Does Global Excess Liquidity Help to Forecast Inflation in Turkey?

by

Nadir Çakır

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This is to certify that I have examined this copy of a master's thesis by

Nadir Çakır

and have found that it is complete and satisfactory in all respects,

and that any and all revisions required by the final

examining committee have been made.

Committee Members:

Assoc. Prof. Dr. Selva Demiralp

Assoc. Prof. Dr. Murat Usman

Asst. Prof. Dr. Özlem Olgu

Institute of Social Sciences, Director

Date : _____

To my loving family

ABSTRACT

In this thesis, I generated excess liquidity series for the United States, the United Kingdom, the Euro Area, Japan and Canada using the P-star model. Using these excess liquidity series I analyzed the predictive power of global excess liquidity on inflation in Turkey.

The results illustrates that co-movement of global excess liquidity series in post the1990 period increased, compared to pre 1990 period and using global excess liquidity as an independent variable in Turkish inflation forecasts produces more accurate results. The impulse response functions of VAR analysis also shows how domestic variables respond to an impulse to global excess liquidity. I found that a rise in global excess liquidity results in a decrease in inflation in Turkey, an appreciation of the Turkish lira relative to other currencies, and a decline in the domestic money gap. An increase in global liquidity results in an appreciation of Turkish lira against global currencies, which creates downward pressure on inflation in Turkey through the exchange rate channel. For future studies, the results from this analysis will be beneficial to economists because it highlights the importance of global excess liquidity for the Turkish economy.

Keywords: global excess liquidity, predictive accuracy, P-Star model, inflation.

ÖZET

Bu çalışma, Amerika Birleşik Devletleri, İngiltere, Avrupa Para Birliği, Japonya ve Kanada ekonomilerinin ekonomik büyüklerinin "P-star" modeli ile analiz edilmesi sonucu bulunan fazla küresel likiditenin Türkiye enflasyonu üzerindeki etkilerini incelemektedir.

Analiz sonuçlarının gösterdiği üzere incelenen ekonomilere ait fazla likiditenin 1990 sonrası dönemde birbirlerine bağımlı hareketlerinde artış olduğu gözlemlenmiştir. Küresel fazla likiditenin Türkiye enflasyonu için yapılan analizlerde bağımsız değişken olarak kullanılmasının tahmin analiz sonuçlarının doğruluğunu artırdığı görülmüştür. Vektör otoregresif modellere ait etki tepki fonksiyonlarına göre küresel fazla likiditenin artması Türkiye'de enflasyonun düşmesine ve Türk Lirası'nın diğer ülke para birimleri karşısında değer kazanmasına neden olmaktadır. Ayrıca küresel fazla likiditenin artığı durumlarda yerel fazla likiditede daralma meydana gelmektedir.

Anahtar Kelimeler: küresel artık likidite, tahminsel doğruluk, p-star modeli, enflasyon

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

Among globalization history academics there is general consensus that world economic history has experienced three waves of globalization (Dollar, 2005). The first modern wave of globalization was experienced between 1870 and 1910 (Daudin et al, 2008). This first wave of globalization was triggered by a combination of falling transport costs and a reduction of tariff barriers. The discovery of new lands in distant places like Argentina, the United States, Australia and New-Zealand created the possibility of using abundant lands for economic production. People from European countries immigrated to those countries and capital was invested in manufacturing in those countries. The first wave came to an end with World War I and the advent of the Great Depression (Dollar, 2005). The period between 1914 and 1945 was passed under protectionist policies. The second wave of globalization started in 1945 and lasted until 1980 (Carbaugh, 2009). During the second wave of globalization, transport costs continued to fall, after World War II, trade liberalization began, and by 1980, the trading of manufactured goods between developed countries were free of barriers whereas trade barriers still existed for most of the developing countries. This structure of the second globalization wave resulted in a redistribution of manufacturing among developed countries to lower wage countries.

The third and the last wave of globalization had started in the mid 1980s. This final wave of financial globalization has been identified by a rise in cross-border capital flow among industrial economies, and between industrial and developing economies (Dollar, 2005). In this time period, the anticipation of benefits that would be brought by cross-border financial flows in terms of better allocation of global capital has resulted in the liberalization of capital controls in many countries. By the third wave of globalization, many developing countries broke into global markets for the first time. Some of the countries who were able to do this were China, Bangladesh, Sri Lanka, India, Turkey, Morocco, Indonesia, Philippines and Mexico (OECD). In total, these countries compose a significant portion in world economics. The percentage of total exports from developing countries of manufactured goods increased from 20% to 70%, and the percentage of goods that are produced in developing countries exceeded 25%,

which had been around 10% in 1980 (Yilmaz, 2004). This integration of world economies and the liberalization of capital controls have resulted in the co-movement of domestic economies in terms of macroeconomic policies.

The rise in cross-border capital flows among industrial economies and between industrial and developing economies, the liberalization of capital controls in many countries, and the integration of many countries into global markets during the third wave of globalization resulted in a surge of global liquidity. Rogoff, states that China's low wage-workers are integrated into the global economy after decades of isolation. This resulted in downward pressures on wages and prices elsewhere, which enabled the rise of global liquidity without creating an inflationary pressure on the global level (Rogoff, 2006).

A surge in global liquidity in the third wave of globalization has produced a new interest in the link between global liquidity and inflation (Berger and Harjes, 2009). The main motivation behind these studies is to find out the relationship between global liquidity and inflation under global integration conditions (D'Agostino and Surico, 2009, Ruffer and Stracca, 2006). The aim of my thesis is to analyze the link between inflation in Turkey and global liquidity by examining the effects of global liquidity on inflation in Turkey. In order to perform such an analysis, I initially need to define the concept of global liquidity.

Global Liquidity

There are different definitions for global liquidity. It is generally defined as a measure of the monetary policy stance[1] that determines the supply of cash, the most liquid asset. "The global market liquidity" is an alternative concept to global liquidity. The level of global market liquidity is named high or low according to the expected cost of converting an asset into cash. One can easily see that there is a high correlation between "global liquidity" and "global market liquidity". For example, under

[1] By monetary stance, I mean the position of the monetary policy tools of the Central Banks such as supply of money and short-term interest rates.

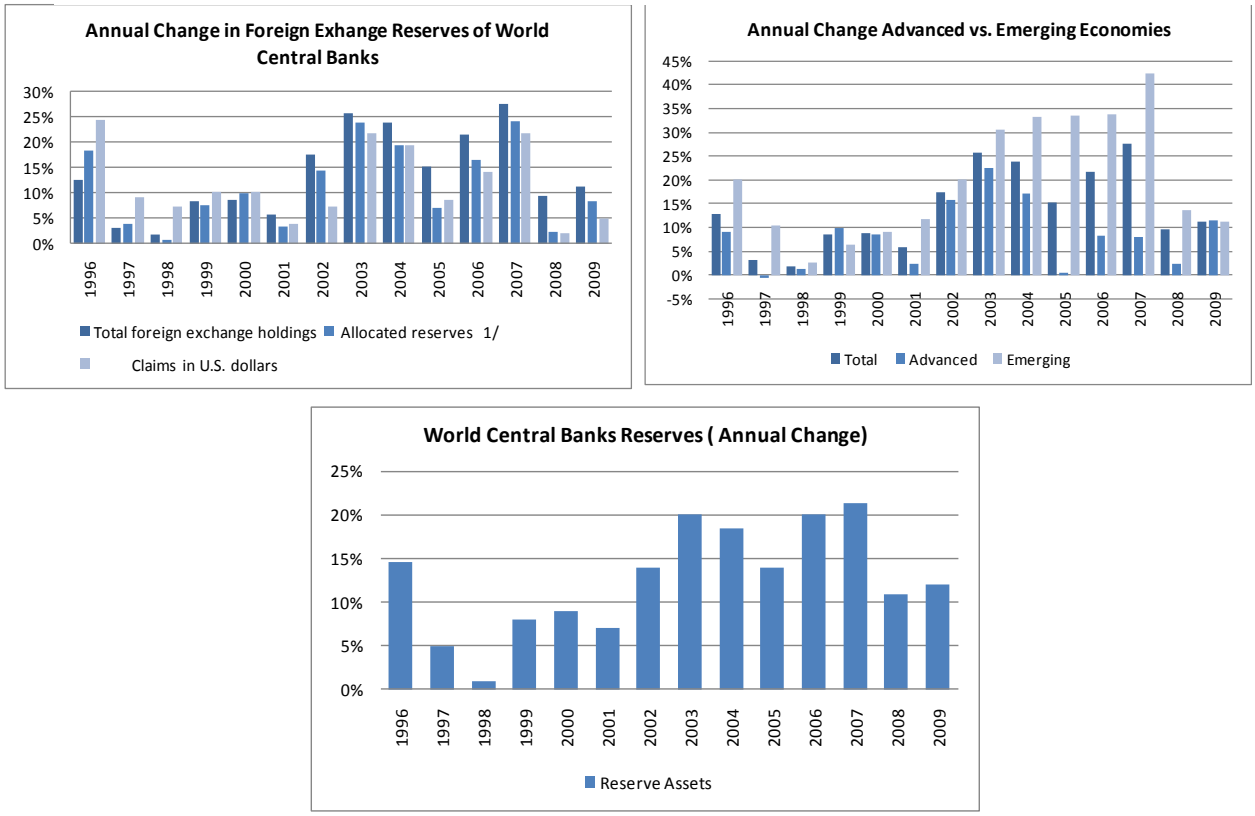
expansionary monetary policy, the supply of highly liquid assets increases, and when there is plenty of liquidity the expected cost of converting a less liquid asset into cash is lower. In this way, global liquidity and global market liquidity move in the same direction. The global market liquidity is also a good way of defining global liquidity, however using the first definition is more beneficial for my analysis. The rationale behind this choice is as follows. In order to quantify global market liquidity, I need the historical data of the difference between market values and liquidation values of immovable and moveable assets. However, all required data is not available. That is why choosing the former concept, global liquidity, is more beneficial for the sake of reliability of the analysis that I will consider in my thesis.

Looking at recent economic developments in world economies, it is seen that there has been a surge in liquidity around the world, especially between the years 2000-2008. The below Figure 1 and Figure 2 support this argument. Figure 1 consists of three panels and represents the annual change in reserve assets[2] and foreign exchange reserves[3] of central banks all over the world. As seen in Figure 1, there is a sharp rise in the reserves of central banks starting in 2000 and a high level of annual increase in reserves continues until the recent global financial crisis started in 2007. Figure 1, panel two shows the distribution of this annual change between central banks of emerging market economies and central banks of advanced economies. Panel two shows that the rise in global liquidity is mainly reflected in the foreign exchange reserves of the emerging market economies.

