IMF Working Paper

WP/97/22

INTERNATIONAL MONETARY FUND

Middle Eastern Department

Broad Money Demand and Monetary Policy in Tunisia

Prepared by Volker Treichel[1]

Authorized for distribution by Abdelali Jbili

March 1997

Abstract

The development of empirical foundations to the conduct of monetary policy in Tunisia is the central concern of this paper. Finding stable money demand functions, it broadly corroborates the choice of monetary aggregates as intermediate targets of monetary policy by the Tunisian Central Bank. It finds, however, a lower income elasticity than the one currently applied by the Central Bank and proposes a different methodology for defining monetary growth targets. The paper also finds that both interest rates and reserve money are feasible operating targets and suggests that the Central Bank orients its monetary policy more towards transparent operating targets.

JEL Classification Numbers:
C52, E41, E52, N15

Author's E-Mail Address: vtreichel@imf.org

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[1]The author thanks, without implication, David Bowman, Paul Duran, Klaus Enders, Henri Ghesquiere, Abdelali Jbili, Oussama Kanaan, Helga Treichel, Milan Zavadjil, and in particular, V. Sundararajan and Jeromin Zettelmeyer for their valuable comments and suggestions.

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SUMMARY

The objective of this paper is to establish empirical foundations for the conduct of monetary policy in Tunisia by examining the nature and the stability of the demand for money and discussing appropriate operating regimes for the control of the money supply.

Based on recursive parameter estimates, tests for cointegration and out-of-sample forecasts, the paper finds that the demand for money in Tunisia has been essentially stable from 1962–95. Even though out-of sample forecasts suggest that a structural break occurred in 1990 after the introduction of highly liquid treasury bills, since 1990, no instability of the demand for money could be detected.

While the stability of the demand for money suggests that the monetary targeting regime currently used by the Tunisian Central Bank is feasible, the paper finds a lower income elasticity and proposes a methodology for deriving monetary growth targets different from the one currently applied by the Tunisian Central Bank. Furthermore, as Tunisia proceeds with reforms of its financial sector, the stability of the demand for money may have to be reexamined.

The paper also analyzes the suitability of interest rates and reserve money as operating targets. Given the controllability of interest rates and the monetary base as well as statistically significant links between interest rates and monetary aggregates on the one hand and the base and the monetary aggregates on the other hand, it concludes that both a price and a base regime are feasible operating regimes, which should facilitate an effective control of the money supply. As indirect monetary policy instruments are strengthened, the Central Bank may have to modify procedures for the control of the monetary base.

I. INTRODUCTION

1. Central Banks in many countries rely on a money demand function both as a means to identify medium-term growth targets for the money supply, but also to manipulate interest rates and the reserve money for the purpose of controlling total liquidity in the economy. The usefulness of a money demand function in the conduct of monetary policy depends crucially on its stability. In the absence of a stable money demand function, monetary growth targets might be inconsistent with developments in the real economy, interest rate targets may be out of line with the planned growth of the money supply and the targeted monetary aggregate might not be an appropriate reflection of total liquidity in the economy. In a number of countries (e.g., United States, Great Britain), demand for money functions were found to be unstable in the aftermath of financial sector reforms and the emergence of new financial assets. As a consequence, many Central Banks have abandoned monetary targets and base their monetary policy on a combination of indicators such as the exchange rate, nominal GDP or the inflation rate.

2. Like other countries in the Maghreb, in South-East Asia and in Latin America, Tunisia has been undertaking reforms of its financial sector as part of a broader macroeconomic adjustment program and structural reforms since 1987. Key elements of the reform were the liberalization of interest rates, the improvement of banking supervision and the introduction of more market-based instruments of monetary policy.

3. Against the background of financial sector reforms in Tunisia, this paper examines the stability of the money demand function in Tunisia and assesses to which extent a money demand function could assist the Tunisian Central Bank in formulating and executing its monetary policy. The paper comes to the conclusion that, in spite of the reforms of the financial sector, both annual and monthly data of real broad monetary aggregates M2 and M4 exhibit a remarkably stable relationship with real GDP. Therefore, monetary aggregates are feasible intermediate targets of monetary policy in Tunisia and the estimated money demand functions for M2 and M4 could serve as a basis for the establishment of a suitable range of monetary growth objectives in the conduct of monetary policy, thus replacing the current judgmental procedure of determining a growth target of the money supply. The only break in the demand for money function occurred in the context of the introduction of highly liquid treasury bills in 1990, which led to a downward shift in the demand for M2. Since then, however, the demand for money has again exhibited stability.

4. The paper thus arrives at a broad corroboration of the monetary policy regime of the Tunisian Central Bank, which relies on a stable relationship of money and GDP. At the same time, however, it proposes a different methodology for deriving a suitable range of monetary growth targets and finds a lower income elasticity than the one currently applied by the Central Bank. Moreover, the stability of the money demand function may have to be reexamined, if interest rates in Tunisia were determined more by market forces, which would be desirable to achieve a more efficient allocation of resources.

5. In executing a monetary targeting regime, the Central Bank has to define an appropriate operating target that is in a predictable relationship with the monetary aggregate. For the purpose of addressing this question, the paper examines the suitability of interest and reserve money operating targets. It concludes that the interest rate on treasury bills is significantly related both with M2 and M4 and that its manipulation could ensure the effective control of the money supply. As regards the relationship between the monetary base and monetary aggregates M2 and M4 it finds that in Tunisia the monetary base is controllable by the Central Bank and that the monetary base is cointegrated both with M2 and M4, which also points to the feasibility of a reserve targeting regime.

6. The rest of the paper is organized as follows: The second section describes the current regime of monetary policy in Tunisia. In the third and fourth sections, the specification of the demand for money in Tunisia is discussed and the utilized data are described. The fifth section presents and interprets the results of money demand estimates. The sixth section presents regressions of monetary aggregates M2 and M4 on the monetary base and the seventh section concludes.

II. The Current Regime of Monetary Policy in Tunisia

7. Currently, the Tunisian Central Bank develops a notion of the appropriate growth of the money supply and the amount of refinancing according to the following three-step procedure: First, the growth of M2 is set at 2 percent below the projected growth of nominal GDP. Second, under the presumption of a roughly constant multiplier, the amount of base money supply consistent with the targeted growth of M2 is calculated. Third, taking into account projected net international reserves and the credit requirements of the agricultural sector, the Central Bank determines the quantities of liquidity to be distributed through the refinancing facilities.[2] On a weekly basis, these amounts are fine-tuned taking into account the perceived financing needs of the commercial banks. While the Central Bank monitors a number of other indicators, such as the level of net international reserves and the monthly inflation rate to assess the appropriateness of its monetary policy, monetary aggregate M2 appears to be the Tunisian Central Bank's leading indicator of monetary policy.

8. Even though this procedure for defining the monetary growth targets is based on the empirical experience of the Tunisian Central Bank, it lacks precision and statistical foundation and may lead to either a too expansionary or too contractionary approach to monetary policy in relation to the development of the real economy, in particular if the underlying relationships are subject to structural change, which is a recurrent phenomenon after financial sector reforms. In this context it is interesting to note that the difference of the growth of M2 and nominal GDP has fluctuated considerably in the past and has rarely amounted to the targeted level of 2 percent. This may reflect either the fact that monetary growth targets are revised in

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[2]Tunisia maintains relatively strict controls on capital account transactions.

the course of the year in light of developments in the real economy or the inflation rate or that the Central Bank's monetary targeting procedure lacks precision.

