The Stability of the Money Multiplier in a Developing Economy: The Case of Turkey

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I. Introduction

Like any commodity, the equilibrium quantity of money is jointly determined by its demand and supply functions. In less-developed (LDCs) as well as industrially advanced countries, the central bank/monetary authority has relatively little or no control over the aggregate demand for money. Therefore, monetary policy consists of varying degrees of control over the aggregate supply of money. In both advanced countries and LDCs the money supply, at any point in time, can be thought of as the product of a stock of high-powered money or monetary base and the money multiplier (or multiplier hereinafter):

$$M = mB \tag{1}$$

where, M = some definition of the money supply,
B = the monetary base which for many studies, including this one, consists of currency in the hands of the non-bank public plus commercial bank reserves, and
m = the multiplier.

This paper will examine the stability of the multiplier in the Republic of Turkey. Two separate notions of stability will be employed: (1) short-run predictability and (2) the presence or absence of structural shifts between two time periods.[1]

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1 Use of predictability as a test of stability was made by Brunner and Meltzer, see Brunner and Meltzer (1963). On structural stability see Chow (1960).

The evidence to date shows that for most of the LDCs studied, including Turkey, the monetary base and changes therein account for a greater percentage of the changes in the money supply than the multiplier.[2] In what follows, it will be assumed that the monetary base is controlled by the monetary authority in Turkey and attention will be focused on the multiplier. This assumption is invoked only as a means to delimit the area of inquiry. As a practical matter central bank control over the monetary base is not perfect. In LDCs, control over the monetary base is often said to be diluted by the absence of a broad or sufficiently flexible money market that impairs open market operations. In Turkey, the unpredictable nature of agricultural credit demand is said to reduce the central bank's ability to frame quantitative loan targets and, thus, monetary base targets in advance.[3]

To central banks in LDCs, control over monetary growth is a matter of no small importance. In LDCs, the low stage of development of financial markets and institutions places severe limitations on the provision of credit. The existence of credit renders the use of a given stock of money, more efficient.[4] Faced with institutional constraints on the potential supply of new credit or money services, central banks in LDCs must rely more heavily on the creation of more money if they want additional money services. To the degree that this leads to rapid growth of the money supply, this produces an inflationary bias in the economics of LDCs.

II. The Multiplier in Turkey

From (1) and an assumed, exogenously determined monetary base, there is a quantitatively unique multiplier associated with each definition of the money supply.[5] Given the following definitions:

C = currency held by the nonbank public,
D_S = sight deposits at commercial banks,
D_C = sight deposits at the central bank,
S = sight savings deposits at commercial banks, and
R = commercial bank reserves consisting of banks' cash holdings, banks' sight depsoits at the central bank and required reserves, the following can be written:

2 See Ahrensdorf and Kanesathasan (1960), p. 133; Bhatia (1971), p. 393; and Fry (1972), p. 78-93.

3 See Fry (1972), p. 91.

4 See Pesek and Saving (1968), p. 24-33.

5 Fry identified seven definitions of money in Turkey. See Fry (1972), p. 82.

$$M = C + D + S$$
$$B = R + C$$

where, $D = D_S + D_C$.
Since the multiplier, $m = M/B$, therefore:

$$m = \frac{C + D + S}{R + C}$$

dividing top and bottom by M and rearranging yields:

$$m = \frac{1}{c + r\,(1-c)} \qquad (2)$$

c = C/M, the currency ratio or the fraction of money that the nonbank public desires to hold in the form of currency.
r = $R/D_S + S$, the reserve ratio or the ratio of banks' required and working reserves to commercial sight and sight savings deposits.

Annual observations of M, B, m, c and r appear in Table 1.

In this form, (2), the currency and reserve ratios are parametric components of the multiplier. They, in turn, are determined by the asset decisions of the public, the banks and the monetary authority, in the last instance through variations in legal reserve requirements. Both parameters, then, are determined by forces not entirely under the control of the monetary authority. Despite assumed control over the monetary base, variations in the currency and the banks' excess reserve ratio may frustrate attempts to control M. Any question concerning the stability of the multiplier is, therefore, a question of the stability of the relationships between the parametric components of the multiplier and their determinants.