2 Reserve assets consist of those external assets that are readily available to and controlled by monetary authorities for direct financing of payments imbalances. Reserve assets are comprised of monetary gold, SDRs, (Special Drawing Rights) reserve position in the Fund, foreign exchange assets (consisting of currency and deposits and securities) and other claims. The IMF determines the value of SDRs daily by summing, in US dollars, the values based on market exchange rates of weighted basket of currencies. The basket and weights are subject to revision from time to time. For further details please see reserve assets statistics on stats.oecd.org

[3] Currency Composition of Official Foreign Exchange Reserves (COFER)
Source: IMF Statistics Department COFER database and International Financial Statistics

Figure 1 - World Central Banks Annual Reserve Changes

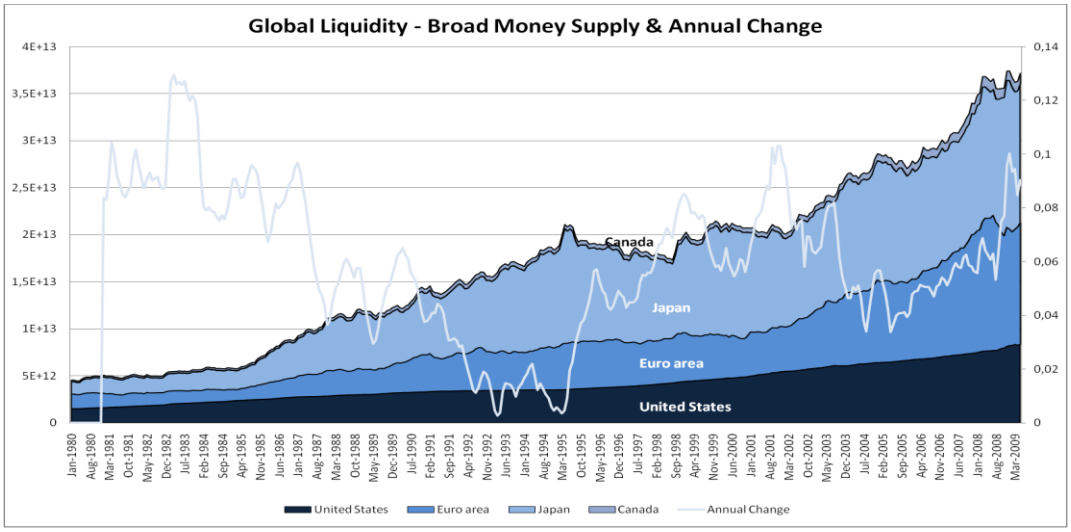


Source: IMF, OECD

Figure 2 presents the broad money supply and annual change of the broad money supply of leading economies. According to Figure 2, the broad money supply also increased rapidly in the post 2000 period. This increase in the money supply is associated with the lowest levels of interest rates recorded in recent history. In the three leading economies, the United States, the Euro Area, Japan, and in Canada we observe exceptionally low interest rates and increased market participation, especially in the post 2000 period. Figure 3 and Figure 4 support this argument. Figure 3 shows that there is a decreasing trend in interest rates for the United States, Japan and the Euro Area and by 2009, interest levels had reached historical low levels. Figure 4 shows the increasing trend in market participation of leading economies in terms of foreign investments. As can be seen from Figure 4, investment outflows that originated from these counties increased more than 20 times in the 1985 – 2007 period. The combination of these economic developments along with recent financial innovations, has led to monetary and

financial conditions characterized by abundant liquidity. Since a huge liquidity injection to financial markets was the policy choice of the Federal Reserve Bank in order to overcome the recent financial crisis, global liquidity become one of the hottest topics in the economic agenda of market participants and economists. Because of huge liquidity injection of Federal Reserve, one can argue that the current level of excess liquidity is exceptional and a temporary issue, as the result of rescue policies implemented by the Federal Reserve in order to overcome the financial crises started in 2007. But, when we look at the developments in the world liquidity series, (see Figure 1, Figure 2 and Figure 3) we see that the increasing upward trend in world liquidity starts before 2000 and it is not a new issue for the world economy.

Figure 2 - Broad Money Supply of Four Leading Economies

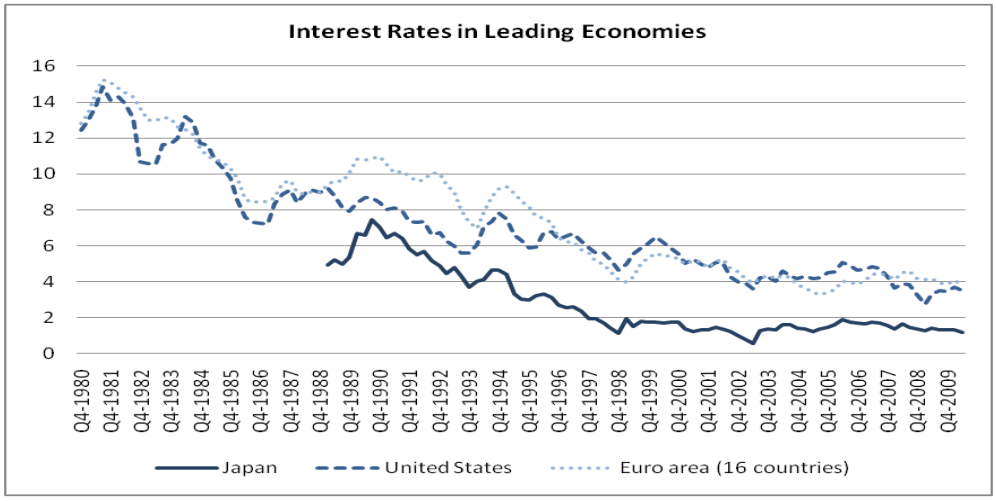


Source: OECD (Annual change computed for world total)

After stating that the surge in global liquidity had already started over the last decade, in my thesis I investigate whether global liquidity is effective on inflation in Turkey or not. Additionally, if global liquidity has effects on inflation in Turkey, whether using global excess liquidity as an independent variable produces more accurate inflation forecast for Turkey. The effects of global macroeconomic conditions on the Turkish economy have always been of interest to the economists. Many economic indicators, including growth patterns, are highly dependent on the trends at a global level. The main reason behind this dependency is the level of openness of the Turkish economy

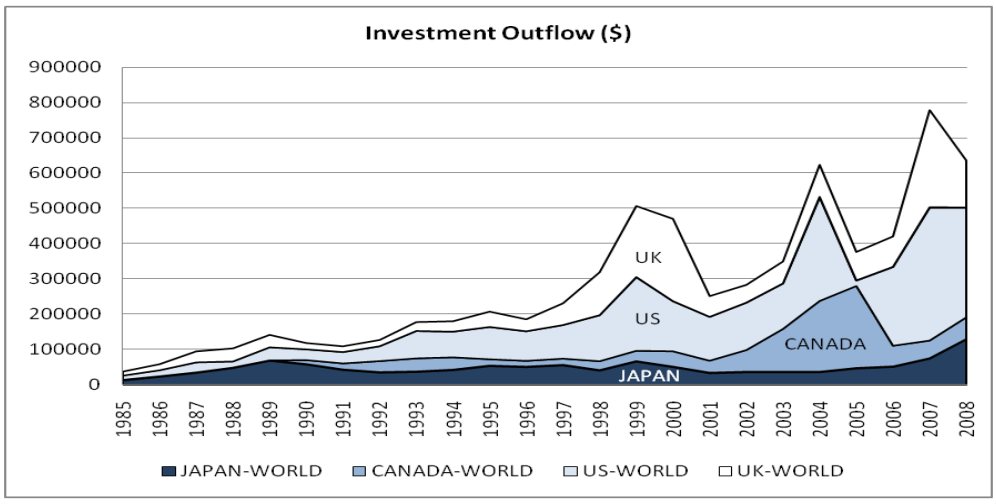
and the need for capital inflow from the outside world (Yeldan, 2004). In order to support this argument, below I include figures representing the investment inflows from outside world to Turkey, foreigners' investment stocks in Turkish markets, and foreign trade of Turkey (Figures 5, 6, and 7). These figures show the dependency of the Turkish economy to global trends of liquidity.

