Reliance, Composition, and Inflation

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This article explores the effect of fiscal policy actions on long-run prices and the inflation rate.

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To pay for their spending, governments use one or more of the following: taxes, sale of debt to the public, and money creation. Taxes and debt issuance are typically under the purview of the treasury (the government's fiscal side), and money creation is under the control of the central bank (the government's monetary side). This split seems natural since most central banks are required to maintain price stability and, hence, ought to have complete control over the money supply. In recent years, however, based on the work of Christ (1968) and Sargent and Wallace (1981), economists have noted that a single, forward-looking budget constraint unifies these two government branches. As a direct consequence of this constraint, every fiscal action potentially has a monetary component to it, and vice versa. As such, it becomes hard to pinpoint whether the central bank really has complete control over money creation or whether it is passively creating money at the treasury's beck and call. If the latter is true, the central bank is severely constrained in performing its task of maintaining price stability. Or is it? This article presents a model in which the central bank retains substantial control over the inflation rate despite being subservient to the treasury in a very precise sense.

We consider a situation in which the government explicitly relies on the central bank to meet a portion of the government's revenue needs. More precisely, our measure of this reliance captures the extent to which the central bank is required to raise revenue from money creation (seigniorage) to pay for the interest expenses on the debt floated by the treasury. Greater reliance implies that seigniorage accounts for a larger fraction of the treasury's revenue requirements brought on by its outstanding interest obligations. This notion of reliance stems from the idea of "economic independence" as described by Grilli, Masciandaro, and Tabellini (1991), Alesina and Summers (1993), and Capie et al. (1994). Capie et al., for instance, differentiate between goal independence and instrument independence. Goal independence exists when the central bank can choose *what* it wants monetary policy to accomplish without regard to the treasury's or other policymakers' desires.[1] Instrument independence is present when the central bank can choose *how* to use the instrument of monetary policy without regard to the treasury's wishes.[2]

In contrast, our measure of reliance has little connection with the idea of goal independence. Interestingly, as Grilli, Masciandaro, and Tabellini (1991) point out, goal independence and instrument independence are not always positively correlated.[3]

In this article, the central bank is (possibly) goal independent although it is not instrument independent because it has to raise a certain amount of revenue for the government. As such, it is constrained in its choice of, say, the money growth rate. It does, however, have control over the composition of government liabilities, namely debt versus money. Our question, then, is: Does the control over the composition of government "paper" translate into control over the inflation rate even when the central bank is not instrument independent in the sense of Capie et al. (1994)?

To get a sense of some of the issues involved, consider the case of a government that floats some debt on the market to, partly, finance its expenditures. The government must credibly demonstrate the presence of enough funds to cover the principal and interest payments on all debt held by the public. Using the government's long-run budget constraint, it is possible to show that having a current outstanding debt requires the government to run surpluses in the future. These surpluses may be generated by cutting expenditures, implementing taxes, or altering the revenue from money creation, or seigniorage.[4]

We are particularly interested in seigniorage. The central bank may print money to pay for the treasury's interest expenses or exchange new money for existing government bonds. In the case of an open market purchase, in which the central bank buys government bonds and gives money to the public, the stock of money in the economy goes up but the interest expense of the debt goes down. Because money does not pay interest, future taxes may go down. This may reduce the government's revenue needs, such that the central bank has more control over the inflation rate. Thus, the central bank, even though it is not independent, can, via open market operations, control the composition of government paper, thereby affecting the government's de facto reliance on seigniorage (and indirectly the inflation rate).

This article illustrates some of these basic ideas within the context of a well-specified general equilibrium model in the tradition of Sidrauski (1967). In our model, a large number of infinitely lived households with 20/20 foresight derive utility from the consumption of a single nonproduced perishable good and from liquidity services (money). The government sells bonds and prints money to cover its interest obligations on these bonds. The central bank is not economically independent; in fact, the government explicitly relies on the central bank to raise a fraction of its interest expenses on outstanding debt (henceforth the reliance parameter).

