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A MONEY DEMAND EQUATION FOR BRAZIL

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by

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The literature on the demand for money is vast and growing. The theory and data are well surveyed by Goldfeld (1975) and Laidler (1977). As for Brazil, the subject is summarized by Barbosa (1976),[1/] who observes that the evidence is either inconclusive or unavailable with regard to problems such as the stability of the demand for money, the problem of simultaneity, the structure of lags, the form of the function, and the role of the interest rate in the demand for money. Even so, Barbosa concludes that the studies examined contain enough evidence to indicate that there are economies of scale in the demand for money, and that the rate of inflation belongs in this demand function.

In this essay, the last two contentions--together with the role of the interest rate, the problem of simultaneity and the part played by adjustment costs in the demand for money--are discussed in the light of more recent statistical information.

Certain aspects of the theory concerning the demand for money are briefly reviewed in Section 1. The methods used to estimate this demand are described in Section 2, which also contains the empirical data for

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* I am indebted to Rudiger Dornbush and Daniel M. Schydlowsky for comments.

1/ Also see Fishlow (1966), Pastore (1969), Simonsen (1970), Campbell (1970) Silveira (1973), Da Silva (1972), Pastore (1973) and Contador (1974).

Brazil in the period 1966-I/1979-IV. The conclusions are presented in Section 3.

1. The Demand for Money

The demand for money is usually explained in terms of demand for transactions, precaution and speculation. The transactions demand theory rests on the models developed by Baumol (1952) and Tobin (1956). These models assume that wealth is held in two forms, money and an interest-yielding financial asset, and that receipt and payment flows are not synchronized. Due to the interest factor, there is a cost attached to holding money rather than the alternative asset, but there is also a cost involved in exchanging assets. When deciding what share of their monetary income they desire to hold in cash, economic agents try to minimize costs by taking into account the number of times they will have to trade the two assets. According to this model, the income-elasticity and the interest-elasticity of the demand for money are 1/2 and -1/2, respectively.

In the Tobin formulation, an explicit restriction is that the number of transactions has to be an integer. Hence, there may not be a demand for an alternative asset on the part of some individuals, for whom the elasticity of the demand for money is unitary in relation to income and zero in relation to the rate of interest. Aggregate demand, or the sum of the demands for money by various individuals, has an income-elasticity ranging from 1/2 to 1 and an interest-elasticity varying from 0 to -1/2 (see Barro [1976]).

Stochastic extensions of these deterministic models, such as those presented by Miller and Orr (1966) and the less successful attempt by Whalen (1966), are equivalent to including the precautionary motive in the explanation of the demand for money.

In Tobin's (1956) analysis, speculation is the point of departure, the maximization of utility creating a demand for assets relative to the expected rate of portfolio returns and changes in these returns. Although money is considered a risk-free financial asset, the real value is subject to changes in the price level. Risk aversion does not account for the demand for money (defined as paper money in circulation plus cash deposits), since other assets, i.e. time deposits, have the same risk characteristics as money and offer higher returns. Thus, while Tobin takes a step forward in financial theory, he does not provide a money demand theory.

From the demand for money, derived from the transactions and precautionary motives, it follows that the demand for real cash, $\underline{m}$, can be written as a positive function of income, $\underline{y}$, and a negative function of the rate of interest, $\underline{i}$:

$$m = f(y, i) \quad (1)$$

Strictly interpreted, the transactions demand theory implies that the rate of inflation does not enter the money demand function. In contrast, the Chicago school ascribes a prominent role to the rate of inflation in the demand for money, since according to its line of thought any good that can be stored may serve as an alternative asset to money. Under these conditions, equation (1) should be rewritten as

$$m = f(y, i, \dot{p}^*) \qquad (2)$$

where $\dot{p}^*$ is the expected rate of inflation.

