Measuring Monetary Policy in Emerging Market Countries: The Case Turkey

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August 1, 2002

(Preliminary)

Abstract

This paper aims to measure monetary policy in emerging market economies with a vector autoregression (VAR) approach. The model for small open economies of Cushman and Zha (1995) is followed, as emerging economies - in particular Turkey - are typical small open economies. The model is adjusted by considering a special characteristic of emerging market countries, namely high inflation. This leads often to substantial rise in the use of foreign currency in inland as in particular for deposits. Interest rates for foreign-currency-denominated deposits or loans gain an important role within the macroeconomics of these countries. As aconsequence, the foreign-denominated interest rate is added into the model presented in this paper. In consideration of this aspect the resulting dynamic of the modified model should give additional information about the effects of monetary policy shock as well as of foreign shock.

JEL classification: E31, E44, E52, F41
Keywords: Monetary Transmission mechanism, structural VAR, block exogeneity

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1 Introduction

The monetary transmission mechanism is still a central and extensive question of monetary policy. It describes the context between the operating targets of the central bank (money supply, discount rate) and the economic performance (price level, real and nominal output).
Analysis of monetary transmission mechanisms are in general of great importance because of their relevance for monetary policy aiming price stability. More information about channels through which monetary impulses affect the output and prices can help monetary authorities to choose their right instruments and to apply an effective monetary policy.
There are different models explaining those causal implications. The most important channels mentioned in the literature, also articulated in Mishkin (1995), are: the interest rate channel, the exchange rate channel, other asset price effects and the credit channel. Needless to point out here that not one channel is the exclusively right one. The most appropriate channel depends mostly on the countries economic structure.
Most studies treat industrial countries which have specific economic features such as, well developed financial markets, price level stability or independent central banks. Emerging market countries, however, distinguishes from even these features. Their economic performance are rather volatile, their financial markets are underdeveloped and they often have to deal with high inflation. Therefore, conclusions made out of studies of industrial countries do not hold for Emerging Market Countries.
This study is an attempt to include one of the charecteristics of emerging market economies as indicated in Kamin, Turner and Van't dack (1998) by modulating an existing model of monetary transmission mechanism. The mentioned charecteristic of emerging markets can illustraded as followed. As of high inflation it is often seen in Emerging Markets that foreign-denominated loans and deposits perform in financial markets. However, the interest rates of them do not have the same level as interest rates in the respective foreign countries. This derives often from risk premiums and probably still existing capital market restrictions. Therefore, in Emerging Markets not only domestic-currency interest rates are important, also foreign-currency interest rates are of importance.
Cushman and Zha (1995) have investigated notionally and empirically the monetary policy of an industrial small and open country. The present paper will treat this model and modificate it for the element mentioned above. The model will be implemented for Turkey being a small open emerging market economy. The main purpose of this paper is to find out the impact of the exchange rate channel for the Turkish monetary policy.

In the following section the model of Cushman and Zha (1995) for a small open economy is presented briefly. The second section concludes all required changes and adjustments of the model and the data for the case Turkey. The last section summarises the preliminary paper and gives an outlook over the future proceeding of this study.

2 Cushman and Zha's model for a small open economy

Cushman and Zha (1995) perform a model for a small open economy with a comprehensive VAR for the identification of monetary policy. Canada is used as case study. They argue that a VAR model with Choleski decomposition is insufficient for interpreting the effects of Canadian monetary policy. Furthermore, they show that thise method leads to liquidity and exchange rate puzzle. With generating their model Cushman and Zha show that such puzzles do not appear at all. Their model deals of Canada as a small open economy as an attempt to identify its moneratry policy explicitly. For this, they ostensibly extend the general methodology developed by Bernanke (1986), Blanchard and Watson (1986), and Sims (1986) in their model. The central idea for the adjusted model is to include foreign endogenous variables (open economy). These have an effect to the domestic variables, which contrariwise do not affect the foreign ones (small economy). Notionally, this implicates block exogenity.
Arguments, Canada being a small open economy are asigned from the fact that Canadian exports with 25 percent of GDP and 75 percent of them go to the USA, which Cushman and Zha define as rest-of-the-world. With small percentages of US exports to Canada it is assumed that the US economy is not affected by Canada. The Granger causality is been proved. In the following, the model of Cushman and Zha (1995) will be iterated briefly.
The model is presented as a structural system of linear, stochastic dynamic form, as of:

$$\mathbf{A}(L)\mathbf{y}(t) = \varepsilon(t)$$

With $\mathbf{A}(L)$ as a matrix polynomial in the lag operator L. $\mathbf{y}(t)$ is a vector of the observations, and $\varepsilon(t)$ is a vector of structural disturbances or shocks.[1]
Written more detailed:

$$\mathbf{A}(0)\mathbf{y}(t) + \mathbf{A}(1)\mathbf{y}(t-1) + \mathbf{A}(2)\mathbf{y}(t-2) + \ldots + \mathbf{A}(p)\mathbf{y}(t-p) = \varepsilon(t)$$

