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Dollarization and Its Long-run Determinants in Turkey

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Abstract
Turkish economy has experienced periods of macroeconomic instability and several stabilization efforts have failed due to the structural weaknesses of the economy. Chronic high fiscal deficit and inflation remained in place for a prolonged period and the credibility of Turkish lira diminished significantly. Under these circumstances private economic agents responded by increasing their holding of foreign currency deposits in the domestic banking system and demanded high real interest rates on domestic currency denominated assets. This paper explains dollarization process in Turkey by an extended portfolio model where dollarization is determined by the relative rates of return of domestic and foreign currency denominated assets, expected change in the exchange rate, exchange rate risk and credibility of current economic policies. The econometrics results are in line with the intuitive predictions of the model. We have found that interest rate differential and the expected exchange rates are the dominant variables in determining dollarization. Paper also provides evidences of inertia in the process of dollarization in Turkey.

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I. Introduction

During last two decades Turkish economy experienced periods of high economic growth as well as severe economic crises. One remarkable characteristic of the Turkish economy has been high and persistent inflation. Starting from 1980 the economy embarked upon several economic reforms and financial liberalisation. With the aim of integrating domestic financial markets with the rest of the world capital account restrictions were eliminated and domestic financial transactions were allowed to be conducted in both domestic and foreign currencies. After this arrangement share of foreign currency denominated assets and liabilities in the banking system increased very rapidly some times followed by partial reversals.

The currency substitution literature has tried to explain why some economies use a foreign currency instead of the domestic currency in their everyday transactions and bank deposits[1]. Basic analytical framework has been the consumer's portfolio selection model where dollarization is determined by the relative rates of returns of domestic currency and foreign currency denominated assets. In some cases the rates of return differentials help to explain dollarization trends (see Balino et.al. 1999). However, in other cases the same model is proved to be less successful in explaining swings in dollarization ratios. In Turkey real rates of return on domestic currency assets have increased significantly relative to foreign currency assets, but dollarization ratio remained persistently high. This suggests that other variables should be incorporated into these models.

Earlier works on the currency substitution has started in the late 1970s as an alternative explanation for the excessive variability experienced by the floating exchange rates of the major currencies after the abandonment of the Bretton Woods system. Another branch of literature developed by Ortiz (1983), Canto (1985), Ramirez-Rojas (1985), Fasano-Filho (1987), Marquez (1987) Canto and Nicklesburg (1987), El-Erian (1988) and Melvin (1988), Calvo and Vegh (1992) and Salvastone (1996) has focused on the determinants and characteristics of the currency substitution in developing countries. The nature of the currency substitution in these countries is different from the one analysed by the literature on developed nations. In particular, in the LDCs

[1] The terms currency substitution and dollarization have been used to depict the same phenomenon. However, the term "dollarization" indicates that a foreign currency serves as a unit of account or as a store of value, and not necessarily as a medium of exchange. In high inflation countries, foreign currency is first used as a store of value or unit of account and only at the later used as a medium of exchange. That is, currency substitution is normally the last stage of the dollarization process. More importantly, in practice, data on foreign currency circulating in the economy usually does not exist, dollarization ratios are used as an indicator of currency substitution (see Calvo and Vegh 1992).

process tends to be asymmetrical because domestic residents usually hold foreign money in their portfolios but there is no foreign demand for domestic currencies.

Currency substitution in developing countries is usually one of the ultimate consequences of high and variable inflation. High inflation, in turn, is the result of the fiscal imbalances, leads to dollarization and eventually to currency substitution. Institutional factors play a crucial role in the process of currency substitution. When restriction on holding of foreign currency removed the dollarization process usually begins with the foreign money substituting domestic money as a store of value. As high inflation continues, some prices -particularly of real estates, cars and other "big ticket" items – start to be quoted in foreign currency. After this some transactions begin to be performed in foreign currency especially those involving large transfer of funds. However, domestic money seems to retain its functions as a unit of account and medium of exchange in almost all non-durable goods (see Calvo and Vegh 1992).

The literature on currency substitution developed in many directions; one of which is the hysteresis literature. Works by Dornbush and Reynoso (1989), Guidotti and Rodriguez (1992), Kamin and Ericsson (1993), Clements and Schwartz (1993) shows that several Latin American countries have hysteresis in the dollarization ratios. Hysteresis refers to the fact that dollarization phenomenon have stayed high in the face of declining inflation rates and increased real rates of returns on domestic assets[2]. This phenomenon can not be explained by the traditional currency substitution models which, following Calvo and Rodriguez (1977), assume that foreign assets (non interest bearing) compete with domestic money in providing liquidity services. In these models, ratio of foreign to domestic currency denominated assets depends positively on the nominal interest rates (when the domestic interest rates increase liquidity provided by domestic money decreases and liquidity provided by foreign money increases (see Sahay and Vegh 1996). Therefore, a fall in inflation (i.e. a fall in domestic interest rates) should lower the demand for foreign currency relative to domestic currency.

To explain hysteresis in these models, it is necessary to assume that there are some costs associated with the process of currency substitution which make it irreversible. Dornbusch and Reynoso (1989) and Dornbusch, Sturzenegger and Wolf (1990) argue that process of financial adaptation is costly (due to sunk cost and learning by doing), which makes them irreversible. In a related explanation Guidotti and Rodriguez (1992) assume that it is costly to switch between

[2] Hysteresis is also called ratchet effect which is used in the money demand literature.

currencies and show that there is a ‘band’ for the inflation differential above which dollarization continues to occur even if inflation falls. A similar result is derived by Sturzenegger (1997), who emphasises the public good aspect of currency substitution by assuming it is costly to transact in foreign currency but only to the extent that others have not yet begun to use it. Uribe (1997) also emphasises the relation between private cost of transaction and the aggregate degree of dollarization.

The literature cited above considers currency substitution but not dollarization which is the observable measure of currency substitution. With this observed data dollarization ratio should respond only to differences in real rates of returns between domestic and foreign currency denominated assets (see Sahay and Vegh, 1996). A fall in domestic rate of inflation rate should not affect dollarization ratio unless it affects real rates of returns. Hence, de-dollarization would only result only from the higher real return on domestic currency denominated assets. Conversely, dollarization would be the consequence of very low real rates of return on domestic currency denominated assets together with the institutional freedom to invest in foreign currency denominated assets at home. In several developing countries, dollarization associated with low real rates of return on domestic currency denominated assets (see Dornbusch and Reynoso (1989) and Salvastone (1996)).

In some countries like Turkey, while real rates of return on the domestic currency denominated financial assets were substantially higher than that of foreign currency assets, the dollarization stayed high. In such cases, real rates of return criterion do not seem to explain the behaviour of the households in the dollarized country. There must be other factors that affect the decision making process by the public. There is an asymmetric substitution process between domestic and foreign currencies, that is, in a dollarized economy the demand for foreign currency rises when the local currency depreciates, but falls by a lesser extent when the local currency appreciates.

Yotopoulos (1997) explains the currency substitution as an asymmetric reputation between hard and soft currencies. Hard currencies have a good reputation of stability, but soft currencies, in contrast, is expected to depreciate in a free currency market since it lacks the reputation of safe haven. Under these circumstances and also when the international financial transactions are present, there is asymmetric demand for domestic residents to hold dollar as a store of value – a demand not offset by Americans' holding of domestic currency as an asset. This asymmetry tends to increase the

price of dollar in home country. This encourages dollarization with domestic resident fleeing from domestic currency in exchange for dollar, which causes further deprecations. Expectation of depreciation feed themselves to become self-fulfilling prophecies, in fixed, floating or pegged exchange rate systems.

With the asymmetric reputation still operating, fixed exchange rate had to fend with the tide of domestic currency denominated asset holders in the country who want to hedge their wealth against depreciation of currency by buying dollars. This was done by offsetting this precautionary demand through increasing the supply of speculative short term capital that the banking system borrowed in the international market. There is a causal relationship between dollarization and inflow of hot money in which the latter is lured by high interest rates in an attempt to thwart the former.

Asymmetric substitution behaviour of the households can be attributed to cost considerations, once the fixed cost of an investment in new money management techniques are born, the new product or strategy remains in place and is not discarded even though interest rates, inflation or depreciation rates decline.

