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Demand for Money in a Period of Rapid Disinflation--The Case of Iceland 1/

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I. Introduction

1. The subject

Since around mid-1983 the Icelandic economy has experienced, inter alia, a sharp slowdown in inflation. Although there was some deceleration in the growth of monetary aggregates from the second half of 1983, credit and monetary expansion remained very rapid compared with the rate of inflation (Chart 1). While a full analysis of the linkages between disinflation and money demand lies beyond the scope of this paper, an attempt is made to examine whether the disinflation process was associated with a substantial increase in the demand for money, which could explain the continued strong monetary expansion well into 1984. Were such an increase in the demand for money to be found as a result of a fall in price expectations, liquidity creation accommodating this increase should not by itself cause renewed domestic or external imbalances.

The literature on inflation and money demand is more than abundant; less so on money demand in a process of disinflation, with the analysis mostly focused on cases of (abruptly) ending hyperinflations. In addition, the character of the Icelandic "micro" economy, which "contains a rare blend of highly developed and underdeveloped institutions" 2/ is unique in many respects. Therefore, an analysis of recent monetary

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1/ I wish to thank Michael Dooley, David Burton, Daniel Gros, and George Kopits for their comments on earlier drafts. I am also heavily indebted to my colleagues in the Northern European Division for their continuous help during all stages of this paper. The remaining errors and shortcomings are my own responsibility.

2/ Eggertsson, 1982, p.1. The country's financial markets, e.g., show a considerable amount of fragmentation; moreover, interest rates have been controlled for most of the past, international capital movements are regulated, and the Central Bank does not engage in open market operations.

developments in Iceland can only lead to very cautious conclusions, and the results presented in this paper are meant to be tentative at best.

The plan of the paper is as follows: after a brief summary in Section I of recent developments in the Icelandic economy, Section II reports the results of efforts to estimate a model of the demand for money applicable to Iceland. Using the estimated money demand functions, simulations of the demand for M_1, M_3, and quasimoney, are made for the disinflation period. The parameters of the money demand functions, together with a comparison between actual values of the dependent variables and their simulated values, can serve as a first test of the hypothesis which relates the continued rapid growth of monetary aggregates directly to the fall in price inflation. Some thoughts on price expectations are given at the end of Section II. Section III summarizes the findings of this paper and contains some concluding remarks. The Appendix gives a brief derivation and discussion of the estimated model of the demand for money.

2. Background

During the 1970s the Icelandic economy was marked by the combination of a persistently high rate of inflation and fairly rapid economic growth in full employment conditions.

The inflationary problem has its roots in a complex of political, sociological and economic factors. An important element is the tendency for increases in export earnings of the fishing sector--which have grown rapidly through the 1970s and today account for some 75 percent of total merchandise export earnings--to lead to wage and cost increases throughout the economy. On the other hand, pressure on profitability of the export sector due to a periodic reduction in fish catches and export revenue has traditionally been alleviated through exchange rate depreciation, with its adverse consequences on domestic inflation. Oil price increases have contributed to the acceleration of price increases. Moreover, inflationary impulses have been reinforced by a wage-price spiral caused by a pervasive system of wage indexation and accommodated by monetary policy.

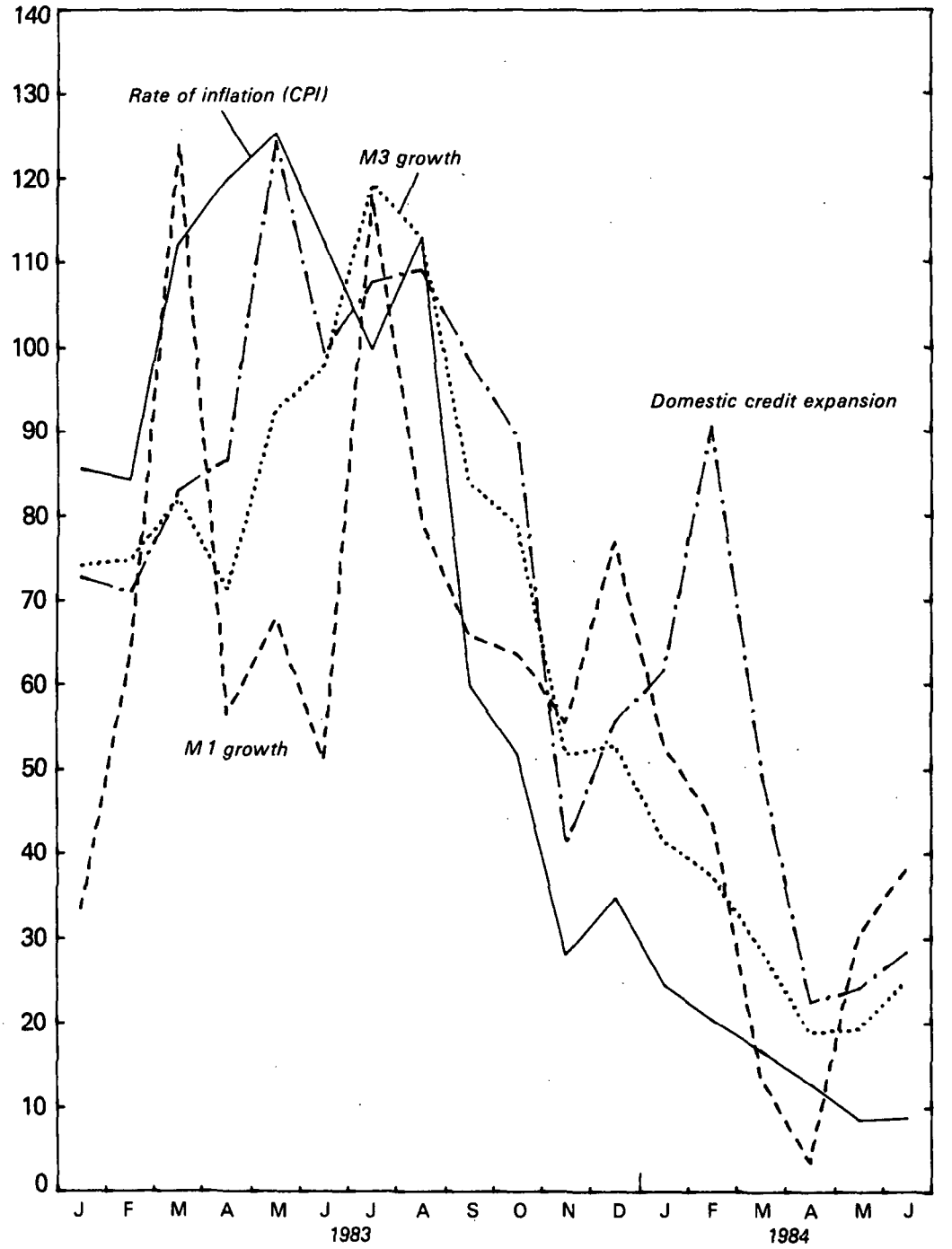
The favorable growth and employment performance resided mainly upon the steady and strong growth in the 1970s of fish catches, an exchange rate policy which maintained competitiveness and financial viability of enterprises in the export sector, and a general readiness of the economy to adjust swiftly to major supply shocks and swings in foreign demand. "First round" adjustment via the exchange rate and partial suspension of wage indexation, however, tended to be followed by a further spin to the inflationary spiral, with real wage cuts--often accompanied by fiscal "concessions" with an inflationary impact by themselves--triggering catch up demands from wage earners after export earnings had recovered.