[1] See Cushman and Zha (1995) for details.

p is the used lag length, which is 12 in this study.
The reduced form of this equation:

$$\mathbf{B}(0)\mathbf{y}(t) + \mathbf{B}(1)\mathbf{y}(t-1) + \mathbf{B}(2)\mathbf{y}(t-2) + \ldots + \mathbf{B}(p)\mathbf{y}(t-p) = \mathbf{u}(t),$$

or shortly

$$\mathbf{B}(L)\mathbf{y}(t) = \mathbf{u}(t),$$

with $\mathbf{B}(0) = \mathbf{I}, \mathbf{B}(\mathbf{L}) = \mathbf{A}(\mathbf{0})^{-\mathbf{1}}\mathbf{A}(\mathbf{L})$, and $\mathbf{u}(t) = \mathbf{A}(0)^{-1}\varepsilon(t)$.
To distinguish the feature of a small open economy the endogenous variables are divided in domestic Canadian $\mathbf{y}_1(t)$ and foreign US $\mathbf{y}_2(t)$:

$$\mathbf{y_1}(t) = (EXC, M1, RD, PD, YD, TX, TM)'$$
$$\mathbf{y_2}(t) = (YF, PF, R, WXP)'$$

Following variables are counted to domestic variables, $\mathbf{y}_1(t)$: the exchange rate (EXC), monetary aggregate (M1), three-month Treasury bill rate (RD), consumer price index (PD), industrial production (YD) (seasonally adjusted), total exports to USA (TX), total imports from the USA (TM). Foreign variables, $\mathbf{y}_2(t)$, are: US industrial production (YF) (seasonally adjusted), US consumer price index (PD), US federal funds rate (R), and world total exports commodity price index in US dollars (WXP). The structural system of the small open economy can now be written differentiatedly as follows:

$$\mathbf{y(t)} = \begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix}, \qquad \mathbf{A(L)} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ 0 & A_{22}(L) \end{bmatrix}, \qquad \varepsilon(t) = \begin{bmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{bmatrix}$$

The feature of a small open economy is to be seen in the formal expression $\mathbf{A}_{21}(L) = 0$. This pattern of the coefficient matrix called block exogenity implies that the second block $\mathbf{y}_2(t)$ is exogenous to the first block $\mathbf{y}_1(t)$ with all its variables. This means that foreign variables have an influence on domestic variables but not vice versa. To support the exogenity of the foreign variables $\mathbf{y_2}$, Cushman and Zha implement a test for Granger causality with the likelihood ratio test. The null hypothesis is accepted, this means that $\mathbf{y_2}$ is Granger causal to the first block $\mathbf{y_1}$.
Other restrictions in the model are the identification of the contemporaneous domestic variables. It is to emphasise that besides of these restrictions, there are no further restrictions such as those on lagged variables. Cushman and Zha chareaterised the identification of the model by three markets: money market, information market, and production sector, as shown in the following equations.

Money demand:

$d_1(M1 - PD) - d_1 YD + a_1 RD = \varepsilon_d$

Money supply:

$d_2 RD + a_2 M1 + a_3 EXC + a_4 R + a_5 WXP = \varepsilon_s$

Information market:

$d_3 EXC + a_6 M1 + a_7 RD + a_8 PD + a_9 YD + a_{10} TX + a_{11} TM + a_{12} YF + a_{13} PF + a_{14} R + a_{15} WXP = \varepsilon_i$

Production sector:

This subsystem is normalised in the lower-triangularised order of TM, TX, YD and PD.

