PRICING OF SOVEREIGN CREDIT RISK: APPLICATION TO TURKEY

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ABSTRACT

PRICING OF SOVEREIGN CREDIT RISK: APPLICATION TO TURKEY

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This thesis investigates the pricing of sovereign credit risk in the bond and credit default swap (CDS) market for Turkey. Using daily data, CDS premiums and Emerging Market Bond Index (EMBI) are examined over the period 1, January 2001- 20, June 2012. Firstly, the short-run and long-run determinants of CDS premiums are compared with those of EMBI, employing the Autoregressive Distributed Lag (ARDL) bounds testing approach. Then, the basis, the difference between CDS and EMBI spreads is analyzed seeking the factors which drive the two markets apart. Empirical results reveal that the CDS and bond market price credit events differently and hence, two spreads deviates in the short run. On the other hand, cointegration analysis shows that two prices move together in the long run, as theory predicts. Applying VECM analysis, the findings suggest that CDS spreads move ahead of the EMBI in the terms of price adjustment.

Keywords: Sovereign spreads, credit risk, CDS, EMBI.

ÖZ

ÜLKE KREDİ RİSKİNİN FİYATLANDIRILMASI: TÜRKİYE UYGULAMASI

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Bu çalışma, Türkiye'de ülke kredi riskinin bono ve Kredi Temerrüt Swapları (CDS) piyasasındaki fiyatlandırılmasını incelemiştir. 1 Ocak 2001-29 Haziran 2012 dönemi için günlük veriler kullanılarak, CDS primi ve EMBI analiz edilmiştir. Öncelikle, ARDL sınır testi yaklaşımı uygulanarak CDS primiyle EMBI'ın kısa ve uzun dönem belirleyici faktörleri kıyaslanmıştır. Ardından, CDS-bono farkının açıklayıcısı olabilecek etmenler araştırılmıştır. Ampirik sonuçlar CDS ve bono piyasalarının kredi olaylarını farklı fiyatlandırdıklarını, bu nedenle CDS primi ve EMBI'ın kısa dönemde ayrıştıklarını ortaya koymuştur. Buna karşılık; eşbütünleşme analizi, teorinin de öngördüğü gibi söz konusu iki fiyatın uzun dönemde birlikte hareket ettiklerini göstermiştir. VECM analizinden elde edilen bulgular, fiyat intibakı bakımından CDS'in EMBI'ın önüne geçtiğini göstermiştir.

Anahtar Kelimeler: Ülke spread'leri, kredi riski, CDS , EMBI.

To My Family

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CHAPTER 1

INTRODUCTION

In today's global financial markets, credit risk pricing has been subject to noteworthy interest by academics, financial regulators, investors and traders of sovereign securities. In the last decade many studies have investigated credit risk for corporate as well as for emerging sovereign reference entities. The studies examining the credit risk, which has been few in number for advanced countries until the global financial crisis, are generally conducted after the collapse of Lehman Brothers.

CDS and EMBI are the two commonly used market indicators of sovereign risk that serve for the purpose of measuring sovereign credit risk.

A Credit Default Swap (CDS) is a bilateral contract that functions as an insurance contract whereby one party agrees to pay a periodic payment in exchange for a contingent payment in the case of a previously specified credit event (bankruptcy, obligation acceleration, obligation default, failure to pay, repudiation/ moratorium, or restructuring). The periodic payment known as the CDS premium is, as expressed by Aktuğ et al. (2008), marked-to-market signal for sovereign risk.

EMBI spread, which indicates the difference between bond yields of emerging market and industrialized economies with identical currency denomination and maturity, serves as an indication of sovereign default risk.

For a particular reference entity, both spreads are considered as prices given for the same underlying credit risk. Removing market frictions and other contractual principles, both spreads should make use of mainly the same data on the credit risk of a given reference entity and therefore should produce the same results. Furthermore, they should reflect the information on the credit risk similarly.

This study aims to examine whether the two standard measures of sovereign risk, credit default swaps (CDS) and emerging market bond index (EMBI) are producing identical signals in equilibrium, as theory predicts and whether they are explained by the same set of variables.

In the first part of the study, the short-run and long run determinants of the two sovereign spreads are analyzed using potential domestic and global factors. In the second part, the determinants of the basis, the difference between CDS and EMBI spreads are considered and the underlying factors that drive price differentials between the two markets are examined. In the last part, dynamic relationship between CDS and bond markets and which market has the leading role in reflecting changes in credit conditions (i.e. the efficiency of price discovery) are evaluated. The analyses specifically consider Turkey over the period 1, January 2001- 29, June 2012.

Various econometric methodologies are utilized in each part of this study. In the first part, in order to examine the short run and long run dynamics of the CDS and EMBI, the Autoregressive Distributed Lag (ARDL) approach of Pesaran, Shin and Smith (2001) which is called the ARDL bounds-testing approach is adopted. ARDL bounds testing approach may be applied to time series variables irrespective of whether they are stationary, integrated of order one or a combination of both. In the second part of the study, in order to explain the deviations between the two measures, the determinants of basis spread are examined by running linear regression of the basis spread on seven explanatory variables comprising market frictions and different types of risks. In the last part, to find out the price discovery relationship between CDS and Bond markets, Vector Error Correction Model (VECM) is employed.

This study contributes to the existing literature in several ways. First, following the recent trend, high frequency (daily) data for 3000 days is utilized to provide a comprehensive analysis. Second, to the extent of our knowledge, this is the first empirical study analyzes both the determinants of two credit spreads, CDS and EMBI of Turkey and the theoretical no-arbitrage and the price discovery relationship between two spreads. This study extends the existing researches by not only by seeking the existence of the equilibrium price relationship between CDS and bond market, but also exploring which factors drive the difference between the two markets within a time series framework.

Third, both ARDL and VECM approaches are employed by focusing on the Turkish data. This study provides the chance of identifying the explanatory power of the country specific factors of Turkey and global factors for the sample period. In addition to that, the data set captures two crisis periods. Hence, this study allows ascertaining the impact of two episodes of crises on the volatility in the basis.

The remainder of this study is organized as follows. Chapter 2 provides a brief review of the theoretical and empirical literature of pricing of sovereign risk. Chapter 3 introduces the data set with its sources, goes over the descriptive statistics of the variables used in the empirical analysis and discusses unit root tests and results. Chapter 4 presents econometric methods used in the study and empirical results, and Chapter 5 discusses the results and offer concluding remarks.

CHAPTER 2

LITERATURE REVIEW

2.1. The Theoretical Background

Over the past two decades, credit risk pricing has attracted much interest among academics and many studies have analyzed this issue from several perspectives as credit risk is contained in many financial transactions. Thus it is crucial that such risk is properly gauged and efficiently priced in the market.

A significant improvement in the credit risk market in the recent years has been the expansion of the credit derivatives market. Credit derivatives are financial instruments that transfer credit risk from one party to another. Since these instruments separate credit risk from other elements (such as market risk involving the fluctuations in interest rates, exchange rates, stock prices, or commodity prices) they are feasible to price credit risk correctly.

Among various credit derivatives the credit default swap (CDS) is the most widely traded and the most liquid instrument for transferring credit risk. A Credit Default Swap (CDS) is a contract that functions as an insurance contract whereby one party agrees to pay a periodic payment in exchange for a contingent payment in the case of a previously specified credit event (bankruptcy, obligation acceleration, obligation default, failure to pay, repudiation/ moratorium, or restructuring) as defined by ISDA (International Swaps and Derivatives Association). Above-mentioned periodic payment is known as the CDS premium[1] or the CDS spread and

[1] In the literature on credit markets, the terms 'credit spread' and 'CDS premium' are used as synonyms because a CDS premium can be construed as the spreads between a corporate bond and the default- risk free-rate (Duffie, 1999).

usually expressed as a percentage (in basis points) of its notional value[2] (Zhu, 2004).

The periodic payment is paid quarterly or semi-annually until the occurrence of a credit event or the maturity date of the contract, whichever comes first.

CDSs are over the counter transactions and the primary players (buyers and sellers) in the CDS market are banks followed, in order of importance, by insurance companies, security houses, and hedge funds (Chan-Lau and Kim, 2004). A CDS contract has two parties: the buyer of protection and the seller of protection. The buyer of the insurance shifts the risk to the seller of the CDS without needing to change the ownership of the cash instrument. In market parlance, protection seller takes “long position” and protection buyer takes “short position” in credit risk. Credit risk arises from the possibility of default on the obligated payment by a particular borrowing entity, which could be a corporate or sovereign entity. The entity is called the reference entity. Each CDS offers protection for a specified bond, which is called the reference obligation.

CDS contracts are the outstanding tool for reallocation of risks in financial markets. In an ordinary bond contract, the bond issuer receives the principal amount from the investor. In return for this right, the issuer agrees to make the bondholder a periodic payment and pay back the principal at the maturity date of the contract. The bondholder faces with credit risk since there is the possibility of default of the issuer; in other words, the investor bears the risk of principal and interest payment

[2] The net notional value is the maximum amount of funds that could theoretically be transferred from the protection sellers to the protection buyers, supposing a zero recovery rate at default. (Report on Sovereign CDS, 2010).

losses. Funding for bonds brings about two additional types of risk: funding risk[3] and the interest rate risk[4] (Report on Sovereign CDS, 2010).

Similarly, a CDS seller also faces with the credit risk like a bondholder, but selling a CDS does not require paying principal amount which is in contrast with the buying of a bond. In a CDS, the seller collects the periodic fee from the buyer but he is obliged to make the contingent payment only when the reference entity has a credit event. Selling CDS has a similar credit risk profile to buying a bond except the funding cost of buying of a bond so CDS is more likely to be preferred to a bond under the same credit risk condition.

When a credit event has taken place, settling of CDS contract materializes in two forms: physical settlement or cash settlement. In physical settlement, which is the most common form, the protection buyer delivers the bond to the protection seller. In return, the seller pays the par amount. In cash settlement, the protection seller pays the difference between par and the bond's recovery value, the latter determined by calculating an average quote from a dealer poll within normally 30 days after the credit event.

2.2. Empirical Literature

Previous studies on the comparison of CDS and bond pricing, such as Duffie (1999), Hull and White (2000), Longstaff, Mithal, and Neiss (2005), Blanco, Brennan, and Marsh (2005) and Zhu (2005) have found that in the absence of market friction arbitrage forces CDS spreads to be approximately equal to the

[3] The funding risk is defined in Report on Sovereign CDS (2010) as "the risk attached to the provision of the initial cash outlay (the principal) for the lifetime of the bond."Higher cost of raising cash back compared to the current yield of the bond generates funding cost. Investors faced with high funding cost (e.g. with high leverage) tend to prefer the unfunded CDS due to funding restrictions in the bond market (Report on Sovereign CDS, 2010).

[4]Interest rate risk arises when the bond has a fixed coupon (interest) payment. If the market interest rate rises, the price of the bond falls. (Report on Sovereign CDS, 2010).

underlying bond spreads, and there are positive correlation between the CDS and bond spreads.

There is an extensive literature analyzing the relationship between bond and CDS spreads. Most of the papers analyze the corporate bond market rather than sovereigns due to the data scarcity for the latter. One group of these papers focus on the determinants of sovereign CDS or bond spreads, most notably of emerging markets. However, previous empirical literature reveals no clear-cut evidence on the relative importance of domestic economic fundamentals with respect to global factors on exploring the determinants of sovereign spreads. A growing strand of literature asserts that the volatility of emerging market spreads is mainly explained by global factors, such as global liquidity, international interest rates and global risk aversion.

For instance, Herrero (2005) focuses on external factors and his aim is to estimate the impact of balance sheet effects, induced by the volatility in real exchange rate, global risk aversion. Moreover, he tests contagion on sovereign spreads by means of Granger causality and Wald test to assess the effect of a third country's downgrade. He puts the Emerging Market Bond Indices (EMBI) provided by JP Morgan as a dependent variable. As defined in the paper of Özatay et al. (2007); EMBI spread, which indicates the difference between bond yields of emerging market and industrialized economies with identical currency denomination and maturity, serves for the purpose of measuring sovereign default risk. The results support the significant effects of these 3 external factors for 27 emerging countries in period from 1993 to 2002.

Longstaff et al. (2007) also study the nature of sovereign credit risk. They use monthly CDS spread data for 26 countries consisting of 23 emerging and 3 advanced countries and conclude that the sovereign credit spreads are primarily driven by 3 common global factors: global financial markets (spread of high yield corporate bonds in US), global risk premia (VIX Index, Equity (S&P E/P) Risk Premium), global investment flows (Bond & Equity Flows of Mutual Funds) rather than local factors such as local stock market return, exchange rate, and foreign reserves.

Gonzales Rozada and Levy Yeyati (2005) have similar approach on this aspect. In their research on the determinants of EMBI, the evidence is supportive of the view that the variability of emerging market spreads are substantially explained by exogenous/global factors such as risk appetite (proxied by high-yield spreads in developed markets), global liquidity (proxied by the 10-year US Treasury rate) and contagion (exemplified by 1998 Russian default crisis).

Powell and Martinez (2008) investigate how much of the reduction in spreads till the end of 2006 can be ascribed to fundamentals or global variables. To tackle with this issue, they use EMBI global index and find that the movement in spreads can be explained better if financial variables such as the VIX, the US high yield and a US interest rate are included to the regression rather than using fundamentals alone. Then, they consider more recent data which includes daily CDS spread for 20 emerging markets over the 2006-2007 period and conclude that the VIX or the High Yield are significant in explaining the variation in CDS spreads.

Another strand emphasizes the impact of country-specific factors. The study of Arora and Cerisola (2001) is based on the determinants of secondary market spreads for eleven emerging countries between 1994 and 1999. They use several macroeconomic variables such as fiscal balance, net foreign asset position of the banking system, central government debt and total external debt (all as a percentage of the GDP ratio), debt- service ratio as well as the ratio of gross international reserves to imports and indicate that country-specific factors and US monetary policy have significant effect on spreads. Kamin (2002) analyzes EMBI spreads over the period 1992-2001 and find that creditworthiness has an impact in the determination of the spreads. As argued by Arora and Cerisola (2001) and Kamin (2002), Çulha et al. (2006) exhibit explanatory powers of domestic economic fundamentals in determining the country spreads by using daily data for the December 31, 1997- December 31, 2004 period. They use EMBI spread of each country as a dependent variable and demonstrate the significant impacts of sovereign ratings of countries (used a proxy for domestic factors) and risk appetite of international investors. Moreover, they fortify these results by applying monthly panel estimation for the variables: public debt, net foreign asset and total exports all as ratios to GDP. In addition, they show that positive or negative political news releases have a strong effect on Turkish spreads during the period under consideration.

In the same vein, Özatay et al. (2007) stresses that the evolution of the borrowing cost faced by emerging economies remarkably depends on exogenous global factors stemming from the variation in global liquidity conditions, risk appetite, crisis contagion and US macroeconomic news. Nevertheless, they add that the stable domestic macroeconomic conditions decrease the EMBI spreads via decreasing the default risk and hence the borrowing cost of the countries.

Ciarlone et al. (2007) consider the reduction in emerging market economies (EMEs)' spreads through analyzing EMBI Global Index over the period 1998 and 2006, in order to assess whether this arises from the improvement in macroeconomic fundamentals or developments in financial markets and global liquidity conditions. They find that global financial conditions, especially volatility in stock markets and agents' degree of risk aversion can explain a large fraction of the correlation between EMEs' sovereign spreads. As stressed also by Özatay et al. (2007), they show that emerging economies remain vulnerable to external shocks, although the improvement in fundamentals has positive effects on the reduction of spreads.

The results of Hilscher and Nosbush (2007) coincide with Çulha et al. (2006). They show that large part of the changes in emerging market sovereign debt prices are explained by the changes in country fundamentals for a set of 31 countries from 1994 to 2007. Particularly, they report that volatility of terms of trade represents economically and statistically significant explanatory variable for the spread variation, even controlling for global factors and sovereign credit ratings.

Another group of the studies consider specifically the determinants of the 'basis', i.e. the difference between two measure of credit risk, CDS spread and the bond spread over the risk free rate on the same reference entity. CDS spread and bond spread over the risk free benchmark contain an insurance aspect and both assets, the CDS and the bond compensate the investors for the same underlying credit risk of a given reference entity. Therefore, theoretically under the assumption of perfect arbitrage, the basis should be equal to zero in equilibrium. (Hull-White, 2004)

However, theoretical relation does not hold in practice. Although the literature (Chan-Lau and Kim (2004), Zhu (2004), Norden and Weber (2004), Blanco et al. (2005), Wit (2006)) points out that these two credit spreads are closely related and tie up in the long run equilibrium relationship, in the short run the equivalence deviates by factors other than credit risk. Numerous studies address the underlying factors that explain the price discrepancy.

First, Zhu (2004) tests the theoretical prediction that CDS and bond spreads should be equal to each other. He analyzes the daily data from twenty-four corporate entities between 1999 and 2002 and finds that the two markets are cointegrated in the long run. He also detects that CDS and bond markets exhibit significant short-run deviations, which is to a large extent due to their different responses to changing in credit conditions.

Theory also puts forward that prices in the CDS and bond markets adjust towards new equilibrium simultaneously when new information on credit risk arrives. Namely, the revelation of new information, or price discovery, should take place in two markets at the same time. Yet, market players assert that the CDS market reflects quicker new information on credit risk. Recent empirical studies seem to confirm this assertion for corporate entities. For instance, Chan-Lau and Kim (2004), via VECM analysis aim to show whether price changes on one of the two markets- CDS or bond- precede the other. They demonstrate that the derivative market tends to lead cash market. The leading property shows that price discovery occurs on CDS market. In addition, it is emphasized in their study that the credit quality and liquidity matters in price adjustment.

In the same vein, Blanco et al. (2005) examine the spreads in a time series framework and use daily data for sixteen US and seventeen European investment grade firms over the period January 2001- June 2002. They find that imperfections in the contract specifications and measurement errors in the credit spread are responsible for the violation of the theoretical equivalence of the CDS and bond spreads. They mention three reasons which are cheapest-to-deliver (CTD) options, liquidity differences between two markets to explain the variation in credit spreads. They concludes that CDS and bond spreads are cointegrated for most of the entities (especially for US firms) and CDS market leads the bond market in the credit risk price discovery process.

Hull, Predescu and White (2004) also analyze the spreads in CDS and bond market for the corporate entities in US and their results support the theory implying the equivalence of two spreads. Furthermore, they point out that the theoretical relation holds well when swap rate is used as a benchmark risk-free rate rather than the treasure rate. Another analysis they conduct is to determine how well CDS prices respond to the credit rating announcements and they find that negative rating events are anticipated by the players in CDS market.