III. The Currency and Reserve Ratios

To explain the currency ratio is to discover why people prefer to hold their cash balances as coin and currency as opposed to bank deposits. A variety of casual factors have been offered to explain an observed decline in the currency ratio over time: economic gowth and development; the increase in the banking habit; and the growth in the number of banks. Observed increases in the currency ratio have been associated with monetization, especially in LDCs; inflation; and the uncertainty associated with war and political and civil strife.[6]

Table 1

YEAR END VALUES OF MONEY, MONETARY BASE, THE MULTIPLIER AND ITS COMPONENTS[1]

	M*	B*	m**	c	r
1961	10.025	7.043	1.423	.413	.513
1962	10.964	7.479	1.466	.413	.474
1963	12.167	8,110	1.500	.405	.452
1964	13.999	9.342	1.499	.417	.431
1965	16.434	10.529	1.561	.385	.417
1966	19.780	12.358	1.601	.362	.413
1967	22.682	14.346	1.581	.384	.404
1968	25.968	15.687	1.655	.317	.420
1969	30.127	17.913	1.682	.301	.420
1970	35.268	21.572	1.635	.336	.413
1971	43.587	28.226	1.544	.319	.483
1972	53.253	37.452	1.422	.300	.583
1973	70.528	46.597	1.514	.294	.528
1974	90.045	58.864	1.530	.290	.524
1975	118.470	78.796	1.504	.278	.541
1976	151.505	94.980	1.595	.280	.484

* Billions of Turkish Liras.
** Calculated as M/B.

1 *Source:* Central Bank of the Republic of Turkey, *Monthly Bulletin,* (June-July, 1977), pp. 25-6, 38.

In order to set the stage for the stability analysis of the multiplier, it may be useful to examine the determinants of its separate components. Using the most readily available data, year-end values of the currency ratio were regressed on year-end levels of real, per capita gross national product and the annual average consumer price index.[7] The following results were obtained for the period 1961-76:

6 See Khazzoom (1966), p. 24-44.

7 Series for m, r, and c were obtained from monetary and bank data found in Central Bank of the Republic of Turkey, *Monthly Bulletin,* various issues. GNP and CPI series were obtained from International Monetary Fund, *International Financial Statistics,* various issues.

$$c = .67719 - .0000951787Y + .000535391P \quad (3)$$
$$(13.80) \qquad (-5.39) \qquad (2.34)$$
$$\bar{R}^2 = 0.88 \quad SEE = 0.20 \quad DW = 1.77$$

Y and P are real per capita gross national product and the consumer price index, respectively. t-values, in parentheses, are significant at the five percent confidence level. R is the ratio of explained to total variation adjusted for degrees of freedom. SEE is the adjusted standard error of estimate. The Durbin-Watson statistic (DW) is in such a range that one can reject the hypothesis of autocorrelation. The obtained negative coefficient with respect to Y, a catch all for economic development, suggests that this process is associated with increased public preference for claims on banks as opposed to coin and currency for media of exchange. The process of economic development encompasses many things: increased availability of banking services, more banks, increased financial sophistication, some or all of whose effects are captured by Y. There is a less ambiguous explanation for the obtained positive coefficient with respect to P. In many countries with relatively high rates of inflation, such as experienced by Turkey over the relevant period, adjustments by the populace include the hoarding of goods such as foodstuffs and jewelry whose purchase is made with hand-to-hand media instead of claims on banks.[8] Table 1 shows that the currency ratio declined over the relevant period. Computed (at the midpoints) coefficient elasticities from (3):

$$\frac{dc}{dY}\frac{\bar{Y}}{\bar{c}} = -1.15; \quad \frac{dc}{dP}\frac{\bar{P}}{\bar{c}} = 0.18$$

and annual compound growth rates of 4.4 and 10.9 percent respectively for Y and P, suggest that the quantitative contribution of variations in real per capita gross national product to variations in the currency ratio were greater than that of the rate of inflation.

Several hypotheses might be offered to explain the behavior of the reserve ratio, r, in Turkey: (a) that through manipulation of the stock of bank reserves, r is exogenously determined by the monetary authority; (b) that effective policy control of the reserve ratio is reduced through the banks' manipulation of excess or working reserves.[9] For banks in Turkey, from the end of 1961 to the end of

8 See Khazzoom (1966), p. 13.

9 The excess reserve ratio is defined as the ratio of bank cash assets and sight deposits at the central bank to the sum of sight and sight savings deposits.

