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Financial Infusion and Exiting from a Money Rule

Prepared by Mark Stone[1]

Authorized for distribution by Joshua Felman

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Abstract

Money demand often surges after successful macroeconomic stabilization. This paper gives a name—**financial infusion**—to these surges because their size, unpredictability, and concurrence with other "success shocks" pose unique challenges to policy, especially under a money rule. An examination of 26 stabilization episodes shows that money to GDP can be expected to decline before stabilization and rise sharply thereafter. Analysis of the policy response to financial infusion under a money rule concludes that it amplifies output and price volatility, even if built into the rule. Finally, the main elements of an exit strategy from a money rule to an exchange rate or inflation target are discussed.

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

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SUMMARY

This paper analyzes financial infusion, or an episode of large, upward, and permanent shifts in money demand prompted by successful macroeconomic stabilization. An examination of 26 successful stabilization episodes indicates that the ratio of money to GDP can be expected to fall before stabilization and rise sharply thereafter at growth rates of around 20 percent. This pattern holds across a broad range of countries, except in Africa. A case study of the Philippines demonstrates how money growth after stabilization can rise to a level far above that explained by a standard money demand function.

Since financial infusion has important macroeconomic consequences, the rest of the paper addresses the appropriate policy response. To this end, financial infusion is quantified in terms of its magnitude and duration, and a few practical approaches to forecasting it are suggested.

The policy response to financial infusion under a money rule is analyzed by embedding it in a small open economy model. Even if financial infusion is built into the money rule, its observational equivalence to temporary money demand shocks will amplify output and price volatility. This volatility can be reduced, but not eliminated, by the transparent introduction of new forecasting information into the rule.

Alternatively, the money target can be replaced by an exchange rate or inflation target. However, exiting from a money target is difficult for recently stabilized countries because they face multiple "success shocks" (financial infusion, capital inflows, and traded sector productivity growth) without having had enough time to establish full credibility. Whether to exit depends on how well a new target would absorb the dominant success shock. When to exit hinges on the prerequisites for success of the new target. How to exit involves customization of targets to fit the circumstances at hand.

I. Introduction

Money growth often surges after successful macroeconomic stabilization. These surges pose an especially difficult challenge to policymakers that stabilized with a money rule because they must decide whether or not to accommodate large increases in money growth unexplained by historical money demand relationships. Accommodation is the right choice if stabilization can be expected to trigger permanent shifts in money demand, and if the entrenchment of stability can be verified. Otherwise, accommodation will be inflationary, and can even threaten stability. Of course, money rule countries can avoid the accommodation dilemma by exiting from a money anchor to an exchange rate target or an inflation target. But a quick exit can aggravate the risks from other new shocks, such as increased capital inflow volatility and traded sector productivity improvements, particularly if the starting conditions for the new target are not yet firmly in place.

This paper addresses the policy challenges posed by post-stabilization money demand surges with an emphasis on countries using a money rule. First, the empirical pattern of money growth before and after stabilization is examined using cross-country data. Second, a few practical approaches to measuring and forecasting post-stabilization increases in money demand are suggested. Third, the policy responses to these money demand surges are rigorously analyzed for a small open economy using a money rule. Finally, the exit strategy from a money rule to an exchange rate or inflation target is evaluated.

It may be useful to give a name—**financial infusion**—to permanent increases in money demand triggered by stabilization because the policy challenges they pose distinguish them from two other, much better known, money demand patterns. The first is **financial deepening**, the trend rise in the ratio of money to GDP sustained by steady policies over several decades for countries starting out from a low level of intermediation (Bordo and Jonung, 1987). Financial deepening does not compel a rethinking of the policy framework because it is gradual and modest.[2] Financial infusion, in contrast, does call for a policy recasting because it is rapid and large. Indeed, financial infusion can be viewed as a catch up burst of monetization in countries where financial deepening was delayed, or reversed, by macroeconomic instability (Figure 1).

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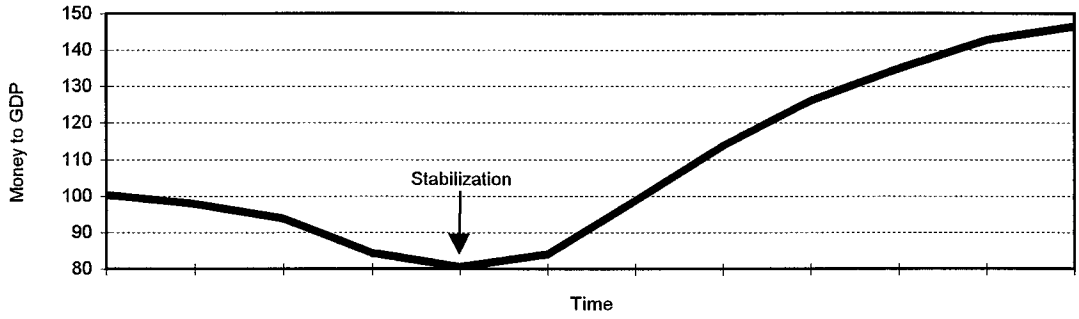
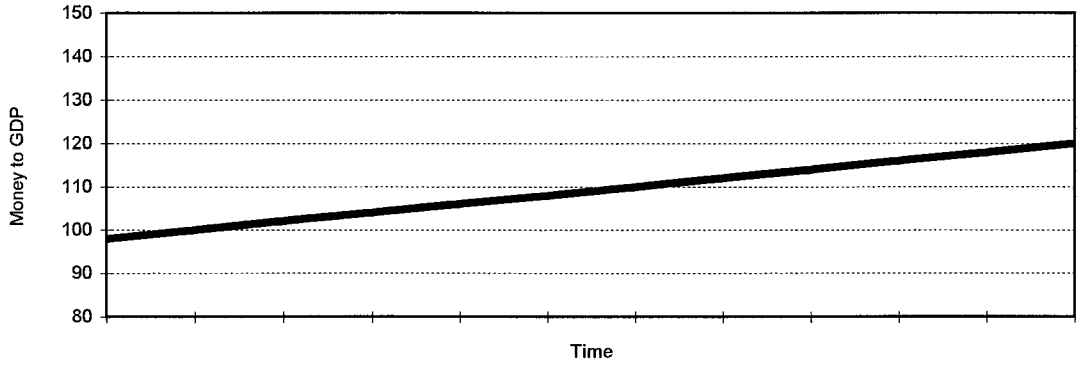
[2]Surges in money demand can also be triggered by rapid financial reform and the lifting of financial controls (Arrau and others, 1991; Bisat and others, 1992; Khan and Sundararajan, 1991; and Tseng and Corker, 1991). The influences of stabilization and rapid financial reform on money demand may look the same if both take place simultaneously.

Figure 1
Patterns of Money Demand

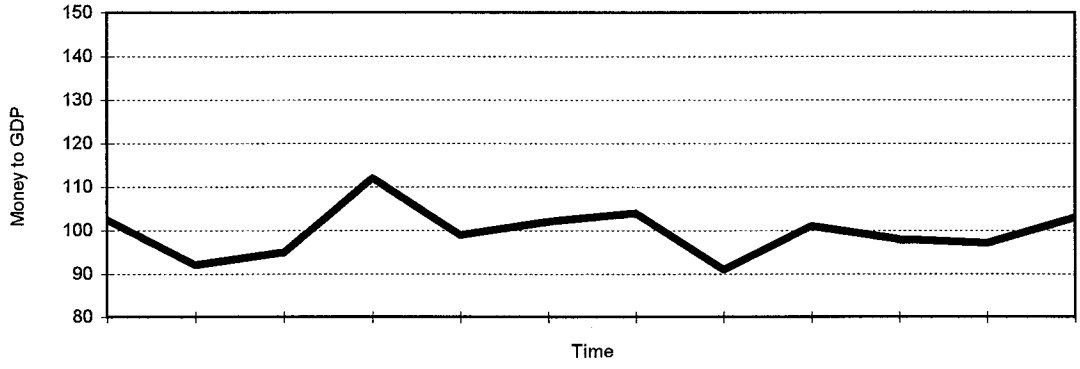
Financial Infusion



Financial Deepening



Unstable Money Demand



Financial infusion is also different from **instability in the demand for money**, which is usually attributed to financial innovation, for at least two reasons.[3,4] First, financial infusion is associated with a usable degree of predictability: post-stabilization changes in money demand can be expected to be positive and permanent, as shown later in this paper. This means that the policymaker of a recently stabilized country can be more confident that a burst of money growth should be accommodated. In contrast, changes in the demand for money associated with instability can be either positive or negative. Second, financial infusion is concurrent with other stabilization "success shocks," such as increased capital inflow volatility and traded sector productivity improvements, which must be accounted for in the policy response to financial infusion. Money demand instability is less likely to be linked with other new economic shocks. The singularity of the policy challenges posed by financial infusion is what motivates this paper.

What causes financial infusion? The structural origins of financial infusion are not well understood, notwithstanding its important macroeconomic consequences, mainly because episodes of stabilization, and therefore of financial infusion, are infrequent. Financial infusion can be viewed as a rapid portfolio readjustment prompted by the **end of a long inflation** which greatly increased the cost of holding domestic money relative to other assets.[5] Financial infusion can also be attributed to a **step increase in (unobservable) permanent income** sparked by stabilization. Of course, even if the underlying structural origins of financial infusion are not fully understood, and they are not the focus of this paper, policymakers must nevertheless deal with financial infusion and its repercussions.

The next section of this paper presents empirical evidence on money demand around the time of stabilization. A functional form for financial infusion is specified in Section III and embedded in a small open economy macromodel in Section IV to allow examination of the policy response to financial infusion under a money rule. In Section V, the decision to exit from a money rule to an exchange rate and inflation target is assessed. Section VI concludes. The international evidence is documented in Appendix I, the properties of financial infusion are explicitly derived in Appendix II, and the solution of the theoretical model is derived in Appendix III.

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[3]Money demand is usually deemed to be empirically unstable if there is no cointegrating vector between real money, real income, and interest rates (Engle and Granger, 1987).

[4]Financial innovation is taken to be the cause of two well-known episodes of money demand instability in the United States: "the case of the missing money" during the 1970s (Goldfield, 1990; and Judd and Scadding, 1982), and the decline in money demand in the early 1990s (Feinman and Porter, 1992).

[5]De Broeck and others (1997) use sluggish inflation adjustment and adaptive expectations to model the rise and fall of money demand in recently stabilized transition countries.

II. The Evidence

How does money demand behave around the time of stabilization? This question is addressed by a comparison of a broad international benchmark with money growth before and after 26 episodes of macroeconomic stabilization. In addition, the experience of the Philippines during the 1990s is reviewed as a case study of how standard macroeconomic indicators can or cannot explain post-stabilization surges in money demand.

