

The Demand for Base Money in Turkey: Implications for Inflation and Seigniorage

K. Azim Özdemir and Paul Turner*

*Research Department
Central Bank of the Republic of
Turkey*

*Economics Department
The University of Sheffield*

azim.ozdemir@tcmb.gov.tr

*Economics Department
The University of Sheffield*

*p.m.turner@lboro.ac.uk
Phone: +44 1509 222722*

Abstract

This paper presents estimates of the demand for money function derived from two alternative opportunity cost of holding money for the Turkish economy over the period 1988-2000. The specification of the equilibrium relationship is problematic in that real money balances are integrated of order one while the inflation rate and the depreciation of TL against US dollar are integrated of order zero. However it is possible to show that the logarithm of real money balances is stationary around a segmented linear time trend with a break in 1994. The parameter estimates obtained are used to investigate the inflation level and the extent to which real seigniorage revenues have been exploited within the Turkish economy.

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* The corresponding author. The views presented are those of the authors and do not necessarily reflect the Central Bank of the Republic of Turkey (CBRT).

1. Introduction

The main purpose of this paper is to understand the significance of the seigniorage revenues for Turkey before and after the currency crisis in 1994. For this purpose we will try to answer the following questions (1) Is there evidence for a stable demand function for base money for the Turkish economy? (2) Is the average inflation rate for Turkey consistent with the need to generate the maximum possible seigniorage revenues? (3) Is the average inflation rate for Turkey inefficient in the sense that it is higher than necessary to generate a given level of seigniorage?

The currency crisis in 1994 is an important structural break for the monetary analysis of the Turkish economy. Before the currency crisis the lack of control over both fiscal and monetary policy had gradually deteriorated the confidence in Turkish lira. (Celasun 1998) and (Özatay 1999) identify the causes of the 1994 crisis as growing domestic demand, fiscal imprudence and the poor export performance due to increasing labour costs and real appreciation of the Turkish Lira (TL) in the late 1980s and the early 1990s, which fed the expectations of a coming crisis. In 1991, the public sector borrowing requirement hit the record 10 percent level of GNP. The share of domestic borrowing in financing the budget deficits started to increase and the Treasury built up public debt. The domestic debt stock climbed to 13 percent of GNP in 1993 from 4.5 percent in 1986. Moreover, the current account deficit also reached its highest level, 3.5 percent of GDP in 1993.

After the crisis high real interest rates became an obstacle, which frustrated sustained growth through their effect on debt service requirements and business confidence. Moreover, the economy has continued to experience high and variable inflation rates, which have acted as further barriers to recovery. However, to restore confidence in Turkish lira the money supply process was significantly changed in 1994. Before 1994 monetary expansion was at least partially backed by the domestic credit expansion, especially credit to the public sector. With a procedure change in the money supply process after 1994, the role of domestic credit in the monetary expansion rapidly declined. With the new procedure the Central Bank (CBRT) has started to create TL through foreign exchange (FX) transactions and used open market operations to smooth out the short-term pressures on the availability of liquidity. It was expected that this new policy choice would enable CBRT to accumulate FX reserves and thereby would reduce the vulnerability of payments system against speculative attacks without causing further monetary

expansion. By 1997 the outstanding money base was completely backed by the net foreign assets. Even in some years this ratio exceeded 100 percent. As a result, these measures partially restored the confidence in Turkish lira, which were severely deteriorating before 1994. The following section introduces the model. Section 4 and 5 estimate the model by using two alternative opportunity cost measures for holding money, the inflation rate and the depreciation rate. Final section presents the conclusion.

2. The model

Our starting point in this paper is the Cagan demand for money function. While we recognise the value of calibrated models such as that of (Selçuk 2001) in drawing out the implications of particular theoretical models, we are wary of imposing *a priori* theoretical restrictions which may determine the outcome of the analysis without testing. The Cagan function reflects a simple well-established theoretical relationship, which is sufficiently general to encompass a range of alternatives. For example, in a high inflation country like Turkey, the inflation rate will capture expectations of future exchange rate movements and thus part of the response of money demand to inflation reflects a currency substitution effect.

The Cagan demand for money function can be written as follows:

$$\left(\frac{M}{P}\right)_t = A \exp(-\beta\pi_t + u_t) \quad (1.1)$$

where A is a constant, π is the rate of inflation and u is a random error term. The level of seigniorage is equal to the product of the inflation rate and the level of real money balances ($S(\pi) = \frac{M}{P}\pi$) and it therefore follows that the average or

expected level of seigniorage is maximised when $\pi = \frac{1}{\beta}$. The identification of β - the inflation elasticity of demand for money - is therefore crucial to an analysis of seigniorage.

