Short selling is the sale of a security that is not owned by the seller or that the seller is borrowed. This strategy is used when the seller expects the price of the security will decline. In Turkish financial sector, market participants can short sell their securities when they have the permission from Capital Markets Board. Moreover, short selling is allowed only in stock market and government securities are not allowed to be subject to short selling. Although short selling is widely discussed and questioned especially during global financial crisis; it may have a positive impact on the secondary market liquidity when the market is well regulated with concrete rules, limits and procedures.

8) Securities Lending Markets: Although government securities are traded in primary and secondary markets, the availability of securities lending markets also has an impact on secondary market liquidity. Although such a market is established in 2003 under Central Bank of Turkey, there has not been any transaction so far in this market. In this market, only benchmark securities are allowed to trade and only primary dealers can borrow or lend securities in this market. Non-pd banks can lend securities but they cannot be borrowers.

9) **Electronic Trading Platforms:** The availability of electronic trading platforms are useful both for stock and bond markets. These platforms help markets to function in a more transparent and efficient manner by providing the necessary data on a timely basis. Moreover, these platforms increase the speed of transactions in a given time and hence directly contribute to secondary market transactions. The NASDAQ Project under Borsaistanbul will increase the capacity of electronic trading platforms and is expected to have positive impact on the secondary market liquidity both in government securities markets and in stock markets.

10) Regulations: The regulations regarding banking and financial sector has an undeniable impact on market liquidity both for stock markets and for bond markets. For instance, taxation of financial instruments, Basel regulations regarding banking sector may change the behaviors of financial market participants in taking risk or in providing liquidity by changing their attitude towards PD system.

Based on our discussion so far, we argue that there are many diverse factors which contribute to enhancing liquidity both in bond and stock markets. These factors are taken into account in developing policies by governments. However, the experience in many countries suggests that market liquidity may suddenly disappear and the private provision of liquidity may not be sufficient especially during stress times. Hence, policy makers should constantly monitor market conditions and should have clear strategy for periods when the liquidity dries up. In the following section we will briefly discuss the measures taken by Turkish Treasury to enhance secondary market liquidity in bond markets during global financial crisis and in the following section we will discuss future policy alternatives.

5.2. Turkish Treasury's Policies to Enhance Secondary Market Liquidity in Bond Markets

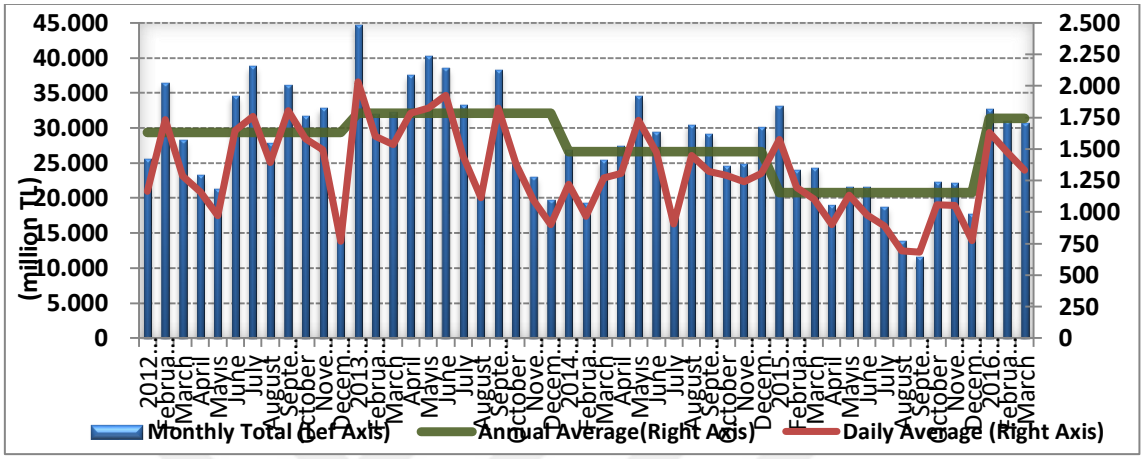
As we demonstrated in the previous chapter, the secondary bond market liquidity started to deteriorate after Bernanke's famous speech in May 2013. This speech has been a turning point in international capital markets, as after that speech, financial market participants closely monitored major central Banks' policies, speeches and actions to get some insight on the timing and speed of exit strategy form their expansionary unconventional monetary policies.

5.2.1 The Causes of the Decrease in Secondary Market Liquidity in Government Bond Market

As we empirically tested, the actions of central banks policies and markets reactions to these policies have created volatility/uncertainty in global financial markets and this volatility/uncertainty negative impacted secondary market liquidity in government bond markets. Moreover, as we also empirically tested, the share of non-residents in domestic debt markets, which showed a declining trend after May 2013, also negatively affected secondary market liquidity.

The following graph shows the transaction volume in Borsaistanbul beginning from the 2012 until the first quarter of 2016.

Figure 32: Trading Volumes in Borsaistanbul Debt Securities Market (million TL)



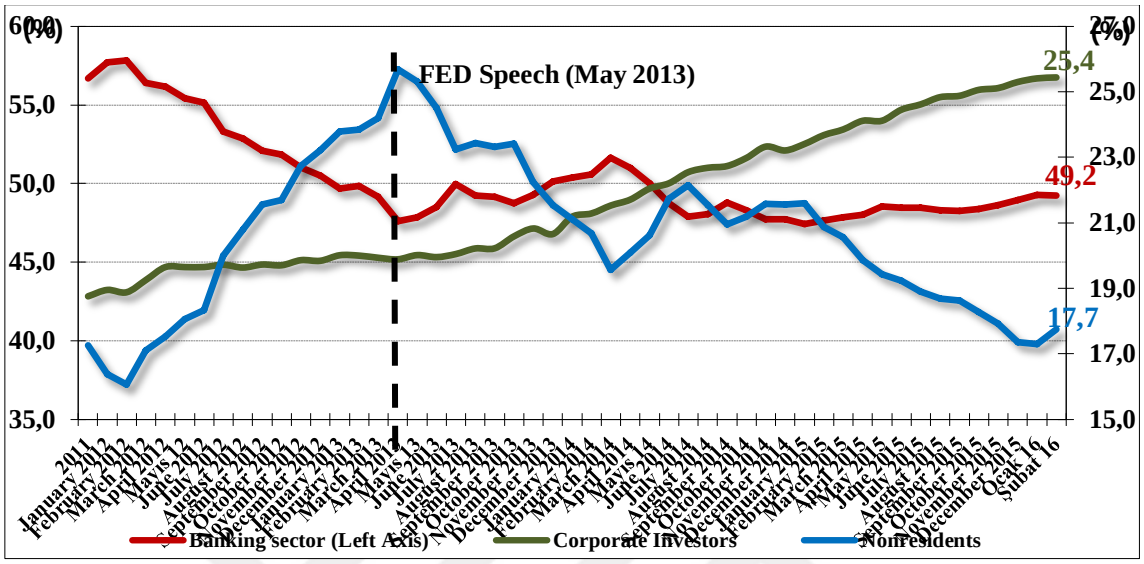
Source: Turkish Treasury

The monthly transaction volume, which was above 40 billion TL at the beginning of 2013, declined around 10 billion in September 2015. In response to this declining trend, the Turkish Treasury had some measures first to stop declining secondary market liquidity and then to enhance it.

Form a policy analysis perspective Turkish Treasury focused on the following causes of the decline of secondary market liquidity:

i) Developments in Investor Base: The shares of pension funds, mutual funds and public funds in government domestic bond stock increased while the shares of banks declined. As these investors are buy-hold strategists unlike banks who are main traders, the increase in the shares of buy and hold investors negatively impacted secondary market bond liquidity.