In a high chronicle inflation countries the asymmetric behaviour of the individuals to change (ratchet effect) can be attributed to a costly process of developing, learning, and applying new strategies to beat inflation or get the highest return on their investment. Such strategies are commonly called financial innovations; inter-alia, rapid switching between demand deposits and saving deposits in domestic currency, the evolution of high yielding or indexed money substitutes, the efficient use of overdrafts, the application of portfolio optimisation methods, and most notably, the flight into foreign currency assets. Over time, an increasing proportion of public resorts to these forms of financial innovations. There are a few incentives for households and enterprises to switch back to domestic currency after the end of instability or when a higher rate of return on the domestic currency is offered. Thus causing a more prolonged -ratchet effect- on the relative demand for foreign and domestic currency. The credibility of the authorities' stabilization effort may shorten or extend the duration of the ratchet effect as well as influence its strength.

Only an expectation of significant decline in inflation or a considerable appreciation of currency or substantial increase in the real rates of return on domestic currency denominated assets can overcome the sunk cost in inflation beating strategies and provide enough incentives for households to eventually revert to traditional domestic money balances.

In this paper, we present a model in which an individual demands monetary assets denominated in both currencies taking into account the return that they offer and the risk associated with them. In particular, we include the exchange rate risk associated with the foreign currency deposits. For the case of Turkey (1986-1999) we found significant evidence that the dollarization ratio has a cointegrated relationship with the interest rate differential, changes in the exchange rate, a measure of the exchange rate risk and credibility.

The paper is organised as follows: in Section II we present the macro economic developments and a brief description of the dollarization in Turkey. In Section III we present the model and the data. In Section IV we present the results of cointegration tests for the dollarization ratios for the Turkish case. Conclusions and final thoughts appear in the final section.

II. Historical Perspective

During the last three decades the Turkish economy has experienced periods of high economic growth as well as severe economic crises. During these fluctuations, both internal economic conditions and external economic events played an important role.

The government, which came to power in the early 1980, prepared a plan for a fundamental reorientation of Turkey's economic policy with a medium-term adjustment program. The stabilization and adjustment program aimed not only at stabilising the economy, reducing government budget deficit, inflation and current account deficit, but also at changing the development strategy that Turkey had followed for decades. This new strategy involved moving towards outward orientation and giving an increasing role to market forces.

In the 1980s several reforms have been carried out including, financial sector reforms and liberalisation of capital account. Major aim of financial reforms was to integrate the domestic financial system with the international markets. Over the course of 1980s and again in the 1990s the range of alternative domestic assets was enlarged as new financial instruments emerged (mutual fund shares, corporate finance bills, Treasury bills and bonds of various maturities, asset-backed securities), and new financial markets were developed. Also, deposit interest rates were liberalised. Emergence of new domestic financial instruments and markets may have controlled the process of dollarization to the extent that these new domestic assets could compete with foreign assets in ensuring the liquidity and maintaining the value of financial wealth.

In the 1980-1983 period, the reforms aimed at eliminating multiple exchange rate practices, providing the commercial banks with more inclination in managing their foreign exchange positions,

and allowing the exporters to hold a portion of their earnings in the form of foreign exchange deposits with commercial banks.

A major step towards liberalising the foreign exchange regime was taken in December 1983. Commercial banks were allowed to engage in foreign exchange operations and transactions in proportion to their foreign exchange liabilities. Finally, banks were allowed to open foreign currency deposit (FCD) accounts to residents, and restrictions on foreign travel and investment from abroad were greatly loosened and simplified.

The liberalisation of the capital account in August 1989 lowered the transaction costs associated with acquiring foreign balances, thereby enabling portfolio changes to be more responsive to the changes in relative returns on assets. Indeed, the package introduced in August 1989 (and amended in 1990) included substantial liberalisation of regulations regulating transactions in securities, permission of residents to purchase foreign exchange from banks or other authorised agencies, and liberalisation of the rules regarding repatriation of cash proceeds from non-residents sales of property. Foreign residents were allowed to purchase or sale any type of Turkish securities- registered on stock exchange, issued upon the permission of the Capital Market Board or issued by public institutions- through intermediary institutions (including banks) and to transfer the gains from sales of these securities abroad through banks and authorised financial institutions. Moreover, residents were allowed to invest abroad in cash up to US$5 million, or its equivalent in other currencies, through banks and special financial institutions (the export of capital exceeding US$5 million limit was subject to approval). Residents in Turkey were allowed to secure foreign credits abroad in cash or in kind, provided that they used banks or special financial institutions as intermediaries. The widening of the possibilities of obtaining foreign balances may have increased the potential for currency substitution (OECD, 1994).

Dollarization

After allowing commercial banks to engage in foreign exchange operations and more importantly, to open foreign exchange deposit accounts to residents in December 1983 Turkish banks' operations in foreign currency have grown substantially and foreign exchange deposits have become a major component of the broad money (see Figure 1)

Until late 1988 in the context of high and volatile domestic-foreign inflation differentials and a depreciation of the nominal exchange rate that broadly reflected movements in inflation, the

increase in foreign currency deposits can easily be explained by residents' desire to hedge against inflation (see Figure 2). However, after the full liberalisation of the financial system in 1989 dollarization have continued besides the fact that real rates of return on the FCDs were substantially less than the TL denominated assets[3]. This is mainly due to exchange rate risk, political uncertainty and macroeconomic vulnerability. Figure 3 illustrates real rates of returns on 3-month FCDs, 3-month time deposits and Treasury Bills. It is clear from the figure that in most of the 1990s real rates of return on TL deposits were higher than that of FCDs. Ten year average of real rates of return on TL deposits were about 20 percent while that rate were about 3 percent for FCDs. Highest rates of return from FCDs is obtained in 1994 (about 73 percent) when the policy makers attempted to manipulate the auction rates of T-bills in 1993/1994.

As can be seen from Figure 4 during 1986-88 period the share of foreign currency deposits in the total deposits has increased from about 15 percent to 27 percent, while the share of time deposits in the total deposits has decreased from about 66 percent to 42 percent. The development in the sight deposits has shown more variation but generally their share in the total deposits has remained the same in this period. In 1988, high return on TL deposits decreased the share of FCDs and increased the share of the time deposits. As can be seen from Figure 4, the share of sight deposits has a declining trend throughout the period. It is important to notice that the share of time deposits and the foreign currency deposits follow an asymmetric pattern. This can be interpreted as economic agents moved from time deposits to FCD or vice versa.

"Figure 1 about here"

"Figure 2 about here"

"Figure 3 about here"

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The process of currency substitution was slowed down for a significant period of time, beginning in 1989. Expectations of a real appreciation due to the improved current account outlook increased demand for Turkish Lira deposits. Moreover, liberalisation of the capital account in August 1989 led to substantial capital inflows that contributed to the appreciation of the real exchange rate. The real exchange rate appreciated by 26 percent during 1989 in a context where inflation fell to around 60

[3] There are many data problems in measuring the actual amount of currency substitution. The ideal measurement would include foreign banknotes circulating as medium of exchange and store of value in the economy, as well as checking accounts and short term deposits denominated in foreign currency in the domestic banking system and abroad.

percent per annum, from 75 percent in 1988. During 1990, the authorities pursued a tight monetary policy, which coupled with an ample crop, led to a further reduction in inflation and further real exchange rate appreciation. Reflecting these developments, dollarization ratio declined until August 1990. However, the decline in dollarization ratio ended in 1991. The downward trend in inflation and nominal exchange rate depreciation was reversed by the increase in oil prices following the outbreak of the Gulf crisis. In addition, as a consequence of the expansionary fiscal policy followed in the period preceding the October 1991 election, and of large real wage increases, inflation accelerated reaching 71 per cent by the end of 1991. Gulf crisis in 1991 had increased uncertainties which resulted in an increase in the share of FCDs in the total deposits. This can be evaluated as a precautionary demand for FCDs. However, after 1991 the increases in the FCDs deposits can not solely be attributed to this factor since the rate of return on TL denominated assets became higher than the rate of return on FCDs but the share of FCDs continued to increase. It is important to note that FCDs to total deposit ratio might be a misleading indicator of dollarization, since with the financial reform alternative instruments have been introduced such as T-bill and repos which is the Central Bank sale of government securities with the commitment to buy the securities back at a given price. Repos have been widely used by households as a highly rewarded substitute for time deposits and by banks to finance off-balance sheet portfolios of Treasury securities. Another point in this regard is that the maturity of the financial assets has shifted from long-run to short run due to lack of stabilization.

