PHILIPPINE INSTITUTE FOR DEVELOPMENT STUDIES
Working Paper 85-02

FINANCING THE BUDGET DEFICIT
IN THE PHILIPPINES

Eli H. Remolona[*]

FINANCING THE BUDGET DEFICIT
IN THE PHILIPPINES

Financing the Budget Deficit
in the Philippines

Eli M. Remolona[*]

1.   Introduction

The last year the Philippines saw a budget surplus for the national government was 1974, just after the first oil price shock. Since then the budget deficits have been chronic. In 1981, for example, the recorded deficit amounted to 4.0 percent fo GNP and 37.2 percent of private savings.

This study examines how those deficits were financed in the past and proposes a rule for financing them in the future. The size of the deficit itself seems to have been managed for stabilization purposes, but little attention has been paid to the way it has been financed in spite of the enormous amount of resources involved and the far-reaching implications on economic efficiency. In the first instance, of course, the national government finances its deficit by issuing debt. But it makes a great deal of difference who ends up holding such debt.

We can in fact distinguish between four basic methods of financing a budget deficit:

(a) the creation of currency, when the Central Bank holds part of the newly issued debt, thereby monetizing it, and it ends up in the hands of the public as freshly printed money or in bank vaults as excess reserves;

(b) raising reserve requirements, when banks are made to hold additional required reserves in the form of cash, balances with the Central Bank, or eligible government securities;

(c) domestic open-market borrowing, when government debt is voluntarily held by the banks or the public for the interest it pays; and

(d) foreign borrowing, when the national government borrows abroad.

The distinction between (a) and (b) reflects recent developments in monetary theory (Fama 1980 and McKinnon 1981), in which the former is seen to correspond to the inflation tax and the latter to a tax on financial intermediation. In the case of (c) and (d), while both may be treated together as a tax on savings, a distinction between them seems in order because of the importance in the Philippines of the balance of payments and the need to service external debt.

The theory developed below chooses the optimal mix of policy instruments by maximizing the welfare of a representative household subject to financing a given budget deficit. It is shown that in credit markets repressed by interest ceilings, such as the ceilings the Philippines had for most of the 1970s, financing a budget deficit calls for heavy reliance on reserve requirements. Under interest repression, reserve requirements serve as a tax to soak up rents accruing to those borrowers who are privileged to have access to cheap capital. The other instruments of deficit financing would only exacerbate the existing distortions. The reserve tax, however, is only a way to make the best of bad situation. Once credit markets are liberalized, such a tax introduces its own distortions and it should therefore be phased out then.

The liberalization of credit markets means the optimal policy mix will consist only of the inflation tax and open-market borrowing. The precise mix will depend on various elasticities of demand. In this paper, an attempt is made to get at those elasticities by estimating demand functions for money and for future wealth. The resulting calculations show that even with credit liberalization, there would still be no room for the inflation tax. The budget deficit at its present levels should be financed entirely by open-market borrowing.

There are six sections to follow. Section 2 is a brief review of background literature. Section 3 is an overview of the Philippine experience in financing its budget deficit in the twelve years between 1970 and 1981. Section 4 develops a theory of deficit finance for the case of a credit market repressed by an interest ceiling. Section 5 provides an analysis of the same problem for the case of a credit market that has now been freed from

interest repression. Section 6 reports the estimates of the demand functions for money and for future wealth and applies those estimates to illustrate the financing rule derived in the previous section. Section 7 concludes with suggestions for further work.

2.   Background Literature

The standard textbook analysis of the financing of a budget deficit distinguishes only between money creation and debt finance.[1] According to this analysis, an increase in the deficit financed entirely by public borrowing shifts the IS curve to the right, resulting in some output expansion together with a higher nominal interest rate in the short run when price are supposedly fixed. If instead this increase in the deficit as financed by money creation, the LM curve shifts to the right as well. This shift in the LM curve has a dampening effect on the interest rate, and hence the output effect must now be greater because there would then be less crowding out of investment.

2.1   The Friedman-Tobin debate

There was for while a lively debate between Milton Friedman and James Tobin as to the relative magnitudes of those effects.[2] Friedman (1971) minimized the effect of a debt-financed deficit, but that effect Tobin (1971) attributed to the unrealistic assumption of a vertical LM curve. Friedman denied (1972) this charge by asserting instead a fairly flat IS curve. However, the two did seem to agree on the sizeable output effects of money creation.

Moreover, Friedman (1971, 1972) seems to have placed more emphasis on changes in the price level, which in the longer run would tend to shift the LM curve back to offset the initial effect on real output while leaving nominal output at a permanently higher level. Tobin (1972) did agree that the more sensitive prices are to

---

[1] See, for example, Dornbusch and Fischer (1981, Chapter 14).
[2] This debate was sparked by the publication in 1971 of Friedman's theoretical framework using the Hicksian IS-LM apparatus. This exchange was published in the form of a symposium of papers in the September-October 1972 issue of the *Journal of Political Economy*.

aggregate demand, the steeper the LM curve. Hence, the difference was only one of emphasis with respect to price changes. The standard textbook analysis now takes account of these price changes by incorporating a Phillips curve.[3]

2.2   The Barro critique

In a very influential paper, Robert Barro (1974) pointed out that the financing of a budget deficit by the issue of public debt would raise output only if such debt was perceived as net wealth by the private sector, since only then could aggregate demand be increased. Barro then showed that if there were operative inter-generational transfers, public debt would not be so perceived, because the private sector would discount their wealth by the future tax liabilities needed to service that debt. This conclusion is very damaging to the standard analysis because it means that budget deficits are completely neutral, and in particular not at all expansionary.[4]

Barro's conclusion, however, depends also on the assumption of a perfect capital market. In the fragmented capital markets of LDCs, the government can often offer debt more efficiently than can other sectors and it can thus create net wealth. Moreover, Barro's results depend on the assumption of lump-sum taxes to service public debt. If taxes were distortionary, as in fact they are, then even if there were no wealth effects, there would still be substitution effects from taxes needed to service public debt, and the neutrality result would be lost. In this case, there would be grounds for balancing the distortionary effects of a debt-financed deficit against the distortionary effects of inflationary finance.

---

[3] See Chapter 11 of Dornbusch and Fischer (1981). John Power (1975) proposes an ingenious alternative in which prices depend on marginal costs and the degree of monopoly, so that the price level would rise as capacity output is approached.

[4] This result, Barro apparently believes, applies also to budget deficits financed by money creation. This is the impression one gets from Barro's (1977) empirical work, I which he shows that only unanticipated changes in the money stock affect real income. Barro's work is part of the so-called Rational Expectations School, which assumes that agents use information efficiently in forming expectations and that markets always clear (see Sargent and Wallace 1976).

2.3   Application to LDCs

Even if the IS-LM analysis of financing a budget deficit survives Barro's attack, it may not be so resilient against the harsh terrain of LDC economies. There are at least three major problems in the application of such a standard framework to a country like the Philippines:

    (a)   First, the tools of monetary policy may be difficult to apply with the required degree of precision. The absence of well-developed capital markets in LDCs makes it hard to conduct open-market operations. Furthermore, the weakness of information systems in those countries delays the recognition of stabilization problems. Finally, the fragmentation of markets could mean that policy effects would have long and unpredictable lags.

    (b)   Second, the underlying model may not even be appropriate. John Power (1977), for example, contends that wages in the modern sector are determined by institutional factors leading to Marxian, rather than Keynesian, unemployment. It has also been pointed out that output fluctuations in the LDCs depend largely on supply factors rather than on aggregate demand.

    (c)   Finally, efficiency rather than stabilization may be the overriding concern. Ronald McKinnon (1973) and Edward Shaw (1973), for example, argue that with fragmented and repressed capital markets the major aim of monetary policy should be the development and liberalization of these markets. Similarly, Power (1977) emphasizes the capital-intensive bias of the existing tariff protection system and points out the importance of trade liberalization.