9. In order to define monetary growth targets in a more appropriate way and improve the accuracy of its monetary targeting, the Central Bank should derive target ranges for the growth of the money supply from a money demand function and define appropriate operating targets.

10. **Operating targets** should be under the direct control of the Central Bank and be related closely and reliably to the monetary aggregate, since the money supply cannot be directly controlled by the Central Bank.[3] In the context of a monetary targeting regime, two operating regimes for the control of the money supply can be distinguished:

11. (1) A **price regime**, in which short-term interest rates are targeted so as to be consistent with the growth rate of the money supply. For the purpose of defining a proper interest rate operating target, the estimated money demand function has to be solved for the interest rate. In this regime, the base money supply is endogenous.

12. (2) A **base regime**, in which after the prediction of a money multiplier the monetary base is manipulated so as to achieve a certain growth of the money supply. In this regime, the interest rate on the money market is endogenous.

13. The feasibility of a price regime is assessed by estimating the interest rate elasticity of the demand for money in the fifth section and that of a reserve targeting regime by examining the controllability of the monetary base and analyzing the relationship between the monetary base and the money supply econometrically in the sixth section.

III. Specification Issues of the Money Demand Function

A. Equilibrium Versus Disequilibrium Models

14. In modeling the demand for money, the short-run and the long-run money demand have to be distinguished. In equilibrium approaches of money demand, economic agents are thought to be permanently in the process of adjusting their current money holdings to the desired long- run level, thus moving from a short-run equilibrium to a long-run equilibrium demand for money. Equilibrium approaches of the demand for money assume perfect price and interest flexibility and perfect information. Since these conditions could not be found to be valid in reality,[4] alternative disequilibrium models of the money demand were developed.[5]

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[3]For a review of operating regimes of the money supply, see Treichel (1993).

[4]See for example, Ahmed, S. (1987) or Scheide, J. (1991).

[5]See for example Boughton (1991, 1993), or Baba, Hendry, and Starr (1992).

15. The central feature of these models is that economic agents are constantly adjusting their current money holdings to some **average target** level. As a result of the unpredictable nature of expenditure and income shocks, the desired and actual money holdings of economic agents might deviate both in the short and the long run from equilibrium, i.e., from that level of money holdings that is consistent with economic fundamentals.

16. The most popular econometric representation of equilibrium approaches is the partial-adjustment model, in which the money supply lagged by one period enters as an independent variable and captures the permanent adjustment of the short-run to the long-run demand for money. The development of disequilibrium or buffer stock approaches to the demand for money necessitated alternative econometric specifications. The most common method of modeling a disequilibrium demand for money are error-correction models, which reflect the adjustment towards a long-run steady state in response to short-term disturbances.

B. Determinants of the Demand for Money in Tunisia

17. The demand for money is usually modeled as a function of an opportunity cost variable (interest rates) and the inflation rate, which reflect the store-of-value motive of money holdings, and an income variable (real GDP), which reflects the transaction motive of the demand for money and structural and seasonal dummies. Thus, the Tunisian real demand for money M/P is specified as follows:

M/P = f(RGDP, INFL, INT):

RGDP = real GDP
INFL = Inflation rate
INT = Interest rates

IV. The Data

18. The data used are as follows: Monetary aggregates RM2 and RM4 (millions of Tunisian Dinar) are the broad measures of money deflated by the consumer price index;[6] RGDP is real income, INFL is the monthly or the annual inflation rate and TRES is the monthly rate of return on treasury bills. Other interest rates that are included are the rediscount rate (DISC) and the money market rate (MMINT).

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[6]M1 is the sum of currency and demand deposits. M2 is the sum of M1 and quasi-money. M3 is the sum of M2 and long-term deposits. M4 is the sum of M3 and treasury bills in the hands of the public.

19. All monetary data were taken from the Statistical Bulletin of the Central Bank. Data for real GDP and the inflation rate were taken from the *International Financial Statistics* until 1989 and from the latest WEO submission from 1990 to 1995. Data on the rate of return on Treasury bills since 1990 were provided by the Central Bank. Data for the money market (from 1981 to 1995) and the rediscount rate (from 1962 to 1989) were taken from the *IFS*. Rediscounting was discontinued in 1989 and a money market was established in 1981.

20. All series are either annual or monthly and seasonally nonadjusted. Seasonality is captured either through seasonal dummies or through seasonal lags in the set of regressors. Monthly real GDP was linearly extrapolated based on the annual series. While this may appear a crude method given the intra-annual fluctuations in economic activity, it could be justified on the ground that a seasonally adjusted series of real GDP may be close to a linear trend. Consequently, the linearly extrapolated time series of monthly real GDP may resemble a deseasonalized time series.

V. Reports of Regression Results

21. This section first presents unit root tests for the variables of interest. Then the existence of a cointegrating vector among real money (M2 and M4) and the set of independent variables is assessed following Engle-Granger (1987) and Johansen's maximum likelihood procedure (1988) and error-correction models are estimated.

A. Integration

22. Before modeling the demand for Tunisian Dinars, the orders of integration of all considered variables were determined. Table 1 lists the augmented Dickey-Fuller (1981) (ADF) statistics for the central variables in our analysis. The ADF test statistics clearly show that the hypothesis of a unit root cannot be rejected in the monetary aggregates, real GDP, the annual inflation rate, the annual money market rate and rediscount rate and the monthly return on Treasury bills[7] and that those variables appear to be I (1).[8] The monthly inflation rate, however, is stationary in levels (I(0)) and cannot form part of a cointegration analysis.

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[7]There are not enough observations of the annual return on treasury bills to conduct a test for stationarity.

[8]For $i \geq 0$, the notation I(i) indicates that a variable must be differenced i times to make it stationary. That is, if x_t is I(i), then $\Delta^i x_t$ is I(0).

Table 1. ADF Statistics for Testing for a Unit Root

Annual data					
Null Order	LRM2	LRGDP	DISC	MMINT	INFL
I(1)	2.5	1.01	1.4	0.96	1.7
I(2)	4.45	4.6 **	3.8 **	2.5 +	4.2 **

Monthly data					
Null Order	LRM2	LRM4	LRGDP	TRES	INFL
I(1)	2.12	0.19	1.20	1.77	6.8 **
I(2)	8.36 **	9.41**	5.23**	5.0**	...

Notes:
1. For a given variable and null order, the augmented Dickey–Fuller (1981) statistic is reported. A constant term is used and the lag length is determined through the Akaike Information Criterion. The maximum available sample is used.

2. For any variable x and a null order of I(1), the ADF statistic is testing a null hypothesis of a unit root in x against an alternative of a stationary root. For a null of I(2), the statistic is testing a null hypothesis of a unit root in $(x-x(t-1))$ against an alternative of a stationary root in $(x-x(t-1))$.