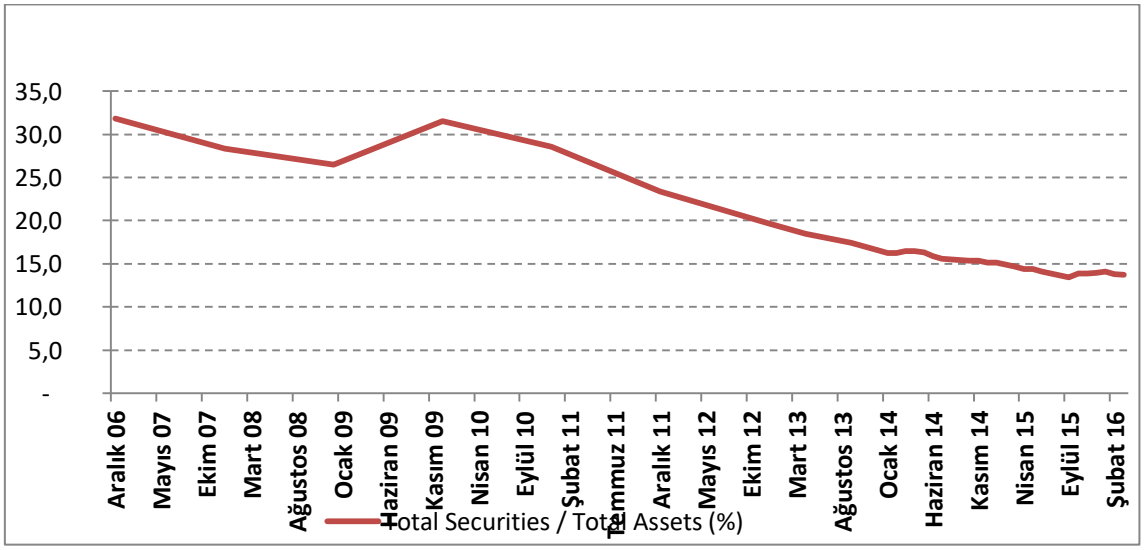
Figure 33: Share of Domestic Debt by Holders (%)



Source: Turkish Treasury

In addition to decline in the share of banking sector in total government debt bond stock, changes in the structure of the banking sector balance sheet and the securities portfolio in banking sector balance sheet also negatively impacted secondary market liquidity in government bond market.

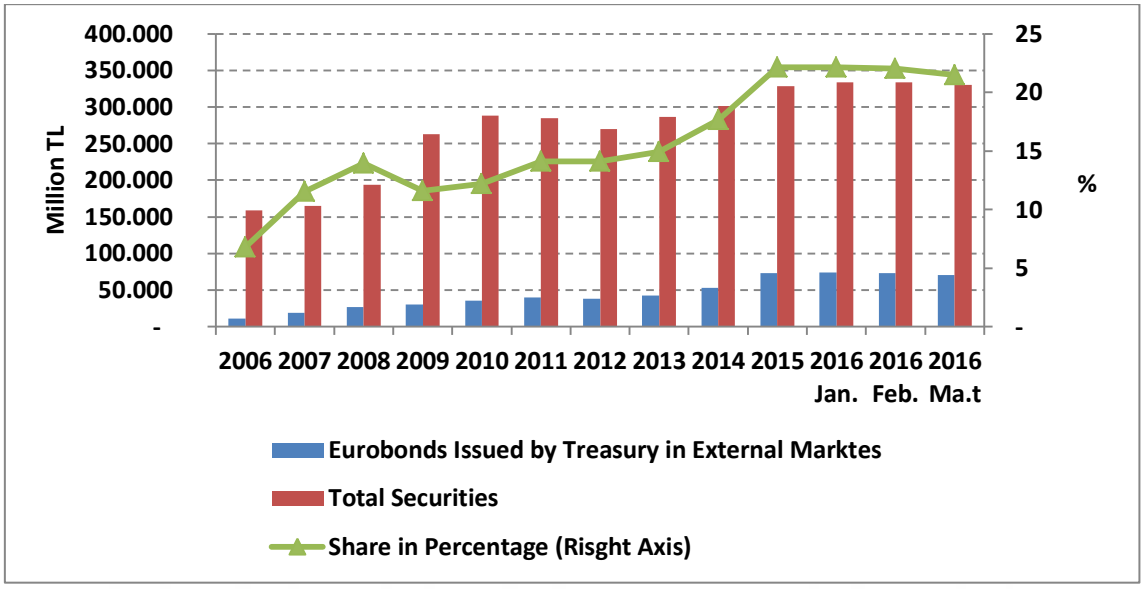
Figure 34: Total Securities/Total Assets in Banking Sector Portfolio (%)



Source: Turkish Treasury

As one can see from figure 34, the share of securities in assets in banking sector balance sheet declined to historically low levels as of end of 2015. In addition to that, the share of Eurobonds in total securities portfolio has increased.

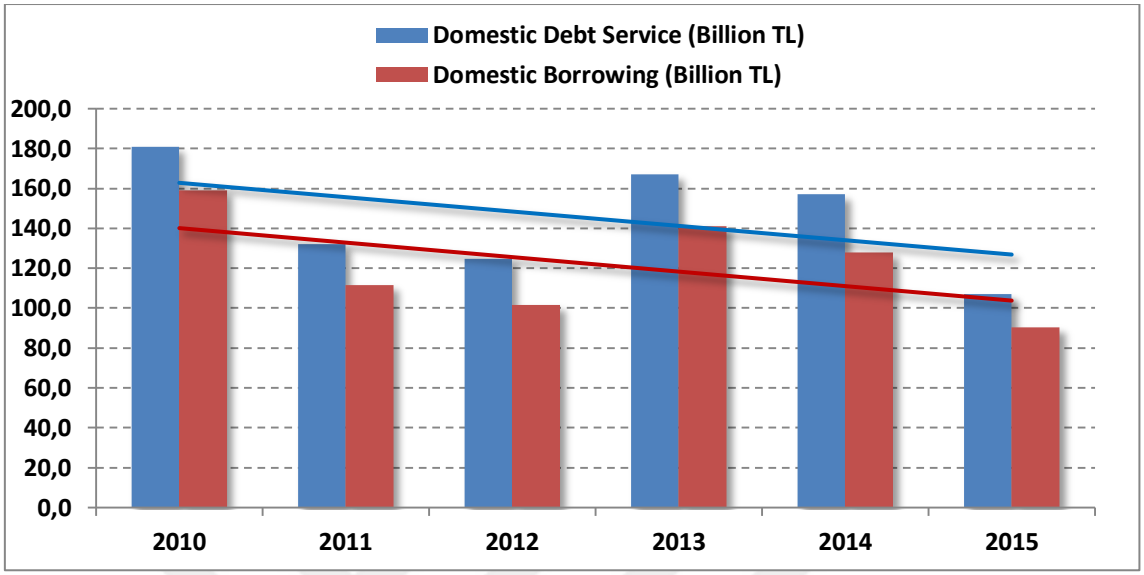
Figure 35: Eurobonds' Share in Total Securities Portfolio in Banking Sector (%)