Consequently, in the context of continued expansionary policies and with the inflationary expectations firmly established given the outcome of labour agreements, foreign currency deposits increased steadily and continuously to reach over 50 percent of M2Y at the end of 1993.

To control its own balance sheet the Central Bank announced a monetary program which targeted key balance sheet components such as total domestic assets and total domestic liabilities from 1990 to 1992. Combined with a lax fiscal policy, this resulted in high real interest rates and appreciation of real exchange rates. During 1992 and 1993, public sector deficit kept rising. With no help from fiscal policy, the Central Bank announced a monetary program for 1993. Turkey was in a high interest rate-repressed exchange rate trap (Agenor, McDermott and Ucer (1997)). Given the limits in domestic borrowing and with the idea of creating a downward pressure on interest rates, the government used the foreign borrowing to finance both public and current account deficits. However, in the third quarter of 1993, the deficits of Turkey looked unsustainable. Foreign creditors

warned that they would not finance the deficits as before. It was apparent that crisis was shaping but the government kept its intention of taking the necessary measures after the municipal elections to be held in March 1994.

From November 1993 onwards there was a rush to the foreign currency. In January 1994, Turkey's credit rating was lowered to below investment grade paper by two international rating agencies, which resulted in a run on the Turkish Lira and a further shift into foreign currencies. To calm the panic and keep the exchange rate within certain limits, the Central Bank intervened in the foreign exchange market by selling its reserves and raised the official US$ exchange rate by 13.6% in a day in mid-January 1994. That did not stop the demand for foreign exchange and the Central Bank continued selling its reserves. From November 1993 to the end of March 1994 the sale of foreign exchange reserves amounted to $7 billion, leaving the reserves at about $3.3 billion. In April 1994 the increase in the price of foreign currency was about 60 per cent. A number of Treasury bill auctions were cancelled in order to manipulate interest rates. This resulted in a sharp erosion of the financial market confidence.

On April 5, 1994 a stabilization program was announced the week after the local elections. In spite of this announcement and a stand by agreement signed with IMF, turbulence in the financial markets continued. Eventually, the government was unable to borrow in the domestic market. Borrowing resumed at end-May 1994 when three months T-bills auctions were conducted, resulting in a 50 percent return over three months. This permitted the debt financing of public sector borrowing requirement (PSBR) and the repayment of the Central Bank advances.

In 1994 the Lira depreciated significantly in real terms due to the overshooting of the exchange rate in the first half of the year. From mid-1994 onwards, the exchange rate begun to be used as a nominal anchor in the fight against inflation. Initially this policy was perceived to be a temporary one that would last until the end of 1994. Yet the nominal anchor policy continued in 1995 and the real exchange rate declined considerably. The period up to September 1995 saw large short term capital inflows and a widespread shift back into TL instruments by residents on the back of financial market sentiments and still high returns offered on domestic securities, which were sustained by the strong pick-up in the real economy. This resulted in a decline in the dollarization ratios. Monetary and exchange rate developments during 1995 were driven by recovery from the 1994 financial crisis, as well as difficulties in pursuing stabilization efforts. Disappointing inflation performance in 1995 and early 1996 may be largely traced to excessive growth of the money supply in the early six months of

1995 and rapid growth of credit to the government after September 1995. During this first period, foreign reserves recovered rapidly reflecting currency substitution back into Turkish Lira. However, the general outlook changed again following the September announcement of early elections for 24 December 1995. Financial market sentiments shifted radically from September 1995 onwards, with the lead-up to the elections. Rapid money growth nevertheless continued, although its sources shifted. In the face of higher pre-election spending and political uncertainty, the Treasury experienced an increasing difficulty in financing the public sector borrowing requirement (PSBR) and started to use short-run advances from the Central Bank. As expected, Treasury bill maturities shortened considerably, interest rates rose sharply, and the exchange rate also weakened significantly, reflecting a renewed currency substitution and a reversal of capital flows.

From November 1995 onwards, the Central Bank began quoting forward foreign exchange rates to stabilise markets, and to provide direction with respect to near term future rates. Sales of foreign exchange, including forward sales, resulted in a drop of some $4.3 billion in reserves in November and December. Returns on TL instruments (measured in real terms) nonetheless remained high during the last quarter, despite the depreciation/inflation shock and diminished the pressure from both Treasury financing operations and open market operations by the Central Bank (OECD, 1996).

The exchange rate, after experiencing a decline of some 12% in December, depreciated at a somewhat steadier pace during the first quarter of 1996 and by-early July 1996 rates on treasury bills had fallen to some 120 %. The foreign reserves had been partially restored. But currency substitution remained high reflecting the state of financial market confidence.

In 1996 the setting of monetary policy was formulated in line with the 1996 budget. The policy framework set a target growth in net domestic assets which required its growth to be significantly below the inflation target. In addition, the Central Bank monitored growth in reserve money and helped to sustain stability in foreign exchange markets. Thus, policy has shifted away from active use of the exchange rate in the strategy to reduce inflation. At the beginning of the year, the Central Bank announced this objective to the public. Except for two sub-periods, the May-July period of increasing political uncertainty and the November-December period during which the Treasury altered its manner of borrowing, it was observed that the changes in the monthly average foreign exchange basket got close to the monthly inflation rates. As of the year's end, the annual increase in the monthly foreign exchange basket was 77.3%, whereas the nominal depreciation of the TL against the US dollar and the

German mark was 84.1% and 70.8% respectively. The annual increase in the wholesale price index, on the other hand, was 84.9% at the end of the year.

Inflation remained steady at around 75 percent in the first half of 1997, but then accelerated to more than 100 percent by the beginning of 1998. A three-year stabilization program was launched in the early 1998, based upon a more active role for monetary policy in the disinflation strategy, commitment to a tight fiscal policy and abolition of the backward indexation of public sector wages. At the same time the economy proved vulnerable to the emerging market crises. The turmoil in Asia did not have an immediately impact on the economy. However its affect started to hurt in the second half of 1998. The Russian crises in the second half of 1998 had an immediate impact on the Turkish economy. The second half of the 1998 was particularly difficult as reflected by massive capital outflows, rising real interest rates and declining economic activity. As a consequence of high real interest rates on TL deposits, the FCDs decreased slightly. However, the high inflationary environment led to an increase in the FCDs in 1999 again.

III. The Empirical Model

Most of the empirical studies aimed at identifying the determinants of currency substitution and dollarization are based on a simple money demand function and incorporate expected exchange rates or inflation and/or interest rate differentials as the main determinants of dollarization. Main assumptions of these models are that the demand for foreign currency by residents is driven by the difference between the real rates of returns on domestic and foreign currency. These, in turn, depend on the interest rates on domestic currency, foreign currency, expected exchange rates and expected inflation rates.

The econometric analysis in this paper is based on a simple structural model of type used by El-Erian (1988), Ramirez-Rojas (1985), Rojas-Suarez (1992), and Clements and Schwartz (1993). However, we extend the model by adding real interest rates differential on domestic and foreign currency deposits. Further, a variable measuring credibility of macroeconomic policies is added to the model. The model used in this paper can be summarised as follows:

$$CS = CS(s^e, (r^d - r^f), s^r, cr, D) \qquad (1)$$

where

CS : dollarization ratio,

s^e : expected exchange rate,

r^d : real rates of return on domestic currency,

r^f : real rates of return on foreign currency,

s^r : exchange rate risk (exchange rate misalignment),

cr : credibility,

D: deterministic variables; seasonal dummies, impact dummy variables, intercept.

In this model we experimented with two different measures of dollarization. The first measure uses the foreign currency deposits of the residents within the domestic banking system as a percentage of broad money including foreign currency deposits (M2Y). The second measure uses the foreign currency deposits of residents within the domestic banking system as a percentage of total deposits of the residents within the domestic banking system.

