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Research Department

**Inflation and Fiscal Deficits:
The Irrelevance of Debt and Money Financing**

Prepared by José M. Barrionuevo

Authorized for distribution by David T. Coe

December 1992

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Abstract

The purpose of this paper is to present a model that circumvents the requirement of explicitly setting a period in which the fiscal budget is to be balanced, yet implies that increases in the growth of public debt are bound to increase inflation when there is no perceived commitment to reduce the fiscal deficit. The model is based on a modified version of the cash in advance constraint. The results of numerical simulations suggest that an increase in the growth of debt to finance current consumption leads to an equal increase in inflation. The timing of this increase varies with the size of the deficit and the pace of economic growth. It is shown that small increases in small deficits yield fairly significant increases in inflation. Three policy conclusions are offered.

JEL Classification Numbers:

C15, E31, E51, E58, E62

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Summary

The experience of many industrial and developing countries suggests that fiscal deficits have introduced significant distortions in the economy without stimulating economic activity. Barro (1974) shows that, under certain conditions, changes in public deficits arising from a switch from tax to bond financing (borrowing) of a given level of real spending will not affect real economic activity. Propositions of this kind are important because they suggest that the only way to stimulate economic activity is by reducing taxes and spending.

Public sector deficits have a bad reputation because, sooner or later, governments will resort to money creation, and hence inflation, to finance them. Sargent and Wallace (1981) and Sargent (1987) discuss deficit financing regimes that are intermediate to the models that use only money or only bonds. In these intermediate regimes, an increase in interest-bearing debt eventually leads to higher inflation because increased debt signals future increases in money. However, these models' predictions of inflation hinge on the assumption about the time required to balance the government budget. A major drawback of this assumption is the uncertainty about whether the government budget can be balanced in 5, 10, or 20 years.

This paper presents a model that circumvents the requirement of explicitly setting a period for balancing the fiscal budget yet implies that increases in the growth of public debt are bound to increase inflation if there is no perceived commitment to reduce the fiscal deficit. The model represents an economy with no certain time horizon within which the intertemporal government budget is to be balanced. Inferences about whether a fiscal deficit is too high or too low at any given time are drawn from the market's expected real rate of return. Two special cases of the model are the Sargent and Wallace money and debt financing irrelevance proposition and the quantity theory of money. More importantly, the model introduces a trading pattern that allows a more flexible use of credit and money.

Three irrelevance propositions on the effects on inflation of debt and money financing are presented. The money and debt irrelevance propositions are used to characterize the mechanics of inflation under alternative financing policies. Numerical simulations are used to illustrate and interpret the dynamics of inflation as implied by the alternative financing strategies. A simple example suggests that declines in inflation can only be achieved only through strong fiscal reform rather than through isolated tightening of fiscal and monetary policy or price controls.

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I. Introduction

Public deficits and the burden of steadily growing public debt are once again at the center of macroeconomic policy debates. In the United States, widespread concern about the growing federal deficit has renewed the need to contain and reduce it through spending reductions, tax increases, or both. In Europe, France, the Netherlands, and Belgium have made the control and reduction of public deficits a corner-stone of macroeconomic policy. Many developing countries have undertaken major expenditure and tax reforms to reduce their fiscal deficits in an effort to lessen inflation and promote economic growth.

In the experience of these countries, fiscal deficits have introduced significant distortions with virtually no improvement in economic activity. Barro (1974) shows that in the absence of liquidity constraints, and with lump-sum taxes, changes in public deficits arising from a switch from tax to bond financing (borrowing) of a given level of real spending will have no effect on real economic activity. Propositions of this kind are important because they suggest that the only way to stimulate economic activity is by reducing taxes and spending.

One reason why public sector deficits have a bad reputation is the view that sooner or later the government will resort to money creation, and hence inflation, to finance the deficit. The government budget constraint and equilibrium models of inflation suggest that the inflationary aftermath of government deficits depends sensitively on the government's strategy for servicing the debt it issues. The reason is that the fiscal deficit and money are not related in a unique way: the government can cover its deficit by issuing interest-bearing government debt, at least to some extent, instead of money.

Barro (1976) and McCallum (1984) examine whether persistent bond-financed deficits are inflationary. Barro suggests that they would be inflationary if the rate of growth of bonds exceeds the rate of output growth. The reason is that in this case the present value of the government's future taxing capacity is bounded. McCallum also suggests that persistent primary deficits are inflationary, but shows that a positive growth rate of bonds can be permanently maintained in a stationary Ricardian economy, provided that this growth rate is smaller than the rate of time preference. This is because after-tax income also includes interest payments from the government. Hence, taxes can exceed output and yet be smaller than after-tax income.

