

**An Identity Crises?  
Testing IMF Financial Programming**

By William Easterly

***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. Financial programming is based on monetary, balance of payments, and fiscal accounting identities. This paper subjects the identity-based framework to a variety of tests. All of the identities contain large statistical discrepancies, which weakens the case for them as a “consistency check.” Financial programming assumes a one for one relationship from the identity between the policy variable (e.g. domestic credit) and the outcome variable (e.g. money supply) posited by financial programming, because the other variables in the identity are assumed to be exogenous with respect to the policy variable. This assumption fails in the data, as all the coefficients of outcome variables on policy variables depart from a unitary coefficient. The elasticity of inflation with respect to excess money growth (money growth – real output growth) is significantly less than one, and shows a high variance in the data. Changes in velocity account on average for 57% of the change in the price level. Velocity is non-stationary. Imports are not significantly related to long-term disbursements in most countries. The median income elasticity of imports is 1.36 and the dispersion of import elasticities in the data has a majority of the distribution outside the usual range used in country projections. Using import availability to predict growth leads to a forecast error more than twice that of the naïve model that growth is a random walk. Government deficits do not have a one for one link with domestic credit creation, as predicted by the identity approach. In sum, the financial programming approach is flawed because it does not take into account the endogeneity of virtually all the variables in each macroeconomic identity, the instability of its simple behavioral assumptions, and the large statistical discrepancies in all the identities. Accounting identities do not a macro model make.

An Identity Crises? Testing IMF Financial Programming \*

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One of the most widely used applied models in macroeconomics is the financial

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programming model of the International Monetary Fund. The IMF emphasizes 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).<sup>1</sup> 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."<sup>2</sup> 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."

Yet a model based mainly on identities seems questionable in light of modern macroeconomic theory. A change in policy variables would affect many items in each macroeconomic identity in most modern macroeconomic theories, so the identity provides little guidance as to how policy variables affect target variables. This paper examines this critique by asking the question of how reliable this identity-based framework is in practice.

Financial programming recognizes three types of variables in accounting identities. First, one of the elements in it is a residual, which will absorb movements in the other components of

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<sup>1</sup> 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.

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

the identity. I 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. I will call this the policy variable. Third, there are other elements in the identity that are projected exogenously or with econometric equations. I 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, an assumption that seems curious in terms of modern macroeconomic theory. In other words, changes in the policy variable will affect the endogenous variable (the residual in the identity) but not the exogenous variables. Assuming this to be the null hypothesis, the orthogonality of the exogenous variable with respect to the policy variable will allow us to estimate an unbiased coefficient when we regress the endogenous variable on the policy variable. 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 by assumption). 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 summarized by a single behavioral parameter, such as the elasticity of imports with respect to GDP, or the velocity of money.

I don't mean to suggest that IMF economists mechanically project economic variables using identities alone. Nor do I think that testing financial programming is the same as evaluating IMF staff's knowledge of macroeconomics, which is quite sophisticated. The variables are projected with some combination of qualitative judgement and econometric equations. The program is usually arrived at iteratively as parameters change. Waivers of program conditions are frequently granted when variables do not evolve as expected. Fund economists have also commented that the practice of financial programming is different than what is portrayed in the written documentation. However, this iterative approach and lack of

documentation as to what is actually done in financial programming makes the process even less transparent to recipient governments and outside evaluators, hindering the political acceptance of a program and the accountability to academic researchers and to the broader society. If the practice of financial programming departs in important ways from the published documentation on it, then it would seem desirable for the IMF to publish an accurate account of how it is applied in practice.

These shortcomings 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 12 years of research in international macroeconomics. Indeed one curious thing about financial programming is how unchanged it has remained over the years despite these criticisms and the large changes in macroeconomic theory and empirics.

In any case, Fund economists use the identities to assess the "consistency" of a program. Often the consistency judgement is based on how reasonable are the above mentioned parameters -- the import elasticity with respect to income and the velocity of money. This paper will ask how stable and economically meaningful are these parameters, and how accurate are forecasts based on these parameters.

## **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.<sup>3</sup> 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  $\Delta M$ , as I 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  $\Delta R^*$  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. I 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

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<sup>3</sup> Sometimes the broader concept of Net Domestic Assets of the monetary system is used instead of domestic credit.

$\Delta DC$  on  $\Delta M$ .<sup>4</sup>

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:

$$(1) MV=PQ$$

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 (3) so (3) 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:

$$(2) \Delta \ln P = \Delta \ln V + \Delta \ln M - \Delta \ln Q$$

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."<sup>5</sup> (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). I will evaluate this predictability and stability below.

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

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<sup>4</sup> 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.

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%.

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

$$(3) T^* - X^* + rL^* = F_p^* + F_g^* - \Delta R^*$$

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,  $F_p$  and  $F_g$  are 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,  $F_g^*$  is the policy variable,  $F_p^*$  and  $X^*$  are exogenously projected and  $\Delta R^*$  is exogenously set as a target. The policy variable  $F_g^*$  is set according to what the programmer deems to be a sustainable level of public 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 I 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

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<sup>5</sup> P. 179, Barth et al. 2000



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, then a marginal additional dollar of  $F_g^*$  will translate one for one into an additional dollar of imports. Again, I don't think that IMF staff necessarily believe this as a theoretical proposition, but for the identity to be a useful tool this prediction must approximately hold. I will test this prediction 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:

$$(4) \Delta \ln T^* = e \Delta \ln Q$$

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 (6) to get the predicted growth rate ( $g = \Delta \ln Q$ ) for a given amount of imports:

$$(7) g = 1/e \Delta \ln T^*$$

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). I will test relationship (7) below.

The balance of payments identity (3) is sometimes used to derive the "financing gap" in  $F_g^*$ . Exports are projected exogenously, imports are projected on the basis of (4), the change in reserves is an exogenous target as before, and then  $F_g^*$  becomes the residual. Some components of  $F_g^*$  are usually 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. This mechanistic approach to the "financing gap" is inconsistent with most economic theories of the current account, which sees it as reflecting endogenous intertemporal decisions of domestic savers and foreign and domestic investors (see Obstfeld and Rogoff 1996). It neglects the role of relative prices, exchange rates, and interest rates, which will adjust to eliminate any financing gap in response to a shock.