Another strand in the literature has focused on credit risk of sovereign entities. Chan-Lau and Kim (2004) use daily Emerging Market Bond Index Plus (EMBI+) spreads, daily CDS spreads, and daily MSCI equity indices over the period March 2001- May 2002. Their results reveal that CDS and bond spreads for five countries out of eight are cointegrated but Mexico, the Philippines, and Turkey do not exhibit long run equilibrium. They also investigate price discovery utilizing Granger Causality tests and VECM model, but their report shows mixed evidence of price discovery.

In the same line with the Chan-Lau and Kim (2004), Ammer and Cai (2007) also explore the CDS- bond basis for the emerging market sovereign borrowers and indicate that two measures of credit risk diverge from the equilibrium in the short run. The main difference between two papers is the data corresponding to bond spreads. Chan-Lau and Kim (2004) uses EMBI+, whereas Ammer and Cai (2007) uses bond spreads from Bloomberg's 5-year sovereign yield estimates.

According to both paper, contract specification factors and liquidity account for the short run deviations. "Cheapest to deliver" (CTD) option[5] embedded in the standard contract affects CDS premium and derives the basis above zero.

The second factor they emphasize is the relative liquidity in the CDS and bond markets. In general, the most liquid market reflects changes in credit conditions and leads the other. Therefore, price discovery process depends on the market liquidity. Since the bond markets in emerging countries has a greater trading volume and liquidity, price discovery occurs in bond market which is in sharp contrast with the corporate studies of Blanco et al. (2005), Zhu, and Hull et al. (2004) on US and Europe. During distress period, however, the CDS market is relatively more liquid due to protection need of the investors and hence price the default risk better than the bond market. Thus, it is important to add that periods of distress are influential in detecting the market which contributes to price discovery.

Jan De Wit (2006) uses a rich data set in his paper including 103 reference entities which consists of both emerging market sovereigns and corporations. Like Blanco et al. (2005), he constructs his analysis using asset swap spreads as the bond spread measure to compare with CDS premium instead of using treasury benchmark curves. He extends previous research by discussing 14 different economic basic drivers which determines the basis. He argues that some of these factors are the reasons why the basis deviates from its long run equilibrium and specifically shows that the basis are significantly higher for emerging market sovereign entities than for corporate ones. Lastly, he notes that the basis for credits is different for the contracts denominated in different currency.

Unlike previous empirical studies, Aktug et al. (2008) employ monthly CDS premiums and Emerging Market Bond Index Global (EMBIG) instead of daily spreads. Their contribution to existing literature on emerging sovereign credit market is the econometric methodology that they follow when analyzing price

[5] When the credit event occurs, "cheapest-to-deliver" option provides protection buyer with the right to deliver the lowest-priced instrument. In this case, the protection seller would expect a CDS premium that is higher than the bond spread. The excess spread, i.e. the cheapest-to-deliver premium reflects compensation to the protection seller for providing the CTD option.

discovery. They utilize the adjustment coefficients of the VECM framework instead of Gonzalo-Granger(1995) scaling. They also point out that the measure for lag-length selection has a significant effect on the results. In the light of the econometric analysis, they confirm the cointegration relationship for the majority of countries except Brazil, Turkey, and Hungary. Overall, their evaluations are consistent with Chan-Lau& Kim (2004) who finds that bonds markets lead CDS markets but contradict with Blanco et al. (2005) and Zhu (2006). Thus, they concluded that corporate market is more efficient than sovereign CDS and bond market.

Levy (2009) improves the literature by attributing the price discrepancy in emerging market sovereign entities to two factors, liquidity and counterparty risk. He presents a model in order to assess the impact of these two market frictions on the basis spread. First, he tests how liquidity differences between CDSs and bonds violate the parity. Liquidity differences bring about different liquidity premiums when pricing the assets, which create pricing inequalities between CDSs and bonds, accordingly.

The second friction that Levy focuses on is counterparty risk associated with CDS contract. Counterparty risk is the possibility of the CDS seller to default and not to pay back its contractual obligations in case of a credit event. Levy's model is based on these two frictions and the regression results strongly support the relevance of liquidity and counterparty risk in the pricing of CDS contracts. He proves that the illiquidity of CDS contracts has a positive effect on the CDS premiums and counterparty risk has a negative effect on CDS premiums. Furthermore, correcting for these two frictions improves the estimates for the relation between the CDS premium and the bond's yield spreads over the benchmark.

The third line of studies focusing on the linkages and determinants of two commonly used indicators of sovereign risk, CDS and bond yield spreads, deals with advanced economies during the recent financial crisis. Before the crisis, volatility and trading activity in CDS market was low due to the perceived high credit quality of the developed country borrowers, and hence sovereign CDS market in developed countries has not attracted much attention. However, after the collapse of Lehman Brothers in September 2008, bailouts and other support measures deteriorated the fiscal position of advanced economies and led public sector deficits to reach unprecedented levels. This turbulence in sovereign debt market has brought about reassessment of the credit risk of many advanced economies since a structural break in market pricing appears during the current crisis particularly in euro area due to expansion of trading activity in sovereign CDS market.

Fontana and Scheicher (2010) perform an empirical study focusing on the determinants of spreads on CDS and the underlying government bonds of ten EU countries over the period 2006-2010. They use alternative explanatory variables such as risk appetite, iTraxx Main Investment Grade Index, public debt of the countries, idiosyncratic equity volatility and conclude that common factor including international risk appetite has the major role in market pricing. Furthermore, they address the basis and find that for most countries the CDS spread is above the spread on the corresponding government bond spread relative to the swap rate; i.e. positive bases with the exception of Greece, Ireland, and Portugal where they observe negative bases. To exploit the deviations from arbitrage-free parity the trader should sell CDS protection and short sell underlying bond in the case of positive basis and buy the bond and CDS protection in the case of negative basis. However, Fontana and Scheicher (2010) state that during the crisis market frictions and structural changes hamper the traders to exploit the possible arbitrage opportunity. Also, they add that the number of traders decrease because of the declining risk appetite and the exit of Lehman Brother which is one of the important player in the market. They conduct a regression analysis comprising set of variables which are expected to be related to the basis and demonstrate that the theoretical long run relation does not hold because bond and CDS spreads are affected by different risk factors. The former is exposed to interest rate risk, default risk, funding risk and market liquidity risk whereas the latter is generally exposed to default risk and counterparty risk. Fontana and Scheicher (2010) explore the possible causes for the persistent non-zero basis through these differences of two assets. After the outbreak of the financial crisis, investors tend to move from risky assets into liquid government bonds which provide mostly safe haven status. ‘Flight to safety' or 'flight to liquidity' effect is responsible for driving bond prices up and declining yield spread, accordingly. Besides, counterparty risk might also have a significant role in explaining the non-zero basis by decreasing the CDS spreads in this distress period. These factors help understanding the positive basis in most of euro area countries. On the other hand, debt outstanding may be the reason why the bases are low in Greece, Portugal, Spain, Italy, and Ireland. Higher bond supply has a negative impact on bond liquidity and raises bond spreads beyond CDS spreads. Nevertheless, Fontana and Scheicher emphasize that the effects of the counterparty risk and debt outstanding on the basis show crossectional differences. In addition, they detect the significant impacts of the cost of short- selling bonds, global risk and country specific factors on the sovereign bases.

Lastly, Fontana and Scheicher (2010) note that before the crisis, there is no cointegrating relationship between CDS and bond spreads for most of the countries in euro area which is probably due to the scarcity of the volume of the trading activity in the CDS market. Since the onset of the crisis, cointegration has emerged but which market dominates the price discovery process is not homogenous across countries.

Arce et al. (2011) follows the framework suggested by Fontana and Scheicher (2010) who study the extent of the relation between CDS and bond spreads in euro area. In the line with the results obtained by Fontana and Scheicher (2010), Arce et al. (2011) investigate the role of the counterparty risk, country specific and global factors and some market frictions for eleven EU countries over the period 2004-2010. They find that counterparty risk indicator, funding costs and illiquidity in the bond market have negative effect on the basis. Furthermore, they carry out a dynamic analysis rather than using static price-discovery analysis because they believe that the price discovery process in sovereign credit risk market in the EU does not show a time invariant pattern. In contrast, the leadership of the CDS or bond market evolves over time. Accordingly, they conclude that CDS market usually reflects credit risk more efficiently than bond market but the direction of the causality changes during the specific episodes, like in the wake of the collapse of

Lehman Brothers. In brief, they assert that the price discovery process is state dependent and the counterparty risk, funding cost, global risk, market liquidity, and the amount of sovereign debt purchased by the European Central Bank in the secondary market are the determinants of which market provides more efficient information on credit risk.

In a similar paper, Palladini and Portes (2011) investigate the interaction between two markets for six euro area countries over the period 2004-2010. Different country sample covered by the analysis and approach are the contributions of this paper. Unlike Arce et al. (2011), they apply a static price discovery metric and unlike Fontana&Scheicher (2010), they don't implement tests for pre and post crisis separately. After verifying the cointegration between CDS and cash market, they run VECM estimation to assess which market has a lead over the other in the period analyzed. Their results are consistent with Zhu (2004) who suggests that derivative market plays a leading role due to the relative liquidity of CDS market comparatively to the bond market in price discovery. Thus, Palladini and Portes (2011) stress that the behavior of euro area sovereign risk is similar to developed countries' corporate credit risk. Moreover, they apply Granger Causality Test which corroborates the findings obtained via VECM analysis.

In a recent paper Alper et al. (2012) analyze pricing sovereign credit risk for advanced countries including 15 euro area countries and also US, Australia, and Japan. Within this scope, they examine the determinants of two commonly observed market indicators of sovereign risk, sovereign credit default swap (CDS) and relative asset swap (RAS) spreads and their role in providing consistent information on sovereign risk during the crisis. Firstly, they suggest the cointegrating relationship between those two indicators with a leading role of the derivative (CDS) market in the price discovery process, especially in peripheral euro area countries, which is probably due to the relative increase in the liquidity of the CDS market in these countries in recent years. Secondly, they analyze the determinants of CDS and RAS spreads during the recent financial crisis and point to the significant effects of several variables. In the CDS spread regressions, the explanatory power of the financial variables (development in the banks' stock performance, money market liquidity conditions, Central Banks' large scale purchases of long term government bonds) and global variables (global growth, global risk aversion, dummies for the different phases of the financial crisis) are much more than the country-specific factors related to fiscal sustainability (such as expected primary deficit, debt to GDP ratio, expected domestic growth). On the other hand, except short-term interest rate and Central Banks' intervention in the long term bond market, the same set of variables appears to be insignificant in the RAS regression. These regression analyses are performed for the subgroups of selected group of euro area economies and large advanced economies and the latter displays more significant results due to recent market pressure in the former. Overall, the CDS market is a better source of information on the price of sovereign credit risk because CDS spreads react more to the news about fundamentals mentioned above than RAS spreads.

CHAPTER 3

DATA AND DESCRIPTIVE STATISTICS

3.1. Definitions of the Variables and the Data Sources

This study utilizes daily data of Turkey to analyze the determinants of the basis spread and detect how much of the changes in Turkey's spreads can be ascribed to global financial conditions rather than to domestic macroeconomic fundamentals.

The comprehensive data set includes daily 5- year sovereign CDS spreads (mid-quotes and bid-ask prices), EMBI Turkey, Eurobond with the maturity: 01/15/2030, TED spreads, VIX index, US interest rates for 3 months, 3- and 10- years, Euribor 3month index, iTraxx Europe index, S&P 500 index and NASDAQ index collected by Bloomberg, overnight interest rate of Turkey and İMKB 100 Index collected by İMKB, from the period January 1, 2001 to June 29, 2012. Moreover, this study comprises the time series of the Standard and Poor's rating for Turkey. Letter designations are transformed into the numerical values, with 0.8 being the worst credit risk of Turkey and 5.2 the best, for the sample period.

The starting date is selected according to data availability of all variables. Additionally, the series for liquidity in the CDS and bond market are proxied by (Ask-Bid)/((Ask+Bid)/2) as in the study of Arce et al. (2011).

Finally, despite having a precise economic meaning on the spreads, to avoid any multicollinearity problem, the correlation coefficients between the variables are calculated and reported in Table 1. The explanations of the variables used in the analyses are as follows:

BSP: Bank Stock Prices

US3M: US Treasury Rate- 3 Month

US10: US Treasury Rate-10 Year

INT: Overnight interest Rate for Turkey

İMKB: İMKB XU100 index (domestic stock market index)

RTN: S&P Rating for Turkey

ITRX: iTraxx Europe index, which comprises the most liquid 125 CDS referencing European investment grade credits, is a measure reflecting aggregate credit market developments.

TED: TED spread, which measures the difference between three-month US Treasury rate and three-month Eurodollar rate is used as a proxy for funding liquidity.

EU: Euribor (Euro Interbank Offered Rate)- 3 Month.

Table 1: Correlation Coefficients (BSP, İMKB, INT, RTN, S&P500 and NASDAQ)

	BSP	IMKB	INT	RTN	S&P500	NASDAQ
BSP	1	0.99	-0.19	0.84	0.47	0.63
IMKB	0.99	1	-0.20	0.86	0.5	0.67
INT	-0.19	-0.20	1	-0.18	-0.015	-0.0079
RTN	**0.84**	**0.86**	**-0.18**	**1**	**0.44**	**0.61**
S&P500	0.47	0.50	-0.015	0.44	1	0.73
NASDAQ	0.63	0.67	-0.0079	0.61	0.73	1

Table 2: Correlation coefficients (EU, TED, ITRX, US10Y, US3M, US3Y and INT)

	INT
EU	0.74
TED	0.32
TRX	-0.56
US10Y	0.64
US3M	0.68
US3Y	0.68

Table 3: Correlation Coefficients (INT, TED, ITRX, US10Y, US3M, US3Y and VIX)

	VIX
INT	-0.2
TED	0.48
ITRX	0.74
US10Y	-0.51
US3M	-0.55
US3Y	-0.55

Table 1 reports that there are high correlations between BSP, İMBK, S&P 500, NASDAQ and RTN. Similarly, Table 2 displays high correlations between Euribor, iTraxx Europe index, US Interest rates and overnight interest rate of Turkey. In addition, in Table 3, the relationships between VIX and other possible related variables are examined and it is found that there is close association between VIX and all other variables, except overnight interest rate for Turkey and TED spread.

According to the listed values, only overnight interest rate of Turkey and TED spread are used and Euribor, iTraxx Europe index, NASDAQ index, S&P index, İMKB 100 index and interest rates of US are not included to the model.

3.2. A Brief Look at the Variables of the Study

In this section, to acquire a preliminary understanding of the variable movements, a brief look into the raw data is provided.

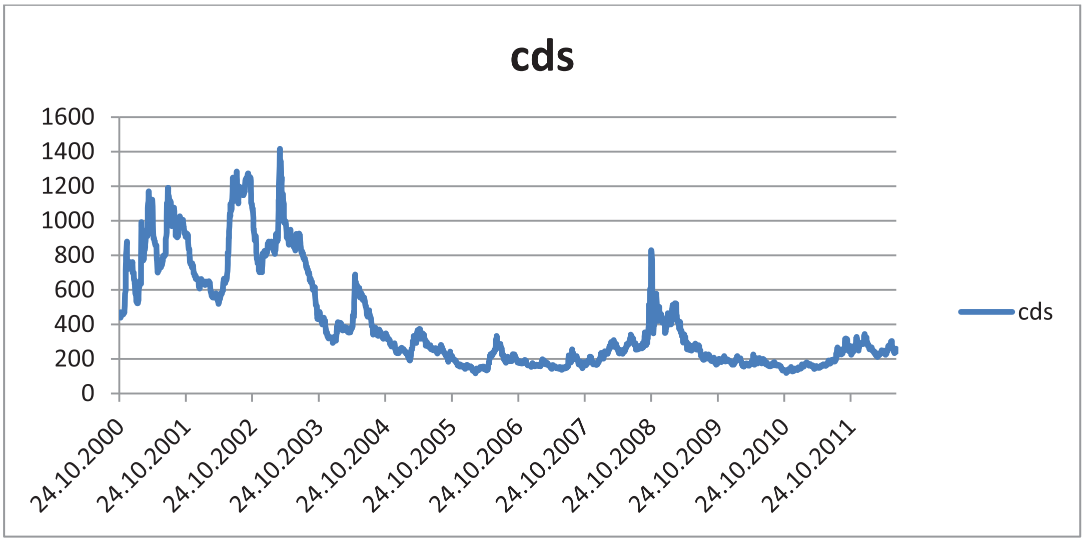

Figure 1. CDS Spread for Turkey

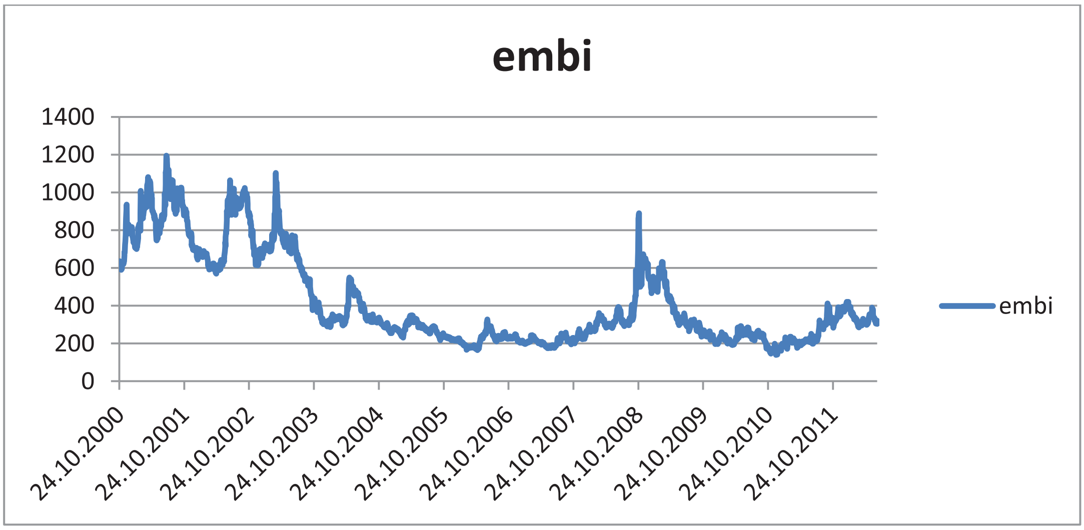

Figure 2. EMBI Spread for Turkey

Figure 1 and Figure 2 plot the time series of CDS spreads and EMBI spreads for Turkey for the period, 24 October 2000 to 24 June 2012 which is larger than the sample period of this study to see the fluctuation of spreads during the crisis in 2001. Between the years 2001 and 2003, variation in CDS and EMBI spreads was high whereas between the years 2003 and 2012 the spreads showed lower volatility.