CHART 1

ICELAND

RECENT MONETARY DEVELOPMENTS (1983-1984)

(Growth rates in percent over preceding 3 months; annualized; all series seasonally adjusted)



Source: Information provided by the Icelandic authorities, and staff calculations.

In 1981-82, the economy entered a period of severe external and internal disequilibrium. The initial reason was a stagnation in the fish catch in 1981 and a sharp decline in 1982 and 1983. The protracted difficulties in the marine export sector were aggravated by the virtual closure of the main market for dried fish in Nigeria. In addition, output in the power-intensive, metal-producing industries was adversely affected by weak world demand for metals. With import demand not being curbed concomitantly, 1/ the current external position deteriorated dramatically (with a deficit equivalent to 10 percent of GNP in 1982). Reflecting an attempt by the Government to use the exchange rate to reduce the current account deficit and to maintain profitability in the export sector, the exchange rate of the króna fell steeply during 1982 and the first months of 1983 (by an estimated 24 percent in real effective terms (based on relative unit labor costs) from the second quarter of 1982 to the third quarter of 1983, Chart 2). This, combined with wage and salary increases compensating for price increases caused by the depreciation of the króna, accelerated the depreciation-inflation spiral, with the rate of inflation reaching an annual rate of around 130 percent by the spring of 1983.

The Government which took office in May 1983 announced a package of measures aimed at internal and external stabilization. The measures included a further devaluation of the króna (by 14.6 percent), followed by a stabilization of the exchange rate in nominal effective terms (Chart 2); 2/ a strictly enforced statutory incomes policy until February 1, 1984; and a two-year ban on any form of wage indexation. The immediate effect of these measures was that a quarterly wage indexation rise of 22 percent scheduled for June 1 was annulled; instead, wages and salaries were raised by 8 percent on June 1, and by 4 percent on October 1. As of January 31, 1984, partners in the labor market were free to enter into wage negotiations, subject to the ban on indexation.

Following these measures, real disposable incomes fell steeply (by about 10 percent on average in 1983), and inflation slowed down to an annual rate of about 30 percent by the end of the year. The current account deficit shrank to a level equivalent to 2 1/2 percent of GNP (1983), reflecting a strong fall in imports (by 11 percent in real terms) and a revival of foreign demand leading to a resumption of merchandise export growth. With gross national savings virtually unchanged as a proportion of GNP (at slightly above 20 percent), the reduction in the savings-investment gap in 1983 stemmed mainly from the fall in gross

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1/ In 1981, import demand surged in response to a real effective appreciation of the króna, and it was sustained well into 1982 by speculations of devaluations as well as measures designed to lower inflation (increase in consumer subsidies and reduction in import duties).

2/ For 1984, the authorities announced that the depreciation of the króna would be limited to 5 percent in nominal effective terms. At the end of August 1984 the weights for calculating the basket index were changed, which in effect resulted in an additional 3 percent depreciation.

fixed investment (from 27 1/2 percent of GNP in 1982 to 24 1/2 percent in 1983) and a sharp turnaround in the inventory cycle (from stockbuilding contributing almost 3 percent to GNP growth in 1982 but -2 percent in 1983). Inflation continued to abate during the first months of 1984; in the first quarter it was running at an annualized rate of 13 percent, and the wage agreements reached in February after the expiration of the statutory incomes policy provided for a 13.6 percent rise in wage rates in four steps over a 14-month period.

However, both partners to the agreement had the option of reopening negotiations before the end of August 1984; the labor unions did indeed invoke the renegotiation clause and now demand substantial wage increases. The latest official forecast puts the current account deficit at about 5 percent of GNP, with little change in real GNP (after a fall of 5 1/2 percent in 1983).

Chart 1 illustrates monetary developments during the disinflation period. Domestic credit was expanding at a seasonally adjusted annualized rate of about 56 percent during the last quarter of 1983, 50 percent during the first, and 29 percent during the second quarter of 1984; broad money (M_3) grew by 53, 29, and 25 percent, respectively. Whether the absence of a more rapid deceleration in the monetary and credit aggregates did pose a substantial risk to the lasting success of the adjustment effort, is the subject of this paper.