The identification of a "financing gap" typically leads to discussions about how to mobilize additional financing (if consistent with debt sustainability), 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).

If more debt relief is granted on the basis of a financing gap, this raises the problem of moral hazard. A country may increase domestic spending, which creates a larger financing gap, in anticipation of debt relief. The conditions on debt relief seek to prevent this by putting a ceiling on spending and directing it towards poverty-alleviating and growth-enhancing expenditures. How successful are these conditions in preventing moral hazard is an open question for further research.

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):

$$(8) B = \Delta DC + E F_g^* + O$$

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  $F_g^*$  playing an important role in both. The assumption that foreign financing is the dominant source of financing the budget deficit, and that government foreign borrowing is also the primary means of financing a current account deficit leads to the "fiscal approach to the balance of payments". This approach believes that controlling budget deficits, and hence government foreign borrowing, will improve the current account balance in (3).<sup>6</sup>

The policy variables  $\Delta DC$  and  $F_g^*$  were already set in the monetary and balance of payments identity. Hence, the fiscal identity (8) 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  $\Delta DC$ . A target for  $\Delta DC$  will be derived consistent with inflation targets from the monetary identities, which will in turn determine the target for the budget deficit from (8). For example, in Tanzania "The budget for 2001/02 will aim at increasing expenditures to the priority sectors within the resource

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<sup>6</sup> The fiscal approach to the balance of payments can equivalently be derived from the national income accounting identity that the current account deficit is equal to the sum of the government budget deficit and the private investment-saving gap. Assuming the latter to be fixed by international interest rates, the budget deficit will pass one for one into the current account deficit. See Barth et al. 1999.

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."

There is nothing special about the ordering of the identities. We could have solved the monetary and fiscal identities first, and then solved the balance of payments identity.

Returning to a recurrent theme, the identity in (8) 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.<sup>7</sup> 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%.

Sometimes another objective in controlling the budget deficit is preventing "crowding out" of the private sector. Here it is important to distinguish between domestic credit going to the public sector ( $\Delta DC_g$ ) and that going to the private sector ( $\Delta DC_p$ ), so we need another identity:

$$(9) \Delta DC_p = \Delta DC - \Delta DC_g$$

The domestic financing entry in the identity (8) now should be  $\Delta DC_g$  instead of  $\Delta DC$ . 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)

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

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<sup>7</sup> There is also sometimes an "adjustment for intergovernmental transfers", which reflects the discrepancy between what the sending and receiving agencies report as transfers.

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 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 much ballyhooed total fiscal adjustment over the last year (1.1 percent of GDP).

## **2. Testing financial programming based on monetary identities**

I first test the idea that changes in domestic credit have a one to one relationship with changes in the money supply. Using annual data for 1961-99, I 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. 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 identity approach to financial programming 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. 45 of the 109 country regressions show an insignificant or negative relationship between  $\Delta M/M$  and  $\Delta DC/M$ .

Figure 1a shows a frequency diagram of the coefficients of  $\Delta M/M$  on  $\Delta DC/M$  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.

To test whether the failure of the one to one 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), I separate out the countries that had capital controls in place for the whole sample period. There were 66 such countries. In countries with capital controls, MABOP should not hold because the private sector cannot freely exchange excess money for foreign currency. However, the prediction that  $\Delta DC/M$  should pass one for one into  $\Delta M/M$  does not fare any better in this sample. The median regression coefficient is actually unchanged at .37. The frequency distribution of coefficients does not look substantially different (Figure 1b).<sup>8</sup>

Another reason the coefficient on  $\Delta DC/M$  could be less than one (as well as other analogous coefficients estimated below) is that there is measurement error in  $\Delta DC/M$  correlated with the error term, which would bias down the coefficient even if the true value is one. However, this explanation does not really offer any consolation for the financial programming approach, since errors in variables would only strengthen the criticism that the identity is not a reliable guide to macroeconomic policy.

Another way to test the value 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 identity approach in which  $\Delta DC$  passes one for one into  $\Delta M$ , the predicted rate of monetary growth is  $\Delta DC/M$ . Note that this is already cheating in favor of the identity model because it assumes we know current period domestic credit with certainty. How well does that predict  $\Delta M/M$ ? I test 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

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<sup>8</sup>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 ( $\Delta DC$ ) 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  $\Delta DC$  but allowing country-specific intercept terms. I get a coefficient of  $-0.25$  when I regress  $E\Delta R^*$  on  $\Delta DC$ , significantly different from both zero and unity.

monetary growth (Table 1). Even knowing the actual current period expansion in domestic credit, one has large forecast errors. Comparing it to a naïve projection that simply assumes this period's money growth will be the same as last period's, the median absolute forecast error is actually slightly larger than that of the naïve model (which is 0.0786) in the pooled cross-country annual time series sample.

<i>Sample period for pooled annual cross-country sample</i>	<i>Median monetary growth in pooled sample</i>	<i>Median absolute forecast error from domestic credit creation model of money growth</i>	<i>Median absolute forecast error from random walk model of money growth</i>
1961-99	.147	.080	.079

What about the link of the money supply to inflation, where there was supposed to be an elasticity of one of inflation with respect to money growth in excess of real growth? I 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. Again, the high variance of the actual annual elasticities shows the limits to confidence in this approach, as shown in Figure 2a.

To see whether the dispersion of elasticities of inflation with respect to excess money growth is special to the use of annual data, I also perform this exercise using 4-year averages. Figure 2b shows 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 usually 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 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. This is borne out when we do an "inflation accounting" exercise, based on (4) above. How much of the change in the price level is accounted for by the change in velocity? I perform 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. Velocity changes account for a large share of changes in the price level.

Another way to test the financial programming approach to predicting inflation is to do some forecast evaluations of this and an alternative naïve model. Let us predict inflation using the actual money growth and actual real output growth, assuming an elasticity of one and zero change in velocity in the pooled cross-country annual sample from 1961 to 1999 (3201 observations). 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 2). In contrast, if we forecast inflation with the naïve assumption 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; I prefer medians because they reduce the influence of extreme inflation observations.) Knowing actual money growth and GDP growth, imposing a unit elasticity, did not help us forecast inflation compared to the naïve model.