Sample highs are mostly reached in beginning of 2000s. With its higher volatility, CDS spread records higher basis points than EMBI during the years 2000-2003. After 2003, comparatively low variability is observed for both spreads until the peak in 10/23/2008.

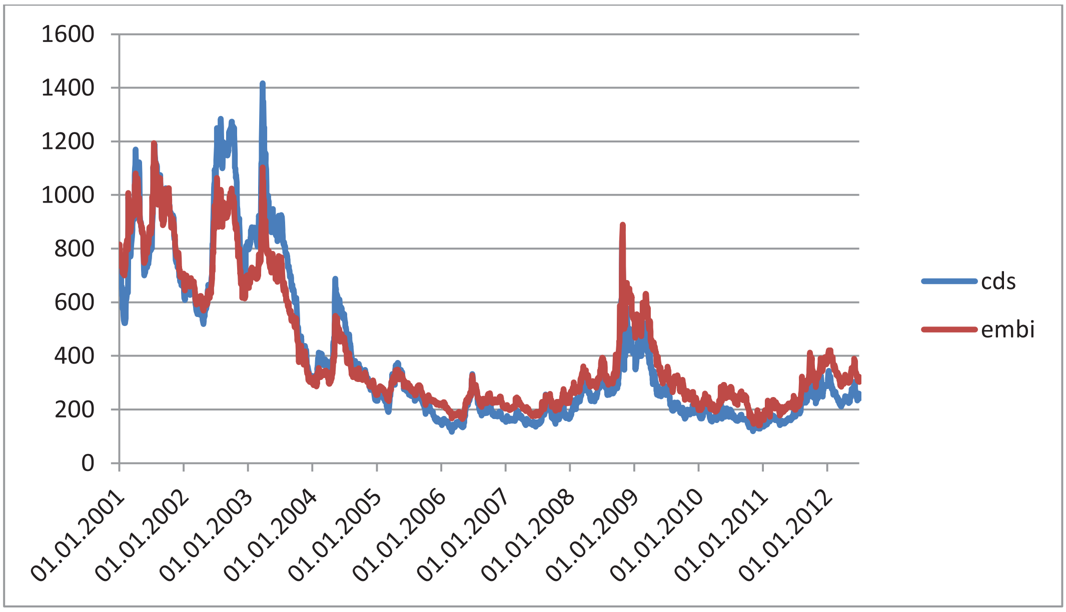

Figure 3. CDS and EMBI Spreads for Turkey

Figure 3 shows the comovement between two measures of credit pricing, CDS and EMBI spreads in the longer run. However, as seen in Figures 4, the basis spread, the difference between CDS and EMBI spreads has been generally negative for Turkey except for between 2002- 2004.

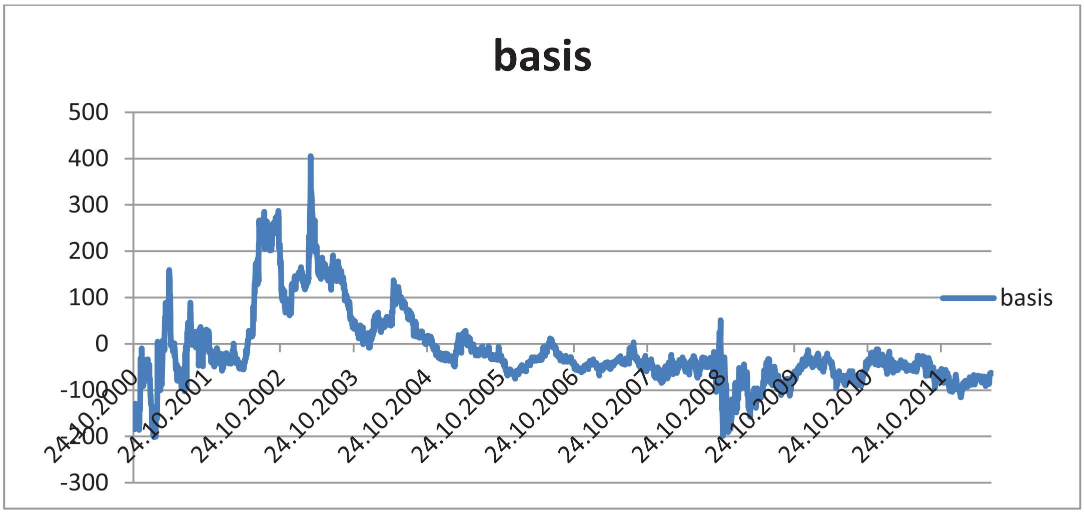

Figure 4. Basis for Turkey

A negative basis occurs when the EMBI spread is comparatively higher than the CDS spread. Such a difference can be arbitraged when both the bond in the cash market and the protection in the CDS market are bought at the same time. Yet, this strategy necessitates funding for the bond purchase. As a result, during market turmoil, traders may reject entering such a position. Specifically, because of the price volatility, there may be risks and they may prefer not to take any steps. All in all, the crisis has affected both market and funding liquidity adversely. The non-zero basis may be also linked to 'cheapest to deliver' options in the CDS contract. As Fontana (2010) and Barot and Guo (2010) put forward when the crises broke out, the basis between CDS and bonds has turned out to be consistently negative. Because of lack of funding liquidity and more counterparty risk in the financial sector, the negative basis does not seem to be easily exploitable. Therefore, as Fontana and Scheicher (2010) suggest, throughout distress periods, the deviations from the arbitrage-free parity are inevitable owing to liquidity and CDS counterparty risk faced by traders.

For the years 2002-2004, on the other hand, the basis is almost always positive. This could be explained by the following reasons. Better domestic macroeconomic fundamentals such as lower inflation rate, interest rate and thereby lower risk trigger capital inflow to Turkey during this period which leads to higher prices for bonds and hence lower bond spreads. As seen in Figure 2, the sharp fall in EMBI reinforces this view. For these years, CDS spread follows the same pattern with the lower basis points relative to EMBI, as shown in Figure 1. The risk perception on Turkey arising from being emerging country plays a large role in high CDS premium.

The crises are the main causes of such differences among those years. As expected, during the liquidity shortage periods, funding cost exerts upward pressure on interest rates. Throughout the 2000-2001 financial crises, with the capital outflow from Turkey, lower demand for bonds tends to put upward pressure on bond's interest rates. Furthermore, during the periods of crises, financial market actors prefer to sell their CDS to meet short-term liquidity needs. Therefore, the CDS premium rise due to the higher credit risk is counteracted by the effect of liquidity requirements. Particularly, during the period of global financial crisis, seeking of a safe haven, capital flows from emerging countries to advanced countries, lead to a decrease in the bond demand at emerging countries. So, negative basis in Turkey after the global crisis can be explained by these factors.

3.3. Unit Root Test

As a preliminary analysis, unit root tests are employed to identify the stationarity of the variables involved. All data except liquidity proxies for CDS and bond spreads are in logarithms and represented by the prefix L.

Determining the order of integration provides insight about the method adopted. To this respect, Augmented Dickey Fuller (ADF) unit root test is conducted for the levels and for the first differences of the variables. The letter D indicates the first difference of the variable. The test results together with the corresponding critical values reported in Table 4 and in Table 5. As supposed, non-stationarity of the CDS and EMBI series and the stationarity of the basis spread are verified. Following Zhu (2004), this implies the equivalence relationship between CDS and EMBI spreads as predicted by the theory, namely the non-existence of arbitrage opportunity between the two markets in the long run.

The test results suggest that the null hypothesis of a unit root is rejected for VIX with intercept only, but it is found to be nonstationary, when trend is included into the test equation. VIX becomes stationary after differencing as proved by Table 5. On the other hand, INT (overnight interest rate for Turkey) is stationary at the 90% level. Similarly, LIQCDS (liquidity proxy for CDS spread) and LIQBOND (liquidity proxy for bond spreads) are found to be stationary at 99% and 95% level, respectively.

Only NASDAQ index is trend stationary for 99% confidence level. The rest of the variables [The country rating (RTN), US10Y (US interest rate for 10 years), US3Y (US interest rate for 3 years), US3M (US interest rate for 3months), BSP (Bank Stock Prices), İMKB XU100 index (domestic stock market index), S&P 500 index, Euribor, iTraxx index, TED Spread] all fail to reject the null hypothesis of nonstationarity in their levels as shown by Table 4, but achieve to reject the null hypothesis of having a unit root when their first differences are taken as demonstrated by Table 5.

Table 4: ADF test results for the levels of the variables

	With **intercept** only		With trend and intercept	
Variables	Lags	**Calculated ADF**	Lags	Calculated ADF
LCDS	9	-1,696157	9	-2,090019
LEMBI	9	-1,765298	9	-2,505874
LBASIS	8	-2,720106*	8	-4,385364***
LRTN	0	-1,143037	0	-2,330133
LVIX	10	-3,092239**	10	-3,101785
LINT	28	-2,801379*	28	-3,559618**
LUS10Y	21	-1,215746	21	-2,693526
LUS3Y	25	-0,738639	21	-0,246427
LBSP	13	-1,003765	13	-0,229489
LİMKB	27	-1,393455	27	-2,282509
LSP500	18	-2,072336	18	-2,331942
LNASDQ	2	-2,295390	2	-4,064929***
LEURBR	25	-1.108939	25	-1.722049
LITRX	13	-1.141874	13	-2.632507
LIQCDS	25	-3.897997***	25	-4.483322***
LIQBOND	22	-3.104453**	22	-4.684959***
LTED	28	-2.353486	28	-2.537112
US3M	26	-2.203832	26	-1.811416

The critical values for the models having only the intercept are -3.43, -2.86 and -2.56 for confidence levels of 99%, 95% and 90% respectively. The critical values for the models including intercept and trend are -3.96, -3.41, and -3.127 for confidence levels of 99%, 95% and 90% respectively. Rejection of null hypothesis is represented by * for 90%, by ** for 95% and by *** for 99% confidence levels. The lag order is chosen using the AIC, with maximum lag length of 28.

Table 5: ADF test results for the first differences of the variables

	With **intercept** only		With trend and intercept	
Variables	Lags	**Calculated ADF**	Lags	Calculated ADF
DLCDS	8	-18,26399***	8	-18,26094***
DLEMBI	8	-18,83924***	8	-18,83938***
DLBASIS	7	-23,26900***	7	-23,27102***
DLRTN	0	-55,18196***	0	-55,17599***
DLVIX	9	-19,14468***	9	-19,14142***
DLINT	28	-19,30812***	28	-19,38253***
DLUS10Y	20	-10,48136***	20	-10,50377***
DLUS3Y	24	-9,364686***	24	-9,377504***
DLBSP	12	-14,41468***	12	-14,41224***
DLİMKB	28	-11,72079***	28	-11,73012***
DLSP500	17	-12,79898***	17	-12,82676***
DLNASDQ	1	-43,03890***	1	-43,11203***
DLEURBR	24	-5.473451***	24	-5.486920***
DLITRX	12	-11.28290***	12	-11.29012***
DLIQCDS	25	-17.29615***	25	-17.29571***
DLIQBOND	21	-16.01931***	21	-16.01672***
DLTED	28	-11.20012***	28	-11.19922***
DLUS3M	28	-9.134754***	28	-9.210074***

The critical values for the models having only the intercept are -3.43, -2.86 and -2.56 for confidence levels of 99%, 95% and 90% respectively. The critical values for the models including intercept and trend are -3.96, -3.41, and -3.127 for confidence levels of 99%, 95% and 90% respectively. Rejection of null hypothesis is represented by * for 90%, by ** for 95% and by *** for 99% confidence levels. The lag order is chosen using the AIC, with maximum lag length of 28.

3.4. Basic Descriptive Statistics

The fundamental descriptive statistics of the variables are presented in Table 6, in order to provide insight about the statistical properties of the series. For this purpose, measures of central location such as mean and median; measures of dispersion such as maximum (Max.) and minimum (Min.) values, and standard deviations (Std. Dev.) as well as measures of distribution shape like skewness and kurtosis are presented in order to present an overall initial description of the data set.

Table 6: Basic Descriptive Statistics of the Variables

	BASIS	LCDS	LEMBI	LINT	LRTN	LVIX	LTED	LIQcds	LIQbond
Mean	-0.11	5.75	5.87	2.86	1.10	3.01	3.50	0.04	0.003
Median	-0.15	5.58	5.73	2.81	1.38	3.00	3.36	0.03	0.003
Maximum	0.34	7.25	7.08	8.40	1.64	4.39	6.13	0.40	0.03
Minimum	-0.44	4.75	4.94	0.85	- 0.22	2.29	1.01	-0.35	0.0005
Std. Dev.	0.17	0.64	0.51	0.74	0.60	0.38	0.72	0.03	0.0013
Skewness	0.48	0.61	0.62	0.62	-1.24	0.45	1.00	0.74	0.71
Kurtosis	2.17	2.13	2.16	4.45	2.97	3.06	3.65	12.20	4.47

CHAPTER 4

EMPRICAL ANALYSES

This section is comprised of three sections. Firstly, the determinants of the CDS spreads and EMBI are assessed. Then, the determinants of the basis spreads, the difference between CDS and EMBI spreads are investigated. Finally, dynamic relationship between the two markets is examined.

Starting with the consideration of the unit root test results, the methods for the analysis of each subsection are chosen.

4.1. Determinants of CDS and EMBI Spreads

Regarding the studies in the existing literature, the determinants of the sovereign spreads are grouped in two main categories. The first includes domestic fundamentals while the second category includes global ones. This section aims to analyze the determinants of CDS and EMBI spreads of Turkey by measuring particularly the extent to which these spreads are determined by domestic fundamentals (such as country ratings and over-night interest rate) versus global ones (such as VIX, TED spread).

To control the impact of macroeconomic conditions on CDS and EMBI spreads, country credit ratings are considered as a proxy. As cited by Özatay et al. (2007), Cantor and Packer (1996) suggest that "sovereign ratings effectively summarize and supplement the information contained in macroeconomic indicators and therefore strongly correlated with market-determined credit spreads". Ratings containing information about main fundamentals such as real GDP, government debt, government effectiveness, external debt, external reserves and default history provide daily data for this study.

Domestic financial conditions are proxied by the overnight interest rate to investigate the role of the changes in the short-term money market rate in determining the CDS and EMBI spreads.

VIX and TED spreads have been two candidates to test the impact of global variables on CDS and EMBI spreads. VIX implying volatility of S&P 500 index options is employed to capture the uncertainty in the global market. Volatility related to market uncertainty is an important proxy of investors' risk appetite. TED, which measures the difference between three-month US Treasury rate and three-month Eurodollar rate, is included as a proxy for funding liquidity. As mentioned by Pu (2012), the TED spread measures the rate of return that the banks are requiring over the risk free rate to lend to other banks, therefore provides insight about the funding liquidity in the general market.

One would expect that better domestic macroeconomic fundamentals as represented by sovereign ratings imply better economic conditions and lead to generally a decrease in CDS and EMBI spreads. In addition, overnight interest rate as a key pricing factor is an indicator of money market volatility and has an impact on sovereign spreads. In particular, higher interest rates trigger possible default and reduce expected payoff in countries exposed to higher volatility especially during the periods of crises and thereby increasing sovereign spreads.

Moreover, an increase in the price of risk (an increase in VIX) push up the CDS and EMBI spreads for all countries. TED is anticipated to be positively related with the sovereign spreads, which proposes that a severe lack of funding liquidity would result in a higher sovereign spreads.

4.1.1. Autoregressive Distributed Lag (ARDL) Approach

To find the determinants of CDS and EMBI, the (ARDL) approach developed by Pesaran and Shin (1999) is used. The reason for selecting this approach is that it can be employed to the series regardless of whether they are stationary, integrated order one or a combination of both. In addition, the bounds testing procedure within an ARDL framework as developed by Pesaran, Shin and Smith (2001) allows identifying both short run and long run dynamics simultaneously.

The bounds testing procedure is suitable for testing the cointegration relation among the variables since the variables employed in the analysis are either I(0) and or I(1). Moreover, generating error-correction model through simple linear transformation on the ARDL model is advantageous.

The ARDL method involves three stages. At the first stage, the existence of cointegration among the variables is tested by applying the bounds testing procedure (Pesaran et al. 2001).

Thus, the lagged levels of the variables in an error correction form of the underlying ARDL model is constructed as follows:

$$\Delta LCDS_t = a_1 + \sum_{k=1}^{p} b_{1k}\Delta LCDS_{t-k} + \sum_{k=0}^{p} c_{1k}\Delta LIQCDS_{t-k} + \sum_{k=0}^{p} d_{1k}\Delta LRTN_{t-k} + \sum_{k=0}^{p} e_{1k}\Delta LINT_{t-k} + \sum_{k=0}^{p} f_{1k}\Delta LVIX_{t-k} + \sum_{k=0}^{p} g_{1k}\Delta LTED_{t-k} + \lambda_{11} LCDSt_{-1} + \lambda_{12} LIQCDS_{t-1} + \lambda_{13} LRTN_{t-1} + \lambda_{14} LINT_{t-1} + \lambda_{15} LVIX_{t-1} + \lambda_{16} LTED_{t-1} + u_{1t} \qquad \textbf{(1)}$$

$$\Delta LEMBI_t = a_2 + \sum_{k=1}^{p} b_{2k}\Delta LEMBI_{t-k} + \sum_{k=0}^{p} c_{2k}\Delta LIQBOND_{t-k} + \sum_{k=0}^{p} d_{2k}\Delta LRTN_{t-k} + \sum_{k=0}^{p} e_{2k}\Delta LINT_{t-k} + \sum_{k=0}^{p} f_{2k}\Delta LVIX_{t-k} + \sum_{k=0}^{p} g_{2k}\Delta LTED_{t-k} + \lambda_{21} LEMBIt_{-1} + \lambda_{22} LIQBOND_{t-1} + \lambda_{23} LRTN_{t-1} + \lambda_{24} LINT_{t-1} + \lambda_{25} LVIX_{t-1} + \lambda_{26} LTED_{t-1} + u_{2t} \qquad \textbf{(2)}$$

This test displays the long run relation by identifying dependent and forcing variables.

In equations 1 and 2, parameters b, c, d, e, f and g represent the short run coefficients and λs represent the corresponding long run multipliers of the underlying ARDL model. The null hypothesis of non-existence of cointegration is defined by Ho: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$ against the alternative H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq 0$.

The calculated F-statistics are compared with the critical values tabulated by Pesaran et al. (2001).

