

An Interest Rate Spread Based Measure of Turkish Monetary Policy

M. Hakan Berument*

Department of Economics

Bilkent University

Ankara, 06800

Turkey

Phone: + 90 312 290 2342

Fax: + 90 312 266 5140

e-mail: berument@bilkent.edu.tr

Nildag Basak Ceylan

Department of Banking and Finance

Yildirim Beyazit University

Ankara, 06690

Turkey

Phone: + 90 312 4667533 -3526

Fax: + 90 312 3241505

e-mail: nbceylan@ybu.edu.tr

and

Burak Dogan **

Research and Fund Management Directorate

Central Bank of the Turkish Republic of Northern Cyprus

Lefkoşa, Bedrettin Demirel Cad.

TRNC

Phone: +90 392 611 5000 x 5078

Fax: +90 392 228 8607

e-mail: burak.dogan@kktcmekzebankasi.org

* We would like to thank Rana Nelson for her helpful comments.

** The views expressed here do not necessarily represent the official position of the Central Bank of the TRNC

An Interest Rate Spread Based Measure of Turkish Monetary Policy

Abstract

A coherent method to measure the effectiveness of a monetary policy improves the monetary authority's management capacity and renders the possibility of applying sound policies prior to and during a crisis. The trend in employing complicated and ambiguity-bearing unconventional monetary tools in the aftermath of the 2008 crisis has increased the value of such a method. The aim of this paper is to introduce a coherent and consistent monetary policy evaluation method for Turkey. Accordingly, we suggest that innovations in the spread between overnight interest rates and Treasury auction interest rates are informative for exchange rate, output and prices. Empirical evidence for this identification reveals that positive innovation in spread (implying a tight monetary policy measure) decreases output temporarily, permanently decreases prices, and appreciates local currency. This result is also robust to alternative specifications.

Key words: Monetary Policy Evaluation, Interest Rate Spreads, Business Cycles

JEL codes: E52, E58, E32

1. Introduction

Finding a proper measure and evaluation method for monetary policy are still among the most tempting pursuits of the economic literature. Conventional pure monetary policy suggests that central banks can utilize interest rate tools by directly adjusting short-term funding rates and by engaging in open-market operations or regulating reserve requirement ratios, which in turn affect market liquidity and long-term interest rates. Therefore, in the literature, short-term interest rates, monetary aggregates such as M1 and M2, and non-borrowed reserves (NBRs) are generally accepted policy tools and innovations in these variables are taken as measures of monetary policy.

Although these monetary tools are handy, their manipulative effects on the actual target variables depend on other effective factors, such as fiscal policy, developments in highly integrated world markets over which monetary policy has no or highly limited control, and domestic macroeconomic conditions. Moreover, the tools themselves are mostly correlated with consumer and investment behaviors, which may affect the main monetary targets and rates in the same or different directions. Thus, monetary policy exhibits endogeneity stemming from the interdependence of monetary aggregates and the real economy bridged by the financial sector. For this reason, it is not an easy task to identify a monetary policy. Mishkin (2011) noted that theoretical and practitioner economists try to impose financial frictions into general equilibrium models to account for interdependence. Accordingly, price stability increases eagerness in the search for yield and financial institutions become involved in risky investments through increasing leverage and currency/maturity mismatches. Referring to Johnson (1988), Woodford (1994) stated that monetary policy alterations should be transmitted to financial market prices to effect broader price measures and thus the real economy. Therefore, distilling the pure effects of monetary policy is quite knotty.

Some various methods proposed in the literature fail to give accurate results under stress because of various deficiencies. For instance, monetary aggregates such as M1 or M2 are used as measures of monetary policy or as measures of liquidity. However, a country's economic conditions can affect these aggregates and thus central banks may be unable to control them. Moreover, many studies in the literature, such as Friedman and Kuttner's (1992), state that monetary aggregates and monetary

targets are barely cointegrated and that the money-income relationship broke down after the 1980s.

As another policy indicator, NBRs, which measure the difference between a bank's total reserves and borrowed reserves (from the central bank), have been introduced as a variable that can be more easily controlled than M1 and M2. For instance, Christiano and Eichenbaum (1992) and Pagan and Robertson (1995) both reported that when NBRs increase, short-term interest rates tend to decrease. Kasa and Popper (1997) and Shioji (2000) also agreed on NBRs as an indicator of monetary policy. Although most of the literature is on developed countries, Berument, Sahin and Togay (2011) used analogue of NBRs as a monetary policy indicator for Turkey. Their new measure also includes the net liquidity provided to the system by a central bank after accounting for the central bank's involvement in the foreign exchange market. However, as Gali and Gertler (2007) suggested, allowing the money stock to adjust interest rate would cause interest-rate volatility. Since volatile interest rates would narrow the investment horizon, real economy deterioration well might be expected. Besides that, as Laurent (1988) and Woodford (1994) mention, weakening relationship between money and target economic variables has required more dependable monetary policy measures since the 1980s. Indeed, Bernanke and Mihov (1998) found no statistically significant empirical evidence that US monetary policy was properly measured by NBRs except for during the 1979-1982 period.

Interbank or central bank funding rates have also been frequently used as monetary policy indicators. Bernanke and Blinder (1992) and Sims (1992) considered Fed's funding rate as a measure of monetary policy for the US by assuming that funding rate is deterministic on depository institutions' reserves and thus on private investors' investment decisions. Sims (1992) considered short-term interest rates when estimating a VAR model for five countries: France, Germany, Japan, the UK, and the US. Even if their innovation in short-term interest rates well explains output behavior, the authors' methodology for interest rates produced inconsistent estimates on prices and exchange rates compared to expectations (puzzles). Eichenbaum (1992) revealed that when short-term interest rates are used as a monetary policy indicator, a contractionary policy might raise prices: the opposite development to what might be expected. Similarly, Grilli and Roubini (1995) discussed the exchange rate puzzle as an anomaly encountered when local currency depreciates in the face of contractionary policy shocks rather than appreciating. There are various efforts devoted to the

solution of these puzzles in the literature. For instance, Sims (1992) argued that inserting additional information variables into the VAR model might give greater insight to the policy maker. Following this logic, he empirically demonstrated for a series of developed countries that adding the commodity prices to the model could solve the price puzzle. Bernanke et al. (2005) also tried to overcome the problem by suggesting a factor-augmented VAR approach to capture even more information in the model. However, both efforts seem to have gone unrewarded because central bank interest rates are still used as policy variables, especially during crises with the presence of puzzles. Arestis et al. (2011) pointed out that the price puzzle persists under the highly volatile environment of the European economy and attributes this to the currency crises of 1992 and 1993, and even to the 2008 sovereign debt crisis. Moreover, as noted by Berument (2007) and Berument et al. (2011), central banks of small open economies face additional challenges that central banks of developed economies do not face. Current account balance deficits (which give rise to sustainability problems) or having insufficient foreign exchange reserves to control exchange rates are among some of the severe concerns of small open economies. Thus, the two concerns are also left unaddressed.

From the information above, it can well be asserted that, especially by the 2008 crisis, it has been practically experienced that the conventional policy measures (such as a narrow definition of money, NBRs, or funding rate) frequently used in the literature give neither sound nor sufficient results. Consequently, central banks have developed altered versions of previous monetary tools to implement their policies, such as required reserve ratios. For instance, the Central Bank of the Republic of Turkey (CBRT) introduced a segmented required ratio policy called the Reserve Option Mechanism (ROM). Accordingly, banks are allowed (though not obliged) to keep 60% of their required Turkish Lira (TL) reserves as foreign exchange (Euro and US Dollar (USD)) and an additional 30% as gold. As an incentive, foreign exchange and gold are accepted with higher coefficients.¹ In this way, the CBRT decreases liquidity

¹ As of October 1, 2012, the first 40% of the allowed foreign exchange partition of required domestic currency reserves is accepted by being multiplied with 1.1. The coefficients for each subsequent 5% increase are 1.4, 1.7, 1.9, and 2, respectively. On the other hand, while the first 20% of the gold allowance is accepted 1 to 1, the following two 5% increases are rewarded with coefficients of 1.5 and 2, respectively.

without altering interest rates and accumulates foreign exchange reserves to enhance resilience against foreign shocks.

In this paper, we do not incorporate these new variables into the econometric model to identify a monetary policy. However, because such actions by central banks alter liquidity in the market in the short run rates relative market demand that can be measured in the long run rates: The difference between short- and long-run interest rates is to be the measure of monetary policy. Therefore, the purpose of this paper is to introduce a new measure of monetary policy for an innovative central bank, i.e., the Central Bank of the Republic of Turkey.

We introduce the spread between interbank and Treasury auction rates as a measure of monetary policy. Interbank rate is a measure of the overnight funding rate for the financial system and Treasury auction rate is a measure of the return on investment in the long run. We assume that private sector expectations are based on a comparison of the monetary policy rate (which is interbank rate here) with the Treasury auction rate for at least three reasons: 1) the comparison contains enough expected yield information to encompass most of the available determinants; 2) the bond market can be complementary *and* supplementary to other financial markets, depending on the given economic conditions, and thus accepted as the financial friction; and 3) the comparison is simple to observe for policy makers and market participants alike.

Berument and colleagues (2007 and 2011) tried to identify certain monetary policies by employing various different identification specifications. In these studies, the system is identified by the policy practices that the CBRT employed at a given time. In the 2007 paper, for instance, the authors employed the spread between the interbank interest rates and the constant daily but variable month-to-month depreciation of domestic currency. The motivation of that study was a unique CBRT practice: according to the above-noted policy, the CBRT had targeted keeping TL returns (interest rates) higher than the depreciation rate (change in exchange rate). Another study was launched based on a CBRT announcement that they would abandon their policy of direct intervention in foreign exchange markets in 2001. Berument et al. (2011) recognized that this identification was not relevant after 2001, the CBRT continued interventions by implementing irregular foreign exchange buying/selling auctions. In the paper, the authors noted that liquidity is injected into the system not only through Open Market Operations but also through buying foreign

exchange. In this regard, they defined a new NBR that also includes the liquidity provided by foreign exchange purchases/sales. However, since November 2010, the CBRT has employed a new set of policy tools (one may visit IFF, 2012, for further discussion of this issue) so that neither real return on domestic return is guaranteed, nor are CBRT purchases of USD used to stabilize the exchange rate and provide liquidity. The current paper is an attempt to come up a measure that is immune to these policy changes.