Table 2: Forecast error in predicting inflation from the excess of monetary growth over output			
<i>Sample period for</i>	<i>Median inflation in</i>	<i>Median absolute</i>	<i>Median absolute</i>



<i>pooled annual cross-country sample</i>	<i>pooled sample</i>	<i>forecast error from monetary model of inflation</i>	<i>forecast error from random walk model of inflation</i>
1961-99	.069	.049	.023

Another problem with the financial programming model of inflation is that velocity turns out to be non-stationary. We have 82 countries on which we have at least 31 observations. We fail to reject a unit root 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.<sup>9</sup> 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 framework based on balance of payments identities

I next test the idea that changes in disbursements of long-term loans in the balance of payments have a one to one relationship with changes in imports. Using annual data for 1971-98 for developing countries, I run the regression country by country of  $T^*/T^*(-1)$  on  $F^*/T^*(-1)$ . I have 81 developing countries with more than 20 observations. The median coefficient is .23. In 50 out of the 80 countries, I can reject the hypothesis that the coefficient is equal to one. 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. When I repeat this exercise with public and publicly guaranteed long-term disbursements, the results are very similar.

The next test is of the import elasticity with respect to growth, which logically should be around one if the identity-based 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} Figure 4 shows the distribution of annual import elasticities in the pooled annual cross-section sample. More than a quarter of the elasticities are below zero, implying

<sup>9</sup> I perform an augmented Dickey-Fuller test with one lag.

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. Figure 5 shows the results using 4-year averages instead to calculate import elasticities. The distribution is little changed from Figure 4.

Another way to test the balance of payments identity approach is to use equation (7) as a predictor of growth in the pooled annual cross-country sample 1961-99, assuming an import elasticity of unity. I 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 3). 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 3: Evaluating Forecast Error in Import Availability Model of Growth Compared to Random Walk Model
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<i>Sample period for forecast error evaluation in pooled annual cross-section data</i>	<i>Assumed import elasticity</i>	<i>Median GDP growth in sample</i>	<i>Median absolute forecast error of import availability model</i>	<i>Median absolute forecast error assuming GDP growth is a random walk</i>
1961-99	1.0	.038	.064	.026
1980-99	Country-specific elasticities calculated from 1961-79	.032	.040	.023

This test might be thought to be unfair, because country economists use country-specific information on import elasticities to project growth consistent with given import availability. I 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). I then 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 3).

#### **4. Testing the framework based on the fiscal identity**

I next regress the ratio of the change in domestic credit to GDP on the budget deficit to GDP country by country. Domestic credit is the residual item in the budget deficit financing identity (8) and foreign borrowing is the exogenous variable, while the budget deficit to GDP is the policy variable. The IMF will typically set a limit on the budget deficit so as to achieve targets for domestic credit creation and money creation.

I have 66 non-industrial countries for which I have at least 15 observations. The predicted coefficient on the budget deficit is unity. The median coefficient in the 66 country regressions is .43. The coefficient in 39 out of the 66 cases is negative or insignificant. The coefficient in 34 out of the 66 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. For many if not most of the country cases, the use of the budget deficit financing identity to derive domestic credit as a residual is not consistent with the data. Expanding the budget deficit does not have a one for one effect on domestic credit creation.

A fairer test of this 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. I also try restricting the expansion of domestic credit to that provided to the government. I 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.<sup>10</sup> There are only 20 low income cases available. The median coefficient is .52. For 16 out of the 20 cases, I reject at the 5% level the hypothesis that the coefficient on the budget deficit is unity. Restricting the sample to low income countries, and narrowing the definition of domestic credit to include only the government component, does not improve the fit of the identity model that derives domestic credit creation from the fiscal identity as a residual.

## 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" pointed out in this paper are the large statistical discrepancies in all the identities, the failure of the identities 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

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<sup>10</sup> The source for both series is the Government Finance Statistics of the IMF.

growth and inflation targets. Accounting identities do not a macro model make. The use of identities for the determination of a residual variable as a function of some policy variable simply does not hold in the data. Identities are simply not a very useful guide to macroeconomic policy formulation.

The instability of the behavioral parameters is a particularly serious problem, since so much depends on them. 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 and the iterative procedure makes the process even less transparent and accountable.

Moreover, the behavioral parameters of the velocity of money and the income elasticity of imports have attained a kind of sainthood through “reification.” Reification is when one treats an abstract concept “as if it had concrete or material existence.”<sup>11</sup> These parameters are treated as causal influences on their respective outcomes. Thus, one “explains” movements in money through movements in velocity. Since velocity is tautologically defined to be the ratio of nominal GDP to money, one will always be able to “explain” a rise in money supply even if nominal GDP is unchanged by saying “velocity fell.” However, this has as much reality as saying the supply of oranges increased because the ratio of GDP with respect to oranges fell and GDP remained unchanged.

In conclusion, financial programming does not appear to be a very useful guide to macroeconomic policies in developing countries. Its shortcomings may be rectified in the field by subjective judgments by the IMF staff, who are technically sophisticated, but there is then a mismatch with the formal presentation of IMF programs and actual practice. There seems to be a mismatch between the formal insistence on benchmark policy criteria and the weak empirical and theoretical underpinnings of an identity-based framework that relies on unstable parameters and fails to take into account the endogeneity of virtually all items in the macroeconomic identities.

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<sup>11</sup> <http://www.dictionary.com/cgi-bin/dict.pl?term=reification>



