An Identity Crisis?

Examining IMF Financial Programming

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Abstract: The IMF uses its well-known "financial programming" model to derive monetary and fiscal programs to achieve desired macroeconomic targets in countries undergoing crises or receiving debt relief. This paper considers under what conditions financial programming would work best, and then tests those conditions in the data. The key restrictions of financial programming are assumptions about exogeneity of some components of identities with respect to others, and the assumption of stable and "reasonable" parameters for some very simple behavioral relationships. In at least the literal applications of the framework, financial programming does not do well in forecasting the target variables, even when some components of the identity are known with certainty.

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One of the most widely used applied models in macroeconomics is the financial programming (FP) model of the International Monetary Fund. The IMF utilizes the monetary, balance of payments, and fiscal identities in its design of macroeconomic programs for developing countries with goals for inflation and foreign exchange reserve accumulation, and secondarily for calculating debt relief requirements and import requirements for growth. As Barth et al. (2000) write in the official training manual for IMF financial programming, the accounting framework "is helpful in policy simulations and in analyzing the ramifications of policy options" (p. 210).[1] Likewise, Blejer et al. (2001, p.5) note "quantitative macroeconomic performance criteria in Fund programs do not typically rely on a specific macroeconomic model. They do, however, make use of various balance-sheet identities that link monetary and fiscal variables with the balance of payments, to ensure that the Fund program is internally consistent."[2] Mussa and Savastano 1999 note that a "blueprint" that contains "a preliminary assessment of the proximate and underlying sources of the aggregate imbalances" is based on "a simple flow-of-funds accounting framework of key macroeconomic relationships."Iteratively applied, Mussa and Savastano 1999 say, this blueprint "enables the staff and the authorities to assess in simple quantitative terms the interactions between the policy measures agreed and the main targets of the adjustment programs." Mussa and Savastano say the policy measures "on which almost all IMF programs focus are the public sector deficit and the creation of domestic credit by the central bank."

Of course, all macroeconomic models contain identities, and it makes no sense to "test" identities as they have to hold by definition. However, there are many different ways to use identities, and a particular use of identities may impose restrictions that are rejected by the data. How does FP use identities?

The simple version of FP would recognize three types of variables in accounting identities. First, one of the elements in it is a target variable, which will absorb movements in the other components of the identity. The paper will call this the endogenous variable. Second, there is another element upon which the IMF is acting through its conditions or its own actions, such as net domestic credit or loan disbursements. The paper will call this the policy variable. The policy variable is assumed to be exogenous with respect to the target variable. Third, there are other elements in the identity that are projected exogenously or with econometric equations. The paper will call these the exogenous variables. The definition of exogeneity does not rule out their being affected by many other economic variables; typically these responses are taken into account in the projection. The exogeneity is with respect to the policy variable – they are assumed not to respond to changes in the policy variable (nor do they affect the policy variable). In other words, changes in the policy variable will affect the endogenous variable (the residual in the identity) but not the exogenous variables (the other variables in the identity). The key is that the exogenous variable is projected independently of the policy variable, based on the assumption that they are orthogonal to each other.

The exogeneity restriction is the first potential problem of FP. The paper will test this exogeneity restriction by assuming that the financial programmer knows the actual value of the policy variable next period, but projects the exogenous variable independently (in this paper, as a random walk). The paper will compare this forecast to the naïve forecast of the endogenous variable as a random walk, and see how much FP helped when one of the variables was known with certainty. The forecast tests are not intended to evaluate FP as a method for predicting macroeconomic variables (which is not its purpose), but only to check the exogeneity restriction.

Assuming the orthogonality of the exogenous variable with respect to the policy variable to be the null hypothesis, this will allow us to estimate an unbiased coefficient when we regress the endogenous variable on the policy variable with ordinary least squares. The effect of the exogenous variables on the endogenous variable will be captured by the constant term and the error term (orthogonal to the policy variable because of the exogeneity restriction). The implication of this use of identities is to assume a one for one effect of the policy variable on the endogenous variable. This paper will test this implication.

The endogenous variable is typically of concern because it affects some economic outcome of concern. For example, if money is the endogenous variable, it affects inflation. If the quantity of imports is the endogenous variable, it affects growth. Usually the relationship between the economic outcome and the endogenous variable is checked by seeing whether a behavioral parameter, such as the elasticity of imports with respect to GDP or the velocity of money, falls within a reasonable range. The reliance on such a simple behavioral relationship between the endogenous variable and economic outcomes is the second potential problem with FP. This paper will examine just how reasonable these behavioral relationships are in practice. This paper will also ask how stable and economically meaningful are the behavioral parameters—such as the import elasticity with respect to income and the velocity of money -- and how accurate are forecasts based on these parameters.

A third possible problem is with measurement. Although the identities hold by definition, imperfect data coming from different sources and classification problems often imply a balancing item such as "other items, net" to make the sum of the policy variable and the exogenous variable equal the endogenous variable. Since there is even less knowledge and theory about the behavior of this balancing item, this also makes FP more problematic. The paper will examine how large these balancing items are in practice.

The paper is not necessarily testing how the IMF applies financial programming in practice, since that involves many subjective judgments by IMF staff that this paper cannot model or test. IMF practitioners suggest that the application of financial programming is considerably less mechanical than the above description would indicate. IMF staff are very aware of the complex relationships among macroeconomic variables and the endogeneity of many of the key variables. They suggest that financial programming is mainly useful as a consistency check of assumptions made for different sectors: balance of payments, fiscal accounts, and monetary balance sheets. Moreover, the program is usually arrived at iteratively as parameters change. Waivers of program conditions are frequently granted when variables do not evolve as expected.

Another important clarification is that this paper does not test the effectiveness of IMF conditionality, a subject on which there is already an abundant literature.[3] The paper does not test whether the conditions themselves are met, nor does it test the effect of IMF programs on development outcomes in general; instead it tests whether an endogenous variable responds as predicted to variation in the policy variable subject to conditionality (regardless of whether the condition is met on that policy variable).

The paper is instead stating the conditions under which FP would perform best, and then seeing how far is the data from those conditions. The results could be thought of as a guide to the limits of the most mechanical and simple uses of financial programming, as set out in published documents, making clear how much judgment will be necessary to make it workable.

These issues have not escaped the attention of previous researchers. Killick 1995 criticizes financial programming on the grounds of unstable parameters and the endogeneity of other items in the identities besides the policy and target variables. Edwards as long ago as 1989 noted that financial programming

> "has failed to formally incorporate issues related to the inter-temporal nature of the current account, the role of risk and self-insurance in portfolio choices, the role of time consistency and precommitments in economic policy, the economics of contracts and reputation, the economics of equilibrium real exchange rates … and the theory of speculative attacks and devaluation crises, just to mention a few of the more important recent developments in international macroeconomics."

Presumably this list of omissions has grown even larger after another 15 years of research in international macroeconomics. Indeed one curious thing about financial programming is how unchanged it has remained over the years despite the large changes in macroeconomic theory and empirics.