The equation for money demand is taken from traditional monetary analyses. Whereby, the money supply equation, which also can be called monetary policy equation, contains variables available to the Central Bank within the month. The information market equation collects all contemporaneous variables as it is assumed that exchange rates react to all this eleven variables within the month. The equation of the production sector proves that only overal output and instantaeous domestic price setting is of relevance for the contemporaneous Canadian foreign trade (TX and TM). Industrial production depends only from prices as contemporaneous variable. Prices keep unaffected through contemporaneous variables and reacts only to lagged variables. Thus, the production sector is a normalised system in the lower-triangular manner. Due to the block exogeneity restriction Cushman and Zha exclude to use ML estimation and inference directly. For the second block the ML estimation and inference is used by the conventional procedure for Choleski normalisation. However, for the ML estimation of the first block and resulting error bands for impuls responses, they use a special algorithm based on Zha (1999)

3 Model and data modifications for Turkey

The model of Cushman and Zha yields an important application facility for small open economies. Their model is also applicable for other countries, which can be identified as small and open. In this section, the theoretical framework for a model adjustment will presented for Turkey as case study. However, not only modifications on the model are made but adjustments for data, as well.

Turkey as a emerging market economy has performed since opening of the economy in 1980 high growth rates, however, with reappearing economy crises of weak to strong degrees. The last financial crises November 2000 and February 2001 showed again the weak and instable structure of the financial system. Another disease of Turkish economy is the long lasting high inflation. Both aspects leads to a phenomenon which is charecteristic for emerging markets. The extensive use of foreign currency in inland, as both transaction and asset instrument. Deposits and loans in foreign currencies such as US Dollar or Euro (before 1999 in DM) are usual. The interest rates of these are different from interest rates abroad. The interest rates for foreign-currency-denominated loans are higher than the interest rates of similar credit lines abroad. This is due to the charge of risk premium put on the domestic interest rates. This risk can be differenciated in exchange rate risks and other risks such as political one. Moreover, there are still financial market regulations existing in Turkey hindering free capital flows, so that arbitrage effects emerge. High inflation strenghens these effects.
For monetary policy authorities this aspect is of importance because the use of foreign currency in that manner, as deposits or loans, influences their monetary policy. The effects of their monetary policy is lessened as the central bank interest rate influences capital market interest rates for domestic-currency-denominated assets. The way how the monetary policy action influences interest rates of foreign-currency-denominated assets is not really differenciated initially. Against the background of this considerations the model of Cushman and Zha shall widened for a domestic variable, namely the interest rate for foreign-currency-denominated deposits (RF). Other model modifications are not been made but some in the data as explained in the following.

Turkey can be seen as a typical small and open economy. The Turkish trade volume at the presen time amounts of nearly 75% of GNP. The most important destinitions are the countries of the European Union, Germany at first place, followed by Italy, France and the United Kingdom. However, USA

is not as important for Turkey as for Canada, with about 10% of the exports. Therefore, it is more realistic for the Turkish case not to take USA as the proxy of the "rest-of-the-world" but a combination of the EU and USA. In the following part about the data the different combinations are explained explicitly.

Turkey is, besides of economic development in the last years, still a small economy in the context of world economy. As mentioned above, this can also be seen as Granger causality which is to be proved.

The modified model for the case Turkey has data running monthly from 1987:01 through 2001:12. The data is modificated as said above. All domestic values are taken from CBRT or SIS. The data for the foreign variables are from Deutsche Bundesbank, ECB, EUROSTAT, Federal Reserve Bank, IMF, and OECD. Furthermore, all variables are logarithmic besides of the interest rates.

For the domestic (Turkey) variables:

- EXC:
  The Turkish economy is strongly dependent of the trade with European countries and the US Dollar also plays an important role in the economy both for trade and financial issues. Due to these, for the exchange rate a basket of US Dollar and EURO is taken equaly weighed. As currency for Europe the EURO is used since 1999 and before that time ECU is taken. For the time before 1991 Deutsche Mark is used which is adjusted for comparable purposes.

- M2:
  As monetary aggregate M2 is taken in contrast to M1 for Canada.

- Short-term interest rates:

  - RD:
    The interest rate from weighted averages of 3-month domestic deposit is used as above mentioned interest rate for domestic-currency-denominated assets.
  - RF:
    As the above mentioned interest rates for foreign-currency-denominated assets, average of weighted averages of 3-month foreign deposit denominated in US Dollar and in EURO (before 1999 deposits denominated in DM) are taken.

- PD:
  The wholesale price index is used as price index because it is seen as a better proxy for the inflation.

- YD:
  As output the industrial production is taken assuming that it is a good indicator for the GDP.

- EX:
  For Exports, merchandise exports from balance of payments are used and deflated with the Turkish consumer price index.

- IM
  For imports, merchandise imports from balance of payments are taken and deflated with the Turkish consumer price index.

The foreign variables are:

- YF:
  As foreign industrial production, the simple average of US industrial production and EU15 industrial production is taken.

