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A primer on monetary and fiscal policy

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Abstract

Monetary policy can be constrained by fiscal policy if fiscal deficits grow large enough to require monetization of government debt. That fact implies that the administrative independence of central banks does not by itself imply that monetary policy is independent of the fiscal decisions of governments. This essay describes limitations, possibilities, and suitable goals for monetary policy within the existing pattern of institutional responsibilities. The economic limitations of what can be achieved by monetary policy are summarized in six propositions developed in the paper. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

A good way to introduce key principles governing monetary and fiscal policies relevant for the 1990s and beyond is to revisit an episode in the 1890s.

1.1. Grover Cleveland's policy

Between 1893 and 1896, President Grover Cleveland weathered a succession of runs on the dollar. The US then lived with a promise to convert each dollar

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into $(20.67)^{-1}$ ounces of gold on demand. A raging public debate undermined that policy's credibility. Many Americans supported unilateral US bimetallism at a ratio near 16:1 (silver to gold), which would devalue the dollar. Politics fed doubts about the longevity of the US government's attachment to gold at the existing par. [1]

In the wake of the McKinley tariff's reduction of US tax revenues, federal deficits emerged in the mid 1890s. These and the rising strength of US silver forces proved by the Sherman Silver Purchase Act of 1890, promoted recurrent runs on the gold stock in 1894 and 1895. Cleveland responded to each run in the same way: he borrowed, then used the proceeds to restore the gold reserve. Each time, this temporarily arrested the run. Four or five such episodes composed Cleveland's defense of gold. McKinley's defeat of Bryan in 1896 diminished prospects of bimetallism. This, together with an end to fiscal deficits, terminated the runs.

Cleveland's actions and their success are puzzling from the perspective of recent experiences in countries facing runs on their currencies, where the market seems to treat governments' attempts to borrow as signaling prospective weakening of its currency.

A theme of this paper will be that government issues of debt mean different things at different times and under different policy regimes. The logic of Barro's 'Ricardian equivalence' proposition (see Barro, 1979) is the key to understanding Grover Cleveland's actions and the market's response to them. For Grover Cleveland, issuing government debt was a credible promise to raise taxes sufficiently to service that debt, and thus signaled an adjustment in the present value of the government surplus designed to sustain the gold standard. Davis's accounts of the Congressional debates over the borrowing support this interpretation (Dewey, 1924). Opponents of Cleveland's borrowing denied that the administration possessed the authority to commit the government to the future taxation inevitably associated with the borrowing. Supporters of the administration appealed to the resumption Act of 1875 as providing authority to borrow to assure convertibility. Thus, both supporters and opponents of Cleveland's borrowing regarded it as being more than an 'open market operation', i.e., a government portfolio rearrangement.

These episodes direct our attention to fiscal policy as handmaiden of monetary policy.

[1] Keynes (1924) reminded the US Congress that a nation's gold reserve was not crucial for adhering to a gold standard; its fiscal policy was crucial.

2. Monetary policy

The press imputes power for producing good or bad economic effects to the government officials who administer monetary policy. In truth, monetary policy is much less powerful than depicted, because its administrators are constrained by economic forces beyond their control. The job of monetary policy is to manage the portfolio of debts owed by the central government. The limits to the power of the monetary policy authorities emanate from their inability to control the *size* of the portfolio of government debts that they must manage. The size of that portfolio is determined by the fiscal authorities (i.e., those who set taxes and expenditures).

In the US, responsibility for determining the total size of the government debt is nominally separated from responsibility for determining the financial composition of that debt, whether it takes the form of noninterest-bearing debt (currency and bank reserves) or interest-bearing debt. The total amount of debt is the cumulative result of past federal government deficits, determined jointly by the legislature and the executive. The Central Bank continuously conducts open-market operations, equal-value trades of one form of government debt for another. By executing these trades, the Central Bank alters the composition of the government debt owned by the government's creditors while leaving the total value of that outstanding debt unchanged at a point in time. 'Monetary policy', 'open-market policy' and 'debt management' are three phrases used to describe the main activity of a Central Bank. 'Fiscal policy' is the phrase used to describe the activities of the executive and legislature that generate the stream of government deficits that have to be financed.

Although United States and other western countries have decentralized authority for making fiscal and monetary policy across distinct institutions, it would be possible and perhaps even desirable to distribute responsibility in different ways. Indeed, the independence of monetary from fiscal institutions is tenuous because the arithmetic of the government's budget constraint requires interdependence. The force of US economic policy institutions is to leave that interdependence implicit, and therefore to leave the procedures for coordinating monetary and fiscal policy to be worked out haphazardly through the interactions of the succession of personalities that happen to occupy economic policy-making positions. Milton Friedman's long-standing proposal for a simple rule that increases the monetary base by a small percentage each year removes this haphazardness and makes explicit and predictable the terms according to which monetary and fiscal policies are to be coordinated. [2]

[2] 'The accord' was the agreement in 1950 to terminate the World War II arrangements by which the Federal Reserve supported prices of US Treasury securities. The Italian authorities made a similar agreement after World War II, but called it 'the divorce'.