3.   An Overview of the Budget Deficit, 1970-1981

The national government has been incurring budget deficits at least since 1975. Going by the official government accounts, there was a small surplus in 1973 and 1974.

Those were the two years of the first oil price shock, when the price of imported crude quadrupled. After a small deficits in 1975, the deficits became chronic for three years, averaging close to P72.5 billion a year. Then in 1979, the year of the next oil price shock, the deficit fell to less than P0.5 billion. In the two final years covered by this study, the deficit rebounded with a vengeance, reaching record levels of P4.0 billion and P12.2 billion. The latter figure amounted to 4.0 percent of GNP.

3.1 Measuring the Budget Deficit

In principle, the budget deficit as recorded in the official government accounts should correspond to the change in outstanding national government debt as recorded in the public debt accounts. In fact the numbers are quite different. There are at least two reasons for the divergence. First, the government could issue more debt than is needed to cover the deficit in order to build up its deposit balances with the banking system. Second, there could be a difference in timing between the recording of government receipts and expenditures, whether on a cash or obligations basis, and the recording of debt issue by the Treasury.[5]

We would expect the government to draw down its deposit balances when it wishes to refrain from issuing too much debt to finance a deficit. Conversely we would expect it to accumulate such balances during surplus years and even to retire bonds issued earlier. In practice, however, this has not been the case. In the 12-year period under study, only in 1976 and 1977 did the government draw down its deposits to finance part of its deficit. The rest of the time, it issued more debt than the deficit and used the excess funds to build up its deposits.

Unfortunately, adjustments to take account of such government cash management do not bring the recorded official deficits very much closer to the recorded changes in public debt. Table 3.1 shows that the unexplained residuals can be quite larger, often even exceeding the official deficit figures. Moreover, it does make a difference

---

[5] We are indebted to John Power for pointing this out.

which numbers one looks at. If it is the changes in public debt that one looks at, then in no year was there a surplus in the entire period under study. The deficit is lowest in 1971 when it was just about half a billion pesos. This time there is little correspondence with the oil price shocks. The surge in the numbers in the final years becomes more striking. In 1980 and 1981, the deficit would represent 5.3 and 5.5 percent of GNP respectively, dramatizing apparent attempts by authorities at countercyclical policy, those being recession years.

Table 3.1. The Budget Deficit as Officially Recorded, as Including Government Cash Management, as the Change in Public Debt, and the Unexplained Residual (in Millions of Pesos)

Year	Officially Recorded	Including Cash Management	Change in Public Debt	Unexplained Residual
1970	(59)	326	1,604	1,278
1971	183	221	508	289
1972	1,011	1,372	2,115	743
1973	(2,090)	381	1,693	1,312
1974	(2,442)	690	2,738	2,357
1975	948	1,290	3,765	2,556
1976	2,229	1,594	1,950	356
1977	2,723	1,404	4,425	3,021
1978	2,456	4,651	6,761	2,110
1979	489	3,744	2,892	(852)
1980	4,054	5,414	14,015	8,001
1981	12,153	15,418	16,677	1,259

Source of basic data: Bureau of Treasury.

For purposes of breaking the deficit down into its sources of financing, we shall use as our measure the change in public debt. We do this only for reasons of consistency. To break the deficit down into its sources of financing, we need to use figures on debt holdings by various sectors. With the deficit itself based on debt figures from the same set of accounts, the numbers will add up. On the other hand, if we defined the deficit in terms of the budgetary accounts, we would have to make an arbitrary decision as to which source of financing to take as the residual.

3.2 The Use of Base Money Creation

When the Central Bank adds to its holdings of government debt, it creates base money in the form of either fresh currency or bank reserves. Hence the part of the deficit financed by money creation corresponds to the increase in Central Bank holdings of government debt. That the deficits seem to have been held down at the time of the oil price shocks might indicate attempts to control the inflationary effects of those shocks by preventing monetary accommodation.

The relation between deficits and money creation, however, is not clear from the evidence. In 1970, for example, debt issue was P1.6 billion which base money creation was P0.7 billion. Then in 1972 debt issue rose to P2.1 billion and yet base money contracted by P0.6 billion.

In an attempt to discover what it is that has guided monetary policy, we regressed base money creation on variables representing possible goals of stabilization and on the size of the deficit itself.[6] Among our better results was the following:

$$h_t = 0.07 + 5.04\ g_{t-1}\ +\ 0.56\ BuD_{t-1}\ +\ 0.29\ \pi_{t-1}$$
$$(2.53)\phantom{5.04\ g_{t-1}}\ (1.81)\ (0.88)$$

$$+\ 0.07\ u_{t-1}\ -\ 0.35\ h_{t-1}$$
$$(0.71)(-1.28)$$

$$R^2 = 0.41 \qquad D.W. = 2.60 \qquad F = 1.29$$

where h is base money creation, g is the ratio of GNP to the previous year's GNP, BuD is the ratio of government expenditures to reserves, π is the inflation rate, u is the unemployment rate, the subscript t-1 indicates a one-year lag, and all the variables are in logarithms.

The t-values in parentheses indicate that only the income growth and budget deficit variables have coefficient significantly different from zero at the 5 percent

---

[6] For a more detailed report, see Araneta (1983).

level. The implication seems to be that the elasticity of base money creation with respect to budget deficits is about 56 percent. On the other hand, the income variable had the wrong sign. Moreover, the regression fails the F test. When we added a dummy variables for the years of the oil price shocks, even the coefficient for the budget deficit became insignificant.
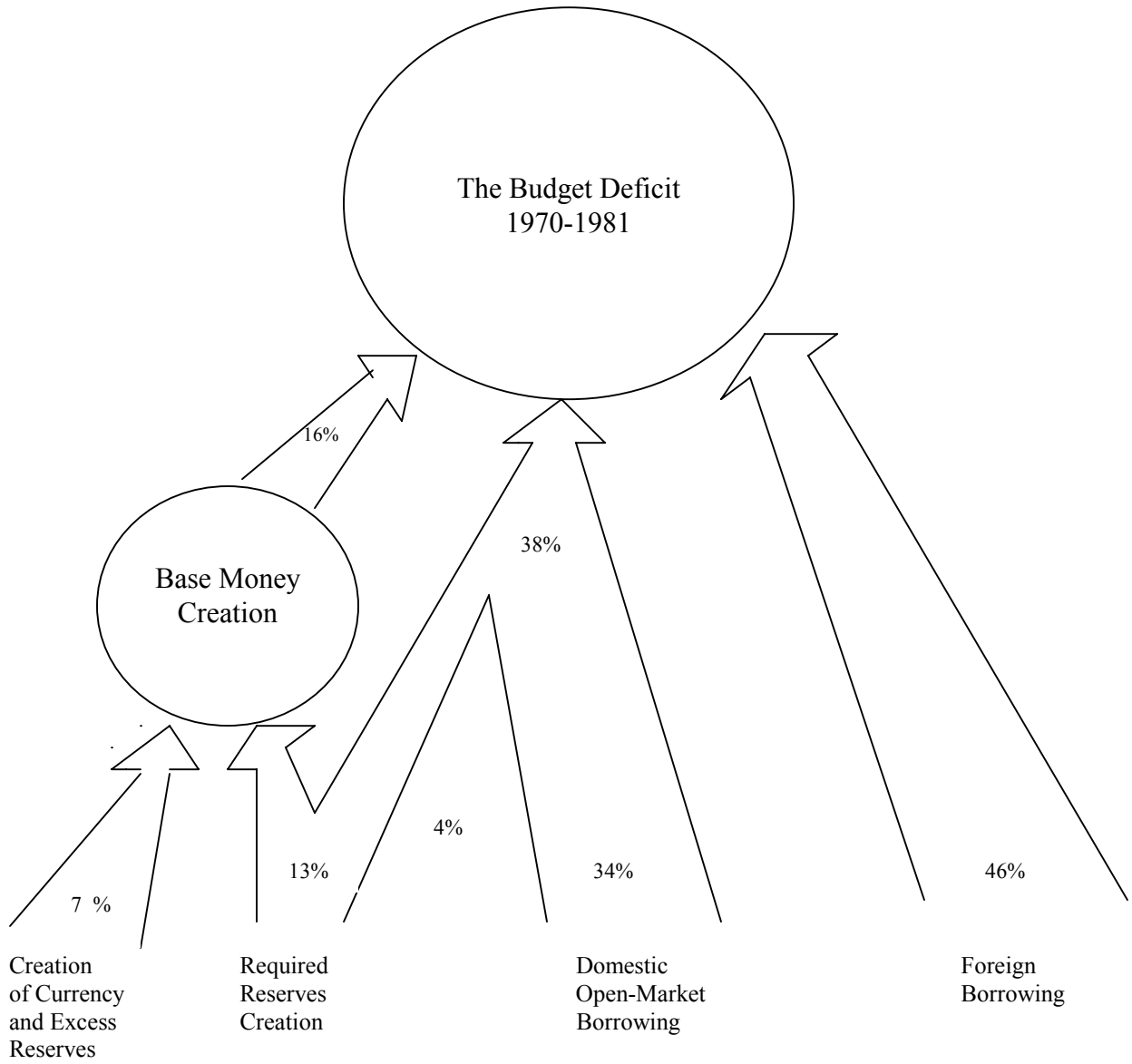
3.3   Sources of Deficit Financing

