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REDUCING OBSTACLES TO ECONOMIC GROWTH

OUR PARTNERS
MACROECONOMIC DETERMINANTS OF CURRENCY SUBSTITUTION IN TURKEY

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1. Introduction
Currency substitution exists in a country when a more stable foreign currency exists along with a domestic currency. Currency substitution effect exists when foreign currency is persistently held by domestic residents for transaction, speculative or precautionary purposes. Holding different currencies facilitates and reduces the costs of transactions and represents possible additional returns given by the rate of appreciation of the currency. Vegh (1989) stresses the transaction motive for holding foreign currency. It is argued that people find it more convenient to use dollars in their transactions due to the change in the exchange rate. Ortiz (1983) and Ramirez–Rojaz (1985) mention the precautionary motive for holding a foreign currency. People hold dollar-denominated financial assets in order to hedge themselves from the depreciation of domestic currency, which can be seen as precautionary motive for holding foreign currency.

Currency substitution may have serious implications for monetary policy. Policies adopted to affect money supply and similar monetary variables may not have the desired results under currency substitution (Miles (1978)). Given the importance of pursuing a successful monetary policy, an empirical analysis of the determinants of currency substitution is crucial. The increase in the ratio of foreign currency in domestic money makes it more difficult for the monetary authority to control domestic liquidity and make predictions. Prock, Soydemir & Abugri (2003) argue that the greater the degree of currency substitution, the more sensitive is a country’s monetary aggregates to sudden changes in the exchange rates, productivity and interest rates.

It is difficult to uniquely define currency substitution as it has been defined in various ways in the literature. Mostly, the experience of increasing holdings of foreign currency deposits is viewed as currency substitution. Calvo and Vegh (1992) emphasized the function transferring role of foreign currency. They argue that domestic currency leaves its store of value and unit of account functions to the foreign currency. Vegh (1989) stresses the transaction motive for holding foreign currency. Ortiz (1983) and Ramirez–Rojaz (1985) mention the precautionary motive for holding a foreign currency. Cuddington (1983) defined currency substitution as the resident’s using foreign currency as well as domestic currency in the medium of exchange function.

Giovanni and Turtelboom (1993) argue that currency substitution is widespread in high inflation, developing and transition countries, although there are developed countries with zero or low inflation which have experienced currency substitution. Currency substitution is

The aim of this paper is to investigate the factors determining the choice of substitution currency by economic agents in Turkey between 2000 and 2014 period. We focus on defining the appropriate variables determining currency substitution for Turkey. In addition to the conventional variables based on portfolio balance approach of currency substitution, which are expected depreciation and interest rate differential, ratio of central bank reserves to M2 and expected inflation are used in our model.

Totally removing foreign currency from a country could be considered as a way of reversing the process. However, there is a need for foreign currency for trade, tourism and economic globalisation purposes. De-dollarization might have higher costs than dollarization does (Akyuz & Boratav (2001)). This paper focuses on the policy implications of currency substitution in Turkey. The rest of the paper is organized as follows. In section two studies on currency substitution for Turkey are summarized. In section three the development in the dollarization in Turkey is analyzed. In section four studies on currency substitution in countries other than Turkey are presented briefly. In section five empirical results of cointegration tests are provided. In section six conclusion and the policy implications of the findings are presented.

2. Earlier Studies on Currency Substitution for Turkey

The definition of currency substitution varies depending on the measures such as foreign currency denominated deposits in the domestic financial system, deposits held abroad by domestic residents, and foreign currency circulating in the country. Because of these various definitions of currency substitution, economists could not agree to choose the precise one. These definitions affect the pre-study research and the study itself. A similar concept; dollarization is used as the observable counterpart of currency substitution. Cuddington (1983) and Calvo & Végh (1992) use currency substitution to refer to the use of different currencies as the medium of exchange. For the transfer between domestic and foreign interest bearing assets however, they prefer to use the term “capital mobility”. Selçuk (1994) defines currency substitution as the replacement of domestic currency in its traditional roles by foreign currencies. According to Sturzenegger (1997) the use of a stable foreign currency for transactions shows currency substitution.

Giovannini and Turtelboom (1992) distinguish between “currency substitution” and “currency substitutability”. According to them, the former is the case when domestic currency is completely replaced by foreign currency, i.e. good money drives out bad money. The latter one is the process by which one currency becomes a substitute for another but does not completely replace it. Calvo and Vegh (1992) distinguish between currency substitution and dollarization. According to them, dollarization occurs when the store of value and the unit of account properties of the domestic currency are transferred to foreign monies. When the medium of exchange property is assumed by foreign money, the process is defined as currency substitution. According to them, currency substitution is the last stage of dollarization and dollarization ratios such as proportion of foreign currency denominated deposits to broad money can only be a proxy for currency substitution since there are usually no data on foreign currency circulating in the economy.
In this section the studies on currency substitution for Turkey are presented. Turkey experienced high and chronic inflation in nearly past 30 years before 2001. Therefore, the credibility of national currency is lost for long years (Central Bank Note (2006)). Currency substitution can be seen as a response of economic agents to inflation uncertainty. Although currency substitution can generate some benefits to economy, several studies have found its negative effects on micro and macro economic variables. Currency substitution increase exchange rate and output volatility, lowers growth of economies with floating exchange rate systems, makes countries vulnerable to external shocks, increases financial risk and makes monetary policy less effective (Akcay et al. (1997).