Turkey experiences a fair amount of monetary policy shifts as a result of and/or in order to control its highly volatile macroeconomic conditions. Such conditions have existed since the mid-1970s, mostly as a byproduct of high and volatile inflation rates. Further, beginning with the second half of the 1980s and intensifying after the millennium, Turkey has undergone several structural reforms, either to establish new markets (such as stock exchange and bond markets) or to regulate and supervise existing markets. Moreover, in its last three decades as an open and fully liberal economy, Turkey has been sensitive to global fluctuations and crises. Monetary policy has had to be frequently adjusted, with the business cycles. Therefore, it is reasonable to study the Turkish experience when searching for empirical evidence for a monetary policy measure.

In Section 2, we provide the motivation for why the spread can be used as a measure of monetary policy. We explore the method and major challenges of VAR methodology (puzzles) in Section 3. After discussing the data in Section 4, we discuss in Section 5 the implication of our specification of Turkish monetary policy developments. We present the empirical evidence and provide a set of robustness analyses in Section 6, and conclude the paper in Section 7.

2. Interbank–Treasury Spread as a Measure of Monetary Policy

There is an undeniable gap between theory and the real economy. In a wide range of literature, from comprehensive orthodox economics to lately emerged heterodox views, all efforts focus on closing this gap. Current discussions on the imposition of the financial dimension on monetary models since the onset of the recent global crisis have re-emphasized this point. Thus, while overnight funding rates are on hand to affect short-term market interest rates, we need a transmitter, a kind of a bridge to set the relation between the monetary policy/objective and output/target variables. As noted in the previous section, we have enough reasons to use the

Treasury auction rate as this bridge. Moreover, as well elaborated below, we believe this rate captures economic agents' long-term funding costs. The spread between overnight rates and Treasury auction interest rates bunches the cost and return of credit for the financial system. Figure 1 shows the trajectory of these two rates for Turkey, except for a few crisis-period Treasury rates that exceeded the central bank's policy rate. Whenever the monetary authority decides to alter interest rates (by directly shifting the short-term policy rate or changing the reserve requirement policy) the depository institutions determine their new positions by comparing the new interest rate with longer-term credit facilities.

[Insert Figure 1 about here]

In the literature, Laurent (1988) recognized that short-term rates are under the influence of the central bank by their manipulative power over the funding rate. On the other hand, although funding rate may affect many monetary aggregates, there is no straightforward reason why the monetary authority's funding rate intervention should directly affect economic activity. Allowing solely the level of funding rate to measure the effectiveness of monetary policy is not explanatory enough. Moreover, movement of the funding rate in either direction can create different results, depending whether the rate is expansionary or contractionary. In the same study, it is assumed that funding rate can increase if credit demand increases, which means that altering the policy rate occurs in an expansionary environment. Similarly, funding rate can also increase if enough credit is absorbed out of the market by the monetary authority to set a contractionary policy.

In this paper, we take interbank rate as the short-term funding rate, over which the monetary authority has full manipulative power, either by setting it or guiding it by providing short-term liquidity through buying/selling short-term bonds, buying/selling foreign exchange, or setting the composition of required reserves. We also take the Treasury auction rate as a measure of or proxy for the return rate of financial agents such as depositors' savings or the supply of credit by commercial banks. The reason for determining auction rate as the other leg of the spread is clear: Treasury yields, especially benchmark bond yields, affect borrowing costs, which in turn affect level of investment, equity values, consumption, employment, and finally, output.

In numerous studies, spread notion has been defined to correlate with different macroeconomic variables. Many of these studies have taken the spread between short- and long-term interest rates according to a most reasonable explanation, which can be summed up as the relative insensitiveness of longer-term interest rates to monetary policy. For instance, Laurent (1988) defined spread as the difference between the 20-year bond rate and the federal funds rate, while Stock and Watson (1989) defined it as the difference between one- and 10-year Treasury bond rates. Bernanke (1990) suggested various spread definitions, such as the difference between the long-term Baa credit rating corporate bond rate and a 10-year Treasury bond rate, or as the difference between the overnight funds rate and a 10-year Treasury bond rate, and stated that the commercial paper-Treasury bill spread emerged as the best predictor. More recently, McCallum (2005) used one-period and two-period bond interest rates, whereas Nautz and Offermanns (2008) took the difference between the Eonia and three-month Euribor interest rates to measure European Central Bank's monetary policy. Berument (2007) introduced a slightly different spread definition, comparing currency depreciation rate with the short-term interest rate for Turkey.

The question thus becomes: Why do we use the Treasury auction interest rate but not anything else for Turkey? Answer: First, we cannot use constant maturity interest rates because the Turkish bond market is not as deep as more-developed markets such as the US; there is thus no constant maturity benchmark note as employed in similar studies on the US economy.

Second, we could have taken the benchmark bond rather than the average of Treasury auction rates, as that is frequently used in similar studies dealing with US data. Indeed, there exists a benchmark note in the Turkish bond market according to which other bonds' performances can be measured. However, this benchmark bond has a shorter maturity and can be changed at any time with any other bond,² which brings out the problem of volatile maturity. It must also be noted that the Treasury determines the maturity along with the interest rate. As the Treasury changes the benchmark bond, it then also changes the prevailing interest rate. Eventually, if we use the benchmark bond with the interbank rate to obtain the spread, when the

² The Treasury bond with a maturity date of February 20, 2013 was the benchmark note at the end of the data time span of this study; however, while this paper was being drafted, the bond was changed to one dated March 5, 2014.

Treasury changes the benchmark it could be signaling a monetary policy shift when in fact it is not.

Then the question becomes: Why do we use Treasury auction rate if we cannot use the benchmark? Answer: By definition, auction maturity changes in each auction. Using Turkish Treasury auction data between 1988 and 2004, Berument and Yucel (2005) reported a statistically significant stable negative relationship between maturity and auction interest rate. Thus, as auction maturity increases interest rate decreases. The authors argue that Treasury is willing to lower the maturity for its borrowing and increasing the interest rate rather than rely on pure interest rates while the economy faces an adverse shock. Otherwise interest rate should have been increased too much. Since this relation is stable, auction interest rate alone captures the credit cost for the depository institution. Thus, we may use auction interest rates alone rather than interest rates and maturity together.

Treasury bond rates are the main interest rates that derive the asset sides of financial institutions. The key factor that correlates the central bank funding rate and auction rate is the amount of government bonds that financial institutions hold on their balance sheets. The government bonds-to-total assets ratio of the commercial bank's consolidated balance sheet was 26.4% on average between 2002:12 and 2011:07;³ therefore, interest rate gains from the bonds constitute a significant share in banks' profits. While auction interest rates in the primary market are highly correlated with secondary bonds' market rates through expected yields, the rates on banks' bond holdings directly affect credit and deposit rates. Moreover, relative movements in funding rates and capital gains are determinant for private banks to supply credit to investors and households. Thus, the link between monetary policy and real economy is bridged, and henceforth, we define the spread as "interbank rate minus Treasury auction rate". A higher overnight rate relative to auction rate (with all other factors unchanged) indicates a tighter monetary policy, and because the central bank provides a lower level of liquidity to the market compared to what the market accepts, we normally expect output and prices to decline in the consecutive periods.

An interest-rate-spread-based indicator as a determinant of monetary policy is expected to reflect all information related to the market. A central bank may change

³ Data gathered from Turkey's Banking Regulation and Supervision Agency's statistics data base: <http://ebulton.bddk.org.tr/AylıkBülten/Gelismis.aspx>.

the level of money reserves within the banking system, which in turn directs the overnight rate to move. As a result, depository institutions usually assess differences between the overnight rate and the market returns of securities and loans (which have longer maturities) as captured by the auction rate. Depository institutions may want to affect economic activity by expanding the money stock level via buying securities in the case that a central bank policy rate falls down. Demand for the several components of monetary aggregates may be influenced by the deregulation of interest rates. It is not clear, however, why the monetary authority affects the supply of deposits and money via changing the movement in addition to the associated interest rate and economic activity changes. Thus, the spread (the difference between short-term rate and auction rate) may be a good indicator of monetary policy. It may be beneficial to use the properties of this measure such that in expansionary monetary policy the spread innovation is negative. Assuming that the other economic variables are constant, monetary policy is expansionary when short-term rates decreases and vice versa.

The spread also exhibits that short-term rate action may not be attributed to monetary policy. In solving the puzzles, using spread is superior to using interest rates at level because the rates may expand or contract. Clients' increasing demand for credit may increase rates, which may show either a rise in the amount borrowed or a decline in the amount saved. This situation implies that in the case of an expansionary environment interest rates increase. A rise may also be attributed to a decline in the amount of liquidity that the monetary authority provides to the market. Therefore, it would be useful to follow the movements of money as well as market liquidity when we are annoyed about the state of the economy.

3. Model

In identifying the effects of policies exclusive to a central bank, it is important to set policy indicators that are largely insensitive to other variables. To do this, we set up a VAR model as suggested by Christiano et al. (1999) and the references cited therein.