This essay describes limitations, possibilities, and suitable goals for monetary policy within the existing pattern of institutional responsibilities. Beliefs about limitations and possibilities must influence ideas about proper goals for monetary policy. Limitations on monetary policy are determined by the arithmetic of the government budget constraint and by the demand for the government debt that the Central Bank buys and sells.

3. Friedmans presidential address revisited

My starting point for describing the limitations and possibilities of monetary policies is Milton Friedman's 1968 American Economic Association Presidential address 'The Role of Monetary Policy' (Friedman, 1968). Long viewed as a proponent of the practical utility of monetary policy vis a vis fiscal policy, in 1968 Friedman surprised many macroeconomists by warning not to expect too much from monetary policy. He said that monetary policy could not be counted on to accomplish some of the goals that were then being advocated for it, such as controlling the paths of unemployment, output, and interest rates. He argued that the economy lets monetary policy have no permanent effects on of unemployment, GNP, or real interest rates. Friedman did maintain that monetary policy can be used to control the time path taken by the price level.

In the light of research that has occurred since Friedman's article, I would like to reexamine, re-present, and lengthen Friedman's list of limitations and possibilities for monetary policy. Subsequent research has reinforced the cautionary notes Friedman sounded. My discussion will center on six propositions governing the role of monetary policy, the first three of which are from Friedman's address.

4. Monetary policy and unemployment

Proposition 1. *Monetary policy cannot be used to influence unemployment.*

Friedman's 1968 article asserted a version of the natural unemployment rate hypothesis, formulated independently by Friedman and Phelps (1967) Friedman and Phelps reinterpreted the *Phillips curve*, the inverse correlation between inflation and unemployment traced out by US and UK data in the first two decades following World War II. Paul Samuelson and Robert Solow had earlier regarded that correlation as a stable relationship confronting the macroeconomic policy authorities with a trade-off between inflation and unemployment (Samuelson and Solow, 1960). According to this interpretation, by running larger government deficits and incurring higher rates of currency expansion, the policy authorities can engineer a reduction in the average unem-

ployment rate. In the late 1960s many macroeconomists recommended that the government accept this trade-off and run a high-inflation, low-unemployment policy.

Friedman and Phelps described a theory that explained the inverse correlation between inflation and unemployment in the postwar data but that also implied that the correlation would not endure a permanent attempt to exploit it. Friedman and Phelps reasoned that at given expectations about future rates of inflation, labor suppliers' behavior would make unemployment vary inversely with the current rate of inflation. However, if workers' expected rate of inflation were to increase, Friedman and Phelps reasoned that the terms of the apparent trade-off between inflation and unemployment would worsen. Indeed, it would worsen so much that no decrease in unemployment would accompany an increase in actual inflation that was just matched by a corresponding increase in people's expected rate of inflation. This theory, constructed by analyzing the factors underlying decisions to supply labor, implies that there is no permanently exploitable trade-off between inflation and unemployment. This *natural unemployment rate* theory makes unemployment responds only to the unexpected part of inflation, which cannot be permanently set to a value other than zero.

Friedman used this theory, together with a theory that people's expected rate of inflation was formed as a geometrical moving average of actual rates of inflation (the so-called adaptive expectations theory), to conclude that monetary policy cannot be used permanently to influence the unemployment rate. With adaptive expectations, people eventually eliminate any discrepancy between actual and expected sustained rates of inflation, and monetary policy's effects on the unemployment rate are entirely mediated through that discrepancy.

4.1. Rational expectations

Whereas Friedman's formulation denied the possibility of any permanent effects, it left open extensive possibilities for dynamically intricate temporary effects of monetary policy on the unemployment rate. [3] These effects could be achieved by subtly manipulating private agents' errors in forecasting future rates of inflation. However, subsequent research has strengthened Friedman's argument by eliminating or greatly weakening even these temporary effects. This modification has resulted from replacing Friedman's hypothesis of adaptive expectations (the weakest part of his theory in relation to economic motivation) with the hypothesis of rational expectations (see Muth, 1961).

[3] These effects are analyzed formally in Phelps, 'Phillips Curves'.

In Friedman and Phelps's model, the people made worse forecasts of future inflation than did the government, which owns the economists' model. The model showed how to make better forecasts of inflation than those made by the simple moving-average schemes attributed to people by Friedman and Phelps. The idea of rational expectations is to remove this asymmetry between the forecasting ability of the person who owns the model and the agents who live in the model by positing that the agents in the model forecast at least as well as the outsider (the government) who owns the model.

Attributing rational expectations to private agents substantially strengthens the limitations on the ability of monetary policy to influence the unemployment rate. There is no systematic monetary policy capable of influencing the unemployment rate even temporarily. Monetary policy affects the unemployment rate only by inducing surprises, and there is no systematic (that is, predictable) way to manipulate those surprises. As for the likely distribution of unemployment rates, monetary policy can do no better than to use a constant growth rate rule such as the one Friedman recommends.

5. Monetary policy and interest rates

Proposition 2. *Monetary policy cannot be used to influence real interest rates.*

As a corollary of the natural-rate hypothesis, it follows that monetary policy cannot be used to influence real rates of interest. A version of this principle was stated in Friedman's 1968 article, and subsequent research has strengthened his statement by replacing his assumption of adaptive expectations with the assumption of rational expectations.