A. The International Benchmark

The international benchmark is based on changes in money-to-GDP ratios for the 120 countries with historical time series in the IMF's *International Financial Statistics (IFS)* database.[6] The benchmark is calculated as follows:

(i) Growth rates for the money-to-GDP ratio for each country during 1976–95 are calculated;

(ii) Country groups are formed according to *IFS* regional classifications;

(iii) Within-group summary statistics of the country money-to-GDP ratio growth rates are generated;

(iv) The benchmark is the range of the summary statistics across country groups.

The benchmark money-to-GDP ratio growth rate range is ½ percent to 4 percent (Table 1). For advanced countries, the median and average growth rates are both about 1 percent. African countries have the lowest money-to-GDP ratio growth rates of any group, the highest dispersion of average growth (owing to several countries with negative rates), and a within-group distribution tending toward negative values—as indicated by its negative skewness. Asia, and, perhaps surprisingly, the Middle East, have the highest money-to-GDP growth rates and relatively small standard deviations, while growth for Western Hemisphere countries is around 1 percent.

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[6]Money is broadly defined to include currency outside banks, and demand, time, and savings deposits of resident sectors; central government and foreign exchange deposits are excluded. The data are documented in Appendix I.

Table 1. Broad Money-to-GDP Annual Growth, 1976–95
Summary Statistics 1/

	Median	Average	Standard Deviation	Skewness
Advanced (22 countries)	0.9	1.3	1.9	0.9
Africa (37)	0.4	0.3	2.4	-1.3
Asia (19)	3.1	3.5	2.4	1.1
Middle East (11)	3.8	4.3	2.3	0.8
Western Hemisphere (31)	1.0	1.2	1.6	0.2

Source: *International Financial Statistics*, IMF.

1/ Summary statistics are for within-group distributions of average country time-series annual growth rates over 1976–95.

B. Pre- and Post-stabilization Money-to-GDP Growth—Nontransition Countries

A concise definition of stabilization is required for the analysis. The definition used here, that of Easterly (1996), encompasses stabilization from high rates of inflation: "stabilizations are all episodes in the cross-country data of movement from two or more years of above 40 percent annual inflation to two or more years of below 40 percent annual inflation." (Easterly 1996, page 71). Of the 22 post-1976 stabilizations identified by Easterly, which exclude transition countries, the three developed country episodes (Israel and two for Iceland) are considered special cases and are excluded. This leaves seven African countries, ten Western Hemisphere countries, and Turkey. Each experienced positive growth one or two years after the year during which inflation peaked, which can be thought of as year zero in "stabilization time" (Fischer and others, 1996).

The pattern of money growth around the time of stabilization is very unusual when gauged against the international benchmark (Table 2 and Figure 2, top panel). **Before stabilization, the money-to-GDP ratio contracts. After stabilization, the money-to-GDP ratio surges**. This broad pattern holds for countries around the world, but its contour varies across country groups. For Western Hemisphere countries and Turkey, the post-stabilization money-to-GDP ratio surge is very large (75 percent), and far exceeds the pre-stabilization contraction (30 percent). For African countries, in contrast, money-to-GDP growth is delayed until the second year after the peak.

Table 2. Broad Money-to-GDP Growth Per Annum for Nontransition Countries that Successfully Stabilized

Stabilization Time	Western Hemisphere 1/						Africa	
	All		Fixed rate		Flexible rate		Flexible rate	
	Median	N	Median	N	Median	N	Median	N
-4	-0.7	10	-5.5	5	1.7	6	-6.2	7
-3	2.2	11	4.5	5	-1.5	6	-10.6	7
-2	-8.8	11	-0.1	5	-11.5	6	-1.8	7
-1	-5.7	11	5.8	5	-10.2	6	-2.0	7
0	-15.9	11	-7.6	5	-17.1	6	-5.2	7
1	9.9	11	1.2	5	13.3	6	-16.4	7
2	21.7	11	21.7	5	23.9	6	2.5	6
3	19.6	11	25.2	5	13.6	6	1.8	6
4	7.2	9	28.9	4	1.2	5	4.9	6
5	7.7	9	16.2	4	1.9	5	0.1	4
6	2.6	5	6.1	2	0.5	3	11.4	4
7	6.4	5	4.0	2	6.4	3	-0.6	3
	Cumulative Median Growth							
-4 to 0	-28.9		-2.8		-38.6		-25.7	
1 to 7	75.0		103.4		60.9		3.7	
2 to 7	65.1		102.2		47.6		20.1	
-4 to 7	46.1		100.6		22.3		-22.0	

Source: See Appendix I.

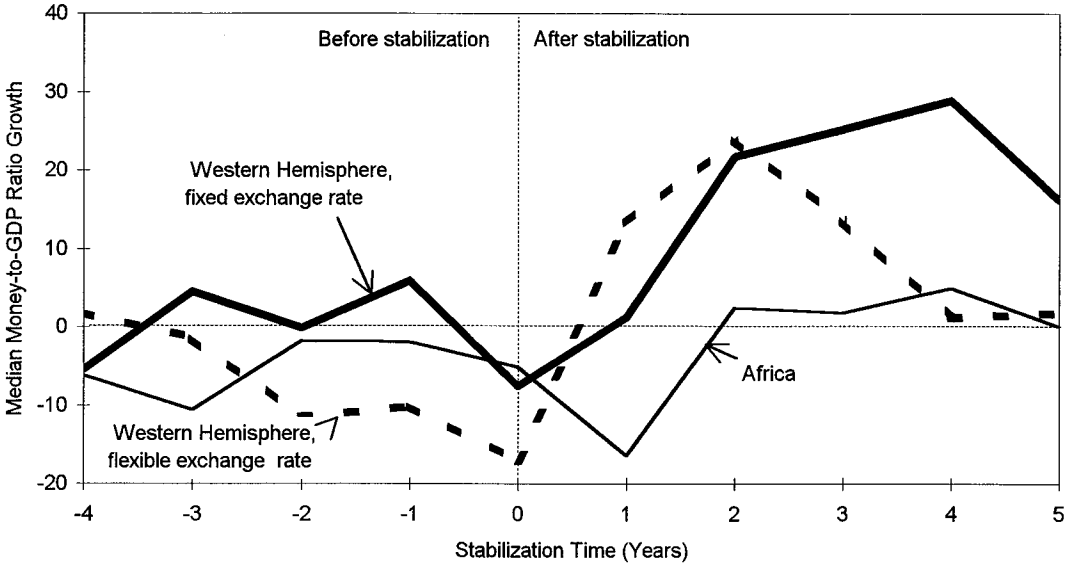
1/ Including Turkey; N denotes number of countries and fixed and flexible rate refers to exchange rate regimes.

Not surprisingly, the exchange rate regime matters. Fixed exchange rate countries have a smaller pre-stabilization money decline, and a sharper post-stabilization money surge relative to flexible exchange rate countries. This discrepancy probably reflects the looser reins on monetary growth under a fixed exchange rate. Further, there is a sample selection bias: a money rule is often made necessary by the absence of the stronger prerequisites for a fixed exchange rate rule (including a cushion of international reserves and a prudent fiscal program). Without these prerequisites, money demand is less likely to surge, regardless of the exchange rate regime.

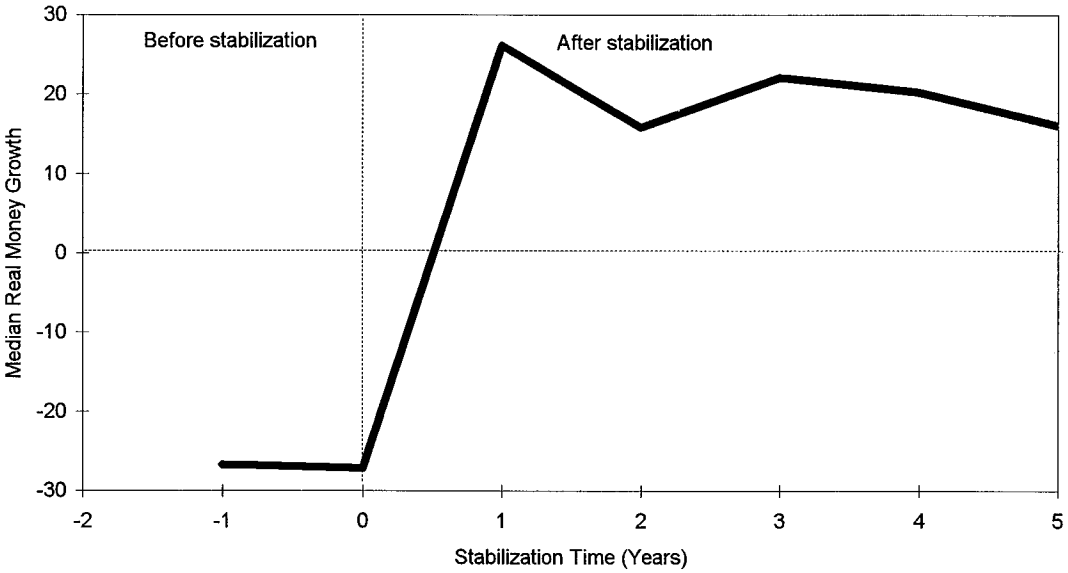
Figure 2

Money Growth Before and After Stabilization

Nontransition Countries--Money-to-GDP Growth



Transition Countries--Real Money Growth



C. Pre- and Post-Stabilization Real Money Growth—Transition Countries

Transition countries are a special case.[7] For them, the abandonment of command economy controls inevitably generated a spike in inflation. Further, many were pushed toward economic imbalance and even hyperinflation by lax financial policies and poor enterprise governance.

Nevertheless, CPI inflation was reduced to below 50 percent in 13 of the 29 transition economies in eastern Europe and Asia (including Vietnam, Cambodia, and Lao P.D.R.) by 1994, just four years after Poland launched the first comprehensive reform and stabilization program.[8] Of the 12 successful stabilization efforts, the four former Soviet Union countries (the three Baltics and Tajikistan) are excluded from this study owing to currency conversion complications. This leaves eight countries for whom inflation peaked from 1989 to 1993 (Appendix I). Money growth for these countries is measured simply by the within-year growth of real money, or the ratio of broad money (excluding foreign currency) to the CPI, owing to data availability.

Is stabilization for a transition country marked by surges in money growth? The answer seems to be yes, albeit based as yet on a limited number of observations (Table 3 and Figure 2, bottom panel). The median real money growth rate is negative before and during the year of peak inflation, rises very quickly to more than 20 percent per annum, then declines but remains above 10 percent.[9] The cross-sectional standard deviations per stabilization year are about the same as the average per year, indicating a wide range of experience. Surprisingly, real money growth is lower for the four countries that stabilized with a fixed exchange rate, but the number of observations is too small to draw any firm conclusions.

