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# Currency Substitution in Turkey

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**Abstract:** We investigated whether the recent depreciations in the Turkish currency (Lira) resulted in the currency substitution away from Lira by using quarterly data over the period from 1987:1 to 2000: 2 with M1 and M2 monetary aggregates and income, interest rate and exchange rate. Other than the variety of monetary aggregates, we tried different ways of including the interest rate into the models to ensure the robustness of our results. Our analysis shows that the currency substitution in fact happened with Lira.

**Key words:** Dollarization, Euroization, Transition Economies, Currency Substitution, Foreign Currency

## INTRODUCTION

Currency substitution, which is frequently interchangeably used with dollarization, occurs as domestic money (both currency and deposits) is replaced by foreign money in the residences' portfolios. Currency substitution is widespread in many financially unstable economies often characterized by high inflation, expectations of exchange rate depreciation and fiscal imbalances. As a result, domestic asset holders increase the share of foreign money in their portfolios to protect the real value of their financial wealth or avoid the inflationary tax. (See[1] for a conceptual discussion and policy implications.)

The presence of currency substitution may have serious implications for the money market equilibrium. It can directly reduce the demand for domestic currency, or does so indirectly by increasing the velocity of domestic money's circulation. These and other effects are known as intermediate consequences in the general equilibrium framework and need to be explicitly considered in the formulation of monetary policy. Sometimes the currency substitution may take the form of a complete replacement of one currency with another. Two good examples of this phenomenon are the US dollar experience[2] and the experience of the common currency of Europe[3]. The latter is more properly called authorization rather than dollarization.

This study focuses on the effect of exchange rate changes on the money market equilibrium through this intermediate channel, i.e., Currency substitution. A crawling exchange rate regime, widely adopted in many developing countries, is said to contribute to the currency substitution process by rationalizing the devaluation expectations ([4] provides a detailed discussion on this specific effect of the exchange rate changes.) This is especially true for a passive crawl regime whose priority is to offset the negative effect of domestic inflation on external competitiveness. An active crawl, whose priority is to reduce the domestic cost of foreign debt or inflation, is not a solution as it leads to overvalued domestic currency. Lower devaluation can only be realized by a continuous rise in the domestic interest rates. Under liberalized capital markets, intentionally lower exchange rates can only be achieved at the expense of higher domestic interest rates, which must compensate for the expected devaluation. In other words, the pressure from foreign debt service is temporarily reduced at the expense of domestic debt service. Financial crises, which originate in the foreign exchange markets and spread to the rest of the domestic financial system, become unavoidable as experienced by many countries in the Eastern Europe, Latin America and Asia[3]. Provides a lucid review of the contagious nature of currency crises in the whole economy.

The market participants' desire to run away from the domestic currency is exacerbated in economies with convertibility, one of which is Turkey. However, Turkey is not alone in this experiment and the examples of currency substitution experience in many economies are numerous. In a non-exclusive manner, we can cite[5] for Cambodia,[6] for the Czech Republic,[7] for Croatia,[8] for Argentina,[9] for Macao,[10] for Russia. Currency substitution can also be found in Latin American countries in[11-14]. Examples of studies in Canada are[15-18].

The Turkish economy has gone through extensive liberalization movements in the early 1980s (see[19] for more details on the liberalization movements in Turkey during 1980s), which made its market participants more market savvy over time. In the absence of a stable

domestic political and economic aura, people are expected to choose to seek the relative safety of a foreign currency such as the US dollar. This undoubtedly has resounding effects on the domestic monetary policy, markedly so in combating economic downturns. We provide the velocity of the narrow definition of money, M1, as well as that of the broad definition of it, M2. Since we use only these two monetary aggregates in this research, we see no problem with calling them narrow and broad definitions of money. As seen in Fig. 1, a run away from the Turkish Lira is clearly identifiable from the examination of the picture on the velocities of the narrow and broad definitions of money, more so for the case of the narrow money.

The velocities are calculated as the ratio of nominal GNP to the monetary aggregate in question. Thus V1 represents the velocity of the narrow definition of money and V2 stands for the velocity of M2.

In this study, we attempted to determine the intermediate effect of depreciation on the Turkish economy by explicitly incorporating it in the money market equilibrium. We accomplished this by directly estimating a money demand function in which exchange rate was considered as one of the opportunity cost variables together with the interest rate since holding domestic currency rather than the foreign one means losing purchasing power in terms of the foreign currency in case of a depreciation of the domestic currency. This research tries to quantify the graphic and narrative observations made so far for the Turkish currency, Lira.