Figure 3 - Interest Rate in Japan, USA and Euro Area



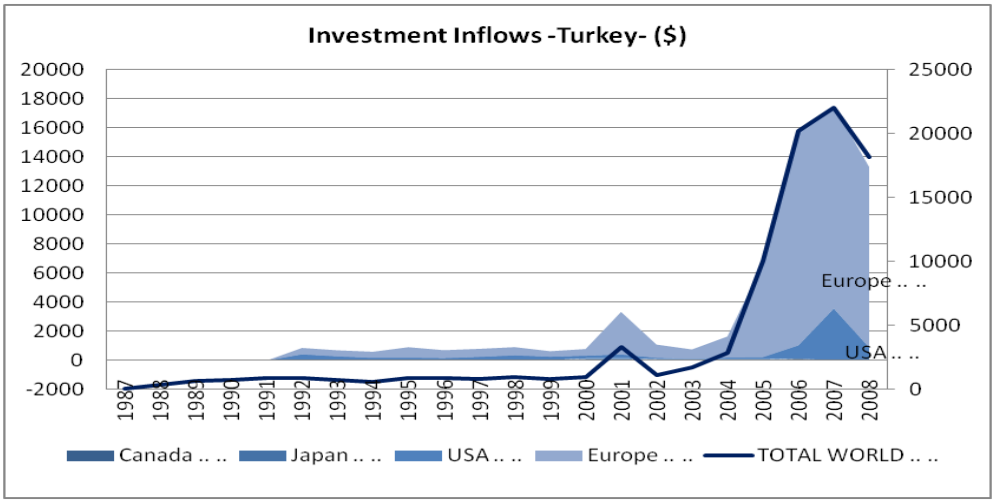
Source: OECD, FED

Figure 4 - Investment Outflows from Developed Counties to World



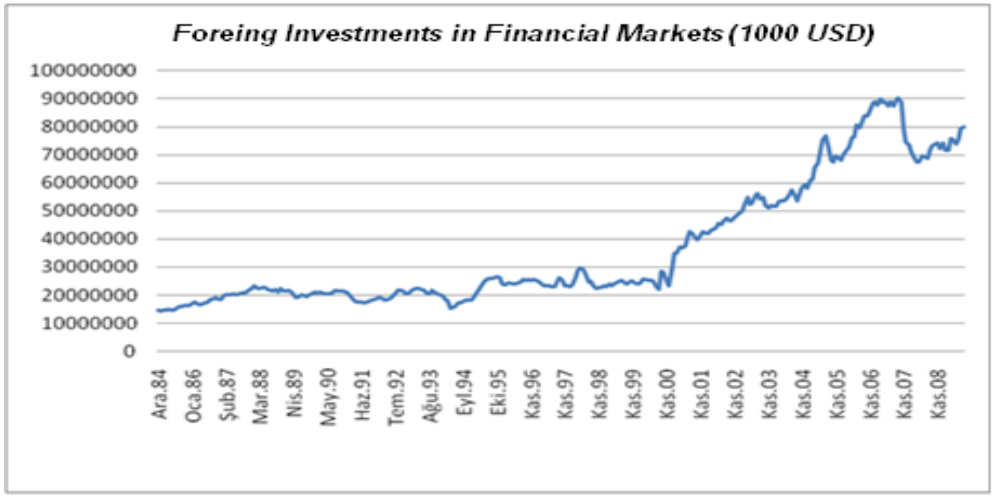
Source: OECD

Figure 5 - Foreign Direct Investment Inflows from Outside World



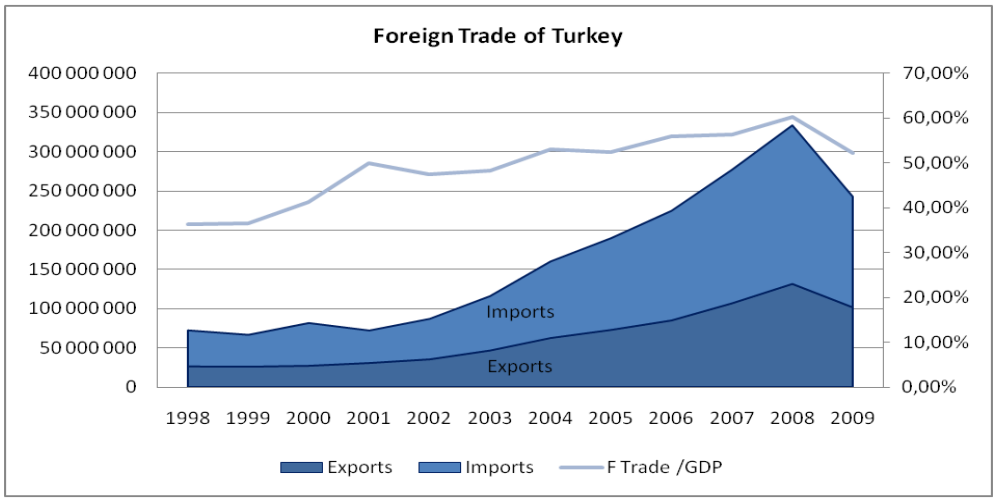
Source: Turkish Statistical Institute (TSI), OECD

Figure 6 - Foreign Investment in Turkish Financial Markets



Source: Turkish Statistical Institute (TSI)

Figure 7 - Foreign Trade in the Turkish Economy



Source: TSI

Figure 5 shows the historical path of foreign investment inflows to the Turkish economy. The initiation of foreign investment inflows to Turkey dates back to the early 1980s. Turkey began its long process of integration with the world commodity markets in the 1980s, however due to the coup d'état and political instability, the real start in integration into world commodity markets could not be realized until the end of the 1980s (Boratav et al. 2000). After 1990, foreign investments in Turkey remained at low levels except for 2001 when there was a short-lived increase. However, by 2003, a sharp rise in foreign investment was realized and this increasing trend still continues, as seen in Figure 5. Figure 6, which shows the accumulated investments of foreigners in the Istanbul Stock Exchange, also supports the same result. According to investment levels shown in Figure 5 and 6, foreign investments are material for the Turkish economy. Looking at trends in investment stocks by foreigners (Figure 6), it is seen that there is an important increasing trend starting in 2000 and continued until the recent financial crisis. It is important to note that by the time the financial crisis began, there was no decrease in foreign investments but the increasing trend had been disrupted. The current level of investment stocks by foreigners in the Turkish financial sector, approximately $90 billion (68% of

ISE total market cap[4]), is another supporting tool for measuring the level of openness of the Turkish economy to the outside world. Third and final metric that I will use to support the argument regarding the dependency of the Turkish economy to the changes in world economies, is the level of foreign trade of the Turkish economy. Figure 7 represents the foreign trade volumes of the Turkish economy from 1998 to 2009. As one can easily realize from the Figure 7, there is an increasing trend in the foreign trade volumes of the Turkish economy starting from 2000 and continues without disruption until 2008. Again the cause of the disruption in 2008 is the recent global financial crisis. In the light of all information presented in Figure 5, 6 and 7, I can argue that, the global trends are effective on the Turkish economy. The rationale behind this idea is the lack of capital accumulation and high level dependency on foreign capital inflow in Turkish economy. At this point it will be useful to examine the economic history of the Turkish economy shortly.

Historical Evaluation of the Turkish Economy

When the Republic of Turkey was founded in 1923, only remaining resources in the country in economic terms and in terms of production facilities were the ruins of the Ottoman Empire and a workforce of roughly 6 million which is composed of uneducated and unskilled people. For approximately 600 years, the economy of the Ottoman Empire was mainly dependant on the spoils of war and taxes collected from citizens of conquered lands. During this time, there was not any production-based economy in the Ottoman Empire. In the early stages of the Republic of Turkey population was very inexperienced in economic activities such as trade and production, and there was no capital accumulation in the economy. Except for Istanbul and Izmir, there was no industry, bourgeoisie or infrastructure in the country. Even in Izmir and Istanbul, production and economic activities were at preliminary levels. During the initial stages of the Republic of Turkey, even the most basic products had to be imported from European countries. Unfortunately, this dependency on the outside world has existed in all stages of the development of the country (Boratav, 2010). The first industrial leap of Turkey occurred

[4] Statistics regarding total market cap and foreigners share gathered from CRA(Central Registry Agency) database. For further detail please visit www.mkk.com.tr

in 1950, and was financed by the United States of America. In Turkish economic history, nearly all of the economic crises, namely 1954-61, 1978-81, 1988-89, 1994, and 2001, were based on the macroeconomic changes in outside world economies (Kazgan, 2008). This high level of sensitivity to world economic changes was mainly due to the fragile structure of the Turkish economy, the result of a lack of domestic capital accumulation. The effects of this situation are still felt in the Turkish economy. For example, as of 2010, the share of foreign investors in the Istanbul Stock Exchange is 68%[5] and in the banking sector this percentage is 40%.[6] In terms of foreign trade, import composes 17.7% and export composes 11.2% of the gross domestic product, which resulted in approximately a 6.5% foreign trade deficit.[7]

The Turkish economy is highly responsive to global macroeconomic conditions, due to lack of domestic capital accumulation and high share of foreign investments in the country. To analyze and draw attention to the potential effects of global liquidity on inflation in Turkey has great importance, because in parallel to the decreasing trend in inflation in the global level, inflation in Turkey also started to become more stable, especially after the 2001 period (Figure 8). It should be stated that the post-2001 period corresponds to the start of the inflation-targeting period by the Central Bank of Turkey, which is likely the most dominant force behind the observed trend. Nevertheless, I believe that global economic conditions are at least partially responsible for the decline in inflation rates, which is what I will try to prove in this thesis.

As Rogoff (2003) argues, over the last decade global inflation has dropped from 30% to 4%.[8] Inflation in Turkey has dropped from 60% to 8% (Figure 8). Figure 8 illustrates that even before Turkey switched to inflation targeting in 2001, the declining trend in inflation had started. This trend mimics other major economies.

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[5] Distribution regarding domestic and foreign investors is reported by MKK (Central Registry Agency). Related data set can be reached at
http://www.mkk.com.tr/MkkComTr/assets/files/tr/piyasa/istatistik/MKKist1.zip

[6] BRSA data are used for the calculation of foreigner share in banking sector, related dataset can be reached at www.bddk.org.tr

7 Turkish Statistics Association www.tuik.gov.tr

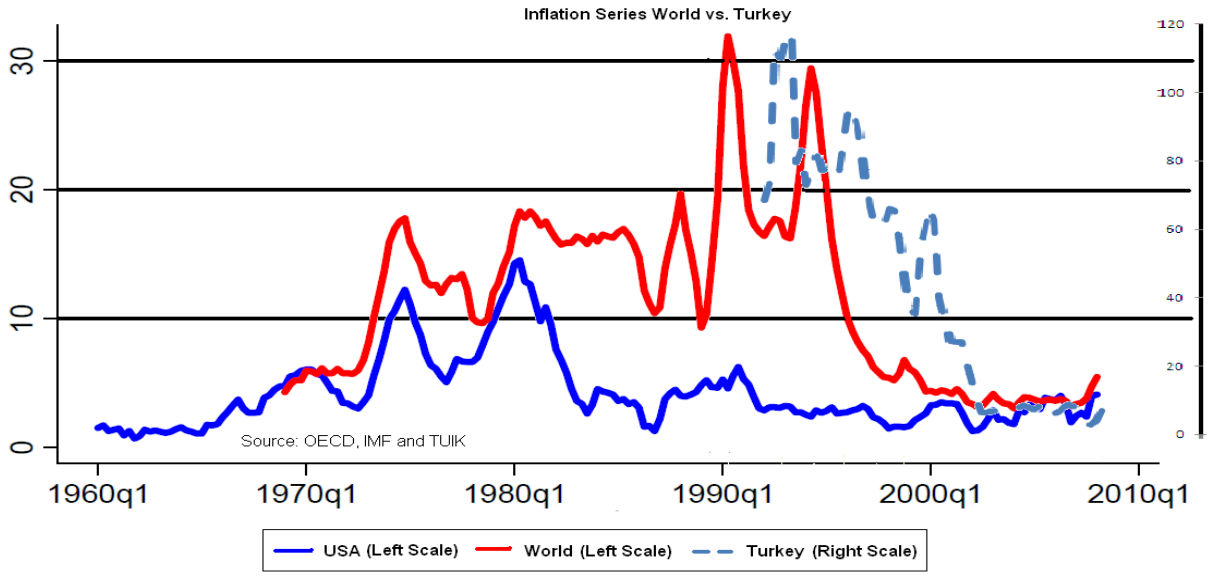
8 Based on 2003 and 2004 average global inflation projections from the IMF's World Economic Outlook

Central banks today are more experienced in controlling general tools such as money supply and interest rate in order to manage inflation dynamics. In the recent past, the importance of global liquidity on domestic inflation is also questioned. Under these conditions, more accurate inflation forecasts become essential for successful monetary policy making. It is important to have accurate forecasts in low inflation periods as Bryan (2007) states, during low inflation periods small changes in inflation trends can potentially have large adverse effects on economies, thus the ability to quickly identify and react to undesired deviations in the inflation path can be crucial.