First, we analyze the long-run relationship between this reliance parameter and the price level, the inflation rate, and the nominal interest rate. In other words, we attempt to answer the question: Do countries that rely heavily on seigniorage endure higher long-run inflation rates in comparison with countries with less seigniorage? Second, we examine the relationship between the composition of government paper—bonds versus money—and the effects on the price level, the inflation rate, and the nominal interest rate. This inquiry may be of topical interest in that more and more governments are realizing primary surpluses and paying off some outstanding debt. Insofar as these surpluses translate into permanent changes in the composition of government paper, we ask how such a change would affect the long-run values of these economic variables.

The two main results are easily summarized. First, we show that the price level is positively related to the stock of government debt as long as the government relies on the central bank to raise some revenue. This reliance requires the central bank to monetize some of the outstanding debt. Consequently, the treasury's debt decisions affect the price level. In short, the price level has a "fiscal" aspect. Viewed another way, the effective stock of money in the economy consists of the actual quantity of money and the fraction of bonds backed by money.

Second, we derive the impact of permanent changes in both the reliance and the composition parameters on the long-run inflation rate. We show that the inflation is positively related to the government's reliance on seigniorage and is inversely related to the composition of government paper. When the latter shifts toward money, government debt falls, implying that the government's expenses are smaller. Hence, less seigniorage is required.

The chief policy lesson is that an economically dependent central bank, via its ability to control the composition of government paper, may be quite successful in controlling the inflation rate.[5]

We begin by laying out the details of the model economy.

THE MODEL ECONOMY

The economy is populated by a large number of dynastic (infinitely lived) households. Time is discrete and is indexed by $t = 1$, 2, 3.… There is a single, perishable consumption good. At each date $t \geq 1$, a household receives a fixed endowment of y units of the single consumption good; it does not have to exert any effort to produce or receive this good.

Households may hold their wealth two ways: government bonds and fiat money. Both assets are nominally denominated (in, say, dollars). Government bonds mature one period after they are issued. If the household pays \$1 for a unit of government debt at date t, it receives \$$I$ at date $t + 1$. In contrast, no interest is paid on money. At date $t = 1$, each household is endowed with \$$B_0$ and \$$M_0$.

At the start of any period, a representative household's wealth comprises three entities: the proceeds from the sale of its endowment of y goods, its money holdings from the previous period (whose value, as we will see, may have gone up or down depending on inflation), and the interest (plus principal) payments on its bond holdings from the previous period. The household may use this wealth to provide for its consumption during that period, buy new bonds and money, and pay a lump-sum tax to the government.

The household's budget constraint, therefore, is

$$(1) \quad p_t y + M_{t-1} + I_{t-1}B_{t-1} = p_t c_t + M_t + B_t + p_t \tau_t,$$

where p is the price level measuring the number of dollars traded for one unit of the consumption good, M is the quantity of money, B is the quantity of government bonds, τ is the lump-sum tax, and c is consumption. Equation 1 stipulates that the dollar value of the household's after-tax resources must equal the dollar value of its expenditures, including savings.

It is possible, and instructive, to convert the household's budget constraint (written in dollar terms in Equation 1) to its goods value. To do this, let

$$1 + \pi_t = \frac{p_t}{p_{t-1}} \quad \text{and } R_{t-1} = 1 + r_{t-1} = \frac{I_{t-1}}{1+\pi_t} = \frac{1+i_{t-1}}{1+\pi_t}.$$

Here, π stands for the rate of change in the price level over time, or the inflation rate; i is the net nominal interest rate; r is the net real interest rate; and R is the gross real interest rate (principal plus interest). Divide both sides of Equation 1 by p_t to obtain

$$(2) \quad y + (1 + r_{t-1})b_{t-1} + \frac{m_{t-1}}{1+\pi_t} - \tau_t = c_t + m_t + b_t,$$

where m denotes the real value of money balances and b the real value of government bonds. Equation 2 states the household's budget constraint—both sources of income and expenditures—measured in units of the consumption good. Note that b can be either positive or negative. With $b > 0$, the government is borrowing from the household. With $b < 0$, the government is loaning resources to households.