If we add up all the budget deficits in real terms for the 12 years of the study and do the same for base money creation, we will find that on the average only 16 percent of the deficit was monetized. However, as Figure 1 shows, more than half of the monetized deficit ended up as required reserves. Hence only 7 percent of the budget deficit was actually financed by the creation of currency in circulation and excess reserves. To be sure the total amount of currency creation and the corresponding inflation tax during the period was greater than that, but the rest of it went not to financing the budget deficit but to Central Bank lending to financing institutions.

The larger part of the deficit was not monetized, that is, most of the debt that was issued was not held by the Central Bank. In fact, 46 percent of that debt went to foreign lending institutions, so that over half of the nonmonetized deficit was financed by foreign borrowing. The rest of the deficit was financed largely by domestic open-market borrowing, with only 4 percent being added to the creation of required reserves in the form of eligible government securities. These securities eligible to be held as required reserves constitute a tax on financial intermediation to the extent that they offer poorer yields than the government securities traded competitively on the open market.

The most erratic source of deficit financing has been the creation of currency and excess reserves. Indeed, as Table 3.2 shows, for half the years of the study, this was a negative source financing. It financed as much as 33 percent of the deficit in 1974 and detracted by as much as 29 percent in 1979 from deficit financing.

Figure 1

The Budget Deficit
1970-1981

16%

Base Money
Creation

38%

4%

13%

7 %

34%

46%

Creation
of Currency
and Excess
Reserves

Required
Reserves
Creation

Domestic
Open-Market
Borrowing

Foreign
Borrowing

Neither the creation of required reserves nor domestic open-market borrowing show any consistent pattern as sources of deficit financing, except that the former tends to be used most when the deficit is not particularly large, as in 1971, 1973 and 1976. The years of big deficits were the years in which the government turned to foreign borrowing quite heavily, as in 1975, 1977, 1978 and 1981. An exception was 1980 when the P14 billion deficit was financed mostly by domestic open-market borrowing. But by and large, it seems that the national government spent more whenever it had access to foreign funds.

Table 3.2 Sources of Budget Deficit Financing as Percentages of the Deficit

Year	Budget Deficit[a] (Millions of Pesos)	Currency Creation	Required Reserves Creation	Domestic Open Market Borrowing	Foreign Borrowing
1970	1,604	(5.4)	25.1	(4.2)	84.5
1971	508	(25.9)	39.2	43.1	46.6
1972	2,115	32.0	7.0	29.6	31.4
1973	1,693	6.4	36.2	58.5	(1.1)
1974	2,738	33.1	17.3	30.4	19.2
1975	3,765	(13.4)	11.1	41.6	60.6
1976	1,950	8.0	39.3	46.2	6.4
1977	4,425	(10.5)	26.6	28.4	55.5
1978	6,761	(0.9)	14.9	31.2	54.8
1979	2,892	(29.1)	21.9	53.4	53.7
1980	14,015	9.7	4.3	59.3	26.7
1981	16,677	24.9	6.6	9.1	59.3

[a] Measured as the change in outstanding debt of the national government.

Source of basic data: Central Bank and IMF

4. Optimal Deficit Finance in a Repressed Credit Market

We provide here a framework for the analysis of the choice among the four methods of deficit financing that we have discussed. To reiterate, these methods are: (i) the creation of currency in circulation and excess bank reserves; (ii) the creation of required bank reserves; (iii) domestic open-market borrowing; and (iv) foreign borrowing. In this analysis,

we stress efficiency rather than stabilization as the objective of policy. In particular we treat those methods of deficit finance as essentially distortionary taxes. The idea is then simply to set these taxes so as to minimize the deadweight loss from financing a given budget deficit.

Minimizing the deadweight loss of deficit finance is no more than an application to monetary policy of Ramsey's (1927) classic approach to commodity taxation, in which taxes are chosen to maximize the utility of a representative consumer subject to the constraint of raising a fixed amount of tax revenue. The e are new twists to the present application because we have to take account of the existing distortion of interest repression, and even when we assume this distortion has been removed, we still have to account for the special characteristics of the taxes used to finance a deficit.

In this section, we take up the case in which such a distortion and another one with similar consequences are accepted as given.

4.1 The Existing Distortions

The existing distortions that present a major concern are those that arise from two particularly onerous systems of government intervention: (i) the system of interest controls; and (ii) the system of tariff protection. In the case of (i), Ronald McKinnon (1973) has shown how usury ceilings have served to fragment financial markets and to prevent interest rates from reflecting the scarcity cost of capital. In the case of (ii), John Power (1977), among others, has pointed out how the tariff structure has resulted in widely varying effective rates of protection and in overinvestment in capital-intensive industries. McKinnon and Power both reach the conclusion that the consequences of such financial and trade repression are the stifling of savings and the misallocation of capital.

Indeed these consequences have not gone unnoticed in the Philippines. The government here has actually responded to the problem by embarking on a program of gradual trade and financial liberalization. The problem now is how to manage the

transition to a liberalized economy. During this transition, as long as elements of repressive intervention remain, second-best policies continue to be called for. As things turn out these existing distortions dominate all other considerations including the distortions the methods of deficit finance would otherwise impose. Hence, the policies called for are specifically those that avoid exacerbating the existing distortions. In other words, the financing of the budget should at the very least not discourage savings any further nor reinforce the patterns of investment engendered by financial repression and tariff protection.

In what follows, we evaluate each of the methods of deficit financing specifically in the presence of the existing distortions of financial repression and tariff protection. We save for the next section the analysis of the case in which those distortions no longer exist.

4.2 The Creation of Currency

Since financial repression is imposed mainly through ceilings on *nominal* interest rates, the creation of currency and excess reserves, to the extent that it is inflationary, can only make matters worse. In such a repressed regime, inflation is a tax not only on real money balances but also on savings deposits. In the 1970s, when nominal interest rates on savings deposits in the Philippines were kept at six to seven percent, the onset of double-digit inflation led to negative real rates of return. Financial repression then was so severe because inflation rates were so high.