Source: Turkish Treasury

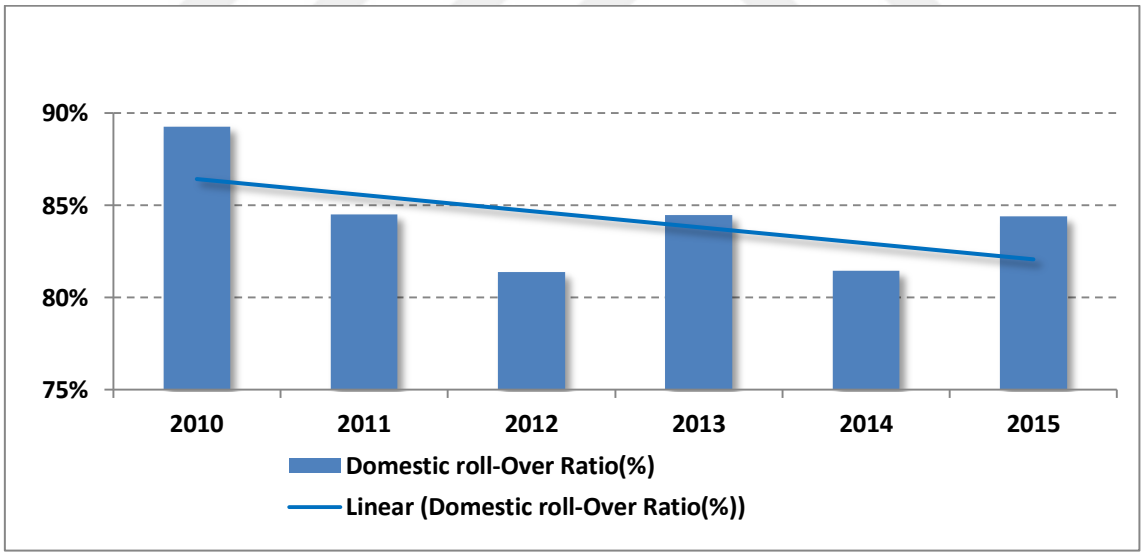
ii) Decrease in Borrowing Requirements: The borrowing requirement of Turkish Treasury decreased and the maturity of the debt stock increased thanks to fiscal discipline ad prudent borrowing policies maintained for more than 10 years. As a result, domestic debt service, supply of domestic government securities in the primary market and the domestic rollover ratio showed declining trend.

Figure 36: Eurobonds' Share in Total Securities Portfolio in Banking Sector (%)



Source: Turkish Treasury

Figure 37: Domestic Roll-Over Ratio (%)



Source: Turkish Treasury

iii) Impact of Different Structures of Securities on Liquidity: Due to their variable interest payment structure, Floating Rate Notes (FRNs) and Inflation-Indexed Bonds are usually demanded by institutional investors, such as by banks, for asset-liability management for their balance sheet. So these securities have lower trading volumes than the fixed rate bonds. Moreover, the pricing mechanism of FRNs is much more

complex. Their coupon payments lag the market interest rates up to six months, prices of these securities do not converge to the par value at the coupon payment date.

As we discussed before, the total stock of a debt security is an important indicator of secondary market liquidity and Turkish Treasury increases the stock of security by reopening. However, due to their structure, lease certificates cannot be reissued and their stock cannot be increased. In addition, these certificates have generally less liquidity since they are demanded by buy and hold type of investors for the portfolio and balance sheet management purposes.

In general, the increase in the number and types of securities issued caused decline in the total amount of issuance of fixed coupon bonds traded in secondary market.

5.2.2 The Measures Taken by Turkish Treasury to Increase Secondary Market Liquidity in Government Bond Market

Although there are many and diverse reasons for the decline in the secondary market bond liquidity, most of them are out of control of Turkish Treasury. For instance, the Treasury cannot determine the behavior of institutional investors in using government securities in their trading book or not. Moreover. the Treasury cannot control whether banks mostly invest in domestic securities or in Eurobonds. Yet, the Treasury had other policy tools to enhance secondary market liquidity, which we discussed below.

5.2.2.1 Narrowing the Bid-Ask Spread in PD System

The PD system has been implemented in Turkey without interruption since 2002. The system is beneficial both for the functioning of primary government securities market and for secondary market. According to PD contract signed between PD banks and Turkish Treasury, PD banks shall give bid and ask prices every trading day for benchmark securities in the secondary market. Bid and offers shall be quoted in terms of prices for coupon securities and the maximum spreads between bid and ask quotations

are decided by Treasury. Until the end of 2015, the spread between bid and ask prices was 50 kurus for all securities regardless of maturity. Based on the theory that narrow bid ask spreads reflect higher secondary market liquidity. The Treasury decided to change the PD contract to differentiate the maximum spread between bid and ask quotations according to maturities of benchmark securities in 2016.

Table 27: New Bid-Ask Spread Quotations After 2016

Maturity Intervals for Bid-Ask Quotations	Maximum Spread Between Bid and Ask Quotations (TL Kurus)
0-2 Years (2 Year included)	20
2-5 Years (5 Year included)	30
5-10 Years (10 Year included)	40
10 Years +	50

Source: Turkish Treasury

5.2.2.2 Regular Buy-Back Auctions

One of the important factors for high and resilient secondary bond market liquidity is the total stock of the security. The higher the stock is the better for the secondary market liquidity. However, due to decline in borrowing requirements and rollover ratios, the stock of government securities could not be increased sufficient enough to enhance liquidity. The main risk behind increasing the stock of a government security is the increased refinancing risk at the maturity date. To overcome this problem and to enhance secondary bond market liquidity the Treasury initiated regular buy-back auctions beginning from March 2016. According to this policy, the Treasury increased the nominal stock of benchmark 5 and 10 year securities during the security are on the run. When the stock reached a sufficient certain level, the Treasury stopped reissuing and started buying back some of the stock on a regular weekly auctions after the security becomes off the run. This policy had several benefits for enhancing secondary market liquidity. First. it allowed the Treasury to increase the nominal stock of the

security. Second, the buy-back program had allowed Treasury to gradually lower the stock and hence the refinancing risk at the maturity. Third, PD banks had the opportunity to bring the security back to the Treasury when they are not able to sell them in the secondary market.

In conclusion, both narrowing down the bid-ask spread policy and the buyback programs had significant impacts on secondary bond market liquidity and the daily transaction volume that decreased to 1 billion in 2015 climbed back to 1.5 billion just after these policies had been implemented.

5.3. Latest Developments and Future Policy Discussions

After the global financial crisis we observed the following developments which may have an impact on market liquidity (IMF. 2015):

1) Regulatory Changes to Curb Risk Taking of Banks: The new regulatory framework for banking sector, Basel III, may have positive or negative impact on the market liquidity. They may reduce liquidity when they cause banks to be less willing in being a primary dealer, which may decrease liquidity. On the other hand, these measures may contribute to the improvement in market liquidity by making financial system much safer. Yet, there has not been enough time to assess the impact of Basel III policies.

2) Change in Business Models of Market Makers: Market makers changed their business models by switching from being dealers to being brokers. In other words, they started to behave as risk distributers instead of risk warehousers because of technological changes and because of the concerns regarding efficient management of their balance sheets.

3) Smooth Normalization of Monetary Policy: As we discussed in the previous chapter, expansionary monetary policies of the FED and ECB had created significant

volatilities in financial market which hampered market liquidity. These central banks are now ready for their exit strategy and this exit strategy should be implemented with great transparency and smoothly to avoid any disruption in financial markets. A sudden normalization strategy may cause sudden decline or stops in risk appetite which may further deteriorate market liquidity.

Based on our observations and empirical findings in the previous chapter we propose the following policy alternatives that may be valid both for bond markets and stock markets.

1) The markets should be redesigned for standardization of instruments, to design circuit breakers that takes not account liquidity in addition to prices and to enhance transparency.