The international evidence can be summarized thus: the money-to-GDP ratio tends to drop before stabilization, and rise quickly thereafter. The median of money-to-GDP ratio growth surges to some 20 percent during two to three years after stabilization, and these surges are not subsequently reversed. **Thus, stabilization can be expected to trigger large**

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[7]Begg (1996), Dodsworth and others (1996), and Schwartz and others (1994) review the post-stabilization policy challenges facing transition countries.

[8]Both money and exchange rate rules have been used to successfully stabilize (Fischer and others (1996), Begg (1996), Dodsworth and others (1996)); although comparisons of the two anchors need to account for the fact that countries exercising fiscal restraint seemed more likely to be able to successfully fix the exchange rate.

[9]Shifts in velocity and money demand for transition countries around the time of stabilization is examined in more detail in De Broeck and others (1997). They find a similar pattern to that shown here, and conclude that cumulative inflation is an important determinant of the level of real money at the onset of stabilization.

program helped restore real growth in the late 1980s, but this recovery waned in the face of external shocks and loose monetary and fiscal policies.

Table 4. The Philippines: Stabilization Indicators and Money-to-GDP Growth
(Annual percent change; except where indicated)

	CPI	Real GDP	Stock Market Index 1/	External Financial Account ($ millions)	Real Effective Exchange Rate	Money-to-GDP
1983	10.0	1.9	NA	-389	-15.9	1.9
1984	50.3	-7.3	NA	781	-0.9	-20.6
1985	23.1	-7.3	NA	328	9.4	-0.6
1986	0.8	3.4	NA	146	-22.0	-3.4
1987	3.8	4.3	NA	318	-8.0	-2.2
1988	8.8	6.8	15.3	571	-2.2	1.8
1989	12.2	6.2	68.2	1,354	7.3	8.9
1990	14.1	3.0	-25.2	2,057	-3.0	3.2
1991	18.7	-0.6	-5.8	2,927	-1.3	0.3
1992	8.9	0.3	38.4	3,208	11.1	2.0
1993	7.6	2.1	26.8	3,267	-2.1	5.9
1994	9.1	4.4	62.4	5,120	6.1	8.4
1995	8.1	4.8	-9.0	5,309	3.4	15.1
1996	8.8	5.5	14.1	NA	9.2	5.1

Sources: *International Financial Statistics*; International Finance Corporation (IFC); and Fund staff estimates for 1996 real growth and December broad money.

1/ Prior to 1988 trading volume was thin (less than $100 million per month).

Although inflation peaked in 1984, which would mark year zero in stabilization time according to the Easterly criteria, financial infusion in the Philippines seems to have been delayed until the mid-1990s by the time it took to implement fully credible stabilization policies. This shows how uneven economic policies can delay the entrenchment of stability and financial infusion, even after a reduction in inflation from a high level.

Lasting stability came with the resolution of political uncertainties and prolonged adherence to tight financial policies. By 1994, real growth resumed, a stock market boom was in full swing, capital inflows swelled, and the real exchange rate was on an upward trend. At the same time as these compelling signs of stability, money growth began to surge.

The unprecedented rate of money growth that began in late 1994 greatly complicated implementation of a policy framework anchored by a money rule. The problem was the breakdown of the historical relationship upon which the authorities based the money targets. The usefulness of this relationship prior to the mid-1990s can be seen by a simple money demand function based on quarterly data from the first quarter of 1984 through the fourth quarter of 1993:[11,12]

$$m_t - p_t = -0.16 + 1.53\, y_t - 0.77\, r_t$$
$$\qquad\qquad (1.32)\ \ (16.40)\ \ (1.60)$$

$N = 40 \qquad R^2 = .90 \qquad D\text{-}W = 1.64 \qquad ADF = -2.65\ (-2.63)$

where m is the log of broad money, p is the log of the consumer price index, y is the log of real GNP, r is the 91-day treasury bill auction rate, t-statistics are reported below parameter estimates, and ADF stands for the augmented Dickey-Fuller statistic with its 1 percent critical value in parentheses.[13] This fit produces reasonable parameter estimates and a stationary residual, judging by the ADF statistic.

But three years later the money demand function no longer produced useful estimates. This can be seen by examining the residual generated by the above specification updated with data through the second quarter of 1996:

$$m_t - p_t = -2.01 + 1.90\, y_t - 1.68\, r_t$$
$$\qquad\qquad (3.90)\ \ (19.83)\ \ (1.01)$$

$N = 50 \qquad R^2 = .92 \qquad D\text{-}W = 1.14 \qquad ADF = -1.21\ (-2.61)$

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[11]The limited number of observations precludes use of the Johansen (1988) cointegration method. In the absence of a multiple equation model, no inference can be made regarding the direction of causality of the relationships, which is not of interest here.

[12]All the individual time series are nonstationary at the 1 percent level of significance based on augmented Dickey-Fuller (ADF) tests (with and without trends and with four lags). Beginning the data sample in 1981, the first period for which quarterly GNP is available, did not produce a stable relationship, judging by the ADF statistic for the regression residual; a stable relationship was obtained by beginning the sample in the first quarter of 1984.

[13]The ADF statistic is generated by the regression of the residual on its own three lags.

Most important for policy, the model is no longer suitable for short-term forecasting because it leaves unexplained a residual gap equivalent to 10 percent of real money during 1994–96, and the recursive residuals fall outside of the two standard error confidence band beginning in the second quarter of 1994. **Thus, for the Philippines during the 1990s, the large share of the post-stabilization increase in money demand unexplained by standard macroeconomic indicators is consistent with the notion of financial infusion**.

III. Quantifying and Forecasting Financial Infusion

Financial infusion warrants a policy response because it generates increases in money demand large enough to have important macroeconomic consequences. Formulation of a policy response requires that financial infusion be quantified and forecasted, even if it is not directly observable. This section proposes a quantification of financial infusion, and suggests a few practical approaches to forecasting it.

A. Quantification of Financial Infusion

Financial infusion is defined as the cumulative increase in money demand unexplained by standard macroeconomic variables and attributable to stabilization. A financial infusion time series, f, can be added to a standard money demand equation:

$$m_t - p_t = a_1 y_t - a_2 r_t + w_t + f_t \qquad \text{(III.A.1)}$$

where w captures temporary white noise shifts in money demand.

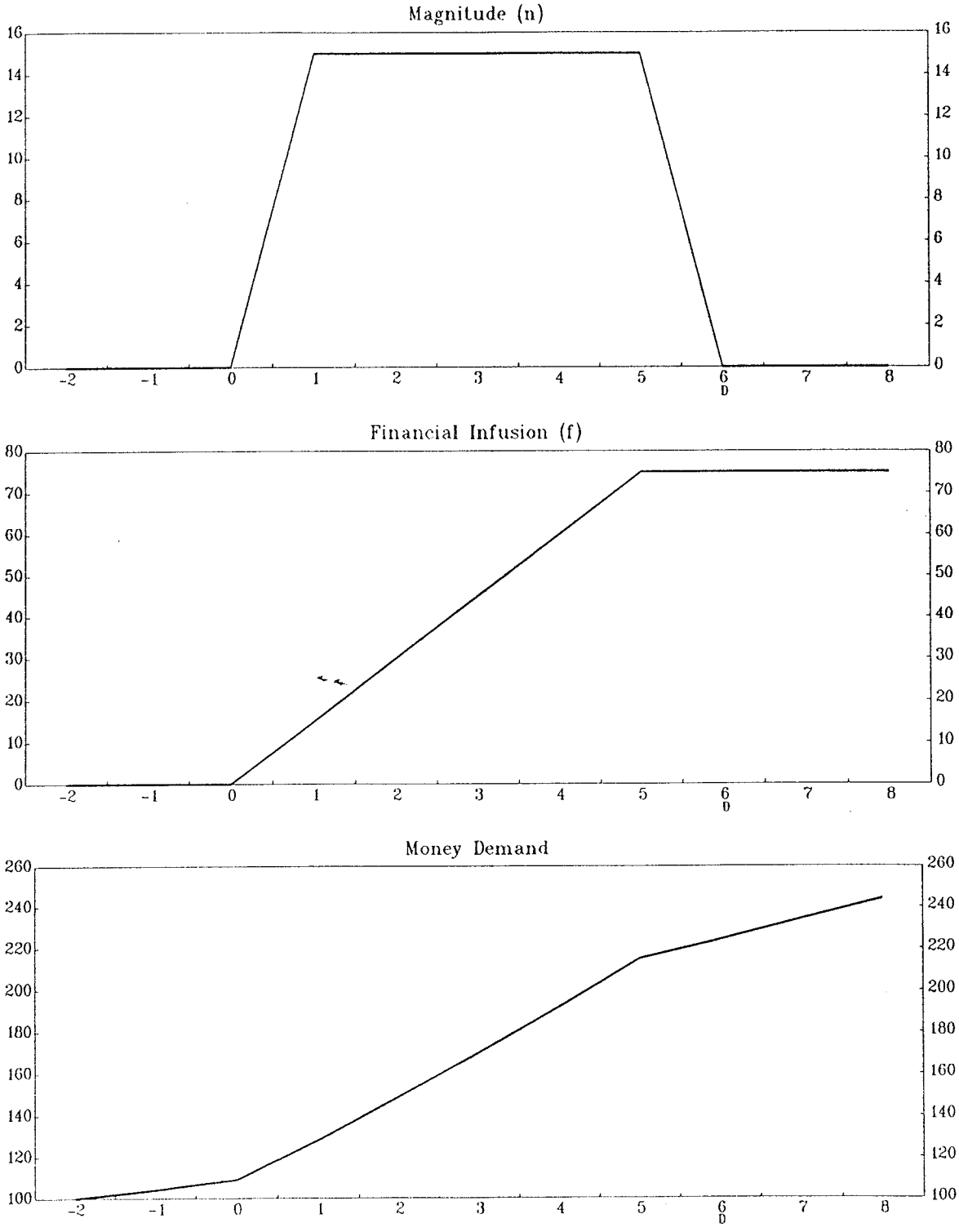
Financial infusion is broken down into two dimensions. The increase in money demand prompted by financial infusion in each individual period is termed its **magnitude**, η (top panel of Figure 3). These increases in money demand last for the **duration** (D) of financial infusion, or the number of periods it takes for money holders to complete the portfolio adjustment process set in motion by stabilization. Duration is depicted on the horizontal axis of each panel of Figure 3 as the interval between period 0 and D. Both η and D are random variables with means $\bar{\eta}$ and $\overline{D}$. Financial infusion is the sum of the magnitudes of each period since it began (middle panel of Figure 3).

$$f_t = \sum_{s=0}^{t} \eta_s. \qquad \text{(III.A.2)}$$

Financial infusion generates a temporary surge in overall money demand over and above the trend increase associated with financial deepening (bottom panel of Figure 3).