Selcuk (1994) investigated the internal dynamics of currency substitution in order to identify the responses of currency substitution to shocks in certain policy variables in the Turkish economy, for the period 1986-1992. Selcuk found that the lagged values of currency substitution have positive coefficients suggesting persistence. It is found that an unexpected real appreciation of the Turkish lira has a negative impact on the growth rate of currency substitution. Selcuk concluded that policy makers have to trade off a less external deficit that can be achieved by depreciation which further results in currency substitution, with more independent monetary policy.

Selcuk (1997) analysed currency substitution in the Turkish economy. Following Imrohoroglu (1994) where a dynamic approach is used to test currency substitution between Canadian and the US dollars, a money-in-the-utility function using Hansen’s GMM procedure is used for estimations. Selcuk found that the elasticity of substitution between the Turkish lira and the US dollar is high and statistically significant for the period 1985-1993. Selcuk (2001) analysed the effect of currency substitution on seigniorage maximizing inflation rate in Turkey. He investigated whether the revenue of seigniorage in Turkey decreases under currency substitution or not. It is found that it does decrease. Akcay et al. (1997) examined the presence of currency substitution and its effects on exchange rate instability in Turkey using the data of the 1987:1-1996:6 period. They tested the view that instability in foreign exchange speeds up currency substitution using E-Garch method. Their findings supported this view.

Civcir (2003) analysed the determinants of currency substitution in Turkey using the data of the 1986:1-1999:12 period. He tested the relationship between money demand, real income, interest rate, inflation and the expected depreciation using cointegration methodology. Civcir found a negative relation between currency substitution and interest rate differential between 3 months Turkish lira and 3 months dollar deposits & credibility variable. A positive relation is found between dollarization ratio and expected exchange rate & exchange rate risk. Parameter stability of short run and long run money demand indicated that there is no serious instability in the estimated coefficients under the period of investigation.

Domac and Oskooee (2002) investigated the role of currency substitution in the dynamics of inflation in Turkey. They found out that high inflation, economic instability and institutional weaknesses are the main reasons of currency substitution in Turkey. Akcay et al. (1997) and Domac and Oskooee found that as currency substitution increases, the volatility of the exchange rate increases as well. Domac and Oskooee concluded that increasing the volatility of exchange rate without raising that of inflation would be effective under inflation targeting regime in order to limit currency substitution. Domac and Oskooee (2002) mention that in addition to high inflation and economic instability, institutional factors are important determinants of dollarization in Turkey.
Özcan and Us (2007) analyze the determinants of dollarization such as exchange rate depreciation volatility, inflation volatility and expectations. According to generalized impulse response function analysis and variance decomposition it is seen that dollarization seems to sustain its persistence and hysteresis still prevails. Özcan and Us state that macroeconomic instability contributes to dollarization and causes inertia. Yazgan and Toker (2008) analyzes currency substitution and exchange rate pass-through in the Turkish economy using vector error correction model for the period from 1987 to 2004. Yazgan and Toker found that 1% increase in the depreciation rate would lead to 42% increase in the inflation rate. This finding indicates that 1994 currency crises has a permanent effect on this relationship and inflation has been declining in the long term.

Sever (2012) analyzed the relationship between exchange rate uncertainty and dollarization in Turkey during 1989 and 2010 using Granger causality test. Exchange rate uncertainty is determined by using exponential GARCH mean model method. It is found that there exists bi-variate causality between these variables till the sixth lag. It is seen that after the sixth lag dollarization leads to the exchange rate uncertainty. Zeybek (2014) investigated the correlation between dollarization, inflation, required reserve ratio and real sector confidence index. Zeybek did not find a significant relationship between dollarization and the required reserve ratio. On the other hand he found out that the correlation coefficient between the real sector confidence index and dollarization is 0.32. In other words when dollarization decreases the confidence index increases, therefore inflation decreases. Also, a significant relationship between dollarization and the cost of borrowing is found to exist. Increases in liability dollarization causes an increase in companies’ cost of borrowing through expenditures caused by currency differences.

In some studies de-dollarization; that is the establishment of the confidence in Turkish lira has been investigated. Yılmaz (2005), Akıncı and Görmez (2005) defend that there is no de-dollarization in Turkey, did not find any evidence supporting de-dollarization. Özcan and Us (2006) investigated the inflation and currency volatility together and did not find any significant evidence of de-dollarization. On the contrary Erbaykal, Darıcı and Kadıoğlu (2008) found evidence supporting de-dollarization in Turkey. Observing the Republic of Serbia case, Milenkovic and Davidovic (2013) state that an economic agent’s confidence is lost quickly, but the containment of negative psychological factors and the restoring of confidence in the domestic currency is a painstaking process in the Republic of Serbia.

Erbaykal, Darıcı and Kadıoğlu (2008) estimated the Turkish money demand function by using monthly data between 2001 and 2006. The variables used are M2 money supply, real GDP, nominal interest rate and nominal exchange rate. Erbaykal, Darıcı and Kadıoğlu investigate whether the currency substitution which occurred in the 1980’s reversed with the “Program for Transition to a Strong Economy” that was applied after the February 2001 crises. After performing co-integration test, a long run relationship is found to exist between the variables. It was determined that after the improvements and forward measures, which have been implemented, the confidence in Turkish lira increased and became preferable by the economic agents.