The left side of Equation 2 represents the resources the household has available to spend at date t. Given these resources, how much consumption can this household afford at the market price? How much money and bonds *should* it hold? We now turn to a determination of the household's demand for consumption, money, and bonds. We study an equilibrium in which the demands for all three are positive. A problem we face in this environment is that money is dominated in rate of return by government bonds, and, hence, households will not hold money unless we build into the model some rationale for money to be demanded.

Possibly the simplest way to achieve our purpose is to assume the household has preferences defined over the consumption good *and* real money balances. In other words, households value liquidity directly and are willing to alter their consumption to get the desired amount of liquidity. We are not arguing that households derive happiness from holding intrinsically worthless pieces of paper. Rather, the fact that money facilitates market exchange makes it relatively more attractive than bonds and accounts for why the latter are not also in the utility function. We do not explicitly model how and why money is more liquid than bonds. Suffice it to say that money-in-the-utility-function is a general formulation that encompasses many deeper reasons why fiat money is valued in the real world despite being dominated in rate of return.[6]

For expositional convenience, the representative household's preferences at date t are represented as

$$(3) \quad U(c_t, m_t) = \ln c_t + \theta \ln m_t,$$

where θ is the rate at which a household will substitute money for consumption. Equation 3 specifies that the household's utility is characterized in a log-separable form. Three properties of the function $U(.)$ are worth noting. First, the household's utility increases when either consumption or real money balances increase. In other words, marginal utility is positive with respect to each variable. Second, an increase in consumption results in declining marginal utility. Third, separability means a household's marginal utility of consumption is invariant to changes in real money balances, and vice versa.

The government consists of two separate entities bound by a single budget constraint. The fiscal authority, or treasury, collects the lump-sum taxes and sells and redeems bonds. It has no other expenditures. Simultaneously, the monetary authority, or central bank, potentially controls the nominal quantity of money over time. It can alter the quantity of money by directly handing money over to each household; alternatively, it could trade money for an equal dollar value of government bonds—an open market operation. Changes in the nominal money stock allow the government to buy goods with the extra money printed. Each authority operates in such a way that the following budget constraint is satisfied period by period:

(4) $$(1 + r_{t-1})b_{t-1} = \tau_t + b_t + s_t,$$

where s denotes the seigniorage raised by the central bank.

Conceivably, the treasury could keep issuing new debt to pay for the interest obligations on outstanding debt but never really retire the debt, thus rolling it over forever. Forward-looking agents will understand this and refuse to lend to the treasury. Hence, we must impose an additional long-run restriction on the treasury's debt issuance. Specifically, as we show in the box entitled "The Long-Run Government Budget Constraint," the present value of government revenues must be equal to the initial stock of the treasury's real bond payments. More concretely, the present value of the treasury's debt must equal the present value of government revenues (that is, future debt obligations must be fully backed by future revenues of the treasury and the central bank). Thus, the treasury is restricted to be neither a lender nor a borrower, at least in terms of the present value of its debt obligations. This policy is sometimes referred to as a no-Ponzi condition.

We now introduce the notion of reliance. Since each authority contributes to the present value of revenues, we can assign the contribution from each. Reliance, therefore, represents the portion of the present value of revenues that must come from each authority:

(5) $$PV(\tau_t) = (1 - \phi)(1 + r_{t-1})b_{t-1},$$

and

(6) $$PV(s_t) = \phi(1 + r_{t-1})b_{t-1},$$

where PV stands for the present value of the term in parentheses. In other words, the present

The Long-Run Government Budget Constraint

In this box we formally derive the government's long-run budget constraint. There are principal and interest expenses associated with outstanding government debt. These expenses are backed by the revenues from taxes and seigniorage.