The economy is assumed to be in the form of a linear stochastic dynamic model. Without considering the constant term, one may write:

$$\Gamma(L)y = \varepsilon, \quad (1)$$

where the lag operator in the matrix polynomial $\Gamma(L)$ is denoted by L , the data vector is denoted by y , and the vector of interpretable disturbances is shown by ε . It is assumed that for $s>0$, $\varepsilon(t)$ and $y(t-s)$ are uncorrelated in determining the model and data vector. It is also assumed that the coefficient on L^0 which in $\Gamma(L)$ is Γ_0 , is nonsingular. In the case that equation (1) holds, having considered the stochastic assumptions on ε and y , the matrix containing the coefficients denoted as $B(L)$ in a reduced to a VAR:

$$y(t)=B(L)y(t)+u(t), \quad (2)$$

that is, related to Γ with the following equation:

$$I-B(L)=\Gamma^T_0\Gamma(L). \quad (3)$$

In addition, the covariance matrix shown as Λ of ε has a relation with the covariance matrix Σ of u with the following equation:

$$\Gamma_0\Sigma\Gamma^T_0=\Lambda, \quad (4)$$

where Γ_0 is a nonsingular matrix that is normalized so that it has ones on the diagonals and shows the contemporaneous relationships between the variables in the vector $y(t)$. In the case that there exist no a priori conditions on $\Gamma(L)$, there also exist no conditions on $B(L)$. Depending on the condition that other parameters are integrated or concentrated out, the likelihood, which is a function of Γ_0 and Λ , is dependent to the data through S , which is the estimated covariance matrix for u , that is, the reduced-form residuals. In the case that there exist restrictions on Γ_0 , which make it identifiable, it is possible to find the flat-prior posterior mean or mode using a nonlinear maximization or integration that depends only on S . In the case that having tried a broad range of identification schemes on Γ_0 , it is not necessary to apply the identifying restrictions in the formation of S or to restore S . This conceptual structure is useful because it does not involve any restrictions that include Γ_s , with $s > 0$, although the knowledge we have for Γ_s for $s = 0$ is scarce and for any $s > 0$ it is none. For now, it is better not to treat our information on Γ_0 and Λ , and carry the informal information on Γ_s for $s > 0$. We will examine the estimated systems where formal identifying restrictions are put on Γ_0 and Γ in the VAR model. One may also visit Sims and Zha (2006) for further discussion of this issue.

We make two basic assumptions regarding the model. First, exchange rate is exogenous for the domestic economy at a given time period but interacts with other variables with a lag. This is a reasonable assumption because Turkey is a small open economy, and thus short-term capital inflows are the main driver of exchange rates

and move according to the relative conditions of rest of the world. Thus, in our monthly data, we assume the CBRT responds to contemporaneous developments in the exchange rate, rather than leading it. The period where CBRT had depreciated the local currency with a pre-determined path (or the period that was well predicted by the market) ended in March 2001. Therefore, in this period, the depreciation rate is also pre-determined to spread (see Berument (2007) for discussion on the issue). Thus, even if the CBRT was influential in setting the exchange rate for the pre-March 2001 period, exchange rate would still precede the spread.

Second, we assume the interest rate spread is exogenous for other macroeconomic variables such as income and prices at a given period. That is, parallel to Leeper, Sims and Zha (1996) and Sims and Zha (2006), innovation in spread leads to innovation in income and prices rather than the opposite at a given time. This is also a reasonable assumption, because a central bank cannot observe the real level of prices and output at the time of decision due to data-gathering trouble, and it is more likely that current interest rate affects current output and prices. However, all variables in the system interact with each other with a lag.

To identify the system, we need to consider the identifying restrictions on Γ_0 and Λ . Thus, parallel to Leeper et al. (1996) and Sims and Zha (2006), we employ the Choleski decomposition and assume that there is no contemporaneous effect of monetary policy on disturbances in the general price level or the level of income. We use this restriction because no contemporaneous data exists for these variables when policy decisions are being made. If we place the monetary policy variable after the output and prices, we would have the extreme information that the central bank knows both variables before they set their policy actions. If we had been using quarterly data, then we could assume that the central bank could observe monthly data within each quarter (or at least the industrial production of the first month and the price levels of first two months) before they set their policy rate and then placement of income and prices before policy rate would make more sense. One may look at Christiano, Eichenbaum and Evans (1999) for discussion on this issue.

4. Data

The monthly Treasury auction interest rate is the weighted average of each auction's interest rate for the corresponding month, excluding consumer price index (CPI)-linked or foreign exchange (FX)-denominated or FX-linked auctions.⁴

Industrial production is taken as a measure of income; CPI is taken as a measure of prices. The exchange rate (exchange) is the official exchange basket that the CBRT has been following in its operations: 0.5 USD + 0.5 Euro.⁵ Interbank rate is the CBRT's overnight interbank rate. Money (m) is M2 plus Repo volume. All data are available from the data delivery system of the CBRT.⁶

The sample starts in 1988:08 due to data availability and ends in 2011:07, when the CBRT abandoned overnight rates as a policy rate, and switched to over-week rates. However, we extend the data span to 2012:07 at a later stage of the analysis by using the overnight borrowing cost. During the estimation, we include 11 monthly dummies to account for seasonality and five intercept dummies (for 1994:04, 1994:05, 2000:11, 2001:02, and 2001:03) to account for financial crises. The intercept dummies take the value of 1 for the corresponding month and 0 otherwise.

[Insert Figure 2 about here]

5. Spread as a Measure of Monetary Policy and Developments in the Turkish Monetary Policy

Figure 2 reflects the cumulative sum of interbank–auction interest rates spread innovations gathered from the VAR specification. Downward movement of the graph implies an expansionary monetary policy, while upward movement implies a contractionary monetary policy.

⁴ The Treasury opens auctions for various maturities each month. Here, we disregard these different maturities for each auction when we calculate the Treasury auction interest rate for each month. Therefore, the auction interest rate that we use is a mixture of several “forward rates”, which is implicit in the term structure of interest rates with different maturities. In other words, the auction interest rate variable is a pooled time series of forward rates with different maturities. Calvo and Guidotti (1992) and Missale and Blanchard (1994) argued that there is an inverse relationship between auction interest rate and maturities. Empirical evidence from Turkey suggests that this relationship does exist (see Berument and Yucel, 2005). Therefore, the “variable-maturity” auction interest rate variable that we use is a monotonic transformation of the “constant-maturity” auction interest rate that one might use to measure fiscal policy, and thus we can use the (variable-maturity) auction interest rates as an indicator of fiscal policy as suggested by the envelope theorem.

⁵ The Euro was introduced in 1999. For the period that we do not have data, we use the official convention between the Euro and the Deutsche Mark (DM) and use the basket as 0.5 USD + 0.974027 DM.

⁶ <http://evds.tcmb.gov.tr/cbt.html>.

We can analyze the graph in comparison with historical developments and policy choices. For instance, a relatively tight policy environment can be seen from an increasing trend between the first quarters of 1990 and 1991. This trend corresponds to the implementation of the CBRT's own balance-sheet-oriented money program, which was the bank's first publicly announced medium-term program (January 16, 1990). Its targets were to control an increase of the CBRT's balance sheet and to restrain monetary easing. The transition effects of these targets were expected to be price stability over the following four years. It should be noted that the program was only implemented for one year, not four, despite a comparatively stable political environment of a one-party government, which would not be experienced again in that decade.

In Figure 2 an expansionary period between 1991 and 1993 can be observed with a downward movement, which reflects the politically unstable environment of the time. Early general elections were held on October 21, 1991, as well as an unexpected presidential election (which indeed carried the head of government to the presidency) after the death of the president on April 17, 1993. The campaign stage of the 1994 local elections also occurred in this period. These developments paved the way for populist expansionary policies. It must be noted that the independence of CBRT policies were in question during this period, and Treasury and other public institutional borrowing from the CBRT were still customary. Monetary expansion of the same period continued throughout 1993, with the newly elected prime minister announcing that he would decrease interest rates to boost the economy.

The monetary easing period ended with the April 1994 financial crisis, which resulted in a stand-by agreement with the International Monetary Fund in June 1994. The shift can be tracked in Figure 2 by a sharp increase at that date, representing a sudden tightening.

However, following another early election call in the next year, the stand-by agreement was canceled and a new era of loose monetary policy continued until December 1999 (a long downward movement can be seen in Figure 2 between December 1994 and October 1999), when an exchange-rate-based disinflation program was implemented. In the meantime, two general elections were held; one on December 24, 1995 and the other on April 18, 1999. In 1996, the CBRT adopted an expansionary policy by announcing that financial stability was necessary to decrease Turkey's high inflation. To limit the effects of the August 1998 Russian financial

crisis, Turkish monetary policy became relatively tighter for two months in 1998 (the upward movement in Figure 2 around July and August of that year), and seemed to provide a short pause for breath in this long expansionary run. However, militarily supported political turmoil, which had forced the prime minister's resignation in 1997, put pressure on the new government to employ populist policies.

Nevertheless, by the end of 1999, an annual CPI inflation rate of around 70% urged tight monetary policy. As evident in Figure 2, an upward movement started in the first quarter of 2000 and continued until mid-2007. Actually, the first attempt to control inflation was an exchange-rate-based stabilization program introduced at the end of 1999. Despite decreasing confidence in the face of mounting current account deficits and a mild financial crisis in November 22, the program was implemented throughout 2000. On February 22, 2001, however, it was abandoned and after a significant level of devaluation, a floating exchange-rate regime was adopted, though tight monetary policy was not discarded. On April 25, 2001, the CBRT's main target was set as inflation and it was given further independence by the parliament, including the choice of policy tool. The bank implemented an implicit inflation-targeting policy between 2002 and 2006 and a conventional inflation-targeting policy afterwards, which were both quite successful at reducing the inflation rate from about 30% in 2002 to about 8% by 2007.

Although the CBRT had officially announced its inflation-targeting regime by 2006, it never ruled out the financial stability leg of macroeconomic performance, partly because of past experiences of fiscal dominance. Ersel and Ozatay (2008) claimed that fiscal dominance due to high public debt had adversely affected monetary policy during the implicit inflation-targeting period, and indeed, the CBRT's 2006 timing of shifting to a formal inflation-targeting regime was determined by its high degree of fiscal dominance. Accordingly, in implementing the regime, the CBRT has taken into account the fiscal side to sustain financial stability. As a result of this consideration, since mid-2007, monetary policy has more frequently switched between tight (i.e., when inflationary pressures are high) and expansionary (i.e., when current account deficits become overwhelmingly high) policies. In this regard, in two different periods (Q2-Q4 2009 and May 2011-January 2012) Figure 2 depicts tight monetary policies (upward movements). But on the other hand, it indicates a loose monetary policy (downward movement) between the last quarter of 2010 and mid-2011.