As in the most of the studies on the dollarization, the data only measures foreign currency in the domestic banking system, that is, it excludes foreign currency held abroad and in circulation. Therefore, the dollarization ratio under estimates its actual extent. However, as put forward by Clements and Schwartz (1993) as long as the institutional and legal environment stays the same, the explanation of the cases of the currency substitution based on the narrow definition will be valid in a strict sense. In this paper, we investigate determinants of dollarization for the period of 1986(1)-1999(12), and the foreign currency deposits were allowed in 1984, therefore the legal environment did not change significantly for the period under investigation, and our results will not be affected. However, since the capital account was fully liberalised in 1989, the impact of this factor on the econometric model will be assessed by the Chow test for structural stability of coefficient estimates.

The real interest rate differentials are measured by the difference between domestic currency and foreign currency interest rates in the domestic banking system. We also evaluated interest rates differentials between domestic assets and foreign interest rates to check whether capital inflows also have any affect on the currency substitution ratio. Previous studies on the dollarization in Turkey (Selcuk (1994), and Akcay et.al (1997)) have not included these variables in their models. In a high inflation economy, even if the interest rate wedge between domestic and foreign currency is in favour of domestic currency, the demand for foreign currency may not decline significantly because of the lack of credibility of the policies. The period investigated in this paper, there was a number of unsuccessful stabilization efforts by the authorities. In response to these developments economic agents demanded higher real interest rates on public debt instruments, shortened maturity of the debt issued and increased their holding of foreign currency deposits. Based on these considerations, in

the empirical analysis, credibility is proxied by average maturity of new domestic non-indexed public debt issues. The expected sign of its coefficient is negative. This means that when the credibility of economic policies increase, dollarization decreases (see Ozatay 2000).

Econometric studies on currency substitution have used different proxies for expected depreciation of the exchange rate. Ortiz (1983) used the difference between the official and real exchange rate for expected exchange rate depreciation. Cuddington (1983) used the ratio of the difference between forward and spot exchange rate to spot rate as a proxy for expected depreciation of the exchange rate. Ramirez-Rojaz (1985) used the same measure for Mexico, the current differential between inflation rates in Argentina and U.S. for Argentina, and the differential between the domestic interest paid on the deposit denominated domestic currency and the domestic interest paid in foreign currency deposits for Uruguay. Clements and Schwartz (1993) used inflation rate differential between U.S. and Bolivia. Selcuk (1994) used trade weighted real exchange rate index and TL per $ nominal exchange rate as a proxy for expected depreciation of the exchange rate for Turkey, and Akcay et al (1997) used estimated exchange rate volatility based on the estimation of PPP for Turkey. Boero and Tullio (1996) in their German money demand function used interest rates differential between Germany and U.S. and percentage deviation of the Mark and Dollar rate from PPP to measure the currency substitution. In this paper the expected depreciation is proxied by the actual monthly changes in the real exchange rate.

Recently, there has been a renewed effort to understand the empirical determinants of currency crises. Most of the empirical studies shown that the real exchange rate (RER) deviation from trend or other forms of calculating real exchange rate misalignment is important variables in predicting crises. Kaminsky et al. (1997) find the real exchange rate to be the most reliable indicator in predicting future currency crises (in terms of their noise-to-signal ratio and longest lead time)[4]. This result can be interpreted as a sign that this relative price is a key summary variable of several underlying fundamentals.

Goldfajn and Valdes (1996) analysed a large set of real exchange rate appreciation derived from an initial sample of monthly real exchange rates for 93 countries from 1960 to 1994 to evaluate whether real exchange rate misalignment leads to nominal devaluation (or future crises). They found

[4] Kaminsky et al. (1997) also show that interest rate differentials are not useful in predicting crises. Interest differentials do not adequately reflect expected depreciation, possibly due to the fact that changes in the interest differentials may reflect short run monetary policies that increase domestic interest rates or changes in the risk premium. These factors may produce enough noise that prevents extraction of reliable expected depreciation measures.

that the probability of eliminating misalignment without nominal devaluation for different degrees of misalignment is extremely low. That means real overvaluation is usually corrected through nominal devaluation rather than inflation differentials. Goldfajn and Valdes (1998) provided empirical evidence that market participants do consider overvaluation in their formation of expectation.

The discussion above shows that real exchange rate misalignment can be taken as a devaluation risk. Therefore, in this paper we will use real exchange rate misalignment based on PPP as a proxy for exchange rate risk. In constructing real exchange rates, wholesale price index is used. The misalignment is calculated as the deviation of the actual series from predicted series based on a regression of the real exchange rate on constant and trend. Increase in the RER reflects appreciation of domestic currency.

All the series are monthly and seasonally unadjusted and estimation sample extends from 1986:1 to 1999:12. Some evidence in the literature suggests that the length of the period is more important than the frequency of the data. We used monthly data for two reasons; some of the monetary variables are available as of 1986:1 and in a high inflation economy economic agents tend to make their decisions quite frequently in small intervals.

IV. Estimation Results

This section presents unit root test for the variables of interest. Then Johansen‘s (1988, 1991) maximum likelihood procedure is applied to test for cointegration among the variables of the model.

Integration

Before modelling dollarization presence of univariate unit roots were tested to determine the order of integration of the variables with and without trend term. Table 1 reports augmented Dickey-Fuller (1981) and Dickey Fuller ϕ test statistics. The lag lengths for the ADF tests are determined by the AIC and likelihood ratio statistics. When the serial correlation problem detected further lag(s) added to eliminate the serial correlation. Tests are carried out with constant and trend, with constant and without constant term included in the ADF regression. In this way unit root allows for the alternative hypothesis trend stationarity and non-zero intercept on the series. The trend stationarity implies that the deviation of the series from a linear function of time follows a stationary process.

Test results show that all the variables contain unit roots. That is, all the variables are non-stationary in levels but stationary after first differencing[5]. Dickey-Fuller ϕ test statistics shows that all of the variables are difference stationary.

"Table 1 about here"

Cointegration

There are number of alternative ways to conduct cointegration tests (for detailed survey see Maddala and Kim (1998)). Earlier tests for cointegration are based on Engle and Granger (1987). However, Banerjee at. al. (1996) have noted that the small sample property of the Engle-Granger method is poor. Additionally, if the regressors in the model are endogenous and/or errors exhibit serial correlation, then the asymptotic distribution of the coefficients will depend on the nuisance parameters. Researchers have demonstrated that, in testing an equilibrium relationship, econometric methods are robust to simultaneity bias and potential endogeneity can make a significant difference to the outcome (Cheung and Lai (1993)). The cointegration tests in this paper are conducted by using reduced rank procedure developed by Johansen (1988) and Johansen and Juselius (1990). This method should produce asymptotically optimal estimates because it incorporates a parametric correction for serial correlation (which comes from underlying VAR) and the system nature of the estimator means that the estimates are robust to simultaneity bias. Alternatively, Phillips and Loretan (1991) and Phillips and Hansen (1991) methods are used, however, these estimators are not informative about the number of cointegration relationships in a given vector. Johansen method, based on maximum likelihood optimisation, provides more robust results, especially when more than two variables involved (Gonzalo, 1994). Optimality of this method has been shown by (Phillips (1991) in terms of symmetry, unbiasedness and efficiency properties. Further, it does not suffer from problems associated with normalisation (see Johansen 1995), and it is robust to departure from normality (Cheung and Lai (1993) and Johansen (1995)). Johansen method detects the number of cointegrating vectors in non-stationary time series and allows for hypothesis testing regarding the elements of cointegrating vectors and loading matrix.

[5] Following the suggestion of Dickey and Pantula (1987) the unit root tests are first performed for two roots, and if two roots rejected then single unit root tested for. Results showed that none of the variables seems to show evidence of two unit roots, these results are not reported here but available from the author. Phillips and Perron (1988) unit root tests are also performed and the results are very similar to the ADF tests. Therefore, they are not reported here but available from the author upon request.

Basically, the cointegration analysis is performed in the following unrestricted vector autoregressive (VAR) framework,

$$\Delta x_t = \sum_{i=1}^{k} \Gamma_i \Delta x_{t-i} + \Phi x_{t-1} + \Psi D + \varepsilon_t \qquad (2)$$

where x_t is vector of non-stationary (in levels) variables, the matrix Φ has reduced rank equal to r and can be decomposed as $\Phi = \alpha\beta'$, where α and β are $p \times r$ full rank matrices, and contains adjustment coefficients and the cointegrating vectors respectively. D is deterministic variables which may include constant term, the linear trend, seasonal dummies and impulse dummies. Finally, the error term follows a normal process.

