Financial Liberalisation, Currency Substitution and Seigniorage

Evidence from Turkey

Aylin Soydan

Middlesex University Business School
The Burroughs, Hendon
London
NW4 4BT

a.soydan@mdx.ac.uk

May 2003

Financial Liberalisation, Currency Substitution and Seigniorage
Evidence from Turkey

1. INTRODUCTION

Government's monopoly over the issue of high-powered money potentially provides a significant resource to finance its deficits among other financing means. It is often argued that, especially in the presence of high public deficits, the relationship between inflation and deficit becomes more apparent mainly due to government's intention for monetisation.

It is also argued that revenue raising from money creation is a particularly attractive method in developing countries, where the traditional tax base is narrow and the tax system is generally inefficient, and where the domestic financial markets are relatively thin to absorb the government debt. Foreign borrowing could provide external resources for deficit financing. However, a low international reputation can force governments to raise resources domestically to finance their spending as many developing countries experienced after the debt crisis in the late 1970s – early 1980s.

Following the debt crisis, most of those countries underwent significant structural reform and stabilisation programmes in the 1980s in order to integrate their economies with the world economies and liberalise their financial systems. In the financial liberalisation process deregulation of markets by abolishing various controls, allowing free capital movements, introduction of new financial assets that denominated both in domestic and foreign currencies, technological developments in the financial activities, all brought significant changes in the financial structure of these countries. Beside other implications, financial liberalisation was also expected

to deepen financial markets, which, in turn, could improve the opportunity for domestic borrowing.

One of the likely consequences of financial liberalisation process is to result in a lower seigniorage creation capacity for the government due to a decreasing money demand in the presence of alternative financial assets (McKinnnon, 1973; Shaw, 1973). Particularly, under high inflationary circumstances, the demand for foreign currency and foreign currency denominated assets increases leading to 'currency substitution'. Currency substitution can have significant implications and needs to be considered in the analysis of the revenue from money creation.

In the literature, there are two main approaches taken to examine how governments use money creation to raise revenue: the *optimal taxation* and *seigniorage maximisation* theories.[1] The first approach deals with the minimisation of the social costs from different forms of resources, mainly conventional tax and seigniorage, [2] while the seigniorage maximisation view only focuses on maximising a particular type of revenue, i.e. revenue form money creation.

In most of the empirical studies the demand for real money balances is a function of inflation, while in some studies real income is also included.

[1] De Haan *et al.* (1993) add a third approach, 'fiscal dominance hypothesis' which is developed by Sargent and Wallace (1981). Sargent and Wallace distinguish between fiscal and monetary authorities. They argue that if fiscal policy is dominant, i.e. if the monetary authorities cannot influence the real deficit net of interest payments, money supply becomes endogenous. At a certain level of the debt ratio, the public is no longer willing or able to absorb the additional government debt. In that case the monetary authorities will be forced to finance the deficit by money creation.

[2] For the optimal taxation hypothesis see e.g. Edward and Tabellini, (1991); Mankiw, (1987); Poterba and Rotemberg, (1990).

This paper aims to empirically investigate that whether governments have tried to maximise their seigniorage revenue in Turkey in the post-liberalisation period. The Turkish economy should make a good case due to its highly inflationary characteristics accompanied by large public deficits for more than two decades.

The conventional method to test the revenue maximisation hypothesis is to employ a Cagan (1956) model, which is generally based on a semi-logarithmic money demand function of inflation, and often also real income. In the paper a Cagan-type model is employed and the implications of the conventional approach in the presence of currency substitution are discussed.

The paper is organised as follows. Next section provides a brief background for the Turkish economy with a focus on the financial liberalisation and changes in the financing methods of the public sector deficits. Section 3 and 4 review theoretical issues and previous empirical work in the revenue maximisation literature. The methodology and empirical results are presented in Section 5. Finally Section 6 provides the conclusions.

2. PUBLIC DEFICITS AND INFLATION IN THE POST-LIBERALISATON PERIOD

Turkey was one of the countries that witnessed a severe debt crisis at the end of the 1970s. In January 1980, the launch of a comprehensive stabilisation and structural adjustment programme opened an important era for the Turkish economy. The programme, with its emphasis on ‘market-oriented’ and ‘outward-looking’ growth

strategy, also aimed at the liberalisation of the financial markets with a higher degree of integration with the world economy.[3]

Prior to the 1980s, the Turkish economy was characterised by the import substitution strategy and, consistent with this economic structure, by a financial system which was 'financially repressed' as termed by McKinnon (1973) and Shaw (1973) (see e.g. Akyuz (1989) for some of the features of the financial system prior to the 1980s). The restrictions on interest rates were removed as one of the first steps during the financial liberalisation process.[4] Foreign exchange regime was liberalised in 1984, and the convertibility of the Turkish lira was provided in 1989. Another important stage was the introduction of foreign exchange deposits within the domestic banking system, which allowed residents to use foreign currency in transactions, cash withdrawals and transfers abroad. With the attempts to liberalise capital movements, the economy encountered massive short-term capital inflows and those became the main source for public sector deficit financing especially during the 1990s.

