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On Stability of the Demand for Money in a Developing OECD Country: The Case of Turkey*

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Abstract:

This paper empirically analyses the stability of the narrow money demand function (M1) in Turkey for the period 1950-2002. As part of the IMF-sponsored stabilisation programme, Turkey has been pursuing base money targets. To ascertain whether this policy framework satisfies the necessary condition for effectiveness, we estimate and test for the stability of Turkish M1 by employing a recent single cointegration procedure proposed by Pesaran *et al.* (2001) along with the CUSUM and CUSUMSQ stability tests. We demonstrate that there is a stable money demand function and it could be used as an intermediate target of monetary policy in Turkey.

JEL classification: E41, E52
Keywords: co-integration, money demand, stability, Turkey

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I. INTRODUCTION

As conventionally agreed, the effectiveness and success of a monetary programme crucially depends on a stable money demand function. The stable money demand function ensures that the money supply would have predictable impacts on other economic variables such as inflation, interest rates, national income, private investments, and so forth. (See, for example, Driscoll and Ford, 1980). Therefore, the stability issue in money demand function becomes an interesting research area for researchers to test the effectiveness of a given monetary programme.

Turkey, as a developing country, has undertaken a number of stabilisation programmes since 1970s (to be exact 18, so far). Under the ongoing IMF-sponsored stabilisation programme, the Central Bank of Turkey (CBT) has been following a base-money targeting strategy. As is well known, the necessary condition for effective monetary aggregate targeting is the existence of a stable *long-run* and *short-run* relationship between the monetary aggregate and the final target – i.e., inflation.

The econometric advances in the last two decades, especially in the case of cointegration techniques, have enabled researchers to test more vigorously the stability issue of money demand functions since the stability concept is essentially a long-term phenomenon. There exist a number of empirical money demand studies utilizing single and multivariate cointegration techniques of the 1980s and the 1990s. For an extensive account of the recent empirical of these studies, see for example, Sriram (2001). However, a recent single cointegration method proposed by Peseran *et al.* (2001) appears to emerge more in empirical studies of money demand functions since the former has a number of econometric application advantages over the previous cointegration techniques.

There has always been an extensive literature examining the stability of money demand functions in the context of developing and developed countries. Yet, to our knowledge, the stability issue has not been probed in the Turkish context. We aim to address this shortcoming and contribute to the literature on the stability/instability of the demand for money in developing countries.

To achieve this objective, the paper is organised as follows. Section 2 provides a brief review of the literature on stability of the demand for money functions. Section 3 illustrates the methodology used. Section 4 provides the results. Finally, the conclusions section will summarise the main findings. Data and variable selection discussions are included in appendix.

II. MONEY DEMAND STABILITY: A BRIEF LITERATURE REVIEW

There are two strands in the literature on the stability of the demand for money. The first focuses on the money-output relationship and reflects the Monetarist-Keynesian debate concerning the relative stability of money-income and expenditure-income multipliers. Proponents of the money-income multiplier, for example Friedman (1969) and Laidler (1969), were aware that its stability is closely related to the stability of the demand for money. The money-income multiplier would be more stable than the autonomous-expenditure multiplier (therefore, the consequences of monetary policy changes would be easier to predict) only if the demand for money is stable.

Using an IS-LM framework, Driscoll and Ford (1980) demonstrate that the stability of the demand for money may not be as significant an issue as the Monetarist-Keynesian debate have led us to believe. That is because the money-income multiplier would be stable only if the demand for money were a 'stable function *solely* of income.' If the demand for money were a function of other variables too (such as interest rates and wealth), it may in fact be necessary to have *instability* in the demand for money in order to have a *stable* money-income multiplier.

Despite this plea for putting the issue into perspective, money demand stability has been tested by many students of economics both before and after 1980s. This work constitutes what we call the second strand of the literature on money demand stability. The main concern here is not whether or not money demand stability is a necessary condition for using monetary policy as a stabilisation tool. This issue is assumed to have been resolved and attention is directed to ascertaining the extent to which the demand for money is a stable function of relevant variables.

