Self-Perpetuating "Inflation":
The Case of Turkey

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In the 1970s, Turkish inflation rose rapidly and is estimated to have exceeded 100 percent at the beginning of 1980. Studies by Fry (1972), Krueger (1975), Yenal (1967),and Akyuz (1973) suggest that the inflation has been caused primarily by a combination of high and rising public sector deficits financed by the issuance of high powered money by the Bank of Turkey. While this mechanism appears to be a reasonable description of the inflationary process in Turkey, it may omit an important feedback force that further contributes to inflation, that is, price increases may increase public sector deficits thereby adding further to inflation.

Studies by Aghevli and Khan (1977, 1978) and Dutton (1971) have shown that in many third world countries, inflation may increase government deficits. Because the financing of deficits through the extension of central bank credit is virturally automatic in many third world countries, inflation may be self-perpetuating. Not only does an increase in the money supply increase inflation, but increases in inflation widen deficits thereby pressuring central banks to finance these deficits.

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There are two possible elements in this feedback mechanism. First, the income elasticity of government expenditures may be greater than that of tax revenues. Second, tax revenues may adjust more slowly than government expenditures to inflation.

This study investigates three issues. First, it determines if such a feedback effect from inflation onto public sector deficits exists in Turkey. Second, if so, it determines the relative contributions of the income elasticities and adjustment lags. Third, it measures the welfare cost of inflation and inflation's impact on real GNP and tax revenues.

1. Theoretical Development of the Model

A. An Overview of the Model

We will investigate the inflationary process in Turkey with a simultaneous model consisting of five equations and an identity. The first two equations measure the impact of prices on government expenditures and tax revenue, respectively.

The third equation gauges the impact of inflation on agricultural State Economic Enterprises (hereafter SEEs). These enterprises were initiated to guide and promote Turkish growth and development. The deficits of some of the agricultural SEEs are financed directly by the Bank of Turkey.

The fourth equation posits that public sector deficits are financed primarily through the creation of monetary base by the central bank and thus through increases in the money supply. Evidence in many countries, including Turkey, suggest that changes in the monetary base dominate changes in the money supply.[1]

The fifth and final equation links the money supply and prices. This equation is derived from a demand for real balances relationship where the two major determinants of demand are real GNP and inflationary expectations.

1 See for example, Akyuz (1973), Yenal (1967) and Fry (1972).

B. Inflation and Government Deficits

We assume that desired real government expenditures are a positive function of real income. This relationship may be expressed in log-linear form in equation 1.

$$(1) \qquad \log (G/P)^D_t = g_0 + g_1 \log Y_t$$

where:

G = nominal government expenditures

P = the price level

$(\frac{G}{P})^D$ = the demand for desired real government expen-

Y = real income

g_0, g_1 = parameters such that: $g_1 > 0$.[2]

It is assumed that an increase in real GNP will increase the demand for goods and services, both public and private. In Turkey, several factors would increase the demand for real government expenditures, such as the perceived need for social overhead, urban infrastructure (there has been a substantial migration to urban areas in the past 30 years) and national defense (Turkey is a NATO member). Also, the government finances SEE deficits and as real GNP grows, the demand for SEE goods and services such as communications and transportation services may grow. All of these factors may serve to increase the value of g_1, the income elasticity of government expenditures.

The adjustment process by which actual expenditures adapt to desired expenditures is as follows:

$$(2) \qquad \Delta \log (G/P)_t = \alpha \, [\log (G/p)^D_t - \log (G/P)_{t-1}]$$

Where α is the coefficient of adjutment, $0 \leqslant \alpha \leqslant 1$

Substituting equation 1 into equation 2, and solving in terms of nominal expenditures yields:

2 If $g_1 = 1$, then equation (1) will be the same whether specified in real or nominal terms.

$$(3) \quad \log G_t = \alpha g_0 + \alpha g_1 \log Y_t + (1\text{-}\alpha) \log (G/P)_{t-1} + \log p_t$$

The size of α, the coefficient of adjustment, is determined by several factors, such as the reluctance of the authorities to allow inflation to reduce government expenditures in real terms or to raise SEE prices sufficiently to match higher costs.