Theoretically seignorage revenue which is described as the revenue of government printing money is expected to decrease with the decline in real money demand under currency substitution. Under de-dollarization in line with the increase in real money demand the seignorage revenue is expected to increase. Taşçi and Darıcı (2008) test the expectation that de-dollarization have effects on seignorage revenue through exchange rate. The money demand
between 1987-2007 is investigated for this purpose. The findings support the expectations that
dollarization has negative, and de-dollarization has positive effect on seignorage revenue via
exchange rate. Due to the decrease in volatility of exchange rate, the confidence in the Turkish
lira increase and thereby dollarization also decreases.

Sarı (2007) states that there is a positive relationship between exchange rate and
dollarization. As the exchange rate increases domestic currency depreciates and dollarization
increases. Especially, the depreciation of domestic currency in high inflation periods increases
the level of dollarization. In order to sustain de-dollarization inflation should be under control at
low levels. According to Sarı in recent years Turkey is in a relatively better position in terms of
dollarization, however pre-2001 instability in the Turkish economy restricts the confidence in the
Turkish lira and therefore de-dollarization can not occur completely.

3. The Development of Dollarization Ratio in Turkey

Turkish economy has experienced economic crises since 1990s. External factors have
played important roles in these crises. Yet, the main reasons for the crises are the unsustainable
domestic debt dynamics and the lack of structural reforms especially in the financial sector. The
Turkish economy has been experiencing dollarization since the introduction of foreign currency
deposits in December 1983. A high and volatile rate of inflation, a depreciating exchange rate,
unsuccessful stabilization efforts, financial crises, and under-developed capital markets all
contributed to the rising dollarization ratios. The instability in the financial sector combined with
high and variable inflation rate caused the credibility of the Turkish lira to drop. In a chronic
inflationary environment deprived of a monetary anchor, high real interest rates become in fact
both the cause and the consequence of high inflation. That is, they feed into high inflation and in
turn are fed by high inflation and the associated risks.

The dollarization ratio described as the share of foreign exchange deposits in M2Y has
increased from 42 % in 2000 to 60 % in 2001 as can be seen in figure 1 below. The dollarization
ratio has dropped in the post 2002 era till 2011. This is due to the conduct of “Transition to the
Strong Economy Program” which has started in 2001. By the conduct of this program the
confidence in Turkish lira had significantly increased in this era. Between 2011 and 2012 the
dollarization ratio has increased because of Euro debt crises and geopolitical risks which were
caused by Arab Spring. Between 2012 and the first half of 2013 the dollarization ratio has
decreased because of FED’s Quantitative Easing 3 Program. Quantitative Easing 3 Program has
increased capital flows to emerging market economies which resulted in weak dollar and strong
local currencies. In the second half of 2013 the dollarization ratio has increased because of
FED’s forward guidance of Quantitative Easing Exit Plan. The ratio has continued to increase
due to the domestic instability caused by the elections held in 2014.

The foreign exchange denominated liabilities of the banks have also increased due to
attractiveness of returns on Turkish lira denominated securities, putting even more pressure on
the open position of the banks, and causing banks to expose more risk and vulnerability to
exchange rate changes. Under these circumstances, in order to reverse currency substitution, it is
critical to know the degree of persistence of the currency substitution in order to find an efficient
monetary policy rule it.
4. Literature Review on Currency Substitution for Countries Other Than Turkey

Dollarization affects the design, implementation and effectiveness of monetary, fiscal and exchange rate policies. According to the studies in the literature dollarization has several effects. These effects include; the reduction of the monetary authorities’ control over domestic liquidity by increasing the component which is difficult to influence and by causing instability of money demand function, the impact of dollarization on the choice of exchange rate regime and increasing the exposure of the banking system to financial crises though the foreign liabilities of the banks. Calvo (1992) states that liability dollarized economies are highly vulnerable to devaluation. The macroeconomic environment, institutional factors and agent’s expectations of future political events are the main factors affecting dollarization process.

Fisher (2006) defines four types of dollarization: 1) asset dollarization, 2) liability dollarization, 3) medium of exchange dollarization, in which a foreign currency is used for some transactions, 4) unit of account dollarization in which future payments are indexed to an exchange rate. This last definition is called real dollarization as well. In the studies on dollarization it is investigated whether different types of dollarization contribute to financial vulnerability and instability. Also, the ways of de-dollarization and the conditions under which less dollarization could be maintained are investigated in the literature.

Selcuk (2001) quotes that Ortiz (1983) points out that; high liabilities in foreign currencies could lead to speculative attacks, which reduces the efficiency of the economy. In credit markets an increase in foreign currency denominated bank deposits will change the portfolio composition of the banks. This will affect the ability of banks to distribute credits in the domestic market. Ize & Levy-Yeyati (1998) define the dollarization of financial assets and liabilities as financial dollarization. It is the holding of foreign currency by residents of a significant share of their assets and liabilities. Us (2003) defines financial dollarization as the ratio of foreign exchange credits to total credits. Holding different types of assets denominated in different currencies and in different locations made it easier to diversify risk for the investors. Domestic money demand estimations using M1 and/or M2 money supply are undertaken in the literature using expected depreciation as an alternative asset in the estimations. The significance of expected depreciation is interpreted as currency substitution.