Sargent and Wallace (1981) and Sargent (1987) discuss deficit financing regimes that are intermediate to the models of only money or only bonds. In these intermediate regimes, an increase in interest bearing debt leads eventually to higher inflation because increased debt signals future increases in money. However, the inflationary predictions of these models hinge on the assumption about the time period over which the government budget is to be balanced. A major drawback of this assumption is the uncertainty about whether the government budget should be balanced in 5, 10, or 20 years.

This paper presents a model that circumvents the requirement of explicitly setting a period in which the fiscal budget is to be balanced. It nevertheless implies that increases in the growth of public debt are bound to increase inflation if there is no perceived commitment to reduce the fiscal deficit. The model is of an economy with no certain time horizon within which the intertemporal government budget constraint is to be balanced. Inferences about whether a fiscal deficit is too high or too low at any given time are drawn from the market's expected real rate of return. An important feature of the model is that both the Sargent and Wallace money and debt financing irrelevance proposition and the quantity theory of money are two special cases.

The model presented in Section II is based on a modified version of the cash in advance constraint. Lucas (1988) argues that a major drawback of cash in advance models is that they imply an unrealistic trading pattern. The model addresses this critique by introducing a trading pattern that allows a more flexible use of credit and money. An important feature of the trading pattern is that investors conclude asset trading with bonds that need to be sold tomorrow to pay for the credit extended today and, thus, not only with bonds needed to finance the purchase of future consumption.

Three propositions on the effects on inflation of alternative debt and money financing policies are offered in Section III. The first is a debt and money finance irrelevance proposition: if there is a common rate of growth in money and debt, inflation will equal this common rate. The second proposition is in the spirit of Sargent and Wallace (1981): if the growth of debt exceeds the real return, inflation will eventually equal the growth of debt. The third proposition is a restatement of the quantity theory of money: inflation is equal to money growth for a given rate of output growth, provided that debt growth equals the real return. These results do not hinge on any specific characterization of preferences or technology.

The eventual increase in inflation to match a higher growth of debt is explained as follows. The market's willingness to hold government debt rises with the real interest rate and, thus, with economic growth. If investors do not expect any current or future reductions in government deficits, expected real returns remain unchanged, so that credit spending increases to match the higher growth of debt. In other words, consumers spend unwanted government debt by paying with credit. Higher credit spending today means higher prices today. Investors thus hold government bonds today to sell them tomorrow to pay for credit and accrued interest.

The money and debt irrelevance propositions are useful to characterize the mechanics of inflation under alternative financing policies. Numerical simulations are used to illustrate and interpret the dynamics of inflation as implied by the alternative financing strategies. Section III concludes with a simple example which shows that declines in inflation can only be achieved with strong fiscal reform, rather than with isolated tightening of fiscal and monetary policy or by price controls. Section IV presents concluding remarks.

II. A Model of Inflation, Money, and Debt

This section presents a model of inflation based on a modified version of the cash in advance trading restriction, ^{1/} the fiscal budget, and the wealth constraint of investors. The modified cash in advance restrictions include a trading pattern that allows a more flexible use of credit and money. The fiscal implications of the model are in the spirit of Sargent and Wallace (1981) and Sargent (1987). However, instead of assuming that the fiscal budget constraint must be satisfied over a given time period, the real returns expected by the market are used to characterize the effects of alternative financing strategies on inflation.

1. Credit and money

A consumer goes to a store to make a purchase. The relationship between the consumer and the store's manager generally begins and ends with this transaction; the two agents probably never met before and, if there are many other stores selling a similar product, the consumer might not return. It is therefore likely that the manager will insist on receiving cash in exchange for the product, which he can then pass along in making purchases of his own. Yet, not all purchases are made with money. Some managers will accept a credit card receipt signed by the consumer in exchange for goods, but only if a third party, usually a financial intermediary, guarantees that payment will be made as promised and, hence, that the extended credit is a suitable substitute for money. The role of the financial intermediary is to confirm that the consumer's past earnings are sufficient to cover the cost of the purchase.

Fisher (1911) argues that money has value in exchange but not in use. Lucas (1988) implements this condition by assuming that trade occurs in decentralized markets that require that the purchase of some goods be made with cash only, while others may be purchased with credit. An important advantage of cash in advance restrictions is that the original real theory is only slightly modified, thereby maintaining its ability to account for important real observations.

