“Analyzing the contagion effect of current financial crisis on repo spreads”

by

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Abstract

From August 9, 2007, the spread between unsecured (Libor) and secured money market rates (GC repo rate) increased sharply (hereafter “repo spread”). This study aims to analyze effects of the current global crisis on repo spread contagion level between December 12, 2002 and June 30, 2009. I use Diebold and Yilmaz (2009) spillover index in order to calculate the contagion level of repo spreads. My findings suggest that the post-crisis contagion level of repo spreads is higher than pre-crisis period (2003-2007).

Keywords: Spillover index, contagion, subprime crisis, repo spreads, interbank money market.

Özet

9 Ağustos 2007 tarihinde GC repo oranı ile Libor arasındaki fark çok hızlı bir şekilde yükselmiştir. Bu farka bu çalışma boyunca "repo farkı" denilmiştir. Bu çalışmanın amacı repo farkının 12 Aralık 2002 ile 30 Haziran 2009 arasındaki dönemde bulaşma etkisini incelemek ve açıklamaya çalışmaktır. Bulaşma etkisini analiz edebilmek için Diebold ve Yilmaz'ın 2009 yılında geliştirdiği "spillover index" kullanılmıştır. Çalışmanın sonucunda elde ettiğimiz bulguya göre kriz dönemindeki bulaşma seviyesi kriz öncesi seviyesine göre daha yüksektir.

Anahtar Kelimeler: Bulaşma İndeksi, bulaşma, eşik-altı krizi, repo farkı, bankalar arası para piyasası.

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1. INTRODUCTION

After the Great Depression of the 1930s, the world economy was faced with the most severe crisis in the third quarter of 2007. This crisis started with the United States (US) economy sub-prime mortgage security markets and dispersed to all the economies in the world. Sub-prime mortgage securities were funded by different countries' investment banks, investors, and funds administrators. Any negative development regarding the funds based on sub-prime mortgage securities especially interest rate adjusted funds, increased the default anxiety for the funds and enhanced the risk perceptions for these funds and their future positions.

In this thesis I investigate the extent of financial spillovers on the repo spread during the recent global economic crisis. I look at the repo spread series from December 12, 2002 to June 30, 2009. I use the spillover index developed by Diebold and Yilmaz (2009) in order to understand the extent of contagion among the repo spreads between different countries during the crisis. My results show that the spillover index, and hence the extend of contagation reaches its peak at the onset of the crisis in the last quarter of 2007. The level of contagation declines slowly in 2008 and 2009 although it is still higher than pre-crisis levels. Diebold and Yilmaz (2009) index is based on rolling windwos estimation. In this study I use 200-day rolling windows. This could be one reason for the slowdown in the spillover index after the last quarter of 207. As the days of negative financial developments are extracted from the rolling window later in the sample, the contagion level could decrease .

I find that the total level of spillover after the financial crisis started is higher than the period before the crisis from 2003 to 2007. The increase of the level of the spillover index after crisis can be used as evidence to the claim that the crisis can be called a global crisis instead of a domestic crisis in the US economy.

The rest of this thesis is planned as follows. In Section 2, I evaluate the financial crisis. In Section 2.1, I briefly go over the causes and the consequences of the recent financial crisis to provide an overall perspective on the issue. Those readers who are familiar with the crisis can skip this section and move onto Section 2.2. In section 2.2, I give information about the interbank money market and the repo market. Developments in the interbank markets during the financial crisis are the main focus of this thesis. Therefore, a good understanding about the nature of these markets is important. Section 3 analyzes the data and gives the methodology of the thesis. In section 4, I try to explain the movements of the spillover index after the financial crisis. Section 5 is the conclusion. In the appendix, I give general information regarding the economic situations of the US, the United Kingdom (UK) and the Euro area.

2. FINANCIAL CRISIS

2.1 EVALUATION OF FINANCIAL CRISIS

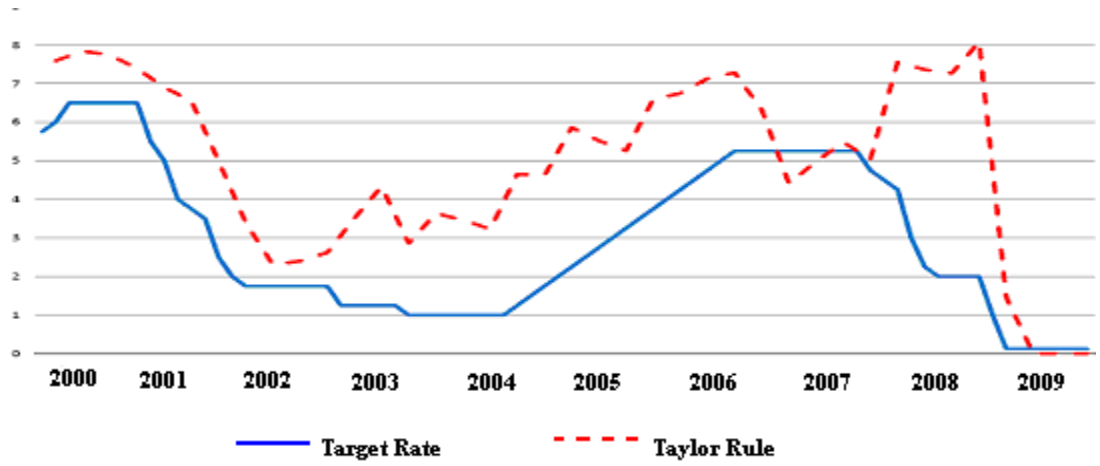
Recent global crisis affected all the countries in the world and it caused a harsh decline in growth rates, wealth, production levels, as well as raising unemployment and poverty rates all over the world. According to International Monetary Fund (IMF) world economic outlook for 2009, the world output would decline 1.1 per cent in 2009 from the growth rate of 3.0 per cent in 2008. The IMF world economic outlook also stated that the growth level of emerging and developing markets economies such as China, India would decline to 1.7 per cent, which means that emerging and developing market economies loose their aggressive growth performance which was close to 10 per cent and only keep a positive growth rate that is the lowest level for the last twenty years. Moreover, the same IMF world economic outlook forecasts that the unemployment rate can only get close to its 2007's level in 2014 and for some countries and regions; it will be higher than that level in 2014. These results let us conclude that the current crisis is absolutely devastating.

The role of monetary policy implementations in the US after 2001 may be important to understand the reason of the crisis. First, I summarize the policy and then evaluate its role in the crisis while comparing two different ideas about its effects on the crisis. After the US recession between March and November 2001 and also the increasing uncertainty in society about the security associated with the terrorist attacks of September 11, 2001, the

Federal Reserve reduced the target funds rate, the interest rate at which banks lend to each other, sharply in order to support economic growth.

The Federal Reserve cut the federal funds rate from 6 per cent in 2000 to 1 per cent in 2003 and kept the federal funds rate at 1 per cent from 2003 to 2004. After June 2004, the Federal Reserve started to increase the federal funds rate from 1 per cent to 5 per cent from August 2004 to the third quarter of 2006.

Figure 1: The Target Federal Funds Rate and the Taylor (1993) Rule Prescriptions



Source: Federal Reserve Board, Bureau of Labor Statistics, Bureau of Economic Analysis

I explain the relationship between monetary policies easing with the current crisis. Monetary policy easing, especially to the lowest level of the target rate during the 2003-2004 periods, increased the liquidity and decreased opportunity cost of lending, which helped investment banks to give sub-prime mortgage products while underestimating possible default risks. Taylor (2008) claims that this easing policy is the reason for this current financial crisis by providing an appropriate climate for the housing boom and

bust. Taylor (2008) said that the Federal Reserve kept target rates very low which ought to be higher according to its previous period's interest rate decisions. In Figure 1, the dashed lines show the federal funds rate implied by the Taylor rule. Note that the actual funds rate (the solid line) remained below the dashed line, indicating that the Federal Reserve followed an easy monetary policy relative to its historical standards.

His claims are based on the Taylor Rule (1993). Taylor rule is an approach that evaluates central banks' interest rate decisions according to deviations in the Gross Domestic Product (GDP) from potential GDP and the deviation in the expected inflation rate from the actual inflation rate. The rule is as follows:

$$i_t = 2 + \pi_t + a(\pi_t - \pi^*) + b(y_t - y_t^*)$$

In this equation,

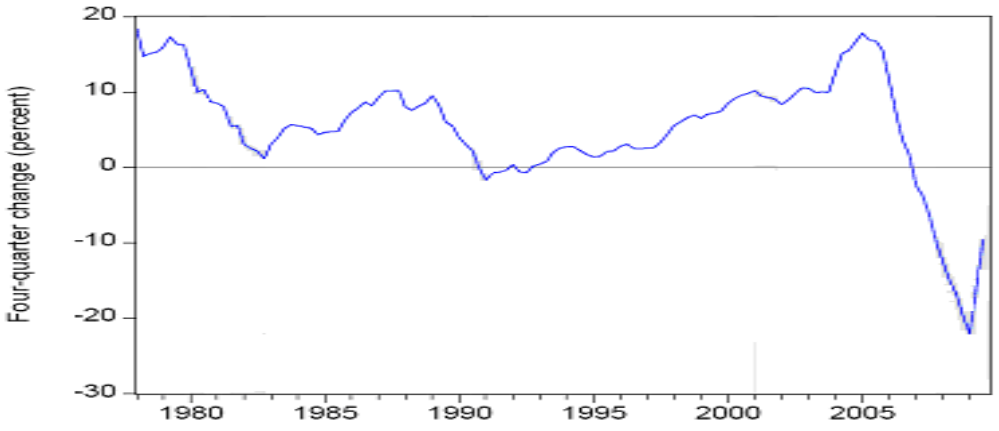
- $\pi_t - \pi^*$ is the deviation of the actual inflation rate π_t from its target π^* in period t
- i_t is the prescribed value of the policy interest rate in a given period t
- $y_t - y_t^*$ is the "output gap" which is the deviation of actual real output y_t from potential output y_t^* in period t
- a and b are positive numbers.

Bernanke (2010), the Federal Reserve chairman, announced his answers about Taylor's claim. He explained that the easy monetary policy that was implemented by the former chairman, Greenspan, was not the main reason for the crisis and the policy was consistent

with the Federal Reserves missions. Moreover, he emphasized that a time lag is crucial in implementing monetary policy and observing its effects on the economy and also getting wanted results. Policymakers should calculate expected changes in economic variables to determine whether those changes are temporary or permanent. That is why implementing monetary policy and determining federal fund target rate according to Taylor Rule cannot be reasonable always. Furthermore, another argument Bernanke (2010) had against Taylor's claim was that the easy monetary policy caused increases in house prices which led to the current financial crisis. Increasing of house prices had not started in the 2000s, increasing of house prices started in the 1990s and followed an increasing path until the financial crisis.