C. Inflation and Tax Revenues

In the case of tax revenues, we assume that government authorities are interested primarily in providing sufficient revenues to finance government expenditures. Growth in GNP would provide a means by which the government could raise new revenue. Thus we postulate the following relationship:

$$(4) \quad \log R_t^D = r_0 + r_1 \log (Y \cdot P)_t$$

where $r_1 > 0$ and R^D is desired nominal tax revenues.

Balance budget considerations would argue for r_1 being set to equal g_1, but it is conceivable that tax revenues may be insufficient to finance the minimum acceptable amount of government expenditures. In such a case, g_1 may exceed r_1.

We assume that the government wishes to maintain its share of real resources. Nonetheless, inflation can cause actual real tax revenues to fall below their desired level because of lags in adjusting the tax base to inflated values. We have the following adjustment process:

$$(5) \quad \Delta \log {}_t^R = \beta \left[\log R_t^D - \log R_{t-1}\right]$$

where β is the coefficient of adjustment, $1 \geqslant \beta \geqslant 0$. Substituting equation (4) into (5) yields:

$$(6) \quad \log R_t = \beta r_0 + \beta r_1 \log (Y \cdot P)_t + (1\text{-}\beta) \log R_{t-1}$$

By focusing jointly upon the government expenditures equation (3) and the tax revenue equation (6), we can see that for inflation to increase government deficits will require either that:

$$g_1 > r_1, \text{ and/or } \alpha > \beta$$

If g_1 exceeds r_1, inflation would increase government expenditures faster than tax revenues thereby causing an increase in government deficits. Yet, even if g_1 equals r_1, inflation may still cause an increase in the government deficit if government expenditures adjust more rapidly than tax revenues, that is, if $\alpha > \beta$.

D. Inflation and Agricultural State Economic Enterprise Deficits

Although the government finances the deficits of many SEEs through transfer payments, some agricultural SEEs such as the Soil Products Office and the Sugar Corporation are provided credit directly by the Bank of Turkey. The Soils Product Office is charged with setting buying and selling prices for agriculture products. The spread between their prices often is insufficient to cover the storage, transportation, and marketing costs incurred by the office. As the World Bank (1980) has pointed out, inflation may push these costs up more rapidly than the increase in the spread, thereby increasing the deficit.[3] Unfortunately our data are for aggregate SEE deficits financed by the central bank and are not disaggregated into expenditures and revenues. Therefore, we test directly for the impact of inflation without measuring the relevant income elasticities or adjustment lags.

We test this relationship in log-linear form as follows:

$$(7) \qquad \log SD_t = s_0 + s_1 \log P_t + s_2 \log T$$

Where SD is the SEE deficit financed by the Central Bank and T is a time trend variable.

As just discussed, the coefficient, s_1, is expected to be positive. The time trend variable reflects all effects on the SEEs not at-

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tributed to inflation such as changes in efficiency, reorganization and government policies regarding support prices. We are uncertain as to the appropriate sign for s_2.

E. The Monetary Base and the Money Supply

From the balance sheet of the Bank of Turkey, we can derive the following equaton for the monetary base, (B):

$$(8)\quad B_t = CG_t + CS_t + NFA_t + A_t$$

where

CG = central bank claims on the government
CS = central bank claims on certain agricultural SEEs
NFA = net foreign assets
A = net other assets

Taking first differences yields

$$(9)\quad \Delta B_t = \Delta CG_t + \Delta CS_t + \Delta NFA_t + \Delta A_t$$

and equation 9 can be rewritten:

$$(10)\quad B_t = (G_t - R_t) + SD_t + \Delta NFA_t + \Delta A_t - B_{t-1}$$

where $\Delta\ CG_t = G_t - R_t$ and $\Delta\ CS_t = SD_t$

Equation (10) assumes that the entire deficits of the government and the SEEs are financed through central bank credit. While the government has been promoting greater private financing of public debt in Turkey in recent years, total private financing has been quite minor.[4]

Equation (10) can be rewritten:

$$(11)\quad B_t = G_t - R_t + SD_t + O_t$$

4 See Akyuz (1973) for a detailed discussion of Bank of Turkey financing of public sector deficits.

where $O_t = \Delta NFA_t + \Delta A_t - B_{t-1}$

Having derived a monetary base equation which explicitly incorporates government and SEE deficits, we proceed to the money supply relationship.