II. The Demand for Money in Iceland

1. Specification and data

Using the standard model of a demand for money function, the level of money balances held in time t can be specified as follows: 1/

$$\ln (m_t) = a_o + a_1 (\ln y_t) + a_2 (dp_t) + a_3 (r_t) + a_4 (\ln(m_{t-1})) + \varepsilon$$

where:

m = real money stock (M_1, quasi-money, or M_3) 2/

y = real income (GNP)

dp = rate of inflation

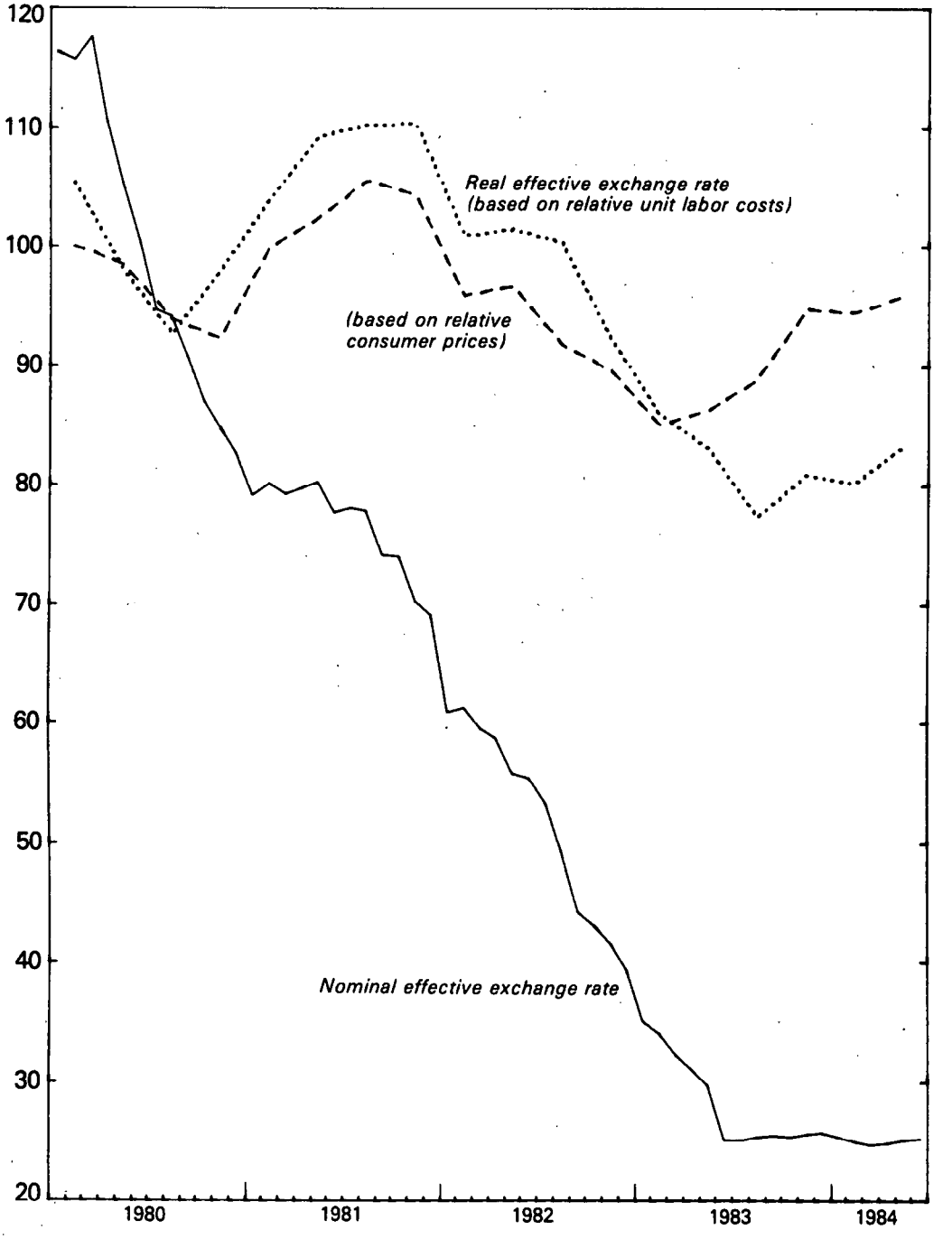
1/ For a brief derivation and discussion of this specification see Appendix.

2/ By calling the broad monetary aggregate (M_1 + quasi-money) "M_3" this paper follows the notation used in Icelandic sources. Unless otherwise specified, money stock figures throughout the paper include accrued interest on money balances.

CHART 2

ICELAND

EFFECTIVE EXCHANGE RATE, 1980-84[1]



Source: Staff calculations.

[1] Icelandic krona against a basket of 28 currencies (14 currencies for relative unit labor costs), weighted according to the countries' share in Iceland's trade.

r = representative nominal rate of interest on money holdings

t = time subscript

m_{t-1} = real money stock lagged one period

ε = error term

It should be noted that this specification does not discriminate between the hypothesis of partial stock adjustment (assuming less than full adjustment of actual money balances to their desired level within one period) and an adaptive expectation hypothesis (assuming geometrically declining weights of actual and past values of a variable in the process generating expectations about future values of the variable). 1/

This equation has been estimated for the period Q_1, 1962 to Q_2, 1983, using quarterly data. Money stock data (M_1 = currency in circulation plus demand deposits; M_3 = M_1 plus quasi-money (time and savings deposits)) have been seasonally adjusted and are quarterly averages of monthly data centered at mid-quarter.

The consumer price index (CPI) has been used for deflating nominal balances and for measuring the rate of inflation, which was calculated as an annualized quarter-to-quarter increase of the seasonally adjusted CPI.

A weighted average interest rate 2/ on money holdings was chosen as the representative interest rate for the purpose of estimating the equations for M_3 and quasi-money. 3/

Since only annual data on GNP are available for Iceland, and no other (semi-annual or quarterly) measures of activity are published, it was necessary to construct an appropriate indicator of economic activity. 4/ The choice of such a constructed income variable naturally limits the strength of the empirical analysis, in particular as regards the estimated

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1/ For an economy experiencing persistently high rates of inflation and relatively large swings in income one might be more inclined to assume rather swift adjustment of expectations and interpret the specification as a slow stock adjustment model. Chapter II.4 seems to confirm this notion. See also the Appendix.

2/ An implicit nominal return was calculated for indexed deposits.