Two observations, however, make this an inconvenient characterization of how trading takes place. First, credit really varies across stores, not across goods. If a store accepts credit, the consumer is likely to purchase all the merchandise using either cash or credit. He will not be required to pay with cash for some specific goods and with credit for others. Second, a major difficulty with cash in advance models is that when they are binding, real money is equal to consumption. However, consumption is significantly higher than real money for most economies. Cash in advance constraints are next modified to incorporate these observations.

^{1/} Cash in advance models are developed in Clower (1967) and Lucas (1984, 1988), among others.

2. The economic environment

The economy is of a storable, one good, endowment technology under uncertainty. Investors, government, and financial intermediaries interact in this environment. Investors own an exogenously given endowment technology, they invest in government bonds to trade contingent claims for future consumption, and use money or credit to pay for current consumption. The government finances its deficit by issuing bonds or money or both. Finally, financial intermediaries buy and sell government bonds, and extend credit to consumers.

The state of the economy is as follows. Private agents are assumed to form rational expectations about economic growth and the fiscal deficit, so that deviations from actual values are independent and identically distributed normal random errors. Let the history of shocks to growth and the deficit (S) be public knowledge prior to all current period trading. The history of shocks follows a markov process with the transition density $f(s', s)$, where $\text{prob}(s < s' | S) = \int f(s', s) ds'$, and s and s' are specific states of the economy in the current and the next period, respectively. Thus, all variables are realized prior to asset and goods trading.

3. Asset and goods trading

Asset and goods trading take place in two sessions. Goods are traded in the first session. At the beginning of each trading day, production and exchange of current goods are carried out in a decentralized fashion with consumers using money or credit to pay for their purchases. Purchases made with credit are subject to interest payments. At the end of goods trading, consumers trade in fiat currency and in government bonds. Agents conclude the assets trading session with the money needed to finance some purchases of consumption goods in the next period and with the bonds needed to pay tomorrow for credit extended today, putting the remaining wealth in bonds to finance future consumption. 1/

Financial intermediaries manage the bond portfolio of consumers and extend credit cards based on bond (asset) holdings. If consumers do not make payments the next period, intermediaries sell their bonds to cover the credit payments. In this sense credit is a binding commitment. Moreover, since credit payments must cover accrued interest, consumers invest in bonds an amount equal, at least, to the nominal credit contracted. Next day, they sell bonds to pay for credit liabilities. 2/ Thus, the modified cash in advance constraint to finance current consumption is given by equation (1),

1/ Consumers carry cash for convenience to pay for some, generally small, purchases. For instance, gas stations charge a higher price for payments made with credit. Moreover, convenience stores usually do not accept credit. Alternatively, consumers may also hold money to write a check next morning to pay for the credit extended today.

2/ In practice, this is justified by high credit rates.

$$c = \alpha \cdot b + \frac{M_{-1}}{p} - \alpha_{-1} \cdot (1+r) \cdot \frac{B_{-1}}{p} \quad , \quad (1)$$

where c is current consumption, α is the fraction of bonds purchased in the asset trading session for the credit obtained in the goods trading session after paying for last period's credit and accrued interest $(\alpha_{-1} \cdot (1+r_{-1}) \cdot B_{-1}/p)$, $1/b$ is real bonds, M_{-1} is the quantity of money that the investor got yesterday to make cash purchases, and r is the real return on government bonds.

Investors own firms (technologies), are liable for taxes, and hold the outstanding debt of the government, so their wealth constraint is:

$$y = c + (1-\alpha) \cdot b + v \cdot \frac{M_{-1}}{p} - (1-\alpha_{-1}) \cdot (1+r) \cdot \frac{B_{-1}}{p} \quad , \quad (2)$$

where y is real output after taxes, $(1-\alpha) \cdot b$ is financial investment, and v is money growth. Equation (2) suggests that after paying taxes, investors use their income to pay for consumption and invest in government securities. More importantly, equation (2) suggests that financial investment in bonds increases with their real return and the level of output.

The government is similarly subject to a budget constraint that relates the fiscal deficit to the quantity of money and bonds needed to finance it. Thus, to finance the current fiscal deficit, each initial choice of money growth (v_0) is associated with a particular value of public debt growth (θ_0) that satisfies equation (3),

$$d_0 = \frac{\mu_0}{v_0} + (\theta_0 - r_0) \cdot \kappa_0 \quad , \quad (3)$$

where d_0 is the primary balance of the government as a percentage of GDP, κ_0 is the fraction of GDP invested in bonds, and v_0 is the velocity of money. Thus, $1/v_0$ is the initial fraction of GDP kept in real money. Not surprisingly, equation (3) suggests that the nominal debt growth required to finance a given initial deficit declines with increases in the growth of money. More importantly, for a given deficit and monetary growth, equation (3) implies a significant growth in public debt for a high initial velocity or for a low initial debt-GDP ratio.