The information content of monetary indicators used for inflation forecasting, has been recently called into question in a few studies. Some economists, including Berger and Österholm (2008), Gerlach and Svensson (2003) proved that domestic money growth has little predictive power for domestic inflation. In light of these findings my motivation is to present a more accurate way of inflation forecasting in Turkey and to highlight the potential effects of global liquidity in Turkish monetary policy.

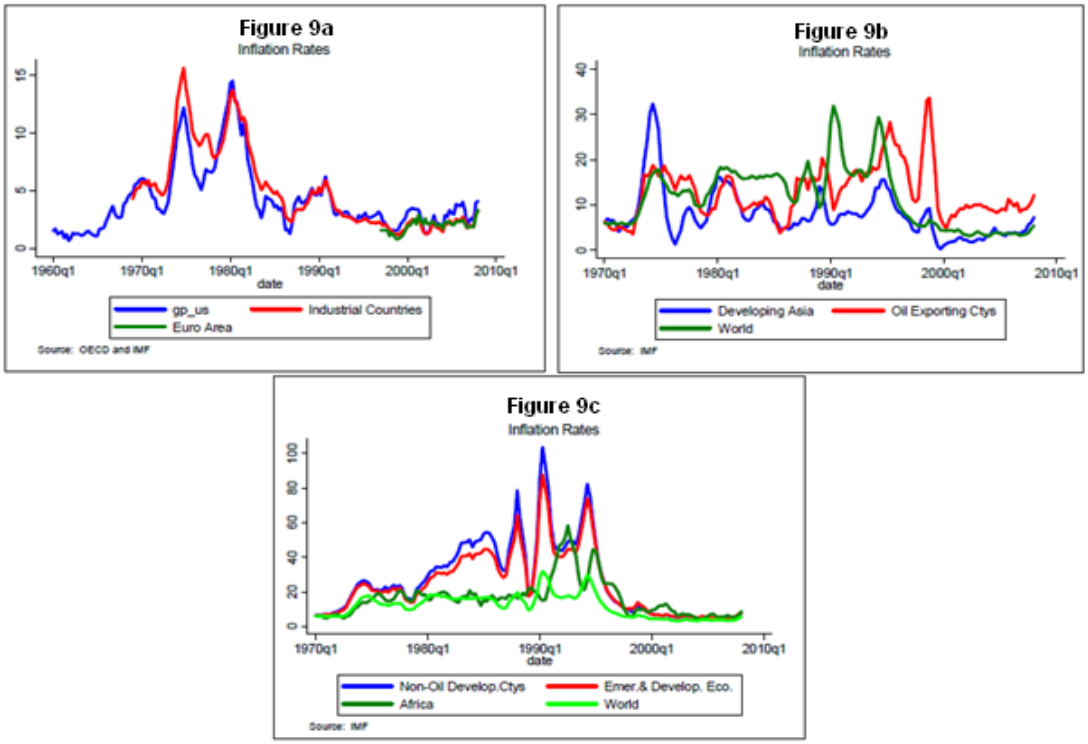
By the last wave of globalization, global inflation dynamics became more synchronized and different countries experienced similar inflation dynamics. Figure 9a, 9b, and 9c represent the historical inflation performances of different countries. In order to represent each country individually on the graph, I grouped those counties based on different economic criteria. Figure 9a shows the comparison between the United States, the Euro Area, and other industrial countries. Figure 9b illustrates the comparison between developing Asia and oil exporting countries, and Figure 9c compares non-oil exporting developing countries, Africa, and emerging and developing economies. The figures support the argument that inflation dynamics among counties has become more synchronized.

Figure 8 - Inflation Dynamics -World vs. Turkey



Source: OECD, IMF and TSI

Figure 9a, 9b, 9c - Comparison of Inflation Series among Countries



Source: IMF and OECD

Effects of Global Liquidity on Inflation in Turkey

There are several channels through which global liquidity may have an impact on future inflation in Turkey. According to the New Keynesian dynamic general equilibrium model with sticky prices, global monetary expansion appreciates the Turkish exchange rate and this leads to a temporary increase in foreign demand for Turkish goods. Since the currency for imported goods is in foreign currency, it may be expected to observe a negative net effect (decrease in inflation) on inflation in Turkey in the short term due to a decline in the price of imported goods. In order to make that assumption, I should state that value of imported goods is higher than the value of exported goods in Turkey. Table 1 represents the dollar values of Turkish imports and exports in recent years. Import values are higher than export values for all years without exception. This shows that our assumption, negative net effect of rise in global liquidity, presented above seems reasonable. Another channel that can be effective on inflation is monetary policy. For example, the Central Bank of Turkey may react to increasing global liquidity by decreasing the interest rates in order to stabilize the external competitiveness. In the case where, global liquidity increased due to decreased interest rates and increased money supply in the outside world. Since Turkey is a small, open economy, if the interest rates in Turkey remain constant, capital inflow to Turkey will occur causing the appreciation of the Turkish lira against world currencies. When the Turkish lira is appreciated against other currencies, Turkish exporters will be negatively affected from this change, and the Central Bank of Turkey may react to this by decreasing the domestic interest rates. If the Central Bank of Turkey decreases domestic interest rates in order to depreciate the Turkish lira successfully, then the level of depreciation is equal to the previous appreciation. In this case, compared to the initial condition, the exchange rate will be the same, but the interest rates will be lower. This decline in interest rates is expected to create an upward pressure on domestic inflation. The third channel is through financial markets. When there is a rise in global liquidity, global investors look for higher returns and this will result in capital inflow into the Turkish economy, which will exerts downward pressure on interest rates and, similar to the second scenario, will lead to inflationary pressure in Turkey. However, in this case the Turkish lira would be expected

to appreciate causing downward pressure on inflation in Turkey due to a decrease in prices of important goods. That is why the net effect on inflation is ambiguous in third case.

Table 1 - Export and Import Values of the Turkish Economy

Year	Import (Million $)	Export (Million $)	Import/Export
1992	22,8	14,7	155%
1993	29,4	15,3	192%
1994	23,2	18,1	129%
1995	35,7	21,6	165%
1996	43,6	23,2	188%
1997	48,5	26,2	185%
1998	45,9	26,9	170%
1999	40,6	26,5	153%
2000	54,5	27,7	196%
2001	41,3	31,3	132%
2002	51,5	36,0	143%
2003	69,3	47,2	147%
2004	97,5	63,1	154%
2005	116,7	73,4	159%
2006	139,5	85,5	163%
2007	170,0	107,2	159%
2008	201,9	132,0	153%
2009	140,9	102,1	138%

Source: TSI

In this thesis, I investigate whether global liquidity has marginal predictive power for forecasting inflation in Turkey. Global liquidity tends to move in similar ways for G7 economies, and forecasts that include global liquidity produce more accurate results compared to traditional models.

Measuring Global Liquidity and P-Star Model

In this section I use a model to measure global excess liquidity and then use this measure to forecast inflation in Turkey. The model that I will use to measure global liquidity is called the "P-star model". The starting point of the P-star model is the assumption that deviations of log level of the actual price level p, from the log level of equilibrium price level p*, called the "price gap", is a very useful tool to predict future price corrections and thus future inflation. Svensson (2000) illustrates that p-p*, the price

gap is equal to the real monetary gap or excess liquidity. Excess liquidity, $\widetilde{m}$, is defined as the difference between real money stock, m_t^{real} and its equilibrium level m_t^{real*}.

Where,

$$m_t^{real} \equiv m_t - p_t$$

and,

$$m_t^{real*} \equiv m_t - p_t^*$$

so,

$$\widetilde{m} \equiv m_t^{real} - m_t^{real*} = m_t - p_t - m_t + p_t^* = p_t^* - p_t \quad (1)$$

As Gerlach and Svensson (2003) stated, the P-star model (shown in equation 1) is expected to generate more accurate inflation forecasts and be a useful tool for discussing the predictive power of monetary aggregates regarding inflation relative to traditional forecasting methods. In order to use this model, I need to define the equilibrium level of prices dependant on current money supply, measure the level of output and the velocity of money via the equation of exchange. All variables are in log levels. In equation 2, the link between M2 and the price level is used as the empirical basis for a dynamic model of inflation that is motivated by long-run quantity-theory considerations.

$$p_t^* \equiv m_t + v_t^* - y_t^* \quad (2)$$

Equation (2) is used by Hallman et al. (1991) but the assumption of constant velocity is replaced by the equilibrium level of velocity, which is not constant. Hallman et al. (1991) find that due to the deregulation of accounts at depository institutions, market interest rates have gone through substantial swings, and the velocities of monetary aggregates have varied considerably. They also state that although there is some trend in the short run there is no trend in velocity of M2 relative to the gross national product in the postwar period. But, I should also state that the absence of a trend is not evidence for the velocities of M1, M1A or the monetary base, which supports the choice of M2 in the analysis as opposed to these alternative aggregates.

Inserting equation (2) into equation (1), gives

$$m_t^{real*} = y_t^* - v_t^*.\ ^{9} \quad \text{and} \quad \tilde{m} = m_t^{real} + v_t^* - y_t^*.\ ^{10}$$

To define v* I use the approach of Reynard (2007). According to Reynard (2007) v* may be expressed as follows;

$$v^* = c + \beta i_t^* \tag{3}$$

where i* is the equilibrium level of short term interest rates and β is the interest rate semi elasticity of real money in demand equation.

Thus the final form of my equation is:

$$\tilde{m} = c + m_t^{real} + \beta i_t^* - y_t^*. \tag{4}$$

Where i* and y* are the equilibrium levels of interest rate and output. I compute the equilibrium levels by using the Hodrick-Prescott filter. This final equation can be estimated and be used in econometric analysis.