The general F-statistics are made use of to test the hypotheses. The calculated F-statistics and the critical values taken from Peseran et al. (2001) are compared. There are two types of critical values. The upper level critical values are organized assuming that all the series are integrated of order one, I(1) whereas the lower level critical values are organized assuming that all the series are integrated of order zero, I(0).When the orders of the series are mixed, the calculated F-statistics need to be compared with the corresponding upper and lower level critical values. There are two possible cases leading to conclusive results: One of them is that the null of "no cointegration" cannot be rejected when the test statistic for the variables falls below the lower critical value. On the other hand, the other case is that the no cointegration null hypothesis will be rejected when the statistic is higher than the upper level critical value. If the statistic is between the lower and upper bounds, the test result is inconclusive (Pesaran and Pesaran, 1997).

Table 7: VAR Lag Order Selection Criteria (CDS)
Endogenous variables: LCDS LINT LRTN LTED LVIX

Lag	LogL	LR	FPE	AIC	SC	HQ
0	4809.887	NA	2.73e-08	-3.225839	-3.215769	-3.222215
1	33899.27	58061.58	9.17e-17	-22.73868	-22.67827	-22.71694
2	34125.07	449.9360	8.01e-17	-22.87349	-22.76273*	-22.83364
3	34165.65	80.71791	7.93e-17	-22.88395	-22.72284	-22.82598
4	34270.36	207.9564	7.52e-17	-22.93747	-22.72601	-22.86138*
5	34312.67	83.88345	7.43e-17	-22.94909	-22.68729	-22.85489
6	34369.21	111.8891	7.27e-17	-22.97026	-22.65811	-22.85794
7	34402.39	65.57191	7.23e-17	-22.97576	-22.61326	-22.84532
8	34426.80	48.13715	7.24e-17	-22.97536	-22.56251	-22.82681
9	34456.96	59.39848	7.21e-17	-22.97883	-22.51563	-22.81216
10	34576.05	234.1053*	6.77e-17*	-23.0420*	-22.52846	-22.85721

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

Table 8: Bounds-testing procedure results (CDS)

Cointegration hypotheses	**F-statistics**
F(LCDS| LINT, LRTN, LVIX, LTED)	3.88**
F(LINT| LCDS, LRTN, LVIX, LTED)	3.12
F(LRTN| LCDS, LINT, LVIX, LTED)	6.55***
F(LVIX| LCDS, LRTN, LINT, LTED)	2.55
F(LTED| LCDS, LRTN, LVIX, LINT)	3.95*

* represents significance at 10%, ** at 5%, and *** at 1%. The critical values from Pesaran and Pesaran (2001) are 2.45-3.52, 2.86-4.01, 3.71-5.06 for 10%, 5%, and 1% significance level, respectively.

Table 8 shows the calculated F-statistics for the cointegration relationships among the CDS spreads, overnight interest rate, country ratings, VIX and TED spread. As seen in Table 7, the optimal lag provided by the LR test, FPE and AIC is ten. Selection lag order according to LR, FPE and AIC, rather than SIC and HQ provides F-statistics confirming the cointegration. The results indicate that there are three cointegrating vectors for the five endogenous variables. The first cointegrating vector indicates that VIX, TED spread, interest rate and ratings are the long run forcing variables of the CDS spread, which is in parallel with the literature. The second vector reveals that CDS spreads, VIX, TED spread and interest rate are the forcing variables of the Country ratings, which does not contradict with the economic sense. However, the third vector shows that all the other variables in the system are forcing variables of the TED spread, which is not plausible as one would not expect that variables of Turkey would have an impact on global variable, TED spread. In the same way, for EMBI spread the optimal lag order proposed by the LR test, FPE and AIC, as seen in Table 9 is ten. Table 10 reports the associated F statistics produced by the bounds test for EMBI spread, interest rate, country ratings, VIX and TED spread. Inspection of Table 8 presents that there are four cointegrating vectors for the five endogenous variables. In other words, except VIX, each of the variables can be dependent variable. However, since the question is the effects of VIX, TED spread, interest rate and ratings on pricing of credit risk, CDS and EMBI spreads will be considered as the dependent variables in estimation. Therefore, single equation model is developed to run this analysis.

These outcomes suggest that a single equation model brings about loss of information and, hence, the possible feedback effects between the variables may be disregarded. For instance, when examined in more detail, the feedback effect of the credit spreads on interest rate can be economically important. That is, credit spreads may not be the mere endogenous variables. To capture these interactions, a dynamic multivariate analysis is offered since it explicitly endogenizes all variables with a VAR model. Thus a VAR and impulse response analysis will be run in the next part.

Table 9: VAR Lag Order Selection Criteria (EMBI)
Endogenous variables: LINT LRTN LTED LVIX LEMBI

Lag	LogL	LR	FPE	AIC	SC	HQ
0	5580.966	NA	1.63e-08	-3.743515	-3.733446	-3.739892
1	34074.58	56872.45	8.15e-17	-22.85638	-22.79597	-22.83464
2	34237.73	325.0983	7.43e-17	-22.94913	-22.83837*	-22.90928
3	34276.59	77.30122	7.36e-17	-22.95844	-22.79733	-22.90046
4	34380.17	205.6900	6.98e-17	-23.01119	-22.79973	-22.93510*
5	34420.47	79.90697	6.91e-17	-23.02146	-22.75966	-22.92726
6	34476.80	111.4761	6.77e-17	-23.04249	-22.73034	-22.93017
7	34512.31	70.16740	6.72e-17	-23.04955	-22.68705	-22.91912
8	34539.35	53.33811	6.71e-17	-23.05092	-22.63808	-22.90237
9	34567.96	56.34490	6.69e-17	-23.05335	-22.59016	-22.88668
10	34682.88	225.8878*	6.30e-17*	-23.1137*	-22.60017	-22.92893

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

Table 10: Bounds-testing procedure results (EMBI)

Cointegration hypotheses	**F-statistics**
F(LEMBI| LINT, LRTN, LVIX, LTED)	3.55*
F(LINT| LEMBI, LRTN, LVIX, LTED)	4.28**
F(LRTN| LEMBI, LINT, LVIX, LTED)	6.72***
F(LVIX| LEMBI, LRTN, LINT, LTED)	2.59
F(LTED| LEMBI, LRTN, LVIX, LINT)	4.87**

* represents significance at 10%, ** at 5%, and *** at 1%. The critical values from Pesaran and Pesaran (2001) are 2.45-3.52, 2.86-4.01, 3.71-5.06 for 10%, 5%, and 1% significance level, respectively.

The second stage of the procedure is to estimate the long run coefficients outlined in the first step using the following ARDL(p,q,r,s,t,w) model. The lag lengths p,q,r,s,t and w are determined by Akaike Information Criterion (AIC) by means of MICROFIT econometric software. Following Özatay et al. (2007), when the low sample variability of RTN is taken into account, the lag length is initially set as 2 for the ARDL relationship. However, chosen lag is not sufficient to overcome the residual serial correction problem. Therefore, leg length is eventually set as 4.

The long run estimation results are presented in Table 11 and Table 12. For CDS, all the coefficients of explanatory variables except that for RTN are strongly significant. For EMBI, the coefficients of INT and VIX are significantly positive as expected. However, RTN and TED do not play significant role in explaining the EMBI spreads. The coefficient of RTN is insignificant for both spreads in contrast to expectations since theoretically, the impact of RTN on the spreads needs to be significantly negative. Likewise, TED spreads are incorrectly signed for both spreads but the explanatory powers of them differentiate, as mentioned before.

The short run estimation results are displayed in Table 13 and Table 14. The lagged level of the CDS spread is significant and incorrectly signed whilst the lagged level of the EMBI spread is correctly signed and significant which signifies a mean reverting tendency of the EMBI. The short run effects of INT and VIX on both spreads are found to be significantly positive, as expected. In the same vein with the literature, the first difference forms of RTN have negative signs in both spreads indicating that rating is a significant determinant of the short run dynamics inherent in the sovereign spreads. For CDS, in the first difference form, TED spread is incorrectly signed and significant. On the other hand, for EMBI, the first difference of TED is positive and significant impact on the spread. The first period lagged value of TED has insignificant sign while the second period lagged value is negative in contrast to expected sign. Overall, in the short run, TED is significantly influential on EMBI. Yet, the short run favorable effect of TED becomes ineffective in the long run on EMBI. While the positive short run impact of INT and VIX endures for longer periods of time on sovereign spreads, the negative impact of

RTN on CDS and EMBI die out in the long run and the coefficient of RTN becomes insignificant. The effect of TED on CDS sustains in the long run whereas its positive and significant impact on EMBI disappears after a while.

Table 11: Estimated Long Run Coefficients using ARDL Approach ARDL (2,3,1,2,0) selected based on Akaike Information Criterion (CDS)

Dependent variable is **LCDS**

Regressor	Coeff.	Prob.
LINT	0.69963	[0.000]***
LRTN	0.11351	[0.657]
LVIX	0.95651	[0.000]***
LTED	-0.23629	[0.024]**
Constant	0.67073	[0.134]

Table 12: Estimated Long Run Coefficients using ARDL Approach ARDL (3,0,1,3,3) selected based on Akaike Information Criterion (EMBI)

Dependent variable is **LEMBI**

Regressor	Coeff.	Prob.
LINT	0.538	[0.000]***
LRTN	0.079	[0.66]
LVIX	0.849	[0.000]***
LTED	-0.098	[0.179]
Constant	0.871	[0.007]***

The third stage is to estimate the short run coefficients by constructing an error correction model (ECM) in the following way:

$$\Delta LCDS_t = a_1 + \sum_{k=1}^{q} b_{1k}\Delta LCDS_{t-k} + \sum_{k=0}^{r} c_{1k}\Delta LIQCDS_{t-k} + \sum_{k=0}^{s} d_{1k}\Delta LRTN_{t-k} + \sum_{k=0}^{w} e_{1k}\Delta LINT_{t-k} + \sum_{k=0}^{v} f_{1k}\Delta LVIX_{t-k} + \sum_{k=0}^{z} g_{1k}\Delta LTED_{t-k} + \varphi_1 ECT_{t-1} \quad \textbf{(3)}$$

$$\Delta LEMBI_t = a_2 + \sum_{k=1}^{q} b_{2k}\Delta LEMBI_{t-k} + \sum_{k=0}^{r} c_{2k}\Delta LIQBOND_{t-k} + \sum_{k=0}^{s} d_{2k}\Delta LRTN_{t-k} + \sum_{k=0}^{w} e_{2k}\Delta LINT_{t-k} + \sum_{k=0}^{v} f_{2k}\Delta LVIX_{t-k} + \sum_{k=0}^{z} g_{2k}\Delta LTED_{t-k} + \varphi_2 ECT_{t-1} \quad \textbf{(4)}$$

In equations 3 and 4, coefficients b, c, d, e, f and g represent short term dynamics and φ is the speed of adjustment. Estimations of the short run coefficients of the variables are provided in Table 13 and 14.

Table 13: Error Correction Representation for the Selected ARDL Model ARDL(2,3,1,2, 0) selected based on Akaike Information Criterion (CDS)

Dependent variable is **LCDS**		
Regressor	Coeff.	Prob.
Constant	0.007	[0.205]
DLCDS(t-1)	0.092	[0.000]***
DLINT	0.02	[0.000]***
DLINT(t-1)	0.012	[0.013]***
DLINT(t-2)	0.009	[0.063]*
DLRTN	-0.039	[0.065]*
DLVIX	0.187	[0.000]***
DLVIX(t-1)	0.105	[0.000]***
DLTED	-0.002	[0.022]**
ECM(t-1)	-0.01	[0.000]***

CUSUM	S	
CUSUMSQ	S	
Serial Correlation		0.825
Functional Form		0.493
Normality		0.000***
Heteroscedasticity		0.028**

Table 14: Error Correct Representation for he Selected ARDL Model
ARDL(3,0,1,3,3) selected based on Akaike Information Criterion (EMBI)

Dependent variable is **LEMBI**		
Regressor	Coeff.	Prob.
Constant	0.012	[0.05]*
DLEMBI(t-1)	0.009	[0.61]
DLEMBI(t-2)	-0.048	[0.007]***
DLINT	0.007	[0.000]***
DLRTN	-0.028	[0.17]
DLVIX	0.188	[0.000]***
DLVIXx(t-1)	0.076	[0.000]***
DLVIX(t-2)	0.019	[0.04]**
DLTED	0.021	[0.000]***
DLTED(t-1)	0.003	[0.47]
DLTED(t-2)	-0.008	[0.087]*
ECM(t-1)	-0.014	[0.000]***
CUSUM	S	
CUSUMSQ	S	
Serial Correlation		0.685
Functional Form		0.931
Normality		0.000***
Heteroscedasticity		0.763

The results show that the error correction term (ECM) is highly significant and negative for both CDS and EMBI. That is to say, the significantly negative error correction term support the cointegration inference depending on the bounds test results of Table 8 and Table 10. This implies that short run deviations adjust back to the equilibrium in the following days. Considering the daily data, the coefficients -0.01 and -0.014 show that the speed of convergence to equilibrium is rather rapid (around three months), once shocked.

Additionally, results need to undergo several diagnostic tests so as to make sure validity is obtained to a great extent. The last point addressed concerns the goodness of fit of the ARDL models. For this purpose, a series of diagnostic and stability tests are conducted. The diagnostic tests aim to analyze serial correlation by using the Lagrange multiplier test of residual serial correlation, functional form by using Ramsey's RESET test with the square of the fitted values, and heteroscedasticity based on the regression of squared residuals on squared fitted values. As seen from the last section of each panel in Table 13 and 14, the diagnostic tests do not show any evidence of misspecification and also the test results cannot provide any evidence of autocorrelation.

To test for structural stability the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) are employed. The results of CUSUM and CUSUMSQ stability test are summarized with letter S representing that the estimated coefficients derived from the bounds testing approach in Table 13 and 14 are stable.

4.1.2. Generalized Impulse Responses

Generalized Impulse Response technique is better suited for determining feedback relations. Impulse responses capture how a variable responds to a shock in the other variable initially and whether the impact of the shock persists or dies out quickly.

In order to evaluate how a shock to INT, RTN, VIX and TED affects CDS and EMBI and how long the affect lasts, the generalized impulse response analyses are conducted.

Impulse responses along with significance bands are plotted out in Figures 5 and 6. The results indicate that the initial impact of a positive shock in VIX is positive and significant for CDS spread and EMBI spread. It is not surprising to see that CDS and EMBI respond to their own shocks, but interestingly insignificant effect of a shock in country ratings is observed in Figure 5 and 6.[6] The initial impact of VIX on CDS spread appears to be considerable larger than those of interest rate. It is also notable that interest rate has an insignificant effect on EMBI spread. However, shock in TED spread appears have a significant initial impact on EMBI whereas insignificant effect on CDS. These results seem to confirm the ARDL analysis in that VIX plays an important role in the CDS and EMBI spreads of Turkey, while ratings of Turkey do not have any impact on them. Although, the result of ARDL approach that interest rate affects CDS spread justified by the impulse response analysis, the impacts of TED on CDS and EMBI induced by ARDL analysis are not consistent with the impulse response results.

[6] The rest of the impulse response graphs other than the abovementioned ones are available in Appendix B.

