THE PRECARIOUS FISCAL FOUNDATIONS OF EMU

CHRISTOPHER A. SIMS

Abstract. After a brief overview of the fiscal theory of the price level, we consider insights it provides into monetary policy formation under certain kinds of deflationary and inflationary stress. Then we consider how the institutions of the EMU are equipped—or unequipped—to deal with such stress. The conclusion is that fiscal institutions as yet unspecified will have to arise or be invented in order for EMU to be a long term success.

I. Introduction

Conventional macroeconomic models specify carefully the connection of monetary policy to the evolution of the price level, while ordinarily leaving the government budget constraint and evolution of the stock of government debt entirely hidden. It has been recognized, at least since Sargent and Wallace (1981), that sufficiently irresponsible fiscal policy could cause problems for monetary policy, but this has been treated as no more than an important footnote to the central role of monetary policy. Recently a number of economists have begun to take the view that fiscal policy plays a role at least as important as monetary policy in determining the price level.

Development of this view has required new models and new forms of analysis of the models, but it is far from a merely technical advance. It has made us realize that there are a wider range of policy approaches to price stability than are apparent from conventional models. It has also made us aware that conventional prescriptions for good monetary policy—commitment to control of monetary aggregates or to vigorous use of interest rate policy to counter inflation—are not by themselves guarantors of price stability.

The European Monetary Union has the appearance of an attempt to create a central bank and a monetary unit that have no corresponding fiscal authority behind them. In the light of this new fiscal approach to the price level, such an attempt appears to carry with it great dangers. This paper outlines the fiscal theory of the price level (FTPL) and examines a number of hazards for EMU that the theory brings out.

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II. The Fiscal Theory of the Price Level

In one sense the fiscal theory of the price level is very simple. If we pretend for a moment that there is no money, just interest-bearing debt (of zero term), the instantaneous government budget constraint is

$$\frac{\dot{B}}{P} + \tau = \frac{rB}{P} \,, \tag{1}$$

where B is nominal government debt, P is the price level, r is the nominal interest rate, and τ is the real primary surplus. A dot over a variable indicates the derivative of the variable with respect to time. Now we introduce $b = B/P$ to stand for the real value of the debt and

$$\rho = r - \frac{\hat{\dot{P}}}{P} \tag{2}$$

to stand for the real interest rate. We use $\hat{\dot{P}}$ to stand for the right derivative of P with respect to time, i.e. the expected rate of change from the current time onward.[1] This allows us to rewrite (1) as

$$\dot{b} + \tau = \left(\rho + \frac{\hat{\dot{P}} - \dot{P}}{P} \right) b \,. \tag{3}$$

Though it is important to bear in mind that an unanticipated disturbance creates a non-zero value for $\hat{\dot{P}} - \dot{P}$, along perfect-foresight solution paths the term is zero, allowing us to reduce (3) to

$$\dot{b} = \rho b - \tau \,. \tag{4}$$

In the simple case where ρ and τ are constant, we conclude that if b cannot grow explosively, the only possible value for it is

$$b = \frac{\tau}{\rho} \,. \tag{5}$$

More generally, b must be the discounted present value of current and future primary surpluses. Equation (5) can be thought of as determining the price level if we rearrange it as

$$P = \frac{\rho B}{\tau} \,. \tag{6}$$

In words, the price level is determined by the ratio of nominal government liabilities to the primary surplus.

[1] The model we are considering here is not stochastic. We assume that all time paths in it are continuous and differentiable and perfectly anticipated, except at the initial date (taken as $t = 0$). At $t = 0$, discontinuity is possible in some variables, but right-derivatives still exist.

A relationship of this form exists in nearly every general equilibrium model including government debt. It is implicit in most standard macroeconomic models. In models with money, it coexists with the "demand for money" equation derived from bond/money arbitrage, which can also be rearranged so as to appear to be determining the price level:

$$\frac{M}{P} = L(r,Y) \quad \rightarrow \quad P = \frac{M}{L(r,Y)} \,. \tag{7}$$

In fact, neither of these equations stands alone, generally, in determining the price level. Each must be understood as a component of a general equilibrium system.

When money is present, the real version of the government budget constraint (3) emerges as

$$\dot{b} = \left(\rho + \frac{\hat{\dot{P}} - \dot{P}}{P}\right) b - \tau - \frac{\dot{M}}{P} \,, \tag{8}$$

which can also be written as

$$\dot{b} + \dot{m} = \left(\rho + \frac{\hat{\dot{P}} - \dot{P}}{P}\right) (b+m) - \tau - rm \,. \tag{9}$$

Comparing the last terms on the right sides of (8) and (9), we see that we can think of the government budget constraint as being written in terms of $b + m$, total real government liabilities, if we count as part of revenue the seignorage term rm, the real interest payments avoided by maintaining money balances. Instead, we can think of the constraint as written in terms of interest bearing debt b alone, in which case we have to count $\dot{M}/P$, the more standard notion of seignorage as expenditure financed with newly issued money, as the seignorage term. The two versions of seignorage are not generally identical.