1976, required reserves accounted for an increasing share of total reserves, 59 to 71.4 percent. Meanwhile, the average reserve ratio increased irregularly from .48 in 1961-63 to .516 in 1974-76. The excess reserve ratio, (exr), was regressed on the consumer price index, a proxy for the opportunity cost of holding money, V, the variance in the past four annual changes in bank assets a measure of the variance of net receitps and disbursements,[10] and the nominal stock of required reserves (RR) held by Turkish banks. The following results were obtained using year-end data for 1961-76:

$$\text{exr} = .231053 - .00147616P - .000621532V + .0137234RR \quad (4)$$
$$(5.05) \qquad (-1.70) \qquad (-2.94) \qquad (2.20)$$
$$\bar{R}^2 = 0.28 \qquad \overline{SEE} = 0.20 \qquad DW = 1.49$$

A positive relationship between required reserves and the excess reserve ratio would be consistent with an exogenous reserve ratio whereas, a negative relationship would be more consistent with hypothesis (b). Obtained regression coefficients are significant save in the case of the consumer price index. The obtained negative coefficient with respect to V is inconsistent with the hypothesis that banks' excess reserves function as precautionary balances. The obtained positive coefficient with respect to the stock of required reserves is consistent with the hypothesis of an exogenous reserve ratio. The Durbin-Watson statistic is inconclusive concerning the existence of autocorrelation. Also, the $\overline{SEE}$ is quite large given an average excess reserve ratio of .167. These results are not surprising in light of the highly regulated nature of banking in Turkey. A variety of official controls over deposit and loan rates as well as the dominance of state-owned relative to private banks has spawned as inefficient, but profitable banking system.[11] Moreover, the asset-theoretic model estimated in (4) explains only 28 percent of the variation in the excess reserve ratio. When the reserve ratio (r) was regressed on required reserves the latter was significant in explaining 28 percent of the variation in the former. The results also indicated the presence of autocorrelation. A tentative explanation for these results is that the reserve ratio in Turkey, in the relevant period, was only one of many policy targets of the monetary authority and not a very important one at that. Given the close degree of regulation over the banking system the monetary authority in

10 For determining the size of precautionary balances such as the excess or working reserves of banks the variance of receipts and disbursements are important. See Whalen (1966), p. 314-324.

11 See Fry (1972), p. 36-46.

Turkey may prefer to pursue its policy objectives through control of interest rates and credit controls quite apart from manipulation of the reserve ratio.

Explaining what determines the currency and reserve ratios does not shed a great deal of light on the stability of the multiplier. The contribution of a stable currency ratio may be offset by an erratic reserve ratio and vice versa. This can be seen more clearly by identifying the separate contributons of the components of the multiplier. Assume the linear form of the multiplier:

$$m = m(c, r) \tag{5}$$

From (2), the total differential of m is:

$$dm = \frac{-(1-r)}{[c+r(1-c)]^2}\, dc - \frac{(1-c)}{[c+r(1-c)]^2}\, dr \tag{6}$$

where, $\frac{dm}{dc} = \frac{-(1-r)}{[c+r(1-c)]^2} = dm_c$; $\frac{dm}{dr} = \frac{-(1-c)}{[c+r(1-c)]^2} = dm_r$

In (6), second order effects, (dc dr), are ignored. From (6), a decrease (increase) in the public's desired currency ratio contributes to an increase (decrease) in the multiplier. Since the public reduces its holdings of hand-to-hand money by switching to bank money, this tends to increase bank reserves, other things equal, which form the basis for a multiple expansion of bank money. Meanwhile, a bank or policy induced reduction in the reserve ratio would tend to increase the money creating ability of the banking system.

It is clear that variations in the currency and reserve ratios may either accentuate or dampen the contributions of the other to the multiplier. Table 2 based upon (6) and Table 1 shows annual, year end to year end changes in the multiplier as well as linear estimates of the quantitative contributions to the multiplier attributable to the currency ratio, column 2, and the reserve ratio, column 3. Columns 2 and 3 do not sum to column 1 for several reasons: Second order effects, (dc dr), were ignored and assumed to be small; the multiplier is calculated as the ratio M/B and not from (2); finally, (6) is only a linear approximation.