F. The Money Supply

The money supply is related to the monetary base by the identity:

(12) $M_t = m_t B_t$

where m_t is the money multipler.

Substituting equation (11) into (12) and taking logarithims yields:

(13) $\log M_t = \log m_t + \log (G_t - R_t + SD_t + O_t)$

This equation which refelects the impact of public sector deficits and other factors such as net foreign assets on the money supply, is non-linear in the variables. Since the other equations are linear, we linearize equation (13) about the sample means[5] to obtain:

5 We used a procedure similar to that used by Aghevli and Khan (1978, p. 343) to obtain parameter values b_0, b_1, b_2, b_3 and b_4 using the sample means of the logarithims of G_t, R_t, SD_t, and O_t.

Let $A = e^{\log GD_t} - e^{\log R_T} + r^{\log SD_t} + e^{\log O_t}$

Where — denotes the sample means of the variables.
Then:

$$b_0 = \log A - \left[\overline{(e^{\log G}t)}\ \overline{(\log G_t)} + \overline{(e^{\log SD}t)}\ \overline{(\log SD_t)} + \overline{(e^{\log O}t)}\ \overline{(\log O_t)} \right] \frac{1}{A}$$

$$b_1 = \frac{\overline{e^{\log G_t}}}{A} \qquad b_2 = \frac{\overline{e^{\log R_t}}}{A}$$

$$b_3 = \frac{\overline{e^{\log SD_t}}}{A} \qquad b_4 = \frac{\overline{e^{\log O_t}}}{A}$$

$$(14)\quad \log M_t = \log m_t + b_0 + b_1 \log G_t - b_2 \log R_t + b_3 \log SD_t + b_4 \log O_t$$

G. Prices and the Demand for Money

The price equation is derived from a demand for desired real money balances equation:

$$(15)\quad \log (M/P)^D_t = a_0 + a_1 \log Y_t + a_2 E_t$$

where E represents inflationary expectations.

No interest rate variable is included in the equation as government policy has kept the real rate of return of financial instruments negative for most of the time period considered.[6] On the other hand, we assume that real assets are reasonably close substitutes for financial assets and so E enters the demand for real balances equation as an estimate of the opportunity cost of holding real balances.

The actual demand for money is expected to adjust to the gap between the current demand for real balances and last period's actual real balances as follows:

$$(16)\quad \Delta \log (M/P)_t = \delta [\log (M/P)^D_t - \log (M/P)_{t-1}]$$

where δ represents the coefficient of adjustment, $0 \leqslant \delta \leqslant 1$.

Substituting equation (15) into (16) and solving for $\log P_t$:

$$(17)\quad \log P_t = -\delta a_0 - \delta a_1 \log Y_t - \delta a_2 E_t - \delta a_3 \log N_t - (1-\delta) \log (M/P)_{t-1} + \log M_t$$

6 For a discussion of the deficiencies of interest rate data, see Akyuz (1973), pp. 24-26.

The expected inflation variable E_t was derived by using Cagan's adaptive expectations model:

$$(18) \quad E_t = \gamma\, \Delta \log P_t + (1-\gamma)\, E_{t-1}, \text{ where } 0 \leqslant \gamma \leqslant 1.$$

The coefficient γ is derived using an iterative procedure discussed in the next section.

II. Estimation and Empirical Results

Our complete model can be rewritten as:

$$(19) \log G_t = \alpha g_0 + \alpha g_1 \log Y_t + (1-\alpha) \log (G/P)_{t-1} + \log P_t$$

$$(20) \log R_t = \beta r_0 + \beta r_1 \log (Y \cdot P)_t + (1-\beta) \log R_{t-1}$$

$$(21) \log SD_t = s_0 + s_1 \log P_t + s_2 \log T$$

$$(22) \log M_t = \log m_t + b_0 + b_1 \log G - b_2 \log R_t + b_3 \log SD_t + b_4 \log O_t$$

$$(23) \log P_t = -\delta a_0 - \delta a_1 \log Y_t - \delta a_2 E_t - \delta a_3 A_t - (1-\delta) \log (M/P)_{t-1} + \log M_t$$

$$(24) E_t = \gamma \Delta \log P_t + (1-\gamma) E_{t-1}$$

This model is estimated using annual data for the period 1950 to 1975.[7]