1. THE IDENTITIES

This section will give a simplified account of the identities used in financial programming by the IMF (the World Bank uses essentially the same identities in its model for evaluating debt sustainability, the so-called RMSM-X model). The most important identity in financial programming is the monetary identity. As Barth et al. (2000, p. 152) put "change in the size of the money stock is one of the main policy instruments by which the authorities influence macroeconomic developments." The following identity that determines the money supply:

(1) $\Delta DC + E\Delta R^{*} = \Delta M$

where DC is net domestic credit, R^{*} is net foreign assets in dollars, E is the exchange rate, and M is liquid liabilities or the money supply.[4] This identity could apply to the central bank, in which case M is high-powered money, or it could apply to the entire banking or financial system, in which case M is broad money. Note that the revaluation of net foreign assets induced by changes in E should be excluded from the definition of ΔM, as the paper will do below. The IMF typically seeks to control money growth by placing a ceiling on DC as a condition for doing a program with a client country. As the IMF's program in Angola says: "It will use a monetary anchor to achieve the inflation target ... The program's ceiling on net domestic assets (NDA) of the banking system ... is the operative intermediate target for monetary control" (IMF 2001c).

Sometimes ΔR^{*} becomes the residual variable in this equation. The excess of domestic credit creation over money growth determines the loss of foreign exchange reserves (the so-called "monetary approach to the balance of payments" -- see IMF (1977), IMF(1987) and Agenor and Montiel 1999, p. 524). Indeed, this was the original formulation of financial programming as laid out in Polak (1998). This approach presumes a fixed exchange rate and full capital mobility, as was appropriate in the 50s and 60s. The paper will test whether this makes a difference later by separating out the countries with capital controls.

However, in more common usage net foreign assets are usually at such a low level when a country initiates a program that they are assumed not to be able to decline further. Alternatively, exchange rates are sufficiently flexible to minimize changes in R in response to monetary policy changes. Perhaps most commonly over the 1960-99 period in developing countries, capital controls prevent reserve changes in response to monetary movements. Under these circumstances, the IMF program will generally build an exogenous change in reserves into the program. Then M becomes the endogenous variable, DC is the policy variable, and R is the exogenous variable. The economic prediction is that there will be a one for one effect of ΔDC on ΔM.[5]

As with the other identities, the identity is often solved backwards. That is, the desirable level of the endogenous variable is derived from, say, inflation and growth targets, and then the identity is solved for the policy variable that will yield this value of the endogenous variable. As the IMF Manual on Financial Programming (Barth et. al. 2000, p. 388) states, domestic credit "is derived as a residual by subtracting the forecast of the change in net foreign assets and other items net from the projected value of broad money."

The target for broad money is derived from the famous monetarist identity:

(2) $MV=PQ$

Where M is the same money supply as before, V is a behavioral parameter called “velocity”, P is the price level, and Q is real output. V is defined by (2) so (2) holds tautologically. It is turned into a behavioral model when V is assumed to be exogenous and stable.

In log first differences, we can then solve for inflation as follows:

(3) $\Delta \ln P=\Delta \ln V + \Delta \ln M - \Delta \ln Q$

If (3) is converted from an identity into a behavioral relationship by assuming that velocity is unchanged (or sometimes, changes by an exogenous amount), then inflation will have a unitary elasticity with respect to “excess money supply growth”, i.e. the excess of nominal money supply growth over real output growth. Sometimes, IMF use more sophisticated behavioral equations for money demand. Velocity is still generally calculated as a consistency check even in these cases, however, and other times is the sole basis of prediction. For example, the IMF's latest manual on financial programming states "if V can be predicted with confidence, then the policymaker can aim at a level of the money supply that is consistent with the desired real growth rate and inflation rate." (Barth et al. 2000, p. 179) More commonly as in the IMF's Ethiopia program, "The monetary program assumes that velocity remains stable" (IMF 2001d). The paper will evaluate this predictability and stability below.[6]

Like the other identities, the monetary identity does not exactly hold in the data. There is an "other items, net" entry in the monetary survey, which is just the difference between measured assets and liabilities of the monetary system. In the Turkey example of Barth et al. (2000), the change in "other items, net" was equal to 25 percent of the change in domestic credit in 1994. In pooled annual data for all countries over 1960-99 in the Monetary Survey in the IMF's International Financial Statistics, the median ratio of the absolute change in other items net to the absolute change in domestic credit is 24%.

Another data problem with the identities is that there are often alternative estimates of the same concept. The IMF is not internally consistent, with different estimates for the same concept from its statistical publication the International Financial Statistics (IFS) and from the country desk who prepare the country reports that guide IMF programs. Table 1 displays a randomly assembled sample of the most recent country reports which reflected active IMF programs, as shown on the IMF web site in February 2004, and compared their data to that available in IFS at the same time. Table 1 shows very distinct estimates in some countries for net international reserves in the monetary survey, a key IMF program variable.

{Table 1 here}

The second basic identity used in financial programming is the basic balance of payments identity:

(4) $T^* - X^* + rL^* = F^* - \Delta R^*$

An * denotes a quantity in constant dollars, T is imports of goods and services, X is exports, L^* is net foreign debt, r is the interest rate of foreign debt, F^* is net capital inflows to the private and government sectors (including IFIs' own loans), and R is international reserves (the same R as in the monetary identity above, except in constant dollars). In the typical application of this identity to analyze the consistency of the program, imports T^* is the endogenous variable, F^* is the policy variable, X^* is exogenously projected and ΔR^* is exogenously set as a target. The policy variable F^* is set according to what the programmer deems to be a sustainable level of external debt, and then imports is derived as a residual. For example, one of the first statements of IMF financial programming (IMF 1987, p. 15) had the following procedure to determine imports. First, set a target for the change in reserves, and project those items of the balance of payments for items "that are considered to be exogenously determined, that is exports of goods and services and net nonbank capital flows." Second, "the target value of imports can be derived as a residual from the balance of payments identity." This value of imports is then to be checked against a benchmark import forecast by assuming a constant income elasticity (which the paper will discuss below).

This residual determination of T* is sometimes justified by assuming that an exogenous amount of external financing is available, which thus determines the T*-X* balance, which in turn is equivalent to excess of domestic demand over income. For example, Mussa and Savastano 1999 say that “the availability of external financing”, which is “largely predetermined” will determine “the magnitude and pace of the necessary adjustment effort.” With exports determined exogenously by world demand factors, imports becomes the adjusting variable. In practice, import demand (and total domestic demand) would be dampened by fiscal and monetary austerity, which of course form the foundation of IMF adjustment programs.

If imports are a residual in the balance of payments identity (in other words, if the exogeneity restriction between capital flows and exports holds), then a marginal additional dollar of F^* will translate one for one into an additional dollar of imports. Knowing the actual data on F^* should help forecast imports. The paper will test these predictions below.