2) Electronic platforms should be the norm and new market participants should be allowed to participate in these platforms to broaden investor base. However, trading algorithms in these platforms should be closely monitored because they may sometimes be harmful for market liquidity especially during volatile times since they have lower adaptability to extreme volatile conditions.

3) Derivative markets should be developed as the availability of them is a significant driver not only of better risk management but also for market liquidity.

4) Central Banks must take market liquidity into consideration in implementing monetary and liquidity policies. In Turkey securities lending program is available under CBT, however it did not function. CBT may take additional measures to revive this program. Moreover, during stress times Central Banks should use various policies, such as collateral policy, to enhance market liquidity.

5) Monetary authorities and other regulatory agencies in financial sector should closely monitor market liquidity for all asset classes. To capture all the features of the liquidity, several liquidity measures should be developed and monitored regularly.

6) Regulatory authorities should use liquidity stress testing for financial instructions by incorporating certain illiquidities in markets such as fire sales and risk of funding.

In conclusion, based on our discussion so far we argue that there are five key building blocks for enhancing market liquidity and keeping it resilient. These are:

1) Sound institutions and macro financial policies including the banking system, exchange system, as well as macro financial and debt management and monetary policies.
2) An efficient infrastructure including payment, trading settlement and clearing systems.
3) A well-functioning repo and derivatives markets
4) A diversified investor base
5) Stable regulatory environment

6. CONCLUSION

The concept of market liquidity has utmost importance for the development of financial markets and from the perspectives of central banks, Treasury, financial market participants and financial sector regulatory authorities. Despite its importance, the concept of liquidity is one of the least understood concepts in the literature.

We argued that there are four main reasons for it to be less understood and its importance to be undermined. First, there is no single type of liquidity and often different types of liquidities such as market liquidity, monetary liquidity and funding liquidity are confused. Second, liquidity has different features and a single liquidity measure may not be able to capture these different features. Third, although liquidity can be considered as public good, meaning that each financial sector participant benefits from the availability of it although they do not voluntarily contribute to it. Lastly, different stakeholders in financial sector, such as issuers of assets, traders, policy makers or financial sector regulators have different perspectives on the concept of liquidity.

The concept of market liquidity, which is the main focus of this thesis, is different from funding liquidity and monetary liquidity. Funding liquidity is the ability of market participants to obtain funding from financial markets at acceptable conditions whereas monetary liquidity is the liquidity that is provided to financial markets and to the economy through increase in monetary aggregates by central banks and monetary authorities. Although these concepts are different, there is a close relation among them. Specifically, funding liquidity is a prerequisite for market liquidity. Similarly, increase in monetary aggregates through monetary easing ease funding conditions and hence facilitate market making activities and help market liquidity.

The market liquidity is defined as the ability to make transactions at a low cost and with a limited impact on market price. This definition of liquidity incorporates the following important features of liquidity: tightness, depth, breath and resiliency.

A market is said to be tight when the bid-ask spread is narrow. The narrowness of the spread indicates a liquidity market and the wider the spread the less liquid is the market. The depth of a financial market illustrates the maximum transaction volume that can be executed without having an impact on the market price. Breadth of a financial market is similar to the concept of depth and many researchers use these terms interchangeably. The measurement of depth takes into account the best bid and ask prices above and below market prices whereas the breath takes into account all bids and ask prices above and below market clearing price. The resiliency of market liquidity shows the speed of returning back to normal liquidity when normal level liquidity disappears due to major event or financial stress.

Since the market liquidity has many and diverse features a single measure of it is not available. Hence, different techniques are developed in the literature to capture different aspects of liquidity. The conventional measures of liquidity are bid-ask spread, transaction volume, trading frequency, turnover ratio and liquidity index ratio. Yet, there are many other measures such as The Index of Martin, The ratio of Hui and Heubel, Roll's Price Reversal, Amihud's Illiquidity measure.

The secondary market liquidity has important implications for financial stability, for efficient functioning of financial markets, for risk management purposes, for central bank operations and for corporations and Treasuries.

First of all, a liquid secondary market allows different prices at different maturities so that an efficient yield curve can be established especially for fixed income securities such as government bonds and corporate bonds. The liquidity is not only a desirable feature for the safe functioning of the financial system but also for issuing part, especially for government debt offices who issue bonds in primary markets. A liquid security usually has higher demand compared with the same illiquid security.

The liquidity of government securities has also implications for central banks in conducting monetary policy and maintaining financial stability. The prices of liquid government securities contain useful information regarding the expectations of

monetary policies and central banks try to get this information by monitoring secondary market developments. Moreover, government bond market is also important for central banks due to their open market operations. Through these operations, central banks can increase money supply by buying back government securities or decrease money supply by selling these securities to markets. Hence, an illiquid government securities market may cause open market operations to fail or produce negative consequences. Secondary market liquidity of government securities is also important for central banks from financial stability perspective. Liquidity in these markets helps restore investor confidence and increase resiliency of financial markets against unexpected shocks and decrease systemic risk. The availability of liquidity decrease dependency on central banks as a last lender of resort since markets can easily get funding form liquid markets.

The concept of liquidity in stock markets was first initiated by Amihud in 1986 and has been subjected to research due to its implications for different perspectives. The liquidity in individual stock or in stock market has implications for pricing of the stock, returns, market efficiency, pricing behavior, dividend policy and firm value.

The liquidity in bond and stock markets has been deeply analyzed in literature. This research is concentrated mainly in two segments: one is on the drivers of secondary market liquidity and the other one is policy discussions regarding to increase liquidity. According to literature, drivers of secondary bond market liquidity can be classified in five categories: macroeconomic variables, financial variables, volatility or uncertainty, events or event announcements and market microstructure. The drivers of secondary market stock liquidity can be classified in two categories: firm and sector specific factors and macroeconomic factors.

In this thesis, we empirically tested the drivers of secondary bond and stock market liquidity by using time series data and OLS model after global financial crisis in Turkey and discussed policy measures taken by Turkish Treasury to enhance liquidity in bond markets and offered alternative policy alternatives. Specifically, we analyzed 2009-2017 period. This period consisted significant volatilities and uncertainties both in domestic and global financial markets due to central banks' policies to combat negative impacts

of global financial crisis through expansionary monetary policies and then through exit strategies. Not only their decisions but also the market expectations and any news regarding their policies created significant uncertainties in global financial markets. Especially after Bernanke's speech in May 2013 regarding on the exit strategy of the FED, global financial markets witnessed significant fluctuations and these fluctuations negatively impacted international financial flows to emerging economies including Turkey.

Based on the developments in global financial markets we formulated and tested the following two hypotheses regarding the drivers of secondary market liquidity in bond and stock markets:

i) The volatility or uncertainty in global financial markets has negatively affected the secondary bond and stock markets liquidity in Turkey

ii) The share of nonresidents in bond and stock markets has a significant and positive impact on secondary market liquidity.

To test our first hypothesis. we used daily data and used bid-ask spread and transaction volume as a measure of liquidity in bond markets and transaction volume of BIST 100 index as a measure of stock market liquidity. To capture global volatilities we included MOVE index for bond markets and VIX index for stock markets, to capture domestic volatilities we included return volatility of the bond or stock and FX volatility both for bond and stock markets.

We empirically found that return volatility as well as global fear factors regarding bond and stock market have significant and negative impacts on secondary market liquidity both in stock markets and bond markets after global financial crisis in Turkey. We argue that these results are in line both with our expectations and with the literature so far although the global fear factors have been firstly used in this thesis as drivers of secondary market liquidity in Turkey.

To test our second hypothesis, we included shares of nonresidents in bond and stock markets and used weekly data as the data on the share of nonresidents are available only weekly. Our results showed that as the share of nonresidents increases in bond or stock markets the liquidity improves.