We begin with the period-by-period expression of the government budget constraint; that is, at date t

(B.1) $$(1 + r_{t-1})b_{t-1} = \tau_t + b_t + s_t.$$

At date $t + 1$, Equation B.1 is written as

(B.2) $$(1 + r_t)b_t = \tau_{t+1} + b_{t+1} + s_{t+1}.$$

Thus, the date t level of government debt is

$$b_t = \frac{\tau_{t+1} + b_{t+1} + s_{t+1}}{(1 + r_t)}.$$

Substitute for b_t in Equation B.1, yielding

(B.3) $$(1 + r_{t-1})b_{t-1} = \tau_t + \frac{\tau_{t+1} + b_{t+1} + s_{t+1}}{(1 + r_t)} + s_t.$$

Next, update Equation B.1 two periods, solving for b_{t+1} and substituting in Equation B.3, yielding

$$(1 + r_{t-1})b_{t-1} = \tau_t + \frac{\tau_{t+1} + b_{t+1} + s_{t+1}}{(1 + r_t)} + \frac{\tau_{t+2} + b_{t+2} + s_{t+2}}{(1 + r_{t+1})(1 + r_t)} + s_t.$$

By repeating this process, we get the following expression

(B.4) $$(1 + r_{t-1})b_{t-1} = T_t + S_t + \lim_{t \to \infty} \frac{b_{t+j}}{(1 + r_{t+j-1}) \ldots (1 + r_t)},$$

where

$$T_t = \tau_t + \frac{\tau_{t+1}}{(1 + r_t)} + \frac{\tau_{t+2}}{(1 + r_{t+1})(1 + r_t)} + \mathrm{K} = \tau_t + \frac{1}{(1 + r_t)}\left[\tau_{t+1} + \frac{\tau_{t+2}}{(1 + r_{t+1})} + \mathrm{K}\right],$$

$$S_t = s_t + \frac{s_{t+1}}{(1 + r_t)} + \frac{s_{t+2}}{(1 + r_{t+1})(1 + r_t)} + \mathrm{K} = s_t + \frac{1}{(1 + r_t)}\left[s_{t+1} + \frac{s_{t+2}}{(1 + r_{t+1})} + \mathrm{K}\right].$$

Equation B.4 states that the government's principal and interest expense is equal to the sum of the present value of its tax revenues, its seigniorage and its long-run debt position. We impose the condition that the treasury cannot roll over its debt (or loans) forever. The standard no-Ponzi condition is represented by the following expression:

(B.5) $$\lim_{t \to \infty} \frac{b_{t+j}}{(1 + r_{t+j-1})\,\mathrm{K}\,(1 + r_t)} = 0.$$

Thus, the no-Ponzi condition implies that the government's date t principal and interest expenses are backed completely by tax revenues and seigniorage.

Now that we have defined our notion of backing, we can articulate our notion of reliance. Suppose the government decrees that a fraction ϕ of its date t debt obligations will be met by tax revenues. Thus,

(B.6) $$T_t = \phi(1 + r_{t-1})b_{t-1}.$$

The government's long-run budget constraint, Equation B.4, together with Equations B.5 and B.6, implies that

(B.7) $$S_t = (1 - \phi)(1 + r_{t-1})b_{t-1}.$$

How should current taxes be set, given Equations B.6 and B.7? Recall that

$$T_t = \tau_t + \frac{1}{(1 + r_t)} T_{t+1} = \tau_t + \frac{1}{(1 + r_t)}[\phi(1 + r_t)b_t] = \tau_t + \phi b_t.$$

Since $\tau_t = T_t - \phi b_t$, current taxes must satisfy

(B.8) $$\tau_t = \phi(1 + r_{t-1})b_{t-1} - \phi b_t = \phi[(1 + r_{t-1})b_{t-1} - b_t].$$

value of lump-sum taxes and seigniorage is equal to the principal and interest expenses of the initial stock of real government bonds. It is possible (see Equation B.8 in the box) to write

$$(7) \qquad \tau_t = (1 - \phi)[(1 + r_{t-1})b_{t-1} - b_t].$$

Thus, another way to think of our notion of reliance is that *current* taxes are responsible for (1 – ϕ) percent of the *current* interest expenses on the outstanding debt or that the central bank is responsible for ϕ percent of the current interest expenses. Hereafter, we refer to ϕ as the seigniorage-reliance parameter.