The IMF derives a behavioral relationship that links the import outcome to a growth outcome by assuming a constant and stable import elasticity of GDP. Thus, “import requirements” for a given growth rate of output are given as follows:

(5) $\Delta \ln T^* = e\, \Delta \ln Q$

where e is the import elasticity.   For logical reasons, e should be assumed to be around unity, otherwise the import to GDP ratio will explode or collapse. We can invert (5) to get the predicted growth rate ($g = \Delta \ln Q$) for a given amount of imports:

(6) $g = 1/e\ \Delta \ln T^*$

So taken together, availability of external financing determines import availability, which in turn determines growth. For example, an IMF program in the year 2000 in Pakistan stated in the staff report for the stand-by arrangement "shortfalls in external financing could constrain imports and affect growth performance." The HIPC document on Benin noted that an adverse external shock could lead to a "a slowdown in import growth, which would be associated with lower GDP growth" (IMF and IDA 2000e). The paper will test the usefulness of relationship (6) below.

The balance of payments identity (4) is sometimes used to derive the "financing gap" in F_g^*. Exports are projected exogenously, imports are projected on the basis of (5), the change in reserves is an exogenous target as before, and then F_g^* becomes the residual. Some components of F_g^* are usuallly projected exogenously, like already identified commercial bank loans and official lending to the government, and then the residual becomes the "financing gap." This is equivalent to the backwards solution of the policy variable (F_g^*) for desired levels of the endogenous variable (T_g^*). As Barth et al. (2000, p. 341) put it, "the incipient overall deficit may exceed the country's international reserves, resulting in a hypothetical *financing gap*." Or as Mussa and Savastano 1999 put it, “financial support from the Fund, of course, can help reduce the country’s financing gap for a temporary period.” Otherwise, the financing gap will have to be closed through some combination of other new loans, debt relief, or macroeconomic adjustment to reduce the current account deficit.

For example, the IMF and World Bank prepared a document for the Heavily Indebted Poor Countries (HIPC) Initiative on Chad. They noted a $31 million financing gap in 2004 in the baseline scenario, which would disappear under more optimistic assumptions about oil exports.

However, under more pessimistic assumptions on oil exports, the financing gap would reach $234 million by 2006.

The identification of a "financing gap" typically leads to discussions about how to mobilize additional financing (if consistent with debt substainability), increase domestic saving, or get more debt relief. For example, the 2000 HIPC document on Nicaragua calculated a financing gap reaching $217 million by 2007 but noted that "these financing gaps are expected to be filled in by debt-service relief from HIPC assistance, which is projected to be about US$215 million annually up to 2019" (p. 44, IMF and IDA 2000c). Likewise, the 2000 HIPC document on Mauritania noted "even after the full application of traditional debt relief mechanisms, a financing gap would remain throughout the projection period." The financing gap averages about $64 million a year in the projections. The document then goes on to recommend debt relief in present value terms of $563-622 million (IMF and IDA 2000d, p. 32, 35, 46).

Moreover, like the monetary identity, the Balance of Payments identity does not exactly balance. There is typically a “net errors and omissions” item in the Balance of Payments identity. For example, in the Turkey example of Barth et al. (2000), there was a net errors and omissions item that swung from +122 percent of the current account balance in 1992 to -97 percent of the current account balance in 1995. As Barth et al. (2000, p. 114) say, "in practice, the BOP accounts may not balance. This may be because data are derived from different sources or because some items are over- or under-recorded or not recorded at all." In the balance of payments data for all countries for 1970-99, the median ratio of the absolute value of errors and omissions to the absolute value of the current account balance was 23%. This weakens confidence in how precisely the “financing gap” can be determined.

The third basic identity in IMF financial programming is the identity for financing the budget deficit. The budget deficit (B) is equal to new domestic credit creation from the monetary system, foreign borrowing, and direct sales of bonds to the domestic public (O):

(7) $B = \Delta DC_g + E\, F_g^* + O$

Bond sales to the non-bank domestic public (O) are not often very important, so the stress in fiscal programming is on monetary financing and foreign borrowing. We can see the close link between the fiscal and balance of payments identities, with foreign financing playing a role in both.

The fiscal identity (7) is used to set the budget deficit that is consistent with the monetary and balance of payments targets. A value for F_g^* will be derived to meet the balance of payments target and consistent with sustainable external debt. Since F_g^* is largely set by the exogenous supply of loans to the government, the residual variable is ΔDC_g. A target for ΔDC_g consistent with inflation targets can be derived from the monetary identities, conditional on a target for private credit creation (see below), which will in turn determine the target for the budget deficit from (7). In other words, ΔDC_g is the endogenous variable and B, the budget deficit, is the policy variable. For example, in Tanzania "The budget for 2001/02 will aim at increasing expenditures to the priority sectors within the resource envelope, avoiding inflationary domestic financing" (IMF 2001a). Or as Barth et al. (2000, p. 283) put it, domestic bank financing of the deficit would be determined "in light of information about the amount of external financing that is available and the scope for the nonbank sector to absorb additional government debt." Since ΔDC is the policy variable in the monetary identity above, we can think of this as a recursive system, in which the budget deficit determines domestic credit expansion, which in turn determines monetary growth.

Returning to a recurrent theme, the identity in (7) does not exactly hold in the data. IMF missions generally include a “statistical discrepancy” term to reconcile inconsistent information on the above-the-line measure of the budget deficit (expenditure-revenue) and the below-the-line measures of financing flows.[7] In the Government Finance Statistics of the IMF, the domestic financing data has both “other” and “adjustment” categories. The former includes non-bank domestic financing of the government budget deficit, but the “adjustment” category seems to be a statistical residual. The median ratio of the absolute value of the “adjustment” in domestic financing to the absolute value of total domestic financing for the pooled cross-country sample 1970-99 is 55%.

Another objective in controlling the budget deficit is preventing "crowding out" of the private sector. Here we need to derive private sector credit (ΔDC_p), so we need another identity:

(8) $\Delta DC_p = \Delta DC - \Delta DC_g$

For a given domestic credit target for the monetary accounts, a higher level of ΔDC_g lowers private credit creation. As the recent IMF document on Colombia puts it "in order to secure adequate credit resources for the private sector to sustain the ongoing economic recovery and prevent any excessive upward pressure on domestic interest rates, the authorities will make every effort to limit the access to domestic financial savings by the combined public sector in 2001"(IMF 2001b). Hence, a target is set for private credit expansion, and then the budget deficit B is set so as to be consistent with the implied value of ΔDC_g .

Sometimes a separate account is done for the private sector, to make comprehensive the framework of accounting identities. Even when the private sector is not programmed, it is implied by the other accounting identities as a residual. For example, the current account surplus plus the fiscal deficit is equal to the private sector excess of saving over investment (although as usual there is a statistical discrepancy, which was one third of the current account deficit in the Barth et al. Turkey example in 1995).

The private excess of saving over investment should in turn be equal to private capital outflows in the balance of payments and net financial asset accumulation (change in money minus change in domestic credit to the private sector). However, financial programming in practice does not usually attempt to reconcile all the disparate identities from different data sources or make sure they have plausible implications for private sector aggregates. Hence, there is yet another layer of statistical uncertainty about whether the identities really balance. For example, in the Fund's most recent staff paper on on Pakistan (IMF 2001e), the fiscal deficit (-5.3

percent of GDP) and current account balance (-1.6 percent of GDP) imply a private sector saving-investment balance of 3.7 percent of GDP. However, the sum of net private domestic financial accumulation and net private foreign asset accumulation is only 1.7 percent of GDP, so there is an implied discrepancy in the program for the private sector accounts of 2 percent of GDP. This is nearly twice as large as the total fiscal adjustment over the last year (1.1 percent of GDP).