Figure 2 shows that the increasing path of housing prices started in 1993 and continued to 2007. This increasing path does not support Taylor's claim that lower interest rates led to housing price booms after the 2003 period.

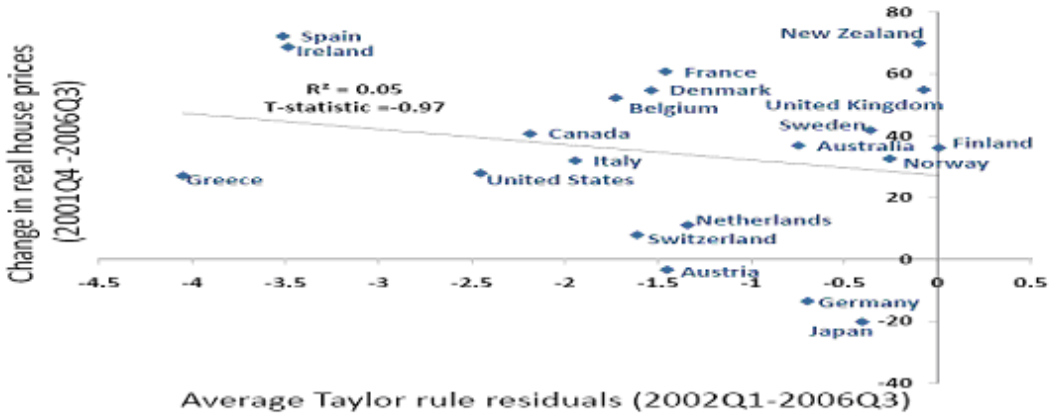
Figure 2**:** Rate of Increases in House Prices 1978:Q1-2009:Q3



Source:FirstAmerican LoanPerformance (Bernanke 2010)

There is a cross-sectional study about the relation between monetary policy and house prices. According to IMF staff calculations, there is no strong link between easing monetary policy and the house price increasing path. The following figure is drawn by Fatas, Antonio, Kannan, Rabanal, and Scott, 2009, and replicated by IMF Board staff.

Figure 3: House Prices vs. Average Deviation from Taylor Rule

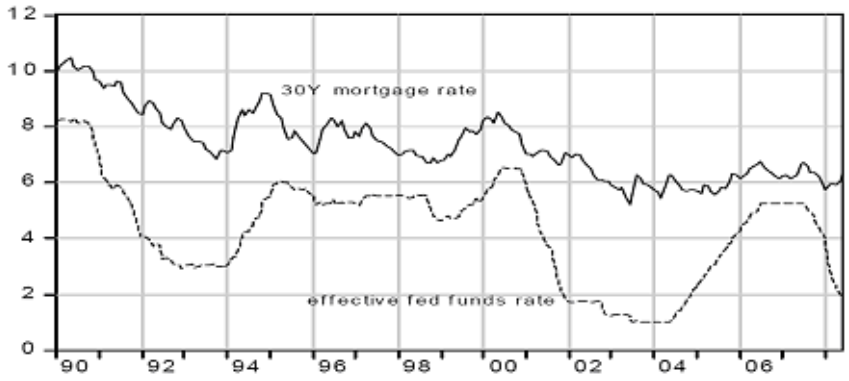


Source: International Monetary Fund

The horizontal axis of the figure shows the deviation of the interest rate target from the Taylor Rule. A negative number means that a country implemented more accommodative monetary policy than Taylor Rule's expectations. It is observed that most of the countries implemented easy monetary policy during that period. Consistent with previous arguments there is no statistical link between easy monetary policy and housing prices rise in these countries. The solid line reflects the expected slope that shows the relation of monetary policy and house prices. The US is under this line which supports Bernanke's arguments rather than Taylor's claims.

Taylor's argument, monetary policy easing before the financial crisis, cannot be assigned the main reason of the crisis. There are opposing views to each claim and it is hard to reach a conclusion in either way. Yet, this easy monetary policy could facilitate the expansion of financial markets volume which could be the main trigger of the financial crisis.

Figure 4: The 30-Year Conventional Mortgage Rate and the Effective Federal Funds Rate



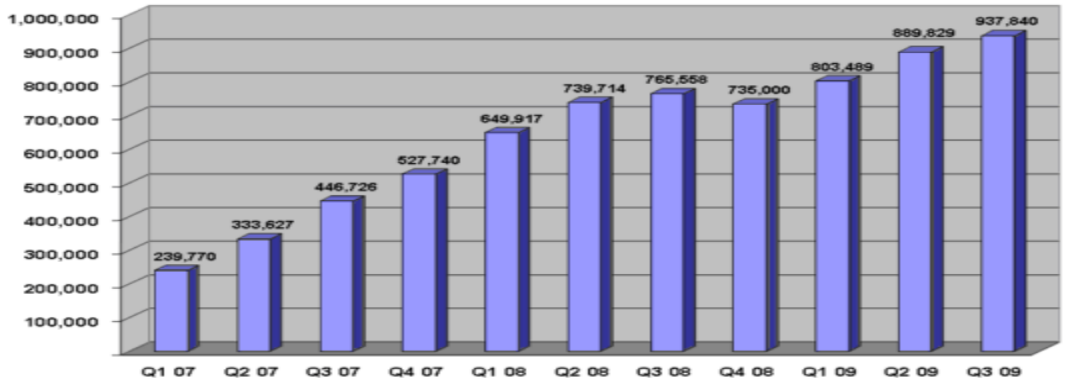
Source: Federal Reserve Bank of St.Louis (Orlowski, 2008)

The low interest rate environment enhanced the lending activities and contributed to expansion of over risky (unsecured) financial instruments. The total estimated value of financial instruments such as pension funds, mutual funds, insurance funds, official reserves, sovereign wealth funds, hedge funds and private equity reached $76 trillion at the end of 2007.[1] Also, the total values of financial assets are called unsecured such as more risk-prone sovereign wealth funds and private funds have reached $9 trillion.

[1]IMF Staff calculation

Most of the sub-prime mortgages were adjustable-rate mortgages, which gave the chance to refinance the loan by using the rise in house prices to borrow more from investment banks. Unfortunately, predicted increases in house prices for the coming months and years has not come true. However, house price has started to decline while adjustable-rate mortgages remained high which caused repayment problems in sub-prime mortgages.

Figure 5: The Foreclosures Value from 2007 to 2009



Source: RealtyTrac Press Releases of "US Foreclosure Market Report"

As seen in the figure above, foreclosure levels increased substantially throughout the crisis. This led to systematic problems in mortgage markets and other markets which were related to this mortgage market and its products.

Sub-prime and other mortgages were assembled into mortgage-backed securities and that increased the effects of the crisis. These securities lost their values substantially due to the repayment crisis from sub-prime mortgages. The problems in the housing markets dispersed to money markets. Housing market problems caused banks and financial institutions to raise the interest rates. Problems in mortgage-based securities therefore caused losses in the banking sector. This problem increased risk perceptions for future

investment decisions in the banking sector and its products. Also the level of asymmetric information increased due to uncertainties in mortgage-based securities and their potential returns. This process led to a lower lending ability in banking sector. All this developments caused rise in interest rate and risk perception.

There were big problems in the investment banking market because of these repayment crises and increasing trends in interest rates. One of the most popular and complex financial product is Collateralized Debt Obligations (CDOs) which was also in trouble after sub-prime mortgage repayment problems began. These complex financial products were very popular because they gave a higher rate of return than other market instruments. The default risks in these complex instruments were underestimated by rating agencies due to low accountability, moral hazard, and difficulties in assessing these complex instruments and risk in their structure. The volume of CDOs was very high in the US economy and also for others. In 2004, the total value of CDOs was $157.4 billion while in 2006 its value was $520.6 and after the collapse of some of them, total value of CDOs declined to $481.6 in 2007 and $61.6 in 2008. (Orlowski 2008). This huge bust affected all economies in the world and increased the effect of financial crisis.

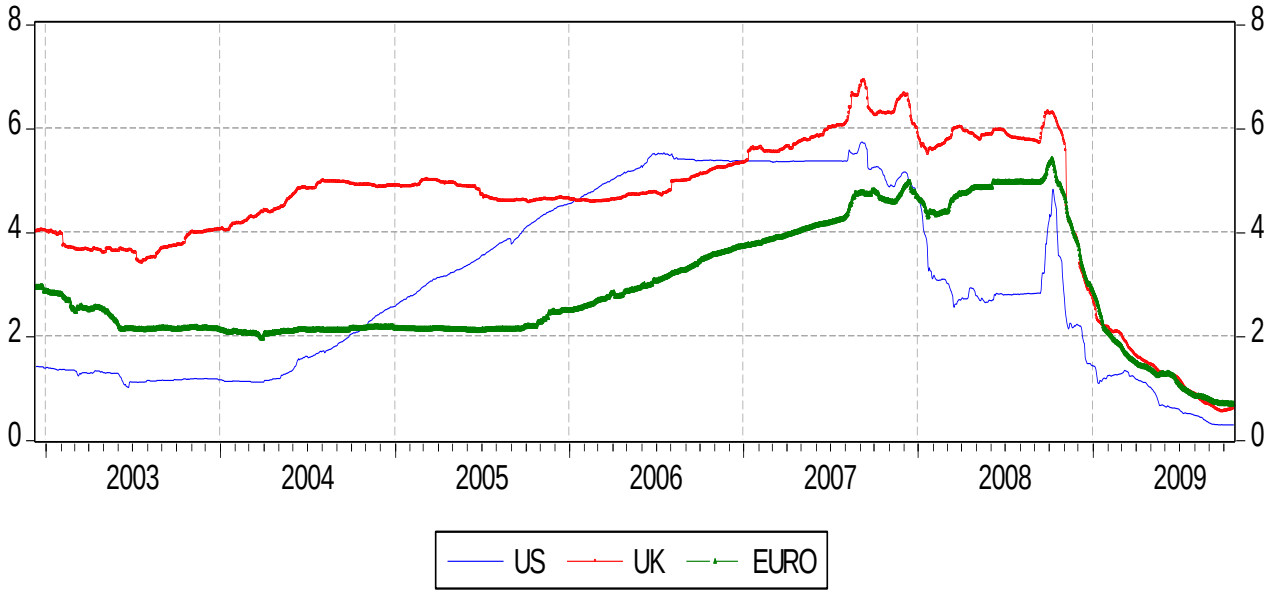
These unfavorable developments in financial markets may be the main factors behind the current devastating financial and economic crisis. Yet, the easy monetary policy can also be partly responsible because of providing cheap money and more liquidity for these financial investors and investment banks.