It can also be inferred from the downward trend in Figure 2 that Turkish monetary policy held a loose stance until May 2009, as did the rest of the world's economies. As a side effect, the TL began to depreciate by the last quarter of 2008. Consequently, while inflationary pressures hiked, current account deficits began to decrease in late 2008 and arrived at a six-year low by October 2009. Simultaneously, global conditions gradually improved. In fact, the second half of 2009 was when the first positive global indications were observed after the 2008 crisis. Therefore, under these domestic and global conditions, the CBRT had shifted to a tight policy by halting decreasing interest rates (overnight lending rates were lowered by 800 basis points in just seven months (by May 2009)). In an environment marked by the zero-bound interest rates of Euro-area and US markets, maintaining high interest rates was quite contractionary. Figure 2 shows this path: a tight policy from mid-2009 until 2010 prevented the TL from further depreciating and thus contained inflationary pressure.

While the 2008 crisis created an expansionary environment in the US and Europe, decreased interest rates and additional liquidity measures directed a significant amount of capital to high-return-offering emerging markets. Turkey was one of those appealing countries; however, increased domestic consumption and credit growth was already a major problem for its anti-inflationary program at the time. Therefore, although higher interest rates could have been a remedy in repressing domestic capital growth, that was not an option because such interest rates could have enlarged the current account deficit via domestic currency appreciation under an environment of surging foreign capital. Under these conditions, the CBRT announced a new strategy in the last quarter of 2010: an interest rate corridor. The aim was to dampen the surge of short-term capital inflow by creating ambiguity in interest rate movements. This interest rate corridor can be broadly defined as letting market interest rates swing between the CBRT's overnight lending and borrowing rates rather than emphasizing the policy interest rate. Further, the CBRT lowered the lower band of the interest rate corridor from 5.75% in November 2010, and then to 1.50% in December 2010. By discouraging commercial banks from parking their excess liquidity in Turkey, monetary policy loosened. The policy was conducted under macro-prudential principles and domestic credit growth was controlled with supportive measures by Turkey's Banking Regulation and Supervision Agency. The agency increased the required ratio of provisions for unsecured consumer credit and

capital adequacy risk weights. In point of fact, the loose monetary policy continued about May 2011 until the reinforcement of regular daily foreign exchange purchase auctions. Figure 2 shows a loose policy era between mid-2010 and mid-2011.

By the end of April 2011, the depreciation rate of the Turkish Lira against the Euro–Dollar basket reached almost 10% on average, compared to November 2010. The first sign of monetary tightening was heralded by twice increasing reserve requirements in April, from 12% to 15% in the first step, and then to 16% in the next. At the end of July, the depreciation rate was 6%, compared to the beginning of the month and the inflation trend was positive. That much depreciation inevitably put pressure on the inflation rate. Under these circumstances, the CBRT further tightened the policy by canceling foreign exchange purchase auctions after July 22, and on August 5 increased the lower band of the interest rate corridor from 1.50% to 9% and started daily foreign exchange sales auctions. Under this quantitative tightening strategy, the CBRT also cancels one-week repo auctions might whenever the CBRT anticipated the necessity. The policy further tightened on October 2011 by an increase in the upper band of the interest rate corridor from 9% to 12.50%. This tight policy period after May 2011 can be observed in Figure 2 with the upward movement of the graph.

6. Empirical Evidence

Identifying monetary policy within a VAR framework is challenging. Impulse responses, i.e., the time path of the model's dependent variables, enclose a set of well-known puzzles when there is an exogenous change in another variable. Two of these puzzles are closely related to monetary policy stance. Accordingly, tight monetary policy, measured with a higher interest rate, may give higher instead of expectedly lower prices (price puzzle), and eventually depreciate local currency rather than appreciating it (exchange rate puzzle). One may visit Kim and Roubini (2000), for a further discussion of these issues.

In this section, we present the results obtained from the set of VAR models, whose distinctive features comprise including the additional explanatory variables in the model (keeping spread measures in each model) or the length of the data span. We interpret the impulse responses of our basic model, where the variables are ordered as: exchange rate (Exchange Rate), the spread between the overnight interbank interest

rate and Treasury auction interest rate (spread), industrial production (IP) as a measure of income, and consumer price index (CPI) as a measure of prices. All variables enter the system in their logarithms except the spread. As Bayesian Information Criteria suggests, the lag order is 1. To account for seasonality, we include 11 monthly dummies. To account for financial crises, we include dummies for 1994:04, 1994:05, 2000:11 2001:02, and 2001:03.

We assess the results and present graphs of the impulse responses generated by the same models. Figure 3 displays the estimated impulse responses in the wake of a contractionary monetary policy, depicted as a positive innovation in the interbank–Treasury auction interest rate spread in the macroeconomic variables considered. We report impulse responses for an 18-month horizon. The middle line shows the median of the draws and the other two lines show the confidence intervals at the 95% level.

[Insert Figure 3 about here]

A positive shock to spread decreases (appreciates) exchange rate. Thus, we do not see the exchange rate puzzle. Second, the shock to spread persists for five months in a statistically significant fashion. The persistence of monetary policy is something expected. Output tends to decrease for three months and then return to its initial level. Eventually, tight monetary policy decreases prices. Thus, we do not see the price puzzle, either. Moreover, the decrease in prices is persistent.

Further elaborating on the basic model, we first make a new specification and ended the sample data as of July 2011. We do this because on August 3, 2011, the CBRT publicly declared the over-week rate as its new policy tool, dropping the overnight rate. It also announced that, whenever it deemed necessary, it might not provide liquidity to the market on the normally scheduled auction dates. When an auction wasn't called, these dates were called “exceptional days” and indeed, the CBRT did not fund the market on those days. Ultimately, there is a cliff between market overnight and official over-week rates in the exceptional days' data. Nevertheless, Figure 4 shows the same estimate by replacing the overnight rate after August 2011 with the effective Interbank Overnight Funding rate, extending the

sample until 2012:07.⁷ By considering the unusual rate divergence on the exceptional days, we repeat the above exercise by replacing funding rate (the official over-week policy rate, constant at 5.75) with interbank rate after August 2011, but also include an intercept dummy after this date. We report the results in Figure 5. The estimates in Figures 4 and 5 are virtually unchanged.

[Insert Figure 4 about here]

[Insert Figure 5 about here]

To assess the role and effect on market liquidity level when there was a change in monetary policy, we include M2 as an additional variable in our benchmark VAR model (see Figure 6). The higher the spread, the lower the output for six consecutive periods; this negative connection is statistically significant at least for three periods, in consistency with our benchmark specification. In coherence with the theoretical expectations, the amount of money also decreases, and is statistically significant for 16 months. A positive innovation of the spread also lowers exchange rate and decreases prices initially; however, these effects are not statistically significant.

[Insert Figure 6 about here]

We use the spread between the interbank rate and the Treasury auction interest rate as an identification restriction. It is plausible that both the interbank and Treasury rates affect economic performance in a non-parallel fashion and thus, in order to account for this possibility, we entered these two variables separately. Figure 7 reports the corresponding impulse responses. A positive innovation in interbank rate increases (rather than decreases) exchange rate; thus the exchange rate puzzle exists. Second, a positive interest rate innovation increases (rather than decreases) prices; thus the price puzzle also exists. From these results we conclude that positive innovations interbank rate solely as a policy tool or as an identifier of monetary policy tool is problematic.

⁷ See Figure A1 in the appendix, which is created from the accumulated spread innovations gathered until July 2012. Accordingly, it can be inferred from figure that a tight monetary policy is still in effect.

[Insert Figure 7 about here]

By considering the CBRT's dual policy tool that had been used prior to March 2001 (i.e., targeting the overnight interbank interest and exchange rates), Berument (2007) suggested using the spread between the interbank rate and the monthly depreciation rate of the Turkish Lira to identify the monetary policy. Hence, we replaced Treasury spread with exchange rate spread and Figure 8 shows the corresponding impulse responses. Unlike in our benchmark specification, we do not observe the exchange rate puzzle but we still see the price puzzle.

[Insert Figure 8 about here]

In order to account for the liquidity that the CBRT provides, Berument et al. (2011) employed an analogue of NBRs, which, unlike the US equivalent, includes the funding from foreign exchange market interventions. Figure 9 shows an impulse response analysis of when a one-standard-deviation shock to spread is introduced when this new liquidity measure is also introduced to the system. The figure suggests that the new liquidity measure (L) is not affected in a statistically significant fashion, and the impulses for other variables are robust.

[Insert Figure 9 about here]

Berument et al. (2011) successfully showed that L can be taken as a measure of monetary policy in Turkey until 2010. Although we lack sufficient observations, we specify the model with one lag for the post-2010 era. Figure 10 reports the impulse responses when we introduce a one-standard-deviation shock to L . Not surprisingly, most of the evidence is not statistically significant, but it does indicate that a positive L measure decreases but not increases prices.

[Insert Figure 10 about here]

Figure 11 reports impulse responses for the post-2002 era after the 2001 financial crisis. Similar issues prevail.

[Insert Figure 11 about here]

7. Conclusion

This paper proposes that innovations in the spread between the CBRT's overnight rates and Treasury auction interest rates are informative for output and prices in Turkey. This rationality arises from the fact that the spread serves well as a transmitter between the monetary policy/objective and target variables such as prices, output, and exchange rate. In this manner, while the CBRT's overnight interest rate stands for the measure of the funding rate of the financial system's assets, the Treasury auction interest rate denotes a measure that the financial system can change in its assets in comparison with the funding rate. Tightness of monetary policy is implied by the size of the spread. That is, an increase in this measure can be taken as a measure of higher funding cost and therefore illiquidity.

The empirical evidence suggests that tight monetary policy measured by the spread defined herein decreases output temporarily and permanently appreciates local currency and decreases prices. Thus, this specification eliminates well-known exchange rate and price puzzles. The empirical evidence is robust for different specifications formed by including different relevant variables and for different sample sizes set according to the possible threshold dates representing radical policy shifts.