Figure 3

Financial Infusion and Money Demand 1/



1/ Based on constant 3 percent magnitude and duration of 6 periods.

It is important to model the amount of financial infusion expected in the future, because markets, and thereby policymakers, are forward-looking. The level of f expected j periods out, or $f^*_{t+j,t}$, where * denotes expectations and the second subscript is the period during which expectations are formed, is:

$$\text{(III.A.3)} \qquad f^*_{t+j,t} = \begin{cases} f_t + \sum_{s=1}^{j} \Pr(D \geq t+s)\eta^*_{t+s,t} & j \leq \overline{D} \\ f^*_{t+\overline{D},t} & j > \overline{D} \end{cases}$$

Expected future financial infusion is that already realized (f_t) plus the sum of the expected increases in money demand each period hence. The expected increase in financial infusion in future period s is the product of the probability financial infusion is anticipated to last in that period ($\Pr(D \geq t+s)$), and its expected magnitude ($\eta^*_{t+s,t}$). Expected financial infusion plateaus in period $\overline{D}$, and remains frozen at that level ($f^*_{t+\overline{D},t}$) thereafter.

The next step is to put $f^*_{t+j,t}$ into explicit functional form so that it can be embedded in a broader framework. This is done by assuming D is distributed according to the exponential distribution with parameter $1/\overline{D}$, which has the following probability density function:

$$\text{(III.A.4)} \qquad \text{pdf}(D) = (1/\overline{D})e^{-(1/\overline{D})j}$$

with mean $\overline{D}$ and variance $\overline{D}^2$.[14] The exponential distribution is used to represent the distribution of time that elapses before the occurrence of some event, for example, the length of time for which a light bulb will burn in the future (DeGroot, 1975). The periodic magnitude parameter η is distributed with expectation $\bar{\eta}$ and variance σ^2_η. Appendix II shows that $f^*_{t+j,t}$ can be expressed:

$$\text{(III.A.5)} \qquad f^*_{t+j,t} = f_t + \sum_{s=1}^{j} e^{-s/\overline{D}}\eta^*_{t+s,t}$$

In Section IV, this function will be embedded in a macroeconomic model for analysis of the broader consequences of financial infusion.

B. Forecasting Financial Infusion

So far, nothing has been said about how the policymaker can forecast financial infusion. If the policymaker is forming an expectation of f_t in time t-1, it seems natural to view

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[14]Arrau and others (1991) account for the impact of financial reform on money demand by adding a random walk disturbance term, which provides for extra money demand shocks that are permanent, but may be either positive or negative. The specification used in this paper assures both that the shocks are permanent and that they shift money demand upward.

expected financial infusion as the sum of that estimated to be already in place ($f^*_{t-1,t-1}$) and the product of the probability financial infusion will carry on in t ($Pr(D \geq 1)$ and the expected magnitude in t ($\eta^*_{t,t-1}$)

$$(III.B.1) \qquad f^*_{t,t-1} = f^*_{t-1,t-1} + e^{-1/\overline{D}}\eta^*_{t,t-1}.$$

Typically, expectations of economic variables are obtained by regressing the variable of interest on other variables to which it is related. But, in this instance, f, η, and D are not directly observable, and, further, the structural links between them and observable information are not well understood. Nevertheless, there are systematic ways to proceed.

First, **regression residuals from a standard money demand equation** such as (III.A.1) can be combined with other sources of information to form expectations of f_{t-1}, $\overline{D}$ and $\eta_{t,t-1}$, which can then be plugged into (III.B.1). Since w_{t-1} is mean zero, the residual itself can be used as an estimate for f_{t-1}

$$(III.B.2) \qquad f^*_{t-1,t-1} \equiv (w_{t-1} + f_{t-1}) = (m_{t-1} - p_{t-1} - \hat{a}_1 y_{t-1} - \hat{a}_2 r_{t-1})$$

where hats denote a parameter estimate. Magnitude can be proxied by the residual normalized by the number of periods since the beginning of financial infusion. In the notation used here, the number of periods during which financial infusion has been in place is t, so the magnitude estimate is:

$$(III.B.3) \qquad \eta^*_{t,t-1} \equiv (w_{t-1} + f_{t-1})/t.^{15}$$

This expression on average will equal the magnitude sample mean. Expected duration is probably the toughest parameter to estimate. Leading indicators of the rise and fall of stabilization, as described below, could be used. These approaches can be complemented by the experience of other countries, as summarized in Section II. The final expression for $f^*_{t,t-1}$ is obtained by substituting the parameter estimates into (III.B.1) and simplifying:

$$(III.B.4) \qquad f^*_{t,t-1} = [1 + e^{-1/\overline{D}}/t](m_{t-1} - p_{t-1} - \hat{a}_1 y_{t-1} + \hat{a}_2 r_{t-1}).$$

Second, a **stabilization proxy** can be used to forecast f. Suppose, for the sake of simplicity, the policymaker feels confident that financial infusion is systematically related to a single stabilization indicator b

$$(III.B.5) \qquad f_t = \tau b_t + \phi_t.$$

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[15]Strictly speaking, the number of periods during which financial infusion is in place (the denominator t in III.B.3 and III.B.4) is unobservable and thus should also be a random variable, but this would further complicate the notation at little gain in rigor. The estimate of the number of periods that financial infusion has been in place can be based on the regression residual and the behavior of other indicators of stabilization.

Here, b represents a new and independent source of information, and ϕ_t is a mean zero white noise measurement error term independent of b, w, and f. Under this approach, the financial infusion forecast is simply:

(III.B.6) $\quad f^*_{t,t-1} = \tau b^*_{t,t-1}$.

Candidates for b are:

- Inflation—The inflation rate, or perhaps the change in the rate, seems to be correlated with post-stabilization changes in money demand (De Broeck and others, 1997).

- Stock market index—Since financial infusion seems to reflect wealth effects from shifts in permanent income prompted by stabilization, and equity holdings make up a large share of wealth, the stock market index seems like a good proxy.[16]

- External debt prices—These prices also serve as a gauge of future economic prospects and are determined in active secondary markets.

- Currency-deposit ratio—Higher money growth accompanied by an increased willingness to hold domestic currency deposits vis-à-vis cash (a lower currency-deposit rate) is more likely to be permanent.

- Real interest rates—A narrower risk premium for holding domestic currency is another widely used indicator of stability.

Empirical analysis of which of these and other stabilization proxies are best suited for proxying financial infusion would seem to be an important area for further empirical work.

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[16]For the Philippines, the stock market index lagged by four periods turns out to be highly correlated with the portion of post-stabilization money demand unexplained by the standard macroeconomic indicators:

$$m_t - p_t = -1.32 + 1.24\, y_t - 0.43\, r_t + 0.13 e_{t-4}$$
$$\qquad\qquad (1.91)\ (9.20)\quad (3.19)\quad (6.83)$$

$$N = 46 \qquad R^2 = .98 \qquad D\text{-}W = 1.61$$

where e is the stock market index from the IFC database.

IV. Financial Infusion, Output, and Monetary and Exchange Rate Policy

A country that stabilized with a money rule can respond to financial infusion by ignoring it, modifying the money rule, or even shifting to an exchange rate target. These responses are analyzed in this section using a standard macroeconomic model augmented by the financial infusion function just presented. The perspective taken is that of the policymaker who must choose whether or not to accommodate a surge of money growth unexplained by standard money demand relationships, but before there is enough time to understand its structural origins, or confirm that stabilization is entrenched.[17]

A. The Model and its General Solution

The model is of a small open economy with forward-looking agents and supply-determined output. Purchasing power parity and uncovered interest rate parity restrictions imply:

$$p_t = s_t + pf_t \qquad \text{(IV.A.1)}$$

$$r_t = rw_t + s^*_{t+1,t} - s_t \qquad \text{(IV.A.2)}$$

where p and pf are the domestic and foreign price indices and s is the price of domestic currency in terms of foreign currency (all in logs), r and rw are the domestic and world interest rates, and $s^*_{t+1,t}$ denotes expectations of s in period t+1 from the perspective of period t. These two equations can be combined by assuming pf and rw are fixed and normalizing pf to zero:

$$r_t = rw_t + p^*_{t+1,t} - p_t . \qquad \text{(IV.A.3)}$$

Money demand is the only variable subject to random disturbances:

$$m_t - p_t = a_0 + a_1 y_t - a_2 r_t + w_t + f_t \qquad \text{(IV.A.4)}$$

where w has a zero mean and standard deviation σ_w, and is nonserially correlated and uncorrelated with f. The model is set up with only money demand disturbances to concentrate the analysis on the consequences of financial infusion under different policy rules (shocks to capital inflows and productivity are discussed in Section V). Output is determined by the deviation of actual from expected prices:

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[17]De Broeck and others (1997) develop a theoretical model of exchange rate, price, and money dynamics during and after stabilization. Under the assumption of adaptive (rather than rational) expectations, the De Broeck model generates the pattern of money demand associated with financial infusion, as well as the initial real exchange rate overshooting common to recently stabilized transition countries.

(IV.A.5) $y_t = \pi_0 + \pi_1(p_t - p^*_{t,t-1})$.

Policy is anchored by a precommitment money rule: the money supply must be set ahead of time under the assumption that information is available with a lag.[18] Alternatively, this money supply equation can be viewed as a one-period-ahead precommitment, as, for example, under an IMF program. The money rule includes the f forecast but excludes w as it is nonserially correlated and thus has zero expected future value:

(IV.A.6) $m_t = z_o + \lambda f^*_{t,t-1}$

where $z_o = a_1\pi_0 + a_0 - a_2 rw_t$ and money supply parameter λ is under the control of the policymaker. Financial infusion is treated as exogenous because this is how it must be viewed by policymakers when there is not enough time to establish a link between it and its specific structural origins. Finally, rational expectations are assumed.

The job of the policymaker is to buffer the real economy from financial infusion through its choice of the money rule parameter and forecasts of financial infusion. The policymaker first wants to avoid systematic deviations of y_t from $\bar{y}$. Second, as long as there are no systematic deviations, the policymaker turns to minimizing output fluctuations.[19]

The reduced form equation for y_t is the basis of the subsequent analysis. This equation is obtained, as shown in Appendix III, by first obtaining a reduced form for dynamic price expectations, substituting this back into the model, and solving for y_t:

(IV.A.7) $$y_t = \bar{y} - \Gamma\{w_t + f_t - \lambda f^*_{t,t-1} - (1-\lambda) f^*_{t,t-2} + (1-\lambda)\sum_{j=1}^{\infty} \delta^j \Delta^* f^*_{t+j,t-1}\}$$

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[18]The setting of policy before the arrival of information is especially relevant for the developing and transition countries experiencing financial infusion because for them output and inflation estimates are usually available only after long lags, and reported interest rates may not fully reflect credit market conditions. McCallum (1994) argues that, in general, only lagged values of output and prices should be included in the policymaker's information set. In the context of the model used here, observation of the current interest rate by itself would not be sufficient to estimate current financial infusion.