In order to test for the number of cointegration relationships amongst the variables Johansen (1988) and Johansen and Juselius (1990) provide two different tests to determine the number of cointegrating vectors, namely trace and maximum eigenvalue tests. In the trace test, the null hypothesis is that there are at most r cointegrating vectors and it is tested against a general alternative. In the maximum eigenvalue test, the null hypothesis of r cointegrating vector is tested against r +1 cointegrating vectors. Once we determine r, the number of relationships, we can do hypothesis testing on both loadings and cointegrating vectors. Restrictions can be imposed on the coefficients to test alternative theory based hypothesis on the long-run value of variables.

One problem with Johansen and Juselius procedure is that it is not able to identify exactly the parameters in α and β matrices. Only if there is just one cointegrating vector found than we can make truly concrete conclusions about any unique long-run relationship between the variables, otherwise we can not.

In the Johansen's cointegration analysis deterministic part of the system is also important. Johansen (1992b) describes a procedure for selecting between a model with an unrestricted constant and one with restricted constant or no linear trend. The basic idea is to estimate the restricted and unrestricted version of the model and accept the model with the fewest cointegrating vectors. If both models accept the same number of cointegrating vectors, then the restricted model should be used. Similarly, when there is an equivalent number of vectors in each model, one can use likelihood ratio test statistics[6] to test whether the restriction can be rejected (if we reject the null hypothesis of restricted constant, then constant term should enter to VECM as unrestricted). However, even if the restriction of the constant to the cointegrating space is accepted by the LR test, the validity of the

restriction should be judged carefully, since the restriction of the constant term to cointegrating space implies that average first difference of the each of the endogenous variables is zero. This might be a strong assumption for some variables. Doornik et.al. (1998) statistically analysed over-specified trend in the cointegration space and suggested that adopting a model that includes a trend in the cointegration space have low cost even when DGP does not display trend. They found that including an unrestricted trend was problematic (for further details see Doornik et al (1998)). Therefore we have restricted the trend in the cointegration space.

Concerning the treatment of impulse indicator variables Hendry and Doornik (1994) strongly recommended that these to be entered unrestrictedly if they are used to establish an estimate of the innovation variance. They certainly advise against their restriction to the cointegrating space. Following these suggestions, we have included dummy variables unrestrictedly into the cointegration space.

Cointegration Results

Johansen procedure is used to determine the rank *r* and to identify a long-run dollarization relationship amongst the cointegrating vectors.

The number of lags used in the VAR is based on the evidence provided by both likelihood ratio test and AIC, however, in the case of serial correlation sufficient number of lags introduced to eliminate the serial correlation of the residuals. The cointegration tests amongst *cs*, s^e, $(r^d - r^f)$, s^r and *cr*, and include 10 lags in the VAR and a set of monthly centred seasonal dummy variables (see Johansen 1995), a constant term and further, the estimates of VAR include also two impulse dummy variables: D8889 is included to capture the interest rate intervention during 1988(10)-89(3) period, and D94 is included to capture currency crises in 1994. We have restricted the trend and credibility variable in the cointegration space.

The diagnostics in the form of vector statistics (and single equation statistics, we do not report here) reported in Table 2 indicates that our VAR model is satisfactorily a close approximation to actual data generating process, apart from some non-normality of residuals.

"Table 2 about here"

[6] . The LR = $\text{Trace}_{(\text{rest.})}(r) - \text{Trace}_{(\text{unrest.})}(r) \sim \chi^2(p-r)$, where p is the number of variables and r is the number of cointegrating vectors.

Table 3 reports the estimates of Johansen procedure and standard statistics. In determining the number of cointegrating vectors we used degrees of freedom adjusted version of the maximum eigenvalue and trace statistics, since in the existence of small samples with too many variables or lags, Johansen procedure tends to overestimate the number of cointegrating vectors (see Cheung and Lai (1993) and Gonzalo and Pitarakis (1994)). These test statistics strongly reject the null hypothesis of no cointegration in favour of one cointegration relationship. Table 3 also reports standardised eigenvectors, β', and adjustment coefficients, α. The first row of β' is the estimated cointegration vector, and can be written as

log(FCD /M2Y)	=	0.004 *Trend*	-0.112$(r^d - r^f)$	+0.344s^e	+0.005s^r	-0.001*cr*	*(3)*
(Standard errors)		(0.0017)	(0.0717)	(0.0642)	(0.0034)	(0.0003)	

The result is inline with the intuitive predictions of dollarization model, and shows a negative relationship between dollarization ratio, real interest rates differential between 3-month deposit and 3-month FCD and credibility variable, and shows positive relationships between dollarization ratio and expected exchange rate and exchange rate risk. There is also a positive linear trend. From these results it can be seen that interest differential and the expected exchange rates are the most dominant variables in determining dollarization. Although the credibility variable is highly significant, in terms of its magnitude it is relatively very small. The semi elasticity of exchange rate variable (34.44 percent) implies that in the long-run a reduction in the monthly rate of exchange rate depreciation by a percentage point would decrease the ratio of foreign currency deposits to broad money by about 34 percent. Similarly, the equation indicates that a decrease in the spread of dollar and domestic currency deposits of one percentage point would in the long-run decrease the share of foreign money by about 11 percentage points. Significance of positive linear trend in the regression can be taken as an evidence of dollarization hysteresis in Turkey. Turkish government started to implement a disinflation program since the beginning of year 2000 and FCD to M2Y ratio decreased. The main element of the stabilization program is to pre-fixed exchange rate, therefore, depreciation of the exchange rate is also reduced significantly (0.009 per month). These developments suggest that there is a scope for reducing dollarization in Turkey. However, the interest rates on Turkish lira deposits and T-bills are already positive in real terms for a long period. Therefore, further increase in real rates of returns on domestic currency denominated assets may not significantly lower the degree of dollarization.

The equilibrium correction coefficient is significant and small in magnitude. It indicates that economic agents do not immediately and fully adjust their holdings to variations in the relative rates of returns on foreign currency balances. The adjustment coefficient -0.007 indicates that only about 1 percent of adjustment between actual and desired balances occurs in the current month. Consequently, actual holding in the previous month have a strong affects on the behaviour of the current months. Significance and small magnitude of this coefficient is consistent with inertia in the process of dollarization in Turkey and pose difficulty in reversing the dollarization process.

The inclusion of variable measuring both interest rates differential and proxy for the expected exchange rate in the same model might be considered as odd. As interest rate differentials themselves could be considered as a proxy for expected depreciation. In this study, however, actual depreciation of exchange rate is used as an expected depreciation. When we excluded actual depreciation from the regression, no cointegration relationship is found and interest rate differential becomes insignificant, therefore we retained the actual depreciation of the exchange rate and interest rate differentials in our model.

In Turkey, real exchange rate appreciated significantly after the fully liberalisation of capital accounts and a number of stabilization efforts failed due to the lack of fiscal adjustment measures. Under these circumstances, economic agents have demanded substantial risk premium for holding financial assets denominated in domestic currency and shifted their portfolio in favour of foreign currency. To examine the impact of this factor on dollarization, we included trend deviation of real exchange rates as a proxy for exchange rate risk in our model. The results show that our measure of risk variable is significant and has correct sign.

Since the real rates of return on domestic assets have been positive in most of period under investigation and dollarization ratio had an upward trend, we also investigated dollarization hysteresis by including a ratchet variable which was the highest rates of deprecations in each month. However this variable was not significant.

To check the robustness of our results we further investigated the dollarization issue in Turkey by replacing the dollarization ratio with the share of foreign currency deposits in total deposits. The results are very similar to the previous results (see Appendix Table 1).