That real interest rates are beyond the influence of monetary policy follows from two features of the economic environment. The first feature, embodied in Irving Fisher's famous theory, is that at given tax rates, real interest rates are determined once the levels of aggregate employment and national product are determined (see Fisher, 1930). Thus, given a time path for national product, real interest rates are determined by the marginal productivity of capital along that path. The second feature is the natural-rate hypothesis, which makes the expected path of employment and national product independent of the choice of a monetary policy rule.

According to Friedman's principle, the monetary policy authority could exert no permanent influence on real interest rates because it could not permanently influence the unexpected component of inflation. Under the adaptive expectations system assumed by Friedman, the monetary policy authorities still had the power to influence real interest rates temporarily by inducing sequences of errors in private agents' forecasts of inflation.

Again, research subsequent to Friedman's has strengthened his result by replacing the assumption of adaptive expectations with that of rational expectations, a replacement that withdraws from the monetary policy authority the superior wisdom and forecasting advantage that would permit it to manipulate private agents' forecast errors (see Sargent, 1973).

5.1. What versions of Propositions 1 and 2 should the monetary authority believe?

Kydland and Prescott (1977) combined the natural rate hypothesis with rational expectations to open up a strategic analysis of the choices confronting the policy maker. Their work focused on the separate outcomes that would emerge from two different assumptions about the *timing* of choices to be made by the monetary authority. One assumption – and this is the realistic one – is that the monetary authority chooses *sequentially*, i.e., each period it reconsiders its options in light of the most recent information. The other assumption is that the authority precommits itself to a course of action – maybe a state-contingent one Kydland and Prescott showed that in the Phillips curve example, sequential choice would eventually lead to worse outcomes than precommitment, namely, higher inflation but the same unemployment rate.

In practice, monetary authorities are required to act sequentially: the current FOMC cannot bind its successors. The literature has sought substitutes for commitment, for example, in the form of complicated systems of public beliefs that confront the monetary authority with incentives that deter it from giving way to temporary temptations to inflate (see Barro and Gordon, 1983).

The undesirable outcomes from sequential choice in Kydland and Prescott's framework rely heavily on the assumption of rational expectations and a benevolent government. Rogoff (1985) has pointed out that outcomes will be better, even under sequential choice, if the monetary authority simply doesn't care about unemployment, but abhors inflation. Rogoff's argument also works if the monetary authority cares about unemployment, but has the wrong model of the economy in the sense that he believes that there is not even a temporary Phillips curve correlation between inflation and unemployment, and so sees not even temporary benefits to inflating. Such a monetary authority believes an oversimplified version of Propositions 1 and 2. But it is in the public interest that he remain misinformed. [4]

[4] This is how sense might be made of the reception accorded to Vice Chairman Alan Blinder's remarks at Jackson Hole. Blinder's remarks would not have created much of a stir at a University seminar.

6. Monetary policy and inflation

Proposition 3. *Monetary policy can influence the time path of the price level* (*assuming that the monetary authority's powers are augmented by sufficient powers to levy taxes*).

Proposition 3 embodies the main possibility left open to the monetary authority in Friedman's analysis, with my parenthetical qualification. This qualification was implicit in Friedman's treatment, and subsequent research has emphasized its importance.

The ability of the monetary authority to influence the price level rests on two aspects of the economic structure: (l) the demand schedule for government-issued currency (currency and bank reserves, so called high-powered money) and (2) the intertemporal sequence of government budget constraints. The demand for currency is proportionate with the price level, a doubling of the price level leading to a doubling of the amount of money demanded. This proportionality reflects the idea that the economic demand is for a 'real' quantity of money, the nominal amount deflated by the price level. The demand for real money balances also depends partly on the levels of real output and real interest rates (which Propositions 1 and 2 state are outside the influence of the monetary authority) and on the path of future price levels expected by private agents. A demand schedule for money with these features implies that if the supply of government-issued currency has a steady and low growth rate, so will the price level. This is the quantity theory of money.

But is it *feasible* for monetary policy to keep the growth rate of currency low? This question brings us to the second condition in Proposition 3, the parenthetical qualifier. The government faces a sequence of budget constraints. Each period, the real value of government expenditures plus interest payments on government debts plus retirements of outstanding debts must equal the sum of three components: tax collections, proceeds from issues of new interest-bearing government debt, and the change in government-issued currency divided by the price level. The last term on the receipts side, sometimes called seigniorage, is under the control of the Central Bank. Government expenditures and tax collections are formally under the joint control of Congress and the president. (Legally the parenthetical qualifier behind Proposition 3 is usually not met in most Western countries. But for Proposition 3 to hold, we shall see that it must be met at least implicitly and informally.) The preceding argument states that the monetary policy authority would be able to control the inflation rate if it could permanently control the rate of growth of currency. But it follows from the government budget constraint that if the rate of growth of currency is controlled with an eye toward stabilizing the price level, then other elements of the government