At the next step, I decided on the variables that should be used for money stock, interest rates and output. I compute excess liquidity series for the United States, the United Kingdom, the Euro Area, Japan and Canada. My main motivation here is to include G7 economies in the analysis, since those are the countries that have potential to affect domestic dynamics in Turkey. Since the Euro Area covers Germany, Italy and France, all G7 economies and non-G7 Euro Area countries are included in my analysis. Variables that are used for the analysis are listed below:

M: *Monetary Aggregate Measure*. For the Euro Area and the United State, this is M3, which is the sum of M2, repurchase agreements, money market fund shares/units, and

[9] $m_t^{real*} = m_t - p_t^* = m_t - m_t - v_t^* + y_t^* = -v_t^* + y_t^*$

[10] $\tilde{m} = m_t^{real} - m_t^{real*} = m_t - p_t + v_t^* - y_t^*$

debt securities for up to two years. For Canada, M2 is used, which is the sum of M1, deposits with agreed maturity of up to two years and deposits redeemable at notice of up to three months. For the remaining countries, the United Kingdom, Turkey and Japan, M4 is used as the monetary aggregate. Monetary aggregates are chosen to make sure they are broad enough to include the expansion in money market funds. The reason for using M4 for the United Kingdom, Turkey and Japan, is the discontinuity in the M3 data. For the case of Canada, again due to data availability, M2 is chosen as the monetary aggregate. All aggregate monetary data that are used are in national currency, seasonally adjusted[11] and end-of-quarter levels. All data that is used in this analysis is in logarithmic form.

I: *Short-term interest rate, per cent per annum*. Data are provided by the national central banks. Short-term interest rates are either the three month interbank offer rate, or the rate associated with Treasury bills, Certificate of Deposits or comparable instruments, each with a three month maturity.

P: *The price level.* I used the consumer price index for each country. The year 2005 is chosen as the base year, so the level of the price level in 2005 is 100 for each country. Log levels are used for the analysis.

Y: *Quarterly real GDP*. In order to form the y*, I have applied the Hodrick-Prescott filter to the level of real GDP and log levels of y and y* are used.

I estimate β coefficients based on simple OLS regressions. I use the v* (where v* is computed using Hodrick-Prescott filter) as dependent variable and i* as the independent variable. According to OLS results β coefficient for the related countries are shown in Table 2. They are quite similar to the β values presented in Berger and Harjes (2009), where coefficients that they estimated as 0.02 for the United States and 0.06 for Japan.

[11] Turkish monetary series are seasonally adjusted using Henderson Trend Filter X12 and muliplicative X11 method.

Table 2 - Interest Rates Semi-Elasticity Estimates

Country	β Coefficient
USA	0.019
UK	0.049
Japan	0.054
Euro Area	0.026
Turkey	0.004

As long as money demand shocks follow standard assumptions, the measure of excess liquidity is stationary by definition.

A typical money-demand function may be written as

$$M^d = P * L(\dot{I}, Y)$$

Imposing unit elasticity to output and taking the log of both sides I define, $m_t^{real} = c - \beta i_t + y_t$

I write equation (4) as:

$$\widetilde{m} = \beta(i_t^* - i_t) - (y_t^* - y_t) + \varepsilon_t$$

where, ε_t is residual money demand shock. As a consequence, $\widetilde{m}$ is stationary as long as ε_t is.

Excess liquidity data computed using equation (4) is presented in Figure 10 for the related countries that will be used in analysis. The excess liquidity of Turkey is presented in Figure 11.

Figure 10 - Generated Excess Liquidity Data for Selected Countries

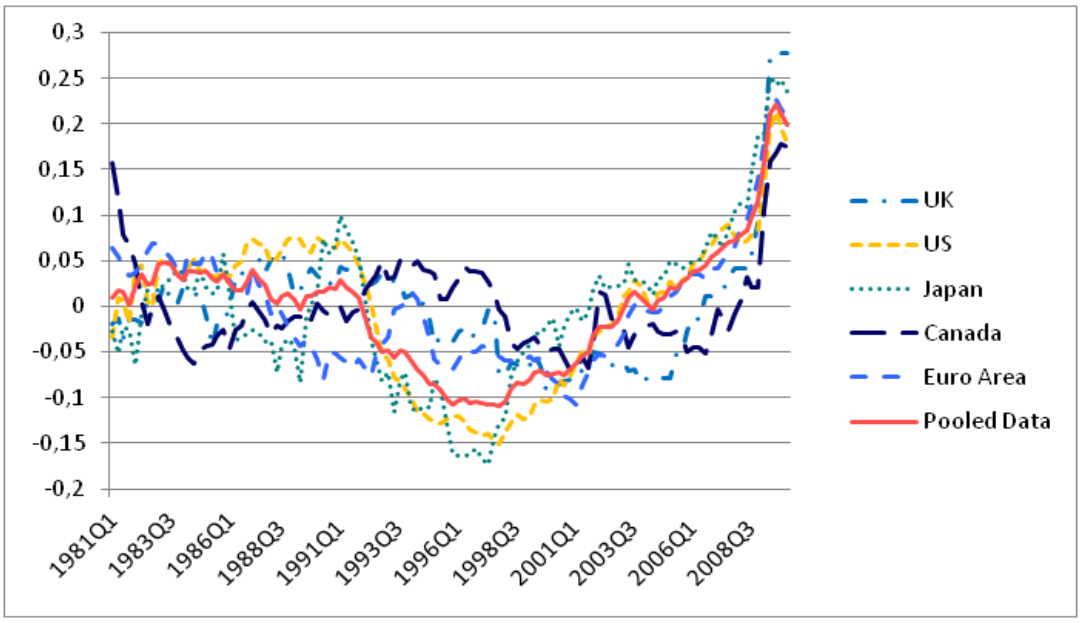
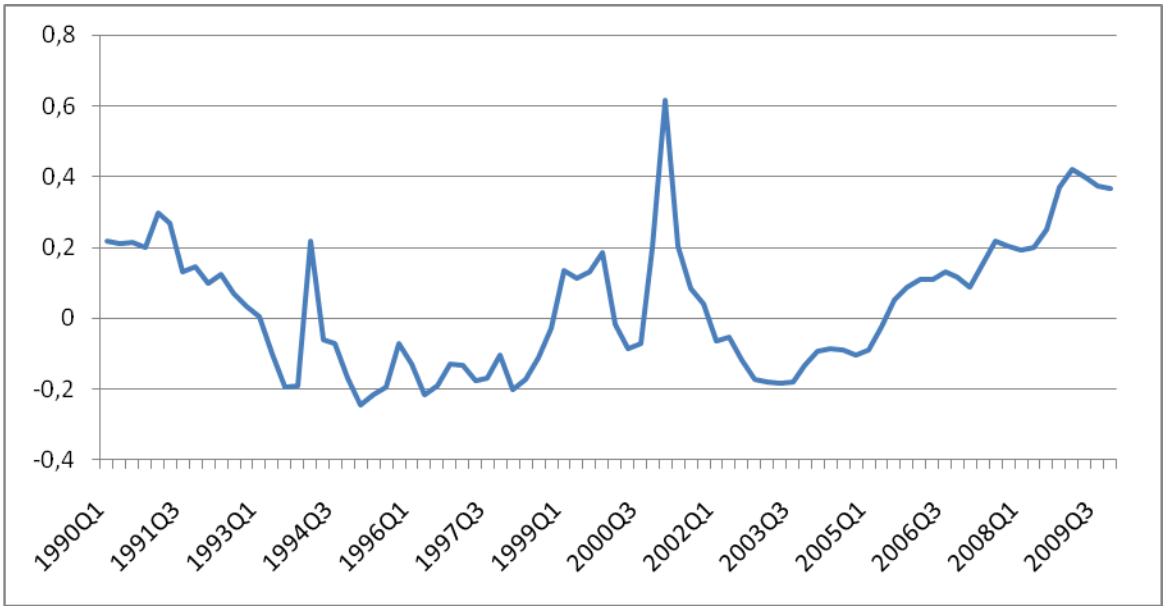


Figure 11 - Excess Liquidity data for Turkey



In Figure 11, the reasons for big jumps in 1994 and in 2001 are the dramatic economic contractions due to the economic crises experienced in those years

Stylized Facts

The generated excess liquidity data is presented in Figure 10. The excess liquidity for all countries for the period between first quarter of 1981 and fourth quarter of 2009 has been computed. At first sight, one can easily see that during 1990s, countries had negative excess liquidity, which returns to neutral by the early 2000s. It is also seen that after the 2008 crisis, excess liquidity reaches its historical peak, which is the result of liquidity injection policies in the various countries in order to decrease the severity of the crisis, and also the result of actions of central banks that were taken to fuel the economies.

The upward and downward movements in the series are important for understanding the excess liquidity series, especially understanding the historical developments within the economies. Thus in this section, I will discuss the trends in the excess liquidity series, referring the historical developments in economies. Except for fourth quarter of 1981, liquidity analysis indicates positive excess liquidity from the first quarter of 1981 to the fourth quarter of 1991, with the peak period occurring between, the second quarter of 1987 and the first quarter of 1991. By the second quarter of 1991, the excess liquidity measure shows a sharp decline, reaching negative levels by the first quarter of 1992, and this negative excess liquidity continues until the third quarter of 2002, reaching its minimum at the third quarter of 1997. The rising trend that starts by the third quarter of 1997 continues with small interruptions till the third quarter of 2008. By the third quarter of 2008, there is a sharp rise that had not been experienced before. This is probably the result of monetary policies that were implemented to overcome the 2008 financial crisis. According to the structure of our series, I believe that it is useful to divide the timeline into four periods; the first quarter of 1981-the second quarter of 1991, the second quarter of 1991 – the third quarter of 1997, the third quarter of 1997 – the third quarter of 2008 and the third quarter of 2008 – the fourth quarter of 2009. By dividing the data into these different time periods, it is clear which economic forces lead these trends in global excess liquidity.

The First Quarter of 1981-The Second Quarter of 1991

In the first time period which is the period between the first quarter of 1981 and the second quarter of 1991, global excess liquidity series present a stable behavior. This finding is consistent with economic history. When I investigate the macroeconomic policies and performance of related countries in 1980s, I see that there is not dramatic change neither in macroeconomic policy nor in economic performance. In analysis of Mishkin (1987), it is also seen that all macroeconomic variables represent a stable path in 1980s.