The organisation of the Capital Markets Board in 1982, the establishment of Istanbul Stock Exchange in 1985 (then reorganisation in 1986), the introduction of an auction market for the government securities in 1985, and the beginning of central bank's open market operations in 1987 were some other significant stages, which had major implications for the fiscal and monetary policies.

[3] There is a literature on the financial liberalisation in Turkey. For a more detailed representation and for the aspects of the financial liberalisation process see e.g. Akyuz (1989), Akyuz and Kotte (1991), Ertugrul and Selcuk (2001), Onder (1998), Uygur (1993), Yeldan (1997), Yulek (1998).

It is argued that increasing public sector deficits was one of the triggering factors for financial liberalisation in Turkey. One of the main consequences of the liberalisation process occurred as the change in the pattern of deficit financing (see Figure 1). Public sector deficits have been increasingly financed through 'domestic' sources since the second half of the 1980s. Moreover, within the composition of domestic finance the share of the bond issuing has increased relative to the share of monetisation by direct advances from the central bank, especially after the introduction of the auction market for public sector debt instruments in 1985. In the early 1990 the central bank announced a new monetary programme based around a new concept of controlling the stock of its balance sheet. In order to restrain the growth of the monetary base, the central bank signed a protocol with the treasury to limit public sector borrowing requirements and monetisation of the fiscal deficits (Ertugrul and Selcuk, 2001;Yeldan, 1997).

< Figure 1 about here>

These changes in the pattern of deficit financing have had significant consequences. Increasing use of domestic borrowing instruments for deficit financing led to the dominance of the public sector in the financial markets. Although financial deepening increased according to some measures, this development benefited the public sector, not raised private investments as expected (Akyuz, 1989; Yeldan,

[4] However, deposit ceilings were reapplied and removed several times until October 1988 due to the instabilities in the system. Over this period the biggest disturbance was a financial crisis in 1982 (Akyuz, 1989).

1997).[5] Tax exemptions, stable and risk free net yields made government securities highly competitive against other financial instruments.[6]

Liberalisation of the exchange rate regime and allowing residents to hold foreign currency led to high currency substitution under high inflationary and unstable economic circumstances (see e.g. Akcay et al., 1997 and Selcuk 1994, 2001). Foreign currency holdings and foreign exchange deposits increased despite the difficulties to measure the extent of this substitution (see Figure 2 for the ratio of foreign exchange deposits/ M2Y).

< Figure 2 about here>

Major changes have taken part during the last two decades in the Turkish economy. On the other hand, the economy has remained one of the limited number of countries that experienced a high but relatively stable inflation rate accompanied by high deficits for a prolonged period without any hyperinflationary episodes (Metin, 1995; Ozatay, 1997) and large public deficits have often been regarded as the major cause of high inflation in many studies concerning inflation in Turkey (for a survey on the inflation in Turkey see e.g. Kibritcioglu, 2001).

[5] In financial liberalisation literature, financial deepening represent increased intermediation between savers and investors. It is argued that with financial liberalisation, financial funds become more available for investors, leading to increase in the economic growth. For the discussion on 'financial deepening' in the case of Turkey, see Akyuz (1989, 1992,1993), Akyuz and Kotte (1991), Uygur (1993).

[6] On the other hand, financial liberalisation became an important factor for increasing PSBR through higher borrowing costs. Despite the developments, financial markets were not deep enough to absorb the debt requirement of the government. Hence, increased government borrowing pushed interest rates up leading to a vicious circle through Ponzi financing (Akyuz, 1989; Yulek, 1998). Reliance on the short-term domestic debt to finance the deficits at high interest rates resulted in an interest payment explosion from the late 1980s whereas the primary balance gave surplus in many years during that period.

3. DEFICITS AND MONEY CREATION: SEIGNIORAGE AND INFLATION TAX

For a given deficit, there exist three essential ways to finance it. The budget identity shows the deficit finance in relation to the underlying expenditures and taxes of the government:

$$(Mh - Mh_{-1}) + (D_p^g - D_{p-1}^g) - E(B_c^* - B_{c-1}^*) = P(G + I^g - T) + iD_{-1}^g$$

where the right hand-side of the identity gives the primary deficit and interest payments and the left hand-side three financing methods: 1) an increase in high-powered money, $Mh - Mh_{-1}$; 2) an increase in the public's holdings of treasury bonds, $D_p^g - D_{p-1}^g$; or 3) a loss of foreign-exchange reserves at the central bank, $E(B_c^* - B_{c-1}^*)$. In other words, the government can 'print money', borrow, or run down its foreign reserves.