budget constraint must be adjusted to assure that it is always satisfied. To take the simplest case, suppose that monetary policy is executed according to Friedman's k percent growth rule, with k equal to zero so that no growth in currency is ever permitted by the monetary authority. For this to be feasible, fiscal authorities must manage their affairs so that government expenditures plus interest payments equal tax collections plus the net proceeds from new issues of interest-bearing debt. [5] One way to accomplish this is to freeze the level of outstanding interest-bearing government debt and to set government expenditures plus interest payments equal to tax collections period by period. This is a balanced-budget rule for fiscal policy, with the gross-of-interest government deficit for each period being equal to zero. This rule is one of many that set the net-of-interest government surplus equal in present value to the outstanding stock of interest-bearing government debt. In general, supporting the no-seigniorage, 0% growth rule monetary policy requires a fiscal policy satisfying the condition that the present value of the government's net-of-interest surplus always equal the current stock of interest-bearing government debt. This fiscal rule instructs the government to behave like a firm (one without a printing press) and to balance any current deficits with the credible prospect of future surpluses sufficient to service debt created by those deficits.

For the monetary authority permanently to influence the price level, a mechanism must be in place for coordinating monetary and fiscal policies that gives the monetary authority the power permanently to withhold a flow of seigniorage from the fiscal authority. [6] To support a no-seigniorage monetary policy, the government budget must be in balance in the present-value sense.

To emphasize the importance of the qualifier in Proposition 3, it is useful to focus on the assumptions used to rationalize neutrality-of-money experiments in textbook models representing the quantity theory of money. [7] These experiments imagine that the monetary authority engineers a once-and-for-all decrease in the stock of currency by open-market sales of government interest-bearing bonds. This operation increases the stream of interest payments that the government must pay to its creditors. To finance these payments, the textbook experiments assume that the open-market sale of bonds is accompanied by a sufficient increase in the stream of taxes to service the higher interest payments resulting from the sale. This experiment illustrates the way tax

[5] For formal analysis, see Sargent and Wallace, Some Unpleasant Monetarist Arithmetic, and Sargent, Dynamic Macroeconomic Theory.

[6] In 'Some Unpleasant Monetarist Arithmetic', Sargent and Wallace describe what will happen if the monetary authority tries to control the price level when no such mechanism is in place.

[7] See Sargent, Dynamic Macroeconomic Theory, chapter 5.

adjustments are required to support the monetary policies that control the price level.

Under current institutional arrangements in the United States, the monetary authority does not have the authority assumed in the qualifier to Proposition 3. It is questionable whether it can acquire that authority by engaging in a 'game of chicken' with the fiscal authorities, as described by Neil Wallace. [8] In any event, under US institutional arrangements the following Proposition, which can be viewed as a corollary to Proposition 3, is actually pertinent.

7. Monetary policy and inflation again

Proposition 4. *Monetary policy cannot permanently prevent inflation* (*given a fiscal policy implying a stream of net-of-interest government deficits*).

Proposition 4 follows from the same premises underlying Proposition 3. Assuming that fiscal policy is managed to create a permanent stream of net-of-interest deficits, it follows arithmetically that monetary policy must supply a permanent stream of seigniorage sufficient to make up the budget shortfall. This is an aspect of the 'unpleasant monetarist arithmetic' explored by Sargent and Wallace.

8. Monetary policy and foreign exchange

Proposition 5. *Monetary policy is incapable of determining the rate of exchange of domestic currency for foreign currencies* (*unless supported by an appropriate fiscal policy*).

This principle follows from adding to Propositions 3 and 4 the logic of purchasing-power parity: the rate of exchange of a domestic for a foreign currency equals the ratio of the foreign price level to the domestic price level. For example, given a constant British price level, a 25% rise in the US price level is predicted by purchasing-power parity to be associated with a 25% depreciation in the value of the dollar in exchange for pounds. Purchasing-power parity is a particular application of the law of one price. Although there can be substantial transitory deviations from the value of exchange rates predicted by the principle of purchasing-power parity, exchange rates eventually tend to adhere to the paths predicted by the principle.

[8] For a description of Wallace's game of chicken, see Sargent, 'Reaganomics and Credibility', and Sargent, 'Interpreting the Reagan Deficits'.

Combining the logic of purchasing-power parity with that of Propositions 3 and 4 immediately produces Proposition 5. By Propositions 3 and 4, the monetary authority cannot permanently set the domestic price level along a noninflationary path unless it is supported by an appropriate fiscal policy. Given time paths for foreign price levels, domestic monetary policy cannot affect the time path of foreign exchange rates unless it is supported by fiscal policies consistent with the required domestic price level paths. [9]

Proposition 5 leaves open the possibility of operating a monetary regime keyed to stabilizing a foreign exchange rate. The international gold standard is one example of a regime under which principle 5 is respected by all participating countries and the foreign exchanges are stabilized. A gold standard is a set monetary and fiscal policy rules designed to stabilize rates of exchange of foreign for domestic currencies for all participating countries. Under a gold standard, each participating government borrows only by issuing promises redeemable in gold. Government debt in the form of currency assumes the form of a note for a given amount of gold, payable to the bearer on demand. Under this system a British pound is an immediate claim on x units of gold, whereas a US dollar is an immediate claim on y units of gold. The exchange rate between pounds and dollars must be x/y.