To justify the necessity of using a simultaneous model, we in-

7 The money supply, the monetary base, GNP, government expenditures and taxes and the consumer price index were derived from the International Monetary's Fund's *International Financial Statistics*. For 1950 to 1952 Government expenditures and taxes were derived from Turkey's State Institute of Statistics. Net foreign assets, agricultural output and SEE deficits financed by the Central Bank were obtained from the World Bank Study (1975).

vestigate the possible two-way causality between the money and price variables using a formal test proposed by Pierce (1977) and Sims (1972). In order to remove past influences upon current values, the two variables were prewhitened using a filter proposed by Sims.[8] The transformed M variable was cross-correlated with up to two years of lagged and future values of the transformed P variable. The results are presented in Table 1. All of the cross-correlations were significant at the 0.01 level, thereby implying a two-way causality between money and price variables.

Table 1

CROSS-CORRELATION OF M* AND LEAD AND LAGGED VALUES OF P*

P^*_{t+2}	P^*_{t+1}	P^*_{t}	P^*_{t-1}	P^*_{t-2}
0.46	0.55	0.60	0.60	0.52

All of the corss-correlations were significant at the 0.01 level.

We are estimating the simultaneous equations system with three-stage least squares (3 SLS), which takes into account all *a priori* restrictions inherent in the model. The results from the model are presented in Table 2.[9]

In Table 3, we present the values of the elasticities and adjustment coefficients. In the government expenditure equation (19) the coefficient for the lagged expenditure variable is 0.32 and is lower than the corresponding coefficient in the tax equation which is 0.36. This implies a speedier adjustment for government

8 The filter flattens the spectral density of the variables so that the transformed series has white noise properties. The filter transforms the variables as follows:

$$M^*_t = 1 - 1.5 \log M_{t-1} + 0.5625 \log M_{t-2}$$

$$P^*_t = 1 - 1.5 \log P_{t-1} + 0.5625 \log P_{t-2}$$

9 We have not presented the Coefficient of Determination, and the Durbin-Watson Statistic for each equation, since it is difficult to interpret these statistics in 3 SLS estimtion of simultaneous models. Nonetheless, in estimating a similar by recursive model, we found very high Coefficients of Determination (above 0.98) and no evidence of auto correlation.

Table 2

ESTIMATES OF STRUCTURAL MODEL

Equation (19)

$$\log G_t = \underset{(4.25)}{-6.82} + \underset{(4.32)}{1.0} \log Y_t + \underset{(1.90)}{0.32} (G/P)_{t-1} + \log P_t$$

Equation (20)

$$\log R_t = \underset{(4.91)}{-5.93} + \underset{(4.99)}{0.75} \log (Y_t \cdot P_t) + \underset{(2.62)}{0.36} \log R_{t-1}$$

Equation (21)

$$\log SD_t = \underset{(4.70)}{-5.34} + \underset{(4.28)}{2.48} \log P_t - \underset{(3.06)}{1.96} \log T$$

Equation (22)

$$\log M_t = .53 + .91 + 1.56 \log G_t - 1.36 \log R_t$$

$$+ .23 \log SD_t + .57 \log O_t$$

Equation (23)

$$\log P_t = \underset{(2.02)}{2.00} - \underset{(2.72)}{0.35} \log Y_t - \underset{(5.49)}{0.79} (M/P)_{t-1} + \underset{(2.14)}{3.14} E_t$$

$$+ \log M_t$$

Equation (24)

$$E_t = .1 (\Delta \log P_t) + .9 E_{t-1}$$

Table 3

INCOME ELASTICITIES AND ADJUSTMENT COEFFICIENTS

Equation (19) Government expenditures

Income Elasticity (g_1) = 1.46

Adjustment (α) = 0.69[a]

Mean adjustment lag $\left(\frac{1-\alpha}{\alpha}\right)$ = 0.46 years[b]