Let us now turn to the empirical evidence. Section 2 starts with the estimation of equation (2), assumming rational expectations and equality between expected and observed inflation rates. The fact that the former can differ from the latter leads to the use of instrumental variables. The analysis is further extended to allow for adjustment costs. Different specifications for the adjustment costs are examined

2. The Demand for Money in Brazil

Equation (2) was estimated for Brazil using quarterly data for the period 1966-I/1979-IV (the statistical information is discussed in detail in the Appendix). Assuming that the expected rate of inflation is equal to the observed rate,[2/] and using the ordinary least squares method, the following results were obtained:

2/ This assumption is relaxed later on, to allow for unexpected shocks.

Table 1

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p}$$

	a_o	a_1	a_2	a_3	R^2	SER	DW
(I)	2.69	0.95	-0.32	-0.27	0.98	0.03	0.71
	(2.09)	(46.25)	(-7.82)	(-0.92)			

NOTE: The t statistics are between parentheses. The rate of interest is that on bills of exchange (see Appendix).

Despite all the coefficients having the expected signs and values, the Durbin-Watson statistic points to serial correlation of the residuals. This indicates a specification error, and it is at once clear that at least two things can be the sources of our problems.

In the first place, equation (2) expresses the desired real cash level, whereas those actually held depend on the adjustment mechanism through which economic agents correct their portfolios when changes occur in the variables that determine their structure. This mechanism, which assumes the existence of adjustment costs, is discussed further on.

In the second place, a problem arises due to the fact that the variables affecting the demand for money correspond to expected values rather than to the observed values used to estimate equation (2), and the former can presumably differ from the latter owing to unforeseen events. Thus, let us simplify our reasoning via a simple regression.

Consider the true model:

$$m_t = b\dot{p}^*_t + u_t \tag{3}$$

Let us also assume that instead of $\dot{p}^*$ we use

$$\dot{p}_t = \dot{p}^*_t + e_t \tag{4}$$

where $\dot{p}_t$ is the current rate of inflation.

Given that expectations are formed rationally, we are assuming that the expected value of inflation is equal to the observed value unless there are unforessen events (represented by the error e). We are also working from the usual hypotheses that $cov\ (u, p^*) = 0$ and $cov\ (e, p^*) = cov\ (e, u) = 0$. Substituting (4) into (3), it follows that

$$m_t = b\dot{p}_t + (u_t - be_t) \tag{5}$$

The ordinary least squares method produces inconsistent estimators for b insofar as the residual $(u_t - be_t)$ is correlated with $\dot{p}_t$. The ordinary least squares estimator for b is

$$\hat{b} = b - b\ (\text{var}\ e/\text{var}\ u) = b\,[1 - (\text{var}\ e/\text{var}\ p)] = b\ [\text{var}\ p^*/\text{var}\ p^* + \text{var}\ e)]$$

The econometric solution to this kind of problem lies in use of the instrument variables method.[3/] Specifically, if the errors $\underline{e_t}$ are not correlated but the variables $\underline{\dot{p}_t^*}$ are serially correlated, lagged values of $\underline{\dot{p}_t}$ can serve as instrumental variables. Using this method to reestimate equation (2), the following results were obtained:

Table 2

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p}$$

Instrumental variables: y_{-1}, i_{-1}, $\dot{p}_{-1}$

	a_o	a_1	a_2	a_3	R^2	SER	DW	Rho
(II)	-0.06	0.92	-0.44	0.43	0.99	0.04	1.93	0.66
	(-0.01)	(9.85)	(-4.06)	(0.31)				

NOTE: The t statistics are between parentheses. The equations were estimated by the instrumental variables method and corrected through the Fair method for serial correlation of the residuals.

3/ See Maddala (1977), chap. 13.

Table 2 confirms the previous results, particularly with respect to the impossibility of rejecting the hypothesis that the coefficient of the expected rate of inflation is zero, and that the variable consequently does not belong into the money demand equation.

However, the coefficient of the rate of inflation may have been estimated inaccurately due to multicollinearity (the simple correlation coefficient between the rate of interest and the rate of inflation is 0.63). In this case, the effects of the two rates may not be adequately differentiated. The equation was therefore run for each of the variable separately, as shown in Table 3.