2.2 THE INTERBANK AND REPO MONEY MARKETS

The Interbank money market provides funding opportunities to depository institutions for short-term. The interest rate is determined between a borrower and lender. In this thesis, I will use The London Interbank Offered Rate (Libor) as a measure of interbank rates.
Libor is a benchmark rate published by the British Banker's Association. The Libor rate is based on a survey of a Libor-participating panel. Each bank is asked how much it would ask for an interbank loan. The survey rate is published just prior to 11:00 AM CET.

The Libor represents lower-bound of costs for unsecured funding and also is a benchmark for financial instruments, future contracts, swaps and mortgage rates. The cost of borrowing unsecured funds is very sensitive to financial developments especially during complicated economic situations. That is why the level of Libor is a good indicator to use for understanding developments in the interbank money market and also for understanding the position of the economy in those markets. Figure 6 shows the daily level of the three month Libor rate in three different currencies.

Figure 6: The Evolution of Libor for US, UK and the Euro area



From the figure above, we see that before the current financial crisis the Libor is not volatile, yet after the onset of the financial crisis it has started to be more volatile in all currency markets.

In repo markets, banks borrow funds by using financial securities as collateral with the agreement to repurchase them later. In this market, funds are secured, that is why the counterparty risk is negligible. This gives great incentives for financial institutions to use repo market especially for overnight funding activities in order to keep their balances safe.

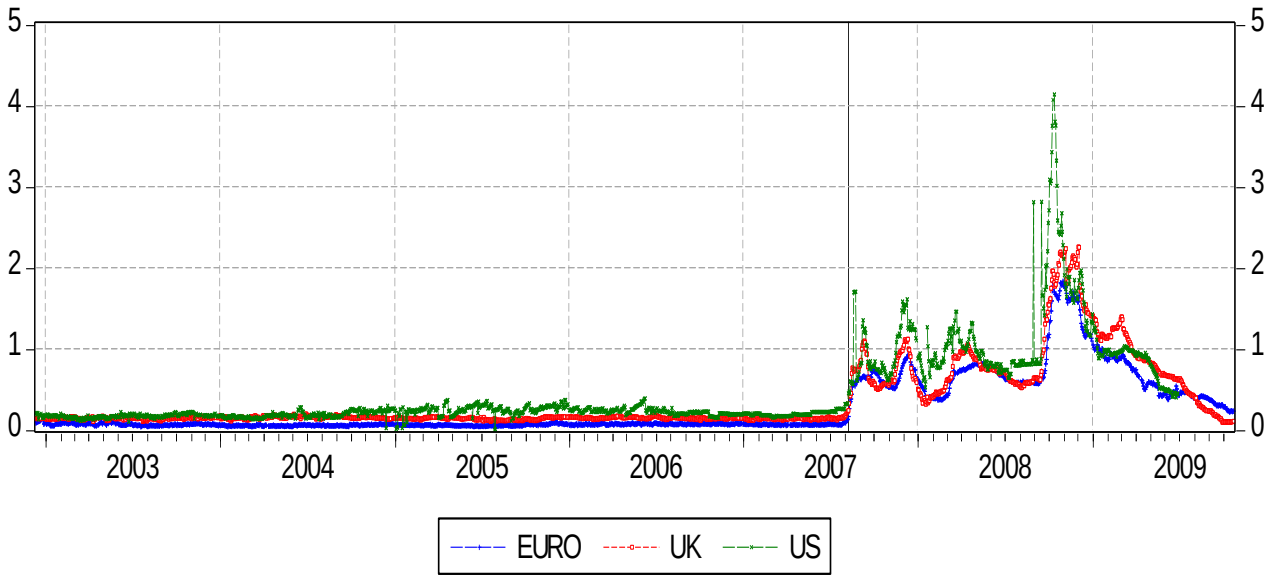
3. EMPRICAL ANALYSIS

In this thesis, I use daily interbank money market rates. I analyze three different regions. These are the United States (US), the United Kingdom (UK) and the Euro area (Euro).
I gathered the Libor rates for US and UK and the Euro interbank offered rate (Euribor) for Euro. The Euribor is published by the European Banking Federation (EBF) at 11:00 AM CET, while the Libor rate is announced by British Banker's Association (BBA) at 11:00 AM GMT. These rates are crucial in determining the lending volume of financial markets all over the world, so their development is valuable to understanding the liquidity needs in financial markets during the current global crisis. Because these rates are used in unsecured funds that contain credit risk and liquidity risk together during the financial crisis I use a repo market rate in order to separate credit risk and liquidity risk. The GC repo rate is a collateralized lending transaction where one party agrees to sell securities to another and receives a transfer of funds in return. Similar to Libor, The GC repo rates are fixed almost at the same time of day in three markets, i.e. 11:00 AM CET for Euro and 11:00 AM GMT for the US and UK. The data is obtained from Reuters, the British Banker's Association (BBA), and Eurepo.org.

I computed the repo spread which is the difference between the Libor rate and the GC repo rate for each currency. With the help of this spread, I can separate credit risk from liquidity risk. This spread only contains credit risk because the Libor contains credit and liquidity risk while repo rate contains only liquidity risk because it is collateralized lending. The sample period starts from December 12, 2002 goes through June 30, 2009.

Figure 7 shows the development of this spread. As shown in the figure, this spread was very low before the onset of the current financial crisis and also not volatile. On the other hand, after the financial crisis began the level of the spread increases and also becomes more volatile.

Figure 7: The Evolution of the Repo Spreads



Source: www.bba.org.uk, www, eurepo.org and Reuters.

*Vertical line shows the beginning of the financial crisis (August 9, 2007)

3.1 METHODOLOGY

My goal in this thesis is to understand the spillovers in the Libor-repo spreads among US, UK and Euro. For that purpose, I use the spillover index which is developed by Diebold and Yilmaz (2009). The spillover index is based on the notion of variance decomposition for autoregression. Briefly, the sum of off-diagonal elements of the variance-covariance matrix for the forecast error relative to the sum of all elements is the spillover index. For a more detailed explanation of the spillover index, I try to illustrate the index with covariance stationary first-order two variable Vector autoregression (VAR).

Consider a simple covariance stationary first-order two variable VAR .

$$x_t = \oplus x_{t-1} + \varepsilon_t$$

where $x_t = (x_{1,t}, x_{2,t})'$ and $\oplus$ is a 2x2 matrix.

By covariance stationarity, the moving average representation of the VAR exists and is given by

$$x_t = \square(L)\varepsilon_t$$

where $\square(L) = (I - \oplus L)^{-1}$. When we rewrite the moving average representation as $x_t = A(L)u_t$ where $A(L) = \square(L)Q_t^{-1}, u_t = Q_t\varepsilon_t, E(u_t u_t^{'}) = I$, and Q_t^{-1} is the unique lower triangular cholesky factor of the covariance matrix of ε_t.

The expected value of the $x_{t+1,t}$ is $\oplus x_t$ with the following 1-step forecast error vector,

$$e_{t+1,t} = x_{t+1} - x_{t+1,t} = A_0 u_{t+1} = \begin{bmatrix} a_{0,11} & a_{0,12} \\ a_{0,21} & a_{0,22} \end{bmatrix} \begin{bmatrix} u_{1,t+1} \\ u_{2,t+1} \end{bmatrix}$$

which has the following covariance matrix

$$E(e_{t+1,t}e'_{t+1,t}) = A_0A'_0$$

The variance of the 1-step-ahead error in forecasting $x_{1,t}$ is $a^2_{0,11} + a^2_{0,12}$ and the variance of the 1-step-ahead error in forecasting $x_{2,t}$ is $a^2_{0,21} + a^2_{0,22}$.

We can decompose the 1-step-ahead error variance in forecasting $x_{1,t}$ that is due to $x_{1,t}$ and $x_{2,t}$. For a more general format let me define two separate variance shares for error variance forecasting. The first one is own variance shares, which is the part of the 1-step ahead error variances in forecasting $x_{i,t}$ owing to shocks to $x_{i,t}$, for $i = 1,2$. The second is cross variance shares, spillovers, which is the part of the 1-step ahead error variance in forecasting $x_{i,t}$ owing to shocks to $x_{j,t}$ for $i, j = 1,2, i \neq j$. In our two-variable examples, there are two spillovers, one is from $x_{1,t}$ to the forecast error variance of $x_{2,t}$ and calculated by $a^2_{0,21}$ and the other is $x_{2,t}$ to the forecast error variance of $x_{1,t}$ and calculated by $a^2_{0,12}$. The total forecast error variation of all shocks from variables spillover, in the two variable examples, is the following:

$$a^2_{0,11} + a^2_{0,12} + a^2_{0,21} + a^2_{0,22} = trace(A_0A'_0)$$

As a result, the spillover index is the following

$$S = \frac{a^2_{0,12} + a^2_{0,21}}{trace(A_0A'_0)} * 100$$

I am applying the Diebold and Yilmaz (2009) spillover index to analyze the repo spread data. According to the spillover index, I use VAR technique in analyzing the forecast error variances of shocks from one variable to another. For applying VAR, I check the stationary of series. I use the Augmented Dickey–Fuller (ADF) test in order to check the stationarity. According to the ADF test, all three series are non-stationary (Results are listed in Tables 1-a, 1-b and 1-c). As shown, I fail to reject the hypothesis of a unit root of 95 level of confidence. I use 4 lags for Euro and UK in accordance with the smaller Akaike Information Criteria (AIC). For the US, 3 lags are chosen by AIC.