Bahmani-Oskooee and Karacel (2006) analyzes domestic money demand in Turkey. Exchange rate, income, interest rate and inflation rate are used in the estimations. It is found that for a successful and effective monetary policy the monetary authorities would focus on M1 since it’s stable and has cointegration relationship with the other variables. It is seen that income and
interest rate don’t belong to cointegration space in M2 formulation. Unexpected depreciation of the Turkish lira could make market participants expect further depreciation of Turkish lira; which means that they would have less desire to hold lira. Bahmani-Oskooee and Karacel argue that therefore M1 should be taken into account while conducting monetary policy in Turkey.

Catao and Terrones (2000) presents a two currency banking model to show that deposit and loan dollarization are determined by interest rate and exchange rate risks. The direction in which dollarization tends to move with macroeconomic shocks is shown to depend on both interest rate and exchange rate risk for dollarization. It has been mentioned that deposit and loan dollarization have not always increased at the same rate. As a result banking system might experience some degree of currency mismatch between assets and liabilities. Dutu (2008) analyzes the shocks that affect the value of the domestic currency. It is found that any shock that increases the value of domestic currency causes depreciation of foreign currency. Kessy (2011) investigates financial dollarization in Tanzania and other East African countries and found that it is high in Tanzania and steadily declining.

Savastano (1996) analyses the role of institutional factors in the process of dollarization for Bolivia, Mexico, Peru and Uruguay. It is observed that as the uncertainty about the future political developments increase; the agents’ incentives to hold foreign currency increase. Prock, Soydemir & Abugri (2003) argue that the greater the degree of currency substitution, the more sensitive is a country’s monetary aggregates to sudden changes in the exchange rates, productivity and interest rates. They point out that policymakers who want to adopt another country’s currency as a domestic currency should implement structural reforms to bring their economy in line with the anchor currency country. Such reforms would lead to endogenous adjustment in the variables such as exchange rate, inflation and interest rate to levels that are more consistent with dollarization.

Fisher (2006) states that asset and liability dollarization makes the financial system and also the economy more vulnerable to exchange rate shocks. In the banking system operating in two currencies, it is believed that banks would be hedged their foreign currency liabilities by lending in dollars. However, they are not hedged, as the borrowers may not be able to pay their dollar denominated loans. Fisher mentions that a deep devaluation could devastate banks’ balance sheets, although banks thought that they have a net long position in foreign currency denominated assets. Therefore, dollarization could increase the vulnerability of the banking and financial systems to exchange rate movements. Broda & Levy – Yeyati (2001) mention about the irreversibility of dollarization. In the light of the findings in the previous studies a decrease in dollarization would have a favourable effect on inflation. However, this general policy implication cannot be applied in practice. Evidence shows that there is hysteresis; i.e. dollarization ratios do not decline even the domestic currencies are stabilized and financial markets are deepened as a result of switching costs and long-lasting memories. Broda & Levy - Yeyati (2001) argue that hysteresis can take place even if the memory of past macroeconomic imbalances does not exist.

5. Empirical Analyses and the Model Used in the Estimations

We construct a model of foreign money demand for our empirical purposes for analysing currency substitution for the investigation period of 2000:1-2014:12 using monthly data. The model used in this paper is an extension of the model used by El-Erian (1988). Similar variables are used by Ramirez-Rojaz (1985), Rojaz-Suarez (1992) and Clements & Schwartz (1993) in modelling currency substitution. The model used in El-Erian (1988) can be written as follows:
\[
\ln(\text{curr})_t = \alpha + \ln(\text{curr})_{t-1} + \beta (\text{expdep})_t + \gamma (\text{intdiff})_t + \delta \phi_t
\]  
(1)

where \( \phi \) is a dummy variable measuring economic and political uncertainties. Following El-Erian (1988) we model currency substitution for Turkey using additional variables such as the ratio of central bank reserves to M2Y as a proxy for measuring liquidity. Also, we add the expected inflation variable as an explanatory variable.

The data is obtained from the Central Bank of Republic of Turkey’s electronic data distribution system. The monetary variable we consider (M2Y) is the broadly defined monetary balances in natural logarithms which is the sum of currency in circulation and demand, time and foreign currency deposits in the banking system. Currency substitution ratio (curr) is defined as the logarithm of the ratio of foreign currency deposits to broad monetary aggregate. Interest rate differential (intdiff) refers to the percentage of interest rate differential between 3-month TL deposits and 3-month foreign currency deposits. Expected depreciation (expdep) is calculated as the change between the logarithm of the nominal exchange rate at period \( t \) and the logarithm of the exchange rate at period \( t-1 \). Expected inflation (expinf) is the change between the logarithm of the consumer price index at period \( t \) and the logarithm of the consumer price index at period \( t-1 \). Central bank reserve ratio (cbres) is the ratio of the level of central bank reserves to monetary aggregate, M2Y.