Table 3

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p}$$

	a_o	a_1	a_2	a_3	R^2	SER	DW	Rho
(III)	1.75	0.94	-0.41		0.99	0.04	1.97	0.68
	(6.67)	(18.97)	(-5.15)					
(IV)	38.00	1.40		-8.48	0.77	0.16	1.74	0.56
	(1.60)	(3.66)		(-1.57)				

NOTE: The instrumental variables are $\underline{y_{-1}}$ and $\underline{i_{-1}}$ in equation (III) and $\underline{y_{-1}}$ and $\underline{\dot{p}_{-1}}$ in equation (IV). The *t* statistics are between parentheses. The equations were corrected using the Fair method.

Once again, our results are confirmed with regard to the rate of interest. In the equation excluding the rate of inflation, the coefficients have the expected signs and values and are precisely estimated. But when the rate of interest is omitted, the values are absurdly high for the income-elasticity, as well as for the elasticity relative to the rate of inflation These effects surely mean that leaving aside the interest rate when explaining the demand for money implies a specification error.

It still remains to consider the adjustment structure, to which we shall now turn our attention.

2.1 Adjustment Costs

Desired real cash levels may differ from those actually held due to the existence of adjustment costs. As a rule, empirical studies of the demand for money formulate the adjustment mechanisms on the basis of a quadratic cost function:

$$C = \alpha(\log m - \log m^*)^2 + \beta\,(\log m - \log m_{-1})^2 \qquad (6)$$

where m = the observed cash level and m* = the desired level expressed in equation (2).

In equation (6), the first and second terms on the right-hand side express, respectively, the costs of the economic agent being out of equilibrium and the costs of raising the real cash level.

Minimization of these costs, relative to log m, leads to

$$\log m = \mu \log m^* + (1 - \mu) \log m_{-1} \qquad (7)$$

where $\mu = \alpha/(\alpha + \beta)$

Equation (7), where m^* is obtained through (2), was estimated by the ordinary least squares and the instrumental variables methods, with the results produced in Table 4.

Table 4

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p} + a_4 \log m_{-1}$$

	a_o	a_1	a_2	a_3	a_4	R^2	SER	DW
(V)	3.77	0.35	-0.10	-0.72	0.65	0.99	0.03	1.73
	(4.75)	(5.51)	(-2.96)	(-3.86)	(9.42)			
(VI)	3.39	0.20	-0.05	-0.75	0.80	0.99	0.03	2.10
	(2.22)	(1.98)	(-0.97)	(-1.91)	(-7.43)			

NOTE: Equations (V) and (VI) were estimated, respectively, by the ordinary least squares method and the instrumental variables method, the variables being y_{-1}, i_{-1}, $\dot{p}_{-1}$ and m_{-1}. The t statistics are between parentheses.

The equations behave well. The estimates obtained using ordinary least squares are confirmed by those made through instrumental variables, especially as to the long-run income-elasticity of the demand for money, which is unitary. Note that equation (7) can be rewritten as

$\log m = a_o + a_1 \log y + a_2 \log i + (a_3 a_4) \log \dot{p} + a_4 \log (M_{-1}/P)$, and that the hypothesis $a_3 + a_4 = 0$ in the equation estimated by instrumental variables cannot be rejected. At this point, the only problem is that when equation (7) is estimated using the instrumental variables method, the coefficient of the rate of interest is far from precise, perhaps due to a poorly specified adjustment mechanism. Consider the following argument. If the interest rate and the income level are constant, even if the rate of inflation does not belong to the desired-cash function, in the presence of inflation, nominal cash levels will have to be corrected in order to maintain real cash at the desired level. Assuming that there is a cost attached to raising nominal cash levels, the cost equation (6) should be rewritten as

$$C = \alpha (\log m - \log m^*) + \beta (\log M - \log M_{-1}) \qquad (6')$$

where $\underline{M}$ = the nominal cash level.