3. Data

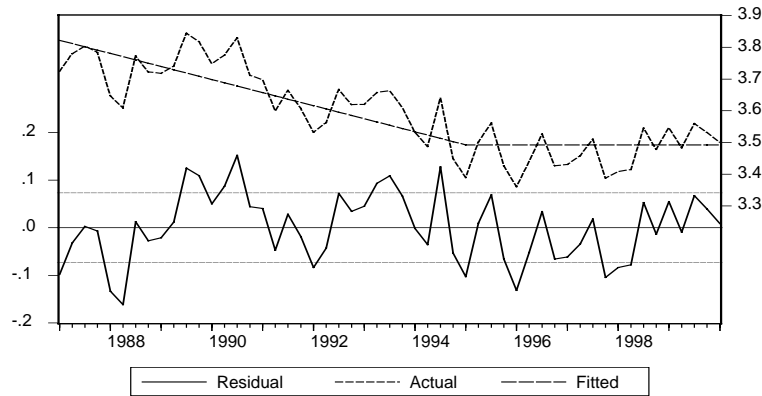
Data are the average values of each quarter for base money, consumer price index (CPI) and TL per US dollar. They cover the period between 1986q1-2000q1. Base Money is calculated as the sum of currency in circulation and deposits of the banking sector at the CBRT. These items of base money are taken from the balance

sheet of CBRT and CPI is from the State Institute of Statistics. The base year for CPI is 1987. Data are published on CBRT's web-site, www.tcmb.gov.tr.

4. Estimation

Our estimating equation is an error correction model using Equation 1.1 as the equilibrium relationship. We begin with a general model including current inflation and four lags plus four lagged endogenous variables. The specification of the equilibrium relationship is problematic in that real money balances are integrated of order one while the inflation rate is integrated of order zero. However it is possible to show that the logarithm of real money balances is stationary around a segmented linear time trend with a break in 1994. An Augmented Dickey-Fuller test for the residuals from a regression of the log of real money balances on a segmented trend yields a value of -4.1 . The decomposition of the log of real money balances into a deterministic segmented trend and a stationary stochastic component is illustrated below in Figure 1:

Fig. 1. Decomposition of log real money balances



The next stage was to estimate a Cagan demand for money function by means of the general to specific approach. The initial equation included the trend, current inflation and four lags of inflation and the endogenous variable. We also experimented with several real income variables including GDP and industrial production but these proved consistently insignificant. We then obtained a parsimonious specification in which all variables included were significant at the 5% level. This specification was then reparameterised into error correction form for ease of interpretation and was subjected to the usual battery of diagnostic tests. The final equation, reported below, fits the data well with coefficient values, which are

both economically sensible and statistically significant and with no obvious dynamic misspecification.

Estimates of the demand for base money in Turkey 1988q1-2000q1

$$\begin{aligned} \Delta(m_0-p)_t = & 1.3785 - 0.0028 DI_t - 0.0998 D2 - 0.2123 \Delta_3(m_0-p)_{t-1} \\ & (3.20) \quad (1.90) \quad (2.39) \\ & -0.3294 [(m_0-p)_{t-1} + 2.7643 \pi_{t-1}] \\ & (2.99) \quad (2.62) \end{aligned}$$

$$\begin{aligned} \sigma = 0.0478 \quad DW = 1.85 \quad LM_4 = 0.65(0.63) \quad ARCH = 0.06(0.80) \quad NORM = 0.33(0.85) \\ CHOW_1 = 0.83 (0.53) \quad CHOW_2 = 0.55 (0.91) \end{aligned}$$

m_0 is the logarithm of base money, p is the logarithm of the consumer price index, DI is a dummy variable which takes the value 1 1988q1-1994q4 and 0 1995q1-2000q1 $D2$ is a dummy variable which takes the value 0 1988q1-1994q4 and 1 1995q1-2000q1 and π is the first difference of p . Δ_3 is the third difference operator ($= 1-L^3$). Absolute values of the t-ratios are given in parentheses below coefficients. The residual diagnostic statistics are as follows: σ is the standard error of the regression, DW is the Durbin-Watson statistic, LM_4 is the Breusch Godfrey test for serial correlation of order 4, $ARCH$ is the LM test for autoregressive conditional heteroscedasticity of order 1, $NORM$ is the Jarque-Bera test for normality, $CHOW_1$ is Chow's breakpoint test and $CHOW_2$ is Chow's Forecast test for a structural break after 1994.4. Numbers in parentheses are p -values.

We now concentrate on the long run properties of our estimated equation. Solving for the equilibrium yields the following:

$$\frac{M_0}{P} = \begin{cases} A e^{-0.0084\tau_t} \pi^{-2.76} & t = 1988.1 - 1994.4 \\ B \pi^{-2.76} & t = 1995.1 - 2000.1 \end{cases} \quad (1.2)$$

where A and B are constants and τ is a time trend which is zero in 1986.1.

The crucial parameter here is the inflation elasticity of the demand for money which we estimate to be -2.76 for quarterly inflation. It is interesting to note that our estimate lies midway between the value of -2.90 reported by (Özmen 1998) and that of -2.62 implicit in Selçuk's (2001) equation (5). Our value indicates a seigniorage maximising quarterly rate of inflation of 36%. Since actual quarterly inflation rates have averaged 13% we conclude that Turkey appears to be on the

depreciation and inflation than can be allowed for in a single equation approach. In a later paper we intend to examine this issue further by use of the VAR methodology.

6. Conclusions

On the basis of our estimates the Turkish inflation rate does not appear to have been excessively high from the point of view of the extraction of seigniorage revenues. The inflation elasticity of demand for real money balances estimated in our model indicates that a more rapid expansion of base money could generate substantially higher real revenues. Of course this is not a policy recommendation. Inflation may generate substantial economic costs, which are not captured by our model. There is also some evidence that currency substitution is important but it is difficult to estimate a single equation demand for money function which includes both inflation and depreciation effects and which produces sensible economic parameter estimates.

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