Since currency substitution is seen as a response of economic agents to inflation, expected inflation is included in our model. The high and fragile public debt structure together with high budget deficits has important effects on currency substitution in Turkey. Governments create inflation in order to reduce the real burden of the debt, which increases the risk premium of the debt denominated in domestic currency.

The interest rate differential is defined as the percentage of difference between interest rates on 3-months TL deposits and 3-months foreign currency deposits. Previous studies on currency substitution indicate that differences in returns between alternative monies and domestic currency determine the allocation of money between domestic and foreign currencies. Agenor & Khan (1996) argue that the interest rate differential between domestic and foreign currencies and the expected depreciation are the important determinants of currency substitution. Sahay & Vegh (1995) define real return differential between foreign currency and domestic currency denominated assets as \( (i^* - \pi^*) - (i - \pi) \), where \( \pi \) and \( \pi^* \) are domestic and foreign inflation rates and \( i \) and \( i^* \) domestic and foreign nominal interest rates. As currency substitution is high even when the relative returns of domestic and foreign currency is higher than the return on foreign currency for Turkey for a long period of time, some other variables are needed in order to capture the determinants of currency substitution in Turkey.

### 5.1. Unit Root Tests

The bounds testing approach of Pesaran et al. (2001) can be used if the variables are either stationary or integrated of order one. In other words, bounds testing cannot be applied if the order of integration for variables is two or higher. In order to determine the order of integration, Augmented Dickey Fuller (ADF) tests are applied to the levels and the first differences. The numbers in parentheses are the lags used for the ADF test, which are augmented up to a maximum of 11 lags. The choice of optimum lag for the ADF test was decided on the basis of minimizing the Akaike Info Criterion (AIC). The letter ‘d’ shows that the variable is differenced once. The ADF test results are given in tables 1 and 2.
Table 1. ADF test results for levels of variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>With trend and intercept</th>
<th>With intercept only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>ADF</td>
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<td>Lncurr</td>
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<td>indiff</td>
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<tr>
<td>expdep</td>
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<td>-6.38***</td>
</tr>
<tr>
<td>Expinf</td>
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<td>-2.17</td>
</tr>
<tr>
<td>Cbres</td>
<td>6</td>
<td>-2.37</td>
</tr>
</tbody>
</table>

Note: The critical values for the models with trend and intercept are -4.01, -3.43 and -3.14 for confidence levels of 99 percent, 95 percent and 90 percent respectively. The critical values with intercept only are -3.46, -2.87 and -2.57 for confidence levels of 99 percent, 95 percent and 90 percent respectively. Rejection of null hypothesis is shown with * for 90 percent, ** for 95 percent and *** for 99 percent confidence levels.

Table 2. ADF test results for first difference of variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>With intercept only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lags</td>
</tr>
<tr>
<td>dlncurr</td>
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</tr>
<tr>
<td>dintdiff</td>
<td>2</td>
</tr>
<tr>
<td>dexpinf</td>
<td>10</td>
</tr>
<tr>
<td>dcbres</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: The critical values for the models with intercept only are -3.53, -2.90, and -2.58 for confidence levels of 99 percent, 95 percent and 90 percent respectively. Rejection of null hypothesis is shown with * for 90 percent, ** for 95 percent and *** for 99 percent confidence levels.

5.2. ARDL Model Results

Since the order of integration of variables are determined previously, we can move on to determine the existence of long run relationship between variables of interest. Engle and Granger (1987) co-integration method determines whether there is one co-integrating vector between the variables or not. It does not consider the existence of more than one co-integrating vector. This method can be considered as a very restricted version of co-integration tests. On the other hand widely popular maximum likelihood based Johansen (1988; 1995) and Johansen and Juselius (1990) multivariate co-integration test can be used to test whether there exists a long run equilibrium between variables provided that the variables of interest are found to be integrated of same order.
We found that the variables of interest have different orders of integration. Therefore, we cannot apply either Engle & Granger (1987) or Johansen (1995) co-integration methods. In this paper, in order to test the existence of cointegration among the variables, bounds testing approaches developed by Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001) are used. The reason for selecting this approach is that this co-integration method allows for different orders of integration of variables. Particularly, it allows the variables to be stationary, integrated order one or a combination of both. Moreover, as illustrated by Pesaran et al. (2001), bounds testing for cointegration is followed by an analysis of an autoregressive distributed lag model (ARDL) based on Pesaran and Shin (1999). This model allows examining both the short run and long run dynamics.

Let us consider the vector error correction model in Eq. (1):
\[
\Delta Y_t = \mu + \lambda Y_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta Y_{t-j} + \epsilon_t
\]  
(2)

In Eq. (2), \(Y_t = [y_t, x_t]'\) is defined as the variable vector in which \(y_t\) represents the endogeneous variable \(\text{lncurr}_t\), that is, the logarithm of foreign currency holdings and \(x_t\) represents the explanatory variables which are assumed to affect the foreign currency holdings in Turkey. We can write the possible co-integration relationship as follows:
\[
\Delta \text{ln} y_t = \alpha + \phi \text{ln} y_{t-1} + \delta x_{t-1} + \sum_{j=1}^{p-1} \beta_{1,j} \Delta y_{t-j} + \sum_{j=1}^{q-1} \beta_{2,j} \Delta x_{t-j} + \eta_t
\]  
(3)