The results in Table 2 suggest that over the relevant period changes in the reserve ratio made quantitatively greater contribu-

tions to the multiplier relative to the currency ratio. Moreover, the contributions made by the currency and reserve ratios were not constant from year to year. In ten of the fifteen cases, the absolute value of the contribution of the reserve ratio exceeded that of the currency ratio. This observation would not be inconsistent with the hypothesis of a policy determined multiplier when it is recalled that required reserves became a greater share of total reserves over the relevant period. But, because of the limited time period studied and the imprecision of the estimates only a weak case exists for a policy determined multiplier. One might well ask whether or not the parameter contributions to, and thus the multiplier itself are in some sense, predictable?

IV. Stability of the Multiplier

In what follows, stability is defined as predictability. Stability of the multiplier is said to exist if the function which identifies the contributions of the currency and reserve ratios to the multiplier yields a predictable multiplier. Such a test of stability appears to be superior to a test based on the presence or absence or constancy in a series. Observed non-constancy in, or fluctuations from quarter-to-quarter or year-to-year in a multiplier is sometimes equated with instability.[12] Unfortunately, critical levels of stability based upon numerical constancy have not been established. Moreover, absolute stability of the multiplier is not required for policy purposes.[13]

To begin the stability analysis, the following form of the multiplier is assumed:

$$m_t = a + bc_t + cr_t \qquad (7)$$

$$b, c < 0$$

where,

Successive estimates of (7) were made for blocks of 15 quarters from I70-III73 to II73-IV76. Observed values of the currency and reserve ratios for IV73 were substituted into the obtained regression equation for I70-III73 and a "predicted" multiplier for IV73 was calculated. The same was done with each successive regression estimate until 14 successive multipliers were obtained. The predicted multipliers were then compared with actual multipliers.

It is important to bear in mind what is and what is not being

12 See Ajayi (1972), p. 257-267.
13 See Teigen (1964), p. 479.

Table 2

CONTRIBUTIONS TO THE MULTIPLIER ATTRIBUTABLE TO CHANGES IN THE CURRENCY AND RESERVE RATIOS

	1 dm	2 $dm_c dc$	3 $dm_r dr$
61	—	—	—
62	.043	0	.039
63	.034	.009	.027
64	-.001	-.014	.028
65	.062	.018	.042
66	.040	.033	.006
67	-.020	-.033	.015
68	.074	.100	-.025
69	.027	.025	0
70	-.047	-.057	.010
71	-.091	.027	-.121
72	-.122	.023	-.162
73	.092	.005	.077
74	.016	.004	.006
75	-.026	.013	-.028
76	.091	.002	.092
Total[1]	.786	.363	.678

[1] Ignores negative signs.

done. (7) is based upon an identity, (1). To estimate (7), therefore, is not to explain the multiplier. Only through explaining the currency and reserve ratios, as was attempted in (3) and (4) can a model of the multiplier have any empirical content. On the other hand, successive estimates of (7) yield regression coefficients that show the quantitative contributions of the currency and reserve ratios to the multiplier. If the functional relationship between the multiplier and its parametric components is stable in the short run, the multiplier should be highly predictable.

Obtained regression coefficients with respect to the parameters along with the predicted and actual multipliers are shown in Table

Table 3

REGRESSION COEFFICIENTS, PREDICTED AND ACTUAL VALUES OF THE MULTIPLIER

	Intercept	c	r	m^1	m^2
IV73	2.79866	-1.48130	-1.60633	1.503	1.498
I74	2.94986	-1.37405	-1.58101	1.488	1.479
II74	2.65216	-1.16140	-1.52838	1.485	1.473
III74	2.64788	-1.14918	-1.52800	1.396	1.407
IV74	2.58526	-1.00509	-1.49681	1.491	1.490
I75	2.57105	-0.99229	-1.47796	1.514	1.516
II75	2.55911	-0.99285	-1.45477	1.506	1.506
III75	2.56054	-0.98730	-1.46083	1.467	1.467
IV75	2.56171	-0.97660	-1.46946	1.478	1.477
I76	2.55871	-0.97836	-1.46278	1.481	1.481
II76	2.54930	-0.98324	-1.44221	1.490	1.491
III76	2.55392	-0.96806	-1.45963	1.499	1.499
IV76	2.55558	-0.97043	-1.46143	1.541	1.545
I77	2.57831	-0.97356	-1.50264	1.541	1.544