Minimization of the costs expressed in (6') in relation to log M, leads to

$$\alpha \log m - \alpha \log m^* + \beta \log M - \beta \log M_{-1} = 0$$

Adding (βlog P) to, and then subtracting it from, the above equation gives $\underline{\alpha \log m - \alpha \log m^* + \beta \log (M/P) - \beta \log (M_{-1}/P)}$. which can be written as

$$\log m = \mu \log m^* + (1 - \mu) \log (M_{-1}/P) \qquad (7')$$

where $\underline{\mu = \alpha/(\alpha + \beta)}$

The difference between (7) and (7') is in the deflator of lagged nominal cash. Whereas current prices are used in (7'), lagged prices are used in (7). In the latter, therefore, if the real value of lagged cash is reduced by inflation, it is immediately corrected. But in (7') this only occurs after a lag because of the cost of raising nominal cash levels.

Equation (7') was estimated by means of ordinary least squares and instrumental variables, the results being shown in Table 5.

Table 5

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p} + a_4 \log (M_{-1}/P)$$

	a_o	a_1	a_2	a_3	a_4	R^2	SER	DW
(VII)	0.79	0.35	-0.10	-0.08	0.65	0.99	0.03	1.73
	(0.98)	(5.51)	(-2.96)	(-0.42)	(9.42)			
(VIII)	0.02	0.21	-0.05	0.05	0.80	0.99	0.03	2.10
	(0.09)	(1.51)	(-1.10)	(0.10)	(5.90)			

NOTE: Equations (VII) and (VIII) were estimated, respectively, by the ordinary least squares method and the instrumental variables method. The instruments include lagged cash deflated by the current price level, as well as the lagged *y*, *i* and $\dot{p}$. The *t* statistics are between parentheses.

If the adjustment costs are correclty specified, equation (VII) indicates that the rate of inflation only affects the demand for money to the extent that it is necessary to change nominal cash levels so as to adjust real cash holdings to their desired levels.[4/] Since the rate of inflation does not enter the desired-real-cash function, due to its coefficient not significantly differing from zero, these results go against the Chicago hypothesis. When equation (7') is reestimated using instrumental variables, all the coefficients, including that of income-elasticity, are very imprecisely estimated (see Table 5).

Thus, equation (7') was again estimated by instrumental variables, but on the assumption—contrary to what was presumed before—that there is no problem of simultaneity with respect to the variables income and rate of interest. The results are given in Table 6.

Table 6

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p} + a_4 \log (M_{-1}/P)$$

	a_o	a_1	a_2	a_3	a_4	R^2	SER	DW	Rho
(IX)	1.40	0.36	-0.09	-0.22	0.64	0.99	0.03	1.69	
	(0.82)	(5.32)	(-2.29)	(-0.56)	(9.07)				
(X)	1.36	0.50	-0.15	-0.16	0.49	0.99	0.03	2.13	0.36
	(1.34)	(7.06)	(-3.42)	(0.69)	(6.33)				

NOTE: Equations (IX) and (X) were estimated through the instrumental variables method, the instruments being lagged cash deflated by the current price level plus the variables $\underline{y}$, $\underline{i}$, and lagged $\underline{\dot{p}}$. Equation (X) was corrected via the Fair method. The $\underline{t}$ statistics are between parentheses.

Once again, the equations indicate that, in Brazil, the rate of inflation only affects the demand for money insofar as nominal cash levels have to be changed to adjust real cash holdings to their desired levels. The income and interest elasticities are accurately estimated. Moreover, we cannot reject the hypothesis that, in the long run, the income-elasticity of the demand for money may be unitary, while the interest-elasticity may be greater than -1/2 and less than zero.

3. Conclusions

The estimates of the demand for money discussed herein show that, in Brazil, the long-run income-elasticity of the demand for money is roughly unitary, and the rate of interest affects the demand for money. Exclusion of the latter variable therefore leads to biased estimates of the coefficients of the money demand equation.

However, the rate of interest does not enter the demand function in most of the studies surveyed by Barbosa, except for some of the equations estimated by Contador (1974), Pastore (1969), and Simonsen (1970).