To adhere to a gold standard, a government has to back its debts with gold or other assets that are themselves as good as gold. In practice as well as in theory, it is unnecessary to hold stocks of gold equal in value to the entire stock of a government's liabilities. Instead, it is sufficient to back debts by sufficient prospects of future government surpluses. By accepting a gold standard rule, a government in effect agrees to operate its fiscal policy by a present-value budget balance rule. Under this rule government deficits can occur, but they are necessarily temporary and are accompanied by prospects for future surpluses sufficient to service whatever debt is generated by the deficit.

Thus a gold standard is as much a fiscal regime as it is a monetary regime. Indeed, during the high tide of the gold standard in the late nineteenth century, most of the central banks of Europe faced rules imposing a low ceiling on the amount of government loans they could purchase. The central banks were permitted to issue bank notes on the security of gold, foreign exchange, and safe evidences of short-term commercial indebtedness. Such rules well capture the spirit and structure of the gold standard as a fiscal institution supported by monetary arrangements that deny the fiscal authority access to the printing press as a source of finance.

[9] For a critical account of alternative mechanisms for sustaining commitment to a fixed exchange rate, see Obstfield and Rogoff (1995).

8.1. Dollar or mark standards

Everything that we said above, about the gold standard applies to countries today seeking to stabilize their currencies in terms of the dollar or German mark. Convertibility can be sustained only by a government agency backed with sufficient fiscal powers.

9. The 'lender of last resort'

During the period of the gold standard, the role of lender of last resort began to be assigned to the central bank. A tradition developed to guide the central bank's behavior during periods of unusual stringency in credit markets. The central bank was supposed to lend as freely as possible (albeit at a high interest rate) to forestall what threatened to be contagious defaults on commercial banks' liabilities, in the form of either suspension of convertibility into central bank notes or outright bankruptcy (see Bagehot, 1873). Feasible practical limits on the range of such operations were imposed, first, by the commitment of the central bank to keep its notes convertible into gold at par and, second, by the limited capital of the central bank. In acting as a lender of last resort during bad times, the central bank was conducting open-market operations by paying out good assets (central bank notes) in exchange for bad assets (commercial loans originally owned by the banks in jeopardy). Such operations would impair the central bank's capital and, if conducted without limit, would destroy the central bank's ability to honor its commitment to convert its notes into gold on demand. Under some constellations of threats to the commercial banks, the central bank simply could not act as a lender of last resort and also honor its commitment to manage its portfolio according to the rules of the gold standard.

The lender of last resort ultimately acts as an insurer of banks' liabilities. In the absence of deposit insurance, requiring a central bank to act as a lender of last resort amounts to setting up an underfunded insurance scheme. For a lender-of-last-resort scheme to be feasible and also consistent with gold standard commitments, it must be properly funded. Alternative ways of funding such a scheme are either explicitly to charge sufficiently high and sufficiently risk-indexed fees for deposit insurance or to commit the general taxing authority of the government as a funding source. In the Great Depression, central banks failed to be lenders of last resort because they lacked such funding.

These considerations indicate how under a gold standard regime the provision of a lender of last resort to the banking system is a matter for fiscal policy. Though somewhat less obvious, it remains a matter of fiscal policy under the fiat standard with which we live today, which is not anchored by the commitment to convert government debt into any bundle of physical assets.

Under a fiat standard a central bank's commitment to pursue price level stability limits the amount of seigniorage it can supply to the fiscal authority, thereby requiring discipline on the part of the fiscal authority. In a fiat system, commitment to price level stability constrains the actions of the monetary authority just as it does under the gold standard. If the central bank is not bound by a commitment to price level stability, it acquires some ability to act as a lender of last resort. By giving up the constraints imposed on its actions by price stability, the central bank in effect acquires a set of taxing powers (it controls an inflation tax) that enables it to reallocate resources between borrowers and lenders. These taxing powers are strongest when loan contracts are denominated in nominal terms and when loans have long terms to maturity (see Beers et al., 1983).

The preceding discussion can be summed up in the following proposition, which can be interpreted as another corollary to Proposition 3.

Proposition 6. *Monetary policy cannot insure bank deposits by acting as a lender of last resort while simultaneously managing the central bank's portfolio in a way designed to assure price stability*.

Note that Proposition 6 does not deny that monetary policy can in some circumstances play an important role in bailing out threatened banks. But without support in resources from the fiscal authority, monetary policy will at times have to sacrifice price stability to prevent failures of commercial banks. This is the meaning of the old adage that "the role of monetary policy is to convert bad loans into good ones."

10. Price and tax effects of a 'lender of last resort'

Proposition 6 grants that it is feasible for a fiscal authority, if not a purely debt managing institution, to insure deposits of a specified list of institutions. The economic effects of deposit insurance depend on how the insurance is priced and financed. In recent practice, deposit insurance has partly or largely been paid for out of general government revenues. That can be expected to affect both the probability distribution of asset prices and of the taxes that must eventually be collected. Ljungqvist (1995) has constructed an extended example that illustrates how unpriced deposit insurance financed from general revenues increases asset price volatility and tax bill variability. It is tempting to regard Ljungqvist's computations as a parable for the boom and bust in many Western markets in buildings following widespread financial deregulation of the early 1980s.