Equation (20) Tax Revenue

Income elasticity (r_1) = 1.17

Adjustment (β) = 0.64

Mean adjustment lag $\left(\frac{1-\beta}{\beta}\right)$ = .57 years

Equation (23) Demand for real balances

Income elasticity (a_1) = 1.67

Adjustment (δ) = 0.21

Mean adjustment lag $\left(\frac{1-\delta}{\delta}\right)$ = 3.8 years

Equation (24) Expected Inflation

$\gamma = .1$

a Not statistically different from unity at the 95 percent confidence level.
b Not statistically different from zero at the 95 percent confidence level.

expenditures, an average lag of 0.46 years, than for tax revenues which has an average lag of 0.57 years. Moreover, the differences in adjustment lags are most likely even greater as the coefficient for lagged expenditures, unlike that for lagged tax revenues, is statistically insignificant at the 95 percent confidence level. Thus, government expenditures can be assumed to adjust instantaneously. The average tax adjustment lag is also fairly short, 7 months, which seems reasonable given that a very large share of taxes is generated by income, goods and service taxes. Presumably, such taxes would quickly reflect inflation.

Moreover, the income elasticity of government expenditures

(1.46) is significantly greater than the income elasticity of tax revenues (1.17). Although the reforms of the 1960s increased the income elasticity of tax revenues, these were insufficient to prevent inflation from widening the govenment deficit given the high income elasticity of government expenditures. In both cases, the income coefficients have the proper signs and are highly significant.

Thus, our results suggest that price increments do raise government deficits and that this effect is attributable both to government expenditures adjusting more rapidly to inflation than tax revenues and to the difference in income elasticities between expenditures and revenues.

In the case of the agricultural SEEs receiving direct credit from the Bank of Turkey, inflation was found to have a highly significant impact on the deficits. The time trend, however, was found to have a highly significant negative coefficient. We are uncertain as to the cause of this result though changes in policy or improvements in efficiency are all possibilities. Having established that inflation increases the deficits of both the government sector and that of some agricultural SEEs, we turn to the impact of these deficits on the money supply.

This equation was initally estimated using three stage least squares but GD_t and SD_t were found to be highly collinear, thereby causing unstable estimates of the coefficients. Therefore, we derived the parameters of the equation mathematically by calculating the sample means of GD, SD, and O using the formulae in Footnote 5.

We find that the signs of the coefficients are as expected. Government expenditures, tax revenues, and state economic enterprise deficits impact as expected on the money supply. Moreover, the other assets variable, most likely reflecting the impact of foreign exchange inflows from workers living abroad, has had a positive influence on the money supply.

The coefficients of the price equation have the proper signs and are all significant. The lagged real balances variable is found to have a highly significant coefficient of 0.79. This implies that the average adjustment lag for real balances is 3.8 years.

Inflationary expectations were found to have a significant positive impact on inflation. For the adjustment coefficient of inflationary expectation, we assumed values from 0.1 to 0.9 (in steps of 0.1). The first value of E_{t-1} was given by P_{t-1} to generate the E_t series. We used each of the E_t series (corresponding to each value of γ) in the price equation

$$(25) \quad E_t = \gamma \Delta \log P_t + (1-\gamma) E_{t-1}$$

and chose the estimated equation with the highest R^2. This procedure leads to consistent estimations of both the adjustment coefficient and the regression parameters. The adjustment coefficient, γ, was found to be 0.10 which suggests that the public is very slow in adjusting to inflationary expectations. Although this result is similar to Dutton's (1971) finding for the Argentine economy, it is considerably slower than the adjustment lag estimated by Aghevli and Khan (1978) for Thailand, Brazil, Colombia and the Dominican Republic. This relatively long adjustment lag may be explained by Turkey's inflationary experience in the time period studied. A simple regression of inflation on a time trend variable reveals that the time trend is statistically insignificant at the 95 percent confidence level. Moreover, Glazikos (1978) found that Turkey's inflation rate, compared to other countries, was highly volatile. Such an inflationary experience, where inflation is highly volatile but without any general trend, could make the public slow to revise its inflationary expectations. Sudden changes in the inflation rate could be perceived more as random events rather than as part of a new trend.

Real income is found to have a highly significant impact on prices. The long-run income elasticity of the demand for money is estimated to be 1.67.