I check the cointegration of these series with the Johansen Cointegration test, according to both trace and maximum eigenvalue tests there is a single cointegration relationship among series (Results are listed in Table 2). In Table 2, we can see that for a 95 level of confidence, the trace statistics and max-eigen statistics are both higher than the critical values. As a result, applying Vector Error Correction (VEC), which is the restricted model of a VAR, is more appropriate for the spillover index. I use VEC model with rolling windows for 200 days. I also verify the stationarity of all rolling windows. For all three series, more than half of the rolling windows are non-stationary. (Results are listed in Table 3). The percentage of the non-stationary samples is seen in the third column of Table 3. With VEC estimation I obtain variance decompositions based on Cholesky orthogonalization and generalized VAR approaches for a 10–month forecast horizon to estimate the spillover indices. (Diebold and Yilmaz, 2009)

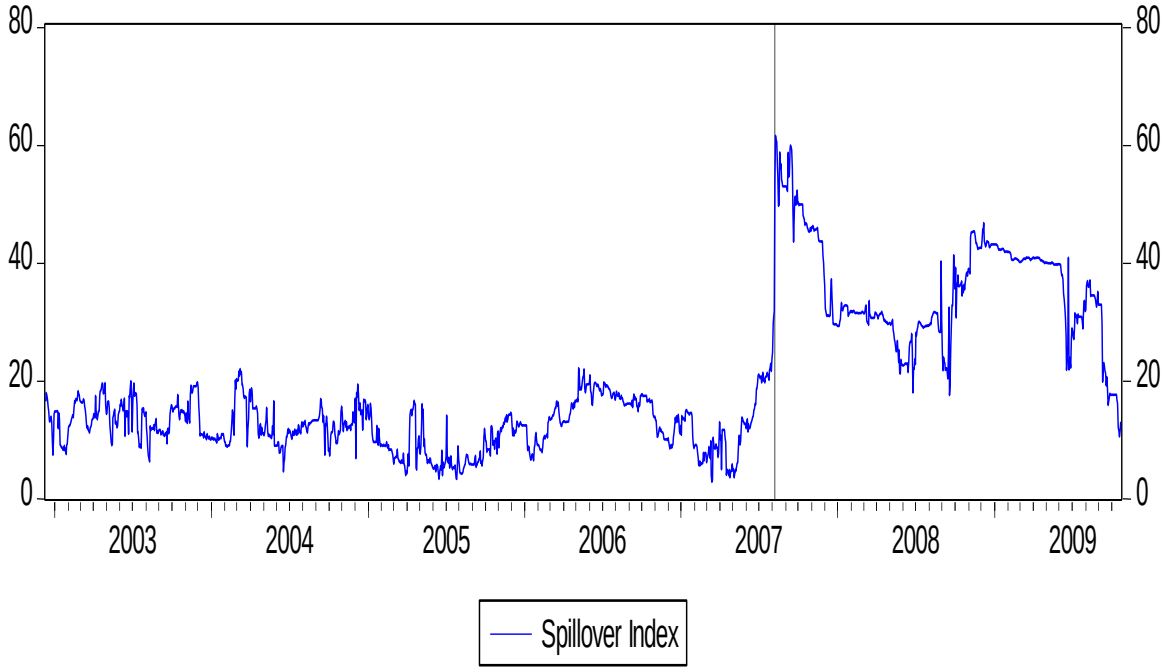
I then obtain next sub-sample for the other 200 day sample on a rolling window basis. For the following sub-samples, I obtain Cholesky and generalized variance decompositions in order to provide spillover indices. As a result, I get the spillover plot for every sub-sample and then obtain the main spillover plot for the whole period from 2003 to the third quarter of 2009. The resulting index is shown in Figure 8. In the next section, I will try to explain the movements in this index during the crisis period.

4. SPILLOVER INDEX MOVEMENTS

From 2003 to 2007, the US economy and other developed countries' economies had an expansionary period with the help of appropriate global liquidity situations. At that period, housing markets had enormous expansion, especially in the US. This expansion entailed great growth in the subprime mortgage market and securities that are based on subprime mortgages. Moreover, the Federal Reserve had an expansionary monetary policy that supported this process. European countries' banks also kept credits and securities that were based on subprime mortgages. Until, August 9, 2007, this system continued. On this day, BNP Paribas, the largest public French bank, announced that they were freezing three asset-based securities funds that were valued at 1.6 billion euros. The bank said that they could no longer value them accurately due to problems in subprime markets in US. Furthermore, on the same day, KFW development bank bailed out IKB, Deutsche Industriebank, that holds subprime investments.

These developments affected default risk in repo markets and caused a great jump in the repo spread on August 9, 2007. The repo spread had a jump in US, Euro and UK markets, but the highest jump was in US repo market due to an increase in subprime market risk perceptions and losses in asset-based securities in subprime market in US. European banks had funds in US subprime market that is why any turmoil in the mortgage market was able to affect all economies in US, Euro and UK.

Figure 8: Spillover Index from December 12, 2002 to October 23, 2009

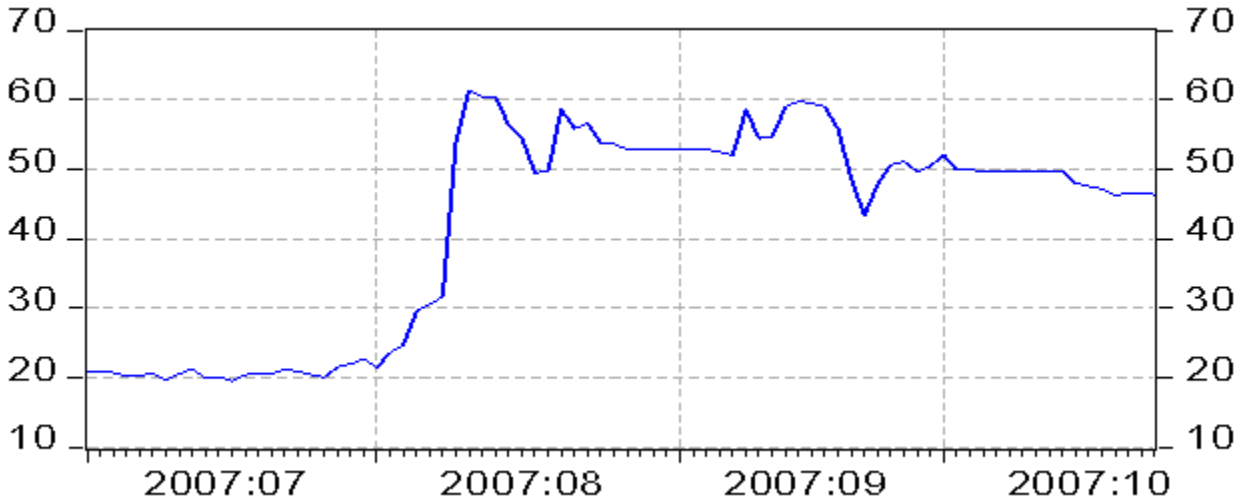


*Vertical line shows the beginning of the recent financial crisis (August 2007)

Figure 8 shows the spillover index that is calculated based on Diebold and Yilmaz (2009) as described in the previous section. The spillover index was approximately 20 per cent in the pre-crisis period. This means that the total variance of the forecast errors for three

repo spread series can be explained by spillovers of shocks across regions and is approximately 20 per cent. The spillover index indicates the total share of the shocks that affects all series. For analyzing the contagion effect, the important point is the change of level in the spillover index comparatively to the previous terms levels.

Figure 9: Spillover index from July to October 2007



The spillover index jumped from 20 per cent to approximately 55 per cent after announcements from banks regarding subprime market funds. The increase in the spillover index indicates that the extend of cross-country contagion of interbank market stress increased drastically after the outbreak of the crisis. At that time, it was not easy to analyze or totally calculate possible losses in mortgage-based securities due to accounting rules. Also, it was difficult to determine with certainty the value of subprime securities. General concerns about mortgage market's futures affected repo spreads sharply and caused huge jumps and also led to more volatile movements after announcements from investment banks from different countries and markets.

In order to prevent further panic and turmoil perceptions, European Central Bank (ECB) provided $130.2 billion to European banks while the Federal Reserve provided $24 billion liquidity into US banking system. On August 18, 2007, the Federal Reserve cut interest rates by 50 basis points in order to support markets with more liquidity. This move was also aimed at decreasing panic about securities and markets. After that interest rate cut decision, the spillover index lost its increasing trend after August 9, 2007, and also started to calm down. This gradual decreasing trend in the spillover index reflected the decreasing level of panic in global markets. Cheaper lending opportunities for investment banks in US economy mitigated liquidity based panic.

The announcement by the Bank of England (BOE) regarding the financing problems of Northern Rock Bank on September 14, 2007, increased concerns about mortgage markets. Northern Rock Bank, a big mortgage lender in Britain, had $152 million in direct exposure to the subprime market, with $400 million in exposure to collateralized debt obligations, some of which was also exposed to the subprime market. Customers of Northern Rock Bank waited in line in order to withdraw their savings. This image also accelerated concerns about mortgage securities and the savings of lenders to the bank. This negative development in the UK increased the general concern about the contagion of the subprime mortgage turmoil from the US to other areas. The gradually decreasing trend in the spillover index changed to a gradually increasing trend after the announcements by BOE regarding the financing problem of Northern Rock Bank.

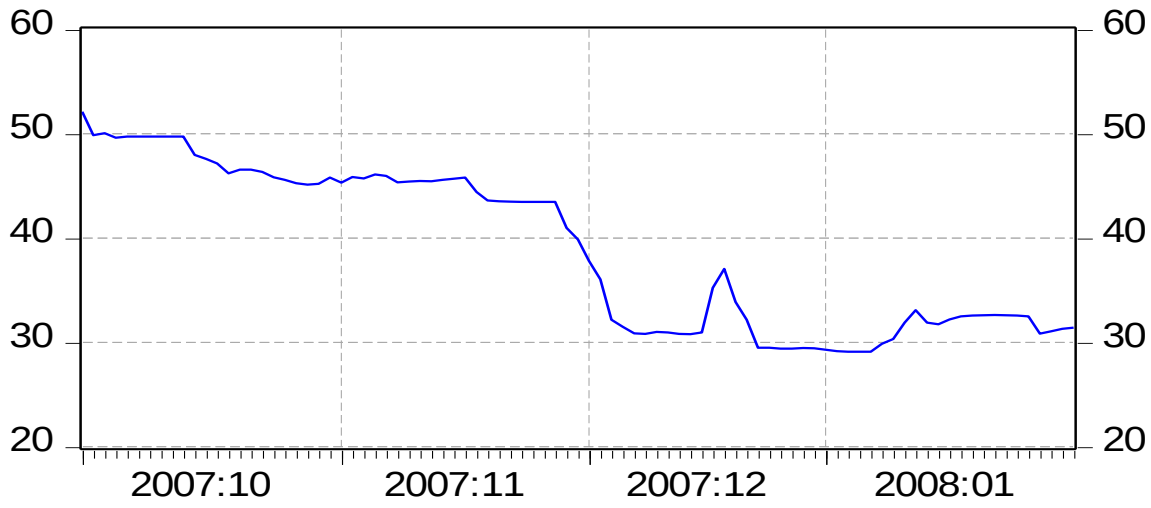
On September 17, 2007, Northern Rock Bank's shares decreased by 36 per cent, which was the lowest level in the last seven years. This decline in Northern Rock Bank also affected other banks; Alliance & Leicester had a 31 per cent decline in shares and Bradford & Bingley had a 15 per cent decline in shares. HSBC holdings, Societe of Generale of France and Deutsche Bank of Germany also declined in shares. BOE lent $19.9 billion into the UK banking system after concerns about Northern Rock Bank financing ability of subprime mortgages. Also, BOE announced that they would accept mortgage collateral from banks for the loans, increasing the possible risks regarding potential losses on mortgage securities. Northern Rock Bank's financing problems and customer panic about savings increased concerns about the crisis that arose from US subpime mortgage market.