- PF:
  As foreign price index, a CPI basket is constructed from US CPI (weighted with one third) and the CPI of important EU trade partners of Turkey (weighted with two third). Germany as the most important country takes two fifths and each of France, Italy and United Kingdom takes one fifths.

- R
  As foreign interest rate, the simple average of the central bank interest rates of USA and EU (Bundesbank rate until 1999, afterwards ECB rate) is used.

- WXP:
  The world commodity export price index is taken from the IMF.

After the data modifications and adjustments the modified contemporaneous variables of the identified model can be written as follows. As to be seen, the equations money demand, money supply and the information market have changed, namely by the interest rate of foreign-currency-denominated assets (RF). Furthermore, another equation for monetary policy is added, which could give some new insights for monetary policy instruments. As a

result of this modifications, the model gets seven further coefficients to be estimate.

Money demand:

$$d_1(M2 - PD) - d_1 YD + a_1 RD + a_2 RF = \varepsilon_d$$

Money supply:

$$d_2 RD + a_3 RF + a_4 M2 + a_5 EXC + a_6 R + a_7 WXP = \varepsilon_s$$

$$d_3 RF + a_8 RD + a_9 M2 + a_{10} EXC + a_{11} R + a_{12} WXP = \varepsilon_s$$

Information market:

$$d_4 EXC + a_{13} M2 + a_{14} RD + a_{15} RF + a_{16} PD + a_{17} YD + a_{18} TX + a_{19} TM + a_{20} YF + a_{21} PF + a_{22} R + a_{23} WXP = \varepsilon_i$$

Production sector:

This subsystem is normalised in the lower-triangularised order of TM, TX, YD and PD.

It is to be stressed out here, that this equations contains only restrictions for the domestic contemporaneous variables. Said formally, the coefficients here are the content of the submatrix $\mathbf{A}_1(0)$. This means the first row of the matrix $\mathbf{A}(0)$. The coefficient matrix above written only for contemporaneous variables is:

$$\mathbf{A}(\mathbf{0}) = \begin{bmatrix} A_{11}(0) & A_{12}(0) \\ 0 & A_{22}(0) \end{bmatrix},$$

The specific submatrixes $\mathbf{A}_{11}(0)$ and $\mathbf{A}_{12}(0)$ can be written explicitly as followed:

$$\mathbf{A}_{11}(0) = \begin{bmatrix} 0 & 1 & a_1 & a_2 & 0 & 0 & 0 & 0 \\ a_5 & a_4 & 1 & a_3 & 0 & 0 & 0 & 0 \\ a_{10} & a_9 & a_8 & 1 & 0 & 0 & 0 & 0 \\ 1 & a_{13} & a_{14} & a_{15} & a_{16} & a_{17} & a_{18} & a_{19} \\ 0 & 0 & 0 & 0 & a_{24} & a_{25} & a_{26} & 1 \\ 0 & 0 & 0 & 0 & a_{27} & a_{28} & 1 & 0 \\ 0 & 0 & 0 & 0 & a_{29} & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix},$$

$$\mathbf{A}_{12}(0) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & a_6 & a_7 \\ 0 & 0 & a_{11} & a_{12} \\ a_{20} & a_{21} & a_{22} & a_{23} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}.$$

The submatrix $\mathbf{A}_{21}(0)$ is due to the restriction of exogeneity a null matrix. Besides this restriction, none is made for the non-Turkish block $\mathbf{y}_2$. This block is keept in its reduced form VAR with normalisation in the lower-triangularised order of YF, PF, R, and WXP.

The presented modified model is to be estimated as Cushman and Zha (1995) suggests by using the conventional procedure for Choleski normalisation. For the first block, the ML estimation and resulting error bands for impulse responses will be implemented by the algorithm outlined in Zha (1999).

4 Summary

The present paper is an attempt to apply the model of Cushman and Zha with some modifications for the case study Turkey. Turkey is a small and open economy which is also an emerging market. These countries are characterised among other things by the importance of foreign-currency-denominated assets, hence, of their interest rates as well. It is supposed, that this interest rate influences the domestic monetary poliy. This model could give some evidence what direction this influence has. Beside of this, the model shall show the importance of the exchange rate channel in Turkey.
Likely problems with the interpretationng of the results of the estimated model lies in the data. Turkey has had until now different exchange rate systems, which is performed within the data. Such structural breaks can distort the results strongly. There are some studies which try to solve this problems. To include this studies into the present model framework could be an interesting investigation for future studies.

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