In order to test for the goodness of fit of our model, we undertook a simulation of the reduced forms of the endogenous variables in the system. The correlations between the actual and simulated values of the endogenous variables (prices, money, taxes, government expenditures and SEE deficits), all proved to be greater than .98, suggesting that our model provides a close fit.

III. Benefits and Costs of Inflation

This section investigates the following: the impact of Turkish inflation (which has averged 8.6 percent per annum for 1950-1975) on (1) revenues from the inflationary tax on real balances, (2) tax revenue losses from tax collection lags, and (3) the welfare cost of inflation.

Inflation, Taxes, and Welfare Costs

For the period 1950-1975, actual tax receipts as a fraction of GNP were 11.83 per annum. Through simulation of our model, we estimate that without inflation, tax receipts would have been higher, 14.69 percent of GNP per annum (see Table 4). Thus, even though we estimate the income elasticity of tax revenues to be slightly greater than unity, inflation would nonetheless reduce revenues because of tax collection lags.

On the other hand, the inflationary tax on real balances, which equals the product of the inflation tax and real cash balances, is estimated to be 1.74 percent of GNP. This gain in government resources is inadequate to offset the tax collection loss and thus results in a total loss of 1.12 percent of GNP per annum.

Table 4

LOSSES FROM INFLATION
ALL FIGURES AS A PERCENT OF GNP

	Zero Inflation	Actual Inflation	Losses From Inflation
Tax Revenues	14.69	11.83	2.86
Inflation Tax on Real Balances	-0-	1.74	-1.74
Total Tax Revenues = (1) + (2)	14.69	13.57	1.12
Welfare Cost of Inflation	-0-	.09	.09
	Total Inflationary Loss		1.21

The tax loss is accompanied by a welfare cost from inflation. This cost refers to the resource cost associated with economizing on real balances and is analogous to the deadweight loss from an excise tax. This cost, which is equal to the product of one-half the inflation rate and the change in real balances due to inflation, is 0.09 percent of GNP. The relatively low rate of inflation contributes to the very low value of welfare cost. Added to the tax loss, the total costs of inflation were 1.21 percent of GNP per annum.

IV. Summary and Conclusions

Our empirical results support our hypothesis that Turkish inflation has a feedback mechanism. Thus, while we find that the Bank of Turkey's monetization of public sector deficits causes inflation, an increase in inflation causes a further increase in public sector deficits, thereby causing yet another round of inflation. The results of the Sims test support this hypothesis of two-way causation. The primary cause of this inflation is the relatively slow adjustment of government tax revenues to higher levels of inflation. Actual government expenditures adjust to desired expenditures instantaneously while tax revenues have an average lag of 0.5 years. Inflation also was found to increase the deficits of the SEEs directly financed by the Bank of Turkey. Both deficits, once widened, seem to impel an increase in the money supply which causes an increase in the price level.

Thus, it would appear that Turkish authorities should shorten the tax revenue adjustment lag, in order to limit the feedback effects on inflation. Another corrective measure would be to improve the efficiency of the SEEs and price SEE goods and services at a level more in line with market conditions. In recent years, the government has taken steps in this direction. Otherwise, the large and growing government and SEE deficits and their financing through central bank credit, may continue to be a source of inflationary pressure.

Reducing inflation in Turkey is desirable, as our study shows that inflation causes a reduction in welfare without increasing real output. Moreover, during the 1950-1975 period, tax revenue losses due to inflation exceeded the tax revenues from the inflationary tax on real balances.

The 1970's saw a rapid acceleration of Turkish inflation with prices doubling from 1970 to 1974 and quadrupling from 1975 to 1979. Although lack of data pevented extension of our model beyond the 1975 period, the general conclusion of our model would be expected to hold, namely, that feedback effects would exacerbate inflation and that the losses, both in tax revenue and welfare costs of inflation, would be substantial.

Development literature has frequently justified inflation as a means of increasing tax revenues whenever the tax system is too inefficient to gather adequate revenues by usual means. Yet, our study has shown that this inefficiency may also include tax collection lags that can reduce government revenue in periods of inflation. In fact, in Turkey, inflation has resulted in a net loss in tax revenues. Thus, it appears that development literature, by overlooking the losses from inflation, has been too favorably disposed towards inflation as a revenue gathering device.

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