As seen in figure 9 the spillover index increased to approximately 60 per cent during the decline in share of Northern Rock Bank and its negative effects to the other markets and economies. After preventions and guarantees by the government for deposits and ordinary saving holders the contagion level started to decrease.

On October 31, 2007, the Federal Reserve cut interest rates by 25 basis points in order to support growth performance in US during the strain in the financial markets. In their decision report they emphasized that housing price correction reflecting a possible slowdown in growth performance. They lowered interest rates to decrease risks regarding growth and also they emphasized that they have somewhat of a tolerance regarding inflationary risk. Therefore, they concluded that the upside of risks to inflation roughly

balance the downside of risks to growth. This expansionary decision contributed to the slowdown of the spread of risks in US, Euro, and UK markets.

Figure 10: Spillover Index from October 2007 to January 2008

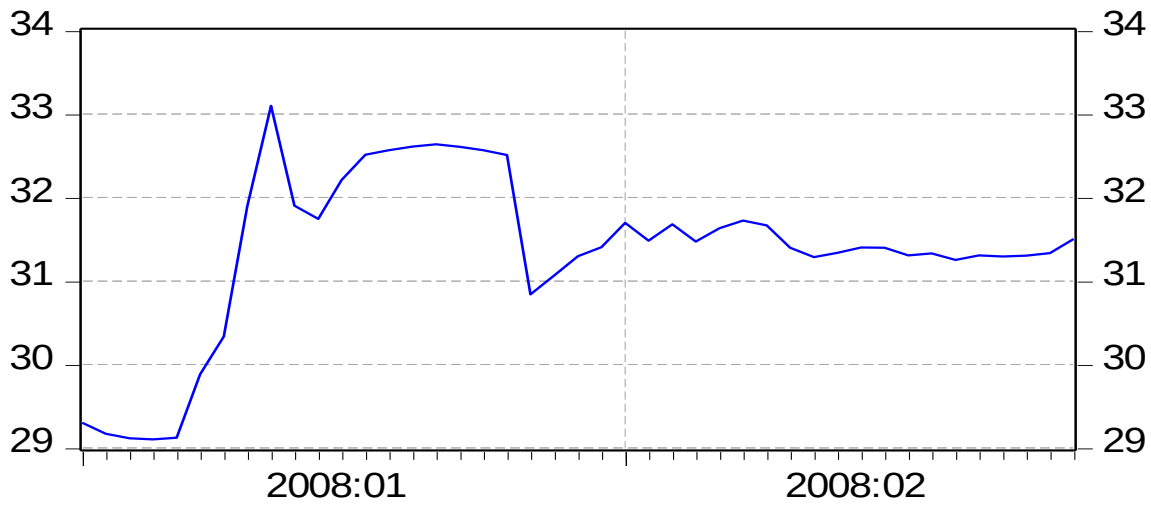


Financial turmoil and risk perceptions in US mortgage securities market did not decrease and these fears started to threaten the economic growth performance of the other countries. The Federal Reserve cut interest rates by 25 basis points on December 11, 2007, in order to prevent economic growth slow down, and they emphasized that business and consumer spending had been affected by financial strains that increased in recent weeks.

After the interest rate cut decision, the Federal Reserve decided to implement further policy in order to mitigate the tensions in financial markets. On December 17, 2007, the Federal Reserve implemented Term-Auction Facilities (TAF) in order to support liquidity in financial markets. The Federal Reserve conducted an auction of $20 billion of its TAF.

This first TAF implementation did not accelerate the slow down path of the spillover index, it only kept risk perceptions constant and volatile around 30 per cent. The spillover index continued from December 2007 to January 2008 at around 30 per cent and had very small volatile movements.

Figure 11: Spillover Index January and February 2008

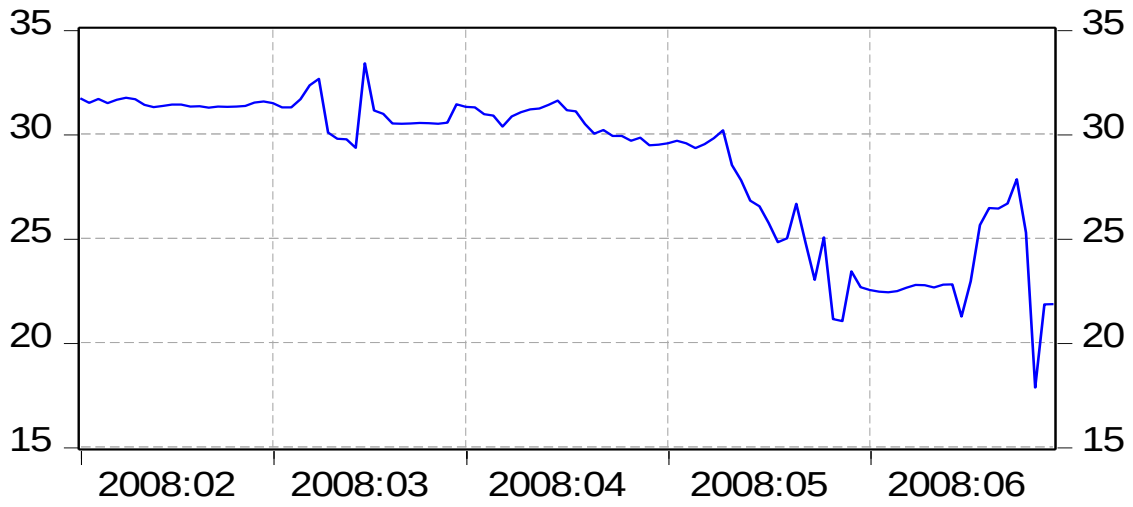


On January 10, 2008, there were surprise announcements from the two biggest central banks in the world. The Federal Reserve announced that they would continue to ease monetary policy by cutting interest rates and implementing TAF. Yet, European Central Bank (ECB) announced that they would increase interest rates according to inflationary risks. This divergence in policy direction against the financial turmoil affected credit risks negatively. These unexpected announcements caused a somewhat increase in the spillover index. The spillover index increased from 30 per cent to approximately 35 per cent within two days.

After this unexpected decision regarding central banks policies, the Federal Reserve implemented TAF on January 14, 2008 in order to prevent possible new turmoil in financial markets. Furthermore, the Federal Reserve had an unscheduled meeting and cut interest rates by 75 basis points in order to prevent financial markets tightening and higher risks for growth performance of US economy. This unexpected interest rate cutting decision did not mitigate financial markets and did not decrease the risks in financial markets.

On January 30, the Federal Reserve cut interest rates by 50 basis points. Moreover, the Federal Reserve implemented TAF on February 11, February 25 and March 10, 2008. All these easing policies kept the spillover index around 30 per cent. March 17, 2008 was important date for the situation of global crisis this is because on that date, the Federal Reserve and JP Morgan came together in order to prevent Bear Stearns, one of the biggest firms on Wall Street, collapsing due to subprime mortgage loans. The Federal Reserve provided a $30 billion credit opportunity to JP Morgan and after that, the Federal Reserve also cut interest rates by 75 basis points to support this process with easier liquidity conditions.

Figure 12: Spillover Index from February to June 2008



This bail-out operation from the Federal Reserve gave a message that central bank could support banks if they had liquidity problems due to mortgage loans. Thanks to this message and operation global markets affected positively and risk perceptions regarding further possible collapse of banks owing to mortgage loans decreased. On March 17, 2008, the spillover index was 33 per cent, which was the highest level since the beginning of 2008. The Federal Reserve's action and JP Morgan's acquisition with Bear Stearns tempered markets somewhat, but it did not decrease repo spreads levels, the contagion level, or the spillover index level, much in a very short time. The Federal Reserve implemented TAF actions on March 24, April 7 and April 21, 2008. These TAF actions in one month could lead risk perceptions to soften gradually.

The spillover index decreased from its highest level, 33 per cent, to around 29 per cent until the end of April, 2008. However, the spillover index and repo spreads level increased a little bit in April, 2008 due to concerns about an increasing trend in oil prices,

weaker growth expectations in US economy. The Federal Reserve cut interest rates by 25 basis points on April 30, 2008 and announced that financial markets and credit conditions were getting tighter, economic growth would slow down owing to house market contractions and uncertainties in credit markets. On May 2, 2008, the central banks of the US, Europe and Switzerland announced that they would work together to provide liquidity to the financial markets in order to prevent tighter conditions in credit and financial markets.

The Federal Reserve announced that the amount of liquidity increased in TAF on May 5 from $50 billion to $75 billion. Moreover, the Federal Reserve had agreement with ECB and the Swiss National Bank (SNB) regarding currency transfers. According to this agreement, the Federal Reserve provided $50 billion to ECB and $12 billion to SNB. These transfers decreased liquidity risks in US and Europe stemming from subprime mortgage funds loans. Furthermore, the Federal Reserve continued to implement TAF auctions on May and three times in June of 2008. After these policy decisions, the spillover index started to decrease gradually from 30 per cent to 20 per cent from May to July 2008. The decline in spillover index means that the contagion level of repo spreads has started to decline. Furthermore, repo spreads followed a decreasing trend until the summer months and then the repo spreads kept its levels for all three regions.

The Federal Reserve also continued to implement TAF auctions and did not cut interest rates in July or August of 2008. The unemployment rate in the US rised to its highest

level since December 2003 after the US economy lost 84.000 jobs in August 2008. These outcomes showed that the subprime mortgage crises started to affect real economy.

On September 7, 2008, the United States Federal government took control of the biggest mortgage finance companies in the US, Fannie Mae and Freddie Mac, in order to prevent further looses in mortgage market loans. These two companies owned or guaranteed half of the mortgage loans in the United States, which was $12 trillion. US treasury secretary, Paulson, said that Fannie Mae and Freddie Mac were critical to turning the corner on housing. Government officials assured the public that these steps would enhance financial stability. After this operation the spillover index had declines thanks to the guarantee of the federal government for subprime mortgage loans.