In Eq. (3), \(\phi\) and \(\delta\) are the long run multiplier coefficients, while \(\Delta y_{t-j}\) and \(\Delta x_{t-j}\) express the short run dynamic structure of our error correction model. The bounds testing approach requires the ordinary least squares (OLS) estimation of Eq. (3) with or without trend component, and then the absence of a long run relationship between the level values of \(y_t\) and \(x_t\) could be tested by use of the \(F\)-statistics in line with the hypotheses: \(H_0: \phi=0, \delta=0; H_1: \phi\neq 0, \delta\neq 0\). In Eq. (3), the rejection of \(H_0\) hypothesis by the standard \(F\)- (or Wald-) tests leads to the acceptance of \(H_1\) hypothesis and indicates a long run equilibrium relationship between the variables. The statistics such estimated then are compared with the non-standard distributed asymptotic critical value bounds reported in Pesaran et al. (2001). If estimated \(F\)-statistic falls outside of the critical value bounds, we can definitely infer whether or not there exists a cointegrating relationship between the variables, regardless of the order of integration of the variables. In this case, if \(F\)-statistic exceeds its respective upper critical values, this means rejection of the null hypothesis of no co-integration between the variables. If \(F\)-statistic is found below the lower critical value bounds, we cannot reject non-existence of a cointegrating relationship. If estimated statistic lies between the bounds, we cannot make any conclusive inference as to the existence of a possible co-integrating relationship and need to know the order of integration of the underlying regressors.

Once the existence of a potential co-integration relationship between the variables is verified, the most appropriate lag specification of the variables in the ARDL model must be determined through the mostly used lag information criteria, so that the long run equilibrium and short run dynamic error correction model coefficients can be estimated by way of employing the standard OLS methodology. In order to determine the appropriate lag length \(p\), following Pesaran et al. (2001), for \(p = 1, 2, \cdots, 5\), the conditional error correction model in Eq. (3) is estimated by OLS methodology both with and without trend components in the regression. The results are given in Table 3 for “with trend” and “without trend” cases.
Table 3. Selection of the Lag Order for Eq. (2)

With deterministic trend

<table>
<thead>
<tr>
<th>p</th>
<th>AIC</th>
<th>SC</th>
<th>χ²(1)</th>
<th>p-value</th>
<th>χ²(4)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4.16</td>
<td>-3.96</td>
<td>1.65</td>
<td>0.19</td>
<td>4.35</td>
<td>0.36</td>
</tr>
<tr>
<td>2</td>
<td>-4.14</td>
<td>-3.85</td>
<td>1.72</td>
<td>0.18</td>
<td>4.20</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>-4.11</td>
<td>-3.74</td>
<td>1.49</td>
<td>0.22</td>
<td>6.50</td>
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</tr>
<tr>
<td>4</td>
<td>-4.14</td>
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<td>1.90</td>
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</tr>
<tr>
<td>5</td>
<td>-4.11</td>
<td>-3.54</td>
<td>0.95</td>
<td>0.32</td>
<td>2.97</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Without deterministic trend

<table>
<thead>
<tr>
<th>p</th>
<th>AIC</th>
<th>SC</th>
<th>χ²(1)</th>
<th>p-value</th>
<th>χ²(4)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4.17</td>
<td>-3.99</td>
<td>1.45</td>
<td>0.22</td>
<td>4.16</td>
<td>0.38</td>
</tr>
<tr>
<td>2</td>
<td>-4.15</td>
<td>-3.88</td>
<td>1.68</td>
<td>0.19</td>
<td>4.28</td>
<td>0.36</td>
</tr>
<tr>
<td>3</td>
<td>-4.12</td>
<td>-3.76</td>
<td>1.43</td>
<td>0.23</td>
<td>6.32</td>
<td>0.17</td>
</tr>
<tr>
<td>4</td>
<td>-4.15</td>
<td>-3.70</td>
<td>0.32</td>
<td>0.56</td>
<td>1.74</td>
<td>0.78</td>
</tr>
<tr>
<td>5</td>
<td>-4.12</td>
<td>-3.57</td>
<td>0.94</td>
<td>0.33</td>
<td>2.90</td>
<td>0.57</td>
</tr>
</tbody>
</table>

In Table 3, ‘p’ shows the lag order of the underlying the conditional error correction model. AIC and SC represent Akaike and Schwarz information criterions, respectively. χ²(1) and χ²(4) are Breusch-Godfrey error terms Lagrange multiplier serial correlation test F-statistics under the null hypothesis of no serial correlation. The lag length is chosen as one for the ARDL equation.