[19]Minimization of y and p fluctuations is equivalent because only money demand shocks are considered, and money demand shocks impact y and p in the same direction.

where:

$$\Gamma = \pi_1/(1 + a_2 + \pi_1 a_1)$$

$$\bar{y} = (1 + a_2)\pi_0/(1 + a_2 + \pi_1 a_1) + a_1\pi_0$$

$$\delta = a_2/(1 + a_2)$$

$$\Delta^* f^*_{t+j,t-1} = f^*_{t+j,t-1} - f^*_{t+j,t-2}$$

Output is $\bar{y}$ in the absence of shocks. The temporary money demand disturbance term w_t influences output because the policymaker must precommit in t-1 and thus cannot adjust money supply in t in response to the realization of w. The lag structure of the impact of financial infusion on output reflects the one-period-behind money rule, and the forward-looking one-period-ahead interest parity condition.

B. Macroeconomic Consequences of Financial Infusion

The implications of different policy responses to financial infusion are examined next using different versions of the general solution (IV.A.7).

- *If overlooked, financial infusion will compress output.*

Suppose financial infusion is underway, but that it has yet to be identified by either the policymaker or the markets. The implication of total unawareness of financial infusion is shown by setting λ in (IV.A.7) to zero and eliminating the f^*'s:

$$\text{(IV.B.1)} \qquad y_t = \bar{y} - \Gamma(w_t + f_t) < \bar{y}.$$

Ignoring financial infusion compresses output since Γ is positive. The unaccommodated upward money demand shock forces the interest rate to rise and the price level to decline to clear the money market. The price decline increases real wages, lowers labor demand, and in this output supply-determined model, reduces output.

- *Future, as well as current, financial infusion affects output today if the policymaker under (or over) accommodates.*

Suppose the policymaker erroneously decides to accommodate only half of the expected financial infusion, perhaps thinking that the positive money demand shocks will subsequently reverse themselves. Here the money rule is

$$\text{(IV.B.2)} \qquad m_t = z_o + \tfrac{1}{2} f^*_{t,t-1}.$$

Again, output will fall.

$$\text{(IV.B.3)} \qquad y_t = \bar{y} - \Gamma\{w_t + f_t + \tfrac{1}{2}(\sum_{j=0}^{\infty} \delta^j \Delta^* f^*_{t+j,t-1})\} < \bar{y}.$$

The point here is that **future**, as well as current, financial infusion influences output today if the money rule parameter is not properly set. The reason is that markets want to even out the consequences of overly tight money market conditions between today and tomorrow. They smooth these consequences by boosting interest rates more today than they would in the absence of forward-looking behavior and this intertemporal smoothing exerts additional downward pressure on output today. Thus, the output compression exacted by the policymaker's incomplete accommodation of financial infusion is amplified by the persistence of financial infusion together with forward-looking market behavior.

From now on, the policymaker is assumed to correctly set λ equal to one, so that the reduced form equation for y is:

$$(IV.B.4) \qquad y_t = \bar{y} - \Gamma(w_t + f_t - f^*_{t,t-1}).$$

- *A rigid money growth rule can temporarily raise output after financial infusion ends, but it will eventually backfire.*

The policymaker may be tempted to act as if financial infusion is permanent, even after it ends, to gain temporary increases in output. Suppose that the policymaker increases money supply by the expected magnitude each period. Under the simplifying assumption that magnitude is constant at $\bar{\eta}$, the policymaker uses the money rule:

$$(IV.B.5) \qquad m_t = z_o + \sum_{s=0}^{t} \bar{\eta}.$$

Assuming that the financial markets presume money demand increases are permanent, the reduced form y equation (IV.B.4) includes:

$$(IV.B.6) \qquad f_t - f^*_{t,t-1} = \begin{cases} 0 & t \le D \\ (t-D)\bar{\eta} & t > D. \end{cases}$$

Before and during period D, there is no systematic deviation of f from f^*, but after D, f^* exceeds f, causing y_t to exceed $\bar{y}$ systematically.

However, this policy rule would backfire for reasons which are not fully captured in the framework used here. First, in reality, policymakers care about inflation and the inflationary costs of over accommodation may outstrip the gains from higher output. Second, after one or two mistakes, the financial markets will catch on and no longer presume that money demand increases are permanent. Third, workers will not stand for declining real wages for very long. Eventually, nominal wages will become fully flexible (the wage indexation parameter in the first footnote in Appendix III will approach one), severing the link between monetary policy and output. For post-stabilization countries, there is a fourth and even more important cost of such a rigid money rule. These countries stabilized by establishing credible macroeconomic policies, and their hard won gains in credibility may be

erased by only a short period of reflation. Thus, the benefits from brief increases in growth are outstripped by the costs of injured credibility, and perhaps even a slip back into macroeconomic instability.

From now on, the policymaker is assumed to update the estimate of financial infusion each period. Since this implies that output will not deviate systematically from its trend, the policymaker is assumed to minimize the fluctuation of output and prices.

- *Financial infusion amplifies output and price volatility.*

Financial infusion amplifies output and price volatility, even if it is identified and fully accommodated only as long as it lasts, because its unobservability makes the forecasts upon which economic decisions are based less precise. **These forecast errors result from the one-period-ahead money rule, combined with the observational equivalence of w and f.** To minimize output and price volatility, the policymaker will want to keep $f^{*}_{t,t-1}$ in (IV.B.4) as close as possible to f_t.

- *The policymaker minimizes volatility by choosing the best possible forecast of financial infusion.*

For example, the policymaker could choose one of the two forecasting approaches proposed in Section III. If the variance of w in the money demand residual estimate (III.B.4) is large, then the direct financial infusion proxy approach (III.B.6) may be preferred. In practice, of course, these approaches cannot be applied mechanically, and all indicators with independent information on financial infusion should be utilized.

- *The financial infusion proxy used in the money rule should be transparent.*

Extra volatility will result if the policymaker keeps its financial infusion proxy under wraps. In this case, the markets are forced to build and use their own proxy, and not one but two financial infusion expectation operators will appear in the output reduced form equation:

$$
\begin{aligned}
(IV.B.7) \qquad y_t = {} & \overline{y} \\
& + \Gamma\{-w_t \\
& - (f_t - f^{*,c}_{t,t-1}) \\
& - (f^{*,c}_{t,t-2} - f^{*,m}_{t,t-2}) \\
& - \sum_{j=1}^{\infty} \delta^j \Delta^* f^{*,c}_{t+j,t-1} - \sum_{j=1}^{\infty} \delta^j \Delta^* f^{*,m}_{t+j,t-1}\}
\end{aligned}
$$

where $f^{*,c}_{t,t-1}$ and $f^{*,m}_{t,t-1}$ are the expectations formed by the policymaker and the markets, respectively. As long as the policymaker keeps its indicator proprietary, its expectations will deviate from that of the market and greater volatility will result. If the policymaker shares its indicator, then the last two lines of (IV.B.7) drop out, and output volatility is lower.

The analysis can be summarized as follows: if overlooked or underestimated, financial infusion will compress output, and, conversely, any attempt to over accommodate will eventually backfire. Even if correctly built into the policy framework, financial infusion amplifies output and price volatility, because the forecast errors inherent under a precommitment money rule will be magnified by the observational equivalence of temporary money demand shocks and financial infusion. However, this volatility can be reduced by the transparent introduction of new information into the money rule. Alternatively, the policymaker can alter policy in a more fundamental way.

- *Switching to a fixed exchange rate neutralizes financial infusion*

This paper has analyzed the policy responses to financial infusion within the framework of a money rule. Another alternative, of course, is to deal with financial infusion by switching to an exchange rate target. This will neutralize the impact of financial infusion on output and prices by causing all increases in money demand to be absorbed by the newly endogenous money supply.

The advantage of an exchange rate rule in the face of money demand shocks can be seen easily in the model used here. Fixing the exchange rate ties the domestic interest rate to the world interest rate, and, in this simple framework, ties domestic prices to world prices. The resulting elimination of price surprises keeps output constant at π_0 and money supply will rise and fall with the two money demand disturbances:

$$(IV.B.8) \qquad m_t - s = a_0 + a_1\pi_0 - a_2 rw + w_t + f_t.$$

V. Responding to Financial Infusion by Exiting from a Money Rule

In this section, the exit strategy from a money rule is sketched out broadly, and qualitatively, owing to the limitations of a single theoretical model. The exit strategy is seen to aim at smoothing real output and preserving stability in the face of new and large economic shocks. With these goals in mind, the policymaker must choose whether, when, and how to exit from a money rule to a new nominal target.

These choices are complicated by two factors special to recently stabilized countries and crucial to the design of a nominal anchor. New **success shocks other than financial infusion** is the first factor. An increase in externally prompted capital inflows for the purchase of domestic securities is one such shock. These inflows are triggered by temporary external

events, such as shifts in world interest rates or portfolio.[20] A second important shock is improved traded sector productivity generated by structural reforms and higher investment. Both of these shocks make it harder to adhere to a new fixed exchange rate anchor. A **lack of full credibility** is the second special factor. Before stabilization, bad economic policies, often resulting from discretionary central bank actions aimed at short-term growth or seignorage income, generated high inflation and undermined credibility. While stabilization restores some degree of integrity, the establishment of full credibility takes time, and is especially important for the implementation of a policy rule in the context of multiple success shocks, which makes it harder for markets to confirm that policy actions support the anchor.[21]

A. Whether to Switch: Identification and Absorption of Shocks

The country must first decide (fairly quickly) whether to stick with a money rule or exit to a new target. An **exchange rate rule** is the traditional alternative target (Aghevli and others, 1991; and Fischer, 1986). More recently, **inflation targeting** has emerged as a new option, in large part because of the remarkable progress toward price stability of developing and transition countries (Masson and others, 1997). The decision to switch involves, first, identification of the dominant shock, which is especially challenging because there may be more shocks than signals.[22,23] Second, the target that best buffers the real economy from the dominant shock is chosen. These issues have been covered extensively elsewhere, and will not be elaborated here.[24]

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[20]Corbo and Hernández (1994) discuss the policy response to capital inflows.

[21]This rules versus discretion dichotomy is seen as artificial by McCallum (1997) on the grounds that an optimizing policymaker will **always** choose to adhere to a rule because this is superior to exercising discretion. While this critique may apply to advanced countries, the dichotomy does seem useful for recently stabilized countries because there remains some doubt as to whether policymakers in these circumstances are behaving optimally, given the patently suboptimal behavior that preceded stabilization.