The ratio of the first term in the equation to the price level denotes (real) seigniorage (*SE*). In general terms, seigniorage is the revenue collected by the government as a result of its sovereign monetary monopoly and measured as the purchasing power of the money put into circulation in a given period: [7]

$$SE = \frac{(M - M_{-1})}{P} = \left[\frac{(M - M_{-1})}{M}\right]\left(\frac{M}{P}\right)$$

[7] There are theoretical and practical issues in the 'seigniorage' in the literature. In the studies various measures are used to present to the same phenomenon (for a summary see e.g. Honohan, 1996). Although there are various underlying theoretical assumptions that are mainly based on the quantity theory of money, those assumptions are not made explicit. For example, replacing M for M_h, $(M-M_{-1})$ for $(P-P_{-1})$ or vice versa, writing nominal money growth as the sum of real economic growth and

Although printing money is virtually without cost and the bills and coins can be exchanged for goods and services, there are two dimensions of this revenue creation process. In the quantity theory of money framework, government can raise revenue without any inflationary pressure by a parallel money growth to the rate of real growth (Friedman, 1971). Hence, an accompanying increase in the demand for real money balances provides government with some 'free' resources. However, an excessive monetary growth beyond this real growth rate leads to inflation reducing the purchasing power of the outstanding stock of real balances. This second phenomenon is referred as the inflation tax, emphasising this involuntary tax-like loss in the value of money holdings although governments issue new currency through a set of voluntary transactions.[8,9] The inflation tax (*IT*) can be measured as

$$IT = \left[\frac{(P - P_{-1})}{P}\right]\left(\frac{M}{P}\right)$$

The demand for real money balances takes a central place in the study of seigniorage. In the standard analysis the money demand is mainly a function of inflation, and also real income:

---

inflation, and so on, assume some kind of relationships between the variables, which need to be put clearly.

[8] Implicit taxation is a more general form of government revenue through the reduction of the value of government liabilities. Financial repression/liberalisation literature focuses on this kind of resources, see e.g. Brock, 1989; Chamley, 1991; Chamley and Honohan, 1990; Giovannini and de Melo, 1993, Repullo, 1991.

[9] In the literature those two terms are used interchangeably leading to confusion. Despite the mixed used of the terms, seigniorage and inflation tax need to be distinguished carefully. Only under certain conditions, in particular when households want to maintain a constant value of real money balances, the inflation tax and seigniorage are equal. Suppose that $M / P = M_{-1} / P_{-1}$. Since M_{-1} / M is then equal to P_{-1} / P, we can write $(M_{-1} - M) / M$ as $(P_{-1} - P) / P$. Thus, *SE* = *IT* when M/P does not change over time. As alternative terms, Fischer (1982) distinguishes between 'active' and 'passive' seigniorage. Seigniorage use is active in the high-inflation countries; it is passive in the rapidly growing countries. In the passive case, Fischer (1982) continues, seigniorage is obtained by

$$(M/P)^D = q(Y,p)$$

and hence, the growth rate of nominal money derived from the function above under equilibrium:

$$g_m = p + bg_y$$

where b is the elasticity of the money demand with respect to income and g_y is the growth rate of income.

Substituting the money growth rate above in the SE formula; [10]

$$SE = \frac{(M - M_{-1})}{P} = \left[\frac{(M - M_{-1})}{M}\right]\left(\frac{M}{P}\right)$$

$$SE = (p + bg_y)\left(\frac{M}{P}\right)$$

$$SE = p\left(\frac{M}{P}\right) + bg_y\left(\frac{M}{P}\right)$$

where the first term is referred as the inflation tax.[11] Despite the first impression, inflation rate is a contradictory variable in the process of revenue creation through money issuing. When the inflation rate is zero, $p\left(\frac{M}{P}\right)$ term equals to zero and

providing high-powered money to meet the rapidly growing demand without necessarily creating high inflation.

[10] An important issue is the distinction between continuous and discrete series. In order to use $(M_{-1} - M)/M$ as the nominal growth and $(P_{-1} - P)/P$ as the inflation, it should be assumed that M and P series are continuous.

[11] This is true in the case of continuous series. If the sequential values are not very close to each other, the cost of holding money is $\pi/(\pi+1)$ not π, and hence the first term in the above equation does not give the amount of inflation tax.

government can raise revenue by creating inflation. However, as inflation increases, the private sector's demand for real balances goes down due to the increasing cost of holding money. p and M/P move in the opposite directions. There is a critical level of inflation at which the government can 'maximise its seiniorage revenue' (Friedman, 1971; Bruno and Fischer, 1990).

In the literature, a Laffer curve is used to show how seigniorage revenue changes with the inflation rate with an analogy to the conventional tax revenues and tax rate. A given amount of seigniorage can be collected at either a low or a high level of inflation (Bruno and Fischer, 1990; Sargent and Wallace, 1987). If the observed inflation rate is less than the estimated seigniorage-maximising inflation, the economy is said to be on the 'correct side' of the curve; i.e. there is still opportunity for a higher seigniorage at higher inflation rates, and there is an implicit loss of seigniorage revenue if the economy moves to a lower level of inflation. However, this point might have serious implications if the current inflation is perceived to be less than the estimated critical level. Any attempt to raise seigniorage revenue higher than this critical level by printing money may put the economy in a higher inflationary path leading to hyperinflation.