A large number of studies tested for the stability of money demand functions using the single and multivariate cointegration techniques of the 1980s and 1990s. The results and implications of these studies clearly depend on the underlying variables, the econometric methods for stability tests, data frequency, and the development stage of a country. A few of recent examples for these studies are noted here. As far as the industrialized countries are concerned, one can refer to: Vega (1998) for Spain; Hamori and Hamori (1999) for Germany; Amano and Wirjanto (2000) for Japan; Karfakis and Sidiropoulos (2000) for Greece; Bahmani-Oskooee and Chomsisengphet (2002) for 11 OECD countries; Bahmani-Oskooee and Shin (2002) for Korea. There are also a few recent studies related to the developing countries. They are: Sriram (1999) for Malaysia; Arize *et al.* (1999) for 12 LDCs; Buch (2001) for Poland and Hungary; Andoh and Chappell (2002) for Ghana; Pradhan and Subramanian (2003) for India; and Nell (2003) for South Africa.

We seek to add to this literature by analysing the stability of the demand for money in Turkey - a developing OECD country pursuing a stabilisation programme since 2001 and aiming to start accession negotiations with the

EU in 2005. We analyse the stability of the demand for M1. First, M1 is a good measure of liquidity in the economy since it consists mainly of financial assets held for transaction purposes. Secondly, the central bank is able to control this aggregate more accurately than broader aggregates such as M2 and M3. Third, M1 definitions tend to be relatively consistent across countries and, therefore, allow for comparison. (Bruggeman, 2000). True, the demand for M1 tends to be affected by portfolio shifts, but the impact of such shifts have been limited in developing countries - mainly due to limited financial innovation. The choice of M1 is also relevant for Turkey because the central bank has been targeting base money rather than broad monetary aggregates such as M2 and M3.

III. EMPIRICAL SPECIFICATION AND METHODOLOGY

We follow the money demand model proposed originally by Mundell (1963) which assumes that demand for money is determined by the level of income, the interest rate as well as the exchange rate. Thus, the following semi-log linear form is adopted:

$$\ln M_t = a_0 + a_1 \ln Y_t + a_2 r_t + a_3 \ln ER_t + \varepsilon_t \tag{1}$$

Here, M is the real narrow money stock per capita, Y is the real national income per capita, r is the interest rate on alternative assets measuring the opportunity cost of holding money, and ER is the nominal exchange rate. The expected signs for parameters are as follows: $a_1 > 0$, $a_2 < 0$. Parameter of the exchange rate a_3 could be positive or negative. A depreciation of domestic currency (an increase in ER) may result in an increase in domestic currency value of foreign financial assets held by domestic residents which, in turn, may lead to an increase in the demand for cash balances. The positive coefficient of the exchange rate variable also supports the wealth effect argument in the literature; see for example Arango and Nadiri (1981) and Arize *et al*. (1999). However, depreciation of domestic currency may also induce expectation of additional depreciation which result in a decrease in the demand for money, implying a negative coefficient for the exchange rate.

For investigating the long-run equilibrium (cointegration) among time-series variables, several econometric methods are proposed in the last two decades. Univariate cointegration examples include Engle and Granger (1987) and the fully modified OLS procedures of Phillips and Hansen's (1990). With regards to multivariate cointegration, Johansen (1988) and Johansen and Juselius (1990) procedures and Johansen's (1996) full information maximum likelihood procedures are widely used in empirical research.

The so-called autoregressive distributed lag (ARDL), which also deals with single cointegration and is introduced originally by Pesaran and Shin (1999) and further extended by Pesaran *et al*. (2001) appears to be applied in recent empirical investigations of the demand for money. (See for example Siddiki, 2000; Tang, 2002; and Bahmani-Oskooee and Ng, 2002). This method has certain econometric advantages in comparison to other single cointegration procedures. First, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided. Second, the long and short-run parameters of the model are estimated simultaneously. Third, all variables are assumed to be endogenous. Fourth, the econometric methodology is relieved of the burden of establishing the order of integration amongst the variables and of pre-testing for unit roots. In fact, whereas all other methods require that the variables in a time-series regression equation are integrated of order one, i.e., the variables are I(1), only that of Pesaran *et al*. could be implemented regardless of whether the underlying variables are I(0), I(1), or fractionally integrated.