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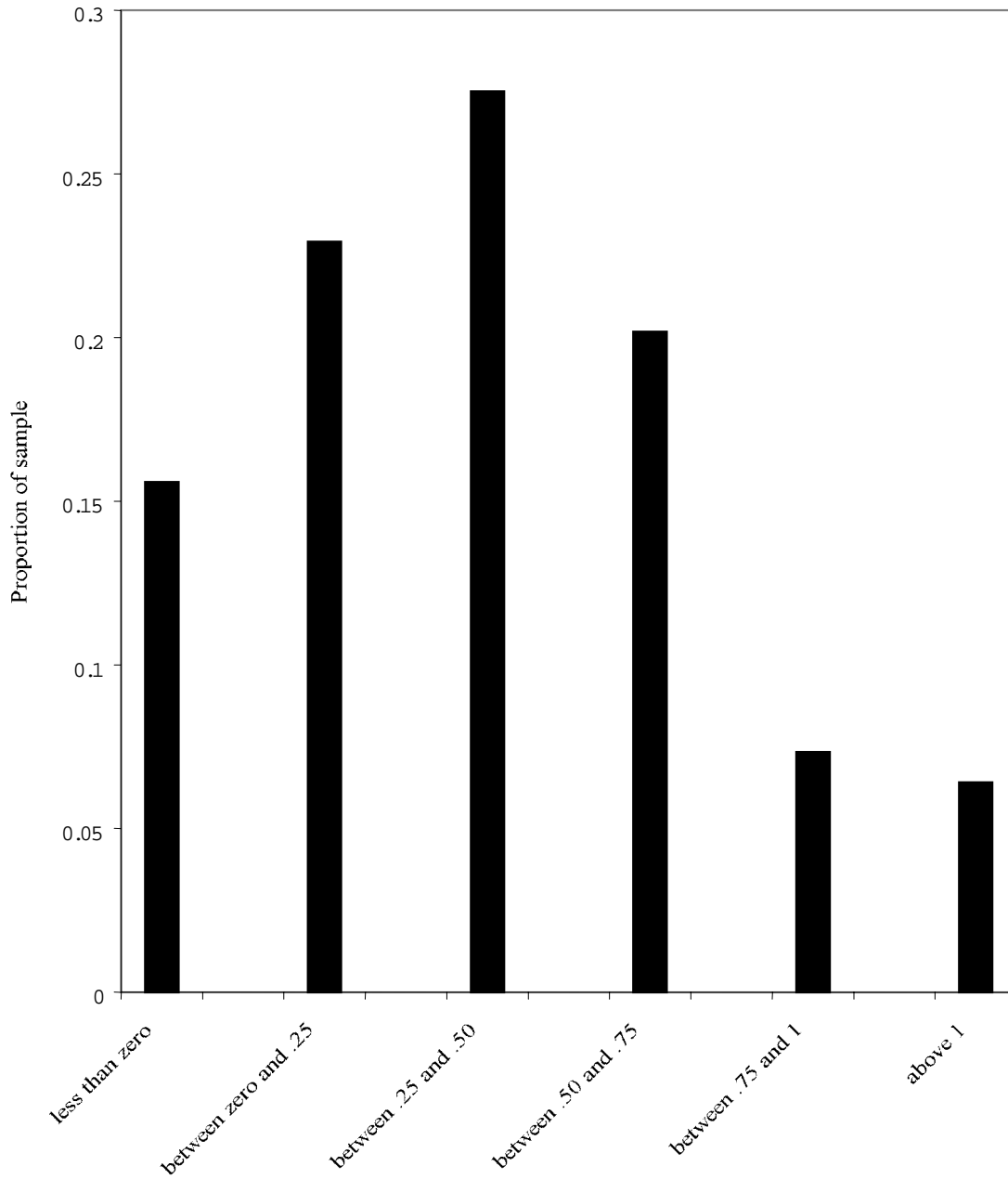
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Figure 1a: Frequency distribution of regression coefficient of percent change in  $M^2$  on (change in DC)  $M^2$ , 1961-99, 109 individual country regressions



**Figure 1b: Frequency distribution of regression coefficient of percent change in M 2 on (change in DC )/M 2, 1961-99, 66 individual country regressions for countries with capital controls**