3. The superscripts +, *, ** denote rejection of the null hypothesis at the 10%, 5%, and 1% critical values.

B. Money Demand Estimates: Annual Data

23. The following estimate was found for M2 over the period from 1963 to 1995 (figures in brackets are t-statistics):[9]

(1) $\ln(RM2) = -3.41 + 0.80 \ln(RGDP) - 0.008\ TRES$
$(1.42)\ (3.26)\qquad (1.54)$

$\bar{R}^2 = 0.996$ D.W. = 1.72 Standard Error = 0.07

Cochrane-Orcutt:

ADF = -0.7 (3.35)

$u_t = 0.94\ u_{t-1}$
(31.2)

24. The Johansen test indicates that real M2 is cointegrated with real GDP at the 10 percent level, but not with the money market rate or the rediscount rate (see Table 2).[10] Based on the test-statistic of the ADF test, the hypothesis of cointegration can be accepted at the 10 percent level; the critical value for accepting cointegration is around 3.5.[11]

25. The income elasticity of 0.8 is relatively low compared to industrial countries, where typically an income elasticity of 1 or higher is found. This might reflect increasing substitution towards treasury bills in the last five years of the estimation period. The coefficient on the treasury bill rate, which obtains values of 0 from 1962 to 1989 and the average weighted return on treasury bills since then, exhibits a negative sign reflecting the downward shift of the demand for M2 in the aftermath of the introduction of the highly liquid treasury bills. Neither the money market nor the rediscount rate were statistically significant. In order to construct

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[9]The inflation rate was insignificant.

[10]The regression with the money market rate as independent variable was estimated over the period 1981–95, in order to avoid problems arising from the lack of data for the money market rate before 1981. The annual rate on treasury bills resembles in many aspects a dummy variable and is therefore excluded from the Johansen test for cointegration. In the Engle-Granger procedure, however, it is included, as dummy variables have not been found to affect the distribution of the critical values.

[11]As low Durbin-Watson statistics indicated residual autocorrelation, the equation was reestimated using the Cochrane-Orcutt procedure. The ADF-test for stationarity of the residuals of equation (1) was carried out, however, using regression residuals that were uncorrected for autocorrelation. The Cochrane-Orcutt procedure involves taking the first difference of the residuals so that the ADF-test would no longer be a valid test for stationarity of the residuals in the levels equation.

Table 2. A Cointegration Analysis of Tunisian Money Demand Data

Variables: LRGDP, LRM2 (Annual data)			
Period: 1962–95			
Eigenvalues	0.97	0.55	
Hypotheses	r=0	r<=1	
P–value	0.07	0.07	
Period: 1962–90			
Eigenvalues	0.98	0.42	
Hypotheses	r=0	r<=1	
P–value	0.01	0.09	
Variables: LRGDP, LRM2, TRES, Seasonal lags (Monthly data)			
Period: 1990–95			
Eigenvalues	0.5	0.04	0.0
Hypotheses	r=0	r<=1	r<=2
P–value	0	0.91	0.63
Variables: LRGDP, LRM4, TRES, Seasonal lags (Monthly data)			
Period: 1990–95			
Eigenvalues	0.45	0.16	0.09
Hypotheses	r=0	r<=1	r<=2
P–value	0.02	0.32	0.04
Variables: LM2, LBAS, Seasonal lags (Monthly data)			
Period: 1992–95			
Eigenvalues	0.27	0.19	
Hypotheses	r=0	r<=1	
P–value	0.001	0.003	
Variables: LM4, LBAS, Seasonal lags (Monthly data)			
Period: 1992–95			
Eigenvalues	0.8	0.45	
Hypotheses	r=0	r<=1	
P–value	0	0.002	

Notes:
1. The number of lags was determined by TSP using the Akaike Information Criterion.
2. The null hypothesis is in terms of the cointegration rank r and, e.g., rejection of r=0 is evidence in favor of at least one cointegrating vector. The critical values are taken from Osterwald–Lenum (1992, Table 1).

an opportunity cost variable, that would reflect more adequately the structural shift induced by the introduction of treasury bills, the rediscount rate (from 1962 to 1989) and the T-bill rate (1990 to 1995) were combined as one variable. This variable, however, was not significant either.

26. In order to compare the computed income elasticity with the income elasticity implicit in the monetary targeting procedure of the Tunisian Central Bank outlined in the second section and examine the validity of the Central Bank's approach to the assessment of the appropriateness of monetary growth, a hypothetical series of M2 was constructed using a growth rate 2 percentage points below the growth of nominal GDP and equation (1) was reestimated based on this revised timeseries of M2. Using this hypothetical series of M2 an income elasticity of well over 1 was found, which is significantly different from the income elasticity in equation (1). Interestingly, the difference between the growth rate of M2 and of nominal GDP averaged about zero over the past ten years, but averaged about 4 over 1990 to 1995, which suggests that either the Central Bank's targeting lacked precision or that, similarly to the German Bundesbank, the Tunisian Central Bank targets a *range* of growth rates, which provides some flexibility to respond to developments in the real economy and to the inflation rate.

27. The hypothesis of cointegration was further confirmed by the subsequently estimated error-correction model, given the negative and statistically significant error-correction term u.[12]

$$\Delta \ln(RM2) = \underset{(1.95)}{0.31\ \Delta \ln(RM2)[-1]} \underset{(1.72)}{-0.28\ u\ [-1]} \underset{(3.03)}{+0.04} \quad (2)$$

$\bar{R}^2 = 0.18$ D.W. = 1.53 Standard Error = 0.05

28. Several diagnostic tests were applied, in order to assess the quality of the estimated long-run equation (1) and of the error-correction model (2). Panel 1 of Chart 1 shows the predicted and the actual values of real M2 using equation (1). Equation (1) tracks real M2 well and forecasting errors are generally of a small magnitude. Over the last five years, equation (1) overpredicts the demand for M2. This most likely reflects a fall in the demand for M2 as a result of the introduction of highly liquid treasury bills which is not entirely captured by the interest rate variable. Panel 2 of Chart 1 also plots the actual and the predicted growth of M2 according to equation (2) . With occasional outliers (1978, 1980, 1987), the equation predicts the growth of M2 quite well. Similarly to equation (1), equation (2) overpredicts the growth of M2 during the last three years. The break of the demand for money becomes also apparent in the out-of-sample forecast of M2 based on equation (2) estimated over 1962–90 (Chart 2), which indicates an upward bias.

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[12]u always represents the residual of the levels - regression.

29. In order to assess the parametric stability of the estimated error-correction model, recursive parameter estimates for all coefficients were computed. The recursive parameter estimate for the error-correction term is graphed in panel 3 of Chart 1. As is evident from that chart, the error-correction term was stable over most of the period, but increased over the past five years. This most likely reflects the sharply reduced demand for M2 during the past five years as a result of substitution into treasury bills. Also, the coefficients on the lagged differences of M2, which are not graphed, increased over the past five years. Overall, there appears to be parametric instability over the period 1990–95 in the demand for M2.

30. In order to determine, whether a statistically significant structural breakpoint can be identified over the estimation period, recursive Chow tests were carried out on the error correction model in equation (2). Chow tests assess the statistical significance of differences between residuals of a sample period to those of the entire estimation period. Panel 4 of Chart 1 plots test statistics for recursive Chow-tests as well as the critical value for rejecting the hypothesis of stability at the 5 percent level. Clearly, all Chow test statistics are below the critical value, thus indicating stability of the equation and the absence of a statistically significant structural break.

31. The question arises, why the parametric instability beginning in 1990 was not captured by the Chow test as a structural break, even though the demand for M2 seems to have shifted from 1990 onwards. This could well reflect a very gradual change in the nature of the demand for money, as agents adjusted slowly towards the newly available financial assets. In that case, not one single point in time could be identified as a break point in the money demand function.

32. In order to assess changes in the demand for M2 induced by the introduction of treasury bills, equations (1) and (2) were estimated over 1962–90 as well. Interestingly, the income elasticity was about 1.5, thus significantly higher than over the period 1962–95, reflecting the downward shift of the demand for M2 following the introduction of liquid treasury bills. Importantly, the hypothesis of cointegration is accepted here at the *one percent* level both on the basis of an ADF-test of the estimated residuals as well as on the basis of the Johansen procedure.[13] This shows that the demand for M2 had a more stable link with real GDP over the period 1962–90 than over the period 1962–95, most likely due to the introduction of treasury bills.