An ARDL representation of Eq. (1) is formulated as follows:

$$\Delta \ln M_t = a_0 + \sum_{i=1}^{m} a_{1i} \Delta \ln M_{t-i} + \sum_{i=0}^{m} a_{2i} \Delta \ln Y_{t-i} + \sum_{i=0}^{m} a_{3i} \Delta r_{t-i} + \sum_{i=0}^{m} a_{4i} \Delta \ln ER_{t-i}$$
$$+ a_5 \ln M_{t-1} + a_6 \ln Y_{t-1} + a_7 r_{t-1} + a_8 \ln ER_{t-1} + \varepsilon_t$$
(2)

Investigation of the presence of a long-run relationship amongst the variables of Eq. (1) is tested by means of bounds testing procedure of Pesaran *et al.* The bounds testing procedure is based on the F or Wald-statistics and is the first stage of the ARDL cointegration method. Accordingly, a joint significance test that implies no cointegration, ($H_0 = a_5 = a_6 = a_7 = a_8 = 0$), should be performed for Eq. (2). The F test used for this procedure has a non-standard distribution. Thus, two sets of critical values are computed by Pesaran *et al*. for a given significance level. One set assumes that all variables are I(0) and other set assumes they are all I(1). If the computed F-statistic exceeds the upper critical bounds value, then the H_0 is rejected. If the F-statistic falls into the bounds then the test becomes inconclusive. Lastly, if the F-statistic is below the lower critical bounds value, it implies no cointegration. This is similar to the Johansen and Juselius multivariate cointegration procedure, which has five alternative cases for long-run testing too.

Once a long-run relationship is established, then the long-run and error correction estimates of the ARDL model can be obtained from Eq. (2). At the second stage of the ARDL cointegration method, it is also possible to perform a parameter stability test for the appropriately selected ARDL representation of the error correction model.

The stability of coefficients of money demand equations are, by and large, tested by means of Chow (1960), Brown *et al*. (1975), Hansen (1992), and Hansen and Johansen (1993). The Chow stability test requires *a priori* knowledge of structural breaks in the estimation period and its shortcomings are well documented (see for example Gujarati, 2003). In Hansen (1992) and Hansen and Johansen (1993) procedures, stability tests require I(1) variables and they check the long-run parameter constancy without incorporating the short-run dynamics of a model into the testing - as discussed in Bahmani-Oskooee and Chomsisengphet (2002). However, it is possible to overcome these shortcomings by employing the Brown *et al.* procedure if we follow Pesaran and Pesaran (1997). The Brown *et al.* stability testing technique, also known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, is based on the recursive regression residuals. The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the break points of the model. Providing that the plot of these statistics fall inside the critical bounds of 5% significance then we assume that the coefficients of a given regression are stable. Usually, graphical representation is used to demonstrate the test results.

A general error-correction representation of Eq. (2) is formulated as follows:

$$\Delta \ln M_t = a_0 + \sum_{i=1}^{m} a_{1i} \Delta \ln M_{t-i} + \sum_{i=0}^{m} a_{2i} \Delta \ln Y_{t-i} + \sum_{i=0}^{m} a_{3i} \Delta r_{t-i} + \sum_{i=0}^{m} a_{4i} \Delta \ln ER_{t-i} + \lambda EC_{t-1} + u_t \quad (3)$$

where λ is the speed of adjustment parameter and EC is the residuals that are obtained from the estimated cointegration model of Eq. (2).

IV. RESULTS

A two-step ARDL cointegration procedure is implemented in estimating of Eq. (1) for Turkey using annual data over the 1950-2002 period. In the first stage, to ascertain the existence of a long-run relationship among the variables in Eq. (2), we performed the bounds testing approach. In the second stage, we estimated Eq. (2) by the ARDL cointegration method.

In the first stage of the ARDL procedure, the order of lags on the first – differenced variables for Eq. (2) is usually obtained from unrestricted vector autoregression (VAR) by means of Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). Bahmani-Oskooee and Bohl (2000) and Bahmani-Oskooee and Ng (2002), however, have shown that the results of this stage are sensitive to the order of VAR. Given that we are using annual observations, we experimented up to 3 years on the first-difference of each variable and computed F-statistics for the joint significance of lagged levels of variables in Eq. (2). The computed F-test statistic for each order of lags is presented in Table 1 along with the critical values at the bottom of the table. Table 1 indicates that for *i*=1, the computed F-statistic is not significant at 90%. It is significant for *i*=2 at 90% and it is also significant for *i*=3 at 95%. The results appear to provide evidence for the existence of a long-run money demand equation. These results also warrant proceeding to the second stage of estimation.