Figure 13: Spillover Index from July to November 2008

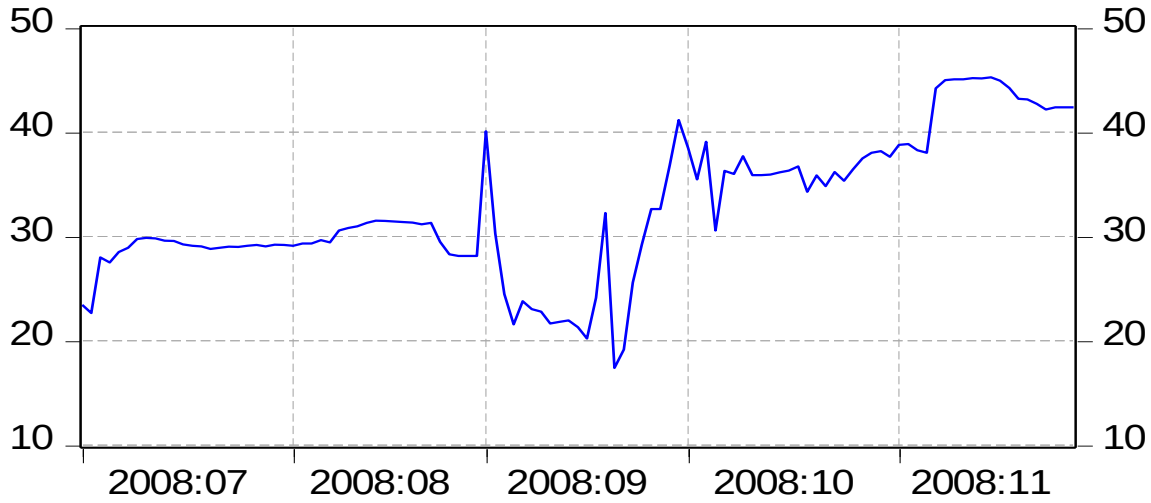
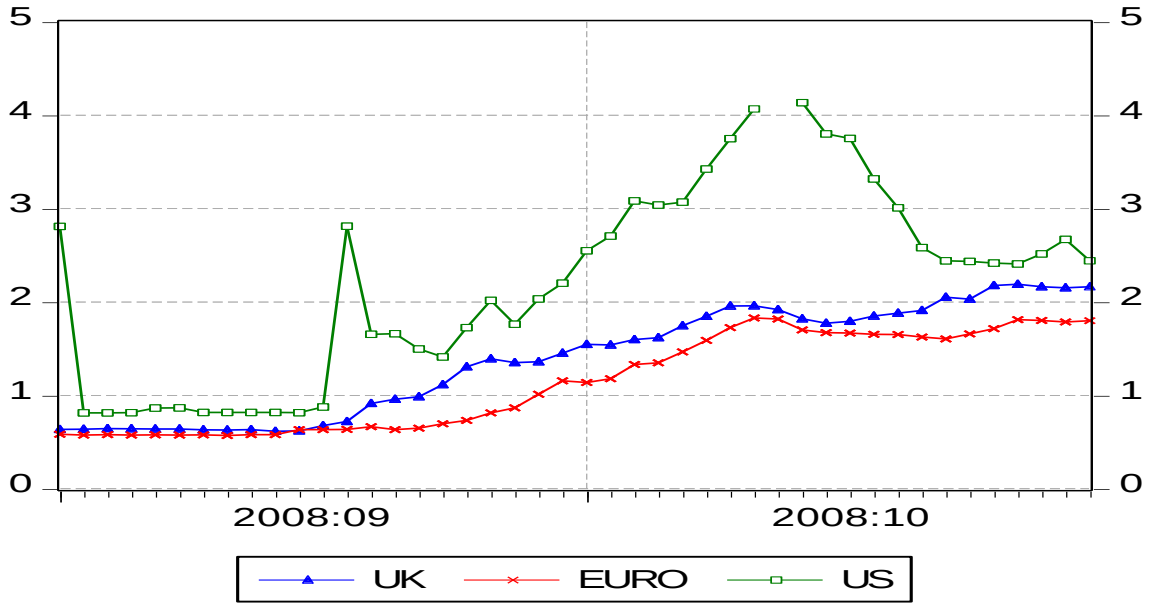


Figure 14: Repo Spreads from September to October 2008



After the collapse of the Lehman Brother's, the spillover index jumped from 18 per cent to 28 per cent in a very short time. Moreover, the repo spread in US jumped to its highest since 2003. The general expectations about the bail-out of Lehman Brother's after Bear Stearns was bought by JP Morgan and other the Federal Reserve actions that guarantee mortgage loans increased, but the federal government did not bail-out Lehman Brother's. After September 14, 2008, a night negotiation about the future of Lehman Brother's, the announcement of the collapse was released. On September 15, 2008, the day of Lehman Brother's collapse, the Dow Jones index fell 504.48 points, its biggest one day point drop since September 17, 2001, the first trading day after the September 11 attack.

As seen in figure 14 the collapse of Lehman Brother's caused higher jump in US repo spreads than UK and Euro repo spreads. This is because the risk perceptions regarding

US money market and investment banking sector was higher than others. This negative development in US money market led to a further rise in repo spreads in UK and Euro. After sharp rose in risk perceptions due to the collapse of Lehman Brother's, the Federal Reserve decided to take the control of problematic insurance giant American International Group (AIG) with $85 billion.

The discussions between US government and congress regarding the rescue plan for financial markets and investment banks also distressed the markets and slowed down repo spreads and the spillover index to fewer than 20 per cent. During further discussions centered on a rescue plan, the Paulson Plan, which gave authority to the United States Secretary of Treasury to spend up to $700 billion in order to purchase distressed assets, mortgage backed securities, and also the ability to make capital injections into banks, increased uncertainty and risk perceptions for the future of the markets and economies. These discussions about the Paulson Plan and the biggest bank failure of America, Washington Mutual, increased the spillover index to around 35 per cent within a few days.

The Paulson plan was rejected on September 29, 2008 via a vote in the House of Representatives. This rejection jumped the spillover index to 35 per cent, which was the highest since April 2008. In addition to the Paulson Plan, the Federal Reserve also continued to implement TAF auctions to promote liquidity in the financial markets. On September 22, and October 6, 2008 the Federal Reserve implemented TAF auctions. On October 3, 2008 the House of Representatives voted Paulson Plan and the plan was

accepted and signed by the president within hours and then $700 billion was given to Troubled Assets Relief Program (TARP) in order to purchase troubled assets.

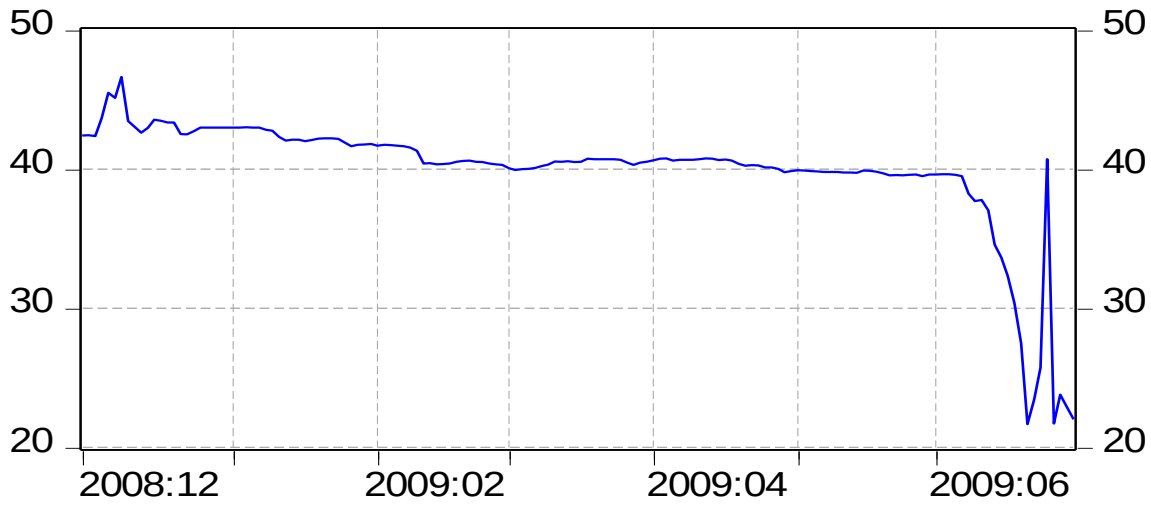
The acceptance of the Paulson plan led markets to slow down gradually and started to decrease the spillover index from 35 per cent to around 25 per cent during the next month, October, 2008. On October 8, the Federal Reserve, ECB, BOE all cut interest rates by 50 basis points in order to support economic growth and financial market stability. The Federal Reserve implemented a TAF auction on October 20 to support this process with more liquidity. On November 3, the Federal Reserve continued to implement TAF auctions by $150 billion. On November 10, US government implemented a second bail-out program for AIG with approximately $150 billion. On the same day, the Federal Reserve implemented another TAF auction with $150 billion to support money markets. Despite these policies, as seen in figure 13 spillover index started to increase back to 35 per cent from 25 per cent which shows us that operations regarding money markets to decrease risks could not prevent panic and decrease risks.

The Federal Reserve implemented two TAF auctions after November 10, 2008, in order to continue supporting the financial markets with $150 billion, on November 17, 2008 and with $150 billion, on November 24, 2008. On November 7, the unemployment rate in the US was at the highest level since March 1994 which was at 6.5 per cent. Moreover, On November 14, 2008, it was explained by offices of the Euro area that in the Euro area countries the GDP dropped by 0.2 per cent in the second and third quarters of 2008. This recession was the first one in the history of the Euro area. The effect of the financial crisis started to show its negative affect on real economies with recessions. These worldwide

negative growth announcements and employment declines enhanced the risk perceptions and anxieties about the future of markets and economies. This trend in real economies across the regions increased the perceptions that the subprime mortgage securities crisis in US spillover to other countries and regions. That supported the idea that this financial crisis turned into a global economic crisis. These developments increased the spillover index again and kept it at very high levels comparative to the pre-crisis period, from 2002 to the onset of the financial crisis.

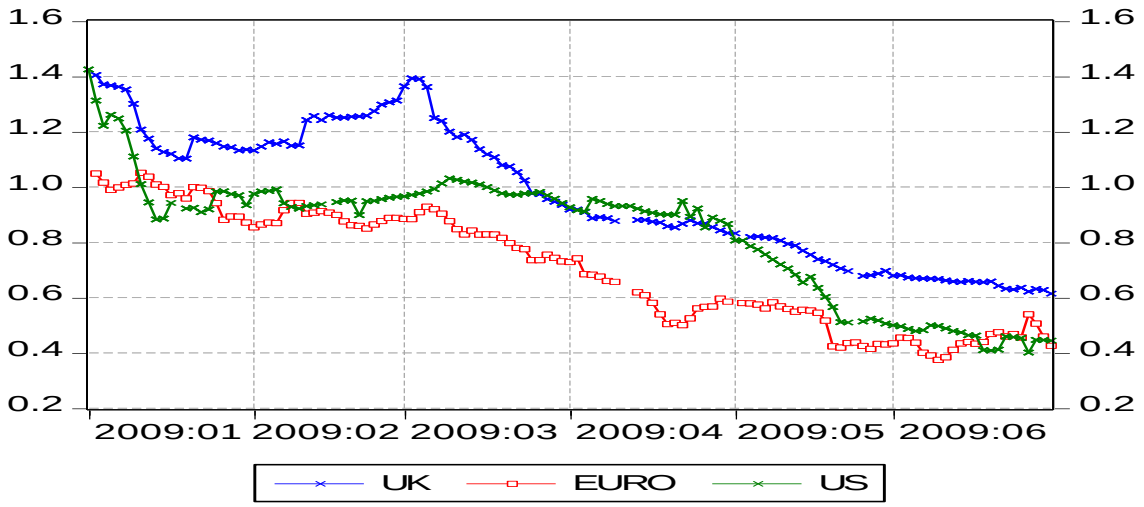
The trend difference between repo spreads and the spillover index could be explained by the change of the dimension of the financial crisis. The increasing and high level trend continued to June 2009 in the spillover index and it was less volatile, between 30 per cent and 35 per cent, from November 2008 to June 2009. During that period, the slow down in economic growth announcements and financial market companies' failures continued.