In many studies money demand is also a positive function of the real income along with the inflation rate. The demand for real money balances can also be affected by the the existence of some other alternative domestic or foreign assets, which can create some opportunity cost of holding money. As the level of demand for real balances has a central role in the seigniorage revenue analysis, similarly, other factors which may have an impact on money demand need to be considered.

One of those factors is the currency substitution. In some circumstances, domestic residents may choose to substitute a foreign currency for the domestic currency when they expect some increase in the cost of holding domestic balances. Currency substitution is a very common phenomenon in the developing countries which experience significant macroeconomic instability, especially high inflation although it can be also observed in the developed world (Agenor and Khan, 1994).[12] Increasing elasticity of substitution between money and those alternative assets, hence, reduces the ability for raising revenue for governments through money creation. One possible result is to use monetary resources more to finance a given deficit leading to a higher inflation rate, which is very likely to create a vicious circle by increasing currency substitution in turn. Additionally, as Selcuk (2001) suggests, if domestic residents are very quick in adjusting real balances, the economy may find itself on a hyperinflationary path.

4. REVENUE MAXIMISATION HYPOTHESIS AND THE CAGAN MODEL

As mentioned earlier, conventional studies employ a Cagan-type (1956) model to estimate the seigniorage-maximising level of inflation. Despite the existence of different functional forms, the most common money demand presentation is a semi-

[12] However, the concept of 'currency substitution' does not have a clear definition in the literature. Giovannini and Turtelboom (1994) provide a comprehensive survey of the approaches and point out the vagueness of the concept in the literature. The definition varies with the specific emphasis on the role of money, from very narrow to broad money characteristics. Therefore, currency substitution may be represented from holding foreign currency in cash to various foreign currency denominated assets held domestically or abroad. Another concept which is very often used in the literature is 'dollarisation'.

logarithmic money demand function with the inflation rate.[13] Many other studies also include the real income as another explanatory variable while there are a limited number of studies using other variables representing the opportunity cost of holding money, such as interest rate. In the standard seigniorage maximisation literature currency substitution effect is not dealt with to a great extent (some examples Phylaktis and Taylor, 1993; Adam et al. 1996).

In the basic Cagan-type model, money demand is a function of inflation:

$$(M/P)^d = ae^{-ap}$$

or taking the natural logarithm;

$$\ln M - \ln P = c - ap + e$$

In his original work, although Cagan (1956) mentions other factors which can affect the money demand, under hyperinflationary circumstances he focuses on the inflation rate as the main determinant of the demand for real money holding. Hence, in the equations above α represents the opportunity cost of holding money due to inflation.[14] α is the semi-elasticity of money demand with respect to inflation. Therefore, the seigniorage maximising inflation rate is[15]

$$p^* = 1/a$$

[13] Some authors who use different money demand function of inflation (linear or non-linear) see e.g. Easterly et al (1992, 1995), Selcuk (2001). For the discussion of different functional forms of money demand see Ashworth and Evans, 1998.

[14] As mentioned before a better representation of the opportunity cost of holding money in relation with inflation could be $\pi/(\pi+1)$ not π in the discrete series (Calvo and Leiderman, 1992; Easterly et al, 1995)

In the money demand function with the real income and inflation rate:

$$(M/P)^d = ae^{-ap}Y^b$$

taking the natural logarithm of this;

$$\ln M_t - \ln P_t = c - ap_t + b \ln Y_t + e_t$$

where Y is the real income, β is the elasticity of the money demand with respect to real income. Under this formulation of real money demand the seigniorage maximising inflation rate is now:

$$p^* = 1/a - bg_y$$

This change in the calculation of seigniorage maximising inflation rate may some significant implications for policy makers. When another significant variable is added to the function, estimated elasticity changes resulting in a lower critical level of inflation rate. Therefore, being on the correct side of the Laffer curve may have a different meaning now. An attempt to increase revenue through inflation can lead to a higher inflationary path.

In addition to the different functional forms with different variables, the definition of 'money' variable varies across the studies. In order to examine how government can

[15] SE= g_m.M/P and in the equilibrium $(M/P)^d$=(M/P). The seigniorage maximising inflation rate is found by substituting g_m and M/P in the SE equation and taking the derivative according to the inflation rate.

use seigniorage revenue opportunity, monetary base, currency in circulation or narrow money are used.[16]

Currency substitution can be a significant factor in determining seigniorage revenue and therefore, a variable to measure this effect should be included in the analysis. This is not an easy task, as the measurement of the currency substitution is not straightforward as mentioned before. However, an exchange rate variable can be used as a proxy in the money demand function, hence, in the seigniorage revenue maximisation analysis.