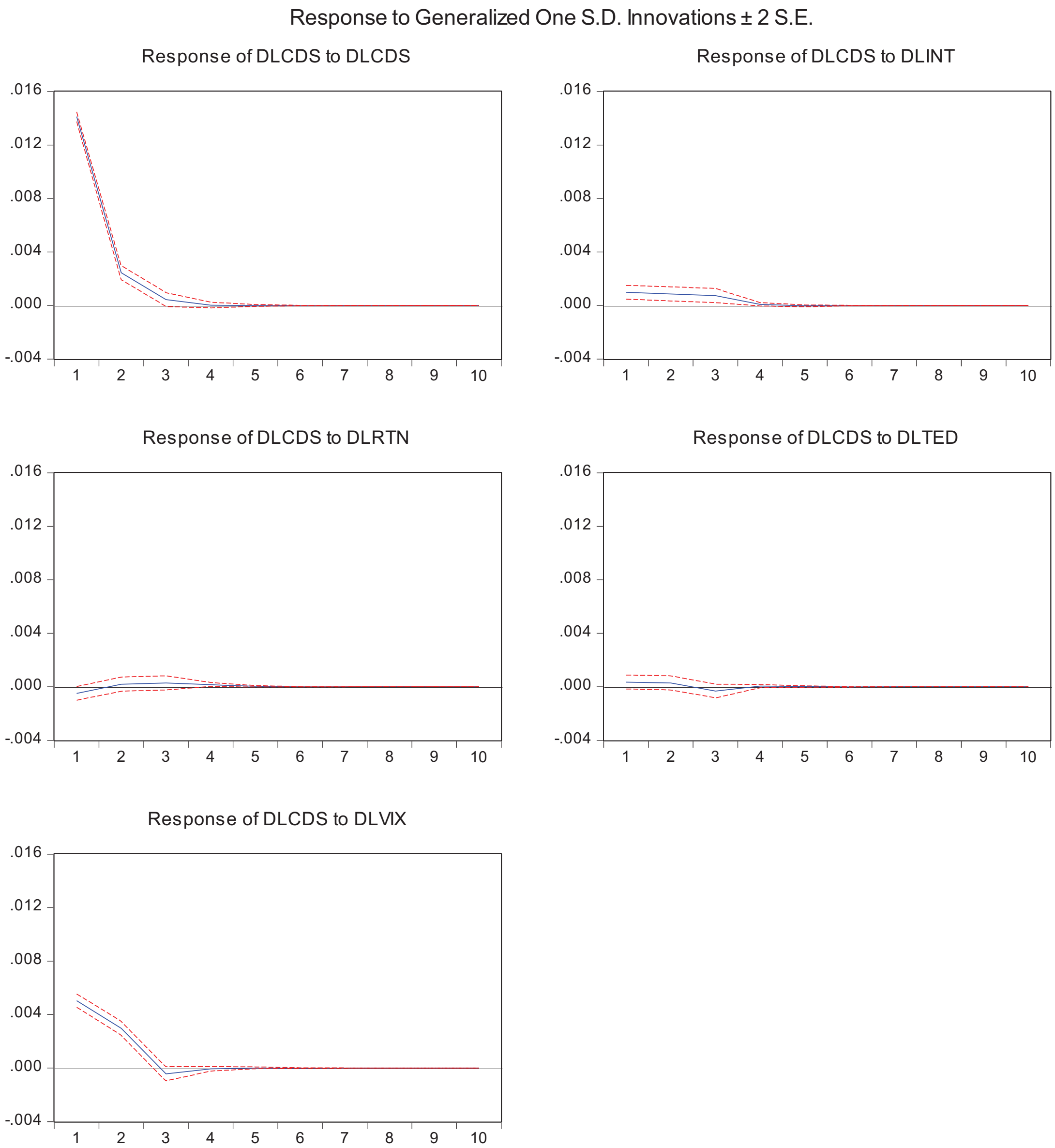

Figure 5: Responses of DLCDS to generalized 1 Std. Dev. Innovations

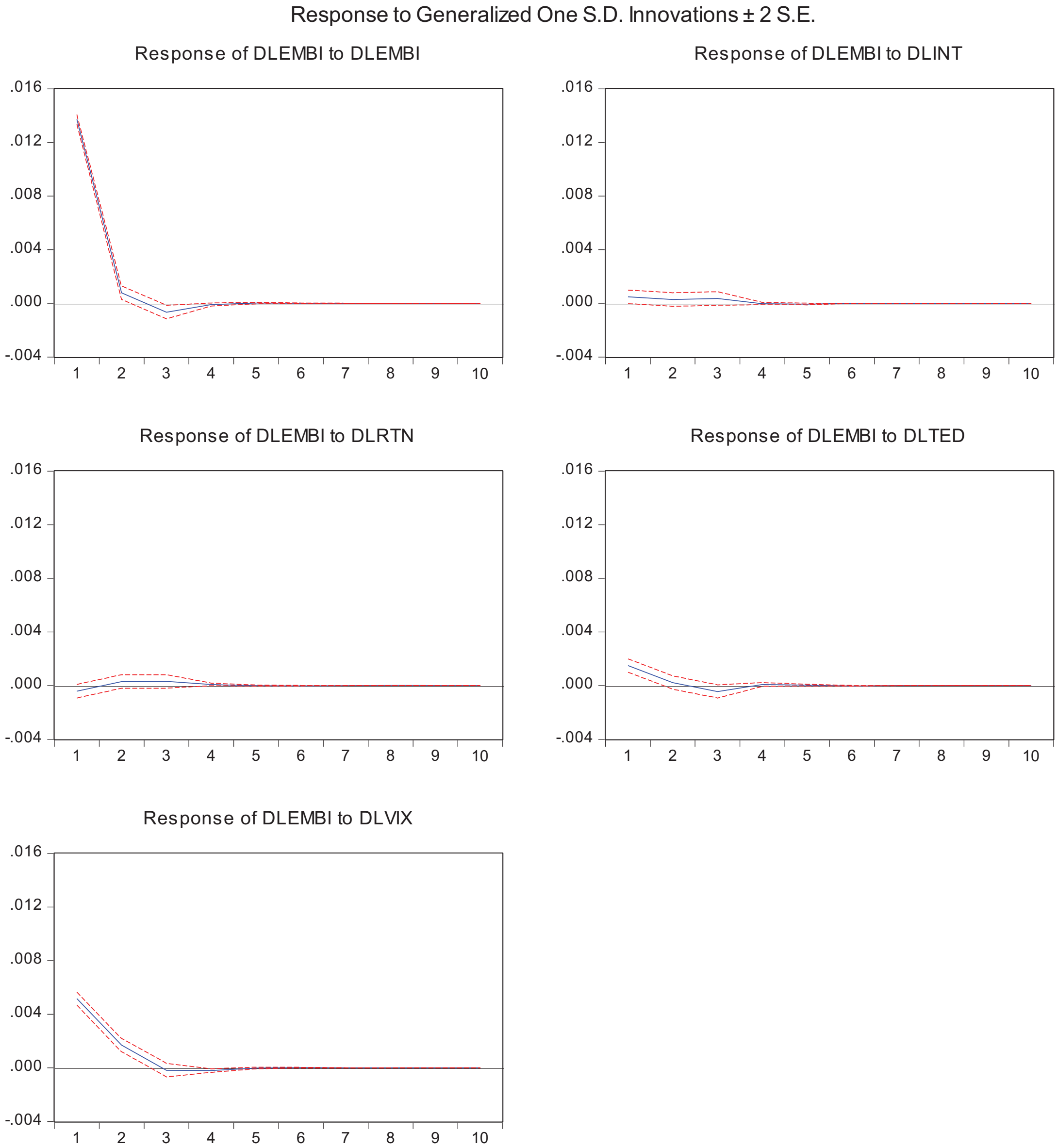

Figure 6: Responses of DLEMBI to generalized 1 Std. Dev. Innovations

4.1.3. Ordinary Least Square Estimation

The robustness of the results of the ARDL approach is checked by running the following two regressions in E-views.

As the time series used in the analyses are frequently non-stationary, the Ordinary Least Squares (OLS) estimation is not appropriate to determine the impact of the country specific and global factors on CDS and EMBI. The use of the first differences instead of levels is the standard way to tackle nonstationary. Accordingly, Çulha et al. (2006), Alper (2012), Fontana and Scheicher (2010) perform linear regressions of the sovereign spreads on the potential explanatory variables. Similar to the literature, this section makes OLS estimations for the same explanatory variables as in the ARDL procedure.

Comparing the results for the ARDL and OLS estimations, it is observed that the coefficient signs are same for both CDS and EMBI. However, OLS estimation demonstrates that the impact of TED spread on CDS spread is insignificant at the 90% level, while ARDL estimation shows on the contrary. Moreover, the contradicting results between two procedures are obtained from the regression on EMBI with regard to the significance of the coefficients of DLEMBI (-1), DLTED and DLINT. According to the OLS estimation results, DLEMBI(-1) and DLTED have significant effects and DLINT has insignificant effect on EMBI spreads.

Table 15: Determinants of CDS spreads

Dependent Variable: DLCDS		
Variable	Coefficient	Probability
DLCDS(-1)	0.166727 (0.016972)	0.0000
DLINT	0.017995 (0.005092)	0.0004
DLRTN	-0.053199 (0.021844)	0.0149
DLVIX	0.175688 (0.009109)	0.0000
DLTED	-0.004582 (0.005098)	0.3688
Constant	-0.000124 (0.000246)	0.6138
Adjusted R-squared	0.14	

Table 16: Determinants of EMBI spreads

Dependent Variable: DLEMBI		
Variable	Coefficient	Probability
DLEMBI(-1)	0.066940 (0.017028)	0.0001
DLINT	0.006627 (0.004859)	0.1727
DLRTN	-0.034101 (0.020834)	0.1018
DLVIX	0.179063 (0.008688)	0.0000
DLTED	0.019976 (0.004868)	0.0000
Constant	-0.000120 (0.000235)	0.6089
Adjusted R-squared	0.13	

4.2. Determinants of the Basis spread

This section tests the explanatory factors of the basis spreads and finds out whether the differences between the CDS and bond market spreads are closely linked to the market, global or country specific factor. Specifically, potential explanatory factors below are taken into consideration:

a. Lagged basis spread

From the theoretical perspective, the average basis spread is always zero, i.e. as discussed by Zhu (2004), the basis is mean reverting. Deviations from the long-run relation tend to decline. Hence, the coefficient of lagged basis spread should be less than 1. When the coefficient is very close to zero, it implies that the speed of adjustment of both a positive and negative basis is faster. (Zhu, 2004)

b. Changes in credit spread (dcds)

Credit spreads in both cash and derivative market depend on credit conditions. If the credit risk is accurately and efficiently priced by both markets, changes in credit conditions should be revealed exactly same in both markets. That is, if the coefficient is not significantly different from zero, it means that both markets have responded similarly to credit events and there is no arbitrage opportunity even in the short run. On the contrary, a coefficient that is significantly different from zero infers different reactions and market inefficiency in the short run. (Zhu, 2004)

c. Liquidity Factors

In theory, CDS premia and bond spreads are equal if the two series include purely credit risk. However, factors other than credit risk such as liquidity premium embedded in the CDS and bond spread break down the equivalence relation. To evaluate for the liquidity effects, following Zhu (2004), the bid-ask spreads are used as a proxy in the regression analysis. The ratio of ask-bid spread to the average of ask-bid spread (i.e. (Ask-Bid)/ [(Ask+Bid)/2]) represents the liquidity. For the CDS, a higher bid-ask spread implies lower liquidity and higher mid premium. On the other hand, choosing a proper proxy for the bond spread is more difficult since historical transaction data is not available for Turkey. Instead, the ask-bid prices for Eurobond with a maturity date of 01/15/2030 are used to identify the degree of liquidity of the bond market. The higher ratio reflects less liquidity in bond markets and lower price hence, a higher bond spread. Overall, one would expect that CDS liquidity proxy has a positive effect and proxy for bond spread has a negative effect on the basis spread. This study follows Arce (2011) who test the relative liquidity effects by constructing a ratio of relative liquidity between bond and the CDS. As this ratio increases, relative liquidity of bond market to the CDS market falls and so does the basis.

d. Global financial conditions

As an additional potential explanatory variable for the basis, VIX is added as a proxy to control global risk premium. If the same credit risk is priced in CDS and bond markets, the impact of the global risk premium on the basis should be zero.

e. Macroeconomic Conditions

Overnight interest rate which is a good indicator of the financial conditions is included in order to check the accuracy of pricing credit risk. Unless both markets misprice the macroeconomic conditions, its impact on basis spreads should be zero.

Table 17 presents the estimation results for the regression analysis of the basis. With regard to the above variables, the model has a high explanatory power for the basis as measured by the high adjusted R^2 of 98 %.

The coefficient on the lagged basis is significantly less than one (0.97) confirming that sovereign basis for Turkey is mean reverting. Furthermore, the magnitude of the coefficient implies that the speed of this reverting process is relatively slow: only 3% of price errors are adjusted back to the equilibrium in the current day. Hence, price discrepancies persistent for a number of days.

The coefficient of CDS spread changes is significant. This result shows that the CDS market and the bond market do not reflect the changes in credit conditions equally. More precisely, the coefficient (0.35) implies that for a 10 basis point increase in the CDS spread, there is a 6.5 basis point increase in the bond spread. This could be a major factor in the variation of the basis, particularly between 2001 and 2003 when credit conditions were very volatile.

Although non-significant at 99% level, the relative liquidity has a negative impact, as expected. The global risk aversion, proxied by the VIX, is not the source of the price discrepancies between the two markets. On the contrary, a significant coefficient for the interest rate implies that the macroeconomic conditions are priced differently in both markets and hence CDS premia and bond spreads drift apart.

Finally, the constant term indicates whether the basis differs, on average, from zero and provides direct information about the magnitude of such deviation (Arce et. al., 2011). The results suggest that the basis is not significantly different from zero, in other words the bond-CDS equivalence relation holds, considering the market frictions described above. In addition, the magnitude of the coefficient is low relative to the average basis during the sample period.

Table 17: Determinants of basis spreads

BASIS		
Variable	Coefficient	Probability
LAGBAS	0.982873 (0.003285)	0.0000
DLCDS	0.352067 (0.012820)	0.0000
LIQ	-2.11E-07 (1.94E-06)	0.9135
LINT	0.003076 (0.000772)	0.0001
LVIX	-0.001636 (0.001116)	0.1428
Constant	-0.002513 (0.001751)	0.1513
Adjusted R-squared	0.98	

4.3. Dynamic Relationship between CDS and EMBI Spreads

The time series graph in Figure 3 illustrates that CDS spreads and EMBI for Turkey tend to move in the same direction over time. As in the majority of the existing literature, to assess the long-run relationship between two markets, cointegration test is performed. Since both variables, CDS and EMBI are integrated of order 1, the

Johansen cointegration test can be employed. Johansen cointegration framework provides evidence on whether the long run CDS-bond equivalence relation holds.

Before proceeding with the Johansen cointegration test, the optimal lags are determined according to the sequential modified LR test statistic, final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ). LR gives 23, FPE and AIC gives 10, SC gives 3 and HQ gives 4 as optimal lag length. Further then, as in the majority of the literature, SC is utilized to choose lag lengths for the underlying VAR systems.

The results of the test are reported in Table 18, which shows the maximum eigenvalue and trace statistics, the 5% critical values as well as the corresponding eigenvalues. The cointegration results in Table 19 are obtained using a VAR specification where the variables and the cointegration space contain linear deterministic trends. From the table it can be easily seen that both λ_{trace} and λ_{max} tests suggest the existence of one cointegrating vectors.

Table 18: Johansen cointegration test results (lag=3) with no deterministic trend

H_0	λ_{trace}	5%	λ_{max}	5%	Eigenvalues
r=0	21.03106	20.26184	16.92034	15.89210	0.005632
r=1	4.110720	9.164546	4.110720	9.164546	0.001371

The optimal lags are determined according to the Schwarz information criterion.

Table 19: Johansen cointegration test results (lag=3) with linear deterministic trend

H_0	λ_{trace}	5%	λ_{max}	5%	Eigenvalues
r=0	20.72262	15.49471	16.90803	14.26460	0.005628
r=1	3.814590	3.841466	3.814590	3.841466	0.001272

The optimal lags are determined according to the Schwarz information criterion.

These cointegration results are in line with the general picture in Figure 3 showing that there are in general co-movements between two measures of credit pricing in the long run. Two-variable system is demonstrated as a vector error correction model (VECM):

$$\Delta LCDS_t=\lambda_1(LCDS_{t-1}-\alpha-\beta LEMBI_{t-1})+\sum_{j=1}^{k}\gamma_{1j}\Delta LCDS_{t-j}+\sum_{j=1}^{k}\delta_{1j}\Delta LEMBI_{t-j}+\varepsilon_{1t}$$

$$\Delta LEMBI_t=\lambda_2(LCDS_{t-1}-\alpha-\beta LEMBI_{t-1})+\sum_{j=1}^{k}\gamma_{2j}\Delta LCDS_{t-j}+\sum_{j=1}^{k}\delta_{2j}\Delta LEMBI_{t-j}+\varepsilon_{2t}$$

where $\Delta LCDS_t$ and $\Delta LEMBI_t$ are the change in the CDS spread and EMBI in logarithm at time t, respectively, ε_{1t} and ε_{2t} are i.i.d. shocks, the expression in parenthesis is the error correction term , the lagged changes in LCDS and LEMBI provide additional dynamics, and λ_1 and λ_2 are speed of adjustment coefficients.

The significance and magnitude of λ_1 and λ_2 state the role of each market in the adjustment to equilibrium. Statistically significant negative λ_1 and statistically significant positive λ_2 implies that both market move to correct the price discrepancy. The relative magnitude of the two adjustment coefficients are interpreted as a share of each market in price discovery. Following the literature, Gonzalo and Granger (1995) measure ($\lambda_2/(\lambda_2-\lambda_1)$) defined as the ratio of the speed of adjustment in the two markets is utilized to evaluate the contribution of each market to price discovery, if both coefficients are significant with correct signs. When this measure is close to 1, it means that CDS market leads the bond market. When this measure is close to 0, bond market leads the price discovery. When it is close to ½, both markets contribute almost equally to price discovery. However, if the coefficient of one market is not statistically different from zero, it means that this market is more efficient than the other in pricing of credit risk.

The estimated parameters and test statistics for Turkey based on the VECM analysis summarized in Table 20. The results show that λ_1 is negative but insignificant whereas λ_2 is positive and significant. Thus, it can be inferred that credit risk is priced in the derivative market first, and the cash market adjusts to remove pricing error. That is, the prices in derivative market of Turkey are quicker to reflect the changes in credit conditions. The parameter β estimated in VECM regression is significantly different from 1, implying non-zero basis, i.e. short term price discrepancies between markets.

Table 20: Vector Error Correction Model (VECM) test results

β in cointegrating vector	λ_1	λ_2
-1.259520	-0.004029*	0.009423
(0.06489)	(0.00434)	(0.00415)
[-19.4107]	[-0.92906]	[2.27082]

* denotes non-significant parameter at the %5 level. The values in parenthesis (.) and in brackets [.] are standard deviations and t-ratios, respectively.

Compared to the studies of Chan- Lau Kim(2004) and Aktug (2008) , this thesis obtains different results. In their study covering respectively 2001-2003 and 2001-2007 period, the authors could not verify the existence of cointegration relationship in Turkey. However, this study confirms the cointegration relationship during the period under consideration, which encapsulates more recent data. This is consistent with the argument that sovereign CDS and bond markets come a long way in recent years in Turkey.

CHAPTER 5

CONCLUSION

Using daily data over the period 1, January 2001-20, June 2012, this study considers the pricing of sovereign credit risk for Turkey based on two commonly used measures: CDS and EMBI spreads. Theoretically, CDS and EMBI spreads should be equal since both spreads are viewed as a price for the same credit risk. Cointegration analysis shows that two prices move together in the long run, as theory predicts. However, data reveal that in the short run there are pricing discrepancies between the two markets due to the factors other than credit risk affecting CDS premiums and bond prices. The aim of this thesis is not only to account for price differences between the two spreads but also to investigate the potential short-run and long-run determinants of CDS and EMBI, separately.

To explore the determinants of both spreads, the autoregressive distributed lag (ARDL) bounds-testing approach developed by Pesaran, Shin and Smith (2001) is used as the series employed in the analysis are all found either I(0) or I(1). Moreover, this procedure allows identifying both short and long-run dynamics simultaneously.

The long run estimation results show that among rating, VIX, TED spread and overnight interest rate for Turkey, all variables except rating seem to play significant role in explaining the CDS spreads while only VIX and interest rates are long run determinants of EMBI spreads.

An overview of the results of the analysis reveals that the long run estimation results show that global and financial variables are significantly effective on the credit spreads. The country-specific variable containing information about fiscal and current account sustainability seem to be irrelevant in explaining the spreads.

In the short run, it is found that CDS spreads are responsive to changes in all variables under study while EMBI spreads appear to react to the movements in all variables except from rating proxied mainly for fiscal variables.

The OLS estimates reinforce the short run results of the ARDL model to some extent. More precisely, the interest rate, VIX and ratings are the key determinants of CDS whereas TED spread do not have any impact on CDS. Furthermore, OLS estimation suggests that variation in global factors explains a large share of the variation in EMBI spreads.

In order to avoid ignoring the possible feedback effects between the variables, the generalized impulse responses are conducted. This analysis documents a similar result; the international financial conditions are more effective on explaining credit spreads than domestic factors.

Then, the dynamics of the basis is observed to explore which factors obscure the no-arbitrage theoretical relation. The estimation results of the regression analysis reveal that sovereign basis for Turkey is mean reverting and significantly linked to the macroeconomic conditions proxied by interest rate. Relative liquidity of bond market to the CDS market and global risk appetite proxied by VIX do not seem effective on the basis. Unexplained component may arise from counterparty risk and contractual agreements which are not covered in this study.