We concluded our thesis with measures taken by Turkish Treasury to enhance secondary market liquidity in government bond market. As the secondary market liquidity deteriorated significantly especially after May 2013, the Turkish Treasury introduced some amendments in primary dealership system and introduced regular buy-back programs. One of the advantages of the primary dealership system is its contribution to the secondary market liquidity. The primary dealers are doing this by giving bid and ask quotations in secondary markets, whose spread are determined by the Treasury. The spread for quotations, which was 50 kurus until 2016 has been reduced and differentiated according to maturity. This policy contributed to enhance liquidity in bond markets. Another policy introduced by the Treasury to enhance liquidity has been the introduction of regular buy-back programs. Through this policy, the Treasury increased the stock of 5 and 10 year benchmark bonds through reopening. When they reached a certain level, to decrease refinancing risk at the maturity, Treasury started to buy back some portion of the stock of these securities. These two policies have been welcomed by market participants and we witnessed a significant increase in secondary market bond liquidity.

As with other researches, this research has also some limitations which are subject to future research. First of all, in our first hypothesis we argued that volatility or uncertainty has negative impact on liquidity and used some quantitative variables to measure domestic or international volatilities. During volatile periods, market makers usually are unwilling to trade their securities since they may not be able to appropriately price the value of their securities. However, some volatilities or uncertainties may not arise from quantitative macro and financial variables but from political or geopolitical developments such as announcements of politicians or policymakers. These announcements may have some impact on the secondary market liquidity and should be subject to new research. However, we argue that intra-day data, instead of daily data, will better capture the impact of announcements.

Second, in thesis, we analyzed the secondary bond market liquidity using only 2 year benchmark government bond data. However, Treasury issues not only 2 –year bond but also 5 and year maturities as well and the liquidity pattern of these securities may be different than that of 2 year bonds. Hence, this research may be extended by including these securities as well.

Lastly, to measure the liquidity in stock markets we used BIST 100 index. However, this index is and aggregate index and covers 100 different stocks from different sectors. The liquidity pattern may differ from one stock to another or from one sector to another. Hence, this research may be extended to cover sub-lists of BIST 100 index.

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TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

YAZARIN

Soyadı:

Adı:

Bölümü:

TEZİN ADI: A Comparative Analysis of Drivers of Liquidity in Bond and Stock Markets after Global Financial Crisis in Turkey

TEZİN TÜRÜ: Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir ☐

2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir ☐

3. Tezminden bir (1) yıl süreyle fotokopi alınamaz ☐

TEZİN KÜYÜPHANEYE TESLİM TARİHİ:

ÖZGEÇMİŞ

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Lisans	Boğaziçi Üniversitesi (İktisat)	2001

İŞ TECRÜBESİ

Yıl	Yer	Görev
2014 Kasım-Şu an	Hazine Müsteşarlığı	Genel Müdür Yrd.
2012-2014 Kasım	Hazine Müsteşarlığı	Daire Başkanı
2011- Yaz dönemi	Kuzey Karolayna Gelir İdaresi	Stajer
2008-2012	Hazine Müsteşarlığı	Uzman
2005-2008	Hazine Müsteşarlığı	Uzman Yardımcısı
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YAYINLAR

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TEZİN TÜRKÇE ÖZETİ

Finansal gelişme ile ekonomik gelişme ve kalkınma arasında önemli bir ilişki olduğu uluslal ve uluslararası birçok calisaya keno olmuştur. Finansal gelişme olarak ise bu çalışmalarda genellikle finansal sektörün büyüklüğü üzerine odaklanılmıştır. Halbuki bize göre finansal gelişmişliğin en önemli göstergelerden biri de finansal piyasalardaki ikincil piyasa likiditesinin varlığıdır. Finansal gelişmşliğin önemli göstergelerinden biri olmasına ragmen likidite kavramının mahiyeti ve önemi çoğu zaman yeterince anlaşılamamaktadır. Bunun temel sebepleri kavramın özellikerinin yeterince anlaşılamamış olması, tek bir ölçüm tekniğinin bulunmaması ve farklı paydaşların likidite üzerinde farklı algılamaları olması gösterilebilir.

Likidite, çok farklı özelliklere sahip olması bakımından çok karmaşık bir kavramdır. En basit olarak ikincil piyasa likiditesi piyasada işlem gören menkul kıymetlerin değerinden fazla bir şey kaybetmeden hızlıca el değiştirmesi olarak tanımlanabilir. Ancak bu tanımlama bile ikincil piyasa likitesinin özelliklerinin tümünü barındırmamaktadır. İkincil piyasının likit olması için alım satım kotasyonları arasındaki farkın dar olması, piyasa derinliğinin olması, ikincil piyasada işlem hacimlerinin yüksek olması ve dışsal bir şokla likidite daraldığı zaman tekrar eski seviyesine hızla gelmesi önemlidir. Tüm bu özellikleri bir arada ölçebilen bir likidite ölçüsü bulunmamakla beraber literatürde farklı birçok likidite ölçüm göstergesi bulunmaktadır. Bu göstergeler genellikle işlem hacmi, alım satım kotasyon farkı gibi temel göstergelere dayanılarak hesaplanmaktadır.

İkincil piyasa likiditesi bir kamu malı olarak düşünülebilir. Bir diğer deyişle tüm piyasa oyuncuları likiditenin varlığından faydalanırken kimse likiditenin artması için özel bir çaba sarfetmemekte, bunu karşı tarafdan veya düzenleyici otoritelerden beklemktedir. Likit piyasaların varlığı, farklı vadelerdeki senetlerin fiyatlarının etkin bir şekilde oluşması açısından önemlidir. Ayrıca senetleri birincil piyasada ihraç eden taraf için de likidite önem arz etmektedir. Örneğin, hazine tahvil ve bonolarının yendien ihracında ikincil piyasa likiditesi maliyet üzerinde önemli bir rol oynamakta, likit olmayan

piyasalarda borçlanma maliyetlerine likidite primi ilave edilmektedir. İkncil piyasa likiditesinin varlığı merkez bankalarının para politikası etkinliğini de artırmaktadır. Merkez bankalarının en önemli politika araçlarından birisis açık piyasa işlemleridir. Söz konusu araç ile merkez bankaları hazine bonosu ve tahvilleri piyasadan alıp karşılığında nakit vererek piyasaya para sürmekte, tersi bir işlemle de piyasadaki para miktarını azaltmaktadır. Bu operasyonlarda likit bir hazine bonosu ve tahvil piyasasının bulunması açık piyasa işlemlerinde kullanılan tahvil ve bonoların fiyatlarında etkinliğini artırarak parsal aktarım mekanzimasının daha etkin çalışmasına imkan sağlamaktadır. Tahvil ve bono piyasalarında olduğu gibi hisse senedi piyasalarında da likit bir piyasanın bulunması hem yabancı giriş ve çıkışlarını kolaylaştıracağı için güvence sağlamakta hem de ilk ihracı yapan şirketlerin daha sağlıklı halka arz yapmasına imkan sağlayabilmektedir.