^{1/} Recall that from the view point of consumers, credit is necessarily a binding commitment.

III. Debt and Money Finance Irrelevance Propositions

This section presents some simple propositions on the ability of a government to finance its deficit by issuing bonds and money as implied by the modified cash in advance restriction, the wealth constraint of private agents, and the government's fiscal balance. The money and debt irrelevance propositions characterize the dynamics of inflation. Numerical simulations are used to illustrate and interpret the dynamics of inflation for various alternative financing strategies. The section is concluded with a simple empirical example.

1. Three irrelevance propositions

The inflation rate implied by the model is obtained after substituting equation (1) in equation (2), dividing by p_{-1} , and solving for inflation, yields,

$$\pi = \frac{(1+\nu) \cdot (1/v_{-1}) + (\theta-r) \cdot \kappa_{-1}}{(1+\gamma)} - 1, \quad (4)$$

where π is inflation and γ is output growth. ^{1/} Equation (4) implies that inflation increases with monetary growth, but also with any increase in nominal debt growth beyond what individuals are willing to hold, as implied by the real return and, thus, savings. Following the standard neoclassical model, the real return increases with higher after tax growth and with a higher deficit-GDP ratio. Moreover, (4) also suggests that inflation is negatively related to output growth. The usefulness of equation (4) lies in its ability to evaluate the consistency of any government financing policy with a particular inflation target.

The government's debt and monetary policy in any given period are a pair $\phi = (\theta, \nu) \in \mathbb{R}$ so that equation (3) is satisfied. Equation (4) maps $\omega = (\phi, \gamma, \kappa_{-1}, v_{-1}, r)$ into $\pi \in \mathbb{R}$, so that the modified cash in advance restriction (1) and the investment constraint (2) are satisfied. Equation (4) implies that inflation increases with monetary growth and declines with economic growth. More importantly, (4) suggests that the greater is the difference between debt growth and the real return, $\theta - r > 0$, the higher is inflation beyond that implied by money growth (ν).

The mechanics of inflation under different monetary and debt policies are characterized as follows. By the mechanics of inflation it is meant the explicit dynamic behavior of inflation from now into the future until convergence is achieved. Rewriting equation (4) as a function of time (t) for initial ω_0 yields,

^{1/} Inflation (π) is defined as $(p/p_{-1}) - 1$.

$$E_0(p_t) = E_0 \left[\frac{(1+\nu_0)^t \cdot (1/\nu_0) + (\theta_0 - r_0) \cdot (1+\theta_0)^{t-1} \kappa_0}{(1+\gamma_0)^t} \right], \quad (5)$$

Equation (5) outlines the expected time path of the price level if current levels of growth, interest rates, money, and debt policies were to remain unchanged from now into the future, given initial conditions on velocity (ν_0) and the debt-output ratio (κ_0). Expected inflation between any two dates is then given by, $E_0(\pi) = E_0((p_{t+1}/p) - 1)$.

The model, as summarized by equation (5), suggests the following propositions, proofs of which are presented in the Appendix:

Proposition 1. For any $\omega = (\phi, \gamma, \kappa, \nu, r) \in R$, $\omega < \infty$, $r = r_0$, and ϕ is s.t. $\theta = \nu$, then $\pi = \theta - \gamma = \nu - \gamma$ at all dates, regardless of κ_0 , ν_0 , and r_0 .

Proposition 2. A finite horizon irrelevance proposition. For any $\omega = (\phi, \gamma, \kappa, \nu, r) \in R$, $\omega < \infty$, $r = r_0$, and $\phi \in (\phi_i, \phi_j)$ s.t. $\phi_i = (\theta_i = \mu > r, \nu_i = 0)$ and $\phi_j = (\theta_j = 0, \nu_j = \mu)$ for all i and $j \in R$, then $\lim \pi = \theta_i - \gamma = \nu_j - \gamma = \mu - \gamma$ for $T_i \neq T_j < \infty$, regardless of κ_0 , ν_0 , and r .

Proposition 3. For any $\omega = (\phi, \gamma, \kappa, \nu, r) \in R$, $\omega < \infty$, and ϕ s.t. $\theta = \nu$, $r = \theta$, then $\pi = \nu - \gamma$ at all dates, regardless of κ_0 , ν_0 , and r_0 .