The Second Quarter of 1991-The Third Quarter of 1997

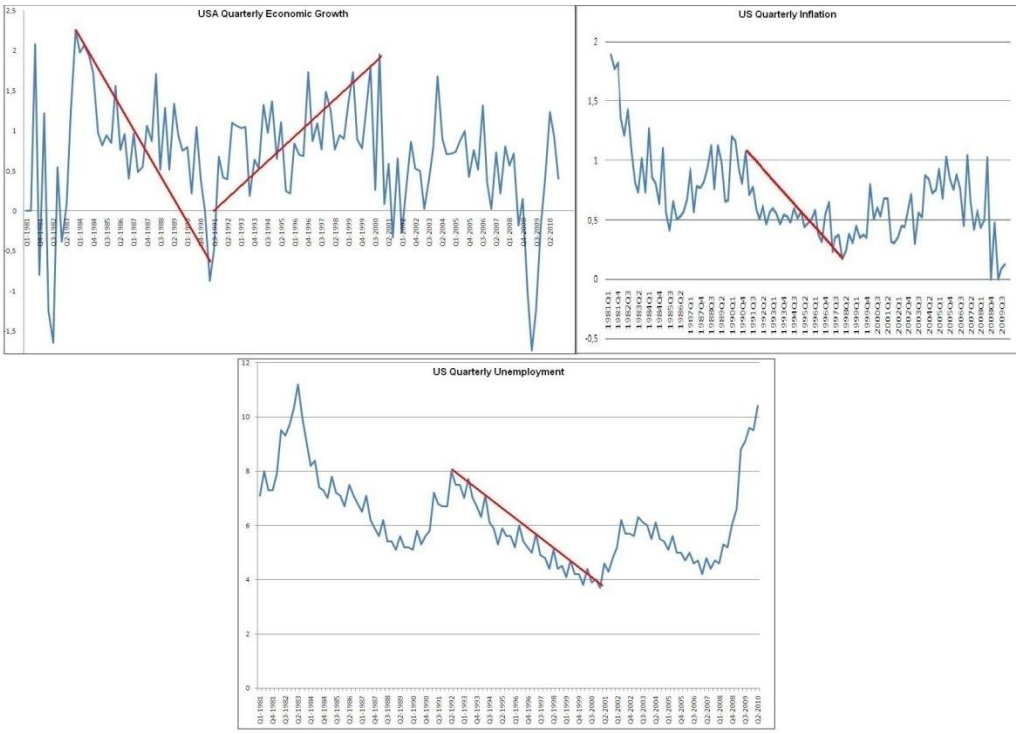
Looking at the decreasing trend excess liquidity that begins in 1990s, one sees that in the United States there is an exceptional macroeconomic performance in the first half of the 1990s in terms of volatility of growth, inflation, and unemployment. The historical performance of growth, inflation, and unemployment indicators are shown in Figure 12. Trends represented in Figure 12 also prove the claim of exceptional macroeconomic performance in the first half of 1990s in the USA. Furthermore, the supply-side of the economy fueled the economic growth in that period, driving the great performance of the economy in early 1990s (Mankiw, 2001). During that period, productivity growth unexpectedly accelerated, and food and energy prices were well behaved. So the decreasing trend in excess liquidity was the result of high growth rates, which results in output level above the historical equilibrium output.

The Third Quarter of 1997-The Third Quarter of 2008

The upward trend in excess liquidity coincides with the Asian economic crisis in the second half of 1997. As I stated before, by the early 2000s the excess liquidity series became positive and continued its sharp rise until the end of the sample.

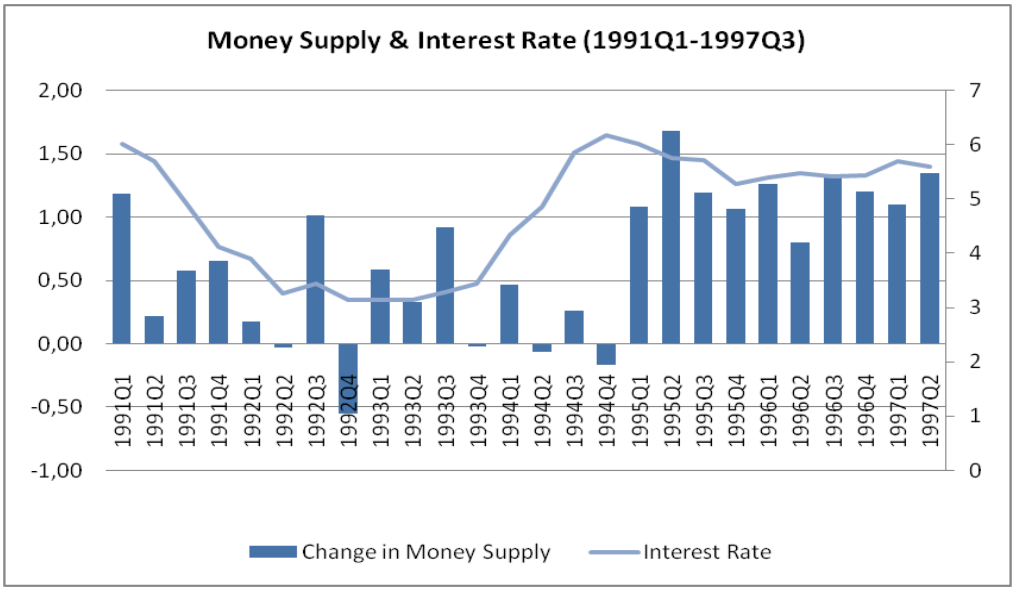
Consistent with Figure 10, Ruffer and Stracca (2006) note the sharp rise in the excess money variable since 2000, a phenomenon, which, in conjunction with very low interest rates, has created a lot of “excess liquidity” in the world economy.

Figure 12 - Economic Growth, Inflation, and Unemployment in the USA



Source: FED, OECD

Figure 13 - Money Supply and Interest Rates From 1991Q1 to 1997Q3

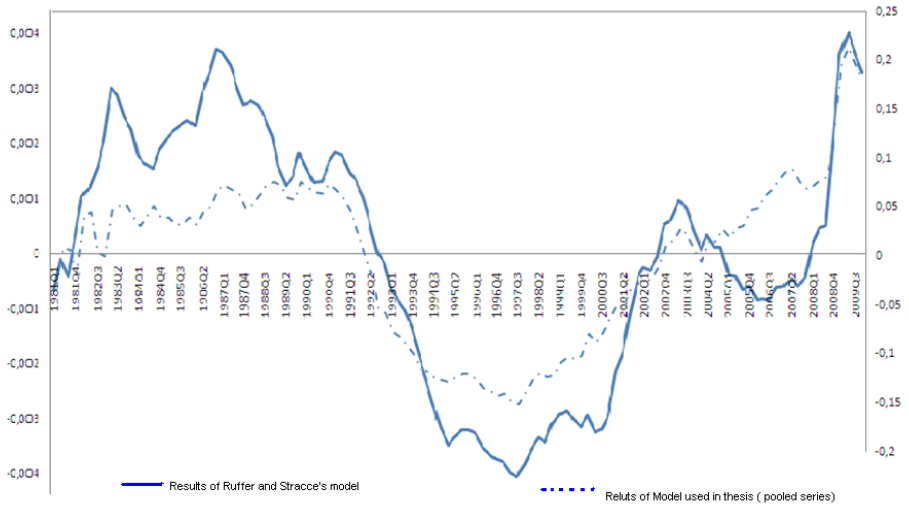


Source: FED & OECD

Comparison Between Excess Liquidity Computation Methods

My computation method for determining excess liquidity includes the possible effects of changes in velocity and other features that influenced the excess liquidity data, for example, output and price level changes. However, Ruffer and Stracca (2006) propose a more simplistic method to determine excess liquidity. Their method assumes that the ratio of money supply to nominal GDP may be interpreted as excess liquidity. They state that this is a preliminary way to compute excess liquidity, and have the ability to capture the main trends in excess liquidity changes. In order to check the performance of the models that I use in my thesis, I compared my results with the results of the Ruffer and Stracca's basic model. Results are presented below (Figure 14).

Figure 14 - Comparison Between Methods



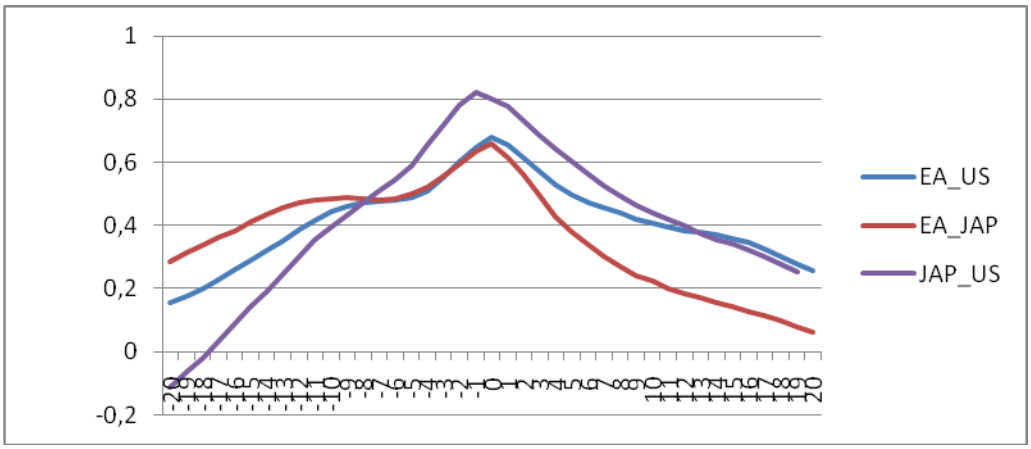
In Figure 14, the dashed line represents my method and the solid line represents the Ruffer and Stracca's basic model. The trends in both models are quite similar, but there are some occasional differences, which may be due to changes in other variables that are not represented in Ruffer and Stracca's model. For example, the downward movement in excess liquidity from 2003 to 2006 that is seen in Ruffer and Stracca's

model may be the result of excluding decreasing interest rates, rates that are included in my modified model.[12]

Correlation Among Countries and the Effects of Globalization

In the introduction, I state that after 1990, the co-movement of inflation dynamics among countries increased. In order to check whether global liquidity series among countries also tended to move in a more synchronized way after 1990, I have plotted Figure 15 and Figure 16. These represent the correlation of global excess liquidity series among countries. In order to check this argument, I analyzed the global excess liquidity correlations among countries and present them below. Figure 15 includes the full sample whereas Figure 16 includes only the post 1990 period. Figure 15 plots cross correlations between the Euro Area-the USA, Euro Area-Japan and Japan-the USA for the full period including 20 leads and 20 lags where 0 stands for the correlation at time t.