İkincil piyasa likidtesini hangi faktörlerin olumlu, hangi faktörlerin olumsuz etkilediği ulusal ve uluslararası literatürde hem hisse senedi piyasası hem de tahvil ve bono piyasası için en çok araştırılan konuların başında gelmektedir. Bu çalışmalarda, tahvil ve bono piyasası için makroekonomik değişkenler, finansal değişkenler, oynaklık ve belirsizlikler ve piyasaların mikro yapısına ilişkin hususlar ikincil piyasa likiditesini belirleyen en önemli başlıklar olarak ön plana çıkmaktadır. Hisse senedi piyasası için ise firma ve sektöre özgü parametreler (kurumsal yatırımcılar, şirket sahipliği, temettü politikası gibi) ve temel makroekonomik göstergeler ikincil piyasa likiditesini belirleyen en önemli hususlar olarak öne çıkmaktadır. Türkiye'deki çalışmalarda ise tahvil ve bono piyasası ikincil piyasa likiditesi için en önemli belirleyici faktörün tahvil ve bonoların getirilerindeki oynaklık ve işlem hacmi olduğu gözlenmektedir. Hisse senedi piyasası için de yine getirilerdeki oynaklığın önemli bir etken olduğu gözlemlenmektedir.

Bu doktora çalışmasında literatürdeki bu tespitten yola çıkılarak Türkiye'de sadece getirilerdeki oynaklığın değil, sebebi ve kaynağı ne olursa olsun her türlü oynaklığın hem tahvil ve bono piyasasında hem de hisse senedi piyasasında ikicil piyasa likitesini olumsuz etkiledeği hipotezi ile yabancı yatırımcıların tahvil ve hisse senedi piyasalarına göstermiş oldukları ilgi emprik olarak test ve analiz edilmiştir. Söz konusu analizin dönemi olarak ise uluslararası piyasalarda oynaklığın arttığı dönem olan küresel finansal kirizin başlangıcı kabul edilen Ağustos 2007'den Eylül 2017'ye kadarki 10

yılık dönem olmuştur. Bu hipotezimizin temel dayanağı ise şu şekilde açıklanabilir. Türkiye'de finansal kesimin büyük bir kısmını bankacılık sektörü oluşturmaktadır. Bankalar özellikle tahvil ve bono piyasasında hem ikincil piyasada piyasa yapıcı olarak görev almakta hem de birincil piyasada aktif rol oynamaktadır. Hisse senedi piyasalarının alınıp satıldığı organize piyasalardaki aracı kurumların da pay sahipliğinde genellikle bankalar da bulunmaktadır. Bankalar gerek tahvil ve bono, gerekse hisse senedi piyasalarında alım satım yaparken almak istedikeri veya satmak istedikleri menkul kymetin fiyatını doğru bir şekilde tespit edebilmelidirler. Finans teorisine göre bir finansal varlığın fiyatı ise bu varlığın gelecekte getireceği nakit akımlarının, risk primini de içeren bir iskonto oranıyla bugüne indirgenmiş halidir. Bu sebeple özellikle risk primini içeren iskonto oranının belirlenmesinin büyük önemi vardır. Ancak özellikle küresel finansal piyasalarda volatilitenin arttığı dönemlerde risk primine ilişkin kaygıların da artması ve bunun da finansal varlıkların fiyatlanmasına olan olumsuz etkisi ikinci piyasa likitesini de olumsuz etkileyebilmektedir.

Belirttiğimiz dönemde analizi yapmadan önce küresel finansal krizin başlanıgıcı, geçirdiği safhalar ve krize karşı başta merkez bankaları olmak üzere alınan önlemler detaylı bir şekilde analiz edilmiştir.

Küresel finansal krizin başlangıcı olarak 2007 Ağustos ayı ele alınmıştır. Zira bu ayda LIBOR ve OIS arasındaki fark (spread) önemli bir sıçrama göstererek krizin ilk belirtisi olarak ortaya çıkmıştır. İncelenen dönemde öncelikle krizin tarihçesine odaklanılmış, daha sonar krize sebep olan yapısal faktörler ve krize karşı alınan merkez bankası önlemleri sunulmuştur.

Literatüre göre küresel finansal krizin temelinde küresel anlamda tasarruf fazlası kavramı yatmaktadır. Kimi araştırmacılara göre bu tasarruf fazlasının sebebi Çin ve Hinsitan gibi cari fazla veren ülkelerdir. Bu ülkeler tasarruflarını genelde ABD tahvil ve bono piyasalarında tuttukları için bu enstrümanlara olan talep faizleri aşağı çekerek krizi tetiklemiştir. Yaygın olan ikinci görüşe göre ABD merkez bankası olan FED'in ekonomideki canlanmayı sağlamak üzere 2001 yılından sonra para politikası faiz oranlarını ciddi bir şekilde aşağıya çekmesidir. Bunun neticesinde kredi genişemesi öyle boyutlara ulaşmış ki kredi almaya hak edecek geliri olmayan kimseler bile konut kredisi

alarak konut balonunu oluşmasına sebebiyet vermişlerdir. Ancak kredilerin zamanı geldiğinde bunların ödenmemesi konut balonunun sönmesine ve finansal krizin başlamasına sebebiyet vermiştir. Bu dönem krizin ilk aşaması olan ipotekli konut krizi olarak adlandırılmıştır. Bu krizden sonar başta bankalar olmak üzere ABD'deki finansal kuruşların karlarındaki gerileme, likidite krizine giren bazı bankaların (Lehman brothers ve Bear Sterns) iflası, emtia fiyatlarındaki hızlı artışlar ve en son kredi mekanzimalarının tamamen kesilmesi krizin diğer önemli aşamaları olarak tanımlanmaktadır.

Kriz temel olarak bu aşamalardan geçmiş olmakla beraber bu aşamaları anlamak tek başına krizi anlamak için yeterli olmayabilir zira bu aşamalara götüren yapısal bazı faktörler de krizin büyümesinde ve yayılmasında önemli rol oynamıştır. Bankaların denetiminin zayıf olması, finansal kuruluşların personellerine aşırı risk almayı teşvik edici bonuslar vermesi, finansal inovasyon sonucu yeni çıkan ürünlerin fiyatlamasında ve denetlenmesinde ortaya çıkan aksaklıklar, bankaların riskli varlıkları bilanço dışına çıkardıkarı için finansal sistemin daha sağlıklı bir yapıya kavuştuğu algısı, bilanço dışındaki riskli varlıklar için sermaye bulundurulma zorunluluğu olmamasısı yönündeki düzenlemeler, düzenleyici otoritelerin büyük bankalara kendi içsel risk modellerine göre işlem yapmaya yetki vermesi, finansal varlıkların daha karmaşık yapıya gelmesi ve son olarak artan kaldıraç etkisi bu yapısal faktörlerin en önemlileri olarak sıralanabilir.

Küresel finansal krize karşı hem gelişmiş ülkeler hem de gelişmekte olan ülkeler maliye ve para poltikaları araçlarını kullanarak önlemler almaya çalışmışlardır. Bu çalışma kapsamında küresel finansal piyasalarda daha fazla oynaklığa sebebiyet verdiği ve finansal piyasalar tarafındna daha yakından takip edildiği içi ABD merkez bankası olan FED ve Avrupa Merkez Bankasının para politikası tebdirleri analize dahil edilmiştir.

ABD merkez bankası küresel finansal kriz sonrasında öncelike para politikası faiz oranını en düşük seviye olan yüzde 0,25 seviyesine çekmiş ancak bunun yeterli olmayacağı anlaşılınca geleneksek olmayan para poitikası tedbirlerini devreye sokmuştur. Bu çerçevede FED politika faizini tarihi düşük seviyelere çekmekle beraber ilk etapta sağlam finansal kuruluşlara likidite desteği sağlamış, daha sonra kredi piyasasında temel borçlanıcı olan tüm kuruluşlara likidite desteği sağlamış ve son

aşamada ise uzun vadeli senetlerin alımına yönelmiştir. Mayıs 2013'te ise ekonomik aktivitedeki iyileşmeye bağlı olarak varlık alım programının sonlandırılacağı ve daha sonra enflasyon ve işsizlik oranlarındaki gelişmelere bağlı olarak faiz oranalrında artışa gidilebileceği kamuoyu ile paylaşılmıştır. Bu açıklama küresel finansal piyasalarda ciddi bir dalgalanmaya sebebiyet vermis ve FED'in bundan sonra atacağı adımlar, üyelerin açıkamaları ve para politikasına yön verecek olan makroekonomik her türlü gelişme yakından takip edilmeye başlanmıştır.