2. TESTING FINANCIAL PROGRAMMING FOR MONEY AND INFLATION

The paper will first test the idea that changes in domestic credit can be useful in an FP framework to predict changes in the money supply, which will amount to testing the exogeneity restriction.

A test of one possible use of the financial programming approach to predicting monetary expansion is to calculate the forecast error using the financial programming approach and contrast it with a naïve model. Under the exogeneity restriction in which ΔDC passes one for one into ΔM, part of monetary growth can be accounted for with ΔDC/M. The exercise assumes the financial programmer knows the actual value of ΔDC/M and then predicts the remainder assuming a random walk for the remainder. Note that this is already cheating in favor of the FP model because it assumes we know current period domestic credit with certainty. How well does that predict ΔM/M? The paper tests this on the pooled cross-country annual dataset for non-industrial countries from 1961 to 1999. The median absolute deviation of predicted from actual percent money growth in the pooled sample is large relative to median monetary growth (Table 2). Even knowing the actual current period expansion in domestic credit, one has large forecast errors. Comparing it to a naïve random walk model that simply assumes this period's money growth will the same as last period's, the median absolute forecast error is actually larger than that of the naïve model in the pooled cross-country annual time series sample for non-industrial countries. Looking country by country, the random walk outperforms the financial programming approach for 114 of 148 countries.

{Table 2 here}

To test whether the failure of the domestic credit prediction is because the monetary approach to the balance of payments (MABOP) holds (that is, because domestic credit expansion causes reserve loss rather than monetary expansion), the exercise next separates out the countries that had capital controls in place for the whole sample period. In countries with capital controls, MABOP should not hold because the private sector cannot freely exchange excess money for foreign currency. However, we still find that the forecast error for the FP domestic credit model exceeds that of the naïve random walk model for monetary growth. The random walk outperforms the financial programming approach in 45 out of the 59 countries with capital controls for the full sample period.

How could a forecast do worse when we actually have more information, i.e. the actual level of domestic credit creation? The problem is that we are not using that information optimally. The restriction that domestic credit is orthogonal to the remainder forces us to put a coefficient of unity on domestic credit and then forecast the remainder. Actually, the coefficient of regressing money growth on domestic credit expansion very often yields a coefficient different than unity, indicating that domestic credit changes affect the remainder as well as money growth.

Using annual data for 1961-99, the exercise is to regress $\Delta M/M$ (excluding valuation changes) on $\Delta DC/M$ for every non-industrial country with at least 20 observations, for a total of 109 individual country regressions, using ordinary least squares with a constant term but no other variables. Under the assumption that any other variables that affect $\Delta M/M$ are not affected by $\Delta DC/M$, they are orthogonal to the right-hand side variable and are components of the error term. Thus under the null hypothesis that the simplest financial programming approach is valid, the regressions will yield an unbiased estimate of the coefficient that is supposed to be unity. However, 97 of the 109 country regressions yield a coefficient that is significantly different than one in a t-test at the 5 percent level of significance. 45 of the 109 country regressions show an insignificant (at the 5 percent level) relationship or negative relationship between ΔM/M and ΔDC/M.

{Figure 1 here}

Figure 1 shows a frequency diagram of the coefficients of ΔM/M on ΔDC/M from the 109 individual country regressions. The median coefficient is .37. Two-thirds of the distribution is concentrated below .5, indicating that domestic credit changes are substantially offset by other items in the monetary identity. This could be because reserve losses offset domestic credit expansion (as in the monetary approach to the balance of payments) or because of movements in net other items that are correlated with domestic credit expansion in the monetary identity.

The prediction that ΔDC/M should pass one for one into ΔM/M does not fare any better in the sample of countries with capital controls for the whole sample period. The median regression coefficient is actually unchanged at .37. The frequency distribution of coefficients does not look substantially different (not shown).[8]

Another reason the coefficient on ΔDC/M could be less than one (as well as other analogous coefficients estimated below) is that there is measurement error in ΔDC/M correlated with the error term, which would bias down the coefficient even if the true value is one. However, errors in variables would only strengthen the criticism that FP is not a reliable guide to macroeconomic policy.

Another way to think about the failure of the orthogonality-based forecast, even knowing the actual value of domestic credit, is by thinking about the variances and co-variances applied to the identity. Since money growth (ΔM/M) is equal to domestic credit expansion (ΔDC/M) plus a remainder (call it R), the variance of money growth is as follows:

$$\text{Variance}(\Delta M/M)=\text{Variance}(\Delta DC/M) + \text{Variance}(R) + 2*\text{Covariance}(\Delta DC/M, R)$$

We have seen evidence that there is a strong negative covariance of domestic credit expansion and the remainder. The failure to use that information can make the orthogonality-based forecast (which constrains the coefficient on domestic credit expansion to be unity) perform worse than the naïve random walk for money growth.

What about the link of the money supply to inflation, which the "MV=PQ" assumption of monetary programming said could be predicted with money growth in excess of real growth? This is an example of the second problem mentioned in the introduction, the assumption of a simple behavioral relationship based on the stability of one parameter (velocity).

The paper again does forecast evaluations of the financial programming approach and an alternative naïve model. Let us predict inflation as equal to the actual money growth minus actual real output growth. Note again that this is already cheating in favor of the model by assuming that we already know current money growth and output growth. The median absolute deviation of the inflation prediction in the pooled sample is large relative to the sample median inflation (Table 3). In contrast, if we forecast inflation with the naïve random walk, i.e. predicting that it is the same as last period, the median absolute deviation of the inflation prediction in the pooled sample is less than half of the median error in the monetary model. (Using mean rather than median absolute deviations gives similar results; medians are appealing because they reduce the influence of extreme inflation observations.) Comparing medians for each country with available data, 87 of the 108 countries do better with the random walk than with the monetary model.

{Table 3 here}

Knowing actual money growth and GDP growth did not help us forecast inflation compared to the naïve model. Why not? Again it is because the FP approach constrains our use of this information, by assuming that the elasticity of prices with respect to excess money growth is unity (i.e. that velocity does not change).

Another exercise is to calculate annual elasticities for the pooled cross-country annual time series sample of 3201 observations over 1961-99, defined as $\Delta \ln P/(\Delta \ln M - \Delta \ln Q)$. The median elasticity is.71, significantly different than unity in a t-test at the five percent level. Again, the high variance of the actual annual elasticities shows the limits to confidence in this approach, as shown in Figure 2.

{Figure 2 here}

To see whether the dispersion of elasticities of inflation with respect to excess money growth is special to the use of annual data, the paper also performs this exercise using 4-year averages. There is somewhat more concentration of the mass of the distribution around a median value, but this value is .75 rather than one. Actually, even the annual data may exaggerate the stability of the elasticity parameter, because IMF financial programming is often done at an even higher frequency: quarterly, or sometimes even monthly.

