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Subject: Fiscal Revenue and Inflationary Finance

CORRIGENDA

Several references and footnotes were inadvertently dropped from the paper. Corrected pages 1, 3, 9, and 16 are attached.

Att: (4)

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I. Introduction

Much of the standard analysis of inflationary finance has ignored the effect of inflation on government finance. 1/ Specifically, if there is any lag between accrual and payment of taxes, inflation in the interim erodes the real value of tax revenues. If the real value of government spending is maintained in the face of inflation, the erosion of real tax revenue can generate an unintended fiscal deficit, which may require a further expansion of the stock of money to finance it. Consequently, it is necessary to analyze the effects of revenue lags on the fiscal deficit.

The notion that fiscal lags exist in government finance was first posited by Olivera (1967) and later crystallized and identified as collection lags by Tanzi (1977, 1978). Olivera focused on the unintended real fiscal deficit in order to provide an explanation of the chronic problem of inflation that plagued several countries in Latin America in the 1950s and 1960s. Tanzi attempted to measure the average lag in collection of taxes and analyzed the erosion of real fiscal revenue by inflation in the case of Argentina. The works of these authors, as well as the studies by Aghevli and Khan (1977, 1978), have made a significant contribution to an understanding of the role of fiscal lags in the standard analysis of inflationary finance.

This paper has two purposes. First, to integrate the Olivera-Tanzi effect formally with a standard inflationary finance model. 2/ This is undertaken in Section II of the paper. Intuitively, total revenue from inflation and the revenue-maximizing inflation rate will be lower and the welfare cost of inflation smaller once the two models are merged. A second purpose is to provide some empirical evidence on fiscal lags and to analyze the importance of fiscal erosion on inflationary finance. As such, empirical estimates of the fiscal revenue lag is obtained from annual data for a sample of 28 countries. Based on this evidence, simulations are carried out to shed light on the extent of fiscal revenue erosion by inflation, the size of the revenue-maximizing inflation rate, and the maximum total revenue. The latter determines the sustainable level of real government expenditure. Alternatively, for a given level of real expenditure, the extent of fiscal erosion determines the sustainable level of the fiscal deficit. The results of these exercises are reported in Section III. The implications of the theoretical and empirical analysis are contained in the final section.

II. Theoretical Analysis

This section discusses the standard model of inflationary finance, and the basic Olivera-Tanzi hypotheses. The final part of this section integrates the two models and examines the basic properties of the generalized model.

1/ See, among others, Friedman (1971), Auernheimer (1974), and Cathcart (1974).

2/ The analysis builds on Tanzi (1978).

1. Standard model

Financing fiscal deficits by the issuance of money leads to inflation because actual real balances held by the public are brought in line with the desired level through a rise in the price level. The real revenue from money creation (henceforth, real inflation revenue) in the standard inflationary finance model is given by 1/

$$f(\pi^e) = \pi^e m = \pi^e m_o e^{-\alpha\pi^e} \qquad (1)$$

where

π^e - the expected rate of inflation
m - the real balance ratio (in terms of real income)
m_o - the real balance ratio when the expected rate of inflation is zero.

The standard inflationary analysis is based on the properties of the inflation revenue function, $f(\pi)$. These properties, which are well known, indicate that the rate of inflation, which maximizes real inflation revenue, when all adjustments are completed, is $1/\alpha$. At this point, the inflation elasticity of real balances is unity. 2/ The revenue-maximizing inflation rate imposes a maximum limit on the equilibrium fiscal deficit. However, most economists have argued against the adoption of the policy of deficit financing through the creation of money, as the consequent inflation imposes a substantial welfare cost on the holders of real balances even disregarding the social cost of wealth redistribution and other economic distortions. 3/

2. Olivera-Tanzi effect

Olivera (1967) used the idea of fiscal lags to argue that, with nominal revenues being fixed in the short-run, the real value of taxation falls in the face of rapid inflation, leading to increases in the fiscal deficit. In the absence of appropriate fiscal adjustment, further expansion of the stock of money to finance the deficit may perpetuate inflation.

1/ See, for example, Friedman (1971).

2/ As inflation rises, the real balance holdings decline as the public desires to hold less of a depreciating asset. This leads to increases in the velocity of money. Thus, the higher the inflation sensitivity of velocity, the lower the inflation rate at which the inflation elasticity for the demand for real balance becomes unity.

3/ Aghevli (1977) is among the few who make a case for a certain amount of deficit financing leading to moderate rates of inflation in the context of a growing economy where inflation revenue is the only source of financing government capital expenditure.

Tanzi (1977, 1978) specified fiscal lags in terms of an average lag in tax collection. The real value of taxation expressed in terms of real income, R, was written as

$$R = \frac{R_o}{(1 + \pi)^n} \qquad (2)$$

where R_o = the real tax ratio when the actual inflation rate, π, is zero

n = the average lag in collection of taxes in months.

The author simulated the erosion of fiscal revenue and inflation revenue from equations (1) and (2) for different inflation rates. Depending on the existing tax system and in the absence of inflation, the value of the tax ratio, R_o, can rise, fall, or remain unchanged. 1/ However, collection lags in tax administration can erode the real value of taxation so that a government's gains from inflationary finance can be lower than commonly assumed. This was an important argument against inflationary finance, quite different from the traditional one based on the welfare cost of inflation. Further, the reduction of real fiscal revenue implies that the inflation rate that maximizes real total revenue is less than the rate that maximizes real revenue from the issuance of money.

3. Integrated model

The integrated model, which follows the approach suggested by Tanzi (1978), consists of two components: the inflation model given by (1), and the fiscal lag model. The latter assumes that the real government expenditure ratio (in terms of real income), E_o, is fixed. Given the initial fiscal revenue ratio, R_o, the fiscal revenue equation can be rewritten as 2/

$$R(\pi) = R_o e^{-\beta\pi}. \qquad (3)$$

The assumption in equation (3) is that the income elasticity of real fiscal revenue is unity. 3/ The fiscal revenue lag coefficient, β, is a measure of the average lag in collection of taxes; the higher this lag, the larger is the erosion of real fiscal revenue.

1/ This implies that the elasticity of real tax revenue with respect to changes in real income may be greater than, equal to, or less than unity.

2/ For a derivation of this form, see footnote 1, p.11.

3/ Relaxing this assumption does not alter the result of the ensuing analysis; it only affects the size of the equilibrium inflation rate.

Consider now the initial fiscal deficit, g_o, which can be written as:

$$g_o = E_o - R_o. \tag{4}$$

If the deficit is financed by money creation, the consequent rate of inflation, π, would cause a certain amount of unintended deficit so that the fiscal deficit would be:

$$g_\pi = E_o - R(\pi). \tag{4a}$$

For notational simplicity, the actual inflation is assumed equal to the expected rate of inflation. Hence, the fiscal function, $\phi(\pi)$, can be defined as the real fiscal deficit ratio:

$$E_o - R(\pi) = \phi(\pi). \tag{5}$$

The effect of inflation on real fiscal deficit is best understood by examining the properties of the fiscal function. It can be seen that:

(i) $\phi(0) = E_o - R_o \geq 0$; $\phi(\infty) = E_o$;

(ii) $\phi' = \beta R(\pi) > 0$;

(iii) $\phi'' = -\beta^2 R(\pi) < 0$.

These properties indicate that the real fiscal deficit rises with the erosion of real fiscal revenue. Also, the larger the size of this increase, the greater is the fiscal revenue lag coefficient.

The integration of the fiscal lag in the government budget with the standard inflationary finance model allows the feedback between the deficit and inflation to influence both the budget and the rate of monetary expansion and, hence, the equilibrium rate of inflation. Equilibrium is reached when the real inflation revenue just finances the real deficit taking into account the fiscal erosion; this occurs when the deficit implied by the inflation and fiscal functions is equal:

$$f(\pi) = \phi(\pi). \tag{6}$$

Assuming that an equilibrium inflation rate exists, 1/ the equilibrium real deficit is higher than the deficit that was intended to be financed by money creation. The existence of equilibrium inflation rate can be analyzed with the aid of Figure 1 where the two schedules are determined by the properties of the equations (1) and (5). The fiscal deficit schedule, $\phi(\pi)$, intersects the inflation revenue schedule, $f(\pi)$,

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1/ A solution yielding a negative inflation is not considered here, although Friedman (1971) has raised the possibility of negative inflation in the steady state.

(1977) made an estimate of the mean time lags for taxes in the context of a partial adjustment model. 1/ By contrast, there are a number of empirical studies on the demand for money where the effect of inflation on real balance holdings is estimated. In view of the thoroughness with which econometric techniques were applied to estimate the money demand functions in a number of these studies, it was decided to use the result of one such study for the purposes of simulations undertaken in this section.

1. Empirical Findings

a. Collection lags

Empirical evidence on collection lags was obtained by estimating a variant of equation (5) using pooled time-series cross section data for a group of 28 developing countries. 2/ Allowances were made for cross-country differences in the constant term by adding 27 dummy variables to the right hand side. However, it was assumed that the buoyancy of real government revenue with respect to real income and the average collection lags were the same across countries. The choice of countries was dictated by data availability. Wide variation in the rates of real income growth, the tax ratios and inflation was found among these countries. For instance, the tax ratios ranged from less than 9 percent to about 39 percent, and inflation averaged as low as 4 percent annually to as high as 160 percent.

The exact form of the real government revenue equation estimated was:

$$\log CR_t = \log \beta_0 + \beta_1 \log y_t - \beta\Delta \log CPI_t + u_t \qquad (15)$$

where CR = government current revenue deflated by the gross domestic product deflator.

y = real gross domestic product.

ΔlogCPI = annual rate of change of the consumer price (1980 = 1.0).

1/ Tanzi (1977) estimated the average lag between a taxable event and payment of taxes for various categories of taxes for Argentina. However, the estimates were the weighted average of all the lags from the various taxes.

2/ Annual data covering the period 1970-87 were obtained for the following countries; Argentina, Costa Rica, Guatemala, Honduras, Peru, Bangladesh, Myanmar, India, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Botswana, Ethiopia, Ghana, Somalia, Sudan, Zaire, Zambia, Egypt, Islamic Republic of Iran, Jordan, Syrian Arab Republic, United Arab Emirates, Yemen Arab Republic, People's Democratic Republic of Yemen. All data used in this study are taken from International Monetary Fund, International Financial Statistics and Government Finance Statistics.

Equation (15) was estimated by pooling the data over the period 1970-1987 for the sample group of countries. 1/ Given constant real income and the assumption that the buoyancy of real government revenue to changes in real income is unity, equation (18) becomes equivalent to equation (4). 2/ The estimated equation is:

$$\log CR_t = \underset{(24.77)}{1.462} \log y_t - \underset{(4.05)}{0.341}\pi_t \qquad (15a)$$

$$R^2 = 0.999$$

The revenue eroding effects of inflation is striking. The value of 0.34 for the parameter β translates to an average collection lag of four months. The size of this lag for a given real income, indicates that a 3 percentage point increase in inflation rate can reduce real tax revenue by 1 percent. However, country-specific sizes of β show wide variation (Appendix table). A value of β less than 0.1, indicating a collection lag of less than 1.2 months, was found in countries which generally experienced frequent tax changes in order to increase real tax revenue; sometimes indexation was the dominant form of changes in taxation. A value of β above 0.7, suggesting a collection lag of 8.5 months or more, was observed in countries which generally suffered reduction or slack in domestic production and/or demand for their traditional exports, or benefited from sharp increases in oil revenues.

The value of the buoyancy of government revenue, represented by the parameter β_1, was also found to be quite large. When discretionary measures are frequently taken to bolster revenue, buoyancy would be higher than elasticity of real revenue. Values of buoyancy less than unity were found in countries with either low growth or relatively stagnant external

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1/ Equation (15) was also estimated for each of the 28 countries. See Appendix table.

2/ Given the structure of taxation, real government current revenue, CR, can be written as a function of real income y as

$$CR = R_o y^{\beta_1} \qquad (a)$$

where β_1 = buoyancy of real government revenue to changes in real income. On the assumption that the average collection lag between accruals and payments of taxes is n-months and the annual rate of inflation is p, the amount of real government revenue collections is

$$CR_\pi = \frac{CR}{(1 + \pi/12)^n} \qquad (b)$$

Taking the limit as π tends toward zero and expressing real government revenue in terms of real income, it can be shown that $R(\pi) = R_o y^{\beta_1 - 1} e^{-\beta\pi}$.

rate of inflation would be able to raise real inflation revenue, net of the erosion of real fiscal revenue, by up to 4 percent of real income.

Inability to raise maximum real revenue much beyond the fiscal revenue level, R_o, when the budget is balanced and inflation rate is zero, leaves little room to increase the level of real government expenditure. In view of the empirical evidence, a sustainable real excess of government expenditure over fiscal revenue through inflationary finance would be about 1-2 percent of real income. Even this real fiscal deficit evaporates rapidly, the higher the initial fiscal revenue ratio. Simulations with the government revenue ratio (R_o) of 30 percent and real balance ratio (m_o) of 20 percent indicate that the deficit that could be financed through money creation at the revenue maximizing rate of inflation would be 0.6 percent of real income. An expenditure level in excess of the maximum total revenue of 30.6 percent of real income would lead to high inflation. Moreover, the scope for increasing the level of real government expenditure would be further reduced by a higher level of initial fiscal revenue ratio.

An important caveat in the simulations above is the inherent lack of dynamics in the equilibrium framework. A frequently observed phenomenon is that price increases lag behind changes in money supply. This observation was supported by the data employed in this study, which were used to estimate an equation between price increases and the growth of the monetary base. 1/ In Figure 2, this equation indicates the behavior of prices and the growth of the monetary base in 24 of the group of sample countries. Each point reflects the annual average growth rate of the monetary base and the corresponding rate for the consumer price index, plotted along the estimated trend. The trend line shows that price increases lagged behind the growth of monetary base, indicating that real balances tended to rise when there was an acceleration in the rate of growth of money. Thus generally, governments acquired real resources for a prolonged period beyond what would appear to be warranted by the

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1/ Using pooled cross-section annual data covering the period 1970-87 for 24 of the group of 28 countries (excluding Ethiopia, Zaire, United Arab Emirates and P.D.R. of Yemen for lack of an adequate time series for the monetary base), the following relationship between price increase and the rate of monetary expansion was estimated:

$$\Delta \log CPI = 0.0076 + 0.6939\ \Delta \log M$$
$$(1.60) \quad (22.27)$$

$R^2 = 0.55$; SEE = 2.64.

From the above estimated equation, the persistence of price lag over such an extended period indicates that the public did not seem to have correctly anticipated monetary changes. This finding is consistent with the results reported by Khan and Knight (1982) for a shorter period (1968-75).

revenue-maximizing rate of inflation. 1/ The empirical evidence also indicates that there must have been significant erosion of fiscal revenue, possibly requiring the governments to enhance their tax efforts. This appears to be consistent with the substantial discretionary tax measures taken during 1970-87. Data indicate that in many of the sample group of countries, government current revenue ratio rose, ranging from 1 percent of GDP to 17 percent.

Table 3 provides the simulation on the welfare losses or gains at the revenue maximizing rates for the real balance and fiscal revenue ratios of 15 percent each. Except for the low revenue lag coefficient ($\beta = 0.1$), the net welfare cost ratio is negative. However, the higher the size of the revenue lag coefficient, the larger is the net welfare gains from inflationary finance because savings from fiscal erosion outweighs the conventional welfare cost. The difference between the conventional welfare cost and the net welfare cost in the presence of fiscal erosion indicates that gains from reduced payments of real fiscal revenue would be of the order of 6 percent of real inflation revenue for the values of $\alpha = 2.0$ and $\beta = 0.35$. For the parameter values of $\alpha = 2.0$, $\beta = 0.35$ and $m_o = R_o = 0.15$, the conventional welfare cost and the net welfare cost ratios are plotted against inflation rate in Figure 3. As seen, the net welfare gains become larger as real fiscal revenue is eroded by higher rates of inflation. This finding should be tempered by the fact that there are social costs and economic distortions from inflation. Indeed, the adverse effects from these costs are what ultimately constrain the economy from hyperinflation.

IV. Conclusions

The paper has analyzed and estimated the effect of inflation on the real value of taxation and examined its implications for financing government expenditure by the issuance of money. The revenue eroding effects of inflation has been known for some time in the context of collection lags, particularly in the case of high-inflation countries. The traditional view that high inflation is the result of budget deficits, whether stemming from domestic considerations or from external factors, has considerable empirical support. But the causation that runs from inflation to deficits via the effect of the former on fiscal revenue reinforces inflationary pressures. Thus, fiscal erosion can substantially reduce the scope of financing deficits through the creation of money.

1/ In Figure 2, the cluster of the countries indicates that the governments acquired real resources with average rates of monetary expansion as high as 30 percent. Beyond this point, price lag was virtually absent. Thus, there seem to be some threshold inflation rate beyond which the public seem to correctly anticipate further acceleration in monetary expansion.