A few remarks about measurement and realism are in order. First, reliance is difficult to measure because it is quite hard to isolate those changes in the stock of high-powered money that the central bank engineered exclusively to finance government deficits. This is because high-powered money could change for reasons other than to finance deficits. Second, we have taken a particular stand with respect to the institutional structure linking the fiscal authority and the central bank. It is difficult to find examples of countries that fit our environment perfectly. As discussed in the introduction, we like to think of ϕ as a continuous version of instrument independence as postulated by Capie et al. (1994). One could be agnostic about all this, simply follow Aiyagari and Gertler (1985), and refer to ϕ as the portion of government bonds eventually backed by money.

In the next section, we turn our attention to the equilibrium relationship between the reliance parameter and the price level in our economy.

A FISCAL THEORY OF PRICES

The household's utility maximization problem can be stated as

$$\max \sum_{t=0}^{\infty} \beta^t \left(\ln c_t + \theta \ln m_t \right)$$

subject to Equation 2. β is a positive fraction that measures the rate at which the household discounts future utility. In equilibrium, the household's maximization problem yields the following decision rule for real money balances and consumption:

$$(8) \qquad m_t = \theta \left(\frac{1 + i_t}{i_t} \right) c_t$$

and

$$(8') \qquad \frac{1}{c_t} = \frac{\beta(1 + r_t)}{c_{t+1}}.$$

In equilibrium, since the good is perishable, the household will consume all its endowment; that is, $c_t = y$ for all t.[7] Substituting for c in Equation 8 and using Equation 7 to substitute for τ, the household's date t budget constraint (*Equation 2*) can be written as

$$(9) \qquad y + \phi(1 + r_{t-1})b_{t-1} + \theta \left(\frac{1 + i_{t-1}}{i_{t-1}} \right) \frac{y}{1 + \pi_t} = y + \theta \left(\frac{1 + i_t}{i_t} \right) y + \phi b_t.$$

Thus, the household's budget constraint is characterized by the size of the endowment, the path of government bonds, the real interest rate, the inflation rate, and the government's long-run reliance on taxes.

In this article, we focus only on steady-state, or long-run, equilibria, that is, equilibrium allocations—consumption, real money holdings, and real bond holdings—that are time invariant. With consumption constant across time, the price of date $t + 1$ consumption measured in units of date t consumption is constant (see Equation 8′). This price is the gross real interest rate, $(1 + r)$. In steady state, therefore, we know that

$$(1 + r) = \frac{1}{\beta}.$$

Using this, we can rewrite the household's budget constraint as

$$(10) \qquad \phi r b = \frac{\theta y \pi (1 + r)}{i}.$$

Next, solve Equation 10 for real government bonds:

$$(11) \qquad b = \theta \frac{(1 + r)\pi y}{i \phi r}.$$

Note that Equation 11 is the quantity of real government bonds that people will hold in equilibrium. Thus, Equations 8, 11, and $c = y$ completely describe the household's steady-state allocations.

We conduct the following experiment to demonstrate how fiscal policy directly affects the price level. Suppose the nominal stocks of money and government bonds are set at their initial levels. It is straightforward to derive the relationship between the equilibrium steady-state price level and seigniorage reliance.[8] We substitute the steady-state expressions for bonds, money, and consumption into the household's budget constraint (*Equation 9*), and after some rearrangement, the steady-state price level is expressed as

$$p = \frac{r\beta}{\theta y}\left(M + \phi B\right). \tag{12}$$

To understand the deeper implications of Equation 12, consider an increase in the central bank's revenue generation responsibility, ϕ. With the central bank raising more revenue, the treasury can reduce the household's taxes and retire some outstanding debt using the funds the central bank raised. Retiring debt means that B falls. It follows that households now have a smaller stock of assets available. In contrast, with lower lump-sum taxes, the household's disposable income rises. If $\phi < 1$, it can be shown that the former effect dominates. The bottom line is that an increase in the central bank's revenue generation responsibility raises the quantity of resources available for the household to spend. More resources chase the same amount of goods. The price level rises as a consequence.