We can test the unitary elasticity hypothesis on a country by country basis by running regressions for the 82 countries that have at least 20 annual observations. In 62 of these 82 countries, we reject the hypothesis that the elasticity of inflation with respect to money growth is unity (in a t-test at the 5 percent significance level). In 51 out of the 82 countries, we reject the hypothesis that the elasticity of inflation with respect to real output growth is minus one.

The departure of the inflation elasticity from unity might lead us to suspect that velocity is not remaining stable like it's supposed to in the simplest FP model. This is borne out when we do an "inflation accounting" exercise, based on (3) above. How much of the change in the price level is accounted for by the change in velocity? The paper performs this exercise for the pooled cross-country annual time series sample of 3201 observations. The median ratio of the absolute value of the log change in velocity to the absolute value of the log change in the CPI is .57 in the pooled sample, a proportion that is strongly and significantly different than zero (in a t-test at the 5 percent significance level). Velocity changes actually account for the majority of changes in the price level.

Another problem with the financial programming model of inflation is that velocity seems to be non-stationary, although the sample period may be too short to be confident about this conclusion. We have 82 countries on which we have at least 31 observations. We fail to reject a unit root (using the Augmented Dickey-Fuller test) for velocity in 69 out of 82 countries in favor of the alternate hypothesis that velocity has a constant mean. We even fail to reject a unit root for velocity in 74 out of 82 countries in favor of the alternate hypothesis that velocity has a stable trend.[9] Since velocity fails to revert either to a stable trend or a stable mean, one cannot argue that the velocity-based model is unreliable simply because of noisy data around a stable model.

3. TESTING THE FP FRAMEWORK FOR THE BALANCE OF PAYMENTS

The paper next tests the idea that changes in disbursements of long-term loans in the balance of payments have predictive value in the identity for changes in imports, which again is a test of the exogeneity restriction between loan disbursements and other items in the balance of payments. The exercise tries to predict $T^*/T^*(-1)$ using $F^*/T^*(-1)$. The exercise assumes that long-term disbursements are known with certainty, and forecast the residual (Import growth – LTDisbursements/ $T^*(-1)$) as a random walk. Despite having the actual value of long-term disbursements, this forecast does worse than simply forecasting import growth as a random walk (Table 4).

{Table 4 here}

One might think that treating capital flows as exogenous with respect to imports might make more sense in low-income countries, which get few private capital flows. They mainly get official financing flows, which are more plausibly exogenous. However, restricting the sample to low income countries, the naïve random walk for import growth still does better than using information on long-term disbursements in the FP framework (Table 4).

Is forcing the coefficient on disbursements to be one and independently forecasting the residual an optimal use of the data? Using annual data for 1971-98 for developing countries, the exercise is to run the regression country by country of $T^*/T^*(-1)$ on $F^*/T^*(-1)$. Under the exogeneity restriction that loan disbursements are orthogonal to the remaining items in the balance of payments, the predicted coefficient is unity. The sample consists of 81 developing countries with more than 20 observations. The median coefficient is .23. In 50 out of the 80 countries, the exercise can reject the hypothesis that the coefficient is equal to one (in a t-test at the 5 percent significance level).. In 64 out of the 80 countries the relationship between long-term disbursements and imports is insignificant or negative. Figure 3 shows the composition of the distribution is heavily weighted toward very low values of the import coefficient on disbursements.

{Figure 3 here}

The next test is of the import elasticity with respect to growth, which logically should be around one if the FP model is to make sense (otherwise import to GDP ratios would explode or collapse). We have a pooled annual cross-section sample for 1961-99 of 4512 observations of $\Delta \ln T^{*}/\Delta \ln Q$. The median import elasticity is 1.36, which has the 95% confidence interval of {1.30,1.42}. More than a quarter of the elasticities are below zero, implying imports and output moving in different directions. Another half of the sample is above 1.25, implying an explosive growth of the import to GDP ratio. In fact, nearly a quarter of the sample has an import elasticity above 3! This seems to suggest that the simple import elasticity approach omits important factors causing a structural shift of import demand relative to GDP, like changes in the real exchange rate or liberalization of trade policies.

Country economists doing balance of payments projections typically assume unit elasticities (the most common) or elasticities below 1, certainly not the explosive ones shown here. The IMF Institute’s 2000 Financial Programming Manual (Barth et al. 2000) has an import income elasticity of .37 for Turkey in an import demand equation that also has a real exchange rate term. The import income elasticities in the long-run projection in the Guyana HIPC document is .76 in one period and .58 in another (p. 33, International Monetary Fund and International Development Association 2000b). Another example is the Mauritania HIPC document, which features an import elasticity of .62 (IMF and IDA 2000d, p. 43) Most of the other HIPC documents feature an import elasticity of unity.

These results are not driven by the use of the relatively high frequency of annual data. The results using 4-year averages show little change in distribution of coefficients.

Another way to test the balance of payments FP approach is to use equation (5) as a predictor of growth in the pooled annual cross-country sample 1961-99, assuming an import elasticity of unity. Call this the import availability model of growth. Even knowing current period import growth, the median absolute deviation of predicted log GDP growth from actual is high in the pooled annual cross-country sample relative to the sample median log GDP growth (Table 5). The naïve random walk model, that this period's log GDP growth will be the same as last year's in the pooled cross-country annual sample, outperforms the import availability model of growth according to the criterion of median absolute forecast error.

{Table 5 here}

This test might be thought to be unfair, because country economists use country-specific information on import elasticites to project growth consistent with given import availability. Next modify the test to first calculate an import elasticity for each country from data on GDP growth and import growth for 1961-79, then apply that import elasticity to project growth for each country using (7). Next calculate the median absolute deviation of actual from predicted growth in the pooled annual cross-country sample for 1980-99. The median absolute forecast error under the naïve model that growth is a random walk in the pooled cross-country dataset over 1980-99 still outperforms the financial programming model when country-specific information on import elasticities is used (Table 5).

4. TESTING THE FP FRAMEWORK FOR FISCAL VARIABLES

Since the budget deficit target is chosen to produce a particular domestic credit expansion consistent with control of inflation and loss of foreign exchange reserves, one can ask to what extent budget deficits predict domestic credit expansion. To examine the tightest linkage, I focus on domestic credit to the government. Again the exercise is to test one possible use of the financial programming approach by predicting government domestic credit expansion using the budget deficit (imposing the restriction that the budget deficit is exogenous with respect to other variables) and contrasting it with a naïve model. Under the FP approach in which the budget deficit B/Y passes one for one into $\Delta DC_g/Y$, part of domestic credit expansion can be accounted for with B/Y. Assume again the financial programmer knows the actual value of the policy variable B/Y and then predicts the remainder assuming a random walk for the remainder. How well does that predict $\Delta DC_g/Y$? The exercise tests this on the pooled cross-country annual dataset for non-industrial countries from 1972 to 1999. The median absolute deviation of $\Delta DC_g/Y$ predicted from the actual budget deficit in the pooled sample is large relative to government domestic credit expansion (Table 6). Even knowing the actual current period budget deficit, one has large forecast errors. In this case, it does slightly worse than a naïve random walk model that simply assumes this period's government domestic credit expansion will the same as last period's. Looking country by country, the budget deficit-based forecast outperforms the random walk for 48 of 96 countries.