33. In summary, as indicated by the error-correction model and the recursive Chow tests, there seems to exist a stable long-run relationship between real money (M2) and real GDP. There has, however, been parametric instability over the past five years. If parametric instability were to continue, the estimated function for M2 would be an inappropriate tool for determining a suitable intermediate target of monetary policy.

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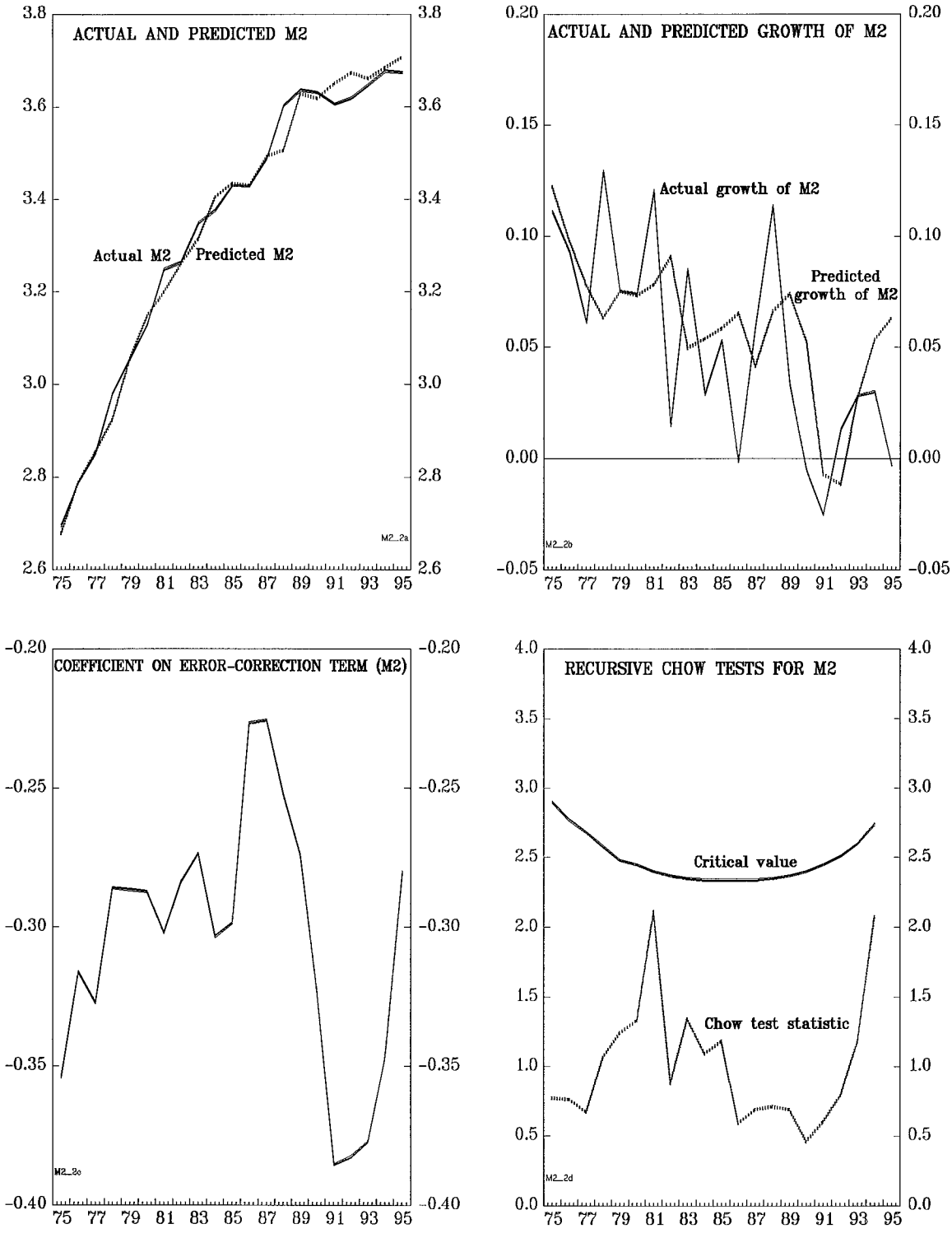
[13]The coefficient of the lagged level of the residual in the ADF-test had a parameter estimate of -0.94 and an ADF-statistic of 4.15.

CHART 1

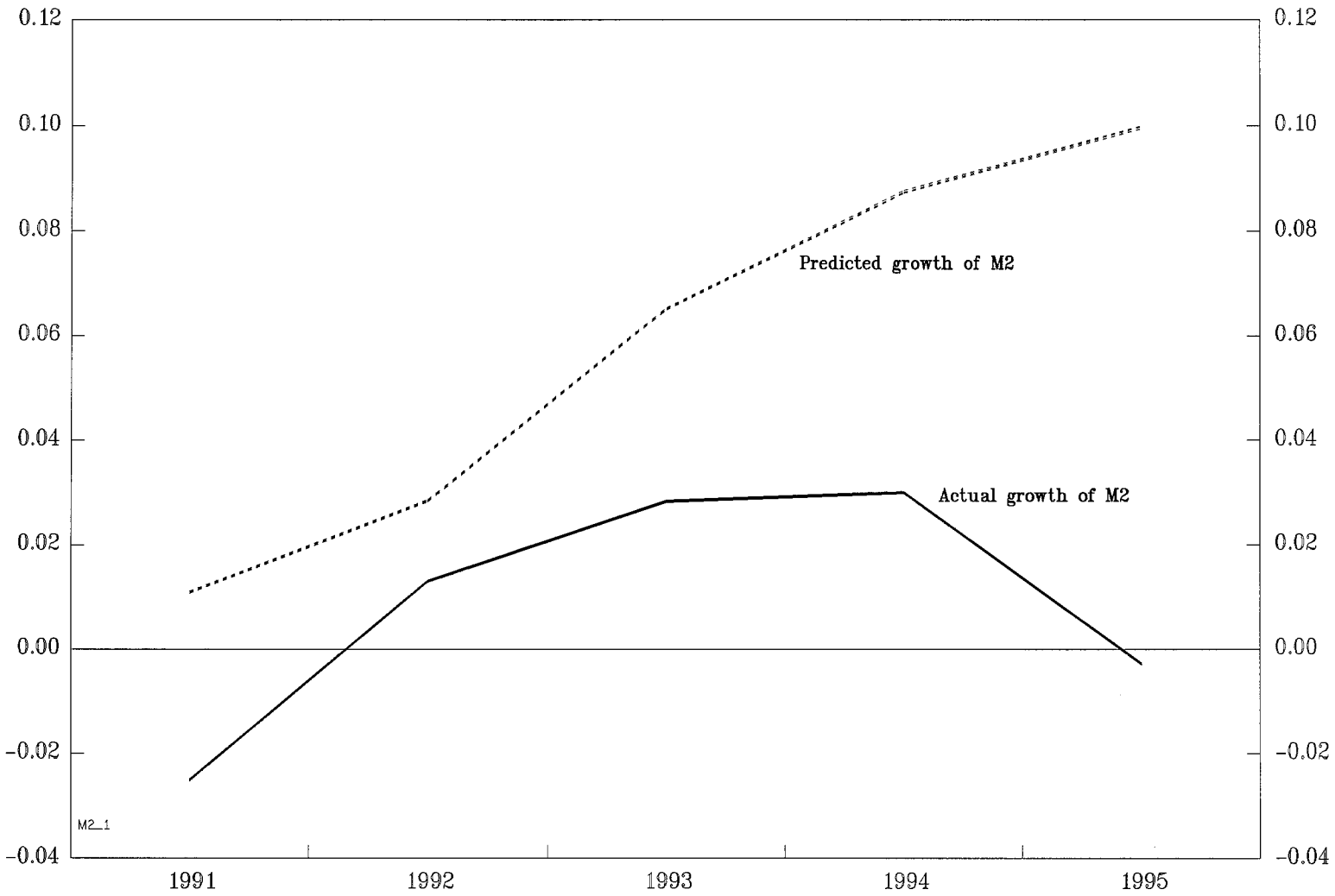
DEMAND FOR M2



Source: Estimated by author.