FED kadar olmasa da uluslararası piyasalar tarafından takip edilen bir diğer merkez bankası da Avrupa Merkez Bankası olmuştur. Avrpa Merkez Bankasının küresel finansal krize bakış açısıyla FED'in bakış açısı biribirinden farklı olduğu için uyguladıkları politikalar da farklılık göstermiştir. Avrupa Merkez Bankası da 2008 yılının sonundan itibaren 2010 Nisana yına kadar faiz oranlarını düşürmüş ve bilanço genişlemesine gitmiştir. Ancak ABD'den farklı olarak 2010-2011 dönemi Avrupa'da bazı ülkelerin borç kriziyle de uğraşmak zorunda oldukları bir dönem olduğu için bu dönemde Avrupa Merkez bankası bilanço daraltmaya öncelik vermiştir. Ağustos 2011'den 2013 Mayıs ayına kadar yine genişleyici para politikası uygulamsına devam edilerek hem faiz oranları azaltılmış hem de bilanço büyütülmüştür. Mayıs 2013 sonrasında ise FED'de olduğu gibi varlık alımlarının azaltılması ve sonlandırılması tartışmaları Avrupa Merkez Bankası'nın da gündemini işgal etmiştir.

FED ve Avrupa Merkez Bankasının politikaları krizin farklı dönemlerinde farklı seyirler izlemiştir. Öncelikle krizin ilk etapta ABD'de başlaması Avrupa tarafına sonradan yayılması bu iki merkez bankasının politika kararlararının zamanlamasına da yansımıştır. ABD'de kriz kredi değerliliği olmayan kesimlere kredi verilmesiyle bağdaştırılırken Avrupa'da ülkelerin yüksek borçluluk seviyeleri krizin temel özelliği olmuştur. Finansal kesimin yapısı da her iki coğrafyada farklılık göstermektedir. ABD'de sermaye piyasaları ağırlıklı bir finansal yapı varken Avrupa Birliğinde bankacılık ağırlıklı bir finansal yapı hakimdir. ABD'de para politiaksı ile maliye politikasının kooridnasyonu nispeten daha kolaydır zira tek bir para politikasına karşılık tek bir maliye politikası vardır. Avrupa Birliğinde ise tek bir para politikasına karşılık 17 farklı ülkenin 17 farklı maliye politkasının olması koordinasyonu güçleştirmektedir. İki coğrafyadaki merkez bankalarının amaçları da birinden farklılık göstermektedir.

FED'in tam istihdam ve fiyat istikrarı olmak üzere iki amacı varken Avrupa Merkez Bankası'nın tek amacı fiyat istikrarıdır. Son olarak Fed'in karar alma mekanizması 17 AB ülkesinin temsilcilerinin olduğu Avrupa Merkez Bankası'nın karar alma mekanizmasına göre çok daha esnek ve basit bir yapıdadır.

Fed ve Avrupa Merkez Bankası'nın kriz döneminde almış oldukları kararlardan özellike varlık alım programlarının tahvil ve bono piyasası ikincil piyasa likiditesine etkisi konusunda literatürde iki farklı yaklaşım bulunmaktadır. Bir görüşe göre bu tür alımlar ilave talep yarattığı için işlem hacimlerinin artmasına ve likiditenin artmasına sebep olmuştur. Diğer bir yaklaşım ise varlık alım programları piyasadaki tahvil stokunu azalttığı için ikincil piyasa likiditesini olumsuz etkilemiştir. Bu konuda farklı görüş ve yaklaşımların olması daha fazla çalışma yapılması gerektiğini de ortaya koymaktadır.

Küresel finansal krizin geçirdiği aşamalar, sebepleri, yapısal faktörler ve merkez bankalarının krizin farklı aşamalarında aldıkları önlemler incelendikten sonra Türkiye'deki tahvil ve bono likitesi ile hisse senedi likiditesinin emprik olarak analizine geçilmiştir. Bu aşamada öncelike bu piyasaların işlem gördüğü Borsistanbuldaki organize piyasalar ile tezgahüstü piyasalarla ilgili genel bir çerçeve verilmiştir. Daha sonrasında, testimizi yapmak üzere kullandığımız dört adet hipotez ve bunun arka planındaki teorik çerçeveye yer verilmiştir. Daha önce de ifade edildiği üzere incelenen dönem içinde küresel finansal kriz ve krize karşı alınan merkez bankaları tedbirleri küresel piyasalarda oynaklıklara yol açmıştır. Tezin temel argümanını da bu oynaklıklar oluşturmaktadır. Zira mevcut literatürde getirilerdeki oynaklığın likiditeyi belirlediği çalımalar ön plana çıkmaktadır. Bizim tezimizdeki temel argüman ise getirilerdeki oyanklıklara ilave olarak küresel fnansal piyasalardaki oynaklıklar da likidite üzerinde ciddi etkiler oluşturabilmektedir. Ayrıca, 2013 Mayıs ayından itibaren merkez bankalarının varlık alım programlarını sonlandırarak sonraki aşamada faiz artırımına gidecekleri yönündeki piyasa beklentileri yabancı yatırımcıların Türkiye tahvillerine olan talebini de olmsuz etkilediği için hem hisse senedi hem de tahvil piyasassındaki varlıklarını azaltma yoluna gitmişlerdir. Bu durumun da talebi ve işlem hacmini azaltarak ikincil piyasa likiditesine olumsuz etkisi olacağı değerlendirilmiş ve analiz bu yönde genişletilmiştir. Özetle aşağıdaki dört hipotez emprik analize tabi tutulmuştur:

i) Tahvil ve bono piyasası likiditesi oynaklıklardan olumsuz etkilenmektedir.

ii) Tahvil ve bono piyasası likitesi yabancı yatırımcı talebinden olumlu etkilenmektedir.

i) Hisse senedi piyasası likiditesi oynaklıklardan olumsuz etkilenmektedir.

ii) Hisse senedi piyasaı yabancı yatırımcı taleninden olumlu etkilenmektedir.

Söz konusu hipotezleri test etmek için tahvil ve bono piyasasında günlük alım satım kotaysonları arasındaki fark ve işlem hacmi olmak üzere iki bağımlı değişken kullanılmıştır. Hisse senedi piyasasında ise Bist100 işlem hacmi bağımlı değişken olarak, bir diğer deyişe ikincil piyasa likiditesinin ölçümü olarak kullaılmıştır. Böylece günlük verilerle 3 ayrı model oluşturulmuştur. Likiditeyi açıklamak üzere tahvil ve bono piyasası için getiri oyanklığı, kur oyanklığı ve tahvil piyasasında küresel oynaklığı ölçen MOVE endeksi bağımsız değişken olarak analiz edilmiştir. Hisse senedi piyasası için ise getiri oynaklığına ilave olarak kur oynaklığı ve hisse senedi piyasasında küresel oynaklığı ölçen VIX endeksi kullanılmıştır.

Daha sonra bu modellere yabancıların yatırımcıların ellerinde tuttukları hazine tahvili ve hisse senedi stoku eklenerek 3 ayrı model daha analiz edilmiştir. Bu modeller analiz edilirken yabancıların elinde tuttukları hisse senedi ve hazine tahvili verisi haftalık olduğu için haftalık veriler kullanılmıştır.