Proposition 1 implies that a fiscal deficit financed by a common rate of money and debt growth yields an inflation rate that is equal to this common rate from now into the future. Proposition 2 suggests that if the fiscal deficit is financed by a rate of nominal debt growth that exceeds the real interest rate, inflation will eventually be equal to debt growth. Proposition 3 is a restatement of the quantity theory of money and, thus, implies that inflation is equal to money growth, for a given output growth, provided that debt growth equals the rate of return.

These propositions hold regardless of initial conditions on the debt-output ratio, velocity, and the real yield. However, the role of initial conditions in affecting inflation should not be understated since they determine the rate of money and debt growth required to finance a given deficit. For instance, if the deficit of the Brazilian and the Canadian governments were the same, Brazil would need higher money growth than Canada to finance this same deficit because its initial velocity of money is higher than that of Canada. Thus, inflation would be higher in Brazil than in Canada. Barrionuevo and Hoffmaister (1992) show that the velocity of money indeed magnifies the effect of the deficit on inflation.

The following examples illustrate these propositions. Charts 1 and 2 show the results of a simulation of the inflation path as implied by (5) when output growth and the real return are 1/2 of 1 percent per quarter, the

fiscal deficit is $1\frac{1}{4}$ percent of GDP, $\frac{1}{10}$ the debt to GDP ratio is $\frac{1}{10}$, and initial velocity is 2 in chart 1 and 10 in chart 2. Chart 1 illustrates proposition 1. Thus, the quarterly policy for financing that satisfies (3) is $\phi_1 = (\theta = 2 \text{ percent}, v = 2 \text{ percent})$ since the deficit to GDP ratio is assumed to remain unchanged during the simulation period. The choice of quarterly economic growth implies a common annualized growth and real yield of 2 percent. ^{2/}

Chart 1 suggests that a 2 percent growth in money and nominal debt implies an immediate increase in inflation to its long run value. Inflation increases to $1\frac{1}{2}$ percent instead of 2 percent per quarter because, first, a quarterly economic growth of $\frac{1}{2}$ of 1 percent increases proportionally the quantity of money that investors are willing to hold. Second, with an unchanged deficit, the real return is equal to the growth rate. Thus, if debt growth is higher than the real return, investors restore their desired bond holdings by increasing credit card spending. Higher credit card spending means again higher prices. These two effects increase inflation in the same proportion as chart 1 suggests.

Chart 2 illustrates proposition 2. This chart illustrates the path of inflation when a government has to finance, just as in Chart 1, a deficit that is $1\frac{1}{4}$ percent of GDP. However, the initial level of velocity in this economy is 5 times higher than that in the economy of the first example. A high initial velocity implies that choosing again a 2 percent money growth requires a $7\frac{1}{2}$ percent growth in public debt to finance the deficit, as indicated by equation (3). The quarterly policy is thus $\phi_2 = (\theta = 7\frac{1}{2} \text{ percent}, v = 2 \text{ percent})$.

Chart 2 suggests that inflation is initially 2 percent, just as implied by the quantity theory. However, unlike the standard model, Chart 2 also indicates that when debt growth exceeds real returns, inflation increases fairly fast initially and then converges slowly to the rate of debt growth. The reason is that bonds, as assets, are used to carry wealth into the future. Thus, the market's willingness to hold debt increases with the real interest rate and economic growth. If investors do not see any present or future public commitment to reduce the deficit, credit spending will rise. Since private credit is a binding commitment, investors hold government bonds today only to sell them tomorrow and pay credit card balances, principal and interest.

Charts 3 and 4 show the results of simulations of inflation as implied by equation (5) when γ and r are $\frac{1}{2}$ of 1 percent per quarter, $\kappa_0 = 0.15$, $1/v_0 = 0.15$, and the fiscal deficit is $1\frac{1}{4}$ percent of GDP. Chart 3 is an example of a high monetary growth policy that illustrates proposition 3: $\phi_3 = (\theta = \frac{1}{2} \text{ of } 1 \text{ percent}, v = 7\frac{3}{4} \text{ percent})$, while Chart 4 offers an example of a high debt growth policy: $\phi_4 = (\theta = 7\frac{3}{4} \text{ percent}, v = \frac{1}{2} \text{ of } 1 \text{ percent})$.

^{1/} To show that the simulation results do not hinge on the choice of a high deficit to GDP ratio, a low deficit to GDP ratio was chosen.

^{2/} This is due to an unchanged deficit as a percentage of GDP.