[22]Further, some signals that are typically used by policymakers to help separate out one economic disturbance from another are not helpful when it comes to success shocks. Most important, equity prices and the exchange rate are less useful because both are pushed up by stabilization regardless of which success shock dominates.

[23]Haque and others (1997) discuss how to separate out one success shock from another.

[24]Corbo and Hernández (1994) discuss the policy response to capital inflows.

arrives, the central bank produces a forecast based on this news, the central bank determines the difference between the inflation forecast and the preannounced target, and this difference determines any adjustment of the monetary stance. Prerequisites are:

- **A transparent and accountable policy framework** based on public agreement between the central bank and government on the goal of price stability and transparent implementation of policy to ensure the markets understand the inflation outlook and the consequences of policy actions.

- **A sound inflation forecasting framework** ideally based on reliable economic relationships estimated using a long historical database to inform policy actions.

- **A well-developed financial system** to enhance the information content of market signals for the policymaker and make more transparent the implications of changes in policy instruments for the markets.

- **Flexible labor and goods markets** to prevent relative price changes from spilling over into general price changes, and thus make inflation easier to control.

C. How to Switch: Customizing Nominal Targets for Success Shocks

Customization of a target to fit a country's circumstances can be just as important for success as the choice of the target itself. As noted earlier, recently stabilized countries want a target firm enough to demonstrate credibility, but flexible enough to accommodate success shocks of large magnitude and uncertain duration.

Several countries have sought to maintain this delicate balance by customizing nominal targets for success shocks. Preannounced target paths based on forecasts of a single predominant success shock are the most popular approach. Countries that stabilized with a money rule and need time to establish the starting conditions for a switch to a new target can in the meantime employ a **preannounced money path adjusted upward by available indicators of money demand shifts**, such as signs of financial infusion, as examined in Section IV. For example, the Philippines added estimates of autonomous increases in money demand to target money supply paths following the surge in liquidity growth in the early 1990s.

The disentanglement of temporary from permanent capital inflows is perhaps the most perplexing policy challenge faced by recently stabilized countries. A hybrid targeting approach can be adopted in these circumstances, as did the Philippines in 1994 when confronted with an acceleration in monetary growth largely driven by capital inflows. They responded by **conditioning switches of the nominal anchor on new information**. The starting point was a money anchor founded on a base money path projection. The base money path was adjusted

upward if (i) capital inflows pushed up net foreign assets by more than expected, and (ii) inflation was less than expected. The combination of high capital inflows and low inflation was viewed as the best available signal that unexpectedly high rates of money growth reflected permanent increases in money demand. If these conditions were satisfied, central bank domestic assets became the effective anchor.[26] But if inflation overshot, the impact of unexpectedly high capital inflows on base money was sterilized, based on the premise that high inflation is a signal of slowing money demand, and base money again became the anchor. Under this framework, real growth increased steadily and progress toward price stability continued.

Wide and crawling exchange rate bands are another example of a customized nominal target. Several countries have adopted this approach to maintain external competitiveness, while gaining some flexibility to respond to shocks.[27] These countries stabilized with a fixed exchange rate, but were forced to reconsider because domestic rates of inflation in excess of that of their trading partners began to appreciate the real exchange rate and undermine competitiveness. A preannounced exchange rate band provides the benefits of a clear commitment to a nominal target by directing the attention of markets to its midpoint. At the same time, the band provides room for adjusting the exchange rate to buffer short-run economic shocks. Further, the downward crawl of the band maintains competitiveness.

While the particulars of adjustable nominal targets must fit the circumstances of each post-stabilization country, there is one common attribute that they should all share: **transparency of the adjustment mechanism**. Transparency minimizes the possibility of surprises that cause unnecessary volatility and in the worst case scenario can even threaten stability. This point was made in the context of an adjustable money rule in Section IV.

VI. Conclusion

This paper has addressed the policy challenges posed by financial infusion, or episodes of large, upward, and permanent money demand shifts prompted by stabilization. The review of the international data concludes that the money-to-GDP ratio tends to drop before stabilization, and rise thereafter. Further, money-to-GDP ratio growth rates surge to some 20 percent during two to three years after stabilization, and these surges are not subsequently reversed. This pattern prevails throughout the world (except for Africa) and under different circumstances, and thus should be useful for policymakers coping with post-stabilization

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[26]Inflation evidently prompted by nonmonetary developments, such as a natural disaster or increase in food prices, did not lead to a downward adjustment of monetary growth, and if inflation overshot for a long period, then the baseline money and net domestic asset paths were reevaluated. See Houben (1997).

[27]Helpman and others, 1994 concluded that the adoption of exchange rate bands by Colombia, Israel, and Mexico, which was accompanied by fiscal restraint, did not result in higher inflation; see also the discussion of Poland and Hungary in Begg (1996).

money growth. The case study of the Philippines shows that financial infusion can greatly complicate policy by bringing money demand growth to levels far above that explained by standard macroeconomic indicators.

The rest of the paper addressed the policy response to financial infusion, since it generates increases in money demand large enough to have important macroeconomic consequences, and it is not well understood. Financial infusion is quantified in terms of magnitude and duration, and a few practical approaches to forecasting it are suggested using proxies derived from money demand estimates, the international experience with financial infusion, and direct indicators of stabilization.

Embedding financial infusion in a small open economy model under a money target shows that overlooking or underestimating financial infusion will compress output. Conversely, any attempt to over accommodate will eventually backfire. Even if correctly built into the policy framework, financial infusion amplifies output and price volatility, because the forecast errors inherent to application of a precommitment money rule will be magnified by the observational equivalence of standard money demand shocks and financial infusion. This volatility can be reduced by the transparent introduction of new information into the money rule.

Alternatively, the policymaker can exit to another nominal target. The discussion of the exit strategy from a money to an exchange rate or inflation target emphasizes that recently stabilized countries must face new multiple success shocks (financial infusion, externally-prompted capital inflows, and traded sector productivity growth. armed with limited credibility). Whether to exit depends on how well a new target would absorb the dominant success shock. When to exit depends on the prerequisites for success of the new target. How to exit involves customization of targets to fit the special circumstances of recently stabilized countries; preannouncement of a forward-looking adjustment path is one approach, a second is switching the target based on current information.

The research agenda on financial infusion and nominal targeting for countries entrenching stability is extensive. This paper took the perspective of a policymaker who must recast the policy framework in the face of large upward shifts in money demand, but before there is enough time to understand its structural origins. A better understanding of the structural origins of financial infusion would provide a firmer foundation for the policy response. For example, the relationship between permanent income and money demand could be fleshed out theoretically and examined empirically using forward-looking indicators such as stock market prices. Identifying indicators of stabilization is another important area of research. Finally, more work on the design of nominal targets that condition on current information could help recently stabilized countries maintain the delicate balance between buffering shocks and maintaining credibility.

References

Aghevli, Bijan B., Mohsin S. Khan, and Peter J. Montiel, 1991, *Exchange Rate Policy in Developing Countries: Some Analytical Issues*, IMF Occasional Paper No. 78 (Washington: International Monetary Fund).

Alexander, William E., Tomás J.T. Baliño, and Charles Enoch, 1995, *The Adoption of Indirect Instruments of Monetary Policy*, IMF Occasional Paper No. 126 (Washington: International Monetary Fund).

Arrau, Patricia, and others, 1991, "The Demand for Money in Developing Countries: Assessing the Role of Financial Innovation," IMF Working Paper 91/45 (Washington: International Monetary Fund).

Begg, David K. H., 1996, "Monetary Policy in Central and Eastern Europe: Lessons after Half Decade of Transition," IMF Working Paper 96/108 (Washington: International Monetary Fund).

Bisat, Amer, R. Barry Johnston, and V. Sundararajan, 1992, "Issues in Managing and Sequencing Financial Sector Reforms: Lessons From Experiences in Five Developing Countries," IMF Working Paper 92/82 (Washington: International Monetary Fund).

Bordo, Michael D., and Lars Jonung, 1987, *The Long-run Behavior of the Velocity of Money: the International Evidence* (London: Cambridge University Press).

Corbo, Vittorio, and Leornardo Hernández, 1994, "Macroeconomic Adjustment to Capital Inflows: Latin American Style Versus East Asian Style;" World Bank Policy Research Working Paper No. 1377 (Washington: World Bank).

Debelle, Guy, 1997, "Inflation Targeting in Practice," IMF Working Paper 97/27 (Washington: International Monetary Fund).

De Broeck, Mark, Kornelia Krajnyak, and Henri Lorie, 1997, "Explaining and Forecasting the Velocity of Money in Transition Economies, with Special Reference to the Baltics, Russia, and Other Countries of the Former Soviet Union," IMF Working Paper 97/108 (Washington: International Monetary Fund).

DeGroot, Morris H., 1975, *Probability and Statistics* (Reading, Mass.: Addison-Wesley).

Dodsworth, John, R., and others, 1996, "Macroeconomic Experiences of the Transition Economies in Indochina," IMF Working Paper 96/112 (Washington: International Monetary Fund).

Easterly, William, 1996, "When is Stabilization Expansionary? Evidence from High Inflation," *Economic Policy,* Vol. 22, pp. 65–108.

Engle, Robert F., and C.W.J. Granger, 1987, "Cointegration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, Vol. 55, No. 2, pp. 251–76.

Feinman, Joshua N., and Richard D. Porter, 1992, "The Continuing Weakness in M2," Finance and Economics Discussion Series (U.S.); No. 209:1-[66], Board of Governors of the Federal Reserve System, Division of Research and Statistics.

Fischer, Stanley, 1986, "Exchange Rates Versus Money Targets in Disinflation," in *Indexing, Inflation and Economic Policy*, ed. by Stanley Fischer (Cambridge, Massachusets; and London: The MIT Press).

———, Ratna Sahay, and Carlos A. Végh, 1996, "Stabilization and Growth in Transition Economies: The Early Experience," *Journal of Economic Perspectives* (U.S.) Vol.10, pp. 45–66 (Spring).

Folkerts-Landau, and others, 1995, "Effects of Capital Inflows on the Domestic Financial Sectors in APEC Developing Countries," in *Capital Flows in the APEC Region*, ed. by Mohsin S. Khan and Carmen Reinhart, IMF Occasional Paper No. 122 (March) (Washington: International Monetary Fund).

Ghosh, Atish R., 1997, "Inflation in Transition Economies: How Much? And Why?," IMF Working Paper 97/80 (Washington: International Monetary Fund).

Goldfield, Stephen M., and Daniel E. Sichel, 1990, "The Demand for Money," in *Handbook of Monetary Economics*, Vol. 1 (North Holland).