{Table 6 here}

To see what the problem is with this forecast, next regress the ratio of the change in government domestic credit to GDP on the budget deficit to GDP country by country. There are 65 non-industrial countries with at least 10 observations. The predicted coefficient on the budget deficit is unity. The median coefficient in the 65 country regressions is .48. The coefficient in 30 out of the 66 cases is negative or insignificant (at the 5 percent level in a t-test). The coefficient in 40 out of the 65 cases is significantly different than one at the 5% level. Altogether, the coefficient in 51 out of the 66 countries is either negative, insignificant, or significantly different than one (at the 5 percent level). For many if not most of the country cases, the use of the budget deficit exogeneity restriction to derive government domestic credit creation as a residual is not consistent with the data. Expanding the budget deficit does not have a one for one effect on government domestic credit creation. The problem with the less than spectacular forecast performance above was that it was not using optimally the actual information on budget deficits to predict government domestic credit expansion. To put it another way, an increase in the budget deficit covaries with the residual in the deficit financing identity, so projecting the residual and the budget deficit independently is not what the data suggest should be done. Of course, IMF staff in practice could well take into account this covariance, so this objection may imply more about the way financial programming should be done rather than invalidating the whole approach.

A fairer test of the FP model might be to restrict the sample to low income countries, where foreign financing of the government deficit is more plausibly exogenous and supply determined. Table 5 shows what happens to the median absolute forecast error when the sample is restricted to low income countries. Again, the forecast error is slightly larger when the budget deficit is perfectly anticipated than when domestic credit is predicted as a random walk.

Next regress domestic financing of the government deficit as a ratio to GDP on the ratio of the total government deficit to GDP for any low income country that has at least 10 annual observations.[10] There are only 22 low income cases available. The median coefficient is .35. For 16 out of the 22 cases, the data reject at the 5% level the hypothesis that the coefficient on the budget deficit is unity. Restricting the sample to low income countries does not improve the fit of the FP model that derives government domestic credit creation from the budget deficit imposing the exogeneity restriction.

5. CONCLUSIONS

This paper agrees with Agenor and Montiel 1999 when they say:

> Although all of the {Bank and Fund} models to be examined have been applied frequently in policy formulation in developing nations, we shall argue that all of them are subject to limitations that constrain their usefulness for both policy guidance and analytical work as medium-term models.

Among the limitations of FP pointed out in this paper are the large statistical discrepancies in all the identities, the poor performance of predictions even when an element of the identity is known in advance with certainty, the failure of econometric tests to yield a strong association between the "policy" variable and the "endogenous" variable, and the systematic instability and high variance of the "behavioral" parameters that are used as "consistency checks" on the endogenous variables with growth and inflation targets.

In conclusion, the conditions under which the simplest and most mechanical use of financial programming would work do not hold in the data. Mechanical financial programming does not appear to be a very useful guide to macroeconomic policies in developing countries. One possible improvement this paper could imply is to use econometric relationships between the policy variable and the endogenous variable, rather than relying on exogeneity restrictions in accounting identities. Or the IMF staff and those who comment on their programs may simply benefit from knowing the limitations of mechanical financial programming, implying that macroeconomic judgements based on good theory and empirics is even more important than previously acknowledged.

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Table 1 : Estimates of Local Currency Equivalent Net International Reserves in December 2002 in Monetary Survey by IMF International Financial Statistics (IFS) and IMF Country Desk

Country	Date of report	IFS	Country desk	Percent difference
Mali	Jan-04	324	285	13.7%
Uruguay	Aug-03	20,831	-31,044	-167.1%
Burundi	Feb-04	18,405	21,100	-12.8%
Turkey	Oct-03	-6.6	-6.5	1.6%
Bulgaria	Feb-04	9,881	9,892	-0.1%
Lesotho	Jan-04	3,770	3,201	17.8%
Gabon	Feb-04	1.9	36.1	-94.8%

Source: IFS and IMF Country Reports on www.imf.org

Table 2: Forecast error in predicting monetary growth from domestic credit creation

Pooled annual cross-country sample, 1962-99, non-industrial countries	*Median monetary growth in pooled sample*	*(1) Median absolute forecast error with actual domestic credit creation and random walk for remainder*	*(2) Median absolute forecast error from random walk model of money growth*	*# of Countries in Which 1962-1999 median (1) exceeds median (2)*
Value	0.1572	0.1181	0.0891	114
# observations	4082	3953	3924	148
Restricted to countries with capital controls for whole sample period:				
Value	0.1633	0.0982	0.0756	45
# observations	1979	1919	1915	59

Source: International Financial Statistics, IMF, author's calculations

Table 3: Forecast error in predicting inflation from the excess of monetary growth over output

	Median Inflation	*(1) Median absolute forecast error from monetary model of inflation*	*(2) Median absolute forecast error from random walk model of inflation*	*# of countries in which (1) exceeds (2)*
Value	0.0695	0.0537	0.0280	87
#observations	4266	2832	3236	108

Pooled annual cross-country sample, non-industrial countries, 1961-1998

Source: International Financial Statistics, IMF; author's calculations

Table 4: Import Growth Predictions Using Long Term Disbursements

Median of:

	Real Import Growth	(1) Absolute Value of Error Using Actual Data for Long Term Disbursements and Random Walk for Remainder	(2) Absolute Value of Error using Random Walk for Import Growth	# of Countries in Which 1972-1998 median (1) exceeds median (2)
All non-industrial countries				
Value	0.0364	0.1580	0.1303	89
Observations	3090	2588	3035	133
Low income countries				
Value	0.0325	0.1755	0.1426	37
Observations	1589	1192	1571	59

Sample: Pooled annual data, 1972-1998

Source: International Financial Statistics, IMF; author's calculations

Table 5: Evaluating Forecast Error in Import Availability Model of Growth Compared to Random Walk Model (all nonindustrial countries)

Sample period for forecast error evaluation in pooled annual cross-section data	*Assumed import elasticity*	*Median GDP growth in sample*	*Median absolute forecast error of import availability model*	*Median absolute forecast error assuming GDP growth is a random walk*
1961-99	1.0	.038	.064	.026
1980-99	Country-specific elasticities calculated from 1961-79	.032	.040	.023

Source: International Financial Statistics, IMF; author's calculations

Table 6: Domestic credit to government expansion to GDP predictions using budget deficit to GDP

	Median Domestic credit to government expansion to GDP	(1) Median absolute value of prediction error using actual value of budget deficit to GDP and random walk for remainder	(2) Median absolute value of prediction error using random walk for government domestic credit expansion	# of countries in which (1) exceeds (2)
All nonindustrial countries				
Value	0.009	0.020	0.019	48
Observations	2423	1298	2282	96
Low income countries only				
Value	0.011	0.020	0.018	21
Observations	902	388	849	33

Source: International Financial Statistics, IMF; author's calculations

Figure 1: Frequency distribution of regression coefficient of percent change in M2 on (change in DC)/M2, 1961-99, 109 individual country regressions