Chart 1
Proposition 1: An Illustration
Policy: Money=2% and Debt=2%

Chart 2
Proposition 2: An Illustration
Policy: Money=2%, Debt= 7.5%

Chart 3
Proposition 3: An Illustration
Policy: Money=7.8% and Debt=0.5%

Chart 4
Inflation, Money, and Debt Finance
Policy: Money=0.5% and Debt=7.8%

Nominal debt growth (θ) in Chart 3 was chosen to match the real yield. Thus, θ corresponds to the rate at which agents invest in government securities to transfer wealth across periods. Money growth was obtained from equation (3). The policy in Chart 4 reflects a rate of money growth that simply matches economic growth, as implied by (3), since the deficit is largely financed by selling bonds.

Chart 3 suggests that in the special case that nominal debt growth matches the real return ($r=\theta$), the rate of inflation implied by equation (5) is given by,

$$\pi = \nu - \gamma \quad , \quad (6)$$

Equation (6) is the classical monetary proposition: for a given economic growth, variations in money growth lead to proportional changes in inflation.

The economic scenario implied by Chart 4 may be interpreted as follows. Assume that in the past the government financed its deficit mainly by using money. Assume further that the government decides today to change its deficit financing strategy by replacing money with bonds. The new strategy implies a lower money growth and a higher debt growth. From equation (3) the change in nominal debt to finance a given, unchanged, fiscal deficit is:

$$\Delta \theta = - \frac{\Delta \nu}{\nu \cdot \kappa} \quad , \quad (7)$$

Equation (7) suggests that the higher velocity and the debt-GDP ratio are, the smaller is the increase in nominal public debt growth required to offset the decline in monetary growth for an unchanged deficit. If the deficit (as a percentage of GDP) and growth remain unchanged, real returns also remain unchanged. Thus, current inflation (π) increases as debt growth (θ) increases because investors do not anticipate a higher real return, leaving investment unchanged. Moreover, as advanced by Fisher (1911), higher anticipated inflation leads to proportional changes in nominal interest rates.

An important policy implication of the Fisher effect is that a longer maturity of public debt implies increases in inflation that are distributed over a longer period, thereby reducing the effect on short-term inflation. This highlights the importance of the credibility of government policies in affecting anticipated future real interest rates and, thus, inflation. If people believe that government spending will decline next period, the higher anticipated real return allows the government to finance its deficit by issuing public debt without increasing expected inflation. More importantly this suggests that debt ought to be used to finance future consumption and, hence, investment.

Charts 4 also indicates that inflation will be running at a 4 percent annualized rate after two years and at 8 percent after about five years. This is a fairly important increase in inflation for a 1 1/4 deficit-GDP ratio. More importantly, charts 3 and 4 imply that in the long run inflation will be the same under both policies. Interestingly enough, this suggests that the loss in consumer welfare is eventually greater for a bond than for a money strategy because of high inflation volatility. ^{1/} In the short term, money finance (beyond that implied by economic growth) reduces consumer welfare more than bond finance.

The inflation aftermath of alternative debt and monetary policies also hinge on the initial conditions of the economy. Charts 5 and 6 present two examples in which debt policies lead eventually to higher inflation than monetary policies. Chart 5 simulates inflation for alternative monetary and bond finance policies and a low initial velocity, while Chart 6 considers alternative money and bond finance policies for a high initial velocity.

The first policy evaluated in Chart 5 is a low money growth and high debt growth policy that is consistent with the government budget (3), $\phi_{5,1} = (\theta = 10 \text{ percent}, v = 1/2 \text{ of } 1 \text{ percent})$, for low initial $v_0 = 2$, and $\kappa_0 = 1/10$. The second policy is one of low debt growth and high money growth, $\phi_{5,2} = (\theta = 1/2 \text{ of } 1 \text{ percent}, v = 10 \text{ percent})$ with the same initial settings as policy 1. Chart 6 considers both of these policies, but for a higher initial $v_0 = 4$. Thus, in Chart 6, $\phi_{6,1} = (\theta = 11 \frac{1}{4} \text{ percent}, v = 1/2 \text{ of } 1 \text{ percent})$ and $\phi_{6,2} = (\theta = 1/2 \text{ of } 1 \text{ percent}, v = 5 \text{ percent})$. In both examples, $\gamma = r = 1/2 \text{ of } 1 \text{ percent}$, and $d = 1 \frac{1}{4} \text{ percent}$.

Charts 5 and 6 indicate that a high initial velocity leads to high inflation regardless of whether the deficit is financed with money or debt. A comparison of Charts 5 and 6 suggests that the higher the initial velocity is, the more likely it is that long term inflation will be the same under both policies. More importantly, the simulations suggest that the higher initial velocity is, the faster is the convergence of inflation under a public debt policy to: (a) inflation under a monetary policy and (b) its long term value. In other words, the higher the initial velocity is, the closer the long term value is to the short term value and, thus, the sooner that the inflationary consequences of debt policies will be felt. The policy implication is that there is little hope that a high inflation country will reduce inflation by shifting from money to debt finance if the fiscal deficit remains the same. ^{2/}

2. Inflation, fiscal deficits, and economic growth

Charts 7 and 8 characterize the mechanics of inflation for various deficit-GDP ratios. Chart 7 considers alternative debt growth policies for

^{1/} For a risk averse investor, a mean-preserving increase in spreads lowers utility and, thus, welfare.