Usury ceilings on interest rates favor the small class of borrowers who can borrow at the controlled rates at the expense of the large number of savers who have to settle for low returns.[7] In such a situation, inflation is a particularly cruel tax, because by lowering real interest rates it raises the subsidy on the already privileged class of borrowers while making the burden on the small savers even more oppressive.

---

[7] See Krugman (1978) for a simple yet vigorous analysis of the effect on saving and investment of usury ceilings.

Indeed in a regime of financial repression, the next best thing to actually freeing interest rates would be to reduce inflation. If pursued far enough, such a policy can even serve to make the usury ceilings non-binding and to effectively eliminate an important instrument of financial repression. In this case, however, not much seigniorage revenue can be extracted and the budget deficit will have to be financed largely by means than currency creation.

4.3 Domestic Open-Market Borrowing

Government debt must in one way or another be serviced by taxes in the future. To the extent that such taxes are anticipated, they are equivalent to a tax on savings and will induce a shift towards present consumption. In a regime of trade and financial repression, where saving is already discouraged, such a tax would only aggravate the situation. In such a regime, financing the budget deficit by means of domestic open-market borrowing should therefore be avoided.

If the private sector has no access to the foreign capital market, the effect of public domestic borrowing must be to directly crowd out domestic investment. In a repressed economy, the crowding out is not necessarily through higher interest rates, since those rates are largely controlled, but through reducing the amount of rationed credit available to private investors. This amount is reduced not only because of what the government appropriates for itself but also because the flow of savings is reduced in anticipation of future tax liabilities.

Note, however, that when the government borrows by requiring financial institutions to hold its debt as reserves, the effect is not quite the same. The effect this time, as will be discussed later, is not to tax savings but to tax loans.

4.4 Foreign Borrowing

If domestic open-market borrowing should be avoided, more so foreign borrowing. Whether the government borrows locally or abroad, the debt has to be serviced by future taxes, but servicing foreign debt must somehow entail taxes that are more burdensome and the more painful the measures that will have to be instituted in the future to pay for that deficit and the greater will be the tax burden on present savings.

Moreover, the system of tariff protection through its effect on the exchange rate invariably results in an overvalued currency and therefore a persistent difficulty of raising the foreign exchange needed to service foreign debt.

4.5 Reserve Requirements

We are left with just one instrument with which to finance the budget deficit. Fortunately this last one suits our purposes. The reserve requirement is a tax on financial intermediation as long as the forms of government debt used as reserve assets yield lower rates of return than the rates that prevail in the market.

The effect of this tax, as McKinnon (1981) has pointed out, is to widen the wedge between deposit rates and loan rates. In a liberalized economy, the resulting disparity in rates of return is inefficient because it distorts investment decisions, and this distortion is a strong case against the reserve tax. For an already distorted economy, however, this tax turns out to be a good second-best measure and therefore more discouraging to savings. The reason for this has to do with the perverse tendency of a repressed economy to incur current account deficits.

The current account deficit may be expressed as the difference between domestic investment and domestic saving. Here domestic saving could be viewed as consisting of private saving and government saving. A budget deficit simply means government

saving is negative. Since economic repression discourages savings at the same time that it promotes overinvestment in capital-intensive industries, the chronic shortage of savings that results is thus what also explains the strong tendency towards current account deficits in such economies. Since it is easier for the government than for the private sector to borrow abroad, there will be less crowding out of domestic investment if the government borrows abroad than if it borrows locally, and the current account deficit will only be larger.

Large current account deficits are a problem because they will have to be matched by large current account surpluses in the future for the repayment of the debt accumulated to finance the deficits. If in the future private savings fail to exceed private investment by enough produce those surpluses, the government must somehow come up with its own budget surpluses. Hence, the more the government borrows abroad, the greater the current account deficit.

When usury ceilings already keep deposit rates below equilibrium levels, the impact of the reserve tax must be entirely on loan rates. By raising loan rates, the reserve tax only serves to soak up the rents accruing to the privileged borrowers who have access to cheap credit. There is no exacerbation of distortions, for a tax on borrowing in a financially repressed economy is tantamount to a tax on a rationed good, the demand for which must then be effectively inelastic. For this reason, heavy reliance on the reserve tax for financing the budget deficit is justified.

Since the reserve tax is only a second-best measure, however, care must be exercised to see to it that the tax is phased out as soon as liberalization is achieved, at which point currency creation and open-market borrowing become the preferred instruments for financing the budget deficit.

4.6 Evaluating the Philippine Record

In terms of the above analysis, the Philippines should have resorted to the reserve requirement much more than it did between 1970 and 1981, since in most of those years there was financial and trade repression.[8] Instead the favorite method during this period was foreign borrowing, followed by domestic open-market borrowing. These policies must have imposed a severe tax on savings, not to mention the strain on the country's capacity to maintain adequate foreign reserves.

Of course, it must have been the stabilization problem that was the major concern of policymakers at that time. Ideally, policy should strike a balance between the short run concerns of stabilization and the longer term concerns of efficiency. In other words, the reserve requirement should not have always been the measure resorted to in financing the budget deficit, but it certainly should have been used much more on the average.

5.   Optimal Deficit Finance After Liberalization

Once the major distortions of interest repression and tariff protection are removed, the distortions imposed by the deficit taxes themselves will become the important ones. Of course some other market imperfections will remain, such as those arising from transactions costs or from small investment indivisibilities, but these can be considered minor. Their effects would simply be to bring demand or supply elasticities closer to zero, following the Le Chatelier Principle (Samuelson 1947, pp. 36-46), and they would be properly reflected in the measurement of the deadweight losses from the deficit taxes.

Moreover, in a credit market free from interest repression, the reserve requirement becomes patently the most distortionary of the four methods of deficit finance. The reason for this is that while the other methods are effectively taxes on final goods, the reserve requirement, as a tax on financial intermediation, is a tax on what is really an intermediate

---

[8] The liberalization program started only in 1981.

17

good. In this regard, we invoke the following argument by Peter Diamond and James Mirrlees (1971, p.24):

> In the absence of profits, taxation of intermediate goods must be
> Reflected in changes in final-good prices. Therefore the revenue
> could have been collected by final-good taxation, causing no greater
> changes in final-good prices and avoiding production inefficiency.

As we have pointed out, the way the reserve requirement causes production inefficiency is by driving a wedge between deposit rates and loan rates and thereby creating disparities in marginal rates of transformation in the economy.

If we rule out the use of the reserve requirement because of the production distortion it alone entails, we will be left with just the choice between the inflation tax and open-market borrowing. The distinction between domestic open-market borrowing and foreign borrowing loses its importance once financial and trade liberalization is complete. Both measures will have the effect of a tax n savings. Hence we shall proceed to derive a financing rule that minimizes only the distortion from the inflation tax and the tax on the future that is used to service present public borrowing.

5.1. The Capital Market

To keep the analysis simple, let us work with just two periods, the present and the future. In this framework, a household can, by the act of investment, transform present resources into a future composite good we shall call future wealth. In Figure 2, the transformation technology is represented by the curve TT. The opportunities for lending and borrowing provided by the capital market are represented by the line AD, which has a slope of - (1 + r), where r is the real interest rate.

To maximize the present value of its wealth, the household produces at point B, which entails an investment of GT in present resources and which yields OF in future

wealth. To maximize its utility, this household consumes at point E, where the market opportunities line is tangent to the indifference curve UU. This point of tangency consists of present consumption of OC and future wealth of OZ.

The household in this example is a lender. The amount of lending is CG and the loan payment is FZ. If the household were a borrower instead, its indifference map would be such that the utility-maximizing point of tangency with the market opportunities line would be somewhere between points B and D.