4/ (from page 14) Observe that, if $(1 - \mu) \log P_{-1}$ is added to and subtracted from equation (7'), the latter can be rewritten as

$$\log m = \mu \log m^* + (1 - \mu) \log m_{-1} - (1 - \mu) \log \dot{p}$$

If $m = m_{-1}$, then $\log m = \log m^* - (\beta / \alpha) \log \dot{p}$. This means that, in the presence of long-run inflation, the adjustment of real cash holdings to their desired levels is less than perfect, since there is an adjustment cost.

It is difficult to compare our results to Contador's (1974), since he does not report the Durbin-Watson statistic and his income-elasticity is far too low (0.17) in relation to both our results and those of other writers. Moreover, the value of the interest-elasticity in some equations (-41.9, for example) is hard to understand.

The Pastore (1969)[5/] and Simonsen (1970)[6/] equations that include the rate of interest point the same direction as our results. Our equation (X) is depicted in the figure below. It behaves very well. Equation X, Table 6, shows that changes in real cash balances can be explained in terms of changes in real income and interest rates. A one percent increase in income leads to a half percent increase in real cash balances in the short run, and to a proportional increase in the

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5/ The Pastore equation is

$$\log m = -.842 + .315 \log y - .106 \log i + .745 \log m_{-1}$$
$$(4.52) \qquad (3.61) \qquad (8.87)$$

R^2 = .87; DW = 1.92; Period: 1954/1968, 43 observations.

The *t* statistics are between parentheses.

6/ The Simonsen equation is

$$m = 24.28 + .7\, y - .43\, i - .18\, \dot{p}$$
$$(.0015) \qquad (.26) \qquad (.064)$$

R^2 = .96; DW = 1.55; Period: 1947/1968, monthly data.

The standard errors are between parentheses. Note that the Simonsen equation is linear, and that the elasticities cannot be directly obtained from reading the coefficients.

long run. A one percent rise in the interest rate leads to a fall of .15 and .30 in real cash balances, in the short and long run respectively.

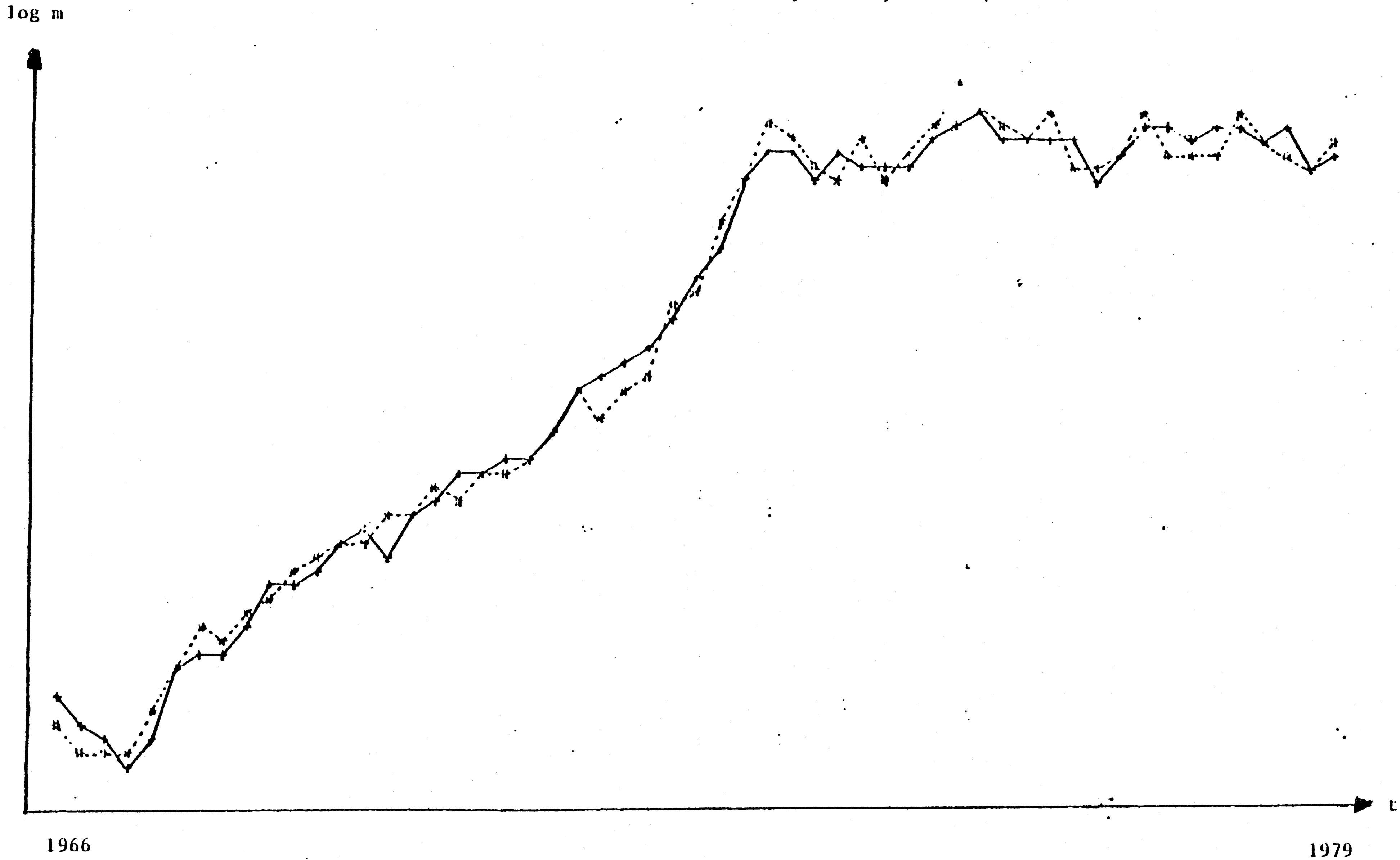
From equations II and III, in Tables 2 and 3, we know that, under the assumption of instantaneous adjustment, the income and interest elasticities are above .9 and .4 respectively. It is interesting to observe that the dynamic specification does not alter income and interest elasticities substantially. This stability across methods and specifications suggests that the theoretical model captures the essential determinants of money demand behavior.