3/ Since the interest rate was found (in preliminary testing) to have no significant impact on the demand for M_1, the equation for M_1 was estimated without the interest rate variable.

4/ An interpolation technique was applied to the annual GNP figures in order to generate quarterly indicators of economic activity.

income elasticity of money demand. However, it seems justified not to discard the results of a quarterly estimation. 1/

2. Empirical results

Table 1 presents the results obtained by ordinary least square regressions of the specified money demand equation. 2/ In general, the model tracks slightly better for broad money than for narrow money. The parameter estimates are all statistically significant at the 99 percent level. The inflation coefficient is negative, as suggested by theory, and the inflation semielasticity is -0.011 (M_1), -0.017 (M_3), or -0.022 (quasi-money). This would imply a strong increase in the demand for real balances as a result of a fall in price inflation. However, a coefficient of similar magnitude, but with opposite sign, has been found for M_3, and quasi-money, with respect to the respective representative interest rate. By consequence, a negative (positive) impact of inflation (disinflation) on the demand for broad money would be mitigated or largely offset by an accompanying rise (fall) in the weighted average interest rate.

It remains to be examined how the interest rate variable actually behaved in recent years, and in particular during the disinflation period. For a substantial part of the estimation period, all deposit rates in Iceland were regulated and kept at relatively low levels compared to the rate of inflation. During the late 1970s, however, efforts were stepped up to mitigate the impact on financial markets of continuously high and rising rates of inflation. Interest rates on time and savings deposits were gradually raised, and with the introduction in 1979 of a new type of fully indexed deposit account, 3/ instruments included in broad money became available that provided "full" protection against inflation: real interest paid on indexed deposits amounted to between zero and 1.5 percent 4/ and indexation is achieved through automatic adjustment of the principal by the percentage increase in the credit terms index. The credit terms index is a weighted average of the cost of living index (2/3) and the

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1/ Since the period under review is sufficiently long, it is reasonable not to expect a systematic over or underestimation of the quarterly data by the interpolation procedure. What is left is the possibility of a systematic over- or underestimation of the size of swings that occurred (after adjustment for seasonal factors). This would result in a bias in the coefficients estimated for the other variables only in case of collinearity with the income-variable (which was found to be small). Even then the predictive power of the model would be affected only in case of a break in the pattern of collinearity.

2/ The Cochrane-Orcutt procedure was employed to correct the estimates for autocorrelation observed in preliminary testing; all three equations were estimated using an instrumental variable technique.

3/ Initially limited to six-month time deposits, but subsequently enlarged to the possibility of indexing all savings deposits of three months or more.

4/ Depending on the maturity of the deposit. As from May 11, 1984, six-month indexed deposits yield 2.5 percent real interest.

Table 1. Demand for Money in Iceland
Estimation Period Q_1, 1962, to Q_2, 1983; Quarterly Data

Response variable	Coefficients: Constant	Ln (GNP)	Inflation rate	Interest rate	$Ln(M_{1(3)t-1})$	Summary statistics
$LN(M_3)$	-0.5821	0.1065	-0.00179	0.00191	0.8937	R^2adj. = 0.9763 (0.9928
	(3.843)	(4.750)	(11.695)	(5.472)	(31.800)	S.E.E. = 0.0147
		Long-run elasticities with respect to				Corr. = 0.4551 (4.7379
		(GNP)	(Infl.) 1/	(Int. Rate) 1/		
		1.0016	-0.0169	0.0179		
$LN(M_1)$	-0.7997	0.1249	-0.00157	--	0.8557	R^2adj. = 0.8770 (0.9546
	(2.862)	(3.481)	(5.941)		(17.649)	S.E.E. = 0.0304
		Long-run elasticities with respect to				Corr. = 0.4299 (4.4050
		(GNP)	(Infl.) 1/	(Int. Rate) 1/		
		0.8653	-0.0109	--		
$LN(M_3-M_1)$	-0.5295	0.0900	-0.00190	0.00204	0.9134	R^2adj. = 0.9881 (0.9941
	(3.938)	(4.882)	(12.410)	(7.494)	(45.919)	S.E.E. = 0.0159
		Long-run elasticities with respect to				Corr. = 0.297 (2.858)
		(GNP)	(Infl.) 1/	(Int. Rate) 1/		
		1.0382	-0.0220	0.0236		

Figures in brackets under the coefficients are T-values.
R^2 adj. = coefficient of determination, adjusted for degrees of freedom (in brackets: R^2 at t original level, before correction for autocorrelation).
S.E.E. = standard error of estimate.
Corr. = coefficient of first-order serial correlation (T-value in brackets).

1/ Semi-elasticities for interest and inflation rates.

construction cost index (1/3) and has been published monthly since June 1979. The availability of indexed deposits and the public's apparent willingness to hold such balances in times of high inflation (see Section II.4.) caused a strong rise in the representative (weighted average) interest rate on M_3 holdings to almost 80 percent by May 1983, and a subsequent steep fall (to about 15 percent by the end of the year) along with the process of rapid disinflation. A significant reduction in (administered) interest rates on fixed rate deposits contributed to this fall of the weighted average.

This suggests an interesting implication of the financial reform started around 1979: while it was an intention and a result of the reform "to prevent a serious exodus of money from the banking system" 1/ in times of high and increasing inflation, the subsequent steep fall in the representative nominal interest rate on broad money holdings could be expected to dampen or "neutralize" the effects of disinflation on broad monetary aggregates. Chapter II.4 below also shows how rising inflation has been accommodated within the broader monetary aggregates without the usual flight out of money in times of high inflation. Consistent with this hypothesis is the negative inflation elasticity of M_1 (similar to the one of M_3), but the lack of influence of interest rates on the narrow monetary aggregates. (It is the inflation rate which drives agents out of M_1, not the interest rate on quasi-money; the latter merely "holds back" in M_3 some of the funds shifted out of M_1.)