5. DATA AND MODEL SPECIFICATION

Data

The data used in the empirical work consist of seasonally unadjusted observations of narrow money (*m)*, consumer price index (*p)*, inflation (*p),* real GDP (*y)*, exchange rate (*exch)* defined as Turkish liras to the US dollar; the estimation period is 1987q1-2000q4. All series are in natural logs and seasonally unadjusted. *(m-p)* represents real M1, and the first difference of the price level (in log) is used as a proxy for inflation rate. Seasonal dummies and D94 dummy for the 1994 crisis are included in the estimations.[17]

[16] If the source of seigniorage revenue is the base money creation, monetary base needs to be used in the analysis. On the other hand, holding demand deposits encounters a loss in the purchasing power, therefore is subject to inflation tax. In the empirical studies, M1 is used in order to consider the 'money creation' ability of the government with the underlying implicit assumption of the direct relationship between M1 and monetary base, which is based on the constant money multiplier.
[17] Data are provided from the Central Bank of the Republic of Turkey and IFS web-sites. For the empirical analysis Microfit 4.0 (Pesaran and Pasaran, 1997) econometric software is used.

Model

The hypothesis examined in the paper is whether the Turkish government tried to maximise its revenue from money creation. To this end Cagan's (1956) model of hyperinflation is utilised with a semi-logarithmic money demand function with the inflation rate and including some other relevant variables, i.e. real income and exchange rate variables.

$$\textit{Model 1:} \qquad (m-p)_t = d_t + ap_t + by_t + e_t$$

$$\textit{Model 2:} \qquad (m-p)_t = d_t + ap_t + by_t + gexch_t + e_t$$

In the seigniorage analysis the underlying assumption is that there exists an equilibrium relationship between the real money demand and a set of variables that explain it. In order to see whether there is a long-run relationship between the variables this study employs cointegration analysis by using the Johansen maximum likelihood technique (Johansen, 1988, 1989; Johansen and Juselius, 1992).[18]

Cointegration Analysis and Empirical Results

Prior to the cointegration tests we should verify the order of integration of the variables. [19] In order to be cointegrated, as a first condition variables should be integrated of order of one, I(1) (Engle and Granger, 1987). The hypotheses that the

---

[18] This approach is regarded to be the most reliable current technique in the cointegration analysis. See e.g. Gonzalo (1994), Kremers et al. (1992).

[19] If two (or more) series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may be non-stationary, they will nevertheless move closely together over time and difference between them will be stationary. This, the concept of cointegration mimics the existence of a long-run equilibrium to which an economic system converges over time. The absence of cointegration leads back to the problem of spurious regression [Harris, 1995]

variables are integrated of order of one, are tested using the augmented Dickey-Fuller (ADF) procedure. There are two forms of ADF tests, one with an intercept and no trend, and another with an intercept and a trend:

$$\Delta x_t = m_0 + g_0 x_{t-1} + \sum_{i=1}^{k} g_i \Delta x_{t-i} + h_t$$

and

$$\Delta x_t = m_0 + m_1 t + g_0 x_{t-1} + \sum_{i=1}^{k} g_i \Delta x_{t-i} + h_t$$

The null hypothesis for the unit root is H_0: $\gamma_0 = 0$ for both autoregressions, but with different critical values. For being integrated of order of one, the null hypothesis of 'unit root' must not be rejected for the level of the variables, and must be rejected for the first differences. According to the unit root tests results reported in Table 1, all variables used in the paper seem to be I(1) with a trend at 5% significance level.

<Table 1 is about here>

The following stage in the analysis is the determination of order of the VAR. To this end unrestricted VAR estimations are undertaken with the dummy variables (see Table 2). Akaike Information Criterion (AIC) generally suggests a higher order than Schwarz-Bayesian Criterion (SBC) does. According to test results, VAR of order 2 is chosen for each model, considering the number of variables and length of observation period.

<Table 2 is about here>

To choose the cointegrating VAR option which specifies the trend and intercept components, the Pantula principle is used (see Harris, 1995). For the models, 'restricted intercepts and no trends' option (option 2) is chosen. The cointegration test results for the first model suggest one cointegrating, i.e. the null hypothesis of 'no cointegration' is rejected by both the maximal eigenvalue and trace statistics, while the null of r ≤1 against the alternative of r =2 cannot be rejected. For the second model, the number of cointegrating vectors is two according to the test results. Cointegration test results for both models are given in Table 3.

<Table 3 is about here>

Table 4 presents the just-identifying cointegration vectors for the models.

<Table 4 is about here>

After imposing exactly-identifying restrictions and testing for some over-identifying restrictions on the cointegrating vectors the following long-term equations are provided (se's in brackets):

Model 1:

$$(m\text{-}p)_t = 6.36 - 19.99p_t + 0.44\, y_t + e_t$$

(8.18) (18.44) (1.02)

Model 2:

$$(m\text{-}p)_t = -7.76p_t + y_t - 0.10exch_t + e_t$$

(1.51) (none) (0.013)

In the long-term equations above α's –19.99 and –7.76, and β's are 0.44 and 1 (over-identifying restriction is not rejected) respectively. None of the variables is significant in the long-run relationship for the first model. However, when exchange rate variable is included to the estimation procedure, all variables in the equation become very significant and have the correct signs.

For the analysis period quarterly average rate of inflation is 13% and of growth rate is 1.21%. Hence, the seigniorage maximising rate of inflation for Model 2 is 11.8%, which is under the actual quarterly rate of inflation (the value for the same rate in Model 2 is equal to 12.88% when the semi-elasticity is used in the calculations only).