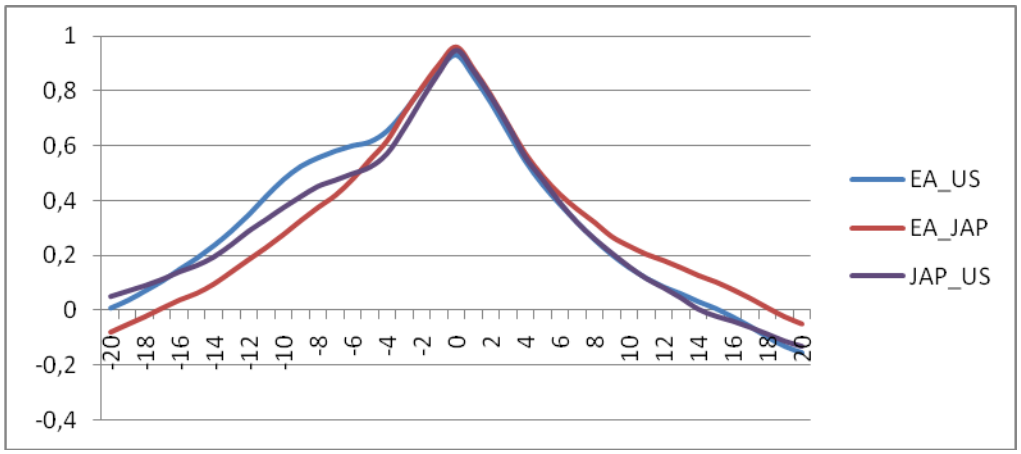
Figure 15 - Global Excess Liquidity Correlations (Full Period)



In a similar way, Figure 16 plots cross correlations between same country pairs for the 1990-2009 period including 20 lags where 0 stands for the correlation at time t.

[12] Remember the excess liquidity equation presented in the previous section ($\widetilde{m} = \beta(i_t^* - i_t) - (y_t^* - y_t) + \varepsilon_t$) and note that change in the interest rates, negatively affect the excess liquidity series.

Figure 16 - Global Excess Liquidity Correlations (1990-2009 Period)



In Figure 15 and Figure 16, it is seen that the correlation coefficient reaches its peak at 0 lag in both samples. The correlation coefficient for the full period is 0.8 and 0.98 for the post 1990 period. This is a signal for increased co-movement of global excess liquidity series in post the1990 period, but not a robust proof of my claim.

In order to check whether the cross correlation difference between periods is statistically significant, I ran test of equality for the correlation series of different periods. The results of the test of equality and cross correlation in different samples are statistically different. The probability coefficients for the test of equality are presented in Table 3.

Table 3 - Comparison of Correlation Coefficient for Different Periods

Test of Equality	
Country Pair	Probability
Euro Area - Japan	0.0262
Euro Area - USA	0.0029
USA - Japan	0.0064

Ruffer and Stracca (2006) highlight this correlation as well between measures of liquidity, especially for the major industrialized countries, and they state that the correlation is higher in post the 1990 period.

Global Excess Liquidity and Inflation in Turkey

After defining global liquidity and estimating the global excess liquidity series, I analyzed the effect of global excess liquidity on inflation in Turkey. In order to perform analysis, I chose a baseline model and a modified model that included excess liquidity as an independent variable. However, before developing the inflation model, I researched the studies conducted on forecasting inflation in Turkey.

Domac (2003) provides a good summary of inflation forecasting models. Domac (2003) compares three different inflation forecasting models which are presented below. In this part I label equations as 5.1, 5.2 and 5.3 where all are inflation forecasting models of Domac (2003).

Mark-up Models

Mark-up models assume that the cost and the pre-determined mark-up is the main driver of the price level in the economy. The mark-up model can be stated as in equation (5.1)

$$P_t = \mu_t (W_t)^{\gamma w} (E_t P_t^*)^{\gamma e} \qquad (5.1)$$

Where,

P is the domestic price level, μ is the mark-up level, W is wages, E is exchange rate and P* is the level of foreign prices.

Monetary Models

The main theory behind the monetary models is the belief that inflation is a monetary phenomenon. If there is a divergence from the equilibrium between money supplied and money demanded, the price level re-establishes the equilibrium. Thus, excess domestic money supply results in inflation and vice versa. Mohanty and Klau (2001) use the monetary model presented in (5.2) which is also used by Domac (2003).

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda \pi_{t-n} + \delta_i mgap_t + \varepsilon_{t+k} \qquad (5.2)$$

where,

π_{t+k} is the change in the natural log of the price level (in other words inflation) in time t. mgap is the monetary gap, which equals the difference between money supply and money demand at time t. A similar model was used as the comparison model, which produced more accurate inflation forecasts, in the following phase of the study. I made two different changes in equation 5.2 for comparison. First, I replaced mgap with the global excess liquidity measure in order to gauge the effectiveness of global excess liquidity on inflation in Turkey. Secondly, I added the global excess liquidity series to equation 5.2 (in addition to mgap) in order to see which model produces more accurate forecasts.

Phillips Curve

The third and the last model employed in Domac (2003) is the Phillips Curve Model. Gordon (1997) states that the Phillips Curve Model, analyzes the dependence of inflation on three basic factors which are demand, supply, and inertia. The Phillips Curve Model is a popular inflation forecasting model due to its relative success compared to other forecasting models (Stock and Watson, 1999). The Phillips curve used by Domac (2003) in inflation forecast analysis is stated in equation (5.3).

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_3 \Delta s_{t-1} + \varepsilon_t \qquad (5.3)$$

where, π_t is the inflation rate at time t, gap_t is the output gap at time t, and s_t is the nominal exchange rate at time t.

After defining the inflation forecasting models, Domac (2003) compares the forecasting performance of the three models presented above (i.e. 5.1, 5.2, and 5.3) according to the levels of root mean squared error, mean absolute error, Theil's inequality coefficient, and cumulative relative absolute error. He finds that the money gap model and Phillips curve models give the most accurate forecasts for inflation forecasting (Domac, 2003). While defining the Phillips curve above, I had mentioned that there is common belief that the Phillips Curve Model performs best compared to other inflation-forecasting models (Stock and Watson 2008). This is also true in the case of Turkey.

Therefore, I pick the two best performing models, the Phillips Curve Model and the Money Gap model, in order to check the effectiveness of global excess liquidity on inflation in Turkey.

Below are two base models and two modified forms for these models (where initially domestic money supply is replaced by global excess liquidity and then global excess liquidity is added as an additional variable without replacement) that will be used for comparison. The main reasoning for using two modified forms is to try to see whether global liquidity should be used in place of domestic money supply or just as an additional variable. Equations are labeled as 6.1, 6.2, and 7.1, 7.2 in order to group different forms of same method. In the first case I will estimate a simple bivariate autoregressive model forecasting future inflation at different horizons by lagged inflation rates and our measures of excess liquidity.

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda_n \pi_{t-n} + \delta_i \tilde{m}_{i,t} + \varepsilon_{t+k} \tag{6.1}$$

where π_{t+k} is the annualized rate of inflation between the current quarter t and k quarters ahead, π_{t-n} is the n period lagged quarterly inflation rate, $\tilde{m}_{i,t}$ (i=Euro Area, US, JP) is the current level of excess liquidity in the Euro Area, USA, or Japan, respectively, and ε_{t+k} is a residual. The lag length *m* is set at 4, independent of the forecasting horizon to keep the model tractable.

In equation 6.2, global excess liquidity is replaced by domestic money supply.

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda \pi_{t-n} + \delta_i \tilde{m}_t + \varepsilon_{t+k} \tag{6.2}$$

The only difference between models is that 6.1 uses global excess liquidity series and 6.2 use domestic money supply. The lag length m again set at 4, independent of the forecasting horizon, to keep the model tractable.

The second forecasting model that is subjected to comparison analysis is Phillips curve model presented below:

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_3 \Delta s_{t-1} + \varepsilon_t \quad (7.1)$$

where, π_t is the inflation rate at time t and gap_t is the output gap at time t and s_t is the nominal exchange rate at time t.

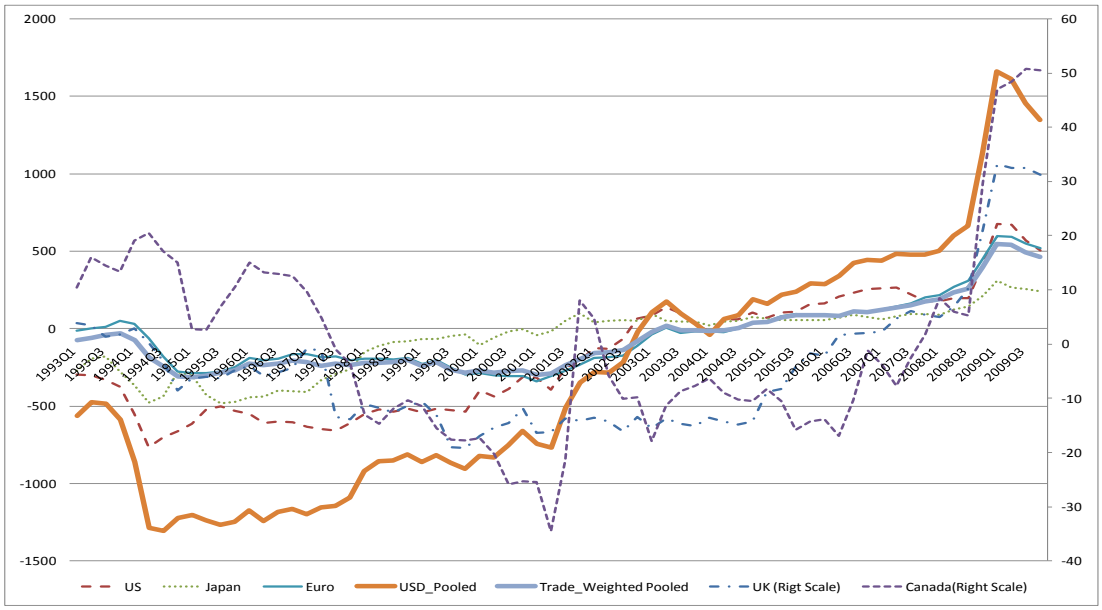
Note that different from the mgap model, only one lag of inflation is included to model as an independent variable and changes in exchange rates is also added to the model. The modified model includes the excess global liquidity data is as follows.