Haque, Nadeem Ul , Donald Mathieson, and Sunil Sharma, 1997, "Causes of Capital Inflows and Policy Responses to Them," *Finance and Development*, Vol. 34, pp. 3–6 (Washington: International Monetary Fund and the World Bank).

Helpman, E. L., L. Leiderman, and G. Buffman, 1994, "A New Breed of Exchange Rate Bands: Chile, Israel, and Mexico," *Economic Policy: A European Forum (U.K.)*, Vol. 9, (October) pp. 260-306.

Houben, Aerdt, 1997, "Exchange Rate Policy and Monetary Strategy Options in the Philippines - The Search for Stability and Sustainability," Papers on Policy Analysis and Assessments No. 97/4 (Washington: International Monetary Fund).

Johansen, Soren, 1988, "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control (Netherlands)*, Vol. 12, pp. 231–54.

Judd, John P., and John L. Scadding, 1982, "Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature," *Journal of Economic Literature*, Vol. 20, pp. 993–1023 (September).

Khan, Mohsin S., and V. Sundararajan, 1991, "Financial Sector Reforms and Monetary Policy," IMF Working Paper 91/127 (Washington: International Monetary Fund).

Koenig, Linda M., 1996, "Capital Inflows and Policy Responses in the ASEAN Region," IMF Working Paper 96/25 (Washington: International Monetary Fund).

Leiderman, Leonardo, and Lars E. O. Svensson, eds., 1995, *Inflation Targets* (London: Centre for Economic Policy Research).

Masson, Paul R., Miguel A. Savastano, and Sunil Sharma, 1997, "The Scope for Inflation Targeting in Developing Countries," IMF Working Paper 97/130 (Washington: International Monetary Fund).

McCallum, Bennett T., 1994, "Monetary Policy Rules and Financial Stability," National Bureau of Economic Research Working Paper (U.S.); No. 4692 (April) pp. 1–43.

———, 1997, "Issues in the Design of Monetary Policy Rules," National Bureau of Economic Research Working Paper Series (U.S.); No. 6016 (April) pp. 1–71.

Sargent, Thomas J., 1982, "Stopping Moderate Inflations: The Methods of Poincaré and Thatcher," in *Inflation, Debt, and Indexation*, ed. by Rudiger Dornbusch and Mario Henrique Simonsen (Cambridge, Massachusets: The MIT Press).

———, and Neil Wallace, 1975, "Rational Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule," *Journal of Political Economy*, Vol. 83, pp. 241–254.

Schwartz, Gerd, Mark R. Stone, and Tessa van der Willigen, 1994, "Beyond Stabilization: The Economic Transformation of Czechoslovakia, Hungary, and Poland," *Communist Economies & Economic Transformation*, Vol. 6, No. 3.

Tseng, Wanda, and Corker Robert, 1991, *Financial Liberalization, Money Demand, and Monetary Policy in Asian Countries*, IMF Occasional Paper, No. 84 (Washington: International Monetary Fund).

Turnovsky, Stephen J., 1987, "Supply Shocks and Optimal Monetary Policy," *Oxford Economic Papers*, Vol. 39, pp. 20–37.

DATA DOCUMENTATION

This appendix documents the international data set used in Section II. For all nontransition countries, money is broadly defined to include currency outside banks, and demand, time, and savings deposits of resident sectors; central government and foreign exchange deposits are not included. The denominator is nominal GDP or GNP. Monetary data are annual averages of the highest frequency data available, except for individual observations for Argentina (1994); Dominican Republic (1995); Ecuador (1995); and Jamaica (1994), which are averages for the current and preceding year; and Turkey (1976–85), which are based on monthly averages of broad money. Owing to the unavailability of data, the endpoints for the country growth series are the closest years to 1976 and 1995. The data are IFS series 39adi reported in pages 90–92 of the *IFS* 1996 yearbook, except for Recent Economic Development reports for Turkey.

For transition countries, real money is the ratio of end-year broad money, excluding foreign exchange deposits, to the CPI. Most CPI data are from *IFS*, while most broad money data are from IMF Recent Economic Development reports.

Table I.1. Annual Money-to-GDP Growth: Western Hemisphere and Turkey 1/

Stabilization Time	Argentina 1989	Bolivia 1985	Costa Rica 1982	Dominican Republic 1990	Ecuador 1992	Mexico 1987	Nicaragua 1990	Peru 1990	Uruguay 1979	Jamaica 1991	Turkey 1980	Median
-4	17.4	0.9	10.6	37.6	-5.5	-12.8	-11.2	-4.1	-2.2	2.5	0.0	0.0
-3	23.8	-7.7	13.0	13.3	-17.3	4.5	2.2	-10.8	19.3	0.2	-3.1	2.2
-2	-0.1	-24.3	2.0	-12.7	-11.7	-8.8	2.3	-37.8	12.5	0.3	-10.4	-8.8
-1	-6.4	-55.5	9.9	13.5	6.2	-5.7	5.8	-10.5	13.8	-12.3	-9.8	-5.7
0	-16.2	-40.7	-15.9	-6.7	-5.0	-7.6	-51.2	-18.4	8.4	-8.2	-21.8	-15.9
1	-45.1	103.0	9.9	-18.8	14.5	-12.8	73.9	26.1	1.2	7.5	16.7	9.9
2	33.8	83.1	-5.2	19.4	20.3	-31.0	44.1	44.4	21.7	10.4	28.5	21.7
3	42.5	7.6	-2.4	20.1	13.1	50.6	-0.9	27.0	25.2	3.7	19.6	19.6
4	33.1	1.2	-4.6	1.7		36.6	24.7	8.9	7.2		-2.0	7.2
5	18.3	38.0	1.9	-3.5		14.1	28.6	7.7	-2.0		0.1	7.7
6		23.1	0.5			9.7			2.6		-8.0	2.6
7		20.3	6.4			6.4			1.6		-7.5	6.4
	Fixed	Flex.	Flex.	Flex.	Fixed	Fixed	Fixed	Flex.	Fixed	Flex.	Flex.	

Sources: *IFS* and IMF Recent Economic Development reports.

1/ "Year zero" in stabilization time is shown below country heading, and stabilization exchange rate regime, from Easterly (1996), is shown in the bottom row.

Table I.2. Annual Money-to-GDP Growth: Africa 1/

Stabilization Time	Ghana 1983	Guinea-Bissau 1992	Nigeria 1988	Sierra Leone 1991	Uganda 1980	Uganda 1987	Zaire 1983	Median	N
-4	-2.7	-6.2	1.8	-28.9	8.4	-18.1	-25.4	-6.2	7
-3	-10.6	-34.5	-2.8	-5.0	-31.9	17.5	-64.9	-10.6	7
-2	-19.5	9.7	4.9	-1.8	-7.3	-16.9	6.9	-1.8	7
-1	11.7	-5.3	-27.7	-2.0	-10.9	6.2	9.1	-2.0	7
0	-31.1	-5.2	-0.4	-11.8	3.1	-26.2	100.1	-5.2	7
1	-9.3	4.1	-20.8	-9.8	-16.4	-19.8	-65.0	-16.4	7
2	13.4		5.1	-9.6	-7.1	-0.1	6.8	2.5	6
3	2.0		14.9	-2.7	-18.1	22.4	1.6	1.8	6
4	7.5		-13.6	-12.4	17.5	11.5	2.3	4.9	6
5	2.3				-16.9	-2.1	3.4	0.1	5
6	16.6				6.2	38.9	-0.8	11.4	5
7	-11.0					5.1	-0.6	-0.6	4

Sources: *IFS* and IMF Recent Economic Development reports.

1/ "Year zero" in stabilization time is shown below country heading, and stabilization exchange rate regime, from Easterly (1996), is shown in the bottom row.

Table I.3. Transition Countries—Real Broad Money Growth 1/

Stabilization Time	Albania	Croatia	Czech Republic	Poland	Slovak Republic	Slovenia	Cambodia	Lao P.D.R.	Vietnam	Median	N
0	1992	1993	1991	1989	1991	1991	1993	1989	1989		
-1		-41.1		-12.3						-26.7	2
1	39.5	80.1	7.4	24.1		28.1	11.8			26.1	6
2	23.5	15.8	-2.5	2.6		29.1	39.1	2.6		15.8	7
0		-3.2		-51.2						-27.2	2
3	43.2		11.6	6.7	4.9	38.4	16.2	28.1	34.9	22.1	8
4			12.6	-6.5	15.6	25.8		72.4	24.9	20.3	6
5				7.1				18.1	16.1	16.1	3
6				23.3				-9.2	10.4	10.4	3
	Flex.	Fixed	Fixed	Fixed	Fixed	Flex.	Flex.	Flex.	Flex.	10.4	

Sources: *IFS* and IMF Recent Economic Development reports.

1/ "Year zero" in stabilization time is shown below country heading, and stabilization exchange rate regime, from Fischer and others (1996) and Dodsworth and others (1996), is shown in the bottom row.

THE FINANCIAL INFUSION FUNCTION

This appendix derives the functional form for expected financial infusion and a transformation of it used in the solution of the macromodel. Derived first is the formula for the **expectation of f in future** periods, $f^*_{t+j,t}$ (equation III.A.5 in the text). The value of f next period expected today is the sum of known f_t and the expected increase in financial infusion in t+1. The latter is either $\eta^*_{t+1,t}$ if financial infusion continues in t+1, which has probability $\Pr(D \geq 1)$, or zero if t is the last period of financial infusion, which has probability $\Pr(D=0)$

$$(A.II.1) \qquad f^*_{t+1,t} = f_t + \Pr(D \geq 1)\eta^*_{t+1,t} + \Pr(D=0)0 = f_t + e^{-1/\bar{D}}\eta^*_{t+1,t}.$$

Expected financial infusion two periods hence is $f^*_{t+1,t}$ plus either $\eta^*_{t+2,t}$ multiplied by the probability that financial infusion continues in t+2, or zero if financial infusion terminates in t+1, with both probabilities conditioned on financial infusion persisting during t+1 and beyond

$$(A.II.2) \qquad f^*_{t+2,t} = f^*_{t+1,t}$$

$$+ \Pr(D \geq 2 | D \geq 1)\Pr(D \geq 1)\eta^*_{t+2,t} + [1-\Pr(D \geq 2|D \geq 1)]\Pr(D \geq 1)0.$$

By the laws of conditional probability and the probability density function of the exponential distribution,

$$(A.II.3) \qquad \Pr(D \geq 2 | D \geq 1)\Pr(D \geq 1) = [\Pr(D \geq 2)/\Pr(D \geq 1)]\Pr(D \geq 1)$$

$$= \Pr(D \geq 2) = e^{-2/\bar{D}},$$

so (A.II.2) can be rewritten

$$(A.II.4) \qquad f^*_{t+2,t} = f^*_{t+1,t} + e^{-2/\bar{D}}\eta^*_{t+2,t} = f_t + e^{-1/\bar{D}}\eta^*_{t+1,t} + e^{-2/\bar{D}}\eta^*_{t+2,t}.$$