Figure 15: Spillover Index from December 2008 to June 2009



Through the end of the second quarter in 2009, the recovery signals were coming from economies with the help of financial support programs, governments' regulations. Because of the recovery of economies and financial markets, tranquility in repo spreads continued a decreasing path. Moreover, the spillover index also started to follow a decreasing trend with a lower level comparative to the period from the beginning of the crisis. The spillover index converged to its pre-crisis level with announcements of recoveries from June 2009.

Figure 16: Repo Spread from January to June 2009



For the whole period after the onset of the financial crisis, the trend of the spillover index and repo spread are generally similar and their reactions to the developments are also in the same direction. However, the reactions of the repo spread are sharper than the reactions of spillover index. It can easily be seen in Figure 19 and 20 that the slow down trend of the repo spread is also sharper than spillover index.

5. CONCLUSION

In this thesis, I try to analyze the contagion affect of the repo spreads in US, UK, and Euro area. I apply the spillover index designed by Diebold and Yilmaz (2009). After applying the spillover index, I find that the contagion level of repo spreads was higher than in the pre-crisis period and also that the spillover index reflected all major shocks in financial markets during the crisis period. Although the spillover index and the repo spread follow each other at the beginning of the crisis, the spillover index diverges from the repo spread after the crisis had its peak level. After the highest jump in repo spreads, the path of the spread started to slow down gradually.

Spillover index level was higher during crisis period due to sensitivity of markets in three regions regarding financial markets, financial developments and risk perceptions.
Furthermore, these shocks affected all three markets and their repo spreads in the same direction.

TABLES

TABLE 1-a: Augmented Dickey Fuller Test of EURO Series

Null Hypothesis: EURO Spread series has a unit root Exogenous: Constant Lag Length: 4 (Fixed)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.441029	0.5634
Test critical values:	1% level	-3.434032	
	5% level	-2.863053	
	10% level	-2.567623	
*MacKinnon (1996) one-sided p-values.			

TABLE 1-b: Augmented Dickey Fuller Test of UK Spread Series

Null Hypothesis: GB Spread series has a unit root Exogenous: Constant Lag Length: 4 (Fixed)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.906259	0.3296
Test critical values:	1% level	-3.434395	
	5% level	-2.863214	
	10% level	-2.567709	
*MacKinnon (1996) one-sided p-values.			

TABLE 1-c: Augmented Dickey Fuller Test of US Spread Series

Null Hypothesis: US Spread series has a unit root

Exogenous: Constant

Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.086668	0.2502
Test critical values:	1% level	-3.434822	
	5% level	-2.863402	
	10% level	-2.567810	

*MacKinnon (1996) one-sided p-values.

TABLE 2: Cointegration Test Results of Repo Spreads

Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value
None *	0.0927	162.76	24.275
At most 1 *	0.0275	46.16	12.320
At most 2 *	0.0105	12.71	4.129
Trace test indicates 3 cointegrating equations at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level			
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
None *	0.0927	116.598	17.797
At most 1 *	0.0275	33.450	11.224
At most 2 *	0.0105	12.710	4.129
Trace test indicates 3 cointegrating equations at the 0.05 level			
* denotes rejection of the hypothesis at the 0.05 level			

TABLE 3: Rolling Sample Non-stationary Results

Series	Number of Observations	Number of non-stationary Observations	Percentage
US	1628	1001	61.48649
Euro	1792	1208	67.41071
UK	1791	1022	57.06309

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APPENDIX A

A.1. EURO AREA

The Euro area is the monetary union of 16 European Union (EU) countries, which assigned the euro as the official currency of the union. The first countries of the union were Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Malta, the Netherlands, Portugal, Slovakia and Spain. ECB was established in order to determine and control the monetary policy of the area. The only authority on monetary policy in the Euro area is the ECB. On the other hand, there is no common authority on fiscal policy. Countries are independent in regards to implementing fiscal policy, yet there is a Stability and Growth Path (SGP) agreement, which aims to facilitate the robustness of the monetary union. Moreover, there is a Maastricht Criteria for EU members to be accepted Euro area and use euro as a currency. There is a restriction on budget deficits, public debt ratio to GDP in order to provide sustainable fiscal performance in the Euro area. Implementing the same monetary policy in the Euro area needs a stable fiscal path for its members because expansionary or contractionary monetary policy implementations can only be successful under stable and suitable fiscal policies. If there is a different path between monetary policy and fiscal policy, there will be unanticipated results in the overall economies in the Euro area. For instance, during periods of recession, central banks tend to implement expansionary monetary policy in order to overcome recession. At those times, if the fiscal situation of the economy is not accommodative to monetary policy, the authority of monetary policy cannot use monetary policy instruments as efficiently as the economy needs to in order to leave the recession.

A.2. ECONOMIC DEVELOPMENTS IN US, UK AND EURO AREA

A.2.1. EURO AREA

The euro started to be used as a currency in the Euro area in 2002, which is why I try to summarize macro economic developments from 2002 to 2009. In 2000, the real GDP increased 3.5 per cent in the Euro area, which was the highest level in the previous ten years. Yet, this growth performance slowed down in 2001 due to increasing oil and other source prices, and because of a tightening in monetary policy by the central banks against a possible inflation rise. In addition to economic situations that tighten the economic expansion, the September 11th terrorist attack reduced business and consumer confidence about the future of the economy in overall economies, especially in US and Europe. Economy policy authorities made decisions in order to prevent potential recessions in economies. Both fiscal and monetary policy paths changed from contractionary to expansionary path. ECB cut interest rates to support the economy. Between 2001 and 2002, nominal short-term interest rates in the Euro area declined on average by around 1 percentage point. Moreover, the inflation level, which was close to 2 per cent, did contribute this expansionary climate in Euro area economies. Furthermore, fiscal authorities cut tax rates in order to prevent a deeper recession in Euro area. This stimulus policy caused an increase in government debt and government deficit ratio to the GDP.

Despite these expansionary monetary and fiscal policies, consumer confidence and consumption level did not increase to an expected level that would bring the European economy back to the potential growth path. There were other factors that had a negative

effect on consumption such as decreasing stock prices level that decrease household's welfare, higher unemployment rates. During this period, appreciation of the euro also dampened export-led recovery in Europe. External imbalances in US economy strengthen euro against the dollar, which made import goods cheaper than domestic goods for Euro area countries. Both appreciation of the euro and increasing of uncertainties in US economy slowed down recovery in Euro area.

In 2004 and 2005, recovery in Europe was not robust. The acceleration of growth in Europe depended global economy that means exported-led growth because domestic demand in Euro area was not high enough to support growth. A high level of unemployment and uncertainties in the future of domestic and global economy were the major obstacles to growth based on domestic demand. In light of this fact, Euro area countries increased exports in order to stem the potential growth rate for the Euro area. Low domestic demand and inappropriate global economy caused lower growth rates in Euro area. For a robust recovery to begin, the economies needed a stronger growth performance.

A slow down in US economy shifted economic dynamism from US to Europe. The growth performance of the world in 2004, 2005 and 2006 was higher than in 2000. The world economy's growth rate was 4.9 in 2004, 4.5 in 2005, and 5.1 in 2006. Furthermore, the integration of developing countries such as China, India, Russia and Eastern Europe into the world trading system has enhanced the growth potential of the global economy. Low interest rates, higher oil prices that enabled source for investments, and higher

company profits also supported this economic environment. The growth rate of Euro area economies is shown in Figure 17.

Figure 17: GDP Growth in Euro Area

Source: http://sdw.ecb.europa.eu/

In 2007, the world economy continued on a growth path for the fourth year in a row. The world growth rate was 5.2 in 2007. The turbulence in the financial markets dampened the US economy growth performance and also affected global financial markets negatively. In 2007, Euro area economies were not affected directly from this turbulence. In 2007, the growth rate of the Euro area was 2.9. Yet, this turbulence increased uncertainties about the global economy and caused a decrease in global output. Concerns about financial markets have affected all economies in the world negatively. Many banks and investment banks lost their market power and potential credit volume to the markets all over the global economies that reduced investment opportunities, risk appetite, trade volumes, and consumption levels in world economy.

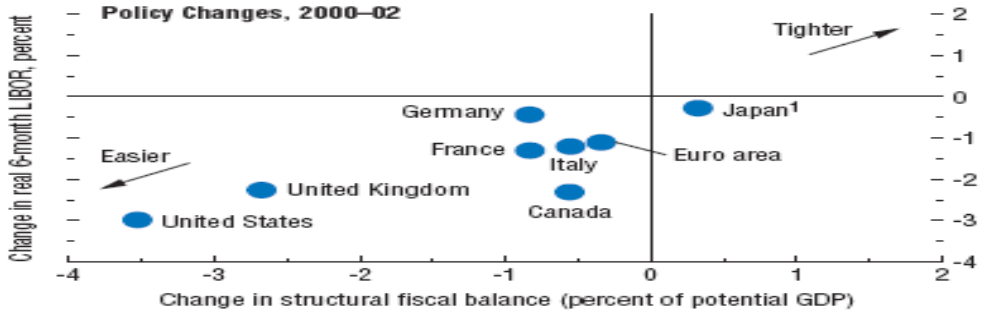
The financial crisis, which has started with the US subprime mortgage market, spilled over to different economies in the world and slowed down world economic growth in 2008. World growth rate was 3.2 per cent which was lower than the previous year. The growth rate was 0.9 in 2008 in Euro area.