In anticipation of the findings, we can say that the currency substitution in fact happened to Lira during the coverage period under the conditions specified in this research project. Our study also revealed that the exclusion of exchange rates from money demand equations in the case of Turkish currency may lead to incorrect predictions of future monetary relations.

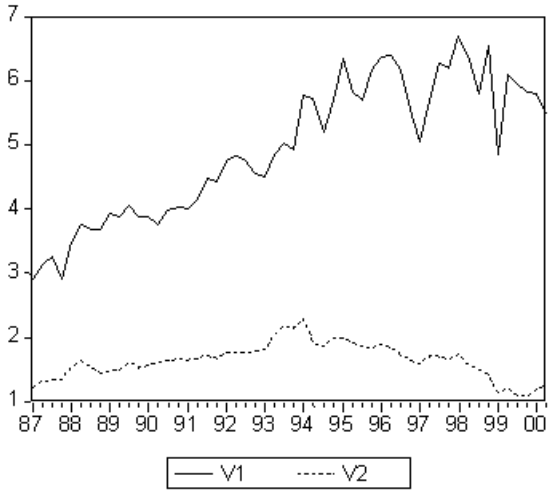


Fig. 1: The Velocities of M1 and M2

Our results are robust to the choice of monetary aggregates, alternative formats of inclusion of opportunity cost concepts and consideration of seasonality in the variables.

## MATERIALS AND METHODS

We used the well-known monetary exchange formula with a little modification by including the exchange rates as necessary as in[20]. While we refer the reader to[21-23] for the derivation of a theoretical model of money demand with currency substitution, our estimation equation takes the form of:

$$\log\frac{M_t}{P_t} = \beta_0 + \beta_1 \log\frac{Y_t}{P_t} + \beta_2 g_1(R_t) + \beta_3 g_2(ER_t) + \varepsilon_t \qquad (1)$$

where, *M* is the domestic monetary aggregate, which can be summarized in the form of both M1 and M2 to cover a wide range of claims made by the empirical macroeconomists regarding the "correct" monetary aggregate to use[24-27]. Among others, employ various aggregates in their studies. The nominal income is represented by *Y*. Nominal variables are converted to real ones with the help of a price deflator, *P*, which is, in our case, the consumer price index. The CPI is normalized to 100 for the year 1987. *ER* and *R* stand for the exchange rate and the interest rate, respectively. We use two different exchange rate concepts, viz. The buying and selling exchange rates as calculated by the Turkish Central Bank for *ER* and the 3-month T-Bill rate by the same source. Specifically, the data used in this study are quarterly data covering the period of 1987:1-2000:2. The dataset, in its original format, is not seasonally adjusted, but is adjusted for seasonality with the X-11 multiplicative method developed by the US Census Bureau. Though a new version of the method is available free of charge at http://www.census.gov/srd/www/x12a/, it is not found to yield any additional benefits over X-11 method. We also experimented with alternative specifications such as multiplicative ratio-to-moving average method or additive forms of these methods, but they did not seem to provide exceptionally different fits to data in the former case, or better fits in the latter case. Pros and cons of these methods are discussed in[28].

Hence, the variables, the corresponding notation and the definitions thereof are as follows:

* *M1*: Money supply (TL Billion)
* *M2*: Money supply, which includes time deposits (TL Billion)
* *P*: Consumer price index, CPI (1987=100)
* *Y*: Nominal income (GNP)
* *R*: Nominal interest rate (as weighted averages of sight deposits)

* *EBUY*: Buying exchange rate (buying rates daily averaged series has been converted to quarterly series)
* *ESELL*: Selling exchange rate (selling rates daily averaged series has been converted to quarterly series)

Returning back to Equation 1, the coefficient $\beta_1$ represents the income elasticity, while $\beta_2$ and $\beta_3$ are coefficients on interest rate and exchange rate, respectively, if these variables are entered linearly, i.e., $g_j(x)=x$, where j=1,2 and x={R, ER}. If the interest rate and the exchange rate are entered into equations after being transformed with the natural log, i.e., $g_j(x)=\log(x)$, $\beta_2$ and $\beta_3$ will have the interpretation of interest and exchange rate elasticities. Being cognizant of the lack of consensus on the "right" form of the "g" function, we also present results with the logarithmic "g" function at the end of the study even though we employ the linear form of the "g" function for the most of the study. The findings do not contradict.