CHART 2

ACTUAL AND PREDICTED GROWTH OF M2 (OUT-OF SAMPLE)



Source: Author.

C. Money Demand Estimates: Monthly Data

Demand for M2

34. The following estimate of the demand for M2 was found using monthly data over the period 1990–95:

(3) $\ln(RM2) = 2.95 + 0.13 \ln(RGDP) - 0.02 TRES$
(5.9) (2.42) (6.27)

$\bar{R}^2 = 0.68$ D.W. = 1.97 Standard Error = 0.02

Cochrane-Orcutt: ADF = -0.56 (4.3)

$u_t = 0.42 u_{t-1}$
(3.75)

35. The Johansen test and the augmented Dickey-Fuller test indicate that M2 is cointegrated with real GDP and the treasury bill rate at the 1 percent level. Importantly, if the monthly treasury bill rate is excluded, the hypothesis of cointegration is rejected both on the basis of the Johansen and the augmented Dickey-Fuller test, showing the importance of this opportunity cost variable for the demand for M2.

36. The income elasticity is significantly lower than over the entire period 1962–95 indicating that the demand for M2 shifted downwards after the introduction of treasury bills. Furthermore, the demand for M2 is significantly interest elastic, which could not be shown for the time period before 1990. The estimated error-correction model confirms the hypothesis of cointegration, given the negative and highly significant error-correction term.

(4) $\Delta\ln(RM2) = - 0.09 \Delta\ln(RM2)[-1] - 0.008 \Delta TRES[-1] - 0.53 u[-1]$
(0.65) (1.04) (3.42)

$+0.53 \Delta\ln(RGDP)[-1] - 0.003 S2 + 0.01 S3 + 0.02 S4$
(0.91) (0.5) (1.75) (2.7)

$- 0.007$
(1.28)

$\bar{R}^2 = 0.38$ D.W. = 1.89 Standard Error = 0.02

37. This regression is clearly dominated by the error-correction term, while all other independent variables are insignificant. The significance of the third and the fourth quarter seasonal dummies point to a strong seasonal element in the demand for M2.

38. The error-correction coefficient is much higher than for the period 1962–95, which indicates that the adjustment towards the long-run equilibrium took place at a much faster pace in the period 1990–95 than from 1962–95. This may reflect the impact of financial sector reform which through the increased availability of banking services and higher returns on financial assets allowed economic agents to reestablish equilibrium levels of money holdings faster than before reforms.

39. Recursive Chow tests did not indicate any statistically significant break point (Chart 3). Furthermore, the out-of sample estimate based on an estimate of equation (4) through 1994 showed a remarkably strong forecasting power in contrast to equation (2), which suggests that the demand for M2 had reached a new equilibrium already by 1990 after the introduction of treasury bills (Chart 4).

Demand for M4

40. The following result was obtained over 1990–95 for the regression of real M4 on real GDP.

(5) $\ln(RM4) = 1.07 \ln(RGDP) - 0.03\ TRES - 5.33$
(38.7) (11.39) (10.5)

$\bar{R}^2 = 0.96$ D.W. = 1.33 Standard error = 0.02

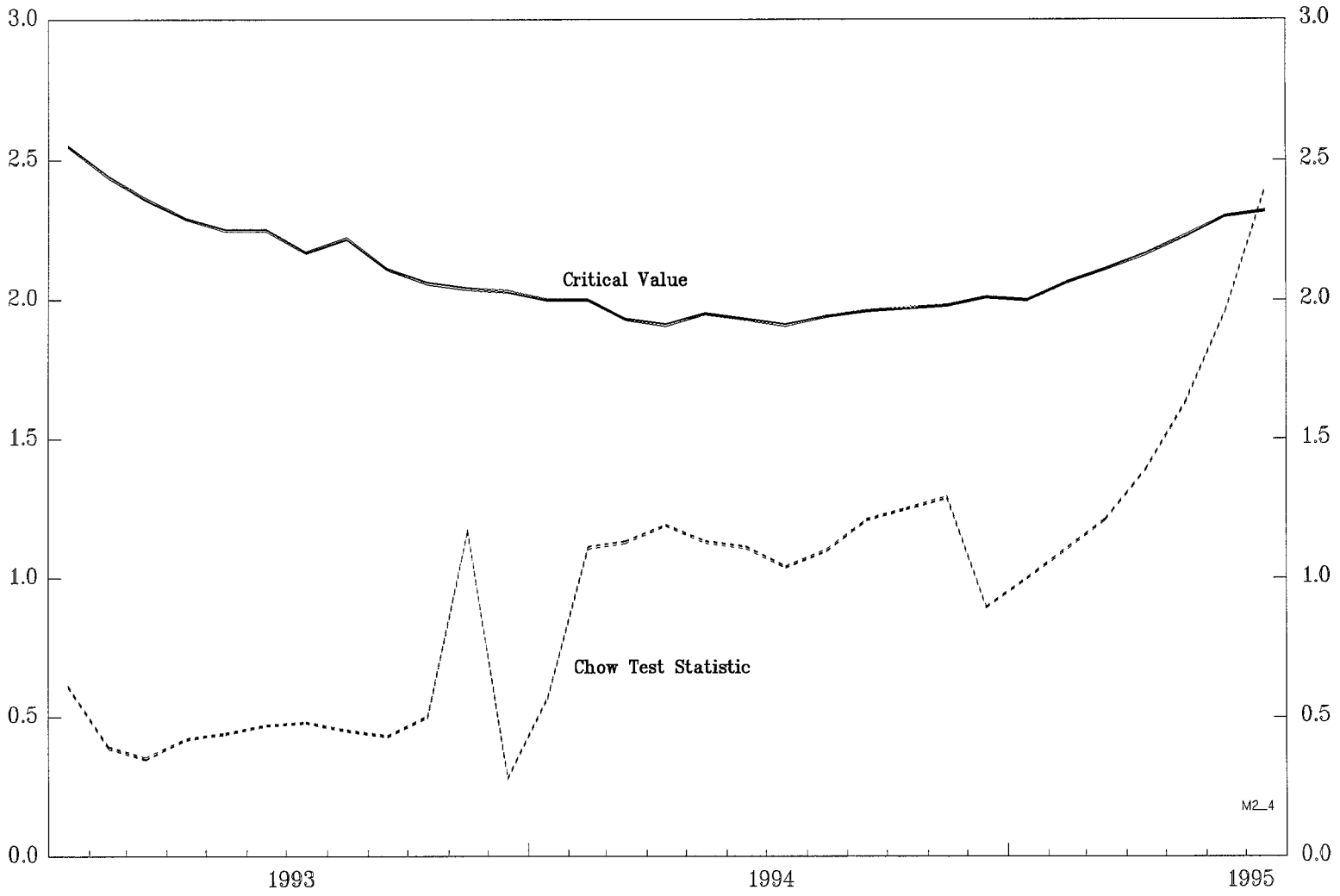
Cochrane-Orcutt: ADF = 0.6 (4.23)