Naive discussions of fiscal policy sometimes, misreading the implications of "Ricardian equivalence", take it to be true that whenever the government issues additional debt, it is implicitly committing itself to raising additional future revenue, in real terms, in order that the new debt have value. But in fact the new debt commits the government only to raising additional future revenue in *nominal* terms. If asset market participants believe that there is no commitment to additional real revenues, the effect is not to make the new debt valueless, but simply to dilute the value of all outstanding nominal debt. This situation is perfectly analogous to what would happen to the value of a private company's stock if it were to issue new shares that were seen by market participants to be devoted to non-productive expenditures.

To trace out the equilibrium implications of this basic point, we consider fiscal behavior rules of two simple forms,

$$\tau = -\phi_0 + \phi_1 b \tag{10}$$

or

$$\tau = -\phi_0 + \phi_1 \cdot (b + m)\,, \tag{11}$$

combined with monetary policy characterized by one of

$$M \equiv \bar{M} \tag{12}$$

or

$$r = \theta(P - \bar{P}) + \beta\,. \tag{13}$$

Leeper (1991) and most of the subsequent literature concentrated on fiscal policies of the form (10), while Benhabib, Schmitt-Grohe, and Uribe (1998) have recently shown the importance of considering fiscal policies of the form (11) when analyzing situations where the nominal interest rate may approach zero.[2]

Here we will summarize conclusions and try to support them with heuristics. In the Appendix we give detailed arguments.

Paralleling the conclusions of Leeper (1991), we find that a complete model has a unique path along which b and m are stable, associated with a unique corresponding initial P, if fiscal policy of the form (10), with $\phi_1 > \rho$, is combined with either (12) or (13) with $\theta > 0$. This form of fiscal policy is what Leeper calls "passive" and Woodford calls "Ricardian", while the monetary policy is what Leeper calls "active".[3] There is also a unique price path associated with stable b and m when fiscal policy of the form (10) with $\phi_1 \leq \rho$ (active fiscal policy, in Leeper's terminology) is combined with monetary policy of the form (13) with $\theta \leq 0$ (passive monetary policy in Leeper's terminology.

Roughly speaking, these results can be explained by the fact that, with seignorage small, the government budget constraint is an unstable differential equation in real debt unless τ responds sufficiently positively to the level of debt, i.e. $\phi_1 > \rho$. At the same time, the consumer's first order condition, relating the rate of growth of consumption to the real interest rate, becomes an unstable equation in prices if policy makes the nominal interest rate r respond positively to the price level. If both these equations (the government budget constraint with the fiscal policy rule used

[2] That the results of Benhabib, Schmitt-Grohe, and Uribe depend on their use of (11) in place of (10) is not made explicit in their paper.

[3] Woodford's usage is more suggestive of the nature of the policy, but may be confusing, as no violation of Ricardian equivalence is implied by "non-Ricardian" fiscal policies.

to substitute out τ and the consumer's FOC with the monetary policy rule used to substitute out r) are unstable, the model has no stable solution. If neither is unstable, the model has a continuum of stable solutions and (therefore) an indeterminate price level. If just one is unstable, the model has a unique stable solution.

The more recent literature has moved beyond Leeper's analysis, however, to recognize that it can occur that paths on which m or b explodes exponentially upward or downward may fail to violate transversality or solvency constraints and thus may be legitimate equilibria. This substantially alters conclusions about the nature of policies that deliver a determinate price level. Furthermore, it turns out that conclusions here depend in detail on the nature of transactions technology, of solvency constraints, and of policy (whether fiscal policy is of the form (10) or (11)).

If money is not essential, in the sense that the economy has a well-defined equilibrium in which money has lost all value (a barter equilibrium), then equilibria in which the price level explodes upward while real balances shrink toward zero are usually possible. This may render the price level indeterminate under most combinations of active monetary with passive fiscal policies. The indeterminacy can be resolved by postulating that it is generally believed that when inflation or the price level become high enough, the passive fiscal rule will be abandoned, being replaced with, say, a policy that redeems government liabilities at a fixed floor real value. If such a policy is understood to be in place, the circumstances that would trigger the switch in fiscal policy will never arise, as only stable price paths will be consistent with equilibrium. But note that the credibility of such a "backstop" policy depends on the existence of a fiscal authority that can be seen to be committed to it. A commitment of the central bank to keep monetary policy active cannot by itself remove the indeterminacy.