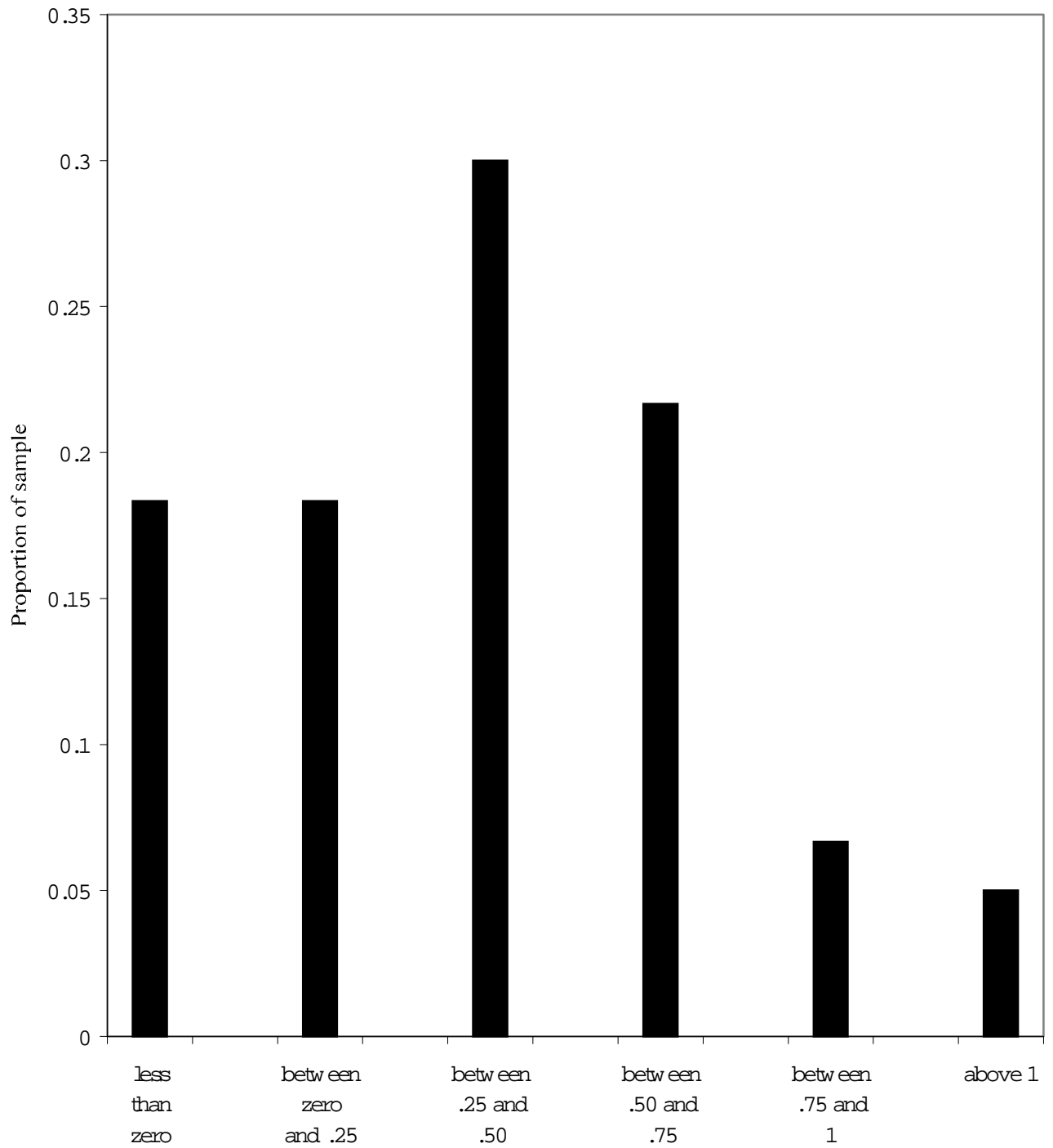
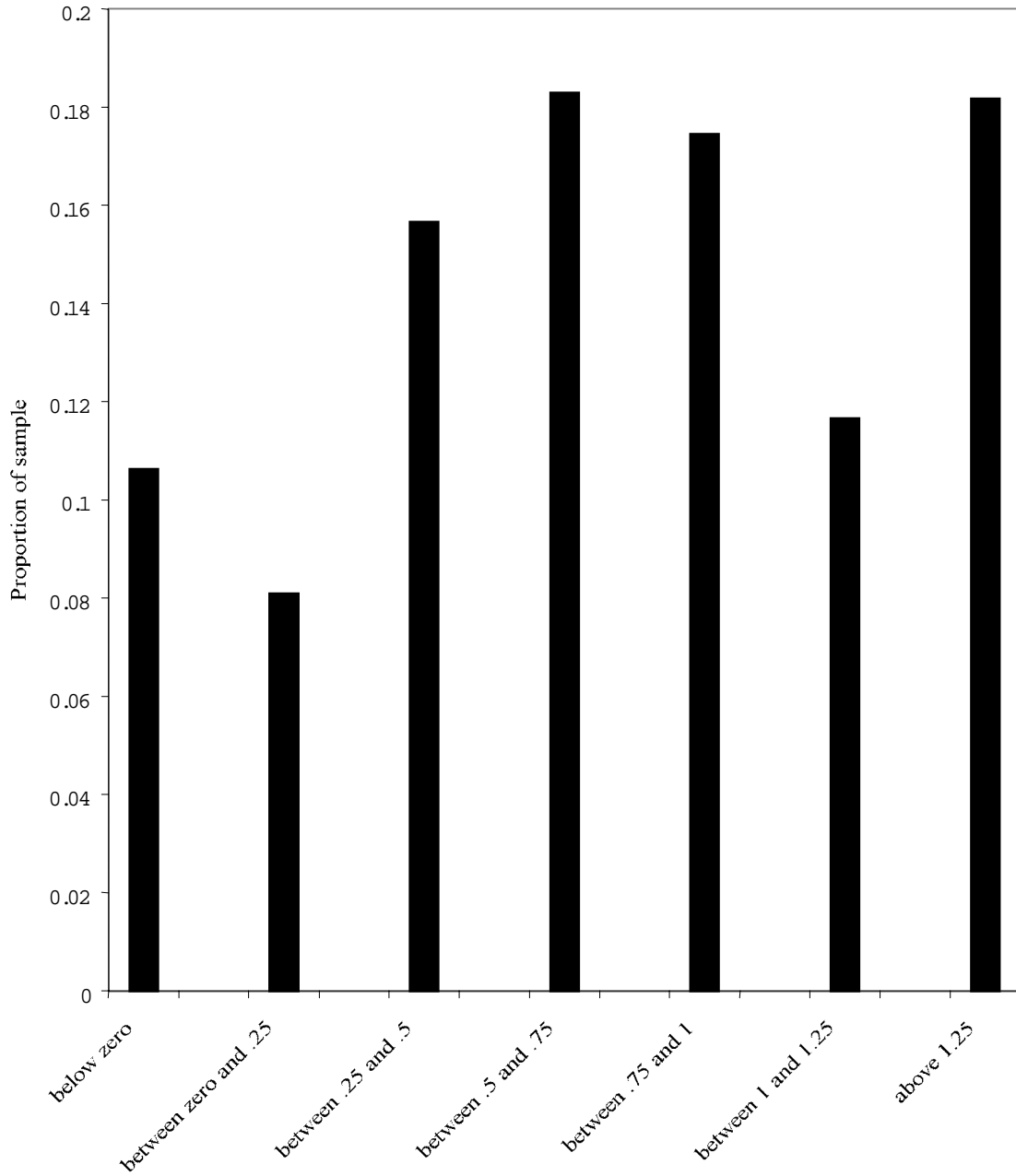
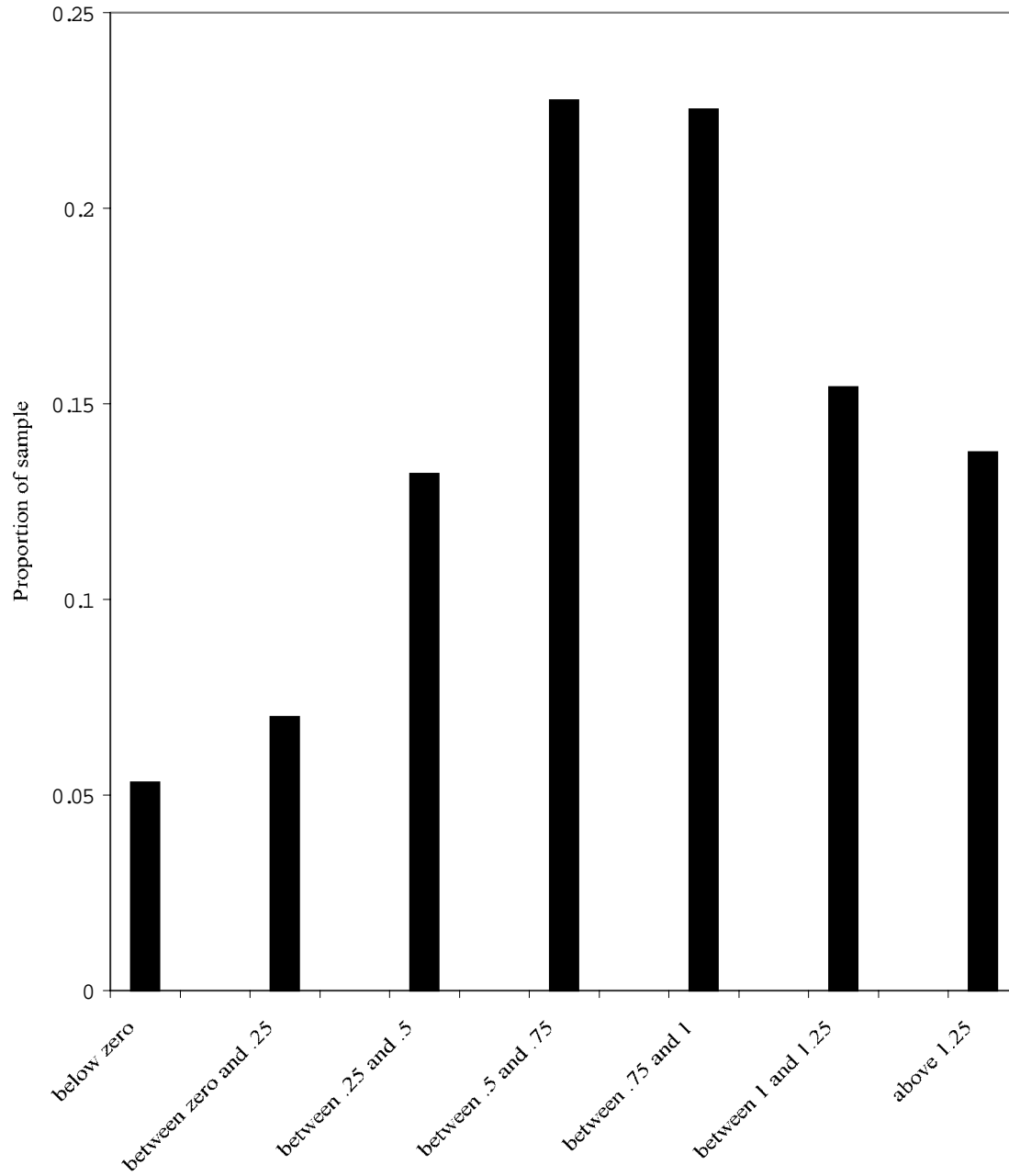