$u_t = 0.33\ u_{t-1}$
(2.84)

41. Based on the Johansen procedure and the ADF-test, the hypothesis of cointegration can be accepted at the 5 percent significance level. The income elasticity of greater than 1 reflects the growing monetization of the Tunisian economy in the aftermath of the introduction of treasury bills. Jointly with equations (1) through (4), there is thus strong empirical evidence that economic agents substituted out of M2 into M4, which includes treasury bills in the hand of the public. A puzzling feature of the above regression may be the significantly negative relationship between the treasury bill rate and the demand for M4. A priori, one would have expected this relationship to be rather neutral than negative, as economic agents substitute from assets contained in M2 into treasury bills thus not affecting the overall size of M4. At the same time, an examination of all interest rates in Tunisia demonstrates that the treasury bill rate moves in parallel with most other interest rates. Thus, the coefficient on the treasury bill rate may not only capture the substitution effect into treasury bills, but also the contractionary impact on credit demand of an interest rate increase.

CHART 3

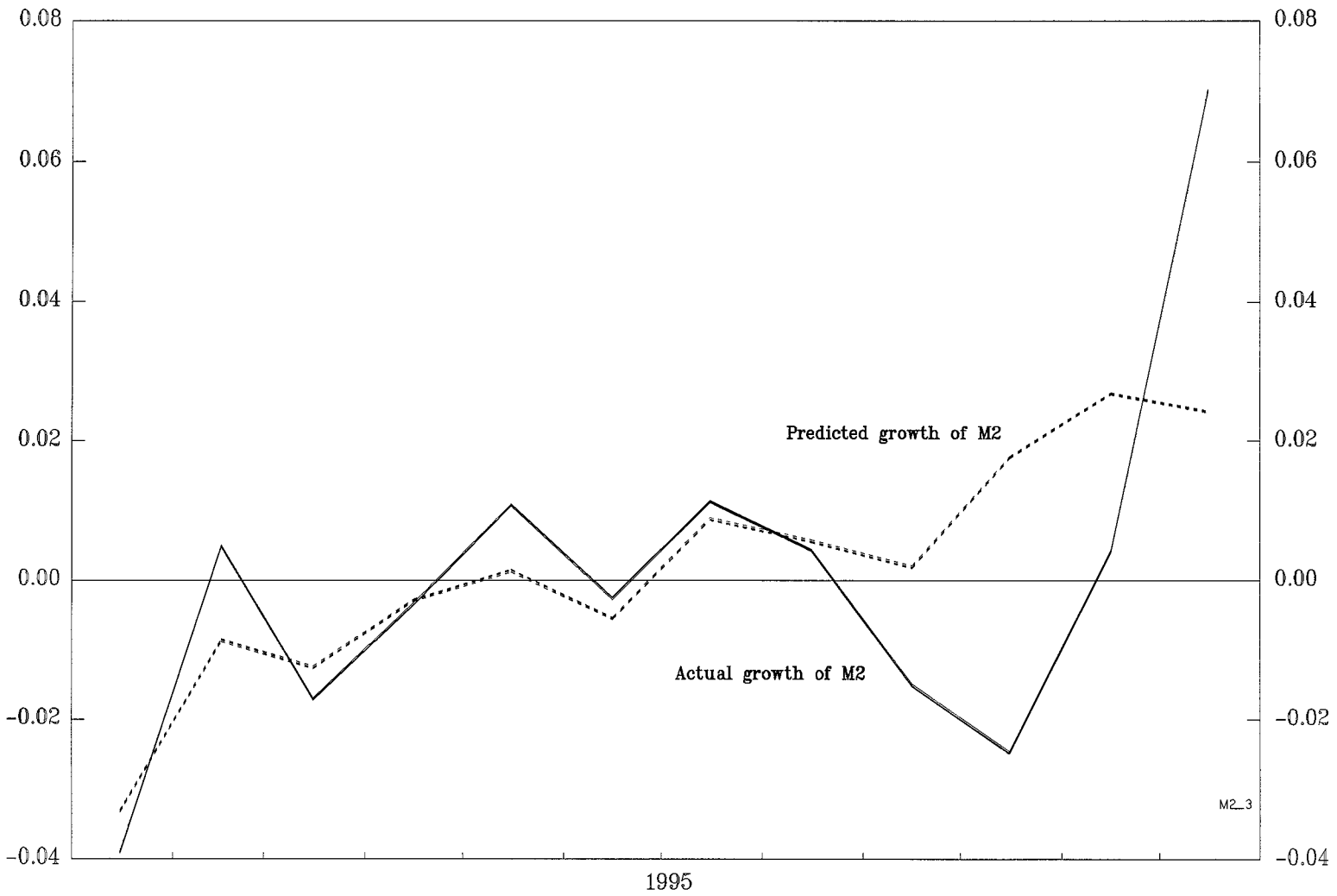
RECURSIVE CHOW TESTS (M2)



Source: Estimated by author.

CHART 4

ACTUAL AND PREDICTED GROWTH OF M2 (OUT-OF SAMPLE)



Source: Estimated by author.

42. The error-correction model, subsequently estimated, further confirms the hypothesis of cointegration, given the significance of the error-correction term at the 1 percent level as well as its negativity.

$$\begin{aligned}(6)\quad \Delta\ln(RM4) = &- 0.18\ \Delta\ln(RM4)[-1] - 0.46\ u\ [-1] - 0.01\Delta\ln(TRES)[-1] \\ &\quad (1.44) \qquad\qquad (3.26) \qquad (1.63) \\ &+ 0.005\ S2 + 0.012\ S3 \\ &\quad (0.86) \qquad (2.29) \\ &+ 0.02\ S4 - 0.005 \\ &\quad (3.48) \qquad (1.27)\end{aligned}$$

$\bar{R}^2 = 0.38$ D.W. = 1.99 Standard error = 0.02

43. Both the third and the fourth quarter seasonal dummies are statistically significant and a comparison of the forecasting qualities of the equation with and without seasonal dummies shows a significant improvement of predictions, when seasonal dummies are included. This points to a strong seasonal element in the demand for M4 in the third and fourth quarter.