For a quantitative estimate of the impact of disinflation on the demand for broad money it has to be recalled that the estimated coefficient on the lagged dependent variable is quite high, which implies a rather slow adjustment of the money stock to changes in the independent variables. Although there would be a long run increase in the demand for broad money due to a steeper fall of inflation than the decline in nominal interest rates, 2/ the effect on the money stock should be small during the first quarters of the adjustment period.

Thus, the essential conclusion which may be drawn from the parameters of the estimated model is that no strong fall in the income-velocity of M_3 was likely to occur during the period under review as a result of the rapid disinflation taking place in Iceland. Even in the early stages of the price stabilization process the increased attractiveness of holding money balances resulting from reduced inflation was to a large extent offset by declining rates of return expected for such holdings of broad money. This notion is largely supported by Chart 3, which shows price inflation and velocity of broad and narrow money. From around 1980, velocity of broad money exhibits what might at first sight appear as a

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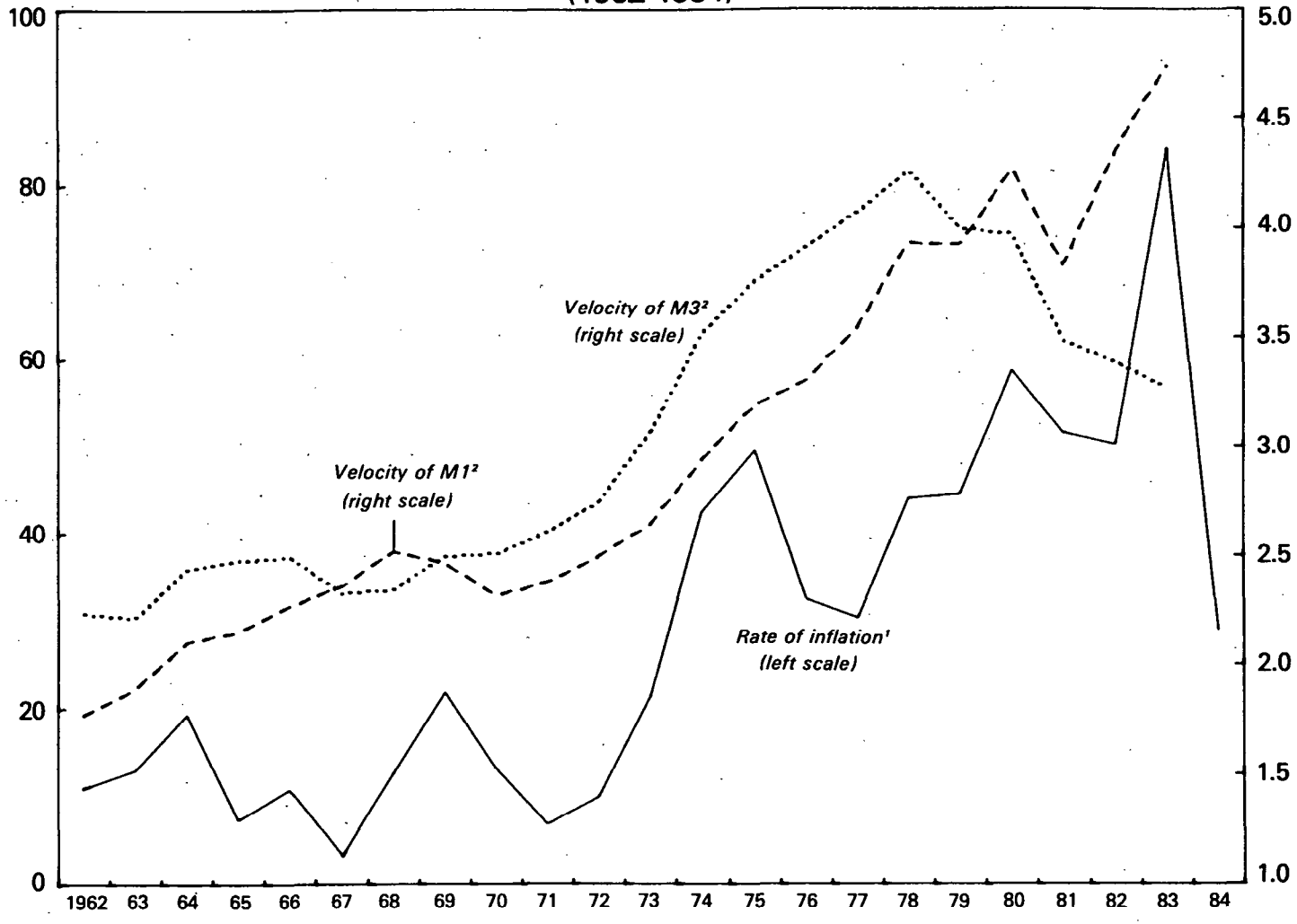
1/ Central Bank Bulletin 1982, p. 37.

2/ The resulting rise in the average real interest rate during 1983 was quite substantial, viz. from about -40 percent in the first quarter to about -14 percent in the last.

CHART 3

ICELAND

INFLATION AND INCOME VELOCITY OF MONEY (1962-1984)



Source: Information provided by the Icelandic authorities.
[1]Annual average increase of CPI, in percent.
[2]Nominal GNP/Nominal money stock, annual averages, velocity of M1 was divided by four in order to conform to the scale of M3.

paradoxical decline with inflation rising at an accelerated pace. 1/ This break in a steady upward trend of velocity of M_3 can be explained by the structural reforms of the financial markets initiated around that time and described above. 2/

With no major "flight out of M_3" induced by high and accelerating rates of price increases it is reasonable not to expect a significant "shift back into M_3" (fall in velocity) as a result of the disinflation process per se. This conclusion, however, holds only under the assumption that the structure of the model 3/ specified for the estimation period also correctly describes the demand for money in the disinflation period. Furthermore, one could argue that the fall in velocity since 1979 would have been much stronger had it not been dampened by high rates of inflation, and that the full impact of the financial reform initiated in 1979 (non-negative real interest rates on certain quasi-money holdings) was not to be felt until after a period distorted by high and accelerating rates of inflation.