”Table 3 about here”

”Figure 5 about here”

We can test various hypotheses on the parameters of α matrix. First interesting aspect is represented by the possibility of identifying long-run weak exogeneity of the variable(s) with respect to the parameters of equilibrium relationships. If the cointegration vector does not have any influence on a particular variable, in which case, all the weights will be equals to zero. Then that variable is said to be long-run weakly exogenous for the long-run parameters and thus can be considered as driving the dynamics of the system as a whole. Table 3 also presents weak exogeneity test of a given variable for the cointegrating vector. If a given row in α is equals to zero disequilibrium in the cointegrating vector does not feed back directly onto the corresponding variable. The test results show that weak exogeneity is rejected for all variables. The weak exogeneity results justify a system approach to analysing cointegration relationship and guides us in answering the question whether we have to model the dollarization in a single equation or in a system context.

Finally Table 3 also reports multivariate stationarity of the given variable. The tests based on the assumption that there is only one cointegrating vector. Here, the null hypothesis is the stationarity of the variable, furthermore, since it is multivariate and so includes a larger set of information these statistics may have stronger power against the ones based on the univariate test (see Johansen, 1995). We reject the null hypothesis of stationarity of all the variables.

Constancy test on the long-run equilibrium

Parameter constancy is an additional and crucial issue to ensure well specified equation. The potential for parameter stability increases significantly during and after financial crises, and the factors affecting dollarization ratio may change. In this section we report graphical instability test[7] in Figure 6. The first graph (a) shows one step residuals and the dollarization equation standard errors, second graph (b) shows sequentially estimated one step ahead Chow statistics, third graphs (c) break point Chow test

"Figure 6 about here"

In the first graph residuals lie inside the ±2s.e. bands indicating that parameter constancy is not violated. In the break point Chow test for the sequence of (1991:10-1999:12 …) none is statistically significant at 5% level indicating that constancy of the parameters can not be rejected for the whole sequences of forecasts. In the one step Chow test , only 3 points are above the 5 percent significance level, but these are numerically small and only in the 1994 crises period. Constancy of the

parameters indicates that, in general, the dollarization process in the long run remained unchanged over the sample period.

V. Summary and Conclusions

Turkey experienced periods of macroeconomic instability and several stabilization efforts have failed due to the structural weaknesses of the economy. Fundamental reforms which are essential for moving towards well functioning market economy have not been implemented or delayed for long period. Therefore chronic high fiscal deficit and inflation remained in place for a prolonged period and the credibility of Turkish lira diminished significantly. Under these circumstances private economic agents responded by increasing their holding of foreign currency deposits in the domestic banking system to hedge against inflation and demanded high real interest rates on government's debt instruments.

In this paper we tried to explain dollarization process in Turkey by an extended portfolio model. In this literature dollarization is explained by a simple portfolio model where the dollarization ratio is function of rates of return differential. In some cases the rates of return differentials helps to explain dollarization trends (see Balino et.al. 1999) however in other cases the same model is proved to be less successful in explaining swings in dollarization ratios. In Turkey real rates of returns on domestic currency assets have increased significantly relative to foreign currency assets, but dollarization ratio remained persistently high. This suggests that other variables should be incorporated into these models. In this study we extended the simple portfolio model where dollarization is determined by the relative rates of returns of domestic currency and foreign currency denominated assets, expected change in the exchange rate, exchange rate risk and credibility of current economic policies.

The econometrics results are inline with the intuitive predictions of dollarization model, where there is a negative long-run relationship between dollarization ratio, real interest rates differential between 3 month deposit and 3 month FCD, and credibility variable, and there is positive long-run relationships between dollarization ratio and expected exchange rate and exchange rate risk and there is a positive linear trend. We have found that interest differential and the expected exchange rates are the most dominant variables in determining dollarization. Significance of positive linear trend in the regression can be taken as an evidence of dollarization hysteresis in Turkey. Further more, the equilibrium correction coefficient is significant and small in magnitude. It

[7] . All the tests presented here employ the null hypothesis of parameter constancy.

indicates that economic agents do not immediately and fully adjust their actual holding to desired balances. Consequently, actual holding in the previous month have a strong affects on the behaviour of the current months. This can be taken as an evidence of inertia in the process of dollarization in Turkey and pose difficulty in reversing the dollarization process.

The inflationary expectations are highly sensitive to the exchange rate, devaluation have a high degree of pass-through to domestic prices in Turkey. Therefore, the policy implication of this study is that a credible disinflation program with an exchange rate anchor may reduce the dollarization ratio. However, timely smooth transition from pegged exchange rate system to more flexible one is difficult. Authorities resist abandoning the fixed exchange rate due to fear of damaging their policy credibility. But the longer the peg is retained the more vulnerability builds up in the financial system and in the external account. In the end a country exits from the peg as a result of crises, which increase the dollarization.

In Turkey the financial system is also highly dollarized (i.e. deposit dollarization as well as liability dollarization). There is a substantial capital inflow in the form of short term borrowing, the devaluation will sharply worsens the balance sheet of domestic banks. Devaluation in a context of weak banking system and large foreign exchange exposure in the private sector can damage the financial system and disrupt real activity. This implies that in highly dollarized economy devaluation as a policy option may be very costly.

Dollarization also reflects absence of macroeconomic stability and existence of distortions in the financial markets. Under these circumstances, dollarization may complicate stabilization and cause extra volatility. Macroeconomic stability and fiscal disciplines are necessary for de-dollarizing the economy. Other direct measures should be avoided. Direct measures through forced conversion to the domestic currency have severe adverse affects. This will substantially diminish the government's credibility and increase the confiscation risk perceived by the domestic residents. This will also increase the demanded interest rates later as it happened in several Latin American countries (see Salvatano (1990) and Berg and Borensztein (2000)).

Recent Argentina's experience shows that exchange rate based stabilization brings stability in the short-run at the price of instability in the long-run (see Eichengreen, 2002). After hyperinflation experience in 1980s Argentina's dollar based "currency board" system increased the credibility of the price stability in the short-run. However this also exposed the economy to fluctuations in the relative value of major currencies. Starting from mid-1990s Argentina's

competitiveness worsened relative to other countries which resulted in an increasing current account deficit and mounting external debt. External debt also reflected substantial deficit of central and provincial governments. Domestic resident and foreign investors saw unsustainability of current account deficit and external debt, and increased their expectation of devaluation some time in the near future. The convertibility law allowed them to shift their domestic currency into dollars and then to take the dollars out of country. The result was a loss of dollar reserves at the central bank and devaluation domestic currency in January 2002. This will diminish governments credibility in the future and increase the inertia in the dollarization.

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“Appendix Table 1 about here”

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Figure 1 : Dollarization Ratios

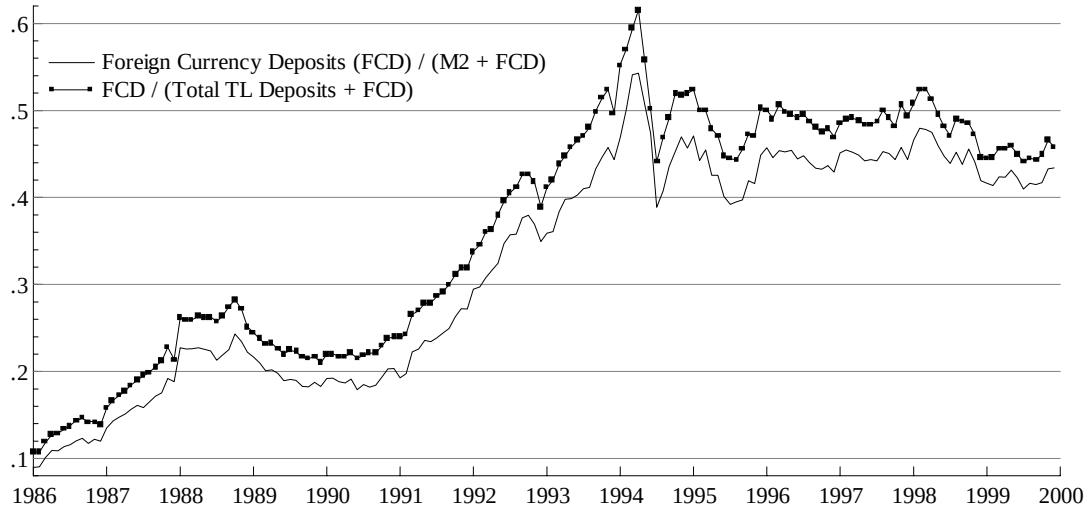

Figure 2: WPI Inflation Differencial and Exchange Rate (Annual % Change)