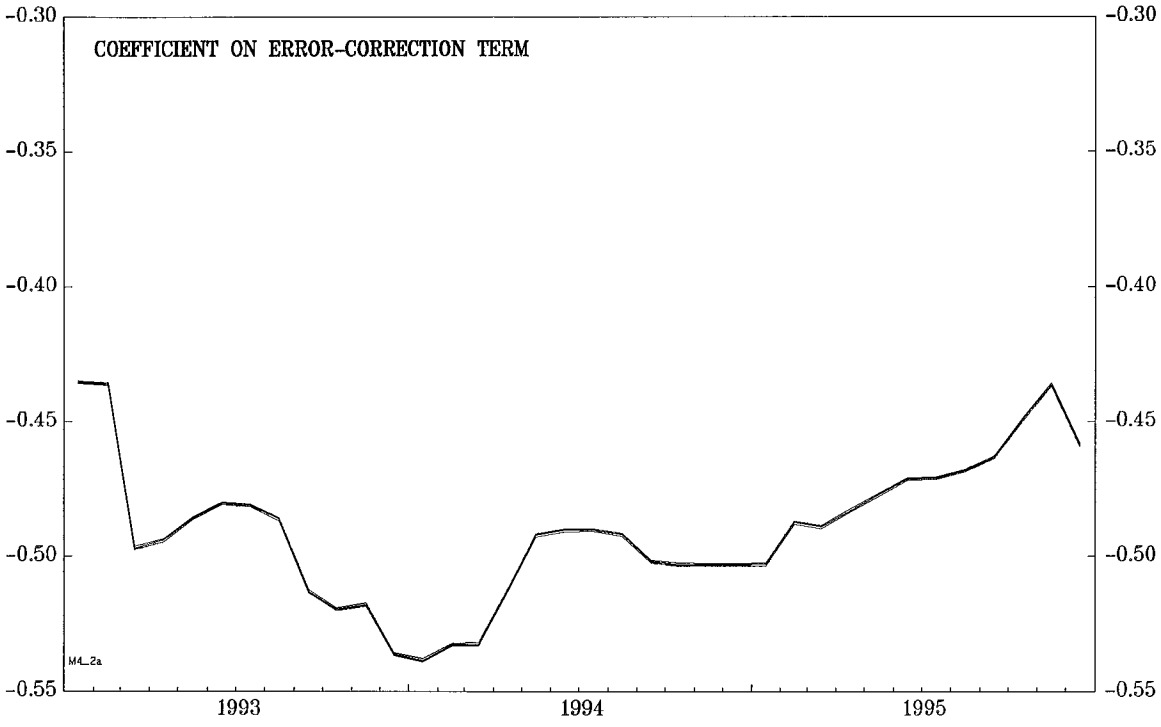
44. The same diagnostic tests were calculated as for equations (2) and (4). Forecasting errors both for the level and the growth equation of M4 are only of a small magnitude. The satisfactory qualities of equation (6) are further demonstrated by the out-of-sample forecasts for the growth of M4 based on an estimate of equation (6) through December 1994 shown in Chart 6. The recursive parameter estimate for the error-correction term did not display any pronounced instability over 1994–95 (panel 1; Chart 5). Recursive Chow tests graphed in panel 2 (Chart 5) show that no statistical evidence for a structural break could be found.

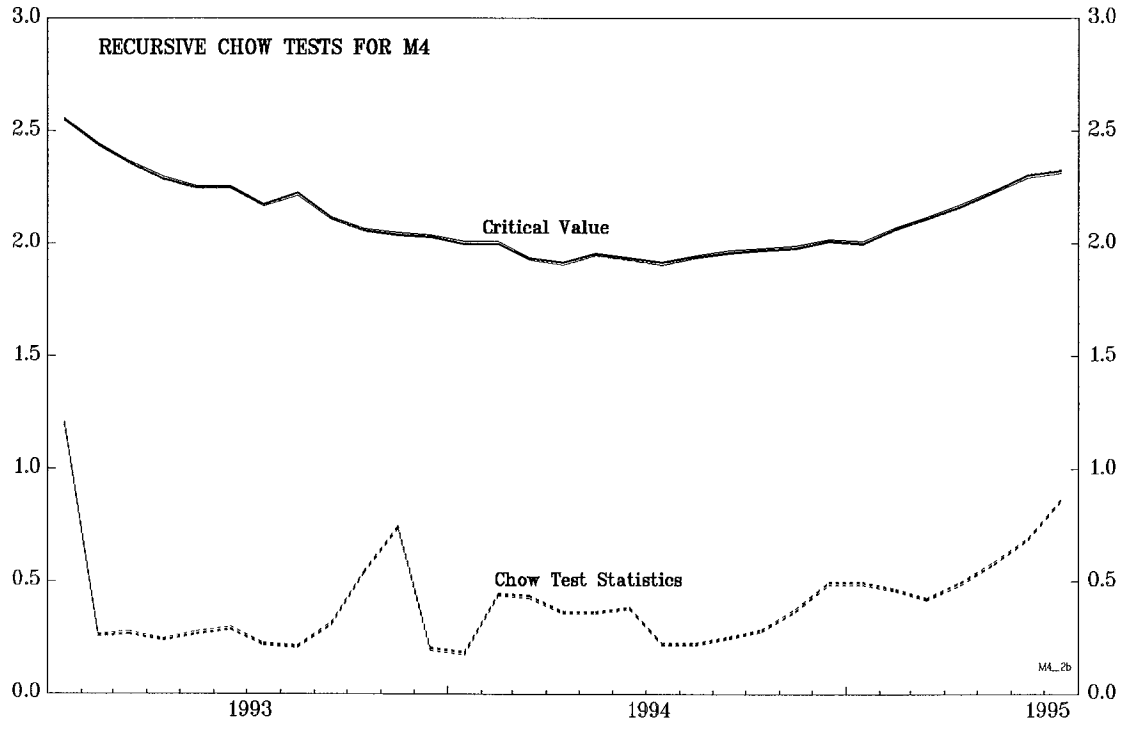
VI. THE CHOICE OF AN OPERATING TARGET

45. The results presented above permit the definition of an *intermediate* monetary growth target that is in a stable and a reliable relationship with real GDP. This result thus essentially corroborates the choice of monetary aggregates as targets of the monetary policy of the Tunisian Central Bank, even though it finds a lower income elasticity than the one implicit in the Central Bank's regime. This section addresses the question of the definition of an *operating* target, which has to be (1) controllable by the Central Bank and (2) exhibit a stable link with the money supply. As pointed out at the beginning of the paper, in principle, a Central Bank can choose between interest rates and reserve money as operating targets in line with particular monetary growth targets.