4. Predictions of M_1, quasi-money, and M_3 for 1983 and 1984

In this section an attempt is made to compute the levels and the growth rates of the money stock as they are predicted by the estimated money demand function for the second half of 1983 and the first half of 1984. Forecasts and actual growth rates can then be compared, which may shed some more light on the question whether monetary growth in the period under review exceeded what one would have expected taking into account factors found to have traditionally determined the demand for money in Iceland. Table 2 shows actual and predicted levels and growth rates of M_1, M_3, and quasi-money, for 1983 and the first two quarters of 1984. Predictions for the second half of 1983, and for 1984, have been calculated using predicted rather than actual values for the lagged dependent variable. The path of forecast values is thus not influenced by actual values assumed by the dependent variable during the forecasting period, which allows a better comparison between the actual monetary growth and the one forecast for the disinflation period.

1/ The fall in velocity since 1979 is slightly less dramatic if defined as the ratio of GDP to money (instead of GNP as defined in Chart 3). For broad monetary aggregates, however, income (GNP) might be more appropriate for a definition of velocity than domestic output (GDP). At any rate, the difference is small and does not seem to invalidate the conclusions presented above.

2/ Statistical tests (CHOW) revealed a structural break around 1979 (significant at the 99 percent level) in the relationship between velocity of M_3 (quasi-money) and inflation. Stability of the same relationship for M_1 could not be rejected. Stability of the relationship between the velocity of M_3 (quasi-money) and the opportunity cost of holding M_3 (quasi-money) was also tested (by testing stability of the estimated money demand functions) and no significant break was identified.

3/ See Appendix.

The forecasts of narrow money are close to actual values, also during the disinflation period. For broad monetary aggregates, however, the model predicts levels significantly below the actual ones for the last quarter of 1983 and the first half of 1984.

At this point it seems important to stress the tentative nature of the above results and, even more so, of their interpretation. With actual monetary growth (if assumed to reflect actual demand for money) exceeding substantially that projected by the estimated model of money demand, one could conclude that the model is misspecified or that the demand for money was determined by a different structure during the forecast period than postulated by the model (correctly) specified for the estimation period (breakdown of the stable demand for money function). An alternative interpretation may be offered by the buffer stock approach to the demand for money. 1/ According to this approach, money supply shocks (unexpected increases or decreases in money supply) engender a temporary desire to hold more or less money than would otherwise be the case. 2/ While such "shock-induced" increases in actual money balances would be well explained by the money demand function of a buffer stock model, the money demand model used in this paper implicitly assumes that the (income, price, or interest rate) arguments of the stochastic demand function adjust instantly to maintain money demand 3/ equal to the money supply. Since this model does not include a "money supply shock term," it is unable to capture (temporary) shifts in the (short run) demand for money due to unexpected variations in the supply of money other than in the error term. A conclusion consistent with a large forecasting error would thus be a shift in the demand for money either temporarily or permanently. While a change in the money supply process could be a possible reason for such a shift, 4/ the quite dramatic changes experienced by the Icelandic economy over the last year may also have had their impact on the structural parameters of the model. Assuming temporary disequilibrium ("involuntary" money holdings induced by a money supply shock) together with the assumption of partial stock adjustment 5/ would imply, however, that agents "work off" their excess balances over time through adjustments in income, prices, and/or interest rates.

1/ Carr, and Darby, 1981.

2/ The buffer stock model includes a "money supply shock term" in the demand for money function, which is the argument that adjusts instantaneously to maintain money demand (here = actual balances) equal to money supply. Adjustment in spending and the income, price, and interest rate variables occurs only over time. For a slightly different version of the buffer stock model see Knoester, 1984.

3/ Adjusted for the (systematic) partial stock adjustment process implicit in the lagged dependent variable model.

4/ Such an innovation could be constituted e.g., by a once and for all money surprise of an unprecedented magnitude, causing a temporary shift of the demand for money.

5/ See Appendix.

Table 2. Actual and Predicted Values of M_1, Quasi-Money, and M_3

(Seasonally adjusted)

	1983				1984	
	I	II	III	IV	I	II
Narrow money (M_1)						
Actual values						
Levels	2,233.1	2,542.6	2,933.4	3,298.5	3,696.3	3,951.4
Growth (ann.)	37.7	52.1	60.1	67.2	65.5	55.4
Growth (qu.)	64.4	68.0	77.2	59.9	57.7	30.6
Predicted values						
Levels	2,180.9	2,504.1	2,856.7	3,273.6	3,695.9	4,102.0
Growth (ann.)	28.5	42.1	57.7	61.5	69.5	63.8
Growth (qu.)	34.0	73.8	69.4	72.4	62.5	51.7
Quasimoney (M_3-M_1) 1/						
Actual values						
Levels	10,071.0	11,764.1	14,287.8	16,217.1	17,433.0	18,173.4
Growth (ann.)	66.0	74.6	89.5	86.1	73.1	54.5
Growth (qu.)	78.6	86.2	117.6	66.0	33.5	18.1
Predicted values						
Levels	10,107.1	11,876.0	13,627.4	14,958.2	16,017.1	17,090.8
Growth (ann.)	66.7	73.1	78.0	75.3	58.5	43.9
Growth (qu.)	97.0	90.6	73.4	45.2	31.5	29.6
Broad money (M_3)						
Actual values						
Levels	12,305.7	14,304.7	17,270.6	19,462.1	21,131.1	22,127.8
Growth (ann.)	60.0	70.1	83.9	82.6	71.7	54.7
Growth (qu.)	77.8	82.6	112.5	61.3	39.0	20.2
Predicted values						
Levels	12,228.6	14,367.3	16,458.8	18,207.9	19,685.1	21,143.1
(M_1 + quasi-money) 2/	(12,288.0)	(14,380.2)	(16,484.1)	(18,231.7)	(19,713.0)	(21,192.8)
Growth (ann.)	58.1	66.7	74.6	72.4	61.0	47.2
Growth (qu.)	79.6	90.5	72.2	49.8	36.6	33.1

Sources: Information provided by the Icelandic authorities, and staff calculations.