In the previous work on Turkey the hypothesis is tested by using a semi-logarithmic money demand function with inflation and real income variables (Akcay, 1995; Ozmen, 1998; Selcuk, 2001).[20] Akcay (1995) finds the revenue maximising inflation rate as approximately 9.7% per month, which is above the actual inflation rate. Similarly, Ozmen (1998) suggests that the actual rate of quarterly inflation (12%) is well below the seigniorage maximising rate, which is 34%, while Selcuk (2001) estimates an approximately 60% quarterly seigniorage maximising inflation rate whereas actual rate is around 25%. Akcay (1995) and Selcuk (2001) use the income elasticity and average growth rate along with α in their calculations. Ozmen (1998) takes the inverse of semi-elasticity to find seigniorage maximising inflation tax rate.

[20] Selcuk (2001) employs a money-in-the-utility-function model to examine the implications of currency substitution.

7. CONCLUSION

This paper employs a Cagan-type money demand function with an exchange rate variable in order to examine the implications of currency substitution on the revenue maximisation in the Turkish case. To this end cointegration analysis is used and results are compared with the previous work.

In comparison with the previous revenue maximisation literature on Turkey, the seigniorage maximising inflation rate in the paper appears to be much lower than the rates in the previous studies and also the actual inflation rate is slightly above this optimum level. These findings suggest that currency substitution limits the potential to raise revenue through money creation as proposed in the theory. Therefore, correct side of the Laffer curve seems to be shorter in the existence of currency substitution and attempts to increase seigniorage revenue may push the economy in a hyperinflationary path.

ACKNOWLEDGEMENTS

The author would like to thank Philip Arestis for his helpful comments on an earlier version of the paper. The usual disclaimer applies.

References:

Adam, C., Ndulu, B. and Sowa, N.K. (1996) "Liberalisation and Seigniorage Revenue in Kenya, Ghana and Tanzania", *Journal of Development Studies*, vol. 32, no. 4, April, pp. 531-53.

Agenor, P-R. and Khan, M.S. (1994) "Foreign Currency Deposits and the Demand for Money in Developing Countries", *Journal of Development Economics*, 50, pp.101-118

Akcay, C. (1995) “Inflation Tax in a Post-Liberalisation Environment: Evidence from Turkey, 1980-1990”, in Balim, C. *et al*. (eds) *Turkey: Politicak, Social and Economic Challenges in the 1990s.* Leiden, New York, Koln: Brill. pp.210-229.

Akcay, O.C., Alper, C.E. and Karasulu, M. (1997) “Currency substitution and exchange rate instability: The Turkish case”, *European Economic Review*, 41, pp.827-835.

Akyuz, Y. (1989) “Financial System and Policies in Turkey in the 1980s”, *UNCTAD Working Paper*, No.25. Geneva: UNCTAD.

Akyuz, Y. (1992) “On Financial Deepening and Efficiency”, *UNCTAD Working Paper*, No.43. Geneva: UNCTAD.

Akyuz, Y. and Kotte, D.J. (1991) “Financial Policies in Developing Countries: Issues and Experience”, *UNCTAD Paper*, No.40. Geneva: UNCTAD.

Brock, P. (1989). “Reserve Requirements and the Inflation Tax”, *Journal of Money, Credit and Banking*, 21, pp. 106-21.

Cagan, P. (1956) “The Monetary Dynamics of Hyperinflation”, in M. Friedman (ed.), *Studies in the Quantity Theory of Money*. Chicago: University of Chicago Press, pp.25-117.

Calvo, G. and Leiderman, L (1992) “Optimal Inflation Tax under Precommitment: Theory and Evidence”, *American Economic Review*, 82, pp.179-195.

Chamley, C. (1991) “Taxation of Financial Assets in Developing Countries”, *The World Bank Economic Review*, vol. 5, no. 3, pp. 513-33.

Chamley, C. and Honohan, P. (1990) “Taxation of Financial Intermediation: Measurement Principles and Application to Five African Countries”, *PRE Working Paper*, 421, Washington D.C.: World Bank.

de Haan, J., Zelhorst, D. and Roukens, O. (1993) “Seigniorage in Developing Economies”, *Applied Financial Economics*, 3, pp. 307-14.

Dickey, D. and Fuller, W. (1981) “Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root”, *Econometrica*, 49, pp.1057-72.

Easterly, W.R; Mauro, P. and Schmidt-Hebbel, K. (1995) “Money Demand and Seigniorage-Maximising Inflation”, *Journal of Money, Credit, and Banking*, 27(2), May, 583-603.

Engle, R.F. and Granger, C.W.J. (1987). “Co-Integration and Error Correction: Representation, Estimation and Testing”, *Econometrica*, 55, pp.987-1007.

Ertugrul, A. and Selcuk, F. (2001) “A Brief Account of the Turkish Economy: 1980-2000”, *Russian and East European Finance and Trade*, Vol.37, No.6.

Fischer, S. (1982) “Seigniorage and the Case for a National Money”, *Journal of Political Economy*, vol. 90, no. 21, pp. 295-311.