11. Conclusion

The first two propositions describe limits placed on the monetary authorities by an economic system in general and by the way monetary policy impinges on the opportunities (budget constraints) available to private economic agents in particular. The next three propositions describe limits placed on the potential accomplishments of monetary policy by the arithmetic of the government's own budget constraint. These propositions provide concrete meaning to an old maxim in central-banking circles: with a tight fiscal policy that hands the monetary authority a small portfolio of government debt to manage, it is easy to run a noninflationary monetary policy; but under a persistent deficit-spending policy, it is impossible to run a noninflationary monetary policy.

Appendix A. Graphical primer on budget arithmetic

As a fraction of GDP, a government raises $(M_t - M_{t-1})/p_t Y_t$ in revenues by printing currency. It is useful to represent this quantity in terms of the approximation

$$(M_t - M_{t-1})/p_t Y_t \approx m_t(x + n),$$

where M_t is the stock of currency, $m_t \equiv M_t/p_t Y_t$ is real balances as a percent of GDP, p_t is the price level, Y_t is real GDP, x is the net rate of inflation between $t-1$ and t, and n is the growth rate of Y between $t-1$ and t. The left side of this equation is often dubbed 'seigniorage,' and is a source of revenues, available to finance government expenditures.

We can represent the government budget constraint as

$$m(x)(x + n) = g_t - \text{tax}_t + (r - n)b_t - \Delta b_t,$$

where g is government expenditures, tax_t is total tax collections, $g_t - \text{tax}_t$ is the net-of-interest government deficit, b_t is the ratio of real government debt to real GDP; r is the real rate of return on government debt; and Δb_t is the change in real government debt over GDP. The right hand side of the above equation is the gross-of-interest government deficit $(g - \text{tax} + (r - n)b)$ adjusted for growth of GDP *minus* the increase in government indebtedness. This is the amount left to be financed by 'seigniorage' or 'inflation taxes.' The right side represents total inflation taxes as the product of real balances (relative to GDP) m, times the inflation rate x, adjusted for growth in the economy (the government collects some seigniorage revenues without inflation in a growing economy). We have represented m as a function of x, in the tradition of Cagan (1956) where $m'(x) < 0$ reflects peoples' economizing on real balances as inflation grows.

Fig. 1 depicts $m(x)(x+n)$ as a function of x. The shape of $m(x)(x+n)$ is inherited from that of $m(x)$. If $m(x)$ were a constant (velocity is constant), then $m(x)(x+n)$ would be a straight line with slope x. If $m'(x) < 0$, then $m(x)(x+n)$ exhibits the type of curvature depicted in Fig. 1. Examples of $m(x)$ functions exist which are so sensitive to inflation that $m(x)(x+n)$ turns down for high rates of inflation. This makes a 'Laffer curve' in the inflation tax.

In Fig. 2, I plot three year moving averages of $(M_t - M_{t-1})/p_t Y_t$ against $x_t = \ln p_t - \ln p_{t-1}$ for several countries in recent years. If money demand is a statistically tight function of expected inflation, and if expected inflation coheres tightly with actual inflation, these scatters of points should convey an impression of $m(x)(x+n)$. These figures depict noisy versions of Fig. 1. The