^{2/} Velocity is generally higher for high inflation than for low inflation countries.

Chart 5
Alternative Policies and Low Initial Velocity

Chart 6
Alternative Financing Policies and High Initial Velocity

Chart 7
Inflation, Fiscal Deficits, and Debt Policy

Chart 8
Inflation, Fiscal Deficits, and Monetary Policy

fixed monetary growth, while Chart 8 considers alternative monetary growth policies for fixed debt growth. The debt growth policies in Chart 7 and the monetary growth policies in Chart 8 were obtained from equation (3) for set values of money and debt growth, respectively. Initial economic growth and real returns are $1/2$ of 1 percent per quarter, initial velocity is 2, and the initial debt to GDP ratio is $1/10$.

The most important lesson from Chart 7 is that the higher the deficit is, the higher is long-term inflation and the faster this limiting rate is achieved. The illustration indicates that a $1/2$ of 1 percent increase in the deficit as a percentage of GDP leads to a 20 percent annual increase in inflation in the long term. This is a significant rise in inflation for such a small increase in a small deficit. Not surprisingly, after five years, inflation is running at almost 20 percent per year for the $1\ 3/4$ percent deficit, at 8 percent per year for the $1\ 1/2$ percent deficit, and at less than 4 percent per year for the $1\ 1/4$ percent.

Chart 8 shows that inflation is eventually equal to debt growth, for given economic growth, even though it starts at different rates. Thus, the mechanics of inflation vary with the magnitude of the deficit. For the smaller deficit, inflation starts at less than 2 percent per year and increases sharply in the medium term. For the higher deficit, inflation starts at a relatively high initial rate and then increases gradually in the medium term until it converges to the common long term inflation rate. The initial inflation rate is given by the rate of monetary growth required to finance the deficit. As a result, initial inflation is relatively high for the higher deficit.

Chart 9 compares the dynamics of inflation implied by a debt strategy when growth is strong to that obtained when growth is weak. The figure suggests that lower growth shifts the inflation schedule to the left, thereby leading to a permanent increase in inflation that is proportional to the decline in economic performance. Thus, the weaker economic performance is, the sooner the inflation consequences of debt financing are felt. The message that each of these illustrations conveys is clear: debt should be used to finance investment, that is, future consumption. If debt is used to finance investment, the effect on current and future inflation is zero. ^{1/}

3. A simple example

To evaluate the importance of changes in fiscal regimes, as opposed to shifts between money and public debt policies, this section compares the projections of inflation implied by the model with the actual path of inflation in Mexico during the 1980s. The goal is to see how reliable such a simple view is in characterizing inflation.

^{1/} In this case, debt growth (θ) equals the real return (r), and the model is back to the quantity theory.

It is often claimed that inflation responds only slowly to restrictive fiscal and monetary measures. In this view, the inflation rate is the rate that firms and workers had come to expect. There is momentum in this process because firms and workers are supposed to extrapolate past inflation rates into the future. This would imply that the 1970s and, for many countries, the 1980s have left numerous economies with high anticipated inflation that will respond slowly to monetary and fiscal actions.

Sargent (1986) presents an alternative view that denies there is any inherent momentum in the process of inflation. This view suggests that people expect high rates of inflation in the future precisely because the government's current fiscal policies warrant these expectations. Charts 2 and 4 through 8 seem to suggest that there is a persistence or momentum that increases inflation over time. However, the persistence of inflation in these charts only reflects: (a) the persistence of high fiscal deficits, and (b) the choice of policies to finance the deficit. The persistence of high fiscal deficits is reflected in unchanged, anticipated real returns, while money and debt policies have different effects on inflation.

Monetary policy implies a once and for all increase in inflation. Public debt policy, however, implies increases in inflation that appear to gain momentum over time. Yet, both the higher inflation of monetary policy and the increasing inflation of public debt policy have the same origin: high fiscal deficits with no change in fiscal policy that would make current deficits and future surpluses sufficiently binding as to be widely believed.