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_4 \Delta s_{t-1} + \beta_i \tilde{m}_{i,t-1} + \varepsilon_t \quad (7.2)$$

Where, π_t is the inflation rate at time t, gap_t is the output gap at time t and s_t is the nominal exchange rate at time t and $\tilde{m}_{i,t-1}$ is the excess liquidity level of country i at time t-1.(i=Euro Area, USA, Japan)

Before analyzing the models, I made some changes on the excess liquidity data to make the data applicable to the Turkish case. The excess liquidity data that is calculated for each country in the previous section is not currency adjusted. In order to include this data in a Turkish model, I need to do a currency conversion for each country and it is appropriate to weight all countries excess liquidity data according to their foreign trade volume with Turkey. For the currency conversation, I converted all excess liquidity series in terms of US dollars, using the quarterly exchange rates of OECD data. Currency was converted and weighted according to the foreign trade volume series, and is presented below in Figure 17.

Figure 17 - Trade Volume Weighted Global Excess Liquidity Series



Comparison of the models

Mgap Models

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda_n \pi_{t-n} + \delta_i \tilde{m}_{i,t} + \varepsilon_{t+k} \tag{6.1}$$

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda_n \pi_{t-n} + \Delta_i m + \varepsilon_{t+k} \tag{6.2}$$

$$\pi_{t+k} = c + \sum_{n=1}^{m} \lambda \pi_{t-n} + \delta_i \tilde{m}_{i,t} + \Delta_i m + \varepsilon_{t+k} \tag{6.3}$$

There are 3 forms of money gap model (6.1, 6.2, and 6.3) which are used to determine whether global excess liquidity has an influence on inflation in Turkey. Equation 6.1 includes only global excess liquidity, equation 6.2 includes only domestic money gap, and both are represented in 6.3. Summary results of the forecasting performance for the above models are presented in Table 4. Note that dummy variables are added to control for the crises in 1994, 2001, and 2008. The inflation-targeting period from 2003 to 2009 are also added as dummy variables for each of the equations.

Table 4 - Comparison of the Money Gap Models

Models	Root Mean Squared Error	Mean Absolute Error	Theil's Inequality Coefficient
Model 6.1	7.13	5.22	0.093
Model 6.2	11.52	8.13	0.153
Model 6.3	6.97	5.13	0.091

In the comparison in the above table, Model 6.3, where both domestic money gap and global excess liquidity are added as independent variables, performs better than the other two models.

Phillips Curve Model

Table 5 shows the comparison of the Phillips curve models, which is represented as Equation 7.1, 7.2 and 7.3.

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_4 \Delta s_{t-1} + \varepsilon_t \quad (7.1)$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_4 \Delta s_{t-1} + \beta_i \tilde{m}_{i,t-1} + \varepsilon_t \quad (7.2)$$

$$\pi_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 gap_{t-1} + \beta_4 \Delta s_{t-1} + \beta_i \tilde{m}_{i,t-1} + \varepsilon_t \quad (7.3)$$

Where

$gap_{t-1} = domestic\ money\ gap$ and,

$m_{i,t-1} = global\ excess\ liquidity$

As in the mgap models, Equation 7.1 includes only the domestic money gap, and only global excess liquidity is included in 7.2. Equation 7.3 includes both the domestic money gap and global excess liquidity as independent variables. Comparisons of the three models are presented in Table 5.

Table 5 - Comparison of Phillips Curve Models

Models	Root Mean Squared Error	Mean Absolute Error	Theil's Inequality Coefficient
Model 6.3	6.97	5.13	0.091
Model 7.1	7.21	5.29	0.094
Model 7.2	12.84	8.83	0.155
Model 7.3	**6.83**	**5.03**	**0.089**

As expected, adding excess liquidity improves the forecasting performances of the alternative models. Furthermore, comparing the last rows of Table 4 with the last rows in Table 5, the Phillips curve model produces more accurate results compared to the money gap model. After comparing the performances of these six models, it is obvious that including global excess liquidity series to inflation forecasting models increases the accuracy of the forecast both in the mgap model and the Phillips curve model. However, replacing domestic mgap with global excess liquidity produces less accurate results, but the inclusion of global excess liquidity as an additional variable increases the predictive power of the models. Moreover, the exchange rate, which is included in Phillips curve model and not in the money gap model, may also be effective for forecasting inflation in Turkey.

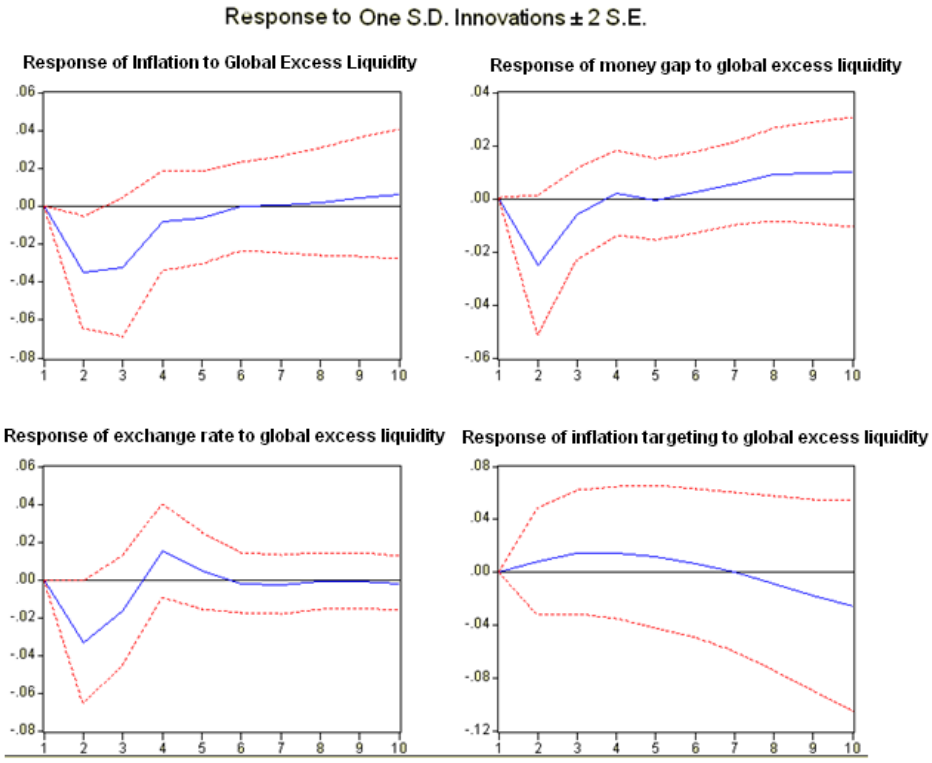
In all models, the coefficient of global excess liquidity is negative, which shows that a rise in global excess liquidity results in compression of inflation in Turkey. The reasons behind this fact could be as follows: a) the appreciation of the Turkish lira against world currencies under global liquidity conditions due to financial inflows into the country, b) an increase in commercial lending through banks, since it is easier for banks to find financial sources from outside world when global liquidity is high, and c) the higher growth potential of the Turkish economy when there is abundant global liquidity.

Impulse Response Functions

In order to measure how global exchange liquidity affects the variables in the final model, I conduct a VAR analysis using the forecasting equation 7.3.[13] Figure 18 shows the impulse responses of variables when there is a one standard deviation positive shock on global excess liquidity. As can be seen in Figure 18, one quarter later inflation responses negatively to impulses on global excess liquidity, and in a similar way, the exchange rate also shows a significant negative response with one quarter lag. According to the impulse response function there is a decrease in exchange rate ($/TL) indicating the appreciation of Turkish lira. This shows that the exchange rate channel is one of the channels that how global liquidity affects inflation in Turkey. Also, the response of the domestic money gap is negative in the second quarter, which may be due to increased domestic economic activity when capital inflows to Turkey rise. The money gap decreases when economic activity increases, because an increase in money demand is dependent on to increased economic activity. Earlier in this thesis I explained the lack of domestic capital accumulation in Turkey and the dependence of Turkish economic growth on capital inflow from abroad. The downward pressure on the exchange is the result of capital inflow on domestic markets in times of excess global liquidity which result in increased economic activity.

[13] Since equation 7.3 produces more accurate forecasts, for the remaining parts I use the equation in model 7.3 in order to point out how global excess liquidity affects Inflation in Turkey.

Figure 18 - Responses to Impulse on Global Excess Liquidity



Conclusion

The surge in global liquidity in the third wave of globalization has created a new interest in the link between global liquidity and inflation (Berger and Harjes 2009). The main motivation of these studies is to find out the relationship between global liquidity and inflation under these global integration conditions. In their studies Berger and Harjes (2009), Berger and Österholm (2008), and D'Agostino and Surico (2009) found that global excess liquidity is effective on inflation in the United States and the Euro Area. In the light of those studies, in this thesis I aimed to find out if there is a link between inflation in Turkey and global liquidity by examining the effects of global liquidity on inflation in Turkey. In order to perform such an analysis, I initially defined the concept of global liquidity. I then generated an excess liquidity series using the p-star model. I used this generated excess global liquidity series as an additional variable in my inflation forecasting methods, which I determined after analyzing previous studies on inflation in

Turkey. I found that adding global excess liquidity series as an additional variable to the inflation forecast models results in more accurate inflation forecasting. The impulse response functions of VAR analysis also shows how domestic variables respond to an impulse to global excess liquidity. I found that a rise in global excess liquidity results in a decrease in inflation in Turkey, an appreciation of the Turkish lira relative to other currencies, and a decline in the domestic money gap. An increase in global liquidity results in an appreciation of Turkish lira against global currencies, with a four quarters lag that creates downward pressure on inflation in Turkey through the exchange rate channel. Additionally, an increase in global liquidity results in a decrease in the domestic money gap, probably due to increase in economic growth (Onaran 2006). For future studies, the results from this analysis will be beneficial to economists because it by highlights the importance of global excess liquidity for the Turkish economy.

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