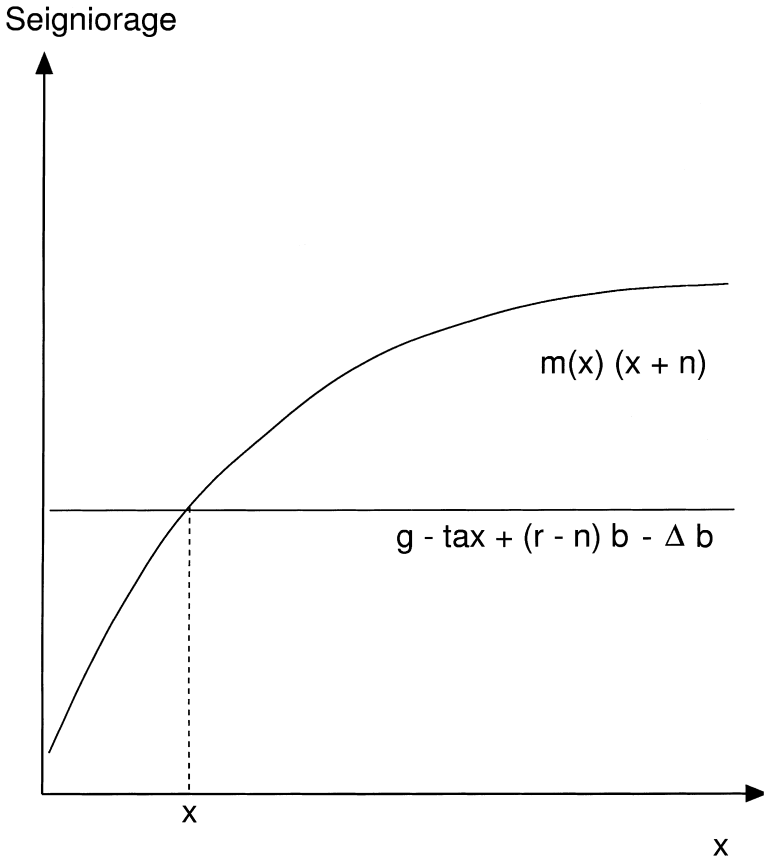
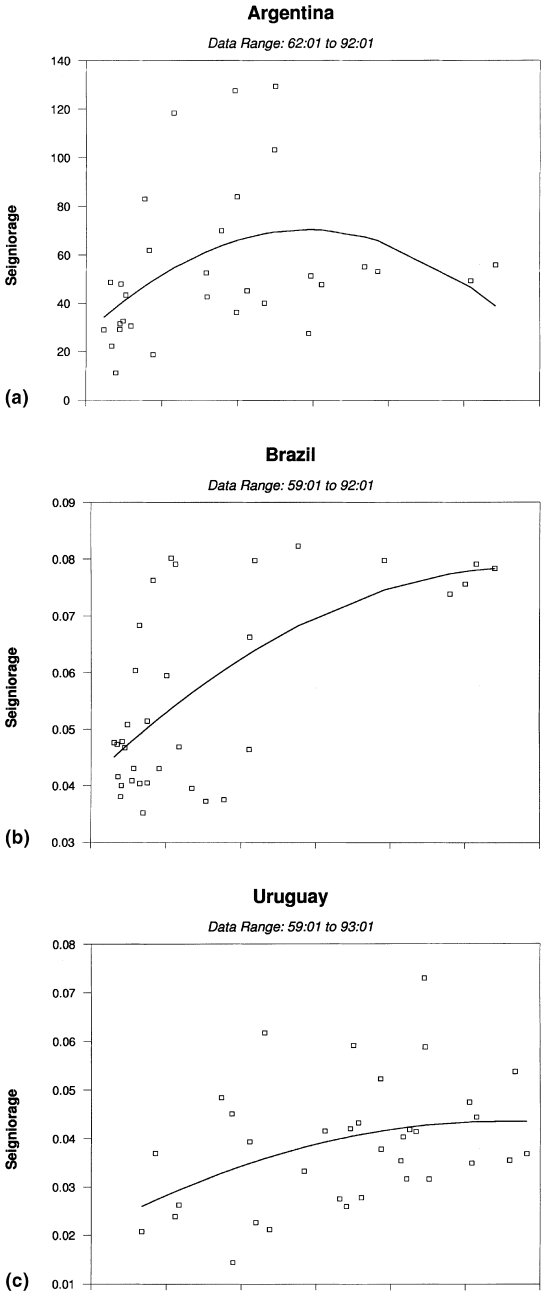
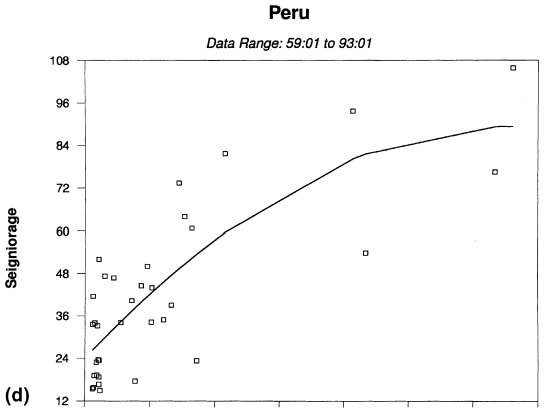
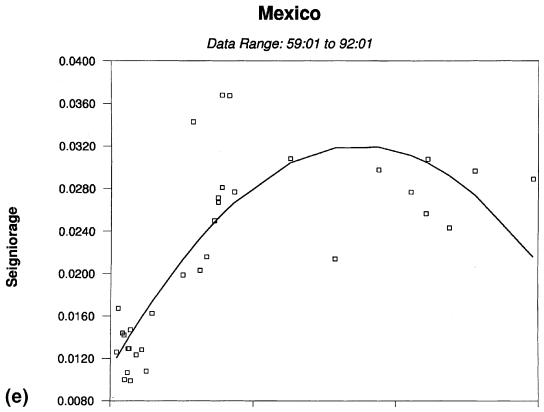
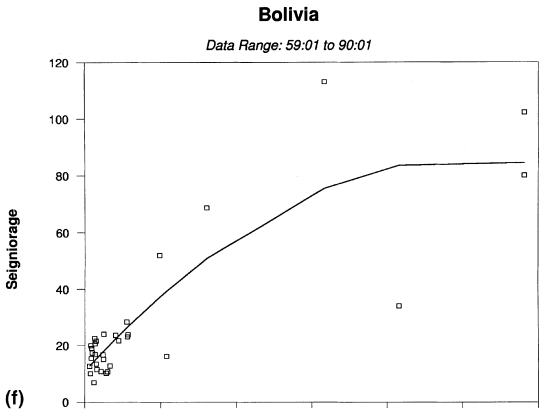


Fig. 1. Seigniorage $m(x)(x+n)$ as a function of the inflation rate. By choosing the gross-of-interest deficit g – tax minus borrowing Δb, the government determines the inflation rate.