Figure 2

Future Wealth

Present Consumption
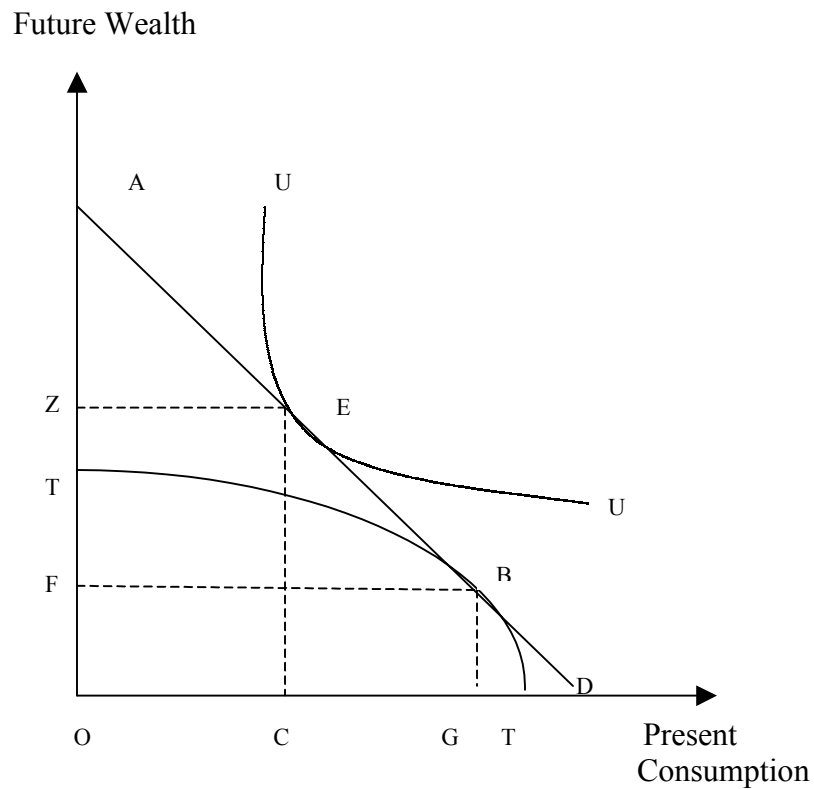
For convenience, let us assume for the time being a perfect capital market. By this we simply mean that there prevails a single real interest rate faced by both lenders and borrowers and that this rate is fixed exogenously.[9] This assumption can be relaxed later. In what follows, we introduce money balances, public debt, inflation and a tax on future wealth.

5.2   Household Welfare

In a perfect capital market, it makes no difference to the analysis of household welfare whether we look at a lender or at a borrower. Let us then just look at a lender. Let us assume that this household start with a present endowment of y^0, which it divides between present consumption c, present real money balances m, lending h, and direct investment k. This allocation yields future wealth of

$$(1) \qquad z = (1 - \ [f(k) \ + \ (1 - \pi)m \ + \ (1 - r)h]$$

where f(k) is direct production of future wealth, τ the tax rate on future wealth, π the anticipated inflation rate, and r the real interest rate. The proceeds from the wealth tax are what was used to service public debt. As specified, this tax is fairly benign in that it distorts only relative prices between periods and not within periods.

Real money balances are assumed to be an argument in the household's utility function to represent the advantage of liquidity. Thus this household maximizes the utility function U(c, m, z) subject to the endowment constraint $y^0 = c + m + h + k$. The first-order conditions for an interior solution are

$$\frac{U_c}{U_z} \ = \ (1 - \tau)f^l$$

$$\frac{U_m}{U_z} = (1 - \tau) \ (f^1 - 1 + \pi)$$

$$f^1 = 1 + r$$

in addition to the endowment constraint.[10]

From those first-order conditions we can derive the household's demand for present consumption, present real balances, and future wealth. The most useful way to proceed is to note that those conditions make the marginal rate of substitution between two goods equal to the ratio of the prices of the goods. If we then select the present consumption good as the numeraire by setting its price equal to one, the resulting prices for present real balances and for future wealth are respectively

$$q \equiv \frac{r + \pi}{1 + r}$$

$$p \equiv \frac{1}{(1 - \tau)(1 + r)}$$

With these prices, the household's maximization problem is equivalent to maximizing $U(c, m, z)$ subject to $w = c + qm + pz$, where $w = y^0 - k + (1 + r)^{-1} f$ and $f^1 = 1 + r$.

Hence we can write the household's demands as $c = c(q, p, w)$, $m = m(q, p, w)$, and $z = z(q, p, w)$. The effects of π and τ can then be traced through their effects on the prices q and p. The advantage of this formulation is that it allows us to work with demands that have the familiar properties of standard demand functions. These are properties we will soon find useful.

---

[10] We take for granted the second-order conditions that assume a maximum.

To examine household welfare, we can reinsert the demands c, m, and z into the utility function and write the indirect utility function $V = V(q, p, w)$. We can then apply Roy's identifies or the Antonelli equations $V_q = \lambda m$ and $V_p = \lambda z$, where λ is the marginal utility of income, to derive the welfare effects

$$V_\pi = \frac{-\lambda m}{1 + r}$$

$$V_\tau = \frac{-\lambda z}{(1 - \tau)^2 \ (1 + r)}$$

What is shown is that the marginal welfare loss from inflation is proportional to the demand for real balances and that the marginal welfare loss from the wealth tax is proportional to the demand for future wealth.

5.3   Specifying Revenues

We assume the government has a present budget deficit which is to be financed by inflation and by public borrowing. Given the inflation rate π and the tax rate τ, we specify the revenue available for deficit finance to be

$$D = qm + \tau pz$$

where D is total revenue per household in units of present consumption and the other variables are as defined before.

Here the revenue from the inflation tax is specified to be $qm = (r + \pi) \, m / (1 + r)$. This form of seigniorage revenue is equivalent to the "honest government" revenue from money creation (Auernheimer 1974) and can also be shown to be the specification that assures a time-consistent monetary policy (see Appendix). Such a specification makes the inflation tax completely analogous to a tax on a good produced at no cost. The after-tax price of that good in this case is q and the tax base is m.

In the case of the wealth tax, the future proceeds of the tax amount to $\tau z/(1 - \tau)$. Since the deficit to be financed is in the present, the government first borrows the funds. The amount of borrowing the wealth tax can support is simply $\tau z/(1 - \tau)(1 + r) = \tau pz$.

5.4 The Optimal Policy Mix

We wish to choose policy so as to maximize the welfare of a representative household subject to financing a given deficit. This is the same thing as minimizing the deadweight loss from the distortions imposed by deficit finance. To simplify matters, assume further that there are no other taxes and no other sources of income, so that the deficit is really total government spending.

The problem is then to maximize with respect to π and τ the Lagrangean

$$L = V(q, p, w) - \mu[D(q, p, w) - D^0]$$

where D^0 is the given deficit. The first-order conditions for an interior solution are

$$-\lambda m = \mu(m + qm_q + \tau pz_q)$$

(1)

$$-\lambda z = \mu(qm_p + z + \tau pz_p)$$

in addition to the deficit financing constraint $D = D^0$. Expressed in terms of elasticities, these conditions are

$$-\lambda qm = (qm + qme_{mm} + \tau pze_{zm})$$

(2)

$$-\lambda pz = (qm_{mz} + pz + \tau pze_{zz})$$

where e_{ij} is the elasticity of the demand for good i with respect to the price of good j.

To simplify these conditions, we can turn to the familiar properties of demand functions. Specifically we can use the Slutsky equation

$$e_{ij} = \epsilon_{ij} - \sigma_j \eta_i \ ,$$

the symmetry condition

$$\sigma_i \epsilon_{ij} = \sigma_j \epsilon_{ji} \ ,$$

and the zero-homogeneity property

$$\epsilon_{mc} + \epsilon_{mm} + \epsilon_{mz} = 0$$
$$\epsilon_{zc} + \epsilon_{zm} + \epsilon_{zz} = 0$$

where ϵ_{ij} is the elasticity of the compensated demand for good I with respect to the price of good j, η_i is the income elasticity of good i, and σ_i is the fraction of the household's income that it allocates to good i.