In general,

$$(A.II.5) \qquad f^*_{t+j,t} = f_t + \sum_{s=1}^{j} \Pr(D \geq t+s)\eta^*_{t+s,t} = f_t + \sum_{s=1}^{j} e^{-s/\bar{D}}\eta^*_{t+s,t}.$$

Next, the **update from t-1 to t of expected f** is derived for the rational expectation macromodel solution in Section IV. First, the expectation of f for period t formed in t-1 is obtained by relabelling (A.II.1),

$$(A.II.6) \qquad f^*_{t,t-1} = f_{t-1} + e^{-1/\bar{D}}\eta^*_{t,t-1}$$

and similarly for period t+1

$$(A.II.7) \qquad f^*_{t+1,t-1} = f^*_{t,t-1} + e^{-2/\bar{D}}\eta^*_{t+1,t-1} = f_{t-1} + e^{-1/\bar{D}}\eta^*_{t,t-1} + e^{-2/\bar{D}}\eta^*_{t+1,t-1}$$

The update from t-1 to t of expected f in t+1 is A.II.1 less A.II.7,

$$(A.II.8) \qquad f^{*}_{t+1,t} - f^{*}_{t+1,t-1} = (\eta_t - e^{-1/\bar{D}}\eta^{*}_{t,t-1}) + (e^{-1/\bar{D}}\eta^{*}_{t+1,t} - e^{-2/\bar{D}}\eta^{*}_{t+1,t-1}).$$

The first parenthesized term is the difference between the actual and expected increase in money demand in t from financial infusion, and the second difference is the update to the expected increase in money demand in t+1. In general, using the first difference of expectations operator

$$(A.II.9) \qquad \Delta^{*} f^{*}_{t+j,t} = f^{*}_{t+j,t} - f^{*}_{t+j,t-1} = \eta_t - e^{-1/\bar{D}}\eta^{*}_{t,t-1}$$

$$+ \sum_{s=1}^{j} (e^{-s/\bar{D}}\eta^{*}_{t+s,t} - e^{-(s+1)/\bar{D}}\eta^{*}_{t+s,t-1})$$

Finally, what is needed for the macro model solution (appendix equation A.III.12) is

$$(A.II.10) \qquad \Delta^{*} f^{*}_{t+j+1,t-1} = \eta_{t-1} - e^{-1/\bar{D}}\eta^{*}_{t-1,t-2} + \sum_{s=0}^{j+1}(e^{-s/\bar{D}}\eta^{*}_{t+s,t-1} - e^{-(s+1)/\bar{D}}\eta^{*}_{t+s,t-2}).$$

SOLUTION OF THE MACROMODEL

This appendix derives the solution of the rational expectations model presented in Section IV. The model equations are:

(A.III.1) $r_t = rw + p^*_{t+1,t} - p_t$.

(A.III.2) $m_t - p_t = a_0 + a_1 y_t - a_2 r_t + w_t + f_t$

(A.III.3) $y_t = \pi_0 + \pi_1(p_t - p^*_{t,t-1})$ [28]

(A.III.4) $m_t = z_o + \lambda f^*_{t,t-1}$

where $z_o = a_1\pi_0 + a_o - a_2 rw$. Defining the random variable z will ease exposition:

(A.III.5) $z_t = z_o + w_t + f_t$

(A.III.6) $z^*_{t+j,t} = z_o + f^*_{t+j,t}$.

The model is a standard rational expectations setup with familiar solution procedures (Sargent and Wallace, 1975; and Turnovsky, 1987). First, the forward-looking price expectation dynamics are derived. A first order difference equation in p^* is obtained by taking conditional expectations of (A.III.1)-(A.III.4) for period t+j from the perspective of time t, and eliminating $y^*_{t+j,t}$ and $r^*_{t+j,t}$

(A.III.7) $p^*_{t+j,t} = [1/(1 + a_2)](m^*_{t+j,t} - z^*_{t+j,t}) + [a_2/(1 + a_2)]p^*_{t+j+1,t}$.

The solution is:

(A.III.8) $p^*_{t+j,t} = [1/(1 + a_2)]\sum_{k=0}^{\infty} [a_2/(1 + a_2)]^k (m^*_{t+j+k,t} - z^*_{t+j+k,t})$.

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[28]The aggregate supply equation is shorthand for

$$y_t = \frac{(1 - \theta)n\ln(1 - \theta)}{1 + n\theta} + \frac{(1 - \theta)(1 - \tau)}{\theta}(p_t - p^*_{t,t-1})$$

where n is the elasticity of labor supply with respect to wages, $(1-\theta)$ is the exponent of labor in the underlying Cobb-Douglas production function, and τ is the rate of wage indexation (Turnovsky, 1987). This relationship is based on the following wage indexation scheme:

$$w_t = w^c_{t,t-1} + \tau(p_t - p^*_{t,t-1})$$

where w^c is the contract wage. With no wage indexation, τ is zero, nominal wages are fixed, and aggregate supply is highly responsive to price surprises. Under the other extreme assumption of full wage indexation, τ is unity, real wages are fixed, and aggregate supply is independent of price developments and monetary policy.

Price expectations reflect the present and future influences of expected money supply and z^*_t, which is a function of expected financial infusion.

Next, the reduced form y_t equation is derived. Begin by going back to (A.III.1)-(A.III.4) and eliminating r_t and p_t

$$(A.III.9) \quad y_t = [1/(1 + a_2 + \pi_1 a_1)]\{(1 + a_2)\pi_0 + \pi_1 [m_t - a_o + a_2 rw - w_t - f_t + a_2 p^*_{t+1,t} - (1 + a_2)p^*_{t,t-1}]\}$$

To eliminate $p^*_{t,t-1}$, replace j in A.III.7 with zero, take expectations from the perspective of t-1, substitute into A.II.9, and rearrange

$$(A.III.10) \quad y_t = \Gamma\{(1 + a_2)\pi_0/\pi_1 + m_t - a_o + a_2 rw - w_t - f_t - (m^*_{t,t-1} - z^*_{t,t-1}) + a_2 (p^*_{t+1,t} - p^*_{t+1,t-1}) \}$$

where $\Gamma = \pi_1/(1 + a_2 + \pi_1 a_1)$. Eliminate the update of price expectations by using A.III.8 to get

$$(A.III.11) \quad a_2 (p^*_{t+1,t} - p^*_{t+1,t-1}) = \sum_{j=1}^{\infty} [a_2 /(1 + a_2)]^j (\Delta^* m^*_{t+j,t} - \Delta^* z^*_{t+j,t})$$

Finally, the y_t reduced form is derived by substituting A.III.11 into A.III.10 and replacing the m_t, and the m^*s and z^*s

$$(A.III.12) \quad y_t = \overline{y} - \Gamma\{w_t + f_t - \lambda f^*_{t,t-1} - (1 - \lambda)f^*_{t,t-2} + (1 - \lambda)\sum_{j=1}^{\infty} \delta^j \Delta^* f^*_{t+j,t-1}\}$$

where $\overline{y} = (1 + a_2)\pi_0/(1 + a_2 + \pi_1 a_1) + a_1\pi_0$ and $\delta = a_2/(1 + a_2)$.

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Table 3. Real Money Growth for Transition Countries that Successfully Stabilized

"Stabilization Time"	Median Growth	Number of Countries
-1	-26.7	2
0	-27.2	2
1	26.1	6
2	15.8	7
3	22.1	8
4	20.3	6
5	16.1	3
6	10.4	3

Source: Appendix I.

and permanent increases in money demand, in accordance with the notion of financial infusion. This pattern prevails throughout the world and under different circumstances, and thus should be useful for policymakers coping with post-stabilization money growth.[10]

D. A Case Study: The Philippines

The policymaker can be expected to face the challenge of having to choose whether or not to accommodate large increases in money growth after rapid stabilization from high rates of inflation. Slower stabilization from medium (10 to 25 percent) rates of inflation may pose an even greater challenge because in these circumstances financial infusion is less conspicuous, and thus harder to identify, but is still important enough to shape macroeconomic policy. The experience of the Philippines during the 1990s serves as a case study of what financial infusion looks like when stabilization is slower and less dramatic.

Stabilization for the Philippines was preceded by a difficult decade (Table 4). The externally financed growth of the 1960s and 1970s was brought to an end by the emergence of debt-servicing difficulties, culminating in 1983 with the drying up of external financing. At the same time, the economy was buffeted by political instability and financial policy gyrations. A more stable political environment and the advent of a comprehensive structural reform

[10]Ghosh (1997) finds that high inflation is strongly associated with negative changes in real money growth, while low inflation is weakly associated with positive changes. The pattern of money demand reported here suggests the possibility that a variation of this general pattern applies to recently stabilized countries: a high **level** of inflation greatly reduces money demand, while a sharp **reduction** in inflation greatly increases money demand.

B. When to Switch: Prerequisites for a New Target

A quick exit away from a money target to dampen output volatility can beget new risks, including even a slide back to instability, if there has not been enough time to establish the extra credibility needed for an exchange rate or inflation target. A successful switch thus requires careful consideration of the prerequisites for the new target.

Important prerequisites for exchange rate and inflation targets are:

- **Broad social and political support** of the new target to resist pressure from those interest groups that perceive they are losing under the new regime (Sargent, 1982).

- A **strong fiscal position** to counter the overheating problems created by an acceleration of capital inflows, offset the fiscal costs of sterilizing the impact of inflows on liquidity, and enhance the credibility of monetary policy (Koenig, 1996).

- A **healthy and properly supervised and regulated domestic financial system** to preserve the integrity of the financial system, especially if banks are not equipped to assess and manage risk owing to a history of state ownership or strong government influence (Folkerts-Landau and others, 1995).

- **The use of indirect instruments of monetary policy** to ease the switch away from a money target by facilitating sterilization and providing for the sophisticated monetary management needed for inflation targeting (Alexander and others, 1995 and Begg, 1996).

Successful exchange rate targeting, in addition to the above conditions, requires:

- **Comfortable reserve coverage** to serve as ammunition in the event the exchange rate comes under speculative attack.

- **Flexible goods and labor markets** to shift the absorption of real exchange rate shocks to wages and prices.

The starting conditions for inflation targeting are the toughest because the lag between policy actions and inflation make it difficult for the markets to confirm that the policymaker is respecting the target.[25] Operationally, inflation targeting works as follows: news on inflation

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[25]Debelle (1997) and Leiderman and Svensson (1995) summarize the experience of countries that have adopted inflation targeting, and Masson and others (1997) assess the scope for inflation targeting in developing countries.