Table 4. ARDL Unrestricted Error Correction Model of the Dollarization

<table>
<thead>
<tr>
<th>Dependent Variable: Δlncurr</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.129</td>
<td>0.051</td>
<td>-2.501</td>
<td>0.0133</td>
</tr>
<tr>
<td>Δintdiff</td>
<td>0.0002</td>
<td>0.0004</td>
<td>0.691</td>
<td>0.4903</td>
</tr>
<tr>
<td>Δexpdep</td>
<td>0.108</td>
<td>0.060</td>
<td>1.802</td>
<td>0.0733</td>
</tr>
<tr>
<td>Δexpinf</td>
<td>-0.480</td>
<td>0.295</td>
<td>-1.628</td>
<td>0.1054</td>
</tr>
<tr>
<td>Δcbres</td>
<td>0.720</td>
<td>1.763</td>
<td>0.408</td>
<td>0.6836</td>
</tr>
<tr>
<td>lncurr,i-1</td>
<td>-0.055</td>
<td>0.026</td>
<td>-6.075</td>
<td>0.0394</td>
</tr>
<tr>
<td>intdiff,i</td>
<td>-0.0005</td>
<td>0.0003</td>
<td>-1.853</td>
<td>0.0656</td>
</tr>
<tr>
<td>expdep,i-1</td>
<td>0.173</td>
<td>0.074</td>
<td>2.341</td>
<td>0.0204</td>
</tr>
<tr>
<td>expinf,i</td>
<td>-0.036</td>
<td>0.360</td>
<td>-0.101</td>
<td>0.9191</td>
</tr>
<tr>
<td>cbres,i-1</td>
<td>2.018</td>
<td>1.044</td>
<td>1.932</td>
<td>0.0550</td>
</tr>
<tr>
<td>Trend</td>
<td>-2.26E-05</td>
<td>0.000</td>
<td>-0.191</td>
<td>0.8486</td>
</tr>
</tbody>
</table>

The Bounds testing approach (Pesaran et al. 2001) tests the null hypothesis of no cointegration. It is mainly a joint significance test of the one period lagged value of the levels in a conditional error correction model (ECM) in Eq. 3. The F-statistics are calculated for different lags chosen for the first differences of the variables. The existence of a potential co-integration relationship between the variables has been found for lag length one by comparing our estimates with the critical values reported in Table CI(iv), Table CI(v) and Table CII(v) m of Pesaran et al. (2001):

Table 5. F- and t-statistics for Testing the Existence of Co-integration

<table>
<thead>
<tr>
<th>p</th>
<th>FIV</th>
<th>FV</th>
<th>tV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.86</td>
<td>8.12</td>
<td>-6.07</td>
</tr>
</tbody>
</table>

0.05 Table Critical Values
In table 5 $F_{iv}$ is the $F$-statistic calculated by applying to Wald tests that impose zero value restriction to the one-period lagged level coefficient values and deterministic trend component. $F_v$ is the $F$-statistic calculated by applying to Wald tests that impose zero value to the only one-period lagged level coefficient values of the variables. $t_v$ is the $t$-statistic of the coefficient of one-period lagged level value of dependent variable, that is, $ln\text{curr}$, in Table 4. We can observe that estimation results of the $F$-statistics exceed the upper critical values and thus, infer that there exists a co-integrating relationship between the time series in the level form. The $t$-statistic of the one period lagged level value of the dependent variable also supports these findings in favour of co-integration. In the light of Pesaran et al. (2001), since the results show that there is a cointegration, an ARDL model following Pesaran and Shin (1999) is built and the estimates of the relationship between levels is examined. We estimate that ARDL (1 1 0 0 0) is suitable for our model using the Turkish data. ARDL model is chosen according to Schwarz Bayesian Criterion. The long run relationship is given in Table 6.

**Table 6. Estimated Long Run Coefficients using the ARDL Approach**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Coefficient</th>
<th>Std.Error</th>
<th>t-Statistics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ln\text{curr}_{-1}$</td>
<td>0.23</td>
<td>0.11</td>
<td>2.09</td>
<td>0.002</td>
</tr>
<tr>
<td>$intdiff_{-1}$</td>
<td>0.0002</td>
<td>0.0003</td>
<td>0.54</td>
<td>0.589</td>
</tr>
<tr>
<td>$intdiff_{-1}$</td>
<td>0.0009</td>
<td>0.0003</td>
<td>2.38</td>
<td>0.018</td>
</tr>
<tr>
<td>$expdep$</td>
<td>0.112</td>
<td>0.005</td>
<td>1.95</td>
<td>0.052</td>
</tr>
<tr>
<td>$expinf$</td>
<td>1.969</td>
<td>0.968</td>
<td>2.03</td>
<td>0.043</td>
</tr>
<tr>
<td>$cbres$</td>
<td>-0.391</td>
<td>0.289</td>
<td>-1.35</td>
<td>0.177</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.128</td>
<td>0.046</td>
<td>-2.77</td>
<td>0.006</td>
</tr>
</tbody>
</table>

The estimation results reveal that in a long run period satisfying a stationary relationship between the variables of dollarization and its determinants behave in accordance with our model expectations. The dollarization ratio with a first lag, the interest rate differential with a first lag, expected depreciation and expected inflation are found to affect the dollarization ratio positively and significantly. Whereas the ratio of central bank reserves to M2Y found to have negative and significant effect. According to the estimation results one unit increase in the expected inflation affects the dollarization ratio by 1.96 units. Also one unit increase in the lagged dollarization ratio affects the dollarization ratio by 0.23. This shows that there is inertia in the foreign currency holdings.

Currency substitution is affected mainly by the lagged currency substitution variable, which suggests that there is a strong inertia in the currency substitution process in Turkey. Selcuk (1994) finds that the lagged values of currency substitution have positive coefficients suggesting persistence in the analyses of currency substitution for Turkey. Domac-Oskooee (2002) find that the exchange rate responds positively to shocks in currency substitution as there is a high elasticity of substitution between domestic and foreign currency. Akcay (1997) argues that currency substitution renders the exchange rate more volatile and more responsive to credibility issues.