Using the above properties of demand functions allows us to reduce (2) to

$$(3) \qquad \tau = \frac{-(\epsilon_{mm} + \epsilon_{zz}) - \epsilon_{zc}}{-(\epsilon_{mm} + \epsilon_{zz}) - \epsilon_{mc}}$$

in which it can be shown that both the numerator and denominator are positive. This condition together with the financing constraint $D = D^0$ determines the optimal combination of π and τ and the corresponding optimal division of the deficit between inflationary finance and debt finance.

That (3) can be expressed entirely in terms of <u>compensated</u> demand elasticities is significant. It means that income effects are completely irrelevant to optimal deficit finance. This is a result due to the assumption of a perfect capital market. In such a

market one tax has just the same income effect as any other tax, so income effects all cancel out in a tradeoff between taxes. Tax distortions then depend only on substitution effects. But as soon as we consider market imperfections, we will have to accept the complications of income effects.

A closer examination of (3) will show that optimal deficit finance depends on the relative degree of complementarity between present consumption and present holdings of real balances and between present consumption and future wealth. When $\epsilon_{mc} < \epsilon_{zc}$, present consumption and present balances are closer complements than are present consumption and future wealth, and only then ćc we have $\tau < 1$, or a positive inflation tax, at the optimum. In general, the greater the degree of complementarity between consumption and real balances the higher the optimal inflation rate and the lower the optimal tax rate on future wealth. This accords with the result reached by Corlett and Haque (1953) that we should tax more heavily goods that are complementary with the untaxed good. In their case, leisure is the untaxed good; here it is present consumption.

6.   Estimating the Parameters for the Financing Rule

This section reports an attempt to estimate the parameters needed to implement the optimal tax rule for deficit financing. As derived in the last section, this rule can be stated in terms of the optimal tax rate on future wealth as

$$(3^1) \qquad \tau^* = \frac{\epsilon_{zm} - \epsilon_{mm}}{\epsilon_{mz} - \epsilon_{zz}}$$

where   is the elasticity of the compensated demand for good i with respect to the price of good j, z in this case representing future wealth and m present real balances.

To estimate the above elasticities we need to estimate demand functions for money and for future wealth in the special way these functions were formulated in the last section.

What is special about that formulation is the specification of the prices of real balances and of future wealth as respectively

$$q \equiv \frac{r + \tau}{1 + r}$$

$$p \equiv \frac{1}{(1 - \tau)(1 + r)}$$

where present consumption is taken to be numeraire, r is the real interest rate, π is the expected inflation rate, and τ is the <u>expected</u> tax rate on future wealth associated with the debt servicing of present public borrowing. In addition to these two price arguments, the demand functions contain the usual permanent income or wealth argument which itself depends on expectations. Hence we must first grapple with the problem of expectations.

6.1 <u>The Formation of Expectation</u>

Agents in the economy are seen to somehow form their expectations on the basis of information available from past periods. Here we model these expectations as arising from a vector autoregression process of the form

(4) $\hat{x}_t = a_0 + a_1 x_{t-1} + a_2 x_{t-2}$

where x_t is a vector representing the inflation rate, the tax rate on future wealth, and income at period t, with the "^" denoting expectation.

The system (4) can be interpreted as the reduced form of the model of the economy that the agents perceive. Since we have left the structural model itself unspecified, we make no restrictions on (4), except to limit ourselves to two lags so as not to exhaust degrees of freedom. Besides, the testing of restrictions in a vector autoregression such as (4) is quite complicated because it involves considering the impact of the restrictions on the system as a whole instead of on just each individual equation (Sims 1980). Rather

than go through such a testing procedure, we shall accept our estimates as reasonable as long they generate expectations that yield the theoretically correct signs on the demand functions.

The best results we obtained are presented in Table 6.1. The inflation rate variable was computed as $\pi_t = \ln(WPI_t/WPI_{t-1})$ where WPI is the Wholesale Price Index. The tax rate variable was computed as $\pi_\tau = \Delta B_t/S_t$ where ΔB_t is the amount of non-monetized debt issue and S_t is aggregate private savings. Finally, the income variable was computed as $\acute{w}_t = y_t + q_t m_t$ where y_t is real GNP, $q_t = i_t/(1 + i_t)$ is the imputed price of liquidity services using the nominal interest rate on time deposits, and m_t is real currency in circulation plus real excess reserves. Such a construction of variables is what comes out of the theoretical framework presented in Section 5. In the vector autoregression itself the wealth variable is in logarithmic form while the inflation rate and tax rate variables are not. The predicted values from such a formulation, when used as the expectational variables, turned out to produce the best fitting demand functions with the theoretically correct signs.

Table 6.1 A Vector Autoregression in the Inflation Rate, the Implied Tax Rate on Future Wealth, and Income, 1970-1981

Lagged Variables	Dependent Variables		
	π_t	τ_t	$\ln W_t$
π_{t-1}	0.09 (0.35)	-0.68 (0.57)	-0.33 (0.28)
π_{t-2}	-0.31 (0.23)	-0.28 (0.38)	0.44 (0.19)
τ_{t-1}	-0.20 (0.14)	-0.48 (0.23)	0.05 (0.11)
τ_{t-2}	-0.03 (0.10)	-0.19 (0.27)	-0.04 (0.13)

$\ln W_{t-1}$	-0.68 (0.49)	-1.58 (0.79)	0.85 (0.39)
$\ln W_{t-2}$	0.64 (0.45)	1.55 (0.74)	0.14 (0.36)
Standard error of estimate	0.07	0.11	0.05
Sample size	22	22	22

Note: Numbers in parentheses are standard errors. Semestral data from Central Bank and National Economic and Development Authority bulletins were used. The variables were defined as: $\pi_t = \ln(WPI_t/WPI_{t-1})$, $\tau_t = \Delta B_t/S_t$, and $w_t = y_t = q_t m_t$, where WPI_t is the Wholesale Price Index, ΔB_t is the amount of non-monetized debt issue by the national government, S_t is personal and corporate savings, y_t is real GNP, q_t is $i_t/(1+i_t)$ with it as the nominal interest rate on time deposits, and π_t is real currency in circulation plus real excess bank reserves.

6.2   Estimating the Demand Functions

Since it is data on nominal rather than real interest rates that are available, we use the fact that $1 + r_t = (1 - \pi_t)(1 + i_t)$ to get

$$q_t = \frac{i_t}{1 + i_t}$$

$$p_t = \frac{1}{(1 - \tau_t)(1 - \pi_t)(1 + i_t)}$$

where i_t is the nominal interest rate. In our estimates, we use the interest rate on time deposits for i_t. For m_t we use real currency in circulation plus real excess reserves, and z_t we derive from $s_t = p_t z_t$ where s_t is real savings.

Assuming sluggish adjustment in the demands m_t and z_t to desired levels, we get equations (a) and (d) in Table 6.2. The coefficients on $\ln m_{t-1}$ and $\ln z_{t-1}$ indicate

adjustment coefficients of 91 percent for real balances and 90 percent for future wealth within a semester. At the 5 percent level of significance, the null hypothesis of 100 percent adjustment cannot be rejected in either case. The P statistics also indicate acceptance of the null hypothesis that the right-hand side variables do not explain demands.

We reestimated the demand functions by dropping the lagged terms, thus assuming complete adjustment to desired levels within a semester and obtained equations (b) and (e) in the table.