Chart 10 plots actual and predicted quarterly inflation in Mexico. The projected time path of inflation was obtained by replacing actual money growth, debt growth, and output growth in equation (4), for the average velocity and debt-GDP ratio. The chart shows that after 1982, projected inflation follows actual inflation more closely. In particular, after 1985.3 the model tracks the short term fluctuations in inflation reasonably well. More importantly, the graph presents evidence of an anticipated sudden decline in inflation in the fourth quarter of 1987. Prior to the fourth quarter of 1987, the chart suggests that persistent budget deficits implied fairly persistent high inflation.

The chart lends strong support to the view that the sudden decline in inflation in Mexico was due to an entirely new strategy that implied a strong fiscal and monetary reform, not simply isolated actions of fiscal and monetary policy or price controls. The model suggests that the drastic decline in the fiscal deficit and, hence, in both money and debt financing led to a decline in inflation not seen since the second quarter of 1980. Prior to this event, the strategy reflects drastic shifts between money and public debt finance, as implied by the relatively more volatile expected inflation.

Chart 9
Inflation and Economic Growth

Policy: Debt=7.5% Money=1%

Chart 10
A Simple Example
Inflation in Mexico

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IV. Concluding Remarks

This paper was motivated by a major disadvantage of the standard debt and money model of inflation: it is difficult to say whether the government budget constraint should be balanced within 10, 20, or 30 years. Yet, people still hold strong views about whether the fiscal deficit and official debt are too high or too low. Instead of explicitly acknowledging the intertemporal budget constraint of the government, this paper presented a model in which inferences about whether a fiscal deficit is too high or too low are drawn from the market's willingness to hold government debt, as revealed by expected real returns.

Three irrelevance propositions about the effects of debt and money finance on inflation were derived from the model. Numerical simulations were used to illustrate these propositions. The results suggest that an increase in debt growth to finance current consumption leads to a proportional increase in inflation. The timing of this increase varies with the size of the deficit and the strength of economic growth. It was shown that small increases in small deficits yield fairly significant increases in inflation. Moreover, initial conditions on velocity and the debt-GDP ratio play an important role in determining the choice of policy, which thus affects inflation.

The analysis conveys three clear policy messages. First, the deficit, not only monetary growth, needs to be drastically reduced to stop inflation. Second, high deficits imply high inflation sooner rather than later. Third, the role of public debt is to finance investment, that is, future consumption. The reason is that if investors do not see any present or future commitment to reduce the deficit, a switch from money to bond finance implies a rise in credit spending. Higher credit spending leads to higher prices today, so that investors hold additional public debt only to sell it tomorrow and pay for today's credit.

APPENDIX

Proof of the Money and Debt Irrelevance Propositions

Proposition 1. Proof. Replacing θ and v by $\phi - \theta - v$ in equation (5), taking the difference of the logarithm of the resulting equation, and assuming that $\gamma = 0$, yields:

$$\pi = \phi \quad , \quad (A.1)$$

Proposition 2. Proof. This proposition is proven for the public debt policy $\theta i = \mu$, the proof for $v j = \mu$ is similar. For simplicity, assume that $v_0 = 1$ and $\gamma = 0$. Taking logs of equation (5):

$$\ln p_t = \ln((\theta - r) \cdot (1 + \theta)^{t-1} \cdot \kappa_0 + 1) \quad , \quad (A.2)$$

For $(\theta - r) \cdot (1 + \theta)^{t-1} \cdot \kappa_0$ small enough, $\ln((\theta - r) \cdot (1 + \theta)^{t-1} \cdot \kappa_0 + 1) = (\theta - r) \cdot (1 + \theta)^{t-1} \cdot \kappa_0$. Thus, dividing (A.2) by its one period lag, solving for $\ln p$, and subtracting $\ln p_{t-1}$ from the resulting equation yields:

$$\pi_t = \theta \cdot \ln p_{t-1} \quad , \quad (A.3)$$

Substituting the one period lag of (A.2) in (A.3) gives:

$$\pi_t = \theta \cdot (1 + \theta)^{t-2} \cdot (\theta - r) \cdot \kappa_0 \quad , \quad (A.4)$$

It must be demonstrated that $\exists$ a $T < \infty$ such that $\pi = \theta = \mu$. Thus, let $\pi = \theta$ at $t = T$ so that for small θ ,

$$T = 2 - \frac{(\ln(\theta - r) + \ln \kappa_0)}{\theta} \quad , \quad (A.5)$$

Thus, (A.5) implies that $T < \infty$ for any θ, r and $\kappa_0 < \infty$.

Proposition 3. Proof. Let $\theta = r$ in (5), taking the difference of the logarithm of the resulting equation, yields:

$$\pi = v - \gamma \quad , \quad (A.6)$$

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