A.2.2. US

World economy's growth rate was 4.8 in 2000 which was the highest level in the previous decade. Yet, for the following years, the growth performance of the world was not as robust as 2000's level as in 2001 and for the following years. The change in growth trend could be explained by some reasons. The first reason was an expected growth slow down in US economy, the second one was a fragile recovery in the Japanese economy, and the third one was a moderate growth performance in Euro area and emerging countries. This trend affected US economy with the same direction as the global economy. On the other hand, US economy's performance did affect the direction of the global economy. In light of this fact, in 1999, US economy's growth rate was 4.2 and in the following year's growth rate was 4.1. This performance was very robust, but the following year's expectation's was not as robust as the previous year's expectations. There was a decline in domestic demand in US economy, increase in energy prices, decrease in equity markets, slow down in technology sector, and deterioration in credit markets. All these factors caused a dramatic decline in business and consumer confidence levels. The growth rate of world global economy was 2.5 in 2001, which was significantly lower than the previous year's growth. The declining trend from 2000s late period switched after overcoming general concerns and uncertainties about politics,

economies, and security concerns due to the terrorist attack on 11th September. The Federal Reserve started to cut interest rates in order to support recovery and protect the economy from a recession. The terrorist attack caused security panics and also jumped consumer concerns about the future. This negative climate in society and the economy affected consumer behavior in their expenditures and saving decisions. To overcome all these factors, the Federal Reserve increased cutting interest rates race. Moreover, an easing of fiscal policies, cutting tax rates also supported the economy against a recession. In Figure 18, it is very clear that US policy makers eased fiscal policy.

Figure 18: Change in Fiscal Policy in Euro Area

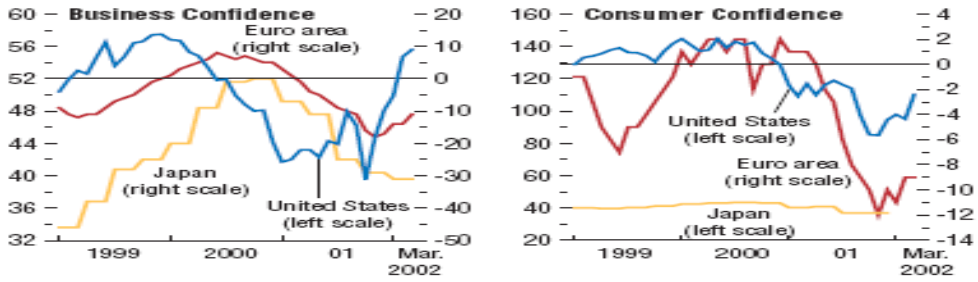


Source: IMF world economic outlook 2003

Easing monetary and fiscal policies changed negative atmosphere in the public and increased both consumer and business confidence level.

Despite these developments in 2001, US economy had positive growth performance. Because of easing policies, and supportive oil prices, which prevents possible inflation concerns, US economy did not have negative growth in 2001.

Figure 19: Consumer and Business Confidence Level

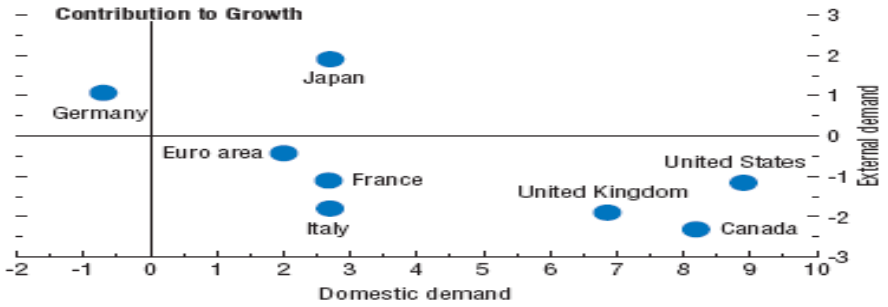


Source: IMF world economic outlook 2002

In 2002, the US economy's growth rate was 2.2, which was higher than the previous year. There were some factors that affected the performance of the economy adversely. In the first part of the year, a mortgage refinancing boom, motor vehicle purchase incentives, tax cuts supported the economy. Beside these positive developments an increase in unemployment rate due to labor market softening conditions, volatility in stock prices anxiety about war in Iraq also increased uncertainty about the future of the economy. Moreover, war expenditures affected the fiscal balance of the government negatively and increased the perception for possible government loans. The growth rate of US economy in 2003 was higher than the previous year.

With the help of a world trade volume increase, the US economy had stronger growth performance and also the depreciation of the dollar against euro and yen also supported trade performance of US with advanced countries. Yet, for overall performance of the US economy from the 2001 recession to 2004, the source of the growth was domestic demand.

Figure 20: Contribution of Domestic and External Demand to Growth Performance.



Source: IMF staff calculations, IMF World economic outlook, 2004

Housing market bubbles, oil price increases, tax rate cuts and other regulations and policy implementations all enhanced consumer demand and housing expenditures. Moreover, debt opportunities to households with mortgage-based securities also supported this process until the current global crisis started. Despite a strong growth performance in US economy, the growth performance in Euro area and Japan slowed. This trend affected US economy negatively regarding trade volume. Yet, overall growth performance mostly based on domestic demand did not affect badly. After a strong growth performance in the world output, and record level increases in oil prices, world economies especially advanced economies had inflationary pressure. Central banks in these economies increased interest rates in order to keep inflation to pre-determined levels. This tightening policies affected financial markets, caused more volatile indexes, and also decreased potential sources for consumers. With increasing interest rates, the cost of debt from central banks increased, which is why appropriate financial environment for more loan volume started to decelerate. Moreover, an increase in current account deficits in US economy from a past recession period caused uncertainties about the future of the economy and also caused more dept requirement for US economy from economies that

have current surpluses, especially Asian economies. Despite the tightening in monetary policies, US had a robust growth in 2006. Yet, the growth rate decelerated and anxieties about the coming years increased. In the first half of 2007, global economy and US economy had moderate growth despite the fact that inflationary pressure continued. Moreover, there was an unexpected rise in food prices that increased anxieties in all part of the economy. On August 2007, the US economy had a spike in credit spreads, risk levels, and corporate spreads owing to rising delinquencies on subprime mortgages. Housing market contraction increased saving incentives for households in order to protect their situation for possible income level decline. This saving trend also decreased consumption levels. Eventually, the decrease in domestic demand and uncertainties in financial markets due to mortgage loans caused a slowdown in US economy.

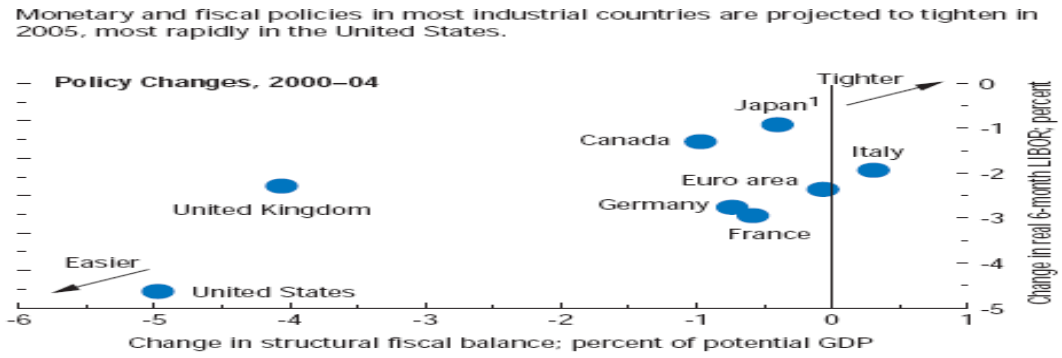
Furthermore, these financial uncertainties affected other regional economies. Euro area countries were particularly affected and their financial markets had problems with mortgage loans. Even though the depreciation of the US dollar continued, export performance of the US economy slowed due to a decline in trade volume growth in the world economy. From 2003 to the summer of 2007, the global economy had a large expansion. In this period, the average growth rate was 5 for overall economies. The financial turbulence stopped this expansion period and caused a global slow down. In 2007, US economy had a 2.0 per cent growth rate, which was the lowest rate since 2002. Globalization and integration of financial markets enhanced the affects of financial problems in US economy to the other economies. Financial market problems spill overed to the real economy and caused slowdowns growth rates in economies. US economy had

only a 1.1 per cent growth rate in 2008 and the unemployment rate increased sharply. Growth performance in US was very low; it was under the potential growth level for 2008.

A.2.3. UK

The UK economy had a robust growth performance in 2000. The unemployment rate was 5.4 in 2000, which was lower than average for European economies rates. Economic authorities supported the UK economy with an easing monetary policy and an expansionary fiscal policy. BOE reduced interest rates with the help of a high sterling exchange rate and low inflation rate. Moreover, public expenditures expanded with the support of budget surplus. These expansionary policies increased domestic demand by 2.5 per cent in 2000. In 2001 and 2002, UK economy continued to have better growth performance than the average of other European countries. Private consumption was the main source of growth performance in UK economy. House prices, real wages, and employment rises all contributed to private consumption increasing and supporting economic growth. Global economic growth slowed down during this growth period, which is why UK export performance decreased slightly. Yet, the export decline was not so severe that could cause an economic recession. It only decelerated the economic growth race. Monetary and fiscal policies supported economic growth from 2000 to 2004 with easing polices.

Figure 21: Fiscal Policy Implementation of UK



Source: IMF world economic outlook, 2004.

Yet, in November 2003 monetary policy ended easing policy and started to increase interest rates in order to keep inflation in pre-determined target zone. On the other hand, fiscal policy has continued to support the economy with the help of a 3 per cent government deficit to GDP. Economic growth continued in 2005. Yet, the growth rate was slightly slower than 2004 due to risk perception about possible house price depreciation, which affected private consumption negatively. Monetary policy kept interest rates constant for a year in 2005 and then decreased 0.25 basis points from 4.75 basis points in order to prevent an economic slow down. But, through the end of 2005, BOE increased interest rates 0.25 basis points to minimize possible risks for the economy. Energy prices increasing and demand decline due to house price depreciation were both possible risks at that period for UK economy. In addition, population aging problem was not massive in UK rather than other European economies. Therefore, fiscal balance was more flexible to support economic growth in UK. In 2005, the UK economy had 1.8 per cent growth rate, which was the lowest rate since 2000, but expansionary fiscal policies with a constant interest rate accelerated the economic growth with

increasing domestic demand in 2006. Furthermore, oil prices declined in August 2006 and this also supported economic growth. In addition, lower oil prices could decrease inflationary pressure that provides an easing monetary policy to BOE. Because of these policies and economic situations, UK economy had 2.9 per cent growth rate in 2006. Domestic demand based growth performance continued until the late summer of 2007. United Kingdom (UK) is the member of European Union but UK is not the member of Euro area economies. UK economy uses its own currency instead of using European Union common currency. This situation affects their economic performance, exchange rate regime, and the exchange rate balance of the sterling against other currencies such as euro and US dollar.

Financial turbulence has started in August in US Subprime mortgage market affected UK economy. Monetary authority started to decrease interest rates from November 2007 until 2009, in order to support economic activity and prevent economic contraction during the period of financial turbulence. Despite the negative economic climate in US and Europe economies, the UK economy had a 2.6 per cent economic growth rate in 2007, which was higher than the average growth rate of all advanced economies. The UK had this performance thanks to its robust domestic demand.