Figure 2a: Frequency distribution of price elasticities with respect to excess money growth, pooled cross-country annual data, 1960-98



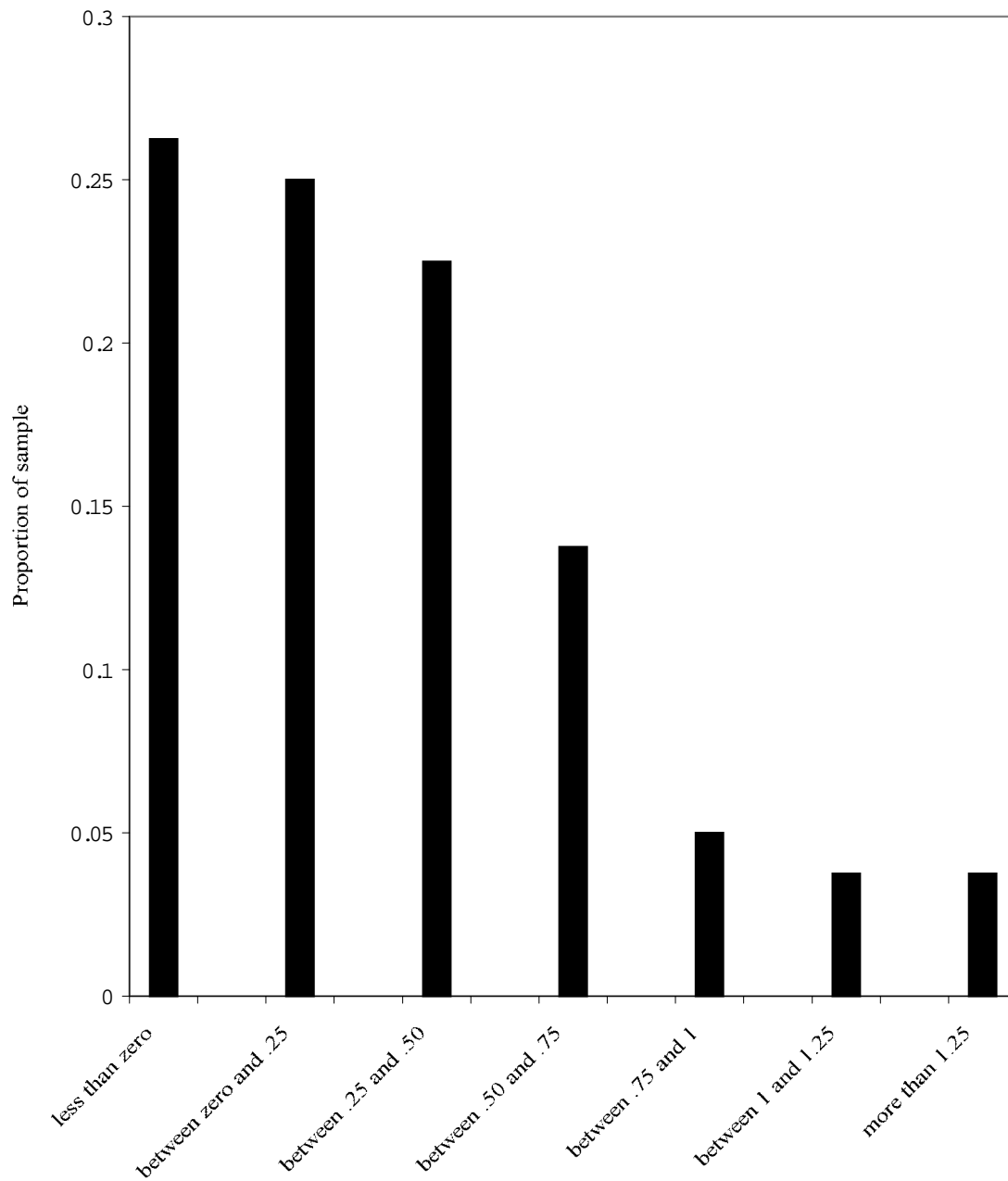
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**Figure 2b: Frequency distribution of inflation elasticities with respect to excess  
in oney growth, pooled cross-country 4-year averages, 1960-98**