Equation 12 says the long-run price level is proportional to the "monetized" portion of the government's liabilities. Note that ϕ represents the long-run fraction of government bonds backed by money. In the minds of forward-looking agents, then, the actual amount of money in the economy is not only the money stock M but also the fraction of bonds backed by money. When the latter goes up, agents see this as an increase in the amount of money in the economy; consequently, the price level rises. With $\phi > 0$, in addition to the central bank, the treasury plays a role in determining the price level through the quantity of government bonds outstanding.

Equation 12 captures an idea in contrast to the standard textbook version of the quantity theory of money, which postulates that only changes in the money stock affect the price level. Here, fiscal policy actions (such as a permanent increase in the treasury's stock of debt) can easily affect the price level as long as $\phi < 1$ holds, even though the stock of money is held constant. Thus, when considering correlations between the price level and money, the appropriate definition of money should include the stock of debt, a point long recognized by proponents of the real bills doctrine.[9]

To finance the government's interest expenses, the money stock will change over time. We turn our attention to the effect that changes in reliance and composition have on the steady-state inflation rate and the nominal interest rate. To that end, with $c = y$, the equilibrium expression for real money demand using Equation 8 is given by

$$m = \theta\left(\frac{i}{1+i}\right)y.$$

Set this equal to real money supply M/p, where p is computed from Equation 12.[10] After some rearrangement, it is possible to show that

$$i = \frac{(1-\beta)(M + \phi B)}{M - (1-\beta)(M + \phi B)}, \tag{13}$$

and

$$\pi = \frac{(1-\beta)\phi B}{M - (1-\beta)(M + \phi B)}. \tag{14}$$

We now can answer our initial question: Does increased reliance on seigniorage increase the inflation rate? Recall that the seigniorage reliance parameter is denoted by ϕ. Then, an increase in this parameter raises the numerator of Equation 14 and reduces the denominator, thereby increasing π. Simply stated, an increase in the central bank's revenue-raising responsibility precipitates an increase in the inflation rate. Analogously, we can show (using Equation 13) that such an action increases the nominal interest rate.[11]

Note that money demand is interest-inelastic (*Equation 8*). This point is important in deriving the relationship between reliance and both the inflation rate and the nominal interest rate. To illustrate, suppose money demand is interest-elastic. Money demand decreases, in percentage terms, more than nominal interest rises. In steady state, nominal interest rate movements reflect movements in the inflation rate; recall that the steady-state real interest rate is $1/\beta$, a constant. In the interest-elastic case, the economy could be on the wrong side of the Laffer curve. In other words, seigniorage would decrease because the tax base (money demand) falls by more than the tax rate. Interest-inelastic money demand assures that this does not occur.[12]

Evidence supports the conclusion that greater reliance is correlated with higher inflation. Grilli, Masciandaro, and Tabellini (1991) examine the period 1950–89. They construct an "economic independence indicator" for a group of European nations and for each of the four decades in their sample. (See Table 14 in their paper.) They estimate the correlation coefficient between each country's decade-average inflation rate and the economic independence measure, finding that countries with more economically dependent central banks (such as Greece, Portugal, and Spain) have consistently higher inflation rates and the highest levels of seigniorage.