Friedman, M. (1971) “Government Revenue from Inflation”, *Journal of Political Economy*, August, pp. 846-56.

Giovannini, A. and de Melo, M. (1993) “Government Revenue from Financial Repression”, *The American Economic Review*, vol.83, no.4, pp.953-963.

Giovannini, A. and Turtelboom, B. (1994)

Gonzalo, S. (1994) “Five Alternative Methods of Estimating Long-Run relationship”, *Journal of Econometrics*, 60, pp.203-233.

Granger, C.W.J. (1988) “ Some Recent Developments in a Concept of Causality ”, *Journal of Econometrics*, 39, pp.199-211.

Harris, R.I.D. (1995). *Using Cointegration Analysis in Econometric Modelling*. London: Prentice Hall-Harvester Wheatsheaf.

Honohan, P. (1996) “Does it Matter how Seigniorage is Measured?”, *Applied Financial Economics*, 6, pp. 293-300.

Johansen, S. (1988) “Statistical Analysis of Cointegration Vectors”, *Journal of Economic Dynamics and Control*, 12, pp. 231-54.

Johansen, S. (1991). “Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models”, *Econometrics*, 59, pp.1551-80.

Johansen, S. and Juselius, K. (1990) Maximum Likelihood estimation and inference on cointegration - with applications to the demand for money, *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Kibritcioglu, A. (2001) “Causes of Inflation in Turkey: A Litereature Survey with Reference to Theories of Inflation”, *Office of Research WP*, No: 01-115, University of Illinois at Urbane-Champaign.

Kiguel, M.A. and Neumeyer, P.A. (1989). “Inflation and Seigniorage in Argentina”, *PRE Working Paper*, No.289. Washington D.C.: The World Bank.

Kiguel, M.A. and Neumeyer, P.A. (1995).”Seigniorage and Inflation: The Case of Argentina”, *Journal of Money, Credit, and Banking*, Vol.27, No.3, pp.673-82.

Kremers, J.M; Erisccos, N.R and Dolado, J.J. (1992) of Cointegration Tests”, Oxford Bulletin of Economics ad Statistics, 54, pp325-346.

Loviscek, A.L. (1996) “Seigniorage and the Mexican Financial Crisis”, *The Quarterly Review of Economics and Finance*, vol. 36, no. 1, Spring, pp. 55-64.

Mankiw, N.G. (1987). “The optimal Collection of Seigniorage: Theory and Evidence”, *Journal of Monetary Economics*, 20, pp.327-341.

McKinnon, J.G. (1991) “Critical Values for Cointegration Tests”, in Engle, R.F. and Granger, C.W.J. (eds.), *Long-Run Economic Relationships: Readings in Cointegration*, Oxford, Oxford University Press.

Metin, K. (1995). “ An Integrated Analysis of Turkish Inflation”, *Oxford Bulletin of Economics and Statistics*, 57 (4), pp.513-531.

Onder, I. (1998) “Financial Liberalisation in Turkey”, *Seijo University Economics Papers*, No.136.

Ozatay, F. (1997). “Sustainability of Fiscal Deficits, Monetary Policy, and Inflation Stabilization: The Case of Turkey”, *Journal of Policy Modeling*, 19(6), pp.661-681.

Ozmen, E. (1998) “Is Currency Seigniorage Exogenous for Inflation Tax in Turkey?”, *Applied Economics*, 30, pp. 545-52.

Pesaran, M.H. and Pesaran, B. (1997). *Microfit 4.0.* Oxford : Oxford University Press.

Phylaktis, K. and Taylor, M.P. (1993) “Money Demand, the Cagan Model and the Inflation Tax: Some Latin American Evidence”, *The Review of Economics and Statistics*, 75, pp. 32-7.

Poterba J.M. and Rotemberg, J.J. (1990). “Inflation and Taxation with Optimizing Governments”, *Journal of Money, Credit, and Banking*, Vol.22, No.1, February, pp.1-18.

Repullo, R. (1991). “Financial Budget Deficits by Seigniorage and Implicit Taxation: The Cases of Spain and Portugal”, *CEPR Discussion Paper,* No.583, October. London: Center for Economic Policy Research.

Sargent, T.J. and Wallace, N. (1981) “Some Unpleasant Monetarist Arithmetic”, *Federal Reserve Bank of Minneapolis Quarterly Review*, Fall, pp.1-17.

Selcuk, F. (1994) “Currency Substitution in Turkey”, *Applied Economics*, 26, pp.509-518.

Selcuk, F. (2001) “Seigniorage, Currency Substitution and Inflation in Turkey”, *Russian and East European Finance and Trade*.

Shaw, E.S. (1973). *Financial Deepening in Economic Development*. London: Oxford University Press.

Uygur, E. (1993). “Liberalisation and Economic Performance in Turkey”, *UNCTAD Paper*, No.65. Geneva: UNCTAD.

Yeldan, E. (1997) “Financial Liberalization and Fiscal Repression in Turkey: Policy Analysis in a CGE Model With Financial Markets”, *Journal of Policy Modeling*, 19(1), pp.79-117.