References

- Arestis, P. Karaoglu, M. and Mouratidis, K.(2011), “Monetary Policy Preferences of the European Monetary Union and the UK”, *Sheffield Economic Research Paper Series, SERP Number: 2011019.*
- Bernanke, B. S. (1990), “On the Predictive Power of Interest Rates and Interest Rate Spreads”, *New England Economic Review*, Federal Reserve Bank of Boston, pp. 51-68.
- , and Blinder, A. S. (1992), “The Federal Funds Rate and the Channels of Monetary Transmission”, *American Economic Review*, 82(4), pp. 901-921.
- , and Mihov, I. (1998), “Measuring Monetary Policy”, *Quarterly Journal of Economics*, 113(3), pp. 869-902.
- , Boivin, J. and Eliasz, P. (2005) “Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach”, *Quarterly Journal of Economics*, v120, pp. 387-422.
- Berument, H. (2007), “Measuring Monetary Policy for a Small Open Economy: Turkey,” *Journal of Macroeconomics*, 29, pp. 411-30,
- , and Yucel, E. (2005), “Return and Maturity Relationship for Treasury Auctions: Theory and Evidence from Turkey” *Fiscal Studies*, 26(3), pp. 385-419,
- , Sahin, A. and Togay, S. (2011), “Identifying the Liquidity Effects of Monetary Policy Shocks for a Small Open Economy: Turkey”, *Open Economies Review*, 22 (4), pp. 649-667.
- Calvo, G. A. and Guidotti, P. E.. (1992), “Optimal Maturity of Nominal Government Debt: An Infinite-Horizon Model,” *International Economic Review*, 33(4), pp. 895-919.
- Christiano, L. J., Eichenbaum, M. (1992), “Identification and the Liquidity Effect of a Monetary Policy Shock”, In: Cukierman A, Hercowitz Z, Leiderman L (eds) Political economy, growth and business cycles Cambridge: MIT Press, pp. 335-70.
- , —, and Evans, C. L. (1999), “Monetary Policy Shocks: What Have We Learned and to What End?”, In: Taylor JB, Woodford M (eds.) *Handbook of Macroeconomics*, Vol. 1A, North-Holland, Amsterdam, pp. 65-145.
- Eichenbaum, M. (1992), “Interpreting Macroeconomic Time Series Facts: The Effects of Monetary Policy: Comments”, *European Economic Review*, 36, pp. 1001-11.
- Ersel, H. and Ozatay, F. (2008), “Fiscal Dominance and Inflation Targeting: Lessons from Turkey”, *Emerging Markets Finance and Trade*, 44 (6), pp. 38-51.

Friedman, B. M. and Kuttner, K. N. (1992), "Money, Income, Prices and Interest Rates", *American Economic Review*, 82(3), pp. 472-492.

Gali, J. and Gertler, M. (2007), "Macroeconomic Modeling for Monetary Policy Evaluation", *Journal of Economic Perspectives*, 21 (4), pp. 25-45.

Grilli, V. and Roubini, N. (1995), "Liquidity and Exchange Rates: Puzzling Evidence from the G-7 Countries," *Working Papers 95-17, New York University, Leonard N. Stern School of Business, Department of Economics*.

Johnson, M. H. (1988), "Current Perspectives on Monetary Policy", *Cato Journal*, 8 (2), pp. 253-260.

Kasa, K, Popper, H. (1997), "Monetary Policy in Japan: A Structural VAR Analysis", *Journal of the Japanese and International Economies*, 11, 275-95.

Kim, S. and N. Roubini, (2000), "Exchange Rate Anomalies in Industrial Countries: A Solution with a Structural VAR Approach," *Journal of Monetary Economics*, 45, pp. 561-86.

Laurent, R. D. (1988), "An Interest-rate Based Indicator of Monetary Policy", *Economic Perspectives*, pp. 3-14.

Leeper, E. M., Sims, C. A. and Zha, T. (1996), "What Does Monetary Policy Do?" *Brookings Papers on Economic Activity*, 2, pp. 1-63.

McCallum B.T. (2005), "Monetary Policy and the Term Structure of Interest Rates", *Federal Reserve Bank of Richmond Economic Quarterly*, 91, pp. 1-21.

Mishkin, S. F. (2011), "Monetary Policy Strategy: Lessons from the Crisis", *NBER Working Papers*, National Bureau of Economic Research, Inc.16755.

Missale, A. and Blanchard, O. J.. (1994), "The Debt Burden and Debt Maturity", *American Economic Review*, 84(1), pp. 309-319.

Nautz, Dieter & Offermanns, Christian J., (2008), "Volatility Transmission in the European Money Market", *The North American Journal of Economics and Finance*, Elsevier, vol. 19(1), pp. 23-39.

Pagan, A. R. and Robertson, J. C. (1995), "Resolving the Liquidity Effect", *Federal Reserve Bank of St. Louis Review*, 77(3), pp. 33-54.

Shioji, E (2000), "Identifying Monetary Policy Shocks in Japan", *Journal of the Japanese and International Economies*, 14, pp. 22-42.

Sims, C. A. (1992), "Interpreting the Macroeconomic Time Series Facts", *European Economic Review*, 36, pp. 975-1011.

—, and Tao Zha. (2006), "Were there Regime Switches in US Monetary Policy?", *American Economic Review*, 96 (1), pp. 54-81.

Stock, J. and Watson, M. W. (1989), "New Indexes of Coincident and Leading Indicators," in *O. Blanchard and S. Fischer, eds., NBER Macroeconomics Annual*, Cambridge, MA: MIT Press, pp. 351-93.

Woodford, M. (1994), "Nonstandard Indicators for Monetary Policy: Can Their Usefulness Be Judged from Forecasting Regressions?" *NBER Chapters, in: Monetary Policy*, National Bureau of Economic Research, Inc., pp. 95-115.