What effect would a change in each type of government paper have on the long-run inflation rate? To answer this, rewrite Equation 14 as

$$(14') \qquad \pi = \frac{1}{\left(\frac{\beta}{1-\beta} \cdot \frac{M}{B} \cdot \frac{1}{\phi}\right) - 1}.$$

Then an increase in *M* reduces the inflation rate, whereas an increase in *B* increases the inflation rate. The intuition is clear: money is a cheaper way to pay off the government's interest obligations because the government does not pay interest on money. On the other hand, an increase in the stock of bonds requires the central bank to eventually raise more revenue, for a given seigniorage reliance, to meet the increased interest obligations on this debt, thereby increasing the inflation rate.

COMPOSITION OF GOVERNMENT LIABILITIES

We can use our setup to answer yet another important question: Does the composition of government liabilities (interest-bearing debt, like bonds, versus non-interest-bearing debt, like money) matter? The answer seems particularly relevant as more and more countries, including the United States, realize budget surpluses and pay down their debt.

Define $\alpha = M/(M+B)$. Then it is possible to rewrite Equation 12 as

$$(15) \qquad p = \frac{r\beta}{\theta y}\left\{\left[1-(1-\phi)(1-\alpha)\right]\left(M+B\right)\right\}.$$

Consider a one-for-one exchange in which government bonds are permanently traded for money. This changes the composition of the government's liabilities but not their total value, $M + B$. With $0 < \phi < 1$, an increase in α, for instance, results in a higher price level.

We next analyze how a change in the composition of government liabilities affects the inflation rate. An increase (decrease) in α may be thought of as representing a less restrictive (tight) monetary policy.[13] Suppose the government initiates a permanent open market purchase of bonds in exchange for money. This open market operation results in more money and fewer bonds, that is, α increases. To see the effect of this on the inflation rate, rewrite Equation 14 as

$$(16) \qquad \pi = \frac{(1-\beta)\phi}{\beta\left(\frac{\alpha}{1-\alpha}\right) - (1-\beta)\phi}.$$

Then, Equation 16 indicates that inflation is inversely related to movements in α.[14] So, the composition of government liabilities does matter. This result has an unpleasant monetarist arithmetic feel to it.[15] An open market purchase lowers the eventual interest expenses associated with interest-bearing government bonds. Consequently, less inflation is needed to fund the smaller expenses. Hence, inflation declines as the composition shifts toward money and away from bonds.

CONCLUDING REMARKS

In this article, we investigate the effects of monetary policy decisions that are explicitly linked to fiscal policy decisions and vice versa. More important, the nature of the linkage—here, the government stipulates how much it will rely on seigniorage to back its long-run expenses—has direct consequences for the inflation rate. Our model economy produces the following prediction: controlling for other factors, if a country's reliance on seigniorage increases, the country's inflation rate will increase. We go on to show that a permanent open market purchase (one in which a country reduces its stock of government bonds and increases the quantity of money) results in a decline in the long-run inflation rate.

Our analysis has implications for a classic question in monetary economics: How much control can a central bank have over the value of its currency? (Sargent 1987, 139). We consider cases in which the central bank is not instrument independent. These central banks can—via open market operations—switch the composition of government liabilities toward non-interest-bearing money and away from debt. We show that the open market operation lowers debt expenses and reduces the government's effective reliance on seigniorage. This way, it can retain substantial control over the value of its currency.

In light of our results, we close with two important questions for future research. First and foremost, how should ϕ and α be measured? This is a difficult issue because ϕ represents the fraction of money created to meet the government's financing needs. Governments typically do not preannounce how much they will rely on the seigniorage. Consequently, one must infer how much money is created for financing needs and how much is created to meet other central bank activities. Second, what is the relationship between ϕ and α? That is, is there a relationship between a country's reliance on seigniorage and its composition of government liabilities?

NOTES

Chapter 4 in Walsh (1998) stimulated many of the ideas presented here. Part of the work was done when Bhattacharya visited the Federal Reserve Bank of Dallas' Research Department in the summer of 1999. We gratefully acknowledge the department's hospitality and helpful comments from Mark Wynne, Mark Guzman, and Jim Dolmas.