Böylece 3 tane günlük veri ve 3 tane de haftalık veri ile olmak üzere toplam 6 model aşağıdaki aşamalardan geçirilerek analiz tamamlanmıştır.

i) Hipotezin ortaya atılması
ii) Verilerin Grafiksel ve betimleyici istatistiklerle analizi
iii) Ekonomerik modelin kurulması
iv) Modelin tahmin edilmesi ve varsayım testlerinin yapılması (verilerin durağanlığı, normal dağılım testleri, otokorelayon ve değişen varyans testleri)
v) Hipotezin test edilmesi ve yorumlanması

Varsayım testleri yapılırken verilerin durağan olup olmadığı hem ADF hem de PP

testleri ve sabit ve sabit+trend modelleri kullanılarak yaılmıştır. Verilerin normal dağılım gösterip göstermediğine bakmak için de basıklık (kurtosis), çarpıklık (skewness) ve Jarque-Berra testleri kullanılmıştır. Değişen varyans testleri için White testi, otokorelasyon içinse Breusch-Godfrey LM testleri kullanılmıştır. Seriler modelde kullanılırken logaritmik fonksiyonları alınarak kullanılmış ve trendlerden arındırılmış halleri kullanılmıştır.

Sonuç olarak model verileri analiz edildiğinde hipotezimizde önerdiğimiz argümanların önemli ölçüde desteklendiği görülmektedir. Tahvil ve bono piyasası için kurdaki volatilite, getiri oynaklığı ve yabancıların ellerinde tuttukları tahvil miktarının likiditeyi önemli ölçüde etkilediği görülmektedir.

Tahvil ve bono piyasasındaki likidite alım satım arasındaki fark ile ölçüldüğünde getirilerdeki oynaklık ile kurdaki oyanklığın likiditeyi olumsuz etkilediği sonucuna ulaşılmaktadır. Ayrıca bu değişkenlerdeki artış tahvil bono piyasasındaki işlem hacmini de olumsuz etkilemektedir. Küresel tahvil piyasalarındaki oynaklığı ölçen MOVE endeksi ise alım satım fiyatları farkını açıklamada önemli bir değişken olmamaktadır. Haftalık verilerle analiz edildiğinde ise getirilerdeki oynaklık, kurdaki oynaklık ve yabancıların elinde tuttukları tahvil stoku önemli değişkenler olarak öne çıkmaktadır. MOVE endeksi ise işlem hacmini etkileyen bir değişken olarak önemlidir.

Hisse senedi piyasasında ise VIX endeksinin, getirilerdeki oynaklığın, kur oynaklığının ve yabancıların ellerinde tuttukları hisse senedi stokunun likiditeyi etkilemekte önemli faktörler olduğu değerlendirilmektedir.

Bu analizlerin tamamlanmasından sonra politika tartışmalarına yer verilmiştir. Bu çerçevede öncelikli olarak ulusal ve uluslararası uygulamalarda likiditeyi artırıcı politikaların genel bir çerçevesi çizilmiştir. Buna göre piyasa yapıcılığı sisteminin olması, senetlerin nominal stokları, ihracına devam edilip edilmediği, geri alım mekanizmalarının olması, yatırımcı tabanı, açığa satış imkanının olup olmaması, senetlerin ödünç alınıp verilmemesi, elektonik işlem platformlarının varlığı ve düzenleyici otoritelerin almış oldukları kararların likidite üzerinde etkileri olmaktadır.
Bu politika seti verildikten sonra Türkiye'de devlet tahvili piyasasndaki ikincil piyasa

likiditesinin 2013 Mayısından itibaren azalmasının politik ve davranışsal sebepleri üzerinde durulmuştur. Kamu kurumlarının borçlanma içindeki payının artması ve bu kurumların ikincil piyasada işlem yapmadan aldıkları senetleri vade sonuna kadar bilançolarında taşımaları ikincil piyasa likidietsini olumsuz etkilemektedir. Ayrıca devlet tahvillerinin bankacılık sektörü bilançcosu içindeki payının da azalmış olması likiditeyi olumsuz etkilemiştir. Hazine'nin son yıllarda borçlanma gereksiniminin azalması da piyasadaki senedin hacmini azaltıcı etkide bulunduğu için de likiditeyi olumsuz etkilemektedir. Ayrıca 2013'ün Mayıs ayından itibaren yabancıların ellerinde tuttukarı hazine tahvillerinde de ciddi miktarda azalmaların olması da likiditeyi olumsuz etkilemiştir.

Tüm bu olumsuz etkileri bertaraf etmek ve ikincil piyasa likiditesini canlandırmak için Hazine Müsteşarlığı tarafından 2016 yılından itibaren iki önemli tedbir hayata geçirilmiştir. Bunlardan birincisi piyasa yapıcılığı sözleşmesi çerçevesinde piyasa yapıcı bankaların ikincil piyasada vermek zorunda oldukları alım satım kotasyonu arasındaki farkın daraltılması ve vadeye göre farklılaştırılması olmuştur. Önceleri tüm vadelerdeki senetler için 50 kuruş olan alım satım kotasyonu arasındaki fark, vadesi 2 yıla kadar olan senetler için 20 kuruş, 2 ile 5 yıl arasındaki senetler için 30 kuruş, 5 ile 10 yıl arasında olan senetler için 40 kuruş ve 10 yıl ve üzeri senetler için 50 kuruş olarak belirlenmiştir.

Alınan bir diğer tedbir ise düzenli geri alım ihalelerinin başlatılması olmuştur. Bu politikaya göre 5 ve 10 yıllık senetlerin nominal stokları yeniden ihraçlarla artırılmakta ve belli bir büyüklüğe ulaştıktan sonra bir mikar kısmı düzenli geri alım ihalaleri ile vadesinden önce geri alınmaktadır. Böylece hem senedin stoku arttığı, hem de geri alım imkanı getirildiği için senetlerin likiditesine olumlu katkıda bulunuş olunmaktadır.

Tezin sonuç kısımında yapılan çalışmalar ve bulunan bulgular kısaca özetlendikten sonra çalışmanın temel kısıtlarına ve ileriki dönem çalışma alanlarına ilişkin önerilerde bulunulmuştur. Öncelikle tezin genel argümanı oynaklığın likiditeyi olusuz etkilediğidir ve oynalık olarak da sayısal değeri olan göstergler de kullanılmıştır. Hâlbuki bunların dışında haber ve politika etkilerinden dolayı da piyasalarda oynaklıklar olabilmeke ve bunların da likiditeye olumsuz etkisi olabilmektedir. Bu tür nicel verilerin de ayrıca

analiz edilmesi gerektiği ancak bu verilerin kullanılmasında gün sonu likidite göstergeleri yerine gün içi likidite gelişmelerini de gösteren verilerin kullanılması gerektiği değerlendirilmektedir. Ayrıca çalışmamızda tahvil ve bono piyasası için 2 yıl vadeli senetlerin verileri kullanılş olup, 5 ve 10 yıl vadeli senetlerin de likiditesinin farklı seyirler izleyebileceği ve bu yüzden ayrıca analiz edilmesi gerektiği değerlendirilmektedir. Son olarak, hisse senedi piyasası için BIST 100 endeksinin işlem hacmi kullanılmış olup bu endkeste 100 tane farklı hisse yer almakta olup bunların her birinin endeks içinde yer alan farklı sektörlerin likiditesinin farklı davranışlar sergileyebileceği değerlendirilmekte olup bunların ayrıca analiz edilebileceği değerlerlendirilmektedir.