CHART 5

DEMAND FOR M4

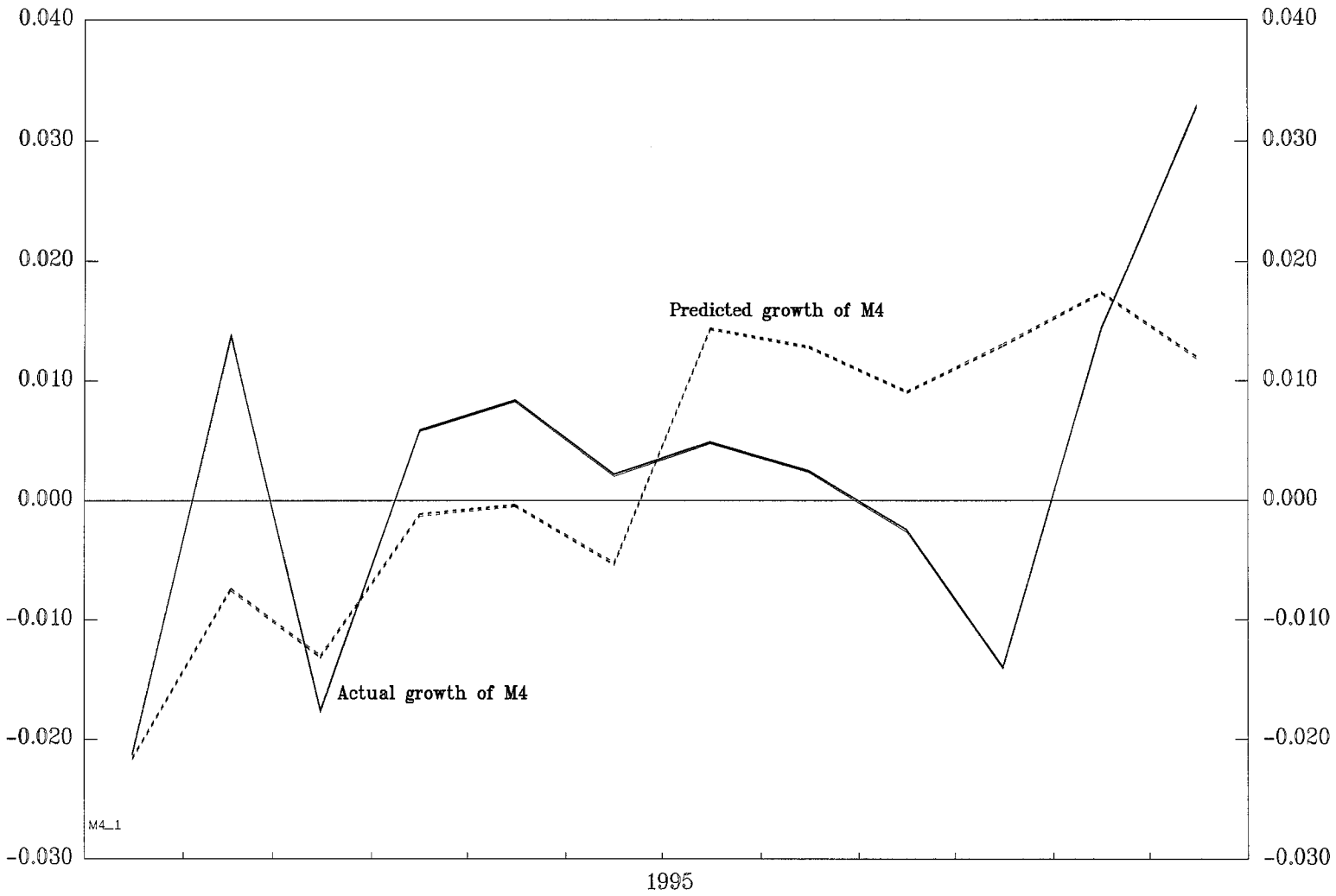




Source: Estimated by author.

CHART 6

ACTUAL AND PREDICTED GROWTH OF M4 (OUT-OF SAMPLE)



Source: Estimated by author.

46. The previous section showed that the demand for M2 and M4 was significantly elastic with respect to the T-bill rate. As indicated before, the T-bill rate is representative of the entire interest rate structure in Tunisia, since, at present, the Tunisian financial system exhibits a remarkable homogeneity with respect to interest rates: changes in interest rates set by the Central Bank usually trigger commensurate changes in the interest rates of the banking system and interest rates vary little among the banking system.[14] This reflects both the limited competition (*accord de place*) among commercial banks and moral suasion by the Central Bank. The controllability of interest rates in Tunisia allows the Central Bank to derive target interest rates from equations (3) and (5) that would be consistent with the desired growth rates of M2 and M4.

47. An alternative operating target to the interest rates in the context of a monetary targeting regime is reserve money, which requires the controllability of base money by the Central Bank. The attainment of a particular base money target involves the adjustment of net domestic assets (NDA) following the projection of net international reserves.[15] In the Tunisian context, net domestic assets of the Central Bank consist primarily of credit to commercial banks supplied through credit auctions (*appel d'offre*) and the repurchase facility (*prises en pension*). These monetary policy instruments resemble in practice quantity tenders at fixed interest rates, providing the Central Bank with a high degree of control both over the quantities of refinancing and the interest rate at which they are supplied. Overall, the monetary base in Tunisia appears highly controllable by the Central Bank. Obviously, if indirect monetary policy instruments were strengthened and an active interbank market was established, the link between the refinancing instruments of the Central Bank and the monetary base would have to be reexamined.

48. In order to assess the question of the link between reserve money and the money supply, the hypothesis of cointegration between reserve money and different monetary aggregates was addressed based on the Johansen procedure and by performing a Dickey/ Fuller test on the residuals of regressions of both nominal M2 and nominal M4 on the monetary base. The following results were obtained over the period 1990–95:

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[14]The T-bill rate is set by the Ministry of Finance in close consultation with the Central Bank and has generally moved in line with the key policy interest rates of the Central Bank in the repurchase facilities (prises en pension) and the credit auction (appel d'offre).

[15]For the monetary base to be controllable, also a flexible exchange rate system needs to be in place, which is currently operated by Tunisia, albeit with interventions to maintain the exchange rate around some target level (IMF; 1996).

(7) $\ln(M2) = 0.84 \ln(Base) + 0.001\ S2 - 0.003\ S3 + 0.05\ S4 + 2.57$
(19.2) (0.08) (0.24) (3.6) (8.09)

$\bar{R}^2 = 0.85$ D.W. = 0.66 Standard error = 0.04

ADF = -0.4 (3.9)

(8) $\ln(M4) = 1.35\ln(Base) + 0.015\ S2 + 0.0009\ S3 + 0.09\ S4 - 0.98$
(17.5) (0.59) (0.03) (3.56) (1.75)

$\bar{R}^2 = 0.81$ D.W. = 0.44 Standard error = 0.08

ADF = -0.3 (3.9)

49. The Johansen tests (Table 2) indicate that cointegration between the monetary base and the money supply can be accepted at the 1 percent level both for the relationship of M2 and of M4 with the base. Also, the ADF-test suggests that both M2 and M4 are cointegrated with reserve money. This result clearly indicates that both equations (7) and (8) could be used to derive a volume of the injection of high-powered money consistent with the targeted monetary aggregate. Thus, given the link between reserve money and the money supply on the one hand and the high degree of controllability of the monetary base on the other hand, it appears that a base regime would be a feasible operating regime for the control of the money supply in the Tunisian context.

50. One objection that has been raised against a reserve targeting regime, where interest rates are fully endogenous, is the risk of excessive volatility of interest rates. Theoretical research has, however, found that the volatility of interest rates in a reserve targeting regime can be positively influenced by the Central Bank's commitment to a particular reserve target. Furthermore, it depends crucially on the ability of banks to adjust to the new regime, which is generally high as banks have to maintain profitability.[16]

VII. Conclusions

51. This paper establishes econometric foundations for a monetary targeting regime in Tunisia and broadly corroborates the current approach of the Tunisian Central Bank to monetary policy given the stability of the estimated money demand functions. It finds, however, an income elasticity that is lower than the one currently applied by the Tunisian Central Bank and proposes a different methodology for the establishment of monetary growth rates, which should facilitate a greater consistency between monetary growth targets and

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[16]Hagen, J. von: Mindestreservesystem und kurzfristige Geldbasissteuerung, in Hermann Göppl und Rudolf Henn (eds.): Geld, Banken und Versicherungen, Karlsruhe, Verlag Versicherungswirtschaft, pp. 251–65 (1985).

developments in the real economy. As regards the choice of suitable operating targets, it finds the feasibility of both a price and a base regime. The implementation of either a base or a price regime should allow the Central Bank to achieve its monetary targets with greater accuracy and strengthen the capacity of the Central Bank to manage the Tunisian economy.

52. Clearly, as Tunisia proceeds with reforms of its financial sector, the stability of the demand for money would have to be reexamined and the instruments of the Central Bank modified to ensure an effective control of the monetary base. Furthermore, even after the establishment of monetary growth targets using the estimated money demand functions, the conduct of monetary policy would not have to be based exclusively on the money supply, but could continue to benefit from other indicators, such as the level of net international reserves or the monthly inflation rate, in order to fine-tune refinancing policies.

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