Table 1. F-statistics for testing the existence of a long-run money demand equation

Order of Lag	F-statistics
1	3.1386
2	3.9080*
3	6.0065**

Notes: The relevant critical value bounds are obtained from Table C1.iii (with an unrestricted intercept and no trend; with three regressors) in Pesaran *et al.* (2001). They are 2.72-3.77 at 90%, and 3.23- 4.35 at 95%. * denotes that the F-statistic falls above the 90% upper bound and ** denotes above the 95% upper bound.

Given the existence of a long-run relationship, in the next step we used the ARDL cointegration method to estimate the parameters of Eq. (2) with maximum order of lag set to 2 to minimize the loss of degrees of freedom.. In search of finding the optimal length of the level variables of the long-run coefficients, several lag selection criteria such as the adjusted $\overline{R}^2$, AIC, SBC and Hannan-Quinn Criterion (HQC) were utilized. The long-run results of Eq. (2) based on several lag criteria are reported in Panel A of Table 2 along with their appropriate ARDL models. The diagnostic test results of Eq. (2) for short-run estimations are also displayed in the respective columns of each selection criterion in Panel B of Table 2. As can be seen from Table 2, the long-run results are very similar with regard to coefficient magnitudes and statistical significance. In fact the results from $\overline{R}^2$ and AIC criteria are exactly the same. All the estimated models display the expected signs for the regressors and they are highly statistically significant.

Table 2. ARDL Estimations

Panel A: the long-run results
Dependent variable $\ln M$

	Model Selection Criterion for			
Regressors	$\bar{R}^2$ ARDL (2,1,0,1)	AIC ARDL (2,1,0,1)	SBC ARDL (1,0,0,0)	HQC ARDL (2,0,0,1)
$\ln Y$	0.90568 (8.3799)	0.90568 (8.3799)	0.938772 (10.8440)	0.93872 (10.0996)
r	-0.012373 (4.5510)	-0.012373 (4.5510)	-0.012966 (5.9926)	-0.011726 (5.0360)
$\ln ER$	-0.050935 (2.3441)	-0.050935 (2.3441)	-0.063654 (4.3148)	-0.060650 (3.5866)
Constant	-1.7295 (4.2369)	-1.7295 (4.2369)	-1.7215 (5.5504)	-1.5770 (4.5537)

Panel B: the short-run diagnostic test statistics

	$\chi^2_{SC}(1)$=0.1413	$\chi^2_{SC}(1)$=0.1413	$\chi^2_{SC}(1)$=1.7941	$\chi^2_{SC}(1)$=0.3415
	$\chi^2_{FC}(1)$=0.3926	$\chi^2_{FC}(1)$=0.3926	$\chi^2_{FC}(1)$=0.3790	$\chi^2_{FC}(1)$=0.0420
	$\chi^2_{N}(2)$=1.2743	$\chi^2_{N}(2)$=1.2743	$\chi^2_{N}(2)$=1.2625	$\chi^2_{N}(2)$=1.6086
	$\chi^2_{H}(1)$=1.6573	$\chi^2_{H}(1)$=1.6573	$\chi^2_{H}(1)$=0.3548	$\chi^2_{H}(2)$=0.4459

Notes: The absolute value of t-ratios is in parentheses. The full tables of the short-run estimates of these models are available from the authors on request. χ^2_{SC}, χ^2_{FC}, χ^2_{N}, and χ^2_{H} are Lagrange multiplier statistics for tests of residual correlation, functional form mis-specification, non-normal errors and heteroskedasticity, respectively. These statistics are distributed as Chi-squared variates with degrees of freedom in parentheses.

In order to conduct the stability test on the preferred error -correction representation of the ARDL method, the ARDL error correction representation of Eq. (3) were estimated as auxiliary models. The estimation results and the respective appropriate optimal lag length selection criteria are displayed in Table 3.