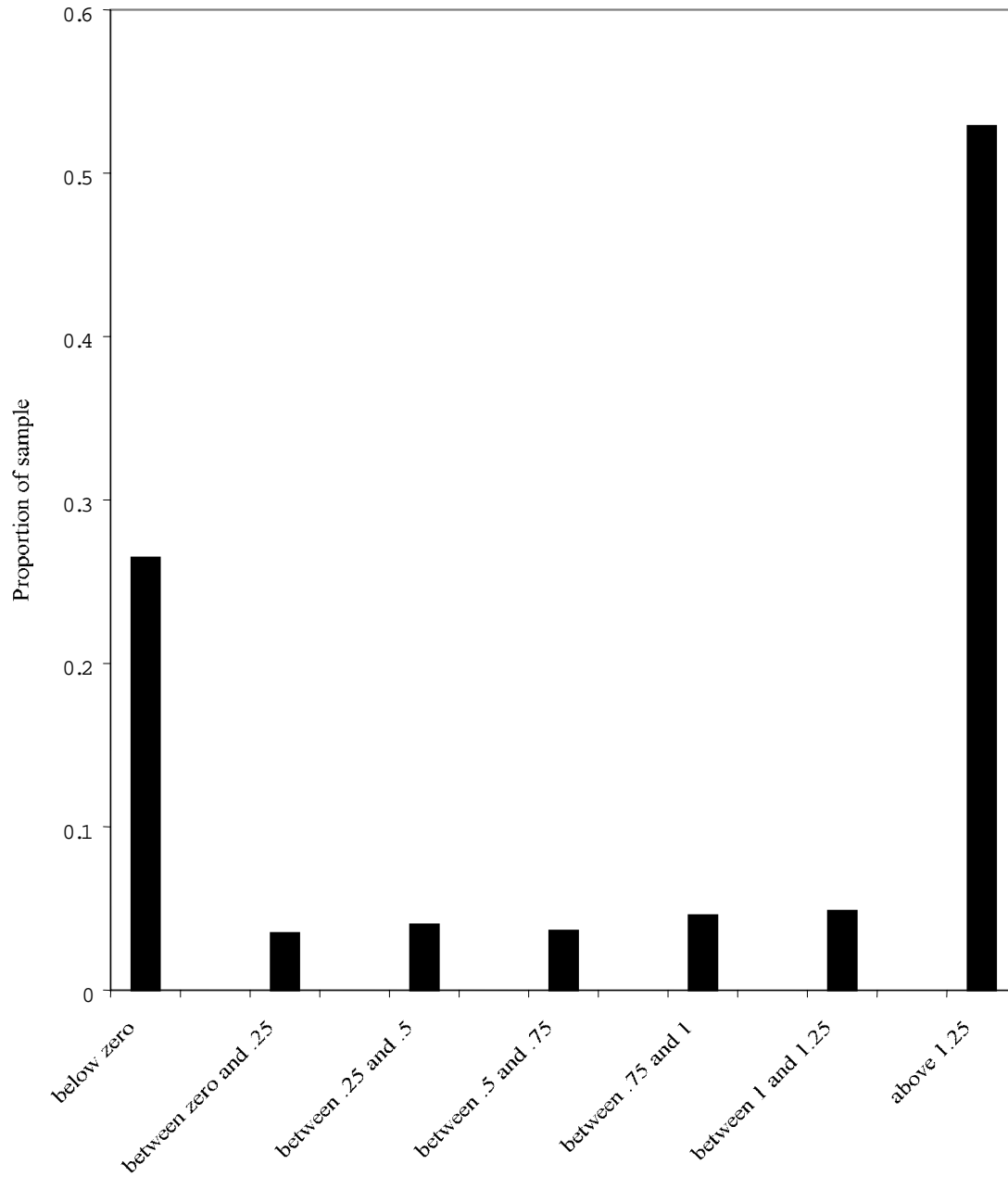
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Figure 3: Frequency distribution of regression coefficient of  $\ln \text{ports}/\ln \text{ports}(-1)$  on  $\text{LT disbursements}/\ln \text{ports}(-1)$ , 80 country regressions 1970-98