Table 6.2 Estimated Demand Functions for Real Currency and Future Wealth

Explanatory Variables	Equations for ln m_t			Equations for ln z_t		
	(a)	(b)	(c)	(d)	(e)	(f)
Constant	4.58	4.54	3.16	-2.05	-1.85	-0.27
q_t	-3.15 (5.82)	-3.56 (4.87)		-6.90 (10.70)	-3.99 (10.47)	
ln q_t			-0.25 (0.36)			-0.02 (0.77)
p_t	-0.48 (0.26)	-0.40 (0.18)		-0.60 (0.43)	-0.43 (0.39)	
ln p_t			-0.46 (0.20)			-0.54 (0.44)
ln w_t	0.44 (0.53)	0.53 (0.41)	0.54 (0.42)	3.35 (0.94)	1.38 (0.89)	1.11 (0.91)
ln m_{t-1}	0.09 (0.27)					
ln z_{t-1}				0.10 (0.25)		
F	2.51	3.51	3.68	2.66	3.51	3.46

$\bar{R}^2$	0.22	0.25	0.27	0.24	0.25	0.25
S.E.	0.11	0.11	0.11	0.23	0.23	0.23

Note: Numbers in parentheses are standard errors. Semestral data were used.

This time the P statistics indicate rejection of the null hypothesis that the right-hand side variables do not explain demand in either case. However, the estimated coefficients imply elasticities of demand that are not altogether that different from the long-run elasticities implied by the previous set of estimates. Since the coefficient of q_t in $\ln m_t$ is negative, the coefficient of p_t in $\ln z_t$ is negative, and the coefficients of $\ln w_t$ in both equations are positive, we do have the signs we would expect for normal goods. What is striking about our results here is that the coefficients of p_t in $\ln m_t$ and of q_t in $\ln z_t$ are both negative, implying the real balances and future wealth are in fact complements.

Equations (c) and (f) in the table are a third set of estimates. The difference between this set and the others is that here the price arguments are in logarithms so that we get constant price elasticities. Moreover, the signs and the orders of magnitude of the estimates are not very different from the others. This third set of estimates is what we shall use for our illustrative calculations because of the convenience of constant elasticities.

6.3 Applying the Elasticities

Based on equations (c) and (d) in Table 6.2, we now present illustrative calculations to determine the optimal division of the financing of a budget deficit between the inflation tax and a tax on the future in a liberalized economy. We have the following uncompensated price elasticities:

$$e_{mm} = -0.24 \qquad\qquad e_{mz} = -0.46$$
$$e_{zm} = -0.02 \qquad\qquad e_{zz} = -0.54$$

and the following income elasticities

$$n_m = 0.54 \qquad\qquad n_z = 1.11$$

The price elasticities show that we do have downward sloping demand schedules and that real balances and future wealth are complements. The income elasticity for real balances supports the inventory model of the demand for money, while the other income elasticity indicates that future wealth is something of a luxury good.

The Slutsky equation $\varepsilon_{ij} = e_{ij} + \theta_j n_i$ then allows us to derive the <u>compensated</u> price elasticities. For the income shares of real currency balances and future wealth we obtained for 1981 $\varepsilon_m = 0.01$ and $\theta_z = 0.09$ respectively. The resulting compensated elasticities are then

$$\varepsilon_{mm} = -0.24 \qquad\qquad \varepsilon_{mz} = -0.41$$
$$\varepsilon_{zm} = -0.01 \qquad\qquad \varepsilon_{zz} = -0.44$$

If we now plug those elasticities into our formulat (3'), we get $\tau^* = 7.67$. What we really have here is a corner solution, since τ cannot possibly exceed unity. Operationally, this means we should finance all of the deficit by means of open-market borrowing. Indeed this also means letting the price level fall at the rate of the prevailing real interest rate, following Friedman's full-liquidity rule, so we would not have an inflation tax.

These calculations, however, are very sensitive to estimated elasticities. Given our standard errors, those estimates are not very precise. Moreover, those demand functions were estimated separately without imposing any of the Slutsky restrictions across equations that demand functions are supposed to follow.

7.   Conclusion

The main results of the study may be summarized as follows:

(a) Between 1970 and 1981, close to 16 perent of the budget deficit was financed by
    the creation of base money, that is, by the Central Bank holding government debt.
    However, 9 percent ended up as required bank reserves, so that only 7 percent of
    the deficit was financed by the creation of currency and excess reserves, on what
    we know as the printing of money.

(b) Nearly 38 percent of the deficit was financed by domestic borrowing outside the
    Central Bank. But 4 percent was in the form of eligible government securities
    which banks held a required reserves. This means the total amount financed by
    the creation of required reserves was 13 percent. Domestic open-market
    borrowing then financed 34 percent.

(c) The rest of the deficit was therefore financed by foreign borrowing, this source
    accounting for 46 percent, by far the most important source of financing during
    the period.

(d) The most erratic source of financing was currency creation, financing as much as
    33 percent and detracting by as much as 29 percent of the deficit. The years of
    the big deficits were also the years in which the government turned heavily to
    foreign borrowing.

(e) In the presence of trade and financial repression, particularly binding ceilings on
    interest rates, the reserve requirement is the best instrument for financing a budget
    deficit, since it is the only one we know that does not exacerbate the existing
    distortions. This means the Philippines relied too much on domestic open-market
    borrowing and foreign borrowing, and too little on raising reserve requirements in
    the 12-year period of the study.

(f) Once trade and financial liberalization has been achieved, the reserve requirement
    becomes the worst instrument to use since, in driving a wedge between deposit
    and loan rates, it is the only one that distorts production. The inflation tax and
    open-market borrowing become the preferred instruments, with the tradeoff

between them depending on various elasticities of the demand for money and the demand for future wealth.

(g) Our estimates of demand elasticities for real balances and future wealth, however, indicate that we should rely exclusively on open-market borrowing and follow Friedman's full-liquidity rule in avoiding the inflation tax.

This study has focused on the purely efficiency aspect of financing a given budget deficit. Since policy should somehow reconcile goals of efficiency with goals of stabilization, there is a need to look more closely at the latter. At the same time, there is room for refinement of our results on the former, including trying to improve our estimates of the relevant parameters.

Appendix: Specifying the Inflation Tax for Time Consistency

To illustrate how Auernheimer's "honest government" revenue leads to time-consistent monetary policy, I use here a discrete-time model of money with perfect foresight. In this example, the policy objective is to maximize the present value of the revenue stream, but it should be clear that the basic argument will apply also to an objective of welfare maximization.

The government issues money only at the start of each period, exchanging it for output at the price level prevailing in the period. Thus if the government issues the nominal stock $M_t - M_{t-1}$ at the start of period t and the price level is P_t, the conventional specification of real seigniorage is $R_t = (M_t - M_{t-1})/P_t$. With M_t then as money supply, the price level itself is determined by the equilibrium condition $M_t/P_t = m_t$, where m_t is the real demand for money for the period. To simplify, I assume that m_t depends only on the inflation rate $\pi_t \equiv 1 - (P_t/P_{t+1})$, where of course $m_t'(\pi_t) < 0$.

Substituting the real demands $m_t = M_t/P_t$ and $m_{t-1} = M_{t-1}/P_{t-1}$ and the inflation rate $\pi_{t-1} = 1 - (P_{t-1}/P_t)$ now allows us to write

$$R_t = m_t - (1 - \pi_{t-1})m_{t-1}$$

$$= (m_t - m_{t-1}) + \pi_{t-1}m_{t-1}$$

(A1)

which is simply the discrete form of the conventional specification of seigniorage. Note that there are two inflation rates in R_t, namely, π_t in m_t and π_{t-1} explicitly and in m_{t-1}.

At $t = 1$, the government would like to choose $(\pi_1, \pi_2 \ldots)$ to maxime

$$Z = \sum_{t=1}^{\infty} \frac{R_t}{(1+r)^{t-1}}$$

(A2)

where r is the given real discount rate. This is a simple dynamic programming problem, that is, we choose a particular inflation rate π_t by taking all inflation rates after period t as optimally given. Hence, for an interior solution, the optimal inflation rate π_t^* must satisfy

$$m_t + (r + x_t^*)m'_t = 0 \qquad\qquad\qquad (A3)$$

for all t from period 1 on. If at some future period, $t > 1$, the government would choose an inflation rate to violate (A3), we have time inconsistency; if not, we have time consistency.

Suppose now the government does not arrive at some future period s and maximizes the present value of the revenue stream from that period on. Note that by controlling the size of money issue at the start of the period, the government can in fact control π_{s-1}. Indeed, given that R_s is seigniorage for the period, the way this problem is typically formulated would have π_{s-1} as the control variable for the period. Raising π_{s-1} does serve to raise R_s. On the other hand, if we took π_s as the control variable, we would get the bothersome result that raising the inflation rate only reduces seigniorage for the period, since $\partial R_s / \partial \pi_s < 0$.

However, differentiating R_s with respect to π_{s-1} yields

$$m_{s-1} - (1 - \pi_{s-1})m'_{s-1} > 0 \qquad\qquad\qquad (A4)$$

which is always positive. Therefore the government maximizes R_s by setting $\pi_{s-1} = 1$. This implies $P_s = \infty$, which is essentially Calvo's (1978) result. Note that this is consistent with maximizing the present value of the revenue stream from period s on, since revenues after that period are constructed to be independent of π_{s-1}. However, this is clearly inconsistent with (A3), and therefore we have a case of time inconsistency. Inflation rates here would invariably be too high.

It may seem odd that the control variable we assign to period s is π_{s-1}, but that is precisely the point. The source of time inconsistency here is the <u>retroactivity</u> of the inflation tax. It is a tax imposed on the holding of real balances in the previous period. Under perfect foresight, however, the tax will be forestalled by money holders, so that it is the government that ends up paying it in the form of reduced seigniorage for the previous period. Raising π_{s-1} in the

effort to raise R_s only results in the reduction of R_{s-1}. But because in period s the government neglects that forerunning effect, it is led to time inconsistency.

Now suppose instead of R_t we define seigniorage for period t as

$$S_t = \left(\frac{r + \pi_t}{1 + r}\right) m_t. \qquad\qquad (A5)$$

All that has really changed here is the accounting procedure for assigning revenues to periods; we would still have the same maximand since

$$Z = \sum_{t=1}^{\infty} \frac{S_t}{(1+r)^{t-1}} \quad,$$

except that for period 1, we would have

$$S_1 = \left(\frac{r + \pi_1}{1 + r}\right) m_1 - (1 - \pi_0) m_0.$$

But the extra term, $-(1 - \pi_0)m_0$, is there only because we started by specifying Z in terms of R_t. We can always exercise our one degree of freedom in specifying initial conditions to assume the term away. In any case, the term will not matter for the choice of inflation rates from period 1 on.

Note that S_t is simply the discrete form of Auernheimer's honest-government revenue. The virtue of this specification is that it leads to time consistency. The control variable for period s must now be π_s. There is, after all, no other inflation rate in S_s. This time, maximizing S_s yields

$$m_s + (r + \pi_s) m'_s = 0 \qquad\qquad (A6)$$

which is precisely condition (A3) for maximizing Z. When the government does arrive at period s and it uses the specification S_t, it will still opt for the same inflation rate it would have chosen from the beginning for that period. In other words, we now have time consistency.

Time consistency is gained because the use of S_τ takes away from the government discretion over a retroactive tax. In period s, the government is prevented from using π_{s-1}. As Kydland and Prescott (1977) pointed out, the resolution of time inconsistency involves a precommitment. Here the government at the start of period s precommit itself to an inflation rate πs for the period. As in Lucas and Stokey (1983), it is a precommitment to a price path.

Such a precommitment is formally equivalent to the maintenance of a sinking fund. At the start of each period t, the government allocates $(1 - \pi_t)m_t/1 + r)$ to a sinking fund earning the real return r, while appropriating for its own uses $(r + \pi_t)m_t/(1 + r)$ as seigniorage for the period. This means that while actual money issue yields only $m_t - (1 - \pi_{t-1})m_{t-1}$ in resources, the government must have on hand m_t to divide between the sinking fund and its seigniorage claim. But the government will indeed have that amount, since it will inherit $(1 - \pi_{t-1})m_{t-1}$ from the previous period's sinking fund.

References

Araneta, R. (1983) "A Government Reaction Function of the Creation of High-Powered Money," Paper submitted for Econ. 231 under Prof. D. Canlas, 2nd Semester, U.P. School of Economics.

Auernheimer, L. (1974) "The Honest Government's Guide to the Revenue from the Creation of Money," J. Polit. Econ. 82, May/June, 589-606.

Barro, R. (1974) "Are Government Bonds Net Wealth?" J. Polit. Econ. 82, Nov./Dec., 1095-1117.

_____ (1977) "Unanticipated Money Growth and Unemployment in the United States," Amer. Econ. Rev. March, 101-115.

Calvo, G. (1978) "On the Time Consistency of Optimal Policy in a Monetary Economy," Econometrica 46 November, 1411-1428.

Corlett, W. and H. Hague (1953) "Complementarity and the Excess Burden of Taxation," Rev. Econ. Stud. 21, 21-30.

Diamond, P.A. and J.A. Mirrless (1971) "Optimal Taxation and Public Production I: Production Efficiency," Amer. Econ. Rev. 61, March, 8-27.

Dornbusch, R. and S. Fischer (1981) Macroeconomics, 2nd Ed. New Yourk: McGraw-Hill.

Fama, E.F. (1980) "Banking in a Theory of Finance," J. Monet. Econ. 6, January, 39-57.

Friedman, M. (1971) A Theoretical Framework for Monetary Analysis, New York: National Bureau of Ecnomic Research.

_____ (1972) "Comments on the Critics," J. Polit. Econ. September/October.

Krugman, P. (1978) "Interest Rate Ceilings, Efficiency and Growth," August, Yale University.

Kydland, F.E. and E.C. Prescott (1977) "Rules Rather than Discretion: The Inconsistency of Optimal Plans," J. Polit. Econ. 85, June, 473-491.

Lucas, R.E. and N.L. Stokey (1983) "Optimal Fiscal and Monetary Policy in an Economy Without kCapital," J. Monet. Econ. 12, 55-93.

McKinnon, R. (1973) Money and Capital in Economic Development, Washington, D.C.; Brookings.

_____ (1981) "Financial Repression and the Liberalization Problem Within Less Developed Countries," in S. Grassman and E. Lundgerg, eds., <u>The Past and Prospects for the World Economic Order</u>, London: Macmillan, 365-386.

Power, J. (1975) "Four Short-Run Macroeconomic Models," Lecture notes, University of Hawaii.

_____ (1977) "Notes on Macroeconomics for Less-Developed Countries," Lecture notes, U.P. School of Economics.

Ramsey, F.P. (1972) "A Contribution to the Theory of Taxation," <u>Econ. J</u>. 37, 47-61.

Samuelson, P.A. (1947) <u>Foundation of Economic Analysis</u>, 9th Printing (1979), New York: Atheneum.

Sargent, T. and N. Wallace (1976) "Rational Expectations and the Theory of Economic Policy," <u>J. Monet. Econ</u>. April.

Shaw, E.S. (1973) <u>Financial Deepening in Economic Development</u>, New York: Oxford.

Sims, C.A. (1980) "Macroeconomics and Reality," <u>Econometrica</u> 48, January, 1-48.

Tobin, J. (1972) "Friedman's Theoretical Framework," in <u>Milton Friedman's Monetary Framework</u> R.J. Gordon, ed., Chicago: University of Chicago Press.