According to our estimation results as the ratio of central bank reserves to M2Y ratio increases the currency substitution in Turkey decreases by 0.39. This shows that the higher the Central Bank reserves the higher is the ability of dealing with the depreciation of the local
currency. So that the economic agents will feel that the expectation of a financial crises or depreciation will be reduced. The sign of the coefficient for interest rate differential is found not to be in line with the theory. Also, it is found to be insignificant in the cointegration relation. This can be related with the suspicions about the debt stock sustainability in the short run, so that people prefer foreign currency deposits instead of high return on domestic money. The high level of debt stock and the short maturity structure causes suspicions about debt stock sustainability. Although the interest rates remained high in Turkey, economic agents prefer to hold foreign currency in the expectation of devaluation, as the exchange rate is generally overvalued after the financial opening up in Turkey.

The ARDL specification of the short run dynamics can be derived by constructing an error correction model (ECM). All coefficients of short run equation are coefficients relating to the short run dynamics of the model’s convergence to the equilibrium and the coefficient of the error term represents the speed of adjustment. The short run coefficients of the variables are shown in table 8 in the error correction model. As results of the ARDL based ECM show, the error correction term (ECT) is negative and highly significant. This means that deviations from the long run equilibrium are corrected through time. Therefore, ECM supports the results of the bounds test for existence of cointegration.

**Table 7. Estimated short run coefficients of the variables**

<table>
<thead>
<tr>
<th>Dependent Variable: Δlncurr,</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistics</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δintdiff,</td>
<td>0.000209</td>
<td>0.000365</td>
<td>0.573230</td>
<td>0.5672</td>
</tr>
<tr>
<td>Δexpdep,</td>
<td>0.079834</td>
<td>0.048837</td>
<td>1.634698</td>
<td>0.1039</td>
</tr>
<tr>
<td>Δexpinf,</td>
<td>0.681223</td>
<td>0.229843</td>
<td>2.963864</td>
<td>0.0035</td>
</tr>
<tr>
<td>Δcbres,</td>
<td>0.801773</td>
<td>1.631219</td>
<td>0.491518</td>
<td>0.6237</td>
</tr>
<tr>
<td>constant,</td>
<td>-1.26E-05</td>
<td>0.002278</td>
<td>-0.005546</td>
<td>0.9956</td>
</tr>
<tr>
<td>ECT(-1)</td>
<td>-0.059510</td>
<td>0.012716</td>
<td>-4.680084</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

In the short run, the dollarization ratio mainly depends on the expected inflation and the expected depreciation. They are found to be significant in the short run. All of the variables are found to affect the dollarization ratio positively.

**6. Conclusion**

In this paper, the macroeconomic determinants of the dollarization ratio are analyzed using monthly data of Turkey for the period of 2000:1 and 2014:12. In the empirical analysis, interest rate differential between 3-month TL deposits and 3-month foreign currency deposits, expected depreciation, expected inflation, and central bank reserve ratio are used. We use autoregressive distributed lag (ARDL) bound testing approach of Pesaran Shin and Smith (2001), based on the fact that bound testing approach allows the variables to be stationary, integrated of order one or a mixture of both. After checking the existence of cointegration, the analyses continue with ARDL approach of Pesaran and Shin (1999) to investigate the short run and long run relations.

The results of the bound tests (Pesaran et al. 2001) suggest that there is a cointegration between the variables of interest. The dollarization ratio with a first lag, the interest rate differential with a first lag, expected depreciation and expected inflation are found to affect the dollarization ratio positively and significantly. Whereas the ratio of central bank reserves to M2Y found to have negative and significant effect.
We found that in the long run the currency substitution in Turkey is positively affected by the currency substitution in the previous period, expected depreciation and expected inflation. This shows that there is inertia in currency substitution in Turkey. If the expected inflation and expected depreciation is high then economic agents will assume that there is instability in the economy, so that these expectations increase currency substitution. The Central Bank would take measures to decrease inflation and depreciation rates of local currency. Currency substitution makes it complicated for the monetary authorities to conduct an efficient monetary policy. Monetary measures are not completely effective so adjustments in fiscal policy are needed as well in order to de-dollarize the Turkish economy.

We found that in the long run Central Bank reserve ratio is negatively related with currency substitution, which implies that the reserve ratio is an important constraint on monetary policy as a way of reducing the growth in money supply. Fiscal adjustment on reducing the level of public sector borrowing requirement together with macroeconomic stability is necessary for de-dollarizing the economy. According to the short run modelling the ECM term is found to be significant and small in magnitude showing that agents do not immediately and fully adjust their holdings to variations in relative rates of returns on foreign currency balances. The small and significant ECM term implies that there is a strong inertia in the process of currency substitution in the short run in Turkey, which makes it very difficult to de-dollarize the economy. Inertial factors play an important role in foreign currency holdings in Turkey.

REFERENCES


Akinci Ö. and Görmez Y. (2005)."Ters Para İkamesi, mimeo (in Turkish), Central Bank of Turkey, Research Department.