Figure 1: Interbank Overnight Interest Rates and Treasury Auction Interest Rates

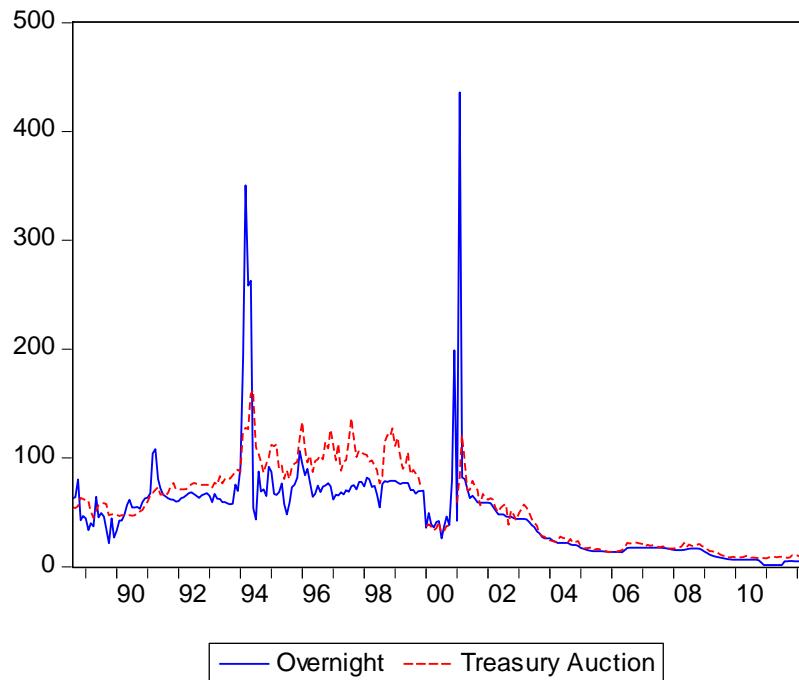


Figure 2: Accumulated Innovations to Spread

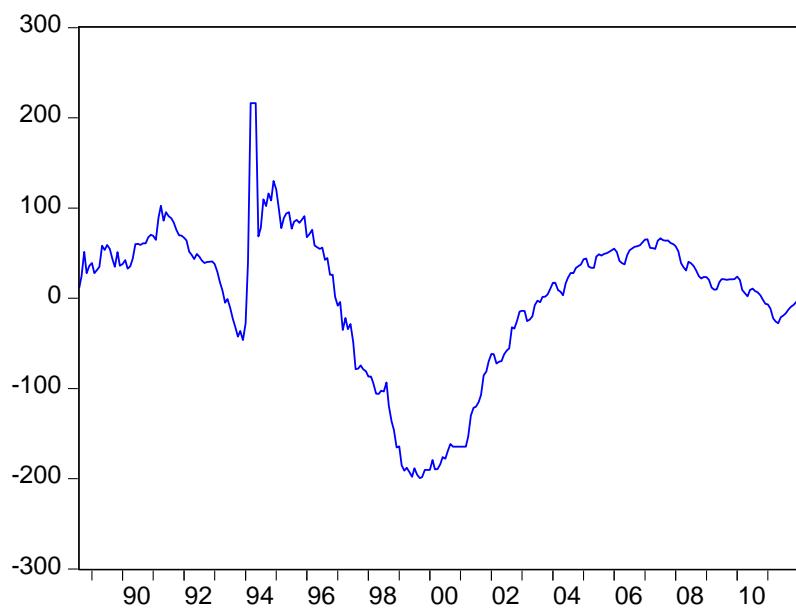


Figure 3: Impulse Responses to Monetary Shocks: 1988:8-2011:7

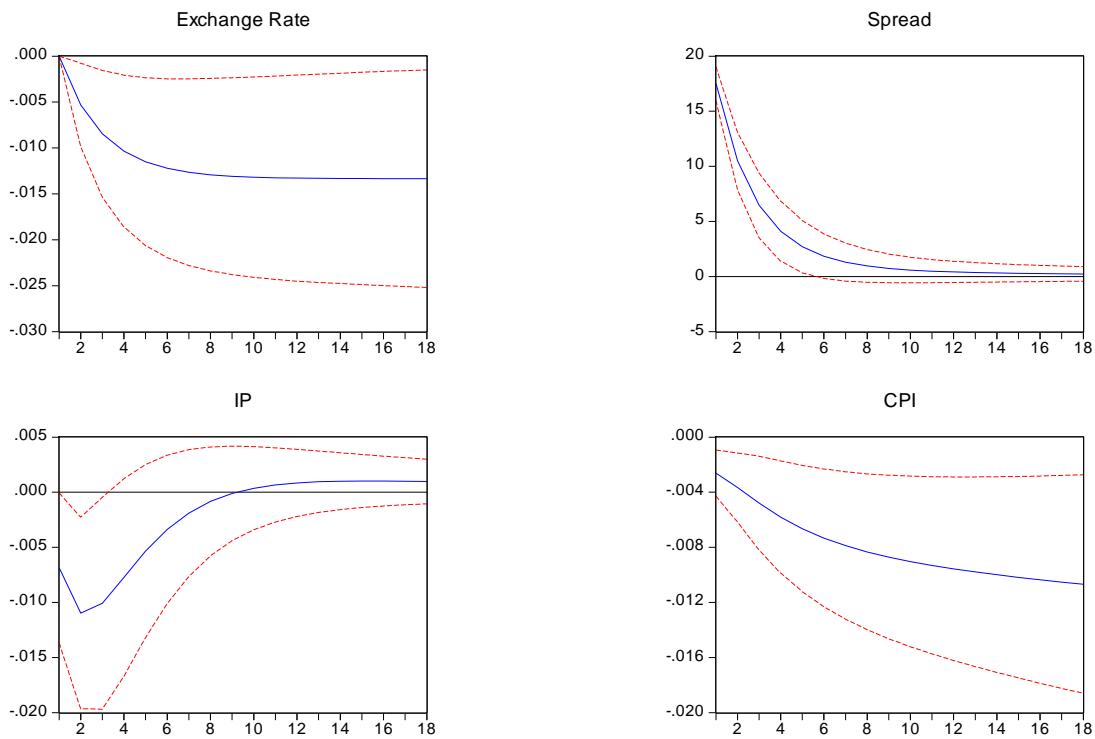


Figure 4: Impulse Responses to Monetary Shocks: 1988:8- 2012:7

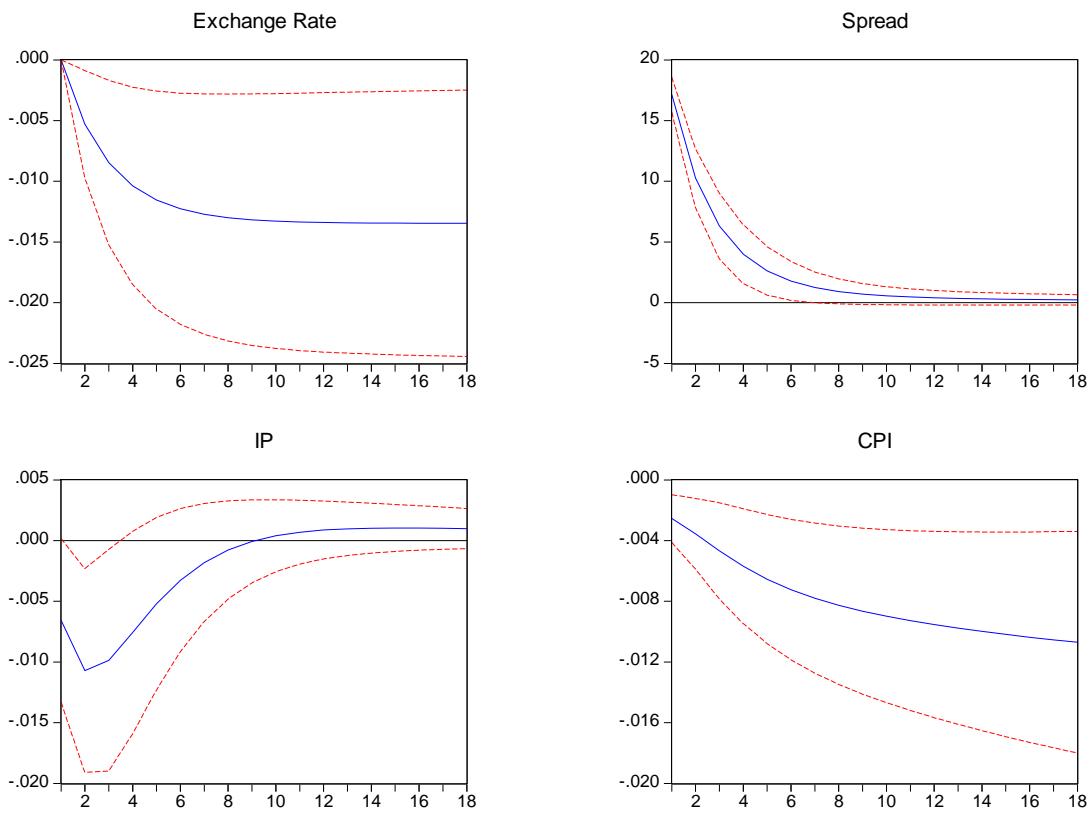


Figure 5: Impulse Responses to Monetary Shocks with the Policy Rate: 1988:8-2012:7