Argentina
Data Range: 62:01 to 92:01
Seigniorage
140
120
100
80
60
40
20
0
(a)
Brazil
Data Range: 59:01 to 92:01
Seigniorage
0.09
0.08
0.07
0.06
0.05
0.04
0.03
(b)
Uruguay
Data Range: 59:01 to 93:01
Seigniorage
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
(c)


Peru
Data Range: 59:01 to 93:01
Seigniorage
108
96
84
72
60
48
36
24
12
(d)


Mexico
Data Range: 59:01 to 92:01
Seigniorage
0.0400
0.0360
0.0320
0.0280
0.0240
0.0200
0.0160
0.0120
0.0080
(e)


Bolivia
Data Range: 59:01 to 90:01
Seigniorage
120
100
80
60
40
20
0
(f)

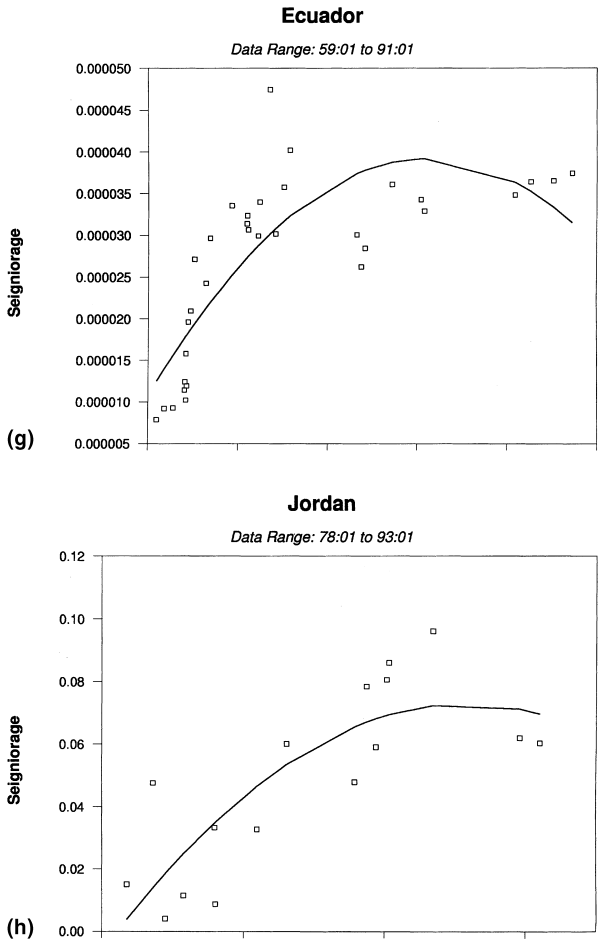


Fig. 2. (a) Three year moving average of seigniorage in Argentina versus three year moving average of annual inflation rate. (b) Three year moving average of seigniorage in Brasil versus three year moving average of annual inflation rate. (c) Three year moving average of seigniorage in Uruguay versus three year moving average of annual inflation rate. (d) Three year moving average of seigniorage in Peru versus three year moving average of annual inflation rate. (e) Three year moving average of seigniorage in Mexico versus three year moving average of annual inflation rate. (f) Three year moving average of seigniorage in Bolivia versus three year moving average of annual inflation rate. (g) Three year moving average of seigniorage in Ecuador versus three year moving average of annual inflation rate. (h) Three year moving average of seigniorage in Jordan versus three year moving average of annual inflation rate.

solid lines are the systematic parts of least squares estimates of quadratic functions. [10]

Fig. 1 can be used to illustrate the underpinnings of Propositions 3 and 4, and also some refinements of them. By setting $g - \text{tax} + (r - n)b - \Delta b$, monetary and fiscal policy pick determine the required seigniorage, and therefore x. In effect, the authorities choose the coordinate on $m(x)(x + n)$, then the market determines the ordinate x. A key ingredient of all long run theories of inflation is that Δb cannot be positive forever, because there are limits on the ratio of debt to real GDP that the government will absorb. Propositions 3 and 4 consider long run situations in which b is stabilized, so that Δb is zero. When Δb is zero, the long run rate of inflation x is determined by the gross-of-interest government deficit $g - \text{tax} + (r - n)b$. Tight money policies with unchanged fiscal policies help things temporarily by deducting Δb from the coordinate in Fig. 1, at the cost of raising $(r - n)b$ tomorrow and beyond. This is the basis of the 'unpleasant monetarist arithmetic.' Proposition 3 ascribes to the monetary authority the power to raise taxes to service the additional debt; Proposition 4 (realistically?) denies such power to the monetary authority.

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[10] The data are from the IFS CD-Rom. For M_t I used figures comparable to M1; seigniorage was measured as the first difference M_t divided by nominal GDP. For inflation, I took the first difference of the logarithm of the GDP deflator.

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