From equation V to X, we must conclude that there is evidence for adjustment lags. The significant coefficient for the lagged endogenous variable across different methods and specifications shows that the adjustment is not instantaneous. The mean lag, measured by the ratio $(1 - \mu)/\mu$, varies between 1 and 4 quarters.

It should also be observed that the empirical evidence, collected here, points out that the rate of inflation only affects the demand for money to the extent that it is necessary to change nominal cash balances so as to adjust cash holdings to their desired balances. Either nominal interest rates capture the expected inflation rates, or goods inventories are not an alternative for holding money in Brazil. Brazilian inflationary experience thus should not be equated to hyperinflation experiences.

Figure 1

Real Cash: Forecast and Observed Values, Brazil, 1966-II/1979-IV



SOURCE: Equation (X), Table 6.

Statistical Appendix

(1) Real money, m:

Real money was obtained by deflating nominal money, M, by the price index, p (see Table A), then calculating the index on a 1977 base. Nominal money, M, is defined as paper money in circulation plus cash deposits in commercial banks, the Banco do Brasil and savings banks. Note that this definition differs from the concept of M_1 used by the monetary authorities in that it includes cash deposits in savings banks. The statistical information is from the Boletim do Banco Central (BBCB), various issues.

(2) Rate of inflation, $\dot{p}$:

The rate of inflation was computed by dividing the current price index by that of the preceding year. The price index, p, is the general price index published in Conjuntura Econômica, column 2.

(3) Rate of interest, i:

The rate of interest is that on bill of exchange. The rates are those collected by the Banco do Brasil in Rio de Janeiro, the terms being 180 days until 1970 and 360 days as of 1971.

(4) Real income, y:

The quarterly index of real income was computed from quarterly data on cement production, industrial electricity consumption, motor vehicle production, and the real revenue of the National Treasury. The coefficients for calculating income on the basis of these variables were obtained from the regression

$$1966/79: \quad y = \underset{(10.02)}{28.84} + \underset{(1.02)}{.14\,C} + \underset{(91.56)}{.23\,E} + \underset{(5.09)}{.22A} + \underset{(2.07)}{.12\,R}$$

where y = index of real domestic product, National Accounts

C = index of cement production in tons

E = index of industrial electricity consumption in São Paulo and Rio de Janeiro, Light Co. data

A = index of motor vehicle production

R = index of real revenue of the National Treasury

The statistical information is from Conjuntura Econômica and BBCB, various issues (see Table A for the values of M, p, i, and y).