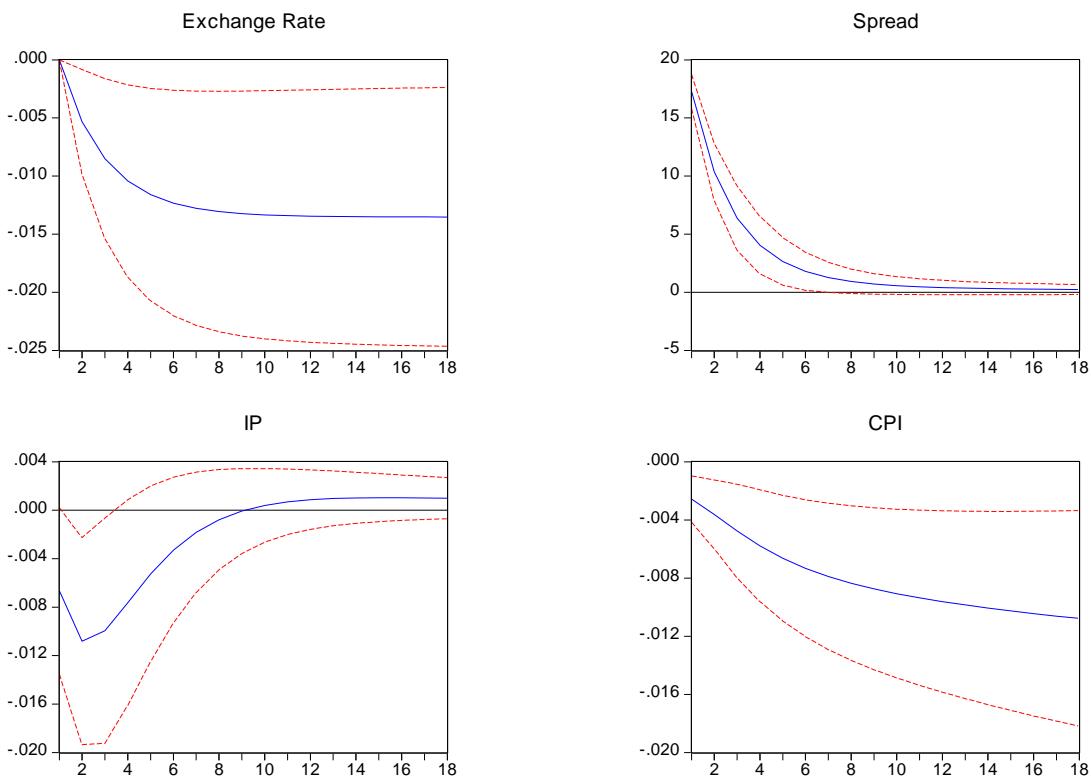


Figure 6: Impulse Responses to Monetary Shocks, including M2

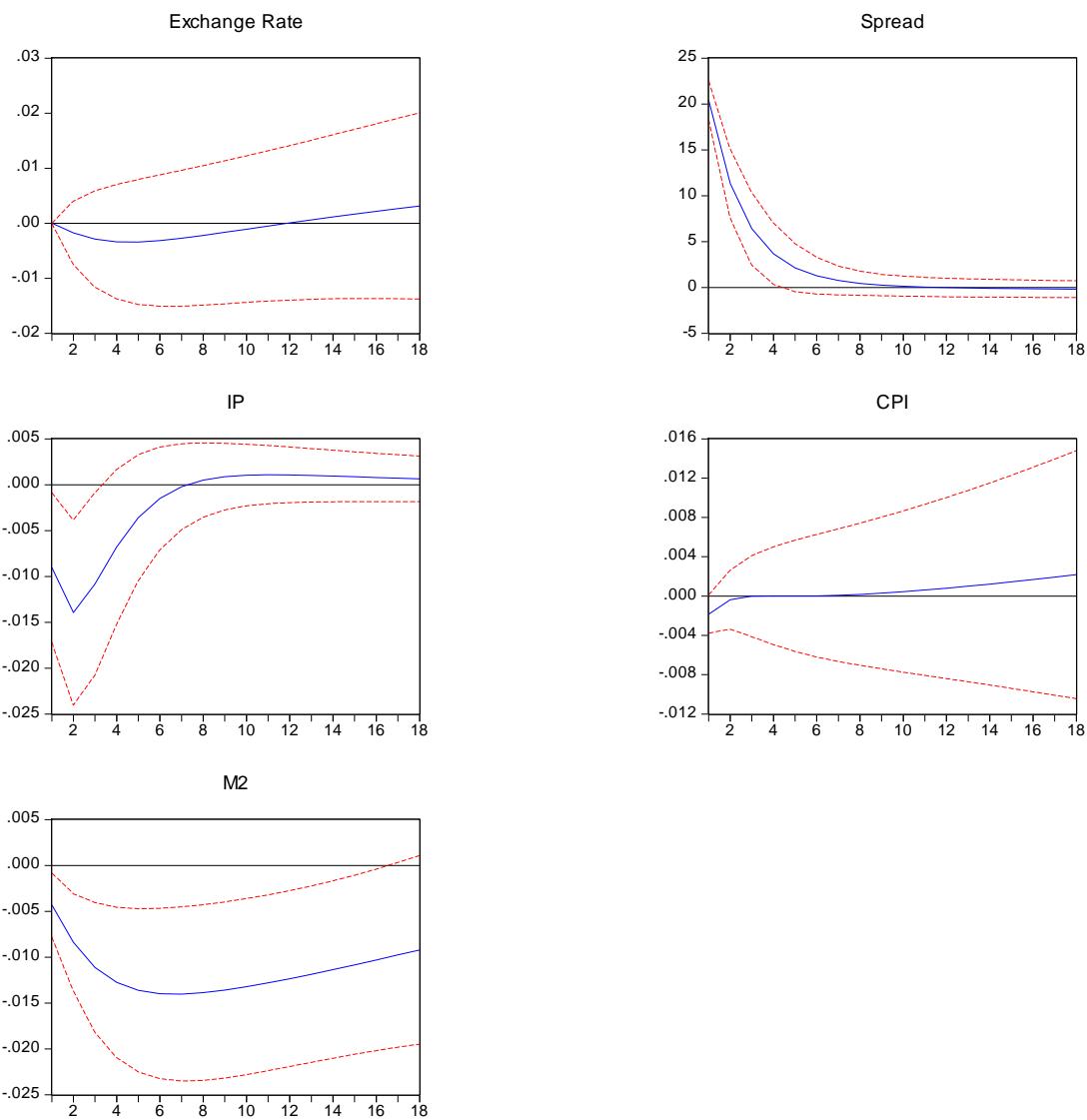


Figure 7: Impulse Responses to Interest Rate Shocks

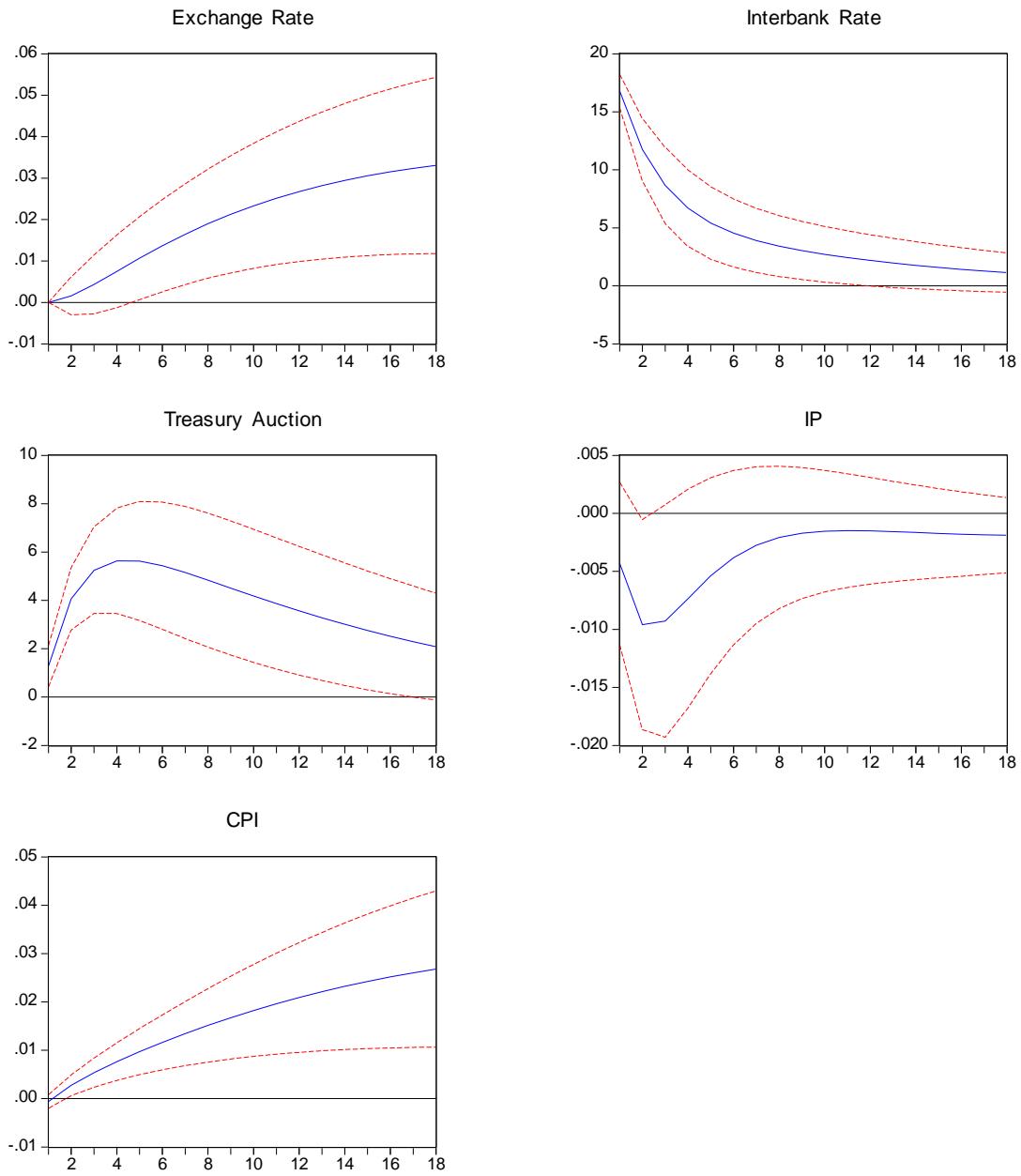


Figure 8: Impulse Responses to Interest Rate-Depreciation Spread Shocks

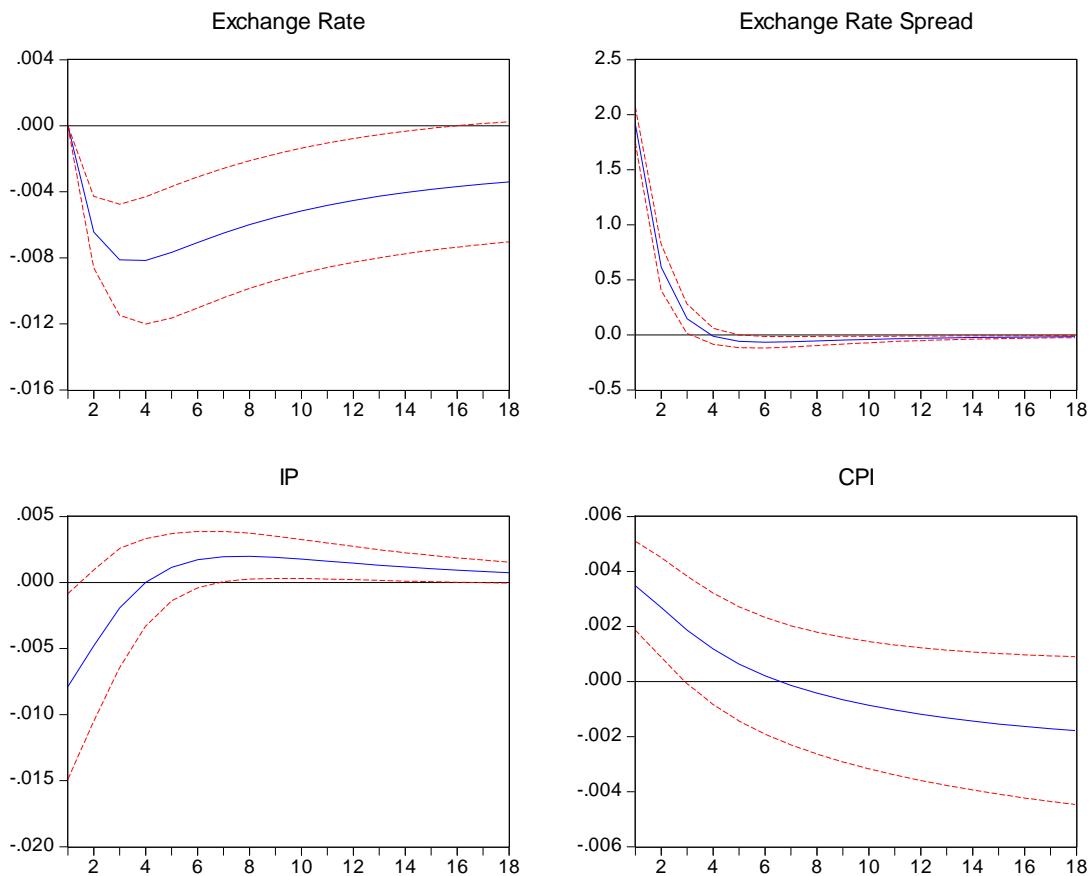


Figure 9: Impulse Responses When a Shock to Spread is given with the New Liquidity Measure