[1] Predicted

[2] Actual

3. Quarterly rather than annual estimates were employed in order to increase the number of test cases[14] and provide a test in terms of short-run stability. For both the predicted and actual multiplier series the arithmetic average was 1.491. Calculated variances were .00113 and .00108 respectively for the predicted and actual series. Such evidence suggests the existence of a highly stable multiplier in Turkey during the period covered in Table 3. The nature of this stability lies in the stability of the parameter contributions of the currency and reserve ratios. Regression estimates based on (7) cannot explain the underlying forces that account for the observed stability. Also, since fairly current information on the monetary aggregates is not available to the monetary authorities in Turkey it is higly unlikely that they could forecast the multiplier using this approach. The model and results offered here do not constitute a

14 Annual series on banks' reserves for Turkey after 1961 are not strictly comparable with series for the pre-1961 period. See Central Bank of the Republic of Turkey, *Summary of Money and Credit Statistics,* various issues, and *Monthly Bulletin,* various issues.

forecasting tool, but instead, offer an ex post test of the stability of regression coefficients based upon an identity.

Computed efficiency ratios for the multiplier and its two components did not contradict the hypothesis of a policy-stabilized multiplier. An index of variability or erratic behavior, the efficiency ratio relates:

> . . . the net change in the level of the . . . ratio to the total path travelled during the period considered . . . The attractive feature of the index is that its value ranges between +100% and -100%. The longer the movement of the . . . ratio persists in the same direction, the closer is the absolute value of the index to 100% and the more efficient is the movement. Conversely, the more the change in the level of the ratio changes direction, the closer is the absolute value of the index to zero, and the less efficient is the movement.[15]

To compute the efficiency ratio or index of the currency ratio, for example, the absolute value of quarterly changes, from 170 to 177, in the currency ratio, are summed and the total is then divided by the number of quarters minus one (28). This is then expressed as a percentage of the difference, positive of negative, between the observed currency ratios in the first and last quarters:[16]

$$\sum_{t=2}^{n} \frac{|x_t - x_{t-1}|}{x_n - x_1} \times 100$$

where x = c, r, m.

Obtained efficiency ratios for the multiplier, currency and reserve ratios were respectively: -16.44; -4.55; and 20. The behavior of the multiplier over the relevant period was erratic, given that the absolute value of its efficiency was nowhere near 100%. Yet, its behavior more closely resembles that of the policy-determined reserve ratio rather than that of the currency ratio.

The second notion of stability, structural stability, unlike predictability, focuses on the presence or absence of a shift in the relationship between the multiplier and its components between two subperiods. Table 4 shows regression coefficients based upon estimates of (7) for the entire 29-quarter period as well as two sub-periods. Table 5 indicates the analysis of variance used to compute the F-ratio for the Chow Test.[17] The obtained Chow Test statistic of

15 See Khazzoom (1966), p. 119.
16 See Khazzoom (1966), p. 117-118.
17 See Chow (1960), p. 591-605.

Table 4

REGRESSION COEFFICIENTS BASED ON EQUATION (7)

	Intercept	c	r
I70-I77	2.66818	-1.16094	-1.55815
I70-III73	2.79866	-1.48130	-1.60633
IV73-I77	2.58408	-0.97808	-1.51029

Table 5

ANALYSIS OF VARIANCE

Period	Source of Variation	Sum of Squares	D.F.
I70-I77	Regression	.123185	2
	Residual	.000510693	26
I70-III73	Regression	.089883	2
	Residual	.000134572	12
III73-I77	Regression	.0150614	2
	Residual	.0000235476	11

17.28 shows that the multiplier relationship is not structurally stable over the relevant time period.

V. Conclusions

This paper has shown that two different approaches to the analysis of the stability of the multiplier in Turkey lead to different conclusions. Parameter contributions to the multiplier, while structurally unstable, nevertheless, exhibit sufficient stability for successive short-run periods so as to render a highly predictable multiplier. Stability of the multiplier, as it is defined here, ultimately depends upon the stability of the relationships between the currency and reserve ratios and their underlying determinants. It is also clear that analysis of stability based upon mere numerical constancy are not particularly useful.

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