Lastly, VECM analysis is applied to see the dynamics of adjustment to the long run equilibrium between CDS and EMBI spreads. It suggests that credit risk is priced in the derivative market first, and cash market adjusts to remove pricing error. This contrasts with Ammer and Cai (2011), suggesting that cash market of developing countries are quicker to reflect the changes in credit conditions.

Overall, this thesis sheds light on the promising research area, relation between sovereign CDS and bond market. A comprehensive analysis is provided under the Turkish case. Specifically, global variables such global liquidity and volatility and domestic financial variables rather than fiscal fundamentals explain a large part of the volatility of credit spreads of Turkey.

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APPENDICIES

APPENDIX A: General Look into the Raw Data

Table A1: Rating for Turkey

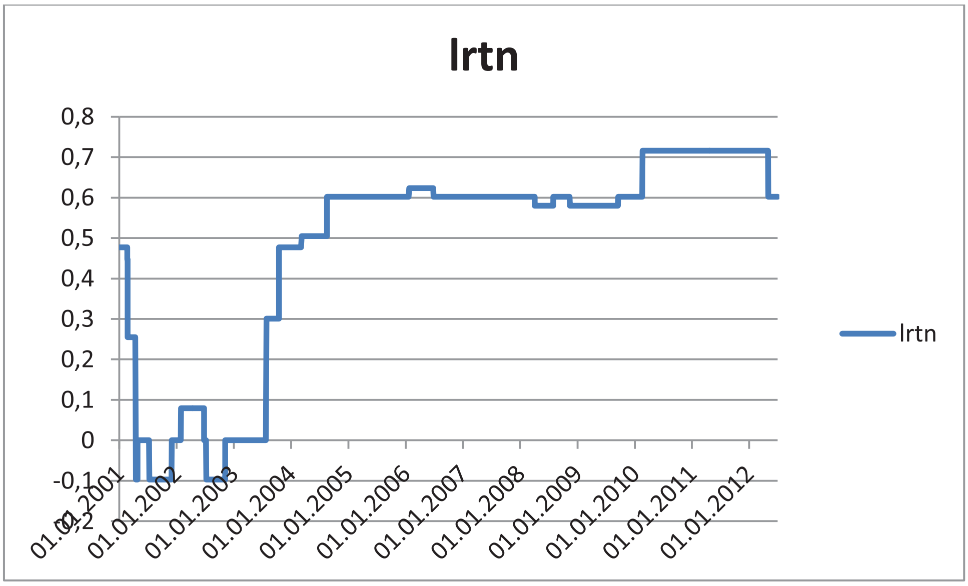


Table A2: VIX Index

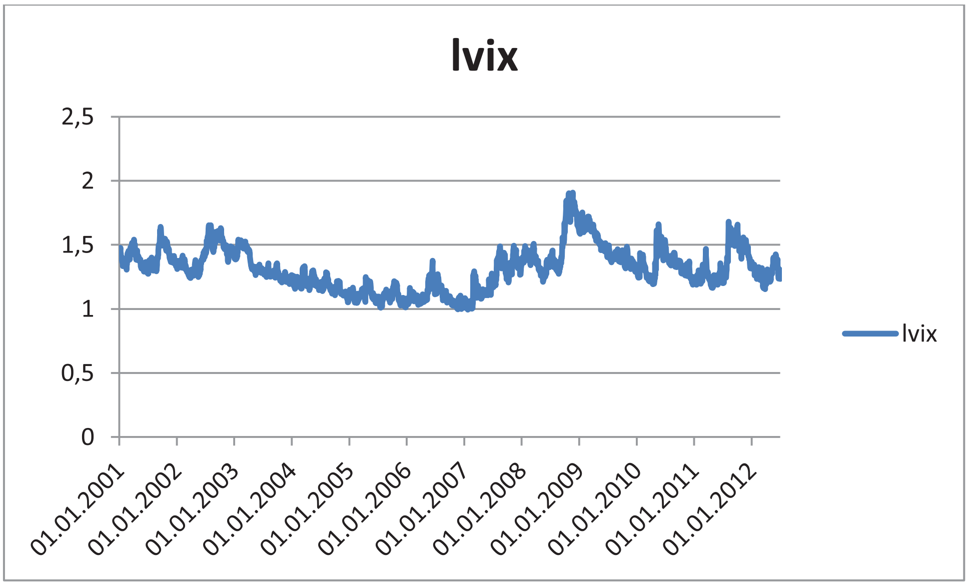


Table A3: Overnight interest rate for Turkey

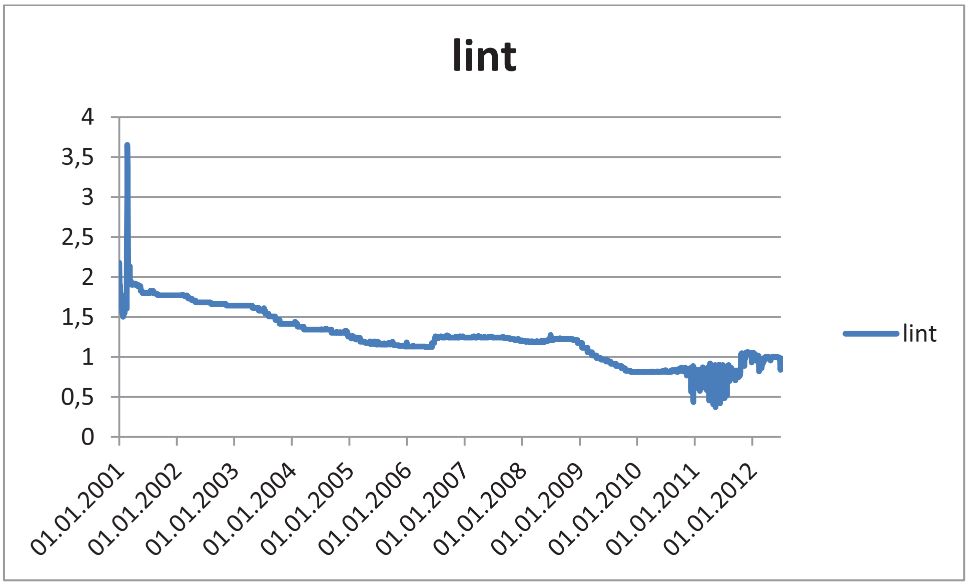


Table A4: TED Spread

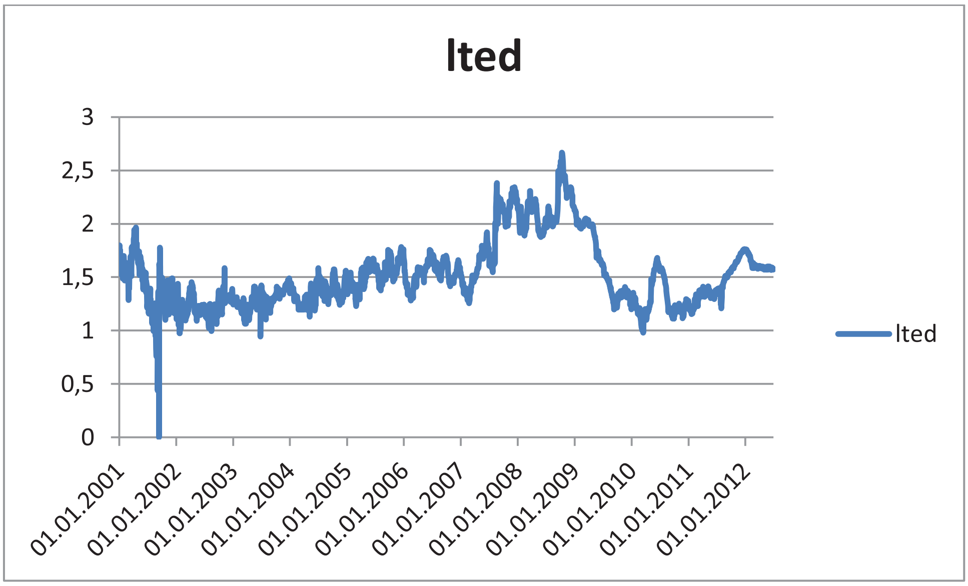


Table A5: Bank Stock Prices for Turkey

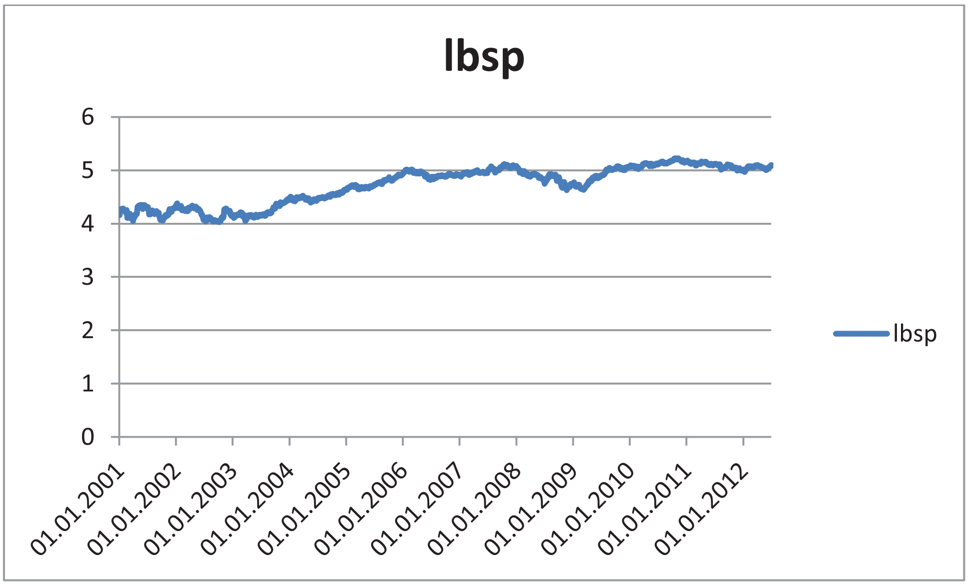


Table A6: İMKB XU100 Index

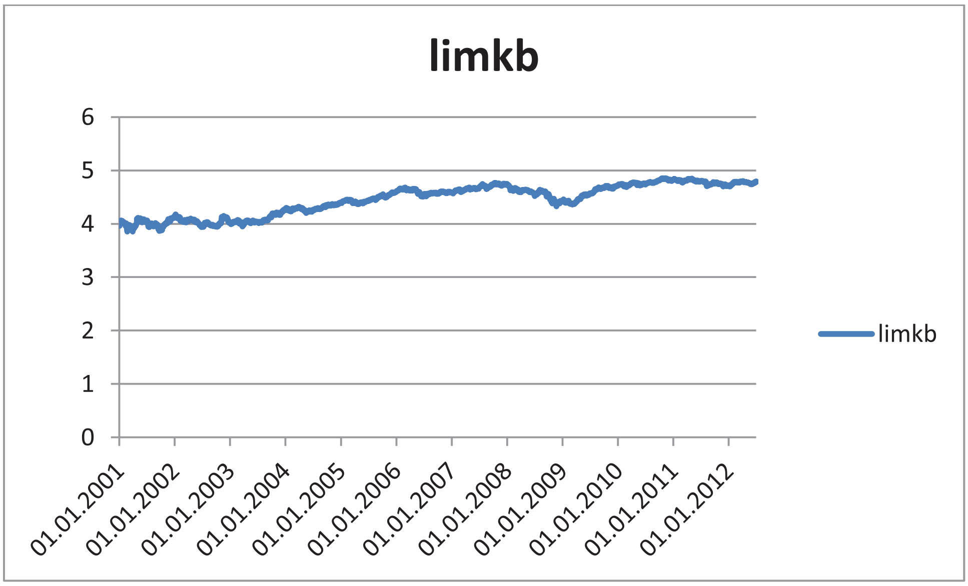


Table A7: Euribor (Euro Interbank Offered Rate)- 3 Month.