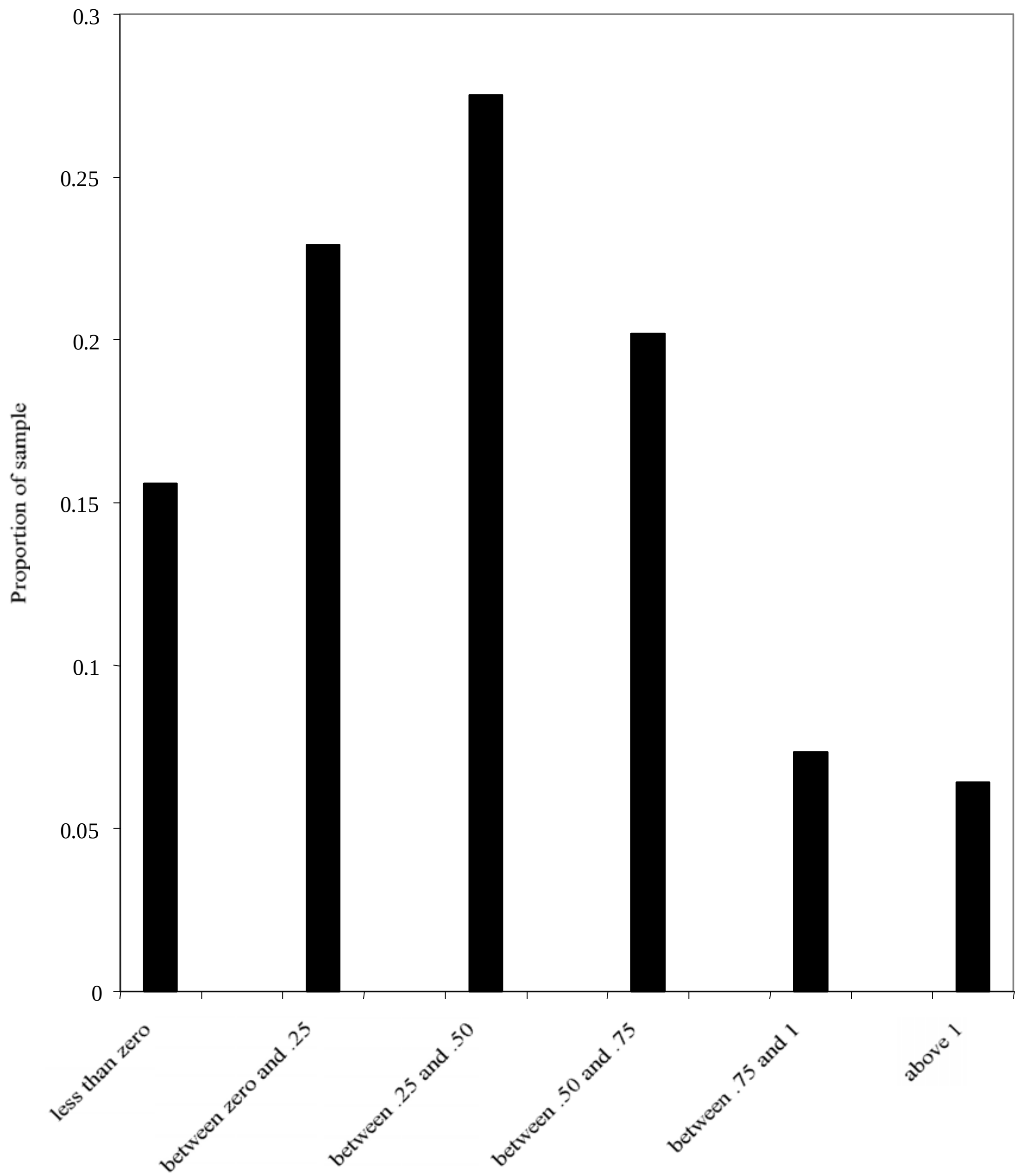


Figure 2: Frequency distribution of price elasticities with respect to excess money growth, pooled cross-country annual data, 1960-98