1 Though they adopt different terminology, Grilli, Masciandaro, and Tabellini (1991) focus on a similar concept. To borrow from their definition, goal independence "is the capacity to choose the *final goal* of monetary policy, such as inflation or the level of economic activity."

2 Alesina and Summers (1993) use slightly different terminology. Specifically, they assert, "Economic independence is defined as the ability [of the central bank] to use instruments of monetary policy without restrictions. The most common constraint imposed upon the conduct of monetary policy is the extent to which the central bank is required to finance government deficits. This index of economic independence essentially measures how easy it is for the government to finance its deficits by direct access to credit from the central bank."

Grilli, Masciandaro, and Tabellini (1991) in Table 13 of their paper provide some evidence on the Alesina–Summers instrument-independence indicator. According to them, instrument independence of the central bank is high in West Germany, Switzerland, the United States, Austria, and Belgium. Conversely, central banks in Italy, New Zealand, Portugal, Greece, and Spain have very little instrument independence.

3 Take the example of India. The Reserve Bank of India (RBI) is definitely politically independent. Nonetheless, during 1998–99, the net lending by the RBI to the Indian government was about 10 percent of the gross fiscal deficit for that year, precipitating an 18 percent increase in M1.

4 Using data from a large group of countries over many years, Fischer (1982) shows that governments do generate revenue from money creation more often than not. Click (1998) documents that between 1971 and 1990, in a wide cross section of countries, currency seigniorage as percent of GDP ranged from 0.3 percent to 14 percent, and seigniorage as percent of government spending ranged from 1 percent to 148 percent.

5 One implication of our findings is that prohibition of deficit financing is redundant. For instance, in the membership requirements put forward by the European Union, there is an upper bound on the debt-to-GDP ratios. What really matters, and what the central bank can achieve, is the mandate for price stability.

6 See Feenstra (1986) for a more formal description of the functional equivalence between models with explicit transaction costs and those with money-in-the-utility-function. It is important to mention here that functional equivalence does not mean that the intuition or interpretation of the results is model invariant.

7 One may wonder why people hold money here since they end up consuming only their endowment anyway. The answer lies in the notion of equilibrium. When agents solve their individual problems to determine how much money to hold, they perceive the possibility of trade in the good and do not know that, *in equilibrium*, they will all simply consume their endowment.

8 For the interested reader, the notion of a steady-state price level is more fully developed in Walsh (1998), 143–46.

9 Sargent and Wallace (1982) and Smith (1988) contain good discussions of the doctrine.

10 Alternatively, one could equate bond demand (see Equation 11) to real bond supply and arrive at the same expressions for i and π as in Equations 13 and 14.

11 For the interested reader, the optimal policy (one that maximizes steady-state welfare of agents) would be to set $\phi = 0$. In words, the household's welfare is highest when the government relies solely on lump-sum taxes to pay for its interest expense. The general flavor of this result extends to several cases in which distorting taxes are present. See Chari, Christiano, and Kehoe (1996) and Correia and Teles (1999).

12 See Lucas (2000) for an excellent discussion on the elasticity of money demand. He provides an overview of the empirical support for the position that money demand is interest inelastic.

13 Greenwood (1998), for instance, focuses on tight money policies. As the recent crisis in Japan unfolds, many commentators are suggesting that the blame should be placed on the Japanese central bank for following tight money policies over the last decade, thereby "strangling'' the economy. The central bank argues that its tight money policies have kept Japanese inflation in check.

14 To verify this, differentiate Equation 16 with respect to α. The sign of the resulting expression is negative.

15 Sargent (1987) discusses the effect a permanent open market sale of bonds has on the inflation rate. Given a fixed deficit, such a sale "bequeaths" a larger stock of interest-bearing debt to the future; eventually inflation would have to rise to pay for the outstanding interest obligations. Sargent and Wallace (1981) called this paradoxical phenomenon (tight money policies increase the eventual inflation rate) the "unpleasant monetarist arithmetic." See Bhattacharya and Haslag (1999) for a survey.

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