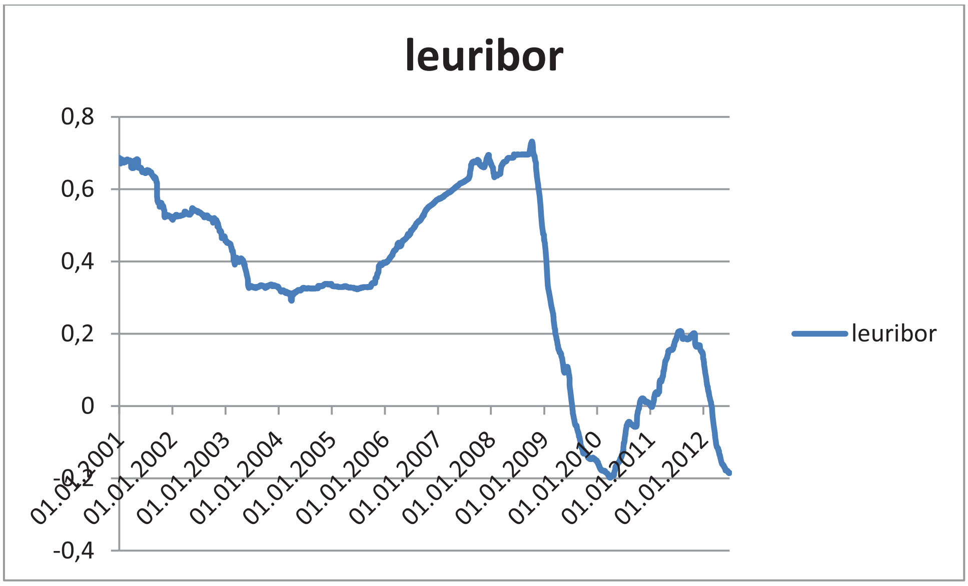


Table A8: iTraxx Europe index

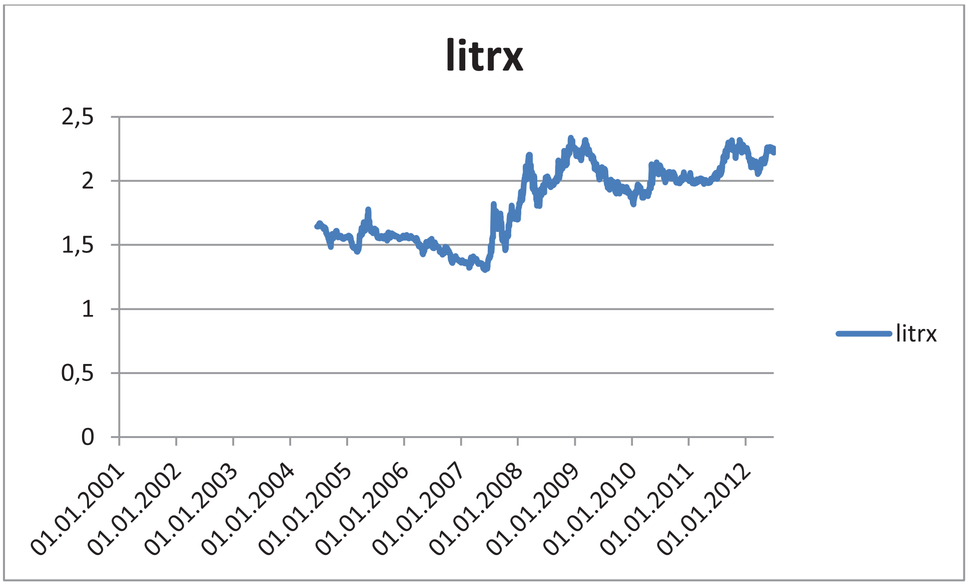


Table A9: S&P500 Index

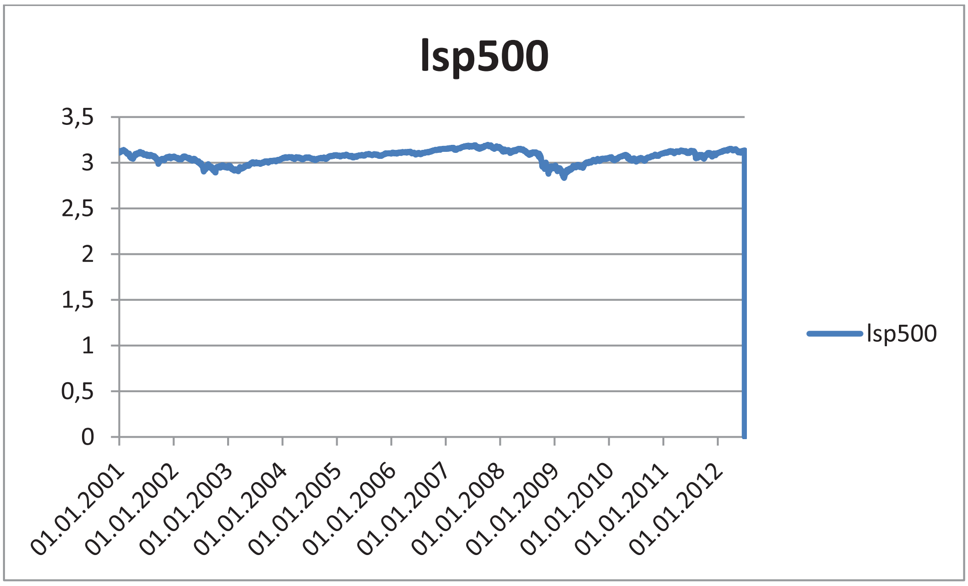


Table A10: NASDAQ Index

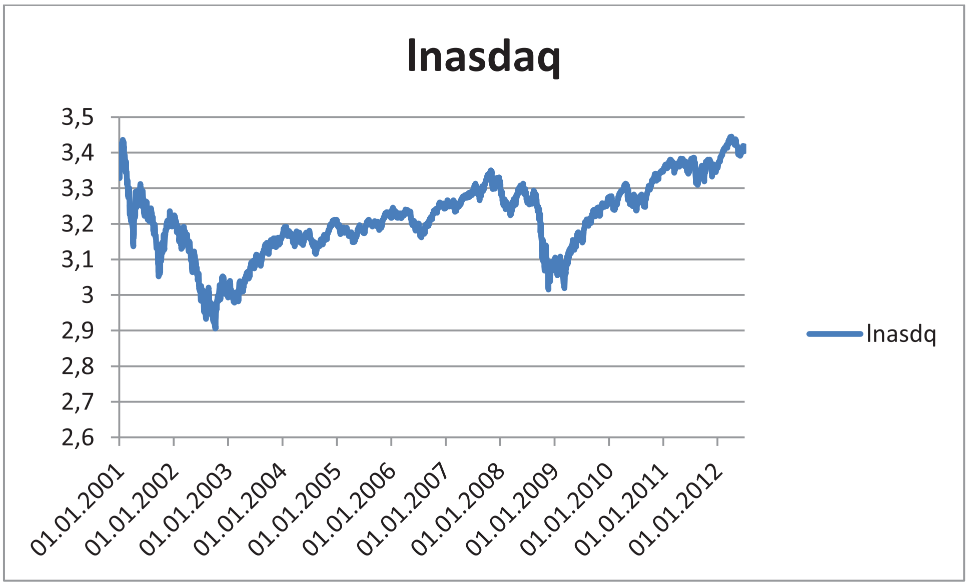


Table A11: US Treasury Rate- 3 Month

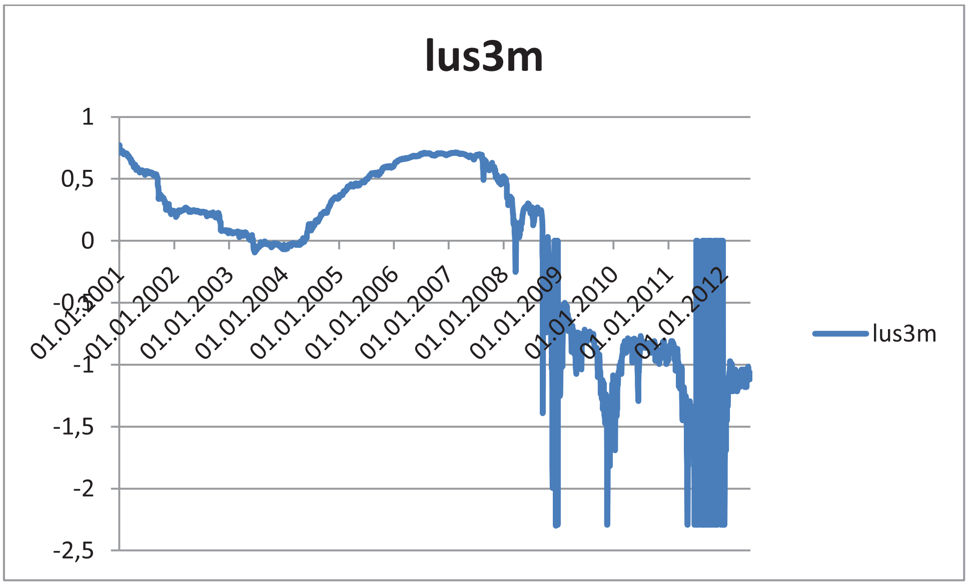


Table A12: US Treasury Rate- 3 Year

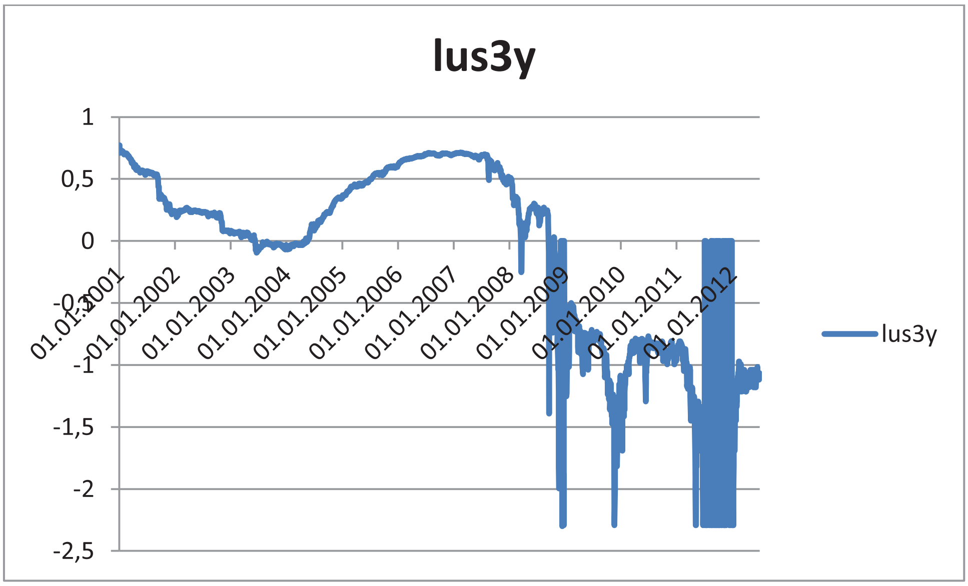
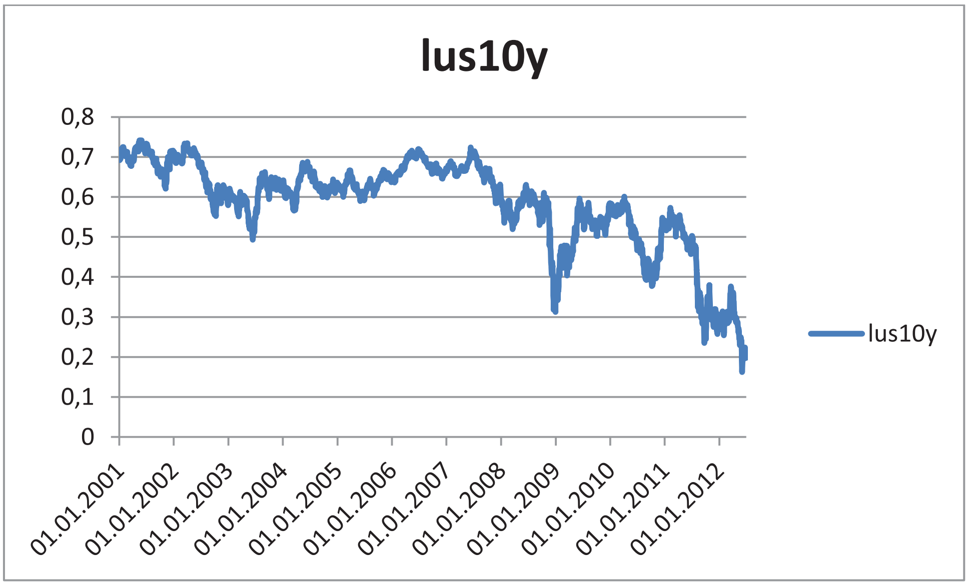