Yulek, M.A. (1998) *Financial Liberalization and the Real Economy: The Turkish Experience*. Ankara: Capital Markets Board of Turkey.

Table 1. Unit Root Tests

Tests include intercept but no trend

Variable	Levels	First differences
$(m\text{-}p)_t$	-2.5435 [4]	-4.3460*[4]
p_t	-2.5994[3]	-8.8118*[2]
$_{yt}$	-0.6587[4]	-3.5414*[3]
$exch_t$	-0.2154[1]	-5.6511*[0]

Tests include intercept but no trend

Variable	Levels	First differences
$(m\text{-}p)_t$	-2.6737[4]	-4.3871*[4]
p_t	-2.4258[3]	-8.9694*[2]
$_{yt}$	-3.1002[4]	-3.4938*[3]
$exch_t$	-2.3443[1]	-5.8595*[0]

Test statistics based on McKinnon (1991).
* denotes significance at 5% level. Lags in ADF are given in the brackets.

Table 2. Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Model 1

Order	LL	AIC	SBC	LR test	Adjusted LR test
6	303.6715	237.6715	174.5747	------	------
5	291.5070	234.5070	180.0143	CHSQ(9)= 24.3291[.004]	13.6243[.136]
4	285.3766	237.3766	191.4880	CHSQ(18)= 36.5898[.006]	20.4903[.306]
3	275.5710	236.5710	199.2866	CHSQ(27)= 56.2009[.001]	31.4725[.252]
2	268.9541	238.9541	210.2738	CHSQ(36)= 69.4347[.001]	38.8834[.341]
1	236.0421	215.0421	194.9658	CHSQ(45)= 135.2588[.000]	75.7449[.003]
0	169.4466	157.4466	145.9745	CHSQ(54)= 268.4497[.000]	150.3318[.000]

Model 2

Order	LL	AIC	SBC	LR test	Adjusted LR test
6	429.6422	321.6422	218.3930	------	------
5	405.9452	313.9452	225.9921	CHSQ(16)= 47.3941[.000]	21.8013[.150]
4	391.6571	315.6571	243.0002	CHSQ(32)= 75.9702[.000]	34.9463[.330]
3	367.6498	307.6498	250.2891	CHSQ(48)= 123.9849[.000]	57.0330[.174]
2	355.4014	311.4014	269.3369	CHSQ(64)= 148.4816[.000]	68.3015[.333]
1	309.3380	281.3380	254.5696	CHSQ(80)= 240.6085[.000]	110.6799[.013]
0	-135.8410	-147.8410	-159.3131	CHSQ(96)= 1131.0[.000]	520.2445[.000]

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

Table 3. Cointegration Tests with restricted intercepts and no trends

Model 1

54 observations from 1987Q3 to 2000Q4. Order of VAR = 2.

List of variables included in the cointegrating vector:
LRM1 DLCPI LRGDP Intercept
List of I(0) variables included in the VAR:
SR1 SR3 D94
List of eigenvalues in descending order:
.52573 .25078 .21498 0.00

Cointegration LR Test Based on Maximal Eigenvalue and Trace of the Stochastic Matrix

		Maximal Eigenvalue		Trace	
Null	Alternative	Statistic	95% Critical Value	Statistic	95% Critical Value
r = 0	r = 1	40.2828	22.0400	68.9443	34.8700
r<= 1	r = 2	15.5907	15.8700	28.6615	20.1800
r<= 2	r = 3	13.0708	9.1600	13.0708	9.1600

Model 2

54 observations from 1987Q3 to 2000Q4. Order of VAR = 2.

List of variables included in the cointegrating vector:
LRM1 DLCPI LRGDP LEXCH Intercept
List of I(0) variables included in the VAR:
D94
List of eigenvalues in descending order:
.91868 .50657 .22477 .093210 0.00

Cointegration LR Test Based on Maximal Eigenvalue and Trace of the Stochastic Matrix

		Maximal Eigenvalue		Trace	
Null	Alternative	Statistic	95% Critical Value	Statistic	95% Critical Value
r = 0	r = 1	135.5057	28.2700	192.6823	53.4800
r<= 1	r = 2	38.1446	22.0400	57.1766	34.8700
r<= 2	r = 3	13.7484	15.8700	19.0320	20.1800
r<= 3	r = 4	5.2836	9.1600	5.2836	9.1600

Table 4. **Cointegration Vectors in Johansen Estimation with just identifying restrictions**

variables	Model 1a	Model 2a	Model 2b
m-p	.286	-.51	-.11
	(-1.00)	(-1.00)	(-1.00)
π	5.72	-4.97	-2.68
	(-19.99)	(-9.69)	(24.97)
y	-.13	2.02	-2.74
	(.44)	(3.95)	(25.58)
exch		-.16	-.20
		(-.31)	(-1.86)
intercept	-1.82	-13.90	24.78
	(6.36)	(-27.08)	(-231.16)

(Normalized in Brackets)
Cointegration with restricted intercepts and no trends in the VAR