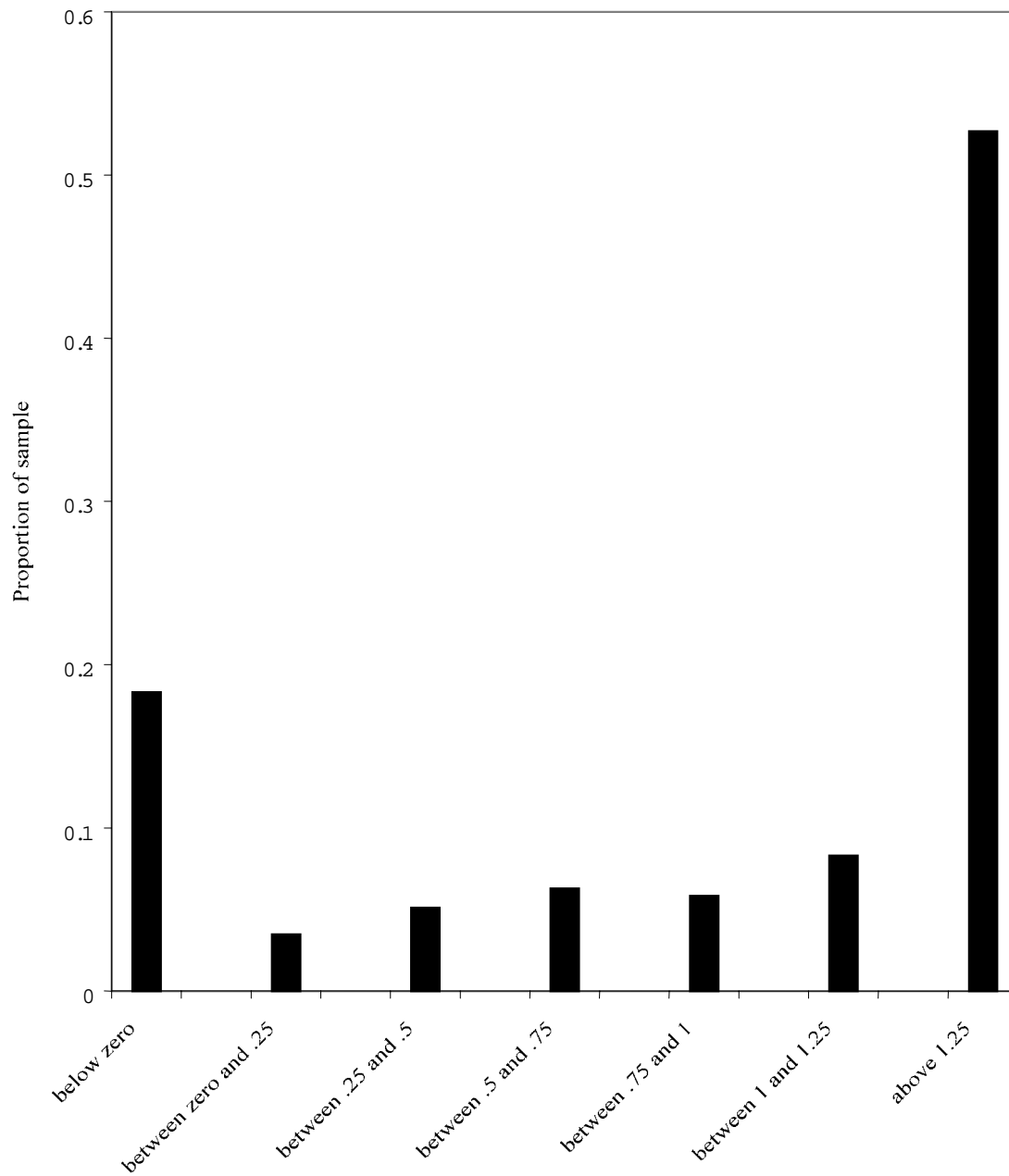
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Figure 4: Frequency distribution of in port income elasticities, pooled cross-country annual data, 1960-99



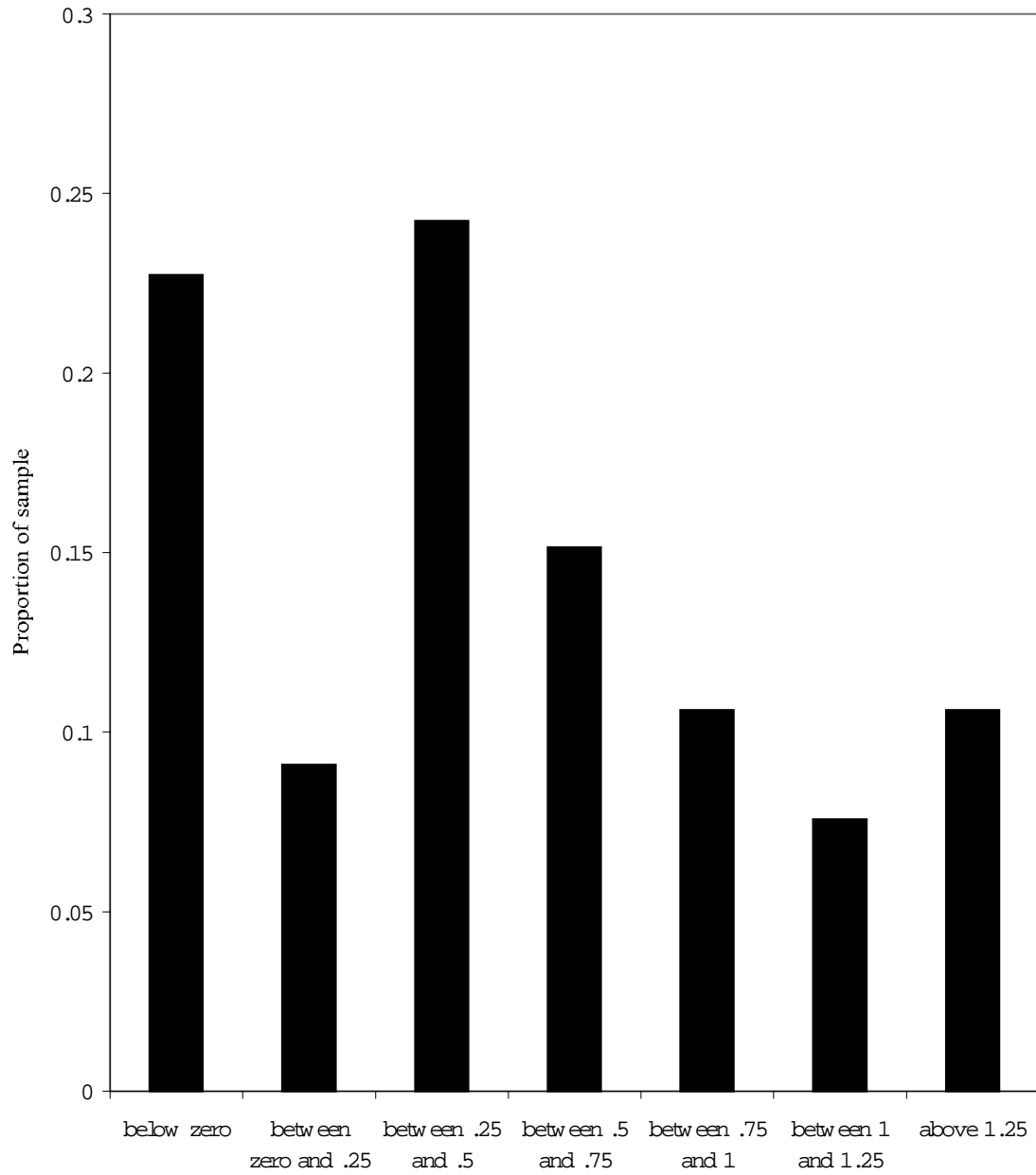
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Figure 5: Frequency distribution of in port income elasticities, pooled cross-country 4-year averages, 1960-99



Import growth tests.xls

Figure 6: Frequency distribution of coefficients of domestic credit creation ratio to GDP regressed on budget deficit ratio to GDP, pooled cross-country annual data, 1970-98



Budget deficits and credit creation.xls



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