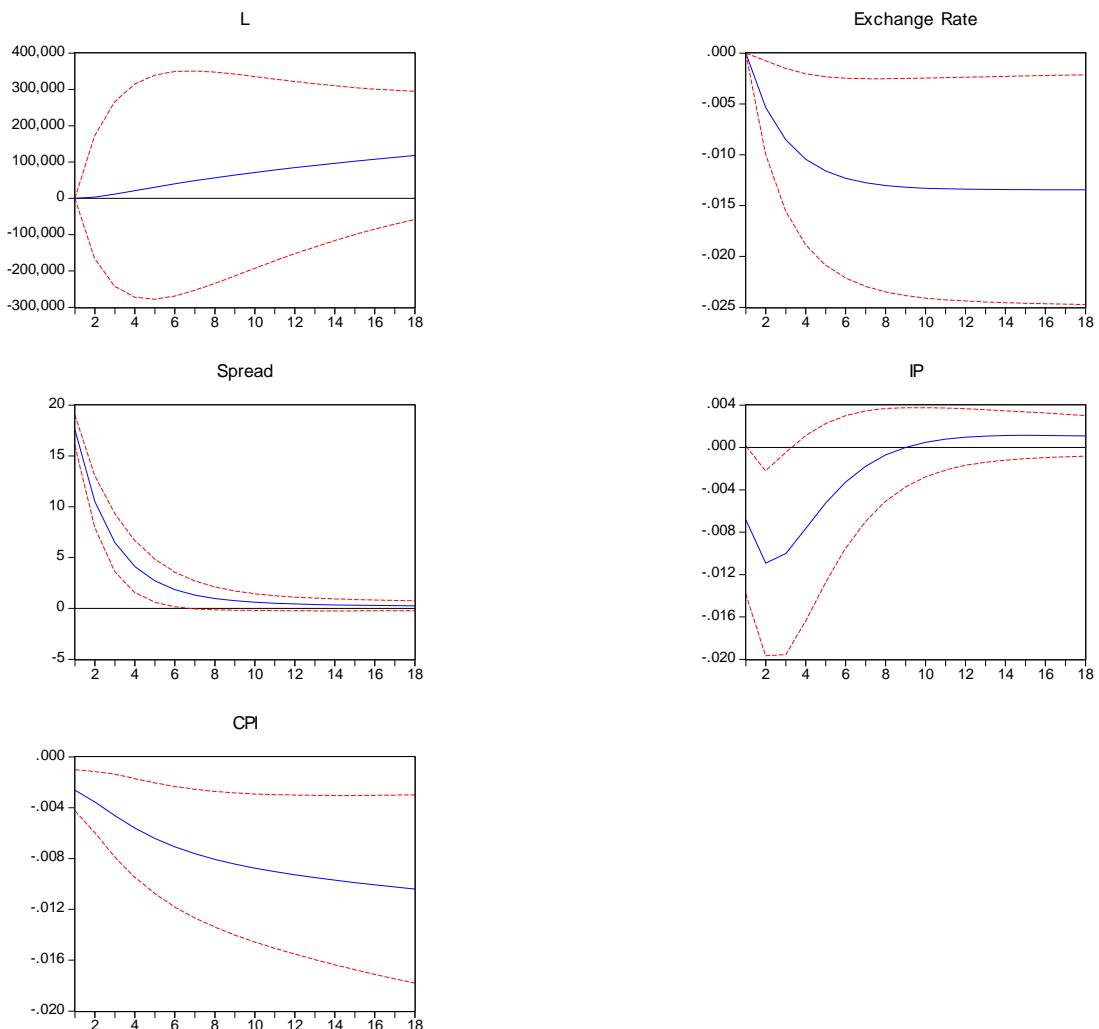


Figure 10: Impulse Responses When a Shock to the New Liquidity Measure is given for post-2010:01.

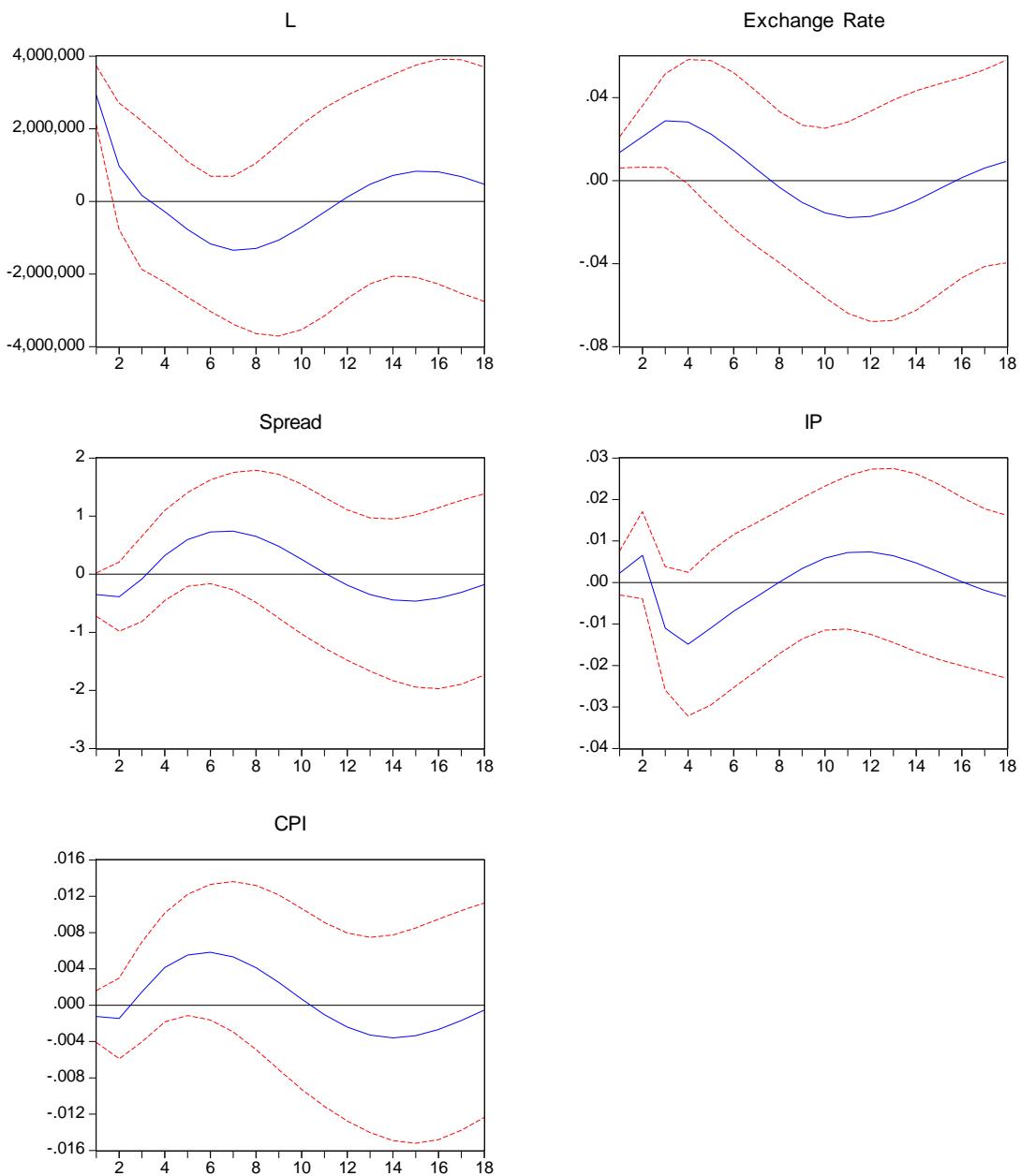
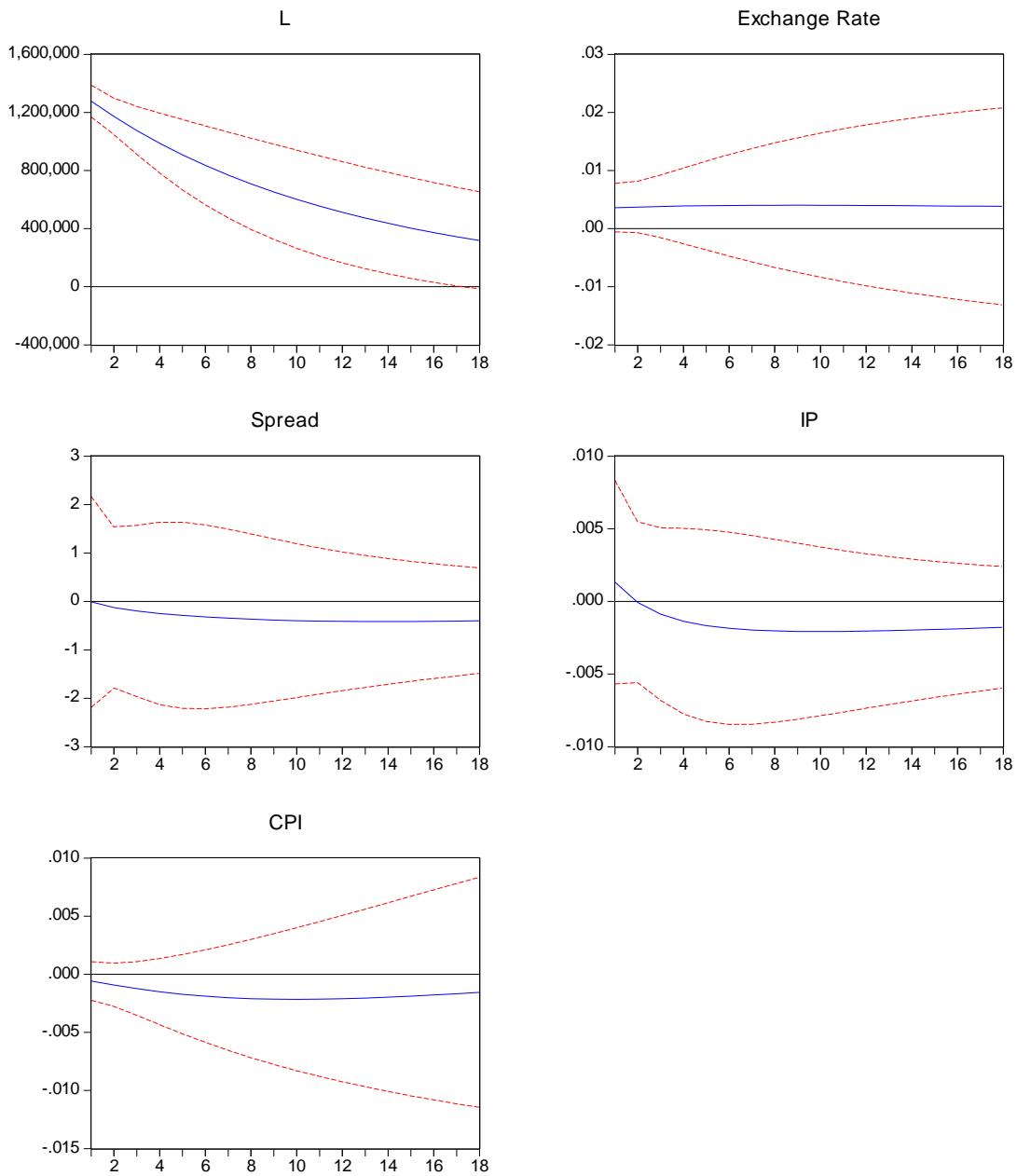


Figure 11 Impulse Responses When a Shock to the New Liquidity Measure is given for the Full Sample.



Appendix

Figure A1: Accumulated Innovations to Spread