Thus, the expected signs of $\beta_1$ and $\beta_2$ are positive and negative, respectively. Since the exchange rates used in this study are quoted as domestic price of the foreign currency, a negative sign on the exchange rate coefficient, $\beta_3$, would indicate a currency substitution in the Turkish Lira as a result of the Lira's depreciation.

Our focus of the study was to investigate the cointegration relationship(s) among the variables of Equation 1, if there is any, with the help of a maximum likelihood approach a la[29-31]. Because of its statistical properties, mainly its robustness in terms of model specification, the Johansen method have been the tool of preference in detecting a possible cointegrating relation among a set of variables. There are far too many applications of cointegration methods in money demand estimation to be exhaustive. However, the reader is referred to a few well-known early examples such as[24, 25, 32, 33].

The cointegration requires that the variables must be integrated of order 1, I (1), individually, with a common stable relationship (of order I (0)) for this type of study. An Augmented Dickey-Fuller (ADF) test run on variables shows that variables satisfy this criterion. Both to save space and the inessential characteristic of these results, we do not provide them in this study. We do the same for some of the other inessential findings in the rest of the study. At any rate, all results are available from the authors upon request. Since the cointegration technique at hand is sensitive to the lag length used in the empirical analysis, we first determine the optimum lag length in accordance with the procedure suggested by[34] by making use of both Akaike and Schwartz Information Criteria, AIC and BIC, respectively. In case of a conflict between AIC and BIC, we choose the smaller in the interest of parsimony in empirical work, which is also a pretty common practice in applied work.

The issues regarding the alternative specification of the opportunity cost concepts and seasonality are addressed for the sake of robustness of the findings.

## RESULTS AND DISCUSSION

We carried out the cointegration experiments for the whole data period, i.e. 1987:1-2000:2. The results of the cointegration tests are presented in Table 1 in a functional form depicted precisely in Equation 1, with and without the exchange rates. A clarification to the cointegration vectors presented in the table is in order here: We present a linear combination of the two statistically significant vectors, when found so, to yield a unitary income elasticity. However, this is merely a convenient restriction that we imposed for expositional purposes only. This is not in violation of the cointegration theory. As shown in the table, in the absence of exchange rates and with 4 lags in the estimation, we fail to obtain a statistically significant cointegration vector for either definition of money, i.e. M1 and M2, which may define a theoretically expected relationship with the explanatory variables. More specifically, while no cointegration vector is found for M1, three vectors are suggested for M2. The latter is obviously in contradiction with the earlier findings of ADF tests as well as graphical observations. Even when we consider the results produced with the optimum lag lengths in the Johansen procedure, we do not arrive with theoretical expectations as far as the coefficient of income for both M1 and M2 is concerned.

The problem with finding a statistically significant relationship between a monetary aggregate and a set of variables is not new in economics. In the case of the US economy, such a debate was initiated by the seminal work of Goldfeld[35]. A recent discussion on the issue is[36]. The failure to find a consistency between theory and empirics led some economists to take dramatic positions on the monetary theories. Goldfeld[35] is an illuminating example of this dispute. The debate has been well researched within the context of financially developed economies, but we think the reasons why we cannot obtain a theoretically expected relationship from the data pertaining to less developed, small, open, economies have a lot to do with the currency substitution. This is because in such economies, residents try to hedge themselves against changes in (domestic) currency by seeking the relatively stable refuge of a foreign currency, especially so for people with higher income. If we broadly consider income as a proxy for wealth, we can say that as one gets richer s/he tends to hold a less amount of money on her/his pocket, either by spending it or converting it into another currency whose value is deemed more stable, or maybe appreciating against the domestic currency.