Table A

PERIOD	M	p	i	y
6501.00	5.32300	5.25500	41.5000	
6502.00	6.13700	5.71600	36.1000	
6503.00	7.27400	6.04800	29.7000	
6504.00	8.46700	6.36900	29.7000	
6601.00	8.73700	7.13500	29.0000	38.0979
6602.00	8.99100	7.83600	29.3000	39.9482
6603.00	9.36700	8.44300	33.1000	41.1181
6604.00	9.96800	8.90200	31.4000	39.8019
6701.00	10.6760	9.57600	34.2000	37.2053
6702.00	12.1380	10.1700	33.4000	38.7273
6703.00	13.4240	10.6270	32.3000	41.3539
6704.00	14.7560	11.0600	32.1000	41.4353
6801.00	15.6250	11.8130	32.2000	40.5776
6802.00	17.3970	12.5970	31.3000	43.7146
6803.00	18.3820	13.2170	31.4000	45.8689
6804.00	20.2260	13.8930	31.3000	47.0204
6901.00	21.4070	14.4290	30.5000	46.3316
6902.00	22.8360	14.9580	30.4000	48.8837
6903.00	23.9130	15.8860	30.0000	50.8951
6904.00	26.2920	16.7350	30.3000	48.8542
7001.00	27.4420	17.3320	30.7000	49.0996
7002.00	29.7650	18.0110	30.8000	51.8518
7003.00	31.1660	19.0980	29.5000	55.1472
7004.00	33.4520	19.9400	29.4000	55.7843
7101.00	34.7610	20.7820	28.1000	55.2908
7102.00	37.5780	21.9420	28.1000	57.8560
7103.00	40.9810	22.9920	28.0000	60.6573
7104.00	45.2080	23.7930	28.1000	64.0180
7201.00	45.6220	24.8590	27.1000	61.4639
7202.00	49.5600	25.7980	25.4000	66.7299
7203.00	52.5200	26.7660	24.5000	67.0235
7204.00	59.3250	27.5700	24.3000	70.6080
7301.00	62.3250	28.5960	22.8000	69.0936
7302.00	72.1130	29.7000	22.2000	74.4085
7303.00	79,4160	30.6060	22.1000	78.3020
7304.00	89.2900	31.7430	22.0000	83.4377
7401.00	93.9530	34.1350	22.7000	80.4827
7402.00	101.447	38.3960	26.0000	83.8062
7403.00	106.162	40.3730	27.1000	88.3814
7404.00	113.020	42.3500	27.1000	88.6133
7501.00	118.054	45.0570	26.9000	81.6207
7502.00	130.664	47.7030	27.1000	86.0257
7503.00	144.708	51.0890	26.7000	90.0011
7504.00	165.191	54.6840	26.7000	91.8463
7601.00	172.022	59.9220	27.2000	90.0708
7602.00	190.424	66.5890	31.2000	96.2796
7603.00	204.019	73.9070	33.1000	97.2367
7604.00	230.416	79.9830	35.9000	98.8347
7701.00	233.077	87.7570	38.6000	95.9887
7702.00	262.979	97.6870	39.3000	98.9434
7703.00	284.298	103.667	42.6000	99.3701
7704.00	319.154	110.867	43.3000	105.693
7801.00	328.357	120.367	42.1000	103.076
7802.00	363.308	132.833	40.6000	108.579
7803.00	397.404	145.067	40.5000	109.446
7804.00	449.611	156.700	43.7000	115.346
7901.00	476.515	172.933	46.5000	106.861
7902.00	525.426	193.667	46.0000	116.536
7903.00	597.174	222.033	48.3000	113.366
7904.00	732.627	265.500	48.9000	120.378

THE DEMAND FOR MONEY

(Other Estimates)