(ann.) = percentage growth over same period a year earlier.
(qu.) = percentage growth over preceding period; annualized.

1/ Quasi-money has been seasonally adjusted separately, which explains why actual levels given in the table for M_1 and quasi-money do not add up precisely to those for M_3.
2/ Sum of predicted levels of M_1 and quasi-money.

4. Indexed deposits and price expectations

The question of how to model price expectations may deserve some additional thoughts. 1/ Assume that economic agents choose among comparable financial assets the one with the highest expected real return, and that potential holders of indexed or nonindexed (fixed-interest) deposits are identical (i.e., have the same inflationary expectations). Then for holders of broad money the choice between indexed and nonindexed deposits (of similar maturities) is largely dominated by the difference in expected nominal yields. The ratio (R) of indexed deposits to total deposits can thus serve as an indicator of the public's relative nominal yield expectations. With the expectation for fixed-interest deposits given by the fixed rate, and the nominal yield expectation for indexed deposits largely reflecting price expectations, a rise, or fall, in R indicates inflationary expectations above, or below, respectively, the yield expectations contained in the nominal fixed rate on time and savings deposits. Table 3 shows the relevant figures for the period March 1983 to August 1984. The fall in R since August 1983 signals a quite dramatic turnaround in price expectations from around mid-1983. With holders of time and savings deposits shifting into fixed rate deposits, which were yielding about 27 percent (nominal return) in December 1983, and 17 percent in March 1984, it appears reasonable to conclude that they expected the credit terms index (or prices in general) to increase by less than these rates, at least over the next three months. 2/

This conclusion suggests that an adaptive expectations hypothesis is inadequate for the Icelandic case. 3/ Agents seem to adjust their expectations rather quickly to currently observable rates of inflation, which is why the latter have been used for the purpose of estimating the money demand equations.

An additional hint at quite rapidly lowered price expectations can be seen in the outcome of the wage negotiations in early 1984, concluded after the expiration of the statutory incomes policy. The agreement provides for a 13.6 percent rise in wage rates in four steps over a 14-month period. It contained, however, a clause permitting the reopening by both partners of negotiations before September 1, 1984, which indicates less firmly lowered long-term expectations.

1/ For the purpose of estimating the money demand equations, plausible models have to be specified for the process generating agents' price expectation. See also the Appendix.

2/ This may, however, be an important qualification, since the demand for money could well be influenced by long-run rather than short-run expectations.

3/ This is particularly true for the slow adjustment speeds to be derived from the estimated money demand functions--if they are interpreted as models including adaptive formulations for expectations.

Table 3. Indexed Deposits and Price Expectations

Period	Indexed deposits / Total time and savings deposits	Increase in credit terms 1/ Index	Interest on 3 months time deposits
March 1983	0.38	69.0	45.0
April	0.39	84.8	45.0
May	0.40	96.3	45.0
June	0.41	122.7	45.0
July	0.42	116.2	45.0
August	0.46	107.1	45.0
September	0.44	106.1	42.3
October	0.41	78.0	36.0
November	0.39	62.6	32.7
December	0.35	28.0	27.7
January 1984	0.32	26.9	21.0
February	0.28	14.9	17.0
March	0.26	8.9	17.0
April	0.22	9.3	17.0
May	0.19	14.4	17.0
June	0.18	10.1	17.0
July	0.17	18.8	17.0
August	0.16	14.9	17.0

Source: Information provided by the Icelandic authorities.

1/ Annualized percentage increase in the Credit Terms Index over the last 3 months.

III. Concluding Remarks

The analysis of this paper suggests that, in the short run, no more than a slight increase in the demand for money was likely to result from rapid disinflation in Iceland. While a substantial increase in the demand for narrow money can be expected in the long run, interest rate movements in line with changes in price inflation should have offset a considerable part of the impact of inflation as well as disinflation on the demand for broad money. Indexed deposits had absorbed a "flight" out of nonindexed deposits in times of high rates of inflation, and accordingly the shift into certain (nonindexed) time and savings deposits as a result of the disinflation process appears to have been to a large extent fueled by funds shifting out of indexed deposits. Indexed interest rates on deposits, following changes in inflation, have prevented both financial disintermediation in times of high inflation as well as "re-intermediation" in times of falling price inflation.

This conclusion is premised on the assumption that adjustment in the financial system to the changes in 1979/80 was completed by 1983. In addition, many caveats apply to an interpretation of the quantitative analysis presented in this paper. The results depend critically upon the magnitude of the estimated elasticities of the demand for broad money with respect to the rate of inflation and the rate of interest on holdings of quasimoney, respectively, as well as upon the relative movement of these rates. Moreover, shifts in the structure of the estimated models may have taken place, and as of now it appears difficult to determine the nature of such possible changes. Although there is no straightforward interpretation of the quantitative results, they seem, however, to be consistent with the general notion that inflation-indexation of certain financial assets--indeed designed to protect asset holders from the effects of price inflation--prevented money demand from rising strongly as a result of disinflation.

Thus, the main conclusion of this paper remains that--under the assumptions mentioned above--the disinflation process in Iceland should not have caused a strong increase in the demand for broad money balances per unit of output. This would suggest that actual growth rates of broad monetary aggregates recorded in 1983/84 reflected a temporary disequilibrium during the disinflation period. Monetary growth decelerated much slower than inflation (Table 4). While part of the continued monetary expansion may be explained by increased demand for broad money (due to somewhat higher real returns on quasi-money), it appears that such an increase was not strong enough to prevent disequilibrium between actual balances and long-run demand from emerging by the end of 1983 as a result of persistently high rates of domestic credit expansion. With the change from a flexible exchange rate regime to stability in nominal effective terms, and the thrust of the stabilization measures directly aimed at breaking the inflationary momentum, a (transitory) monetary disequilibrium could be expected to be "worked off" primarily via the external balance rather than threaten directly domestic (price) stability. Some of the excess liquidity may have leaked through the external accounts during

the period November 1983 to July 1984, when net foreign assets of the Central Bank fell by about ISK 0.5 billion (about 9 percent of the monetary base), 1/ and those of the whole banking system by about ISK 3.5 billion (about 20 percent of M_3). 1/ Imports have risen strongly in 1984 and the current account deficit is now forecast to rise from 2 1/2 percent in 1983 to 5 percent in 1984, with a projected increase in final domestic demand by 2 percent (as against a fall by 10 1/2 percent in 1983). Moreover, the outcome of the wage negotiations currently in progress is very uncertain.