Table 1: Cointegration Results

| Variables | Lags | # CV | CV |
|---|---|---|---|
| lM1/P, lY/P, R | 4 | 0 | |
| | 1* | 1 | 1, 1.0360869, 0.0007554 |
| lM2/P, lY/P, R | 4 | 3 | |
| | 3* | 1 | 1, -2.234708, 0.016514 |
| lM1/P, lY/P, EBUY, R | 4 | 2 | 1, -1, 6.26E-6, 0.016162 |
| | 3* | 2 | 1, -1, 3.2E-6, 0.014618 |
| lM2/P, lY/P, EBUY, R | 4 | 1 | 1, -29.04797, -9.025E-5, 0.098729 |
| | 3* | 1 | 1, -1.313877, 4.24E-7, 0.012776 |
| lM1/P, lY/P, ESELL, R | 4 | 2 | 1, -1, 6.25E-06, 0.016189 |
| | 3* | 2 | 1, -1, 3.18E-6, 0.014625 |
| lM2/P, lY/P, ESELL, R | 4 | 1 | 1, -28.54599, -8.82E-5, 0.096992 |
| | 3* | 1 | 1, -1.31771, 4.08E-7, 0.012787 |

Maximum likelihood estimates of cointegration tests using the Johansen method. Constant but no trends are assumed in the cointegrating vector. The lag structure is determined via the procedure mentioned in Lutkepohl (1991). Optimum lags are marked with an asterisk. The test period is 1987:1-2000:2. The significance is determined at 5%. #CVs gives the number of statistically significant cointegration vectors. These vectors are shown in the CV column. lM1/P (lM2/P) stands for the natural log of real M1 (M2). While R represents the nominal interest rate, lY/P is used for the natural log of the real income. EBUY (ESELL) is the buying (selling) exchange rate denominated as the domestic price of the foreign currency.

Table 2: Cointegration Tests With Log (Opportunity Costs)

| Variables | Trace | Mx EV |
|---|---|---|
| lM1/P, lY/P, lR | 26.698 | 18.925 |
| lM1/P, lY/P, lR, lEBUY | 57.509 | 32.198 |
| lM1/P, lY/P, lR, lESELL | 57.329 | 32.007 |
| lM2/P, lY/P, lR | 40.766 | 24.397 |
| lM2/P, lY/P, lR, lEBUY | 57.179 | 29.061 |
| lM2/P, lY/P, lR, lESELL | 57.107 | 28.985 |

The definitions of the variables are as in the above table with the addition of logging opportunity cost concepts. Trace stands for the Trace test statistic and Mx EV for maximal eigenvalue test statistic. The null hypothesis in the trace test is no cointegrating vectors. The 5% critical value with 3 variables in the process is 31.3. It is 48.4 when 4 variables are investigated. The null hypothesis for the maximal gain value test is no cointegrating vectors while an alternative is one factor. The 5% critical values 3 and 4 time series are 21.3 and 27.3, respectively.

Table 3: Cointegration Tests in the Presence of Seasonality

| Variables | Trace | Mx EV |
|---|---|---|
| lM1/P, lY/P, R | 29.061 | 20.248 |
| lM1/P, lY/P, R, EBUY | 60.140 | 32.253 |
| lM1/P, lY/P, R, ESELL | 60.041 | 32.125 |
| lM2/P, lY/P, R | 43.454 | 28.363 |
| lM2/P, lY/P, R, EBUY | 64.603 | 36.263 |
| lM2/P, lY/P, R, ESELL | 64.653 | 36.286 |

The definitions of the variables are as in the above table with the addition of logging opportunity cost concepts. Trace stands for the Trace test statistic and Mx EV for maximal eigenvalue test statistic in the presence of seasonality for seasonally unadjusted series. The null hypothesis in the trace test is no cointegrating vectors. The 5% critical value with 3 variables in the process is 31.3. It is 48.4 when 4 variables are investigated. The null hypothesis for the maximal gain value test is no cointegrating vectors while an alternative is one factor. The 5% critical values 3 and 4 time series are 21.3 and 27.3, respectively.

Otherwise, the opportunity cost of not doing so in a highly inflationary economy with a fast "depreciating currency" can be quite costly. As a matter of fact, we found out that the anecdotal evidence supports this expectation for the case of Turkish Lira.

Inclusion of an exchange rate in the process, together with the optimum lag lengths, on the other hand, totally changes the scene where we now find a positive income elasticity, though in some cases it is still slightly above unity. We consider this finding a support for our assertion that in economies such as Turkey, the exchange rate is an essential variable to take into account in analyzing monetary relations.

The coefficient on interest rate for both narrow and broad definitions of money is negative with or without exchange rates or the type of the latter included in the estimation process when a significant factor is found.