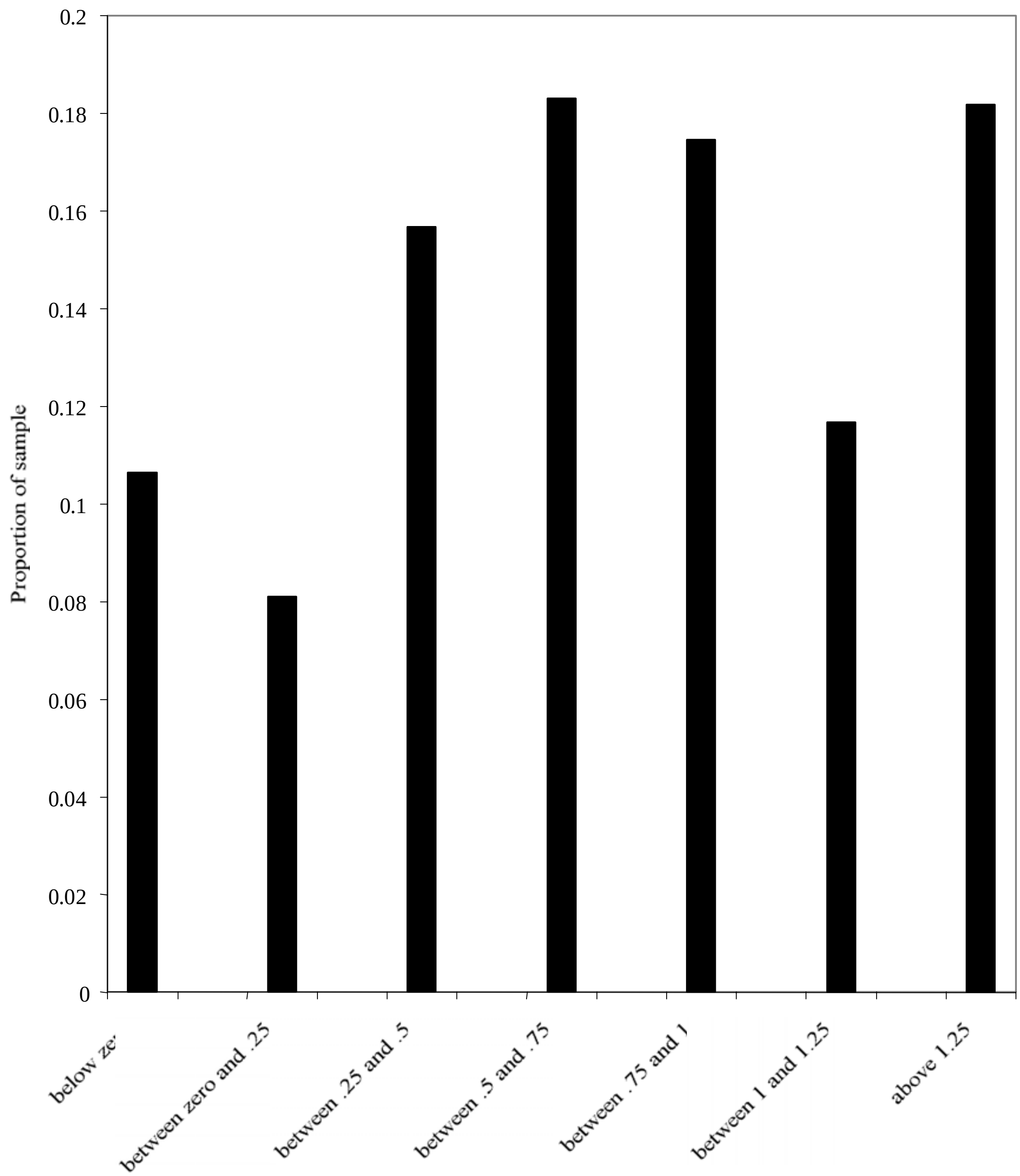
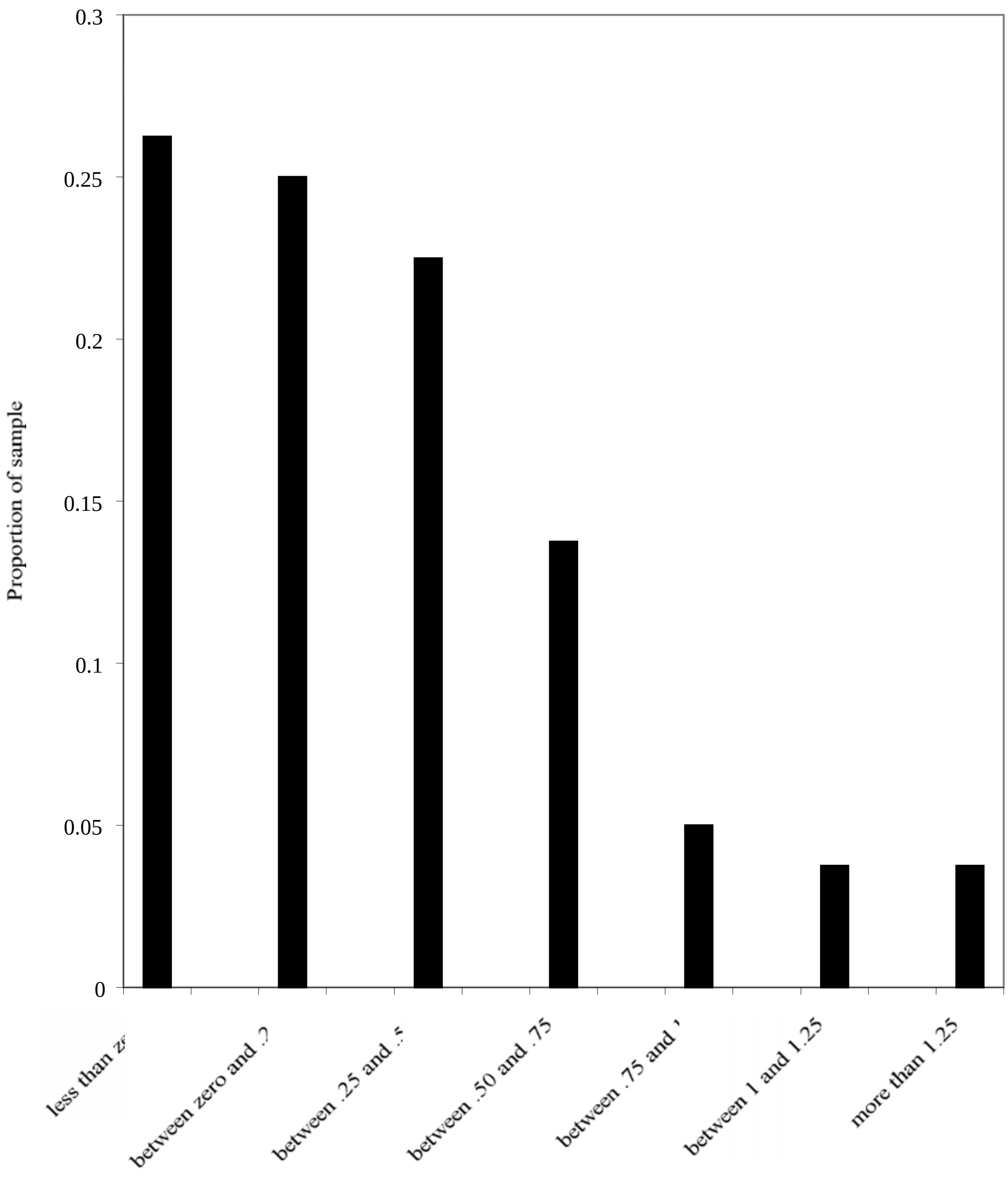


Figure 3: Frequency distribution of regression coefficient of imports/imports(-1)

on LT disbursements/imports(-1), 80 country regressions 1970-98



Endnotes

[1] There may be differences between financial programming as taught in training courses and financial programming as it is actually practiced by country desks in the IMF (although I will give several country examples below). Nevertheless, the training manual is the main source of written documentation of the model so that is what outside reviewers have to go by.

[2] Polak (1998) disagrees and argues that the "monetary approach to the balance of payments" is a coherent macro model underlying financial programming.

[3] A partial list of references by way of introduction to this literature includes Ashiya (2003), Barro and Lee (2005) , Bird, G. (2001), Bird(1995), Bird and Rowlands, (2002), Conway (1994), Dicks-Mireaux, Mecagni, and Schadler (2000), Easterly (2005), Goldstein. and Montiel (1986), Haque and Khan (2002), Killick, (1995). Some of this literature also concerns itself with IMF predictions, but more with a view to assessing whether conditions are kept, in contrast to this paper.

[4] Sometimes the broader concept of Net Domestic Assets of the monetary system is used instead of domestic credit.

[5] This contrasts with the prediction of the classic Mundell-Fleming model, in which a country with fixed exchange rates and full capital mobility will have any domestic credit expansion offset one for one by a decline in foreign exchange reserves, with a zero effect on money supply. There was a large literature that estimated these "offset coefficients”. Nevertheless, the approach as I have stated it appears to be the most common use in IFIs.

[6] Mussa and Savastano 1999 acknowledge that the parameter estimates are “generally not estimated by formal econometric techniques” but are instead “based on rough statistical work” due to the “predominance of unstable relationships and unreliable data.” Although Mussa and Savastano nevertheless defend financial programming as viable because it is iterative and adjustments are made at each stage of the program, it is not clear why second-round estimates are any more likely to be reliable than those in the first round.

[7] There is also sometimes an “adjustment for intergovernmental transfers”, which reflects the discrepancy between what the sending and receiving agencies report as transfers.

[8]I also do the reverse test: in countries with full capital mobility and fixed exchange rates, MABOP should apply. Is there a coefficient of –1 when I regress the change in net foreign assets ($E\Delta R^*$) on the change in domestic credit (ΔDC) under such circumstances? Since there are so few observations that satisfy this criteria, I do a pooled sample of all such observations over 1960-98 (183 observations), imposing a constant coefficient on ΔDC but allowing country-specific intercept terms. I get a coefficient of -.25 when I regress $E\Delta R^*$ on ΔDC, significantly different from both zero and unity.

[9] I perform an augmented Dickey-Fuller test with one lag.

[10] The source for both series is the Government Finance Statistics of the IMF.