1/ As of November 1983.

Table 4. Domestic Credit, M_3, and Inflation
(seasonally adjusted)

	Domestic credit expansion 1/ 2/	Actual growth of M_3 1/ 3/	Rate of inflation (CPI) 1/
1983			
III	105.1	105.4	90.9
IV	62.0	61.1	38.2
1984			
I	67.5	35.8	20.6
II	25.1	21.1	10.1
January	61.5	41.5	23.5
February	90.6	37.3	20.1
March	50.3	28.7	17.0
April	22.6	18.9	13.6
May	24.1	19.3	9.2
June	28.5	25.1	10.1
July	42.7	23.4	13.4
August	34.3	21.3	16.2

Sources: Data provided by the Icelandic authorities; and staff calculations.

1/ Monthly figures are annualized increases over preceding three months, in percent; quarterly figures are quarterly averages of monthly figures.
2/ Domestic assets of the banking system, including accrued interest.
3/ Broad money including accrued interest.

A Model for the Demand for Money in Iceland

The demand for real balances has been modeled as a function of real income (y, scale variable) and an opportunity cost variable (c).

Using the basic model of a demand for money function, the level of money balances held in time t can be specified as follows (assuming homogeneity of degree zero in the price level):

$$(1) \quad m_t = e^{a1} \cdot (y_t)^{a2} \cdot e^{a3 \cdot c_t}$$

where m_t stands for the demand for real balances in time t, y_t is expected or perceived real income, and c_t is a measure of the expected opportunity cost of holding money.

For a substantial part of the period under review, interest rates in Iceland have been regulated. In addition, there exist only a few alternative assets to money, so that nominal interest rates alone cannot serve as a useful opportunity cost variable. The rate of price inflation is an appropriate proxy for the opportunity cost of holding noninterest bearing money balances if the asset choice is largely restricted to holding either money or real assets. With money balances yielding nominal returns different from zero and varying over time, however, the asset choice of potential money (or real asset) holders is dominated by a combination of the expected nominal return (interest rate) on money balances and the expected rate of price inflation. Thus the opportunity cost variable has been modeled as follows:

$$(2) \quad c = c_1 (dp_t) - c_2 (r_t); \; c_1, c_2 > 0$$

where dp is the expected rate of inflation and r is the expected (weighted average) nominal interest rate on money balances. Inserting into (1), taking logs and adding a stochastic term yields

$$(3) \quad \ln (m_t) = b_1 + b_2 \cdot \ln (y_t) + b_3 \cdot dp_t + b_4 \cdot r_t + \gamma_t$$

with $b_3 = (a3.c_1)$ and $b_4 = (-a3.c_2)$.

Assuming a partial adjustment process of actual money balances to their desired level of the form

$$(4)\quad m_t - m_{t-1} = \lambda (m_t - m_{t-1}) + \delta_t ,$$

where δ is a random disturbance, and λ is the elasticity of actual balances m with respect to desired balances m , and combining (3) and (4) yields the following relationship.

$$(5)\quad \ln (m_t) = d_o + d_1 (\ln y_t) + d_2 (dp_t) + d_3 (r_t) + d_4 (\ln (m_{t-1})) + \varepsilon_t$$

where m_{t-1} is the (actual) money stock lagged one period and ε_t is an error term. 1/ With y_t, dp_t, and r_t being agents' perceptions or expectations about income, inflation and the nominal return on money balances, respectively, plausible models have to be identified for the process generating these perceptions or expectations. Several approaches to expected inflation and interest rates have been tested; 2/ eventually currently observed values have been used for the purpose of estimation of equation (5). This implies the assumption that agents expect inflation (and interest rates) to behave as a random walk, so that their best forecasts of the future path of these variables are their current values. Similarly, current (quarterly) GNP figures have been used for the income variable in (5), after some alternative models (permanent income) have been tried unsuccessfully.

It should be noted that the partial stock adjustment model with current values for the independent variables is observationally equivalent (except for the error term) 3/ to a model including adaptive formulations for expected inflation, permanent income, and the expected interest rate, with the same coefficient of adaptation for all three

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1/ The derivation of the partial adjustment model (5) results in an error term which is a linear combination of two random disturbances and thus should not cause inconsistence in the estimated coefficients.

2/ Among the hypotheses tested were "extrapolative expectations" (of the form $p^e = a_o \cdot p_t + a_1 \cdot (p_t - p_{t-1})$, where p_t, p_{t-1} are actual rates of inflation in t, and t-1, respectively), adaptive expectations (by means of the Almon technique), perfect foresight and autoregressive schemes (optimal forecasts based on past values). They all gave worse results (statistically insignificant coefficients or obviously unreasonable lag structures) than current values.

3/ The derivation of the adaptive expectations version of the model in general gives the error term a moving average structure in the estimated equation. As a remedy against possible estimation problems resulting from this structure an instrumental variable technique has been employed in the estimation procedure.

variables; or to one in which only one of the variables is an expectation formed adaptively. However, the adaptive expectations mechanism is probably an inadequate approach to the problem of expectations in Iceland, as has been noted in the main body of this paper. 1/

In equation (5), the long run elasticity of real money balances with respect to income equals $d_1/1-d_4$. The long run semi-elasticity with respect to inflation is $d_2/1-d_4$ and should be negative if a_3 in (1) is negative (i.e., if increased opportunity costs reduce the demand for real balances) and if c_1 in (2) is positive (i.e., if rising inflation raises the opportunity cost of holding money). The concept of the interest rate variable outlined above should result in a positive value of the semi-interest elasticity of the demand for broad money ($d_3/1-d_4$).

1/ Section II.4.

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