The crucial coefficient in this estimation is that of the exchange rate. In all specifications of estimation of Equation 1 above, we find a negative coefficient on exchange rate concepts, suggesting currency substitution taking place in Turkish currency irrespective of the monetary aggregate or the exchange rate concept employed in the analysis.

It is worthwhile to mention that the exchange rate coefficient obtained from these estimations indicate an inelastic relationship between money demand and changes in the exchange rate. It is simple to infer the elasticity from the given exchange rate coefficient. Especially for high levels of money, inelasticity becomes even more prominent. We conjecture that the Turkish people have come to know the workings of the currency market with the convertibility in place. This has been characterized by a secular depreciating trend of the Turkish Lira in recent decades after the liberalization movements of 1980s. This type of behavior of market participants obviously sharply curtails the monetary authorities' ability in making the policy, especially at times of crises.

One last issue is the fact that the M2 exchange rate elasticity is larger than the M1 exchange rate elasticity, in absolute value, though not statistically. This might indicate the higher opportunity cost exchange rate deprecations associated with the broad monetary aggregate. Likewise, it can also be considered as an indicator of the weight people assign to M2-Wealth relationship rather than to the M1-Wealth relationship.

To ensure the robustness of our results, we briefly focused on two issues in this section. Specifically the format of the opportunity costs when entered into the estimation equations and the impact of seasonality (or lack thereof) on the findings.

Even though we entered opportunity cost concepts, interest and exchange rates in Equation 1 as in levels, the literature is not unanimous regarding its format. Furthermore, the log of opportunity costs is not uncommon in empirical research. One example is[20]. Broadly speaking, at both the Trace and Maximal Eigen Value test statistics in Table 2 show, an inclusion of the exchange rate into the estimation process would provide a strong support for the rejection of a null hypothesis of no cointegration, irrespective of the monetary aggregate in question at the 5% level of significance. Hence, these findings suggest no reversal of our major results so far.

Another contentious issue in the literature is the way to handle seasonality in variables. All of the empirical work so far has been performed on seasonally adjusted variables. Although[28] and the references therein propose the use of seasonally adjusted data, especially within the context of forecasting, when appropriate to minimize forecast errors,[37] and the references therein advocate the use of seasonally unadjusted data when available[38], however, recommends inclusion of seasonality in a model *even* with seasonally adjusted data. As a result, we carried out the Johansen tests on the original data with no seasonal adjustment of the variables themselves, to address the controversy in the literature. The results are shown in Table 3.

It is clear from both the trace and maximal eigenvalue tests that the functional form of "g" in Equation 1 does not play a crucial role and thus it does not reverse our earlier findings regarding the relation among the variables in that equation. We then conclude that, under the light of all these findings, exchange rates are an indispensable part of monetary relations within the Turkish currency framework once the impact of income and interest rates are accounted for.

## CONCLUSION

We empirically analyze the determinants of two Turkish monetary aggregates, namely M1 and M2, where GNP as a scalar variable and interest rate alone with the exchange rate as the opportunity cost variables are used. We found evidence of currency substitution in the Turkish currency with an inelastic demand and concluded that this could be an important restrictive factor in policy making for Turkish monetary authorities, more so at times of crises, which are not very uncommon to the Turkish economy.

Since our results stood the tests of functional form of the opportunity cost specification and presence or absence of sensuality for both narrow and broad definitions of monetary aggregates, we believe that exchange rate factors may be quite important for a more effective monetary policy making in Turkey.

Yet, this research can be extended in many ways. One clear extension could be research based on different time periods to search for consistency in the results. Especially, given that Turkey has recently gone through a restructuring in its currency and that the dollar has lost quite a bit of its value, the currency substitution can be analyzed under a new light for the Turkish Lira. The questions that might be relevant under these circumstances would be whether currency substitution has disappeared (or diminished) in the new environment, if there is one such environment in the statistical and economic sense of structural break, or is dollar replaced by the Euro. We, however, have to wait for a little longer to give these events sufficient time for the data to occur.

Further research is also warranted to investigate the effectiveness of inflationary financing of government spending in economies such as that of Turkey when people tend to avoid holding domestic currency, which may practically render such government aspirations powerless.

We used time series techniques, which are very common in the literature. Alternatively, one could survey market participants in Turkey and carry out cross-sectional exercises to test the robustness of time series' findings. The problem, though, with this method is that it may very well be costly in terms of funding and time, among other technicalities.

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