Table A13: US Treasury Rate- 10 Year



APPENDIX B: GENERALIZED IMPULSE RESPONSE GRAPHS

Table B1: Impulse Responses to generalized 1 Std. Dev. Innovations

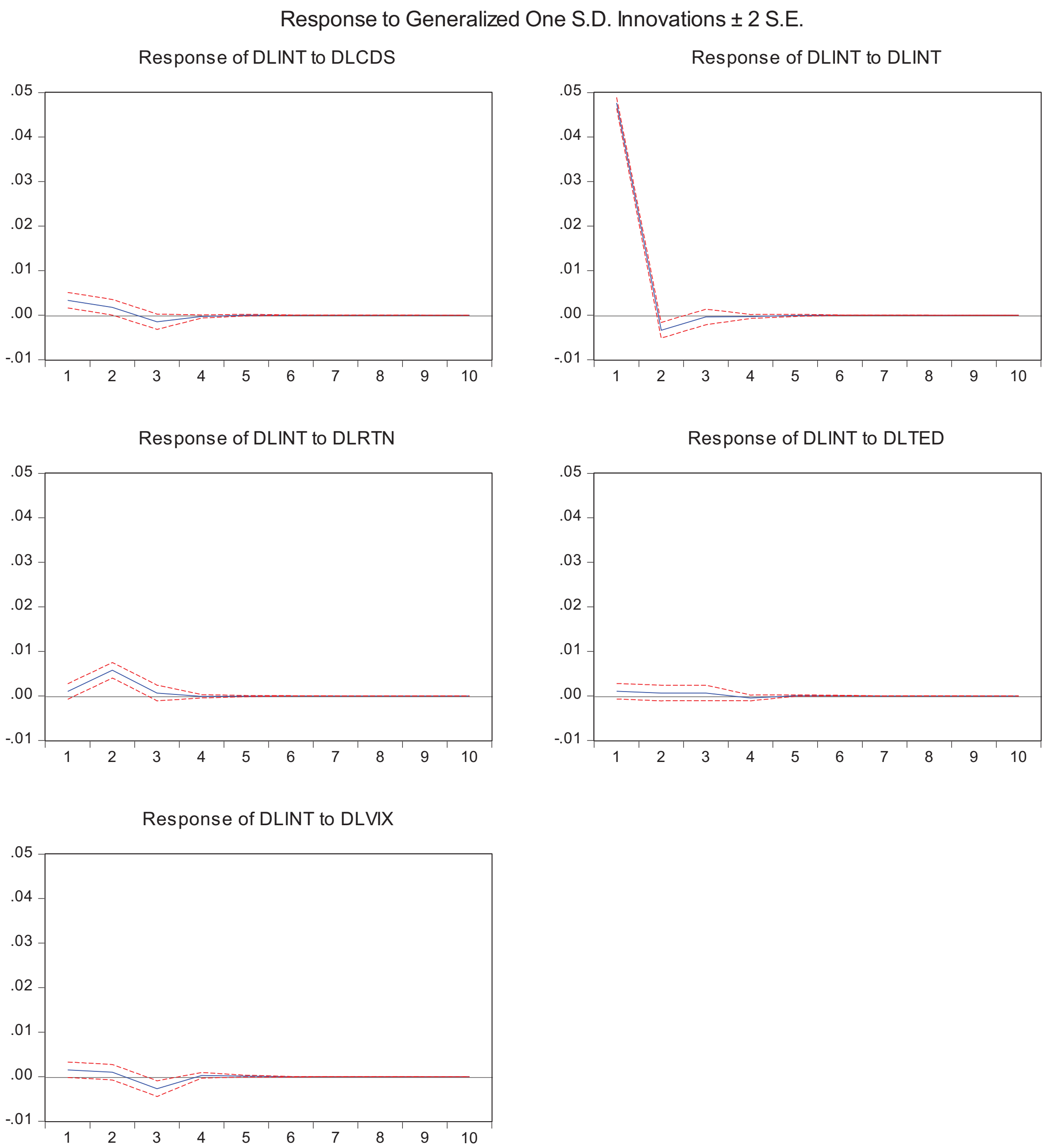


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

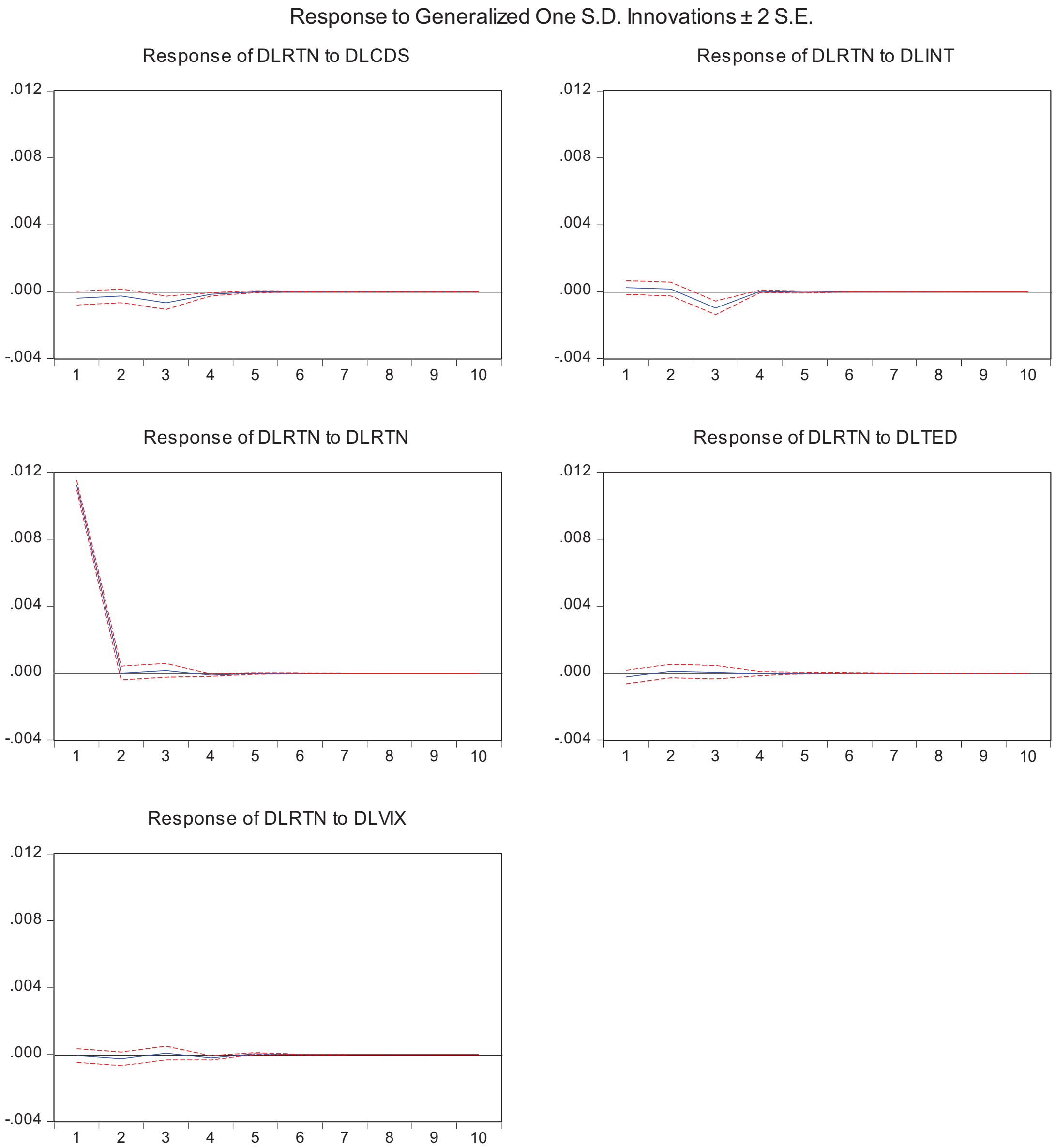


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

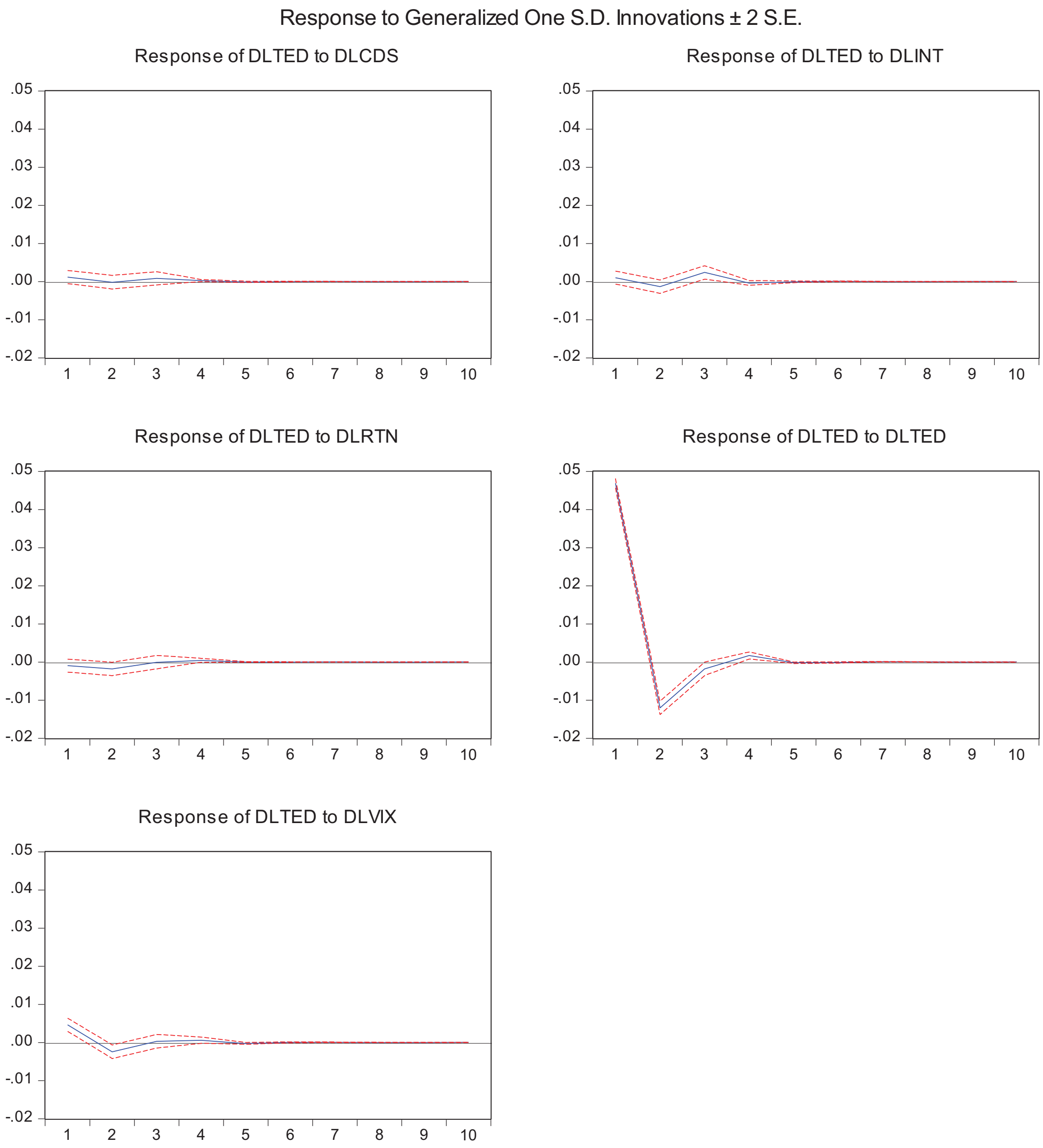


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

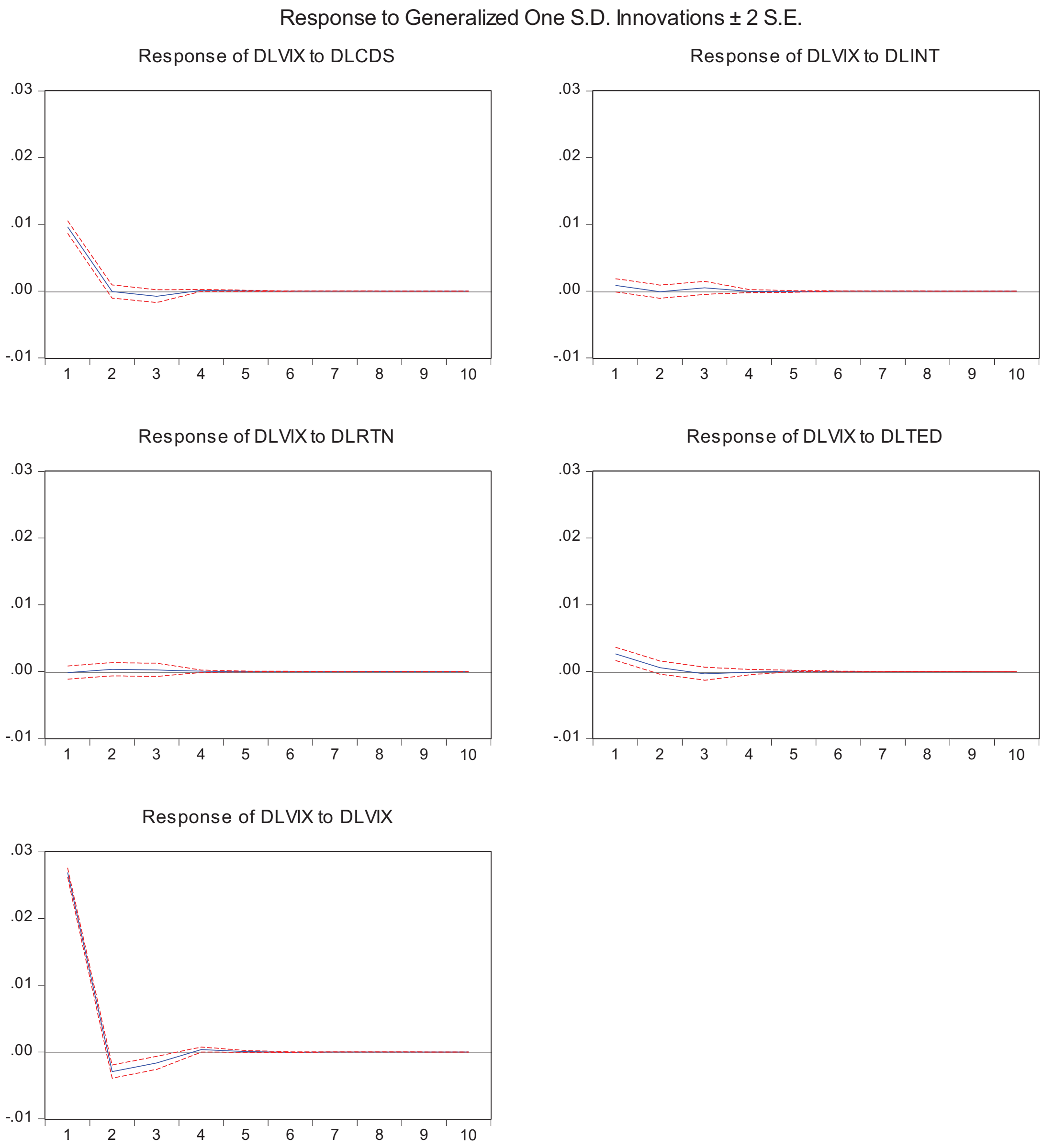


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

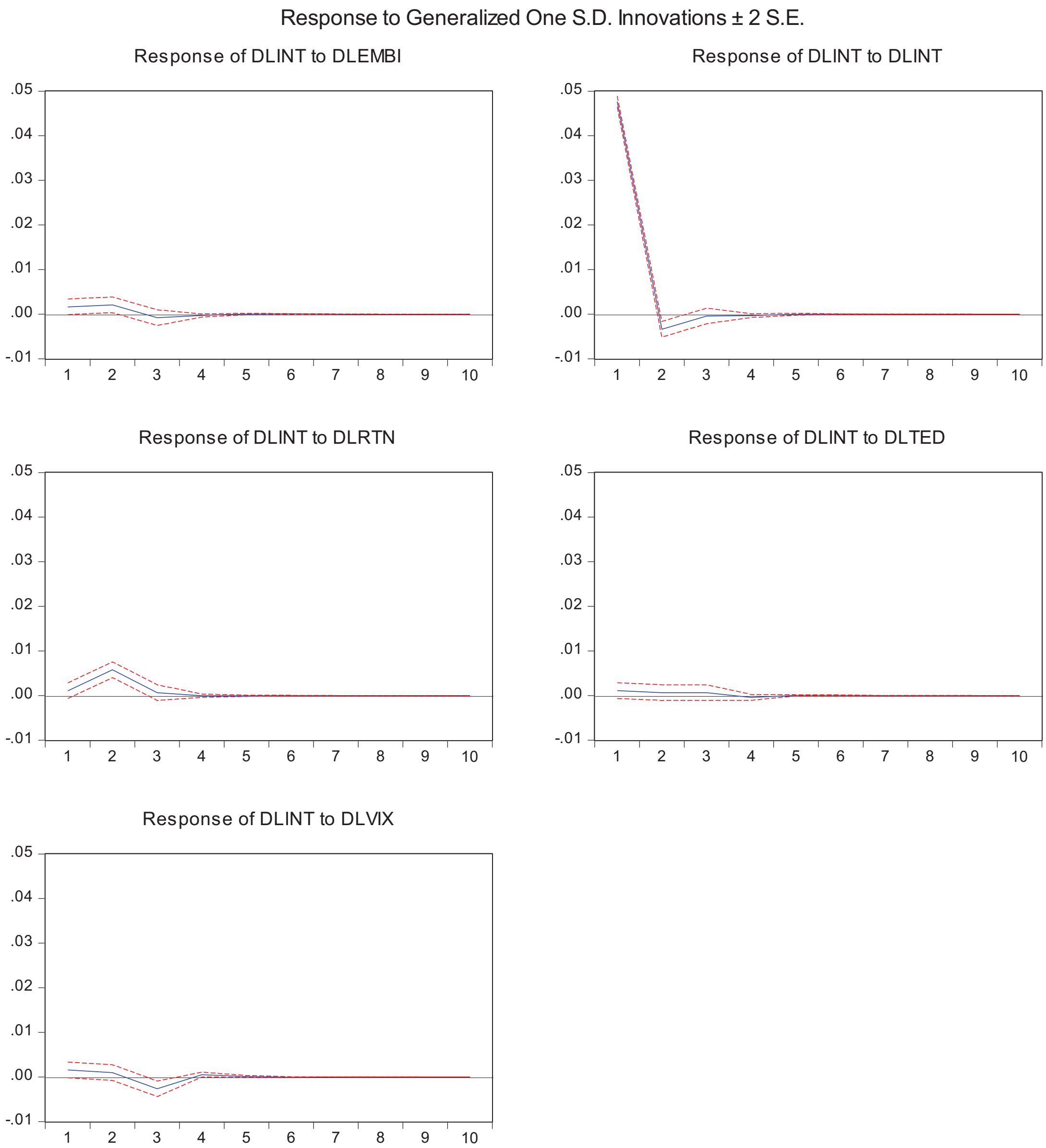


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

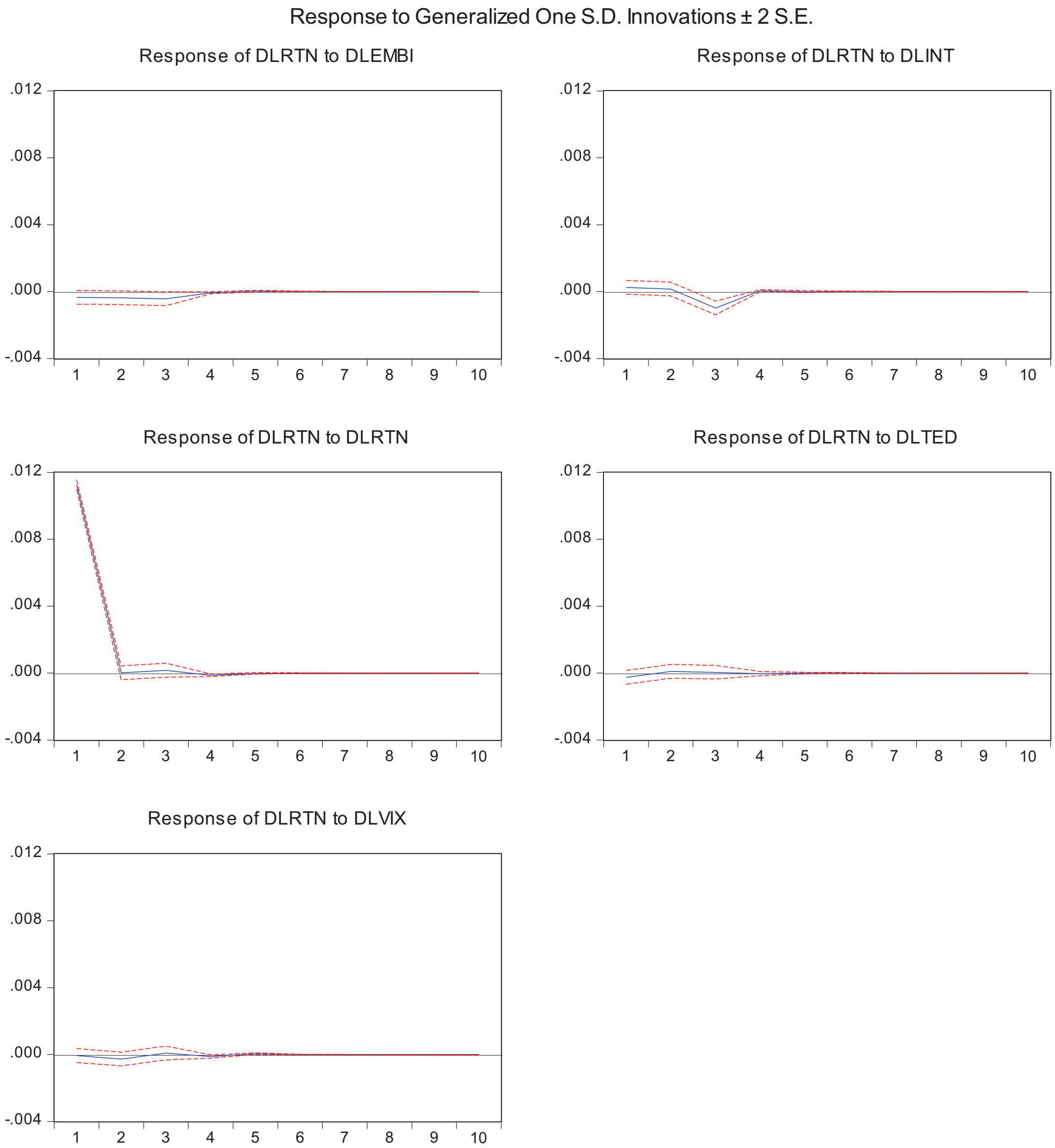


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations

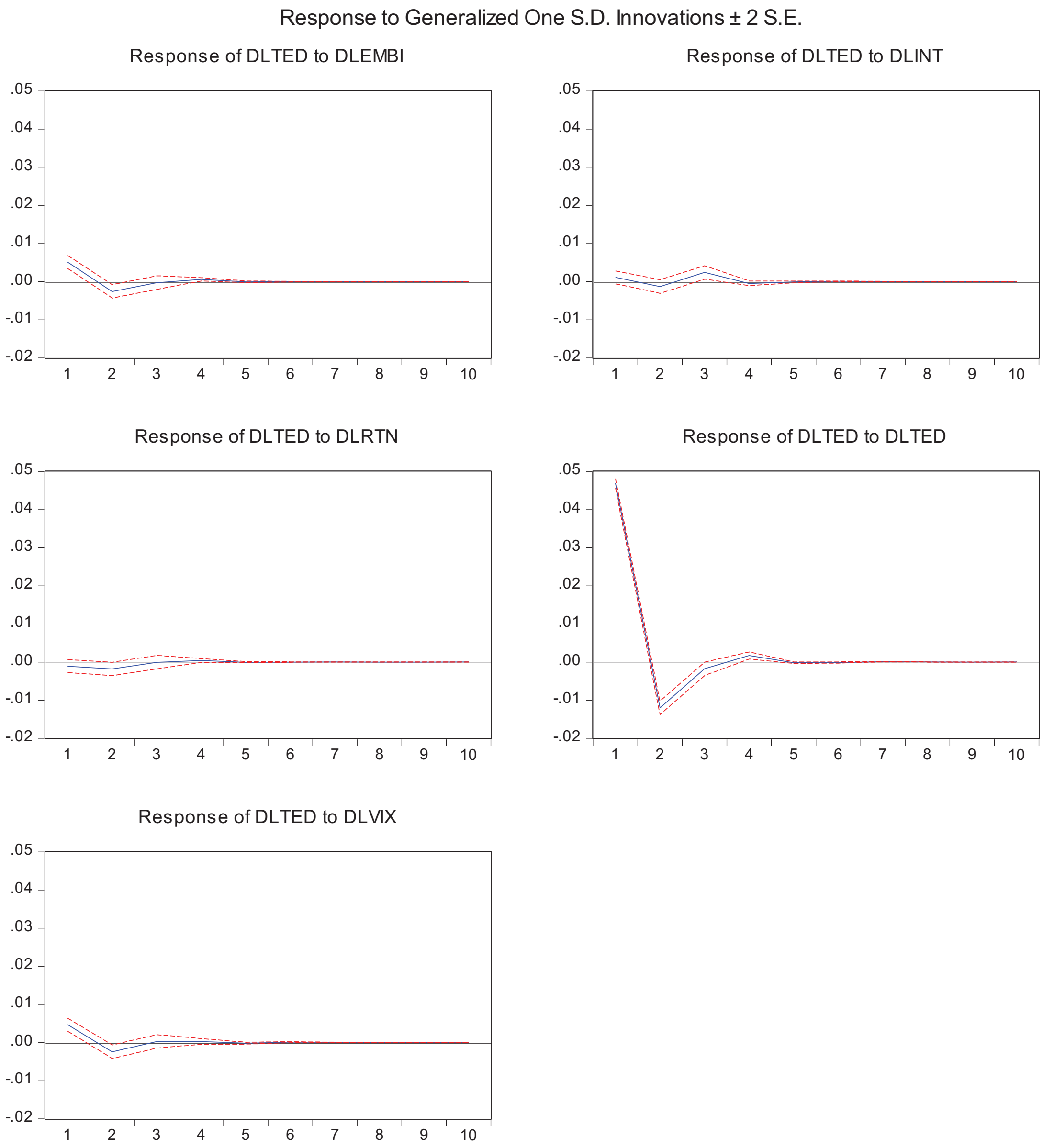
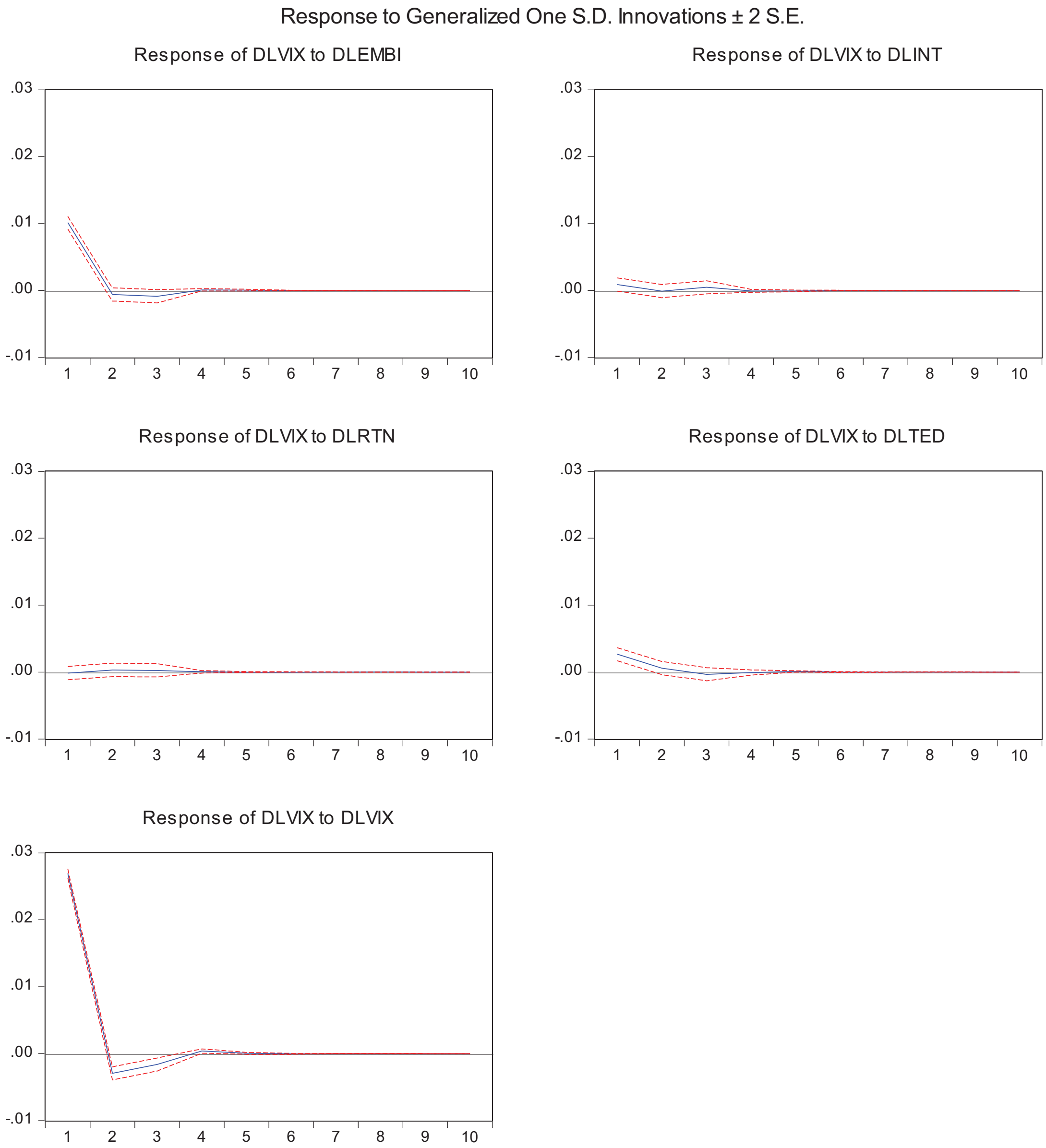


Table B1 (cont'd): Impulse Responses to generalized 1 Std. Dev. Innovations



APPENDIX C

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	
Sosyal Bilimler Enstitüsü	X
Uygulamalı Matematik Enstitüsü	
Enformatik Enstitüsü	
Deniz Bilimleri Enstitüsü	

YAZARIN

Soyadı : ASLAN
Adı : AYLİN
Bölümü : İKTİSAT

TEZİN ADI (İngilizce) : PRICING OF SOVEREIGN CREDIT RISK: APPLICATION TO TURKEY

TEZİN TÜRÜ : Yüksek Lisans [X] 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. Tezimden bir (1) yıl süreyle fotokopi alınamaz. [X]

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: