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Fiscal Revenue and Inflationary Finance

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Abstract

This paper analyzes the erosion of fiscal revenue by inflation resulting from the issuance of money. The empirical evidence for a number of developing countries supports the well-known hypothesis that an increase in inflation will result in a fall in real fiscal revenue because of collection lags, thereby possibly widening the fiscal deficit. As such, attempts to generate resources to finance government expenditures via the inflation tax will involve a loss in other revenues, making this form of taxation even less desirable.

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Contents

Summary

This paper analyzes the effect of inflation on the revenue from taxation and estimates the effect of fiscal erosion on resources generated by inflationary finance. The erosion of fiscal revenue arising from collection lags is well recognized, particularly in the case of high-inflation countries. However, the interaction between inflation and sustainable levels of fiscal deficits has not yet been fully analyzed. The traditional view that high inflation is generally the result of large budget deficits has a great deal of support. But there is also the causation that runs from inflation to the deficit via the effect of the former on fiscal revenue. This paper develops a theoretical model demonstrating that fiscal erosion can substantially reduce the scope of deficit financing by the issuance of money. This argument against inflationary finance is independent from the traditional one based on the welfare costs of inflation, and the distortions it creates in the economy.

Empirical evidence for a large number of developing countries supports the hypothesis that an increase in inflation will generally result in a fall in real fiscal revenue. As such, the use of the inflation tax will involve a loss in other revenues, thus widening the fiscal deficit for a given level of real government spending. The sustainable level of the fiscal deficit financed by the inflation tax will also be smaller. Beyond this level, attempts to finance the fiscal deficit by the inflation tax can lead to higher and higher inflation.

The above results have important implications for fiscal policy, particularly in developing countries. A government that chooses the inflation tax option must take into account the possible effect of fiscal erosion on the budget deficit, thereby jeopardizing the objective of price stability. These considerations substantially strengthen the case for reliance on increasing fiscal revenue rather than the use of the inflation tax as a means of financing government expenditure.

I. Introduction

The standard analysis of inflationary finance has generally 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. This interaction between the inflation tax and other revenues has not yet been fully analyzed.

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. Neither of the two authors, however, formally used the notion 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. 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).

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/

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

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

$$R = \frac{R_0}{(1 + \pi)^n} \tag{2}$$

where R_0 = 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_0, 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 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_0, is fixed. Given the initial fiscal revenue ratio, R_0, the fiscal revenue equation can be rewritten as 2/

$$R(\pi) = R_0 e^{-\beta\pi}. \tag{3}$$

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 2, p.10.

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

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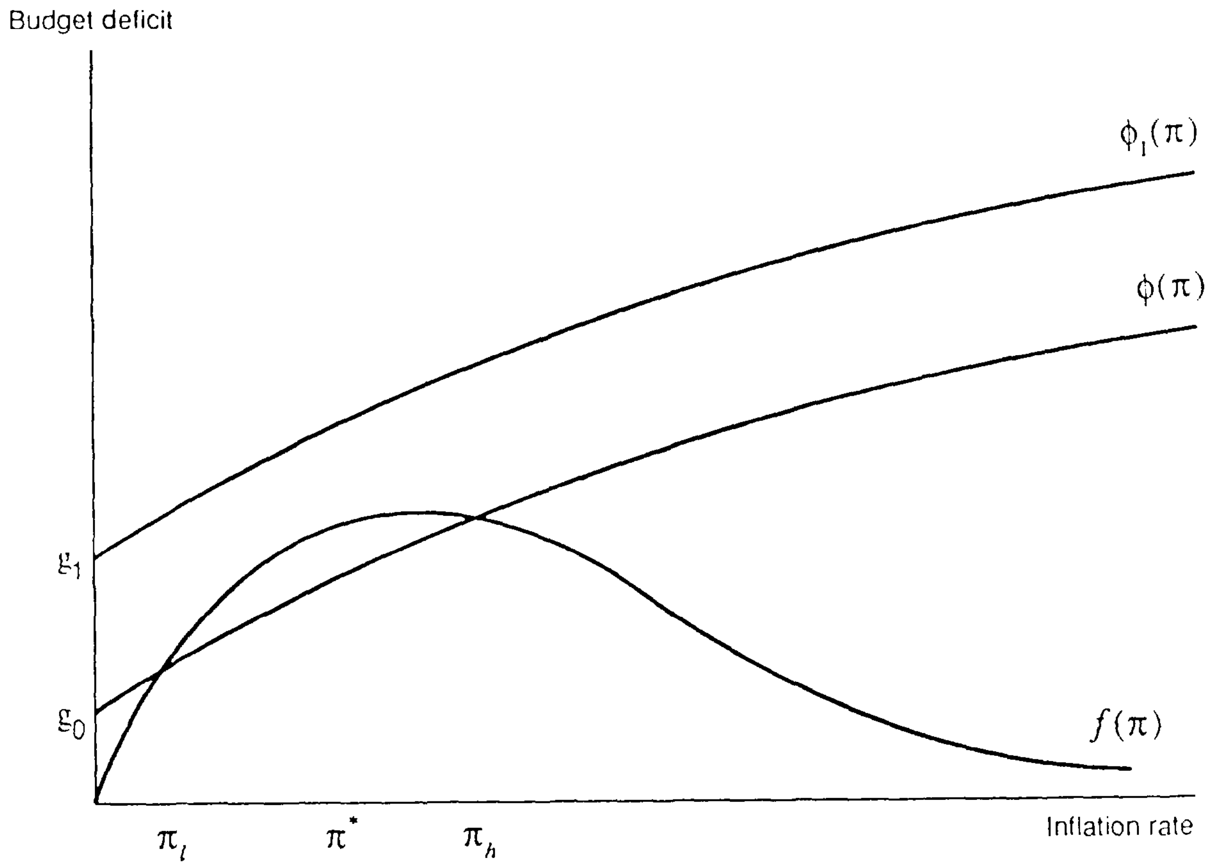
1/ A solution yielding a negative inflation is not considered here, although Friedman (1971) has raised the possibility of negative inflation in the steady state.

Figure 1.

BUDGET DEFICIT AND INFLATION



at two points, although only the equilibrium low-inflation rate is stable. 1/ However, the existence of an equilibrium inflation rate is not necessarily guaranteed. As indicated by the schedule $\phi_1(\pi)$, an intended fiscal deficit may be so high that real inflation revenue is insufficient to cover it and the deficit increases continually as monetary expansion is stepped up to close the fiscal gap. 2/

The equilibrium low-inflation rate, π_l^*, is stable. At this rate, real inflation revenue is just sufficient to cover the deficit which is higher than the intended level because of fiscal erosion. Any further monetary expansion yields additional real inflation revenue which is greater than the erosion in real fiscal revenue, reducing the deficit. This leads to a lower rate of monetary expansion and the inflation rate is reduced. This process continues until the rate reverts to π_l^*. A similar reasoning would establish that the equilibrium high-inflation rate, π_h^*, is unstable, although a deceleration in the rate of monetary expansion would eventually reduce inflation to the equilibrium low-inflation rate.

Real total revenue from inflation and taxation is:

$$TR(\pi) = f(\pi) + R(\pi). \tag{7}$$

The maximum amount of real total revenue is given by the rate, π^*. At this point the two schedules have the same slope, implying that any further attempt to increase inflation revenue leads to higher inflation and lower real total revenue. From this condition, the revenue-maximizing inflation rate is given by 3/

1/ The second order derivatives of both $f(\pi)$ and $\phi(\pi)$ are negative in the neighborhood of the low equilibrium inflation rate, thereby ensuring stability.

2/ The fiscal schedule $\phi_1(\pi)$ in Figure 1 indicates that there is no equilibrium even though in the conventional analysis an equilibrium could exist as long as the intended fiscal deficit is less than or equal to maximum revenue from inflation. In such situations, equilibrium can only be restored by a fiscal shock. Without such a shock, continual deficit financing leads to ever-widening fiscal gap.

3/ π^* is obtained from the solution of $TR'(\pi) = f'(\pi) + R'(\pi) = 0$. The second order derivative is $TR''(\pi) = -\alpha(2/\pi - a)\, f(\pi) + \beta^2 R(\pi) \lesseqgtr 0$ for

$$\pi \gtrless \frac{2}{\alpha + \dfrac{\beta^2 R(\pi)}{\alpha\, f(\pi)}} .$$

Thus at π^*, $TR'' < 0$ so that $TR(\pi^*)$ is the maximum revenue from inflation and taxation.

$$\pi^* = \frac{1}{\alpha + \frac{\beta R(\pi^*)}{f(\pi^*)}} < \frac{1}{\alpha} \quad . \tag{8}$$

Several interesting points emerge from the above analysis. 1/ First, π^* is less than the revenue-maximizing rate in the standard model because further gains from inflationary finance are more than offset by the erosion of fiscal revenue. Second, the revenue-maximizing rate is not only determined from real balance holdings but also from the level of taxation and the extent of fiscal erosion. Third, the higher the initial ratio of real fiscal revenue to real balance holdings, the lower will be the revenue-maximizing rate. 2/ Fourth, the higher the value of the coefficient of expected inflation (α), the lower the value of π^*. 3/ Finally, as in the standard model, the revenue-maximizing rate is also independent of the level of government spending.

In the standard model, the maximum amount of total revenue is given by:

$$TR(1/\alpha) = f(1/\alpha) + R_0. \tag{9}$$

This amount is greater than the maximum amount of total revenue, $TR(\pi^*)$, in the presence of fiscal lags. 4/ This has important implications. A given level of government expenditure that is at or below the maximum level of total revenue in the standard model may be above the maximum level of total revenue when fiscal lags are present. Consequently, if

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1/ These observations are based on the signs of the derivatives of π^* with respect to α, β, R_0 and m_0.

2/ A relatively high level of taxation would lead to a greater loss of real tax revenue and hence the revenue maximizing rate would be lower than if the level of taxation was relatively small.

3/ A high value of α implies that the inflation elasticity of real balance is greater for a given expected rate of inflation. Thus, an increase in the expected rate of inflation would lower the desired real balance holdings more than it would if α were small. Hence, gains in revenue from inflation would be higher at a relatively low expected rate of inflation.

4/ Introduction of the explicit cost of collection of fiscal revenue, as in Vegh (1989), would lower the maximum amount of total revenue since the revenue maximizing inflation rate would be raised because $f' = - R' (1 - \psi')$ where $\psi(R)$ is the collection cost function and $0 \leq \psi' < 1$.

the lags are significant then an increase in the level of government expenditure may lead to high inflation and even hyperinflation. 1/

The welfare cost of inflation is also affected by fiscal erosion. The traditional welfare cost ratio, $\lambda(\pi)$, is defined as the welfare cost per unit of inflation revenue: 2/

$$\lambda(\pi) = \frac{w(\pi)}{f(\pi)} \tag{10}$$

$$\text{where } w(\pi) = \int_{m(\pi)}^{m(o)} \pi dm = mo/\alpha - (1/\alpha + \pi)\, m_o e^{-\alpha\pi} \tag{11}$$

is the welfare cost in terms of real income. It is an increasing function of the rate of inflation. 3/

In the presence of fiscal lags, the welfare cost or excess burden imposed by inflation on the private economy needs also to account for the erosion in the real value of taxation. For the private economy, a reduction in real tax revenue from inflation increases real disposable income by the same amount as it partially compensates for the forced saving by inflation. The excess burden of inflationary finance, or the net welfare cost, would thus be smaller by the amount of reduction in real tax payments, which can be expressed as

$$\delta(\pi) = R_o - R(\pi) \ . \tag{12}$$

1/ This argument is consistent with the experience of several high inflation debt-ridden countries. In these countries, the debt shock resulting from a rise in the foreign interest rate (as well as depreciation of domestic currency) increased the burden of interest payments on external debt on the budget, causing a rise in the real deficit. Financing such deficits in order to maintain real expenditure was accompanied by high rates of monetary expansion and inflation.

2/ The welfare cost ratio is analogous to the cost-benefit ratio as in project selection. The inflation revenue acquired by the government is beneficial to the economy in the sense of the balanced-budget theorem, whereby an increase in real government spending, financed by forced savings, leads to an equivalent increase in real income. However, in equilibrium analysis, an increase in forced savings reduces disposable income and consumption.

3/ For details on the properties of this function, see Bailey (1956).

Thus in the presence of fiscal revenue lag, the net welfare cost can be defined as: 1/

$$w_n(\pi) = w(\pi) - \delta(\pi) \qquad (13)$$

Unlike the conventional welfare cost function, it is quite likely that as inflation rises, the net welfare cost of inflation can become negative as savings acquired from delayed payments of taxes more than offset the cost of foregone services of real balances. 2/

The net welfare cost ratio, λ_n, can be obtained by dividing w_n by the real revenue from inflation, $f(\pi)$. Thus,

$$\lambda_n(\pi) = \frac{w_n(\pi)}{f(\pi)} \ . \qquad (14)$$

Up to a certain rate of inflation the net welfare cost would be increasing with inflation. Beyond this rate, it would become negative, implying that inflationary financing provides net benefit to the private economy as welfare gains from paying less real taxes than accrued outweigh the cost of foregone services of real balances. Whether or not the net welfare cost ratio becomes negative at high rates of inflation, it is less than the traditional welfare cost ratio. 3/

III. Empirical Findings and Simulations

This section provides some empirical evidence on collection lags and reports simulations of the estimated effect of fiscal erosion on inflationary finance. Estimates of collection lags from an application of econometric techniques are almost non-existent, although Aghevli and Khan

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1/ A variant of this treatment of welfare cost has been employed by Aghevli (1977) in defining total utility of consumption goods in the context of inflationary finance. Total utility was defined as the consumption of goods, c, minus the welfare cost of inflationary finance, $w(\pi)$; i.e. total utility, $u(c, \pi) = c - w(\pi)$.

2/ This can be seen from the net welfare cost function since $w_n(0) = 0$ and $w_n(\infty) = mo/\alpha - R_o$. For certain parameter values, the net welfare cost would become negative.

3/ From equations (13) - (14), λ_n can be expressed as

$$\lambda_n(\pi) = \lambda(\pi) - \frac{\delta(\pi)}{f(\pi)}, \text{ implying that } \lambda_n(\pi) < \lambda(\pi).$$

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:

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

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

y = real gross domestic product.

$\Delta \log CPI$ = 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 (the legal lag, which pertains to tax administration, and the delinquency lag, which exists when payment is made after the expiry of the legal lag).

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 $R(\pi) = R_o y^{\beta_1 - 1} e^{-\beta\pi}$.

demand and/or terms of trade; the higher values above 1.5 were observed in countries with either indexation of taxation or frequent discretionary increases in revenue.

b. Demand for real balances

The estimated equation for demand for real balances was obtained from Khan's study (1980). 1/ The coefficient of expected inflation in the demand for real money balances was found to be negative, and the value of α was estimated to be 2.0, indicating that an increase in the expected rate of inflation reduces the stock of real money balances in line with theory. However, a more meaningful parameter is the expected inflation elasticity ($-\alpha\pi$), which was calculated by Khan at the respective sample mean of the inflation rates for each of the countries. Generally, these elasticities were positively related to the expected rate of inflation, implying that in countries with higher rates of inflation the public *would respond more to a given change in the expected rate of inflation.* The long run income elasticity of demand for real balance was estimated to be 1.5. A finding of the values of the income elasticity greater than unity is a standard result for developing countries, mainly because as monetization occurs, demand for cash balances tends to rise at a faster rate than income.

2. Simulations

Simulations were done by selecting the parameter values on the basis of the empirical evidence reported in this paper, as well as in Khan (1980). The range of values for the coefficients of expected inflation and the collection lag are shown in Table 1. The real balance (monetary base) and real government revenue ratios were selected from the average values for a majority of the countries from the group of 28 countries. For simplicity, it was assumed that real income was constant. Allowing real income to grow at some constant rate would not alter the conclusions. 2/

1/ From a sample of 11 countries, five of which are common with the group chosen for the fiscal revenue equation in this study, Khan estimated the equation for actual real money balances in the spirit of rational expectations literature (e.g., see Frenkel, 1975).

2/ The revenue maximizing rate would be raised or lowered as $\beta_1(1 - (\alpha + \alpha_1)\pi) \gtrless \beta(\alpha + \alpha_1)$, where α_1 is the long run income elasticity for real balance. For the values of these parameters in Table 2, the revenue maximizing rate would be lowered when real income grows at a constant rate. This strengthens the conclusion obtained from a constant real income with unitary buoyancy of tax revenue.

Table 1. Parameter Values for Simulation Experiment

Parameters		
Real Tax Revenues	R_o	0.15
	β	0.10 0.35 0.50 0.75
Real Balances	m_o	0.15
	α	1.0 2.0 5.0 20.0

Simulations of revenue maximizing rate and maximum real revenue from inflation and taxation based on the above parameters are reported in Table 2. 1/ What is striking is the relatively low values of the revenue-maximizing rates, which guarantee stability of the system as long as real government expenditure remains at or below the level of maximum revenue for the values of the coefficient of the expected rate of inflation greater than 2.0. Also, the revenue maximizing rate becomes progressively low, the higher the values of the average collection lag. Moreover, these rates are about one-third or less of the revenue maximizing rates for the value of β equal to 0.35 or greater.

Equally noteworthy is the level of maximum real inflation revenue. 2/ For the values of $\alpha = 2$ and $\beta = 0.35$, the maximum real inflation revenue is only 1.8 percent of real income, corresponding to a revenue maximizing rate of 16.8 percent. Moreover, after taking into account the erosion of real fiscal revenue, 3/ net maximum real inflation revenue is less than 1 percent of real income and diminishes rapidly with higher values of α and β. Since the expected inflation elasticity of demand for real balance at the revenue maximizing rate is 0.336 for the value of $\alpha = 2$, the public would be responsive to the level of inflation and would reduce real balances. The greater the reduction, reinforced by fiscal erosion, the lower is the maximum real total revenue. 4/

Empirical evidence on inflationary financing provides little comfort for generating much real inflation revenue in a steady state. The higher the value of the coefficient of the expected inflation rate of the demand for real balances, the narrower the gap by which maximum real total revenue exceeds fiscal revenue (R_o) when there is no inflation. The empirical parameters indicate that maximum real total revenue would be higher than the level, R_o, by only less than 1 percent of real income in equilibrium, though countries with a lower coefficient of the expected

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1/ The revenue maximizing rate was computed from equation (8) expressed as:

$$\pi^* = \frac{\log(1 - \alpha\pi^*) - \log\left(\beta \frac{R_o}{m_o}\right)}{\alpha - \beta}$$

2/ Real inflation revenue is obtained from equation (1):

$$g^* = f(\pi^*) = \pi^* m_o e^{-\alpha\pi^*}$$

3/ Erosion of real fiscal revenue is estimated from

$$\delta(\pi^*) = R(\pi^*) - R_o = R_o(e^{-\beta\pi^*} - 1).$$

4/ Maximum real total revenue is obtained from

$$TR(\pi^*) = f(\pi^*) + R(\pi^*) = \pi^* m_o e^{-\alpha\pi^*} + R_o e^{-\beta\pi^*}.$$

Table 2. Simulations of Inflation and Fiscal Revenue
(Parameter values: $R_o = m_o = 0.15$)

$\beta \backslash \alpha$	20.0	5.0	2.0	1.0
		(In percent)		
		Total revenue maximizing inflation rates		
0.10	3.01	12.14	30.78	63.06
0.35	1.52	6.28	16.83	38.10
0.50	1.03	4.33	12.07	29.65
0.75	0.44	1.91	5.75	17.20
		Ratio of total revenue to inflation revenue maximizing inflation rates		
0.10	60.20	60.70	61.56	63.06
0.35	30.40	31.40	33.70	38.10
0.50	20.60	21.65	24.14	29.65
0.75	8.80	9.60	11.50	17.20
		(percent of real income)		
		Real Inflation Revenue		
0.10	0.25	1.02	2.49	5.03
0.35	0.17	0.69	1.80	3.90
0.50	0.12	0.52	1.42	3.31
0.75	0.06	0.26	0.77	2.17
		Fiscal Revenue Erosion		
0.10	-0.05	-0.20	-0.45	-0.92
0.35	-0.08	-0.33	-0.86	-1.87
0.50	-0.08	-0.32	-0.88	-2.07
0.75	-0.05	-0.21	-0.63	-1.81
		Maximum Real Total Revenue		
0.10	15.20	15.81	17.04	19.12
0.35	15.09	15.36	15.94	17.03
0.50	15.05	15.20	15.54	16.24
0.75	15.01	15.05	15.14	15.36

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_0, 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_0) of 30 percent and real balance ratio (m_0) 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:

$$\Delta \log CPI = \underset{(1.60)}{0.0076} + \underset{(22.27)}{0.6939}\, \Delta \log M$$

$R^2 = 0.55$; 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 $m_0 = R_0 = 0.15$, 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. However, the interaction between inflation and government revenue and sustainable levels of fiscal deficits had not yet been fully analyzed. 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.

Figure 2.

GROWTH OF MONETARY BASE AND INFLATION, 1970-87

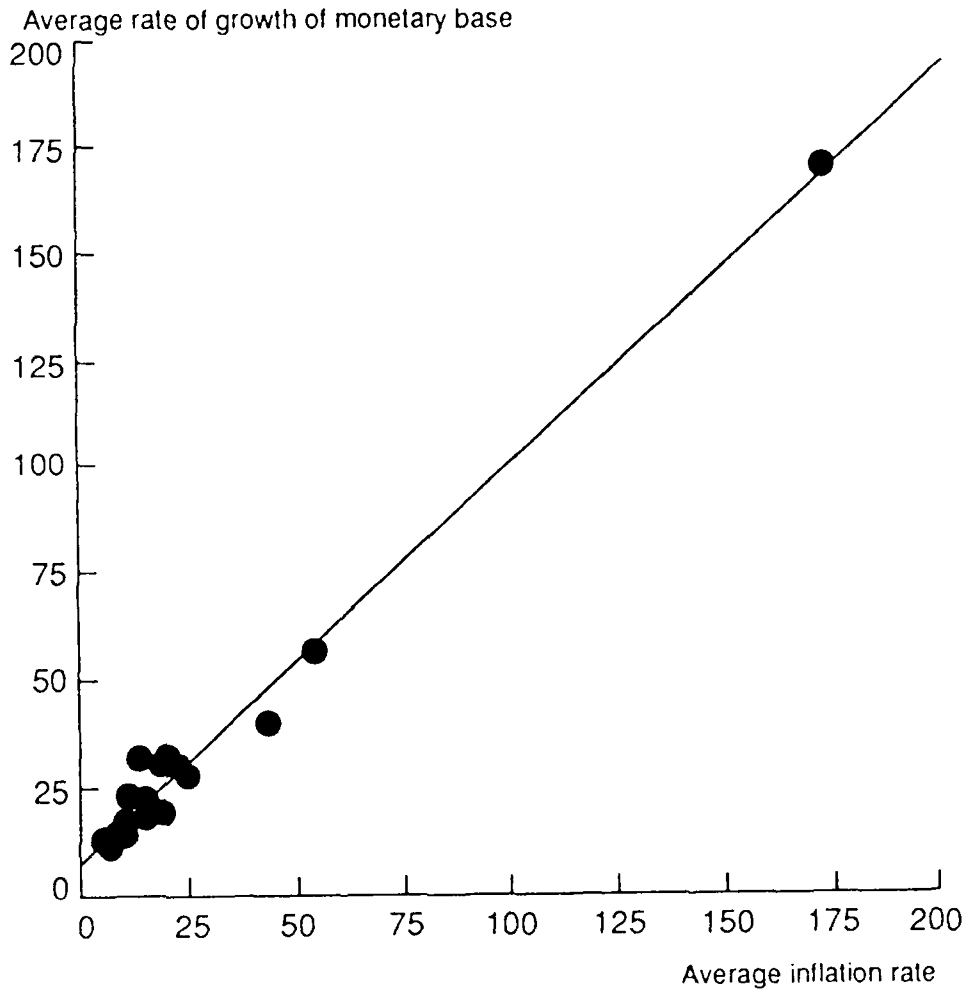
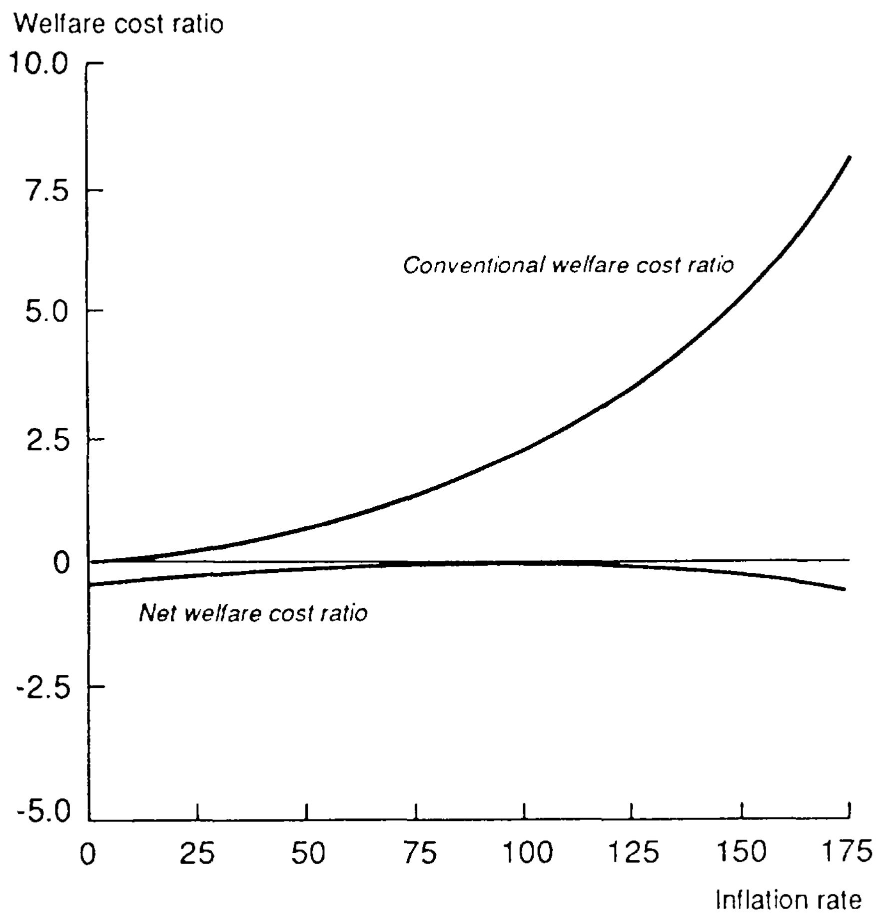


Figure 3.

WELFARE COST RATIO AND INFLATION [1]



[1] Simulations based on the parameter values of: $\alpha = 2.0$; $\beta = 0.35$; $R_0 = m_0 = 0.15$

Table 3. Welfare Cost Ratios
(Parameter Values: $R_o = m_o = 0.15$)

Parameters Values	$\beta \backslash \alpha$	20.0	5.0	2.0	1.0
	0.10	0.31	1.29	3.43	7.56
Net welfare	0.35	-0.34	-1.40	-3.66	-8.81
Cost Ratio	0.50	0.42	-1.77	-4.90	-11.79
(λ_n)	0.75	0.31	-1.35	-4.09	-12.26
	0.10	0.61	2.51	6.55	14.07
Conventional welfare	0.35	0.19	0.82	2.41	6.46
Cost Ratio	0.50	0.09	0.42	1.32	4.20
(λ)	0.75	0.02	0.09	0.32	1.50

This argument against inflationary finance is quite independent of the traditional one based on the welfare cost of inflation.

Empirical evidence for developing countries supports the hypothesis that inflation erodes real fiscal revenue. An increase in inflation will result in a fall in real tax revenue. As such, attempts to generate resources by means of the inflation tax will involve a loss in other revenues, thus widening the fiscal deficit. The sustainable level of the fiscal deficit financed by the inflation tax will also be smaller than commonly assumed; simulations indicate that this level is of the order of 1-2 percent of real income. Beyond this level, attempts to finance higher deficits by the inflation tax greatly increases the risk of inflation.

The above results have important implications for fiscal policy, particularly in developing countries. As the inflation tax is an inefficient means of resource generation, reliance on it should be reduced. A government choosing the inflation tax must take into account the possible effect of fiscal erosion on the fiscal deficit. The use of this tax can seriously threaten the price stabilization objective of fiscal policy. These considerations substantially strengthen the case for the adoption of a fiscal policy, which relies primarily on increased fiscal revenues to finance an expansion in government expenditure, rather than one that is based on generating revenues through inflation.

Appendix Table: Estimates of Real Current Revenue Equation for 28 Selected Countries, 1970-87

Country	Constant	Coefficient of: Real income β_1	Coefficient of: Expected Inflation β	R^2	SEE	D-W
All sample countries		1.462	-0.341	0.999	38x10^3	
		(24.77)	(4.05)			
Western Hemisphere						
Argentina	-13.349	2.083	-0.007	0.348	0.215	1.260
	(-1.55)	(2.55)	(-0.08)			
Costa Rica	-9.242	1.626	-0.009	0.916	1.091	1.059
	(-5.51)	(11.64)	(-0.06)			
Guatemala	-5.002	1.280	-0.218	0.746	0.628	1.025
	(-2.58)	(6.08)	(-0.50)			
Honduras	-6.652	1.536	-0.098	0.967	1.248	1.019
	(-10.85)	(21.70)	(-0.295)			
Peru	-11.944 1/	1.857	-0.137	0.815	0.323	1.640
	(-2.97)	(5.45)	(-1.13)			
Asia						
Bangladesh	-8.987	1.530	-0.458	0.770	0.739	0.952
	(-1.96)	(4.28)	(-0.93)			
Myanmar	-3.198	1.125	-1.554	.943	1.437	1.499
	(-2.12)	(8.02)	(-5.02)			
India	-9.871	1.538	-0.604	0.942	1.912	1.101
	(-6.64)	(15.01)	(-1.77)			
Malaysia	-3.607 2/	1.189	-0.112	0.975	3.344	1.329
	(-3.99)	(13.89)	(-0.21)			
Pakistan	-5.112	1.254	-0.289	0.986	2.859	1.339
	(-8.65)	(27.60)	(-1.16)			
Philippines	-0.846	0.912	-0.598	0.904	0.727	1.039
	(-0.78)	(11.12)	(-3.31)			

Appendix Table (continued). Estimates of Real Current Revenue Equation for 28 Selected Countries

	Constant	Coefficient of Real income β_1	Coefficient of Expected Inflation β	R^2	SEE	D-W
Singapore	-5.704	1.436	-0.574	0.979	4.080	1.267
	(-8.74)	(22.50)	(-1.57)			
Sri Lanka	-1.847 1/	1.022	-0.036	0.815	1.091	1.194
	(-0.965)	(6.26)	(-0.06)			
Thailand	-5.975	1.297	-0.097	0.986	2.833	1.492
	(-10.09)	(29.78)	(-0.43)			
Africa						
Bostwana	-5.414	1.706	-3.422	0.990	4.552	2.02
	(-9.67)	(24.18)	(-2.87)			
Ethiopia	-11.009 2/	2.026	-0.944	0.739	2.089	0.947
	(-1.54)	(2.52)	(-1.18)			
Ghana	-10.231	1.651	-1.057	0.458	1.378	0.984
	(-0.56)	(1.15)	(-2.91)			
Somali	2.448	0.624	-0.638	0.438	0.073	1.805
	(0.49)	(1.42)	(-0.36)			
Sudan	6.292	0.165	-0.612	0.324	0.027	1.683
	(2.87)	(0.74)	(-1.77)			
Zaire	-32.913	3.661	-0.524	0.700	0.755	1.449
	(-3.27)	(4.33)	(-2.48)			
Zambia	-2.39	1.122	-0.582	0.215	0.052	1.547
	(-0.33)	(1.37)	(-1.88)			
Middle East						
Egypt	2.139	0.761	1.029	0.564	0.030	1.342
	(0.26)	(0.95)	(-0.69)			
Iran	-8.261	1.428	-0.265	0.373	0.670	0.380
	(-0.92)	(2.59)	(-0.19)			

Appendix Table (concluded). Estimates of Real Current Revenue Equation for 28 Selected Countries

	Constant	Coefficient of Real income β_1	Coefficient of Expected Inflation β	R^2	SEE	D-W
Jordan	-3.966 1/	1.367	-0.040	0.977	3.597	1.509
	(-7.31)	(18.56)	(-0.06)			
Syrian Arab Republic	2.013	0.706	-0.203	0.335	0.211	1.401
	(0.42)	(1.66)	(-0.11)			
United Arab Emirates	10.423	-0.295	-12.771	0.641	13.692	0.787
	(0.71)	(-0.23)	(-3.16)			
Yemen Arab Republic	-10.361	1.868	-1.593	0.830	2.389	0.954
	(-3.67)	(6.72)	(-1.86)			
Yemen, P.D.R.	-18.403	3.937	-4.489	0.382	0.613	0.933
	(-1.54)	(1.90)	(-1.74)			

Note: In the estimated equations t-values are reported in parentheses; R^2, SEE and D-W are respectively, the coefficient of determination, the standard error of the estimated equation and the Durbin-Watson statistics.

1/ Coefficient of the dummy variable for countries for the period 1974-78:

Peru	-0.12	Sri Lanka	-0.058	Jordan	0.175
	(-2.35)		(-0.68)		(3.29)

2/ Coefficient of the dummy variable for countries for the period 1974-88:

Malaysia	0.127	Ethiopia	0.507	Jordan	0.320
	(1.78)		(2.46)		(3.94)

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