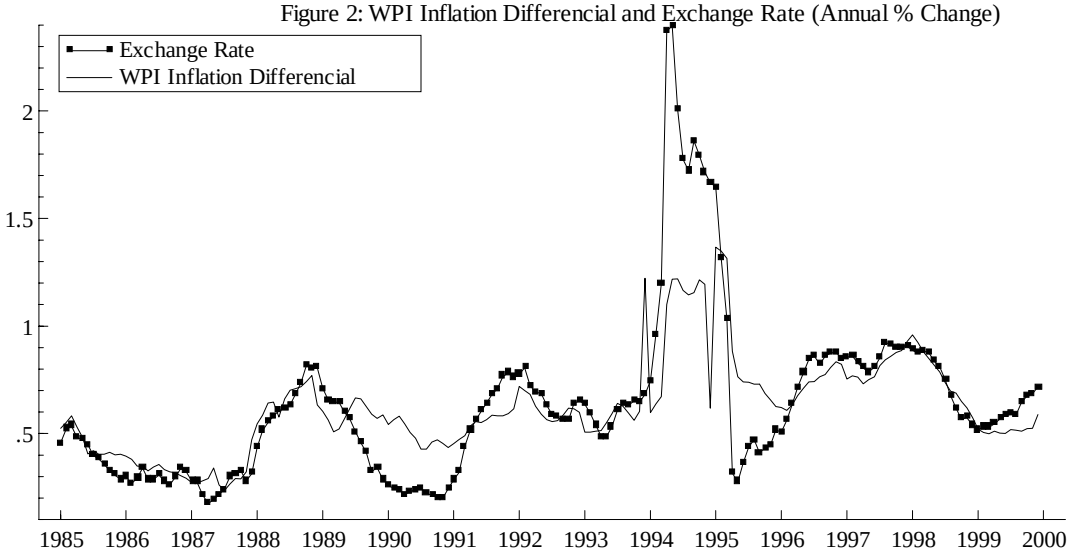

Figure 3: Annual Real Rates of Returns

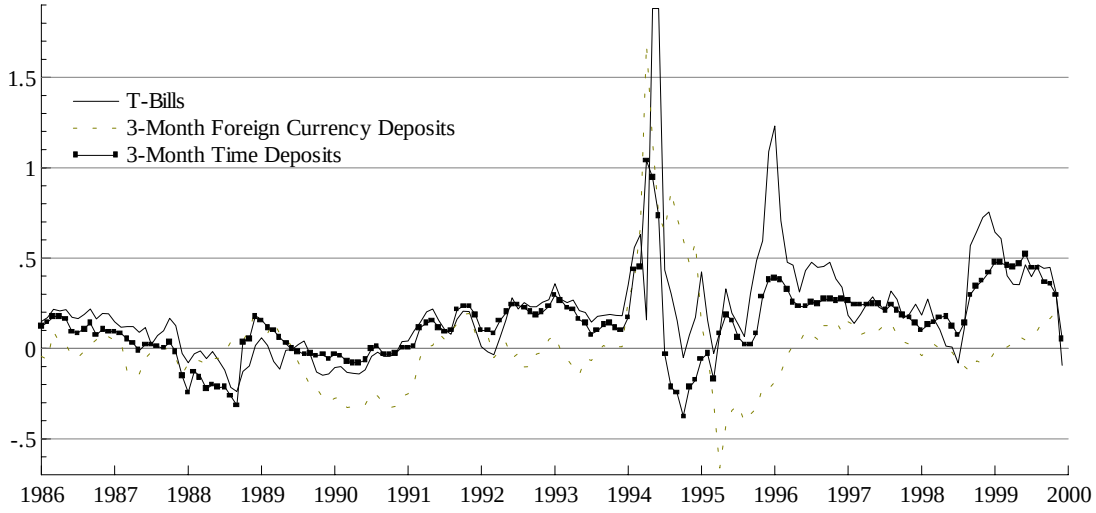

Figure 4: Share of Deposits

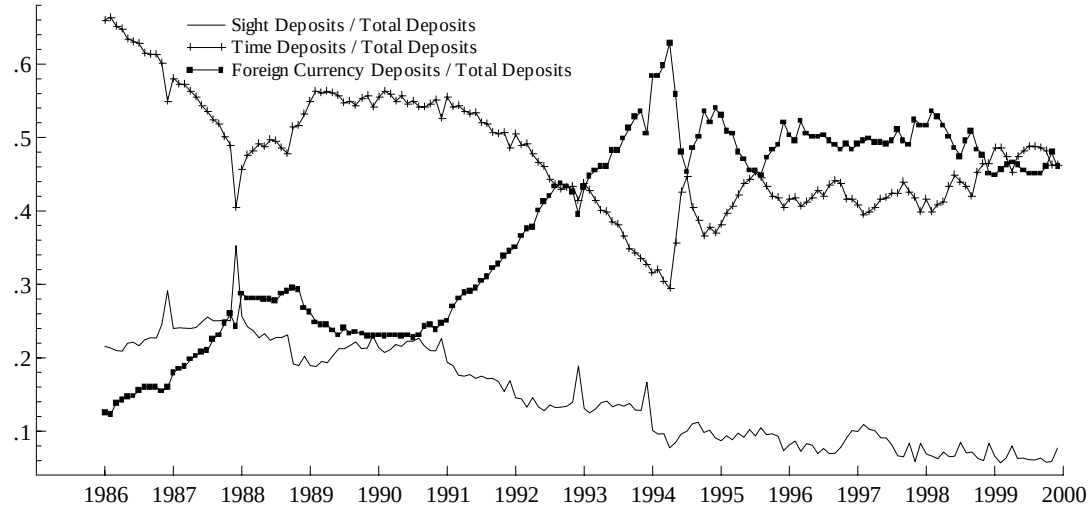

Figure 5: Cointegration relationship

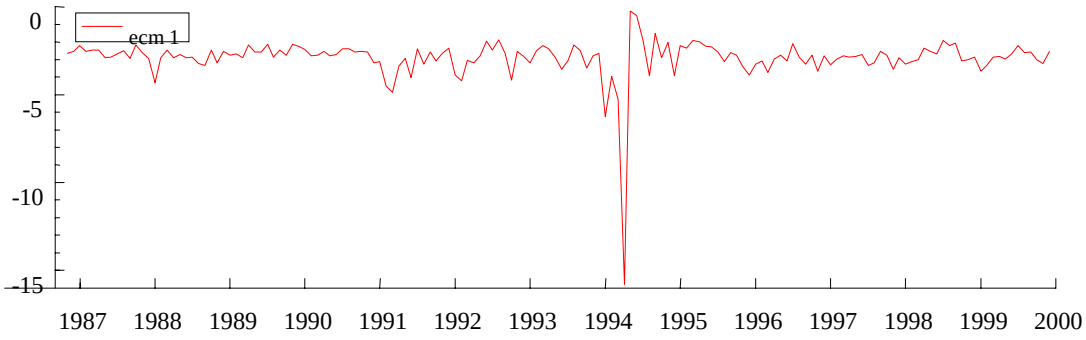

Figure 6: Constancy tests on the long-run dollarization relationship

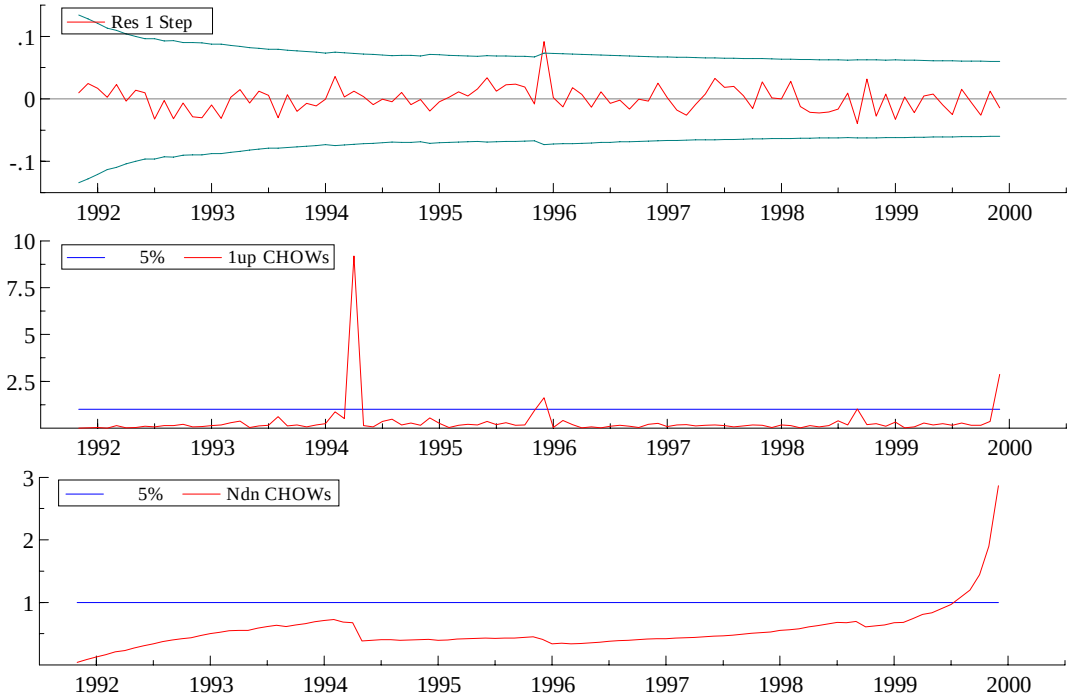

Table 1: Unit Root Test Results

(LEVELS)

Variables	**k**	**A**	**B**	**C**	**F3**	**F1**
log(FCD) – log(M2Y)	12	-2.496	-1.707	-1.316	4.402	4.679
log(FCD)- log(TDEP)	12	-2.222	-1.716	-1.214	5.200	5.372
$(r^d - r^f)$	9	-3.381	-2.262	-1.915	5.600	5.639
π_{WPI}	11	-2.908	-2.927*	-0.088	3.360	5.420
π_{CPI}	11	-2.941	-2.992*	-0.387	3.849	6.636
s^e	10	-3.537*	-3.438*	-1.242	6.663	11.592
s^r	3	-2.486	-2.453	-2.453*	3.395	6.633
Cr	12	-1.782	-1.005	0.569	2.353	1.748
1% Critical Value*		-4.026	-3.478	-2.580	8.730	6.700
5% Critical Value		-3.443	-2.882	-1.942	6.490	4.710

Notes:

1) k is the number of lagged dependent variables in the ADF regression

2) Column A, B and C give the t-statistics from ADF regression including constant and trend, constant and without constant respectively.

3) The critical values are from MacKinnon (1991). The superscripts * and ** denotes rejection at 5% and 1% critical values.

Table 2: Full system diagnostics

Statistics	Values	p-values
Vector portmanteau 12 lags	91.016	
Vector AR 1-7 F(112,284)	1.0321	[0.4116]
Vector normality $\chi^2(8)$	155.92	[0.0000] **
Vector heteroscedasticity F(840,112)	0.18844	[1.0000]

Table 3: Cointegration tests and related statistics

Cointegration tests

Eigenvalues	Hypothesis	L-max	%95 c.v.	L-trace	%95 c.v.
0.333868	r = 0	47.94**	31.5	75.6**	63
0.104255	r < 1	12.99	25.5	27.66	42.4
0.082733	r < 2	10.19	19	14.67	25.3
0.0372385	r < 3	4.478	12.3	4.478	12.3

Standardised eigenvectors (β')

log(FCD)-log(M2Y)	(r^d-r^f)	s^e	s^r	*cr*	Trend
1.000	0.112	-0.344	-0.005	0.001	-0.004
2.916	1.000	-0.849	0.007	-0.001	0.008
1.033	-1.603	1.000	-0.130	-0.001	-0.029
1347.600	960.660	-1040.200	1.000	-3.699	9.990

Standardised adjustment coefficients (α)

log(FCD) - log(M2Y)	-0.00697	-0.005116	-0.006422	0.000001
(r^d-r^f)	10.28700	1.000200	-0.429960	0.000407
s^e	10.26300	1.075800	-0.455350	0.000517
s^r	-4.12960	-1.075900	0.387210	0.000143

Weak exogeneity test statistics (Ho: weakly exogenous)

	(r^d-r^f)	s^e	s^r
LR-test, χ^2 (1)	28.856	26.834	9.883
	[0.0000] **	[0.0000] **	[0.0017] **

Joint weak exogeneity tests

LR-test, χ^2 (3) 48.701 [0.0000] **

Multivariate unit root tests (Ho: variable stationary)

	log(FCD)-log(M2Y)	(r^d-r^f)	S^e	s^r	*cr*
LR-test, χ^2 (5)	50.728	45.804	25.652	60.424	57.328
	[0.0000] **	[0.0000] **	[0.0001] **	[0.0000] **	[0.0000] **

Notes:

1) The estimation period is 1986:1-1999:12. VAR includes 10 lags on each variables, a constant term, centred seasonal monthly dummy variables, D8889 dummy and D94 dummy variables. MDAY and Trend variables are restricted to the cointegration space.

2) The λ-max and λ-trace are maximum eigenvalue and trace test statistics, adjusted for degrees of freedom. The critical values are taken from Osterwald-Lenum (1992).

3) The multivariate stationarity, weak exogeneity and significance tests statistics are evaluated by assuming a single cointegration vector.

4) The values in [.] are p-values. The * and ** indicate rejection of likelihood ratio tests at 5% and 1% significancee levels, respectively

Appendix Table 1 : Cointegration tests and related statistics

Cointegration tests

Eigenvalues	Hypothesis	L-max	%95 c.v.	L-trace	%95 c.v.
0.326315	r = 0	46.61**	31.50	74.61**	63.00
0.110898	r < 1	13.87	25.50	28.00	42.40
0.078765	r < 2	9.68	19.00	14.13	25.30
0.037025	r < 3	4.45	12.30	4.45	12.30

Standardized eigenvectors (B')

Log(FCD/TDEP)	(r^d-r^f)	s^e	s^r	*cr*	Trend
1.000	0.119	-0.356	-0.006	0.001	-0.003
4.407	1.000	-0.989	-0.033	-0.002	0.013
-0.744	-1.557	1.000	-0.096	-0.000	-0.021
630.750	464.340	-503.930	1.000	-1.802	5.595

Standardized adjustment coefficients (a)

Log(FCD/TDEP)	-0.004138	-0.004374	-0.007076	0.000002
(r^d-r^f)	10.253000	0.423050	-0.656990	0.000995
s^e	10.262000	0.460210	-0.700770	0.001228
s^r	-4.271200	-0.469980	0.657620	0.000237

Weak exogeneity test statistics (Ho: weakly exogenous)

	(r^d-r^f)	s^e	s^r
LR-test, χ^2 (1)	30.030	28.007	11.337
	[0.0000] **	[0.0000] **	[0.0008] **

Joint weak exogeneity tests

LR-test, χ^2 (3) 45.737[0.0000] **

Multivariate unit root tests (Ho: variable stationary)

	Log(FCD/TDEP)	(r^d-r^f)	s^e	s^r	*cr*
LR-test, χ^2 (5)	40.243	40.682	19.235	57.365	53.003
	[0.0000] **	[0.0000] **	[0.0017] **	[0.0000] **	[0.0000] **

Significance tests (t-stat)

	(r^d-r^f)	s^e	s^r	*cr*	Trend
Coefficient	-0.1191	0.3563	0.0057	-0.0005	0.0029
Standard error.	0.0657	0.0670	0.0026	0.0002	0.0014

Notes:

1) The estimation period is 1986:1-1999:12. VAR includes 10 lags on each variables, a constant term, centred seasonal monthly dummy variables, D8889 dummy and D94 dummy variables. MDAY and Trend variables are restricted to the cointegration space.

2) The L-max and L-trace are maximum eigenvalue and trace test statistics, adjusted for degrees of freedom. The critical values are taken from Osterwald-Lenum (1992).

3) The multivariate stationarity, weak exogeneity and significance tests statistics are evaluated by assuming a single cointegration vector.

4) The * and ** indicate rejection of likelihood ratio tests at 5% and 1% significance levels, respectively