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p} + a_4 \log m_{-1}$$

	a_o	a_1	a_2	a_3	a_4	R^2	SER	DW	Rho
(XI)	0.96	0.54	-0.22		0.42	0.99	0.03	2.12	0.45
	(5.67)	(7.26)	(-5.01)		(5.43)				
(XII)	4.85	0.22		-1.04	0.78	0.99	0.03	1.90	
	(6.44)	(4.45)		(-6.03)	(14.58)				
(XIII)	5.57	0.24		-1.20	0.77	0.99	0.03	1.85	
	(4.71)	(4.39)		(-4.62)	(13.76)				

$$\log m = a_o + a_1 \log y + a_2 \log i + a_3 \log \dot{p} + a_4 (\log (M_{-1}/P))$$

	a_o	a_1	a_2	a_3	a_4	R^2	SER	DW
(XIV)	0.45	0.35	-0.11		0.65	0.99	0.03	1.74
	(3.44)	(5.57)	(3.31)		(9.60)			
(XV)	1.23	0.22		-0.26	0.78	0.99	0.03	1.90
	(1.45)	(4.45)		(-1.38)	(14.58)			
(XVI)	2.35	0.26		-0.50	0.75	0.99	0.03	1.76
	(1.42)	(3.72)		(-1.39)	(10.71)			

NOTE: Equations (XI), (XII), (XIV) and (XV) were estimated by the ordinary least squares method. Equation (XI) was corrected through the Cochrane-Orcutt method. Equations (XIII) and (XVI) were estimated by the instrumental variables method, the instruments being $\underline{y}$, $\underline{\dot{p}_{-1}}$ and $\underline{m_{-1}}$ in equation (XIII) and y, $\underline{\dot{p}_{-1}}$ and $\underline{M_{-1}/P}$ in equation (XVI). The *t* statistics are between parentheses.

REFERENCES

Barbosa, F.H., "A Demanda de Moeda no Brasil: Uma Resenha da Evidência Empírica," Pesquisa e Planejamento Econômico, 8(1), 1978.

Barro, R., "Integral Constraints and Aggregation in an Inventory Model of Money Demand," Journal of Finance, Mar. 1976.

Baumol, W., "The Transactions Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, Nov. 1952.

Campbell, C.D., "The Velocity of Money and the Rate of Inflation: Recent Experiences in South Korea and Brazil, " in Maiselman (ed.), Varieties of Monetary Experience, Chicago, 1970.

Contador, C.T., "Desenvolvimento Financeiro, Liquidez e Substituição entre Ativos no Brasil," Pesquisa e Planejamento Econômico, 4(2), 1974.

Da Silva, Adroaldo M., "The Expected Rate of Inflation and the Demand for Money: An empirical Study of Argentina, Chile and USA," Ph.D. diss., Chicago, 1972.

Fishlow, A., "The Monetary Policy in 1968" and "Projections and Policies for the Plano Trienal," IPEA, mimeo., 1968.

Goldfield, S.M., "The Demand for Money Revisited," Brookings Papers on Economic Activy, no. 3, 1973.

Laidler, D., The Demand for Money, International Text Book, 1977.

Miller and Orr, "A Model of the Demand for Money by Firms," Quarterly Journal of Economics, Aug. 1966.

Pastore, A.C., "Inflação e Política Monetária no Brasil," Revista Brasileira de Economia, 1969.

Pastore, A.C., "Aspectos da Política Monterária Recente no Brasil," Estudos Econômicos, vol. 3, 1973.

Silveira, A.M., "The Demand for Money: The Evidence from the Brazilian Economy," Journal of Money, Credit and Banking, 1973.

Simonsen, M.H., Inflação-Gradualismo x Tratamento de Choque, Rio de Janeiro, APEC, 1970.

Tobin, J., "The Interest-Elasticity of Transactions Demand for Cash," Review of Economics and Statistics, Aug. 1976

Tobin, J., "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies, Feb. 1958.

Wallen, E.H., "A Rationalization of the Precautionary Demand for Cash," Quarterly Journal of Economics, May 1966.

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