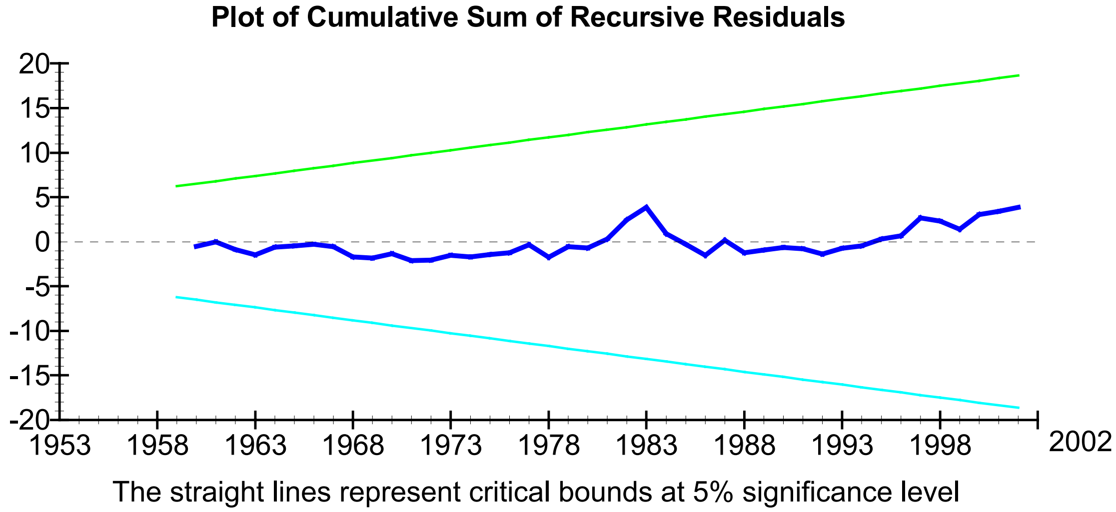
Table 3. Error Correction Representations of ARDL Model
Dependent variable $\ln \Delta M_t$

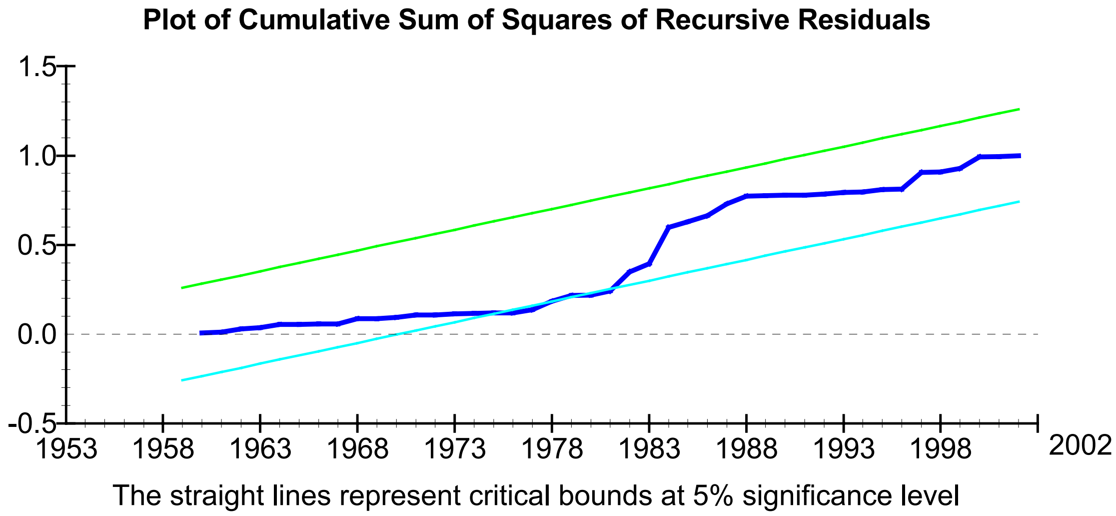
	Model Selection Criterion		
Regressors	AIC ARDL (2,1,0,1)	SBC ARDL (1,0,0,0)	HQC ARDL (2,0,0,1)
$\ln \Delta M_{t-1}$	0.76825 (2.8818)	0.6672 (4.5372)	0.93339 (4.2735)
$\ln \Delta M_{t-2}$	-0.14138 (1.0638)		-0.19038 (1.6964)
$\ln \Delta Y_t$		0.46912 (3.4819)	0.63433 (4.6986)
$\ln \Delta Y_{t-1}$	-0.46900 (2.4773)		
Δr_t	-0.0033042 (2.2882)	-0.0040228 (3.5426)	-0.0046148 (3.7928)
$\ln \Delta ER_t$		-0.070564 (1.5213)	
$\ln \Delta ER_{t-1}$	-0.033058 (0.47512)		0.088564 (1.4168)
Constant	0.24251 (1.0512)	0.0090729 (0.52116)	-0.035262 (1.6872)
EC_{t-1}	-1.0780 (3.3175)	-0.86969 (4.1866)	-1.1086 (4.2998)
$\overline{R}^2$	0.305	0.568	0.510
F-statistics	4.5944	13.9221	9.5153
DW-statistics	2.0717	1.8303	1.9175
RSS	0.36440	0.23160	0.25691

Notes: The absolute values of t-ratios are in parentheses. RSS stands for residual sum of squares. Since the AIC and $\overline{R}^2$ criteria produces exactly the same error correction results, the latter estimation, therefore, is not reported here. The full tables of the error correction estimates of these models are available from the authors on request.

Table 3 enables us to select the most appropriate model of implementing the stability test for the money demand equation. According to the reported diagnostic tests results, the SBC-based error correction model of Eq. (2) seems to be relatively better fit than others. Therefore, although we performed the CUSUM and CUSUMSQ stability tests for all error correction models, we present only the graph of the SBC-based error correction model. It can be seen from Figure 1, the plots of CUSUM and CUSUMSQ statistics are well within the critical bounds implying that all coefficients in the error correction model are stable, even though the second test statistic seems to be crossing the lower band marginally during the period 1976-1981.

Figure 1. CUSUM and CUSUMSQ Plots for Stability Tests





V. CONCLUSION

In this article, we attempt to examine the stability of money demand function in Turkey for 1950-2002. Using a recent single cointegration technique, ARDL, we are able to demonstrate that there is a long-run relationship between the narrow M1 money aggregate and its determinants: national income, interest rate and exchange rates. We also tried to incorporate the short and long-run dynamics of money demand function in order to perform a more robust account of the stability of money demand function. To this end, we utilized the CUSUM and CUSUMSQ stability tests and they indicate that there exists a stable money demand function. These results suggest that it is possible to use the narrow money aggregate as target of monetary policy in Turkey. As far as the Turkish central bank's monetary policy is concerned, we assume that stability of a money demand function will reduce the uncertainty associated with the financial environment and will increase the credibility of its ability to pursue a monetary target.

APPENDIX. DISCUSSION ON VARIABLE SELECTION AND DATA SOURCES

It is assumed that expressing the money and income variables in per capita is more plausible as the population of Turkey has increased substantially (i.e., more than three folds) over the estimation period.

Considering the economic and political structure of Turkey during the estimation period, it is argued that M1 as a money stock serves a better proxy than M2 in formulating the money demand equation of Turkey. Besides, a significant number of studies discuss whether the narrow or broad money is stable. Some studies on developing countries indicated that the models on narrow money worked better since these countries have weak banking system, low level of financial deepening and the large extent of the public economic entities with their own financial resources and budget separate from those of the central government as discussed in Crockett and Evans (1980) and Sriram (1999).

An exchange rate variable is in the money demand function since major foreign currencies play important roles in the Turkish economy as mediums of transaction and saving. In spite of a strict ban on holding unofficial foreign currency before the 1980s, a strong black exchange market operated along with the official exchange market. For example, the workers' remittances were main source of the foreign currency earnings for Turkey until the 1980s and the foreign currency black market thrived as a consequence. For a detailed discussion between the linkage and implications of the black exchange market and money demand, see for example Bahmani-Oskooee (1996).

All series are in natural logarithmic form (Ln) except the interest rate (r). Definitions of variables and data sources are as follows:

M is the real Turkish M1 per capita in millions of Turkish Liras (TL) at 1990 prices. M1 is deflated by the Turkish consumer price index of 1990=100. Source: International Financial Statistics, IMF (various issues). Y is the real Turkish GDP per capita in millions of Turkish Liras (TL) at 1990 prices. The nominal GDP is deflated by the Turkish consumer price index of 1990=100. Source: International Financial Statistics, IMF (various issues). r is the nominal average interest rate for bank time deposit. Before 1970, discount rate of the central bank of Turkey is used as a proxy for the average interest rate since there is no data available for those years. Source: Central Bank of Turkey Annual Statistics (various issues). ER is the annual average official nominal exchange rate TL per US dollar. Source: International Financial Statistics, IMF (various issues).

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