As pointed out by Benhabib, Schmitt-Grohe, and Uribe (1998), a combination of (12) with a "passive" form of (11) ($\phi_1 > \rho$) does not imply a uniquely determined price level, because of the possibility of liquidity traps, in which prices spiral downward with nominal interest rates zero. Along an equilibrium path descending in to a liquidity trap under these policies, real balances increase without bound. Government *lending* also increases without bound, leaving the net worth of the public bounded as M/P rises. There is thus no conflict with transversality conditions on such a path. But this conclusion depends on the idea that, despite the absence of interest-bearing debt, the government feels obliged to tax to back the value of its outstanding non-interest-bearing liabilities. While this may seem far-fetched, the actions of the US Federal Reserve in the Great Depression suggest that it was concerned about the inflationary potential of excess reserves and applied the implicit tax of a reserve requirement increase to absorb the excess. Also, with policy characterized by (10) and $\phi_1 > \rho$, and with initial $b > \bar{b}$, the real primary surplus is implied to be falling, regardless of what happens to the price level. In a deflationary spiral, a fixed nominal primary surplus would grow in real value. If fiscal authorities display some money illusion and are therefore slow to cut the nominal primary surplus, fiscal policy could behave more like what is implied by (11) than by (10), and a deflationary spiral would be possible.

The liquidity trap indeterminacy of Benhabib, Schmitt-Grohe, and Uribe does not arise if the fiscal policy is set according to (10) with $\phi_1 > \rho$. In this case b tends, as P spirals downward, to some positive limit, regardless of initial conditions, while M/P, and thus private net worth, grows without bound. This would violate the representative agent's transversality condition, and therefore deflationary spiral paths are not equilibria of the model under this policy configuration.

The principle here is that along a deflationary path, active monetary policy generates expansionary pressure by forcing a rise in the real value of high-powered money M. But this expansionary pressure can be completely offset by misguided fiscal policy motivated by a desire to absorb "excess liquidity" or by sluggish adjustment of fiscal instruments to price declines.

III. Liquidity Traps

The analytical results cited in the previous section suggest that a central bank may have difficulty halting a deflationary spiral if inappropriate fiscal policies are followed. We can make this difficulty more concrete by considering particular historical circumstances.

In a recent paper (Sims 1999) I showed that postwar US monetary policy reactions would have implied negative interest rates during the 1930's in the US. Since this was infeasible, what could the US monetary authorities have done instead, and why did they not take effective action? This is of course a question that has already been debated at length. One suggestion is that the Fed could have engaged in more aggressive open market operations. But banks already had large amounts of excess reserves in the form of non-interest-bearing deposits with the Fed. Would actions that replaced their nearly non-interest-bearing holdings of government securities with additional non-interest-bearing reserve deposits have been likely to change bank behavior? It seems unlikely. When interest rates are zero, open market operations are pointless.

The banks were not lending because they had portfolios of loans of questionable liquidity and depositors who were alert for any sign of distress in their banks. The Federal Reserve could have taken action to give the banks increased confidence in lending, by moving aggressively to discount bank loans. By greatly reducing bank concerns about solvency, such actions would probably have increased bank lending and reduced public fears of bank failure. In fact, simply by making clear that it was ready to discount loans it might have had substantial effects before it actually discounted very many loans.

But to be successful such a policy move would have had to be bold and broad. If it were limited only to banks that were in distress, the stigma of coming to the discount window would have discouraged banks from using it. If it were limited only to the very soundest of loans in bank portfolios, it would have helped little to relieve concerns about solvency. Discounting a substantial volume of somewhat dubious loans would clearly have been risky, and would thereby have acquired a fiscal dimension. The Federal Reserve System would have been taking on risk, and if the result was substantial losses, there would have been a need for Congressional approval of appropriations to restore Federal Reserve solvency.[4]

We see this tension, in which policy to shore up a banking system, even if undertaken by the central bank, is forced to be in some sense fiscal policy, in two recent examples. In Mexico, the central bank in 1994 in effect discounted loans with a face value now of $60 billion, exchanging them for government bonds. The bank did not obtain legislative approval at the time, and it has this year (1998) tried to obtain legislative approval for completing the bailout—effectively permanently lodging ownership of the questionable loans with the government. The result has been an extended political battle that is having its own repercussions on the central bank and the banking system in Mexico.

In Japan, similar concerns about banking system solvency have taken a long time to resolve. Unlike in Mexico, the Japanese environment has been deflationary, with short term interest rates close to zero. Conventional monetary policy has been powerless, therefore, to reinvigorate bank lending. In this case, the central bank has not undertaken any quasi-fiscal actions on its own, as the need for a fiscal component in the resolution has been apparent.

IV. Inflationary Shifts in Demand for Government Liabilities

Another kind of test of a monetary authority's ability to maintain stability is a sudden drop in demand for the liabilities of the government. This will of course be inflationary if not counteracted by policy. If the decline has occurred because of a reduced need for transactions balances, it can be offset by letting the public adjust its portfolio to hold less money and more government debt. This is the kind of thing

[4]It is sometimes suggested that a central bank cannot have a solvency problem because it can always "print money". But if the asset side of the bank's balance sheet deteriorates, and at the same time the demand for high-powered money drops, the bank's ability to absorb high-powered money via open market operations, and thereby preserve the value of the currency, is compromised. Being able to "print money" is no help, of course. It is previously printed money that the public is attempting to convert into something it values more—interest-bearing securities.

that open market operations are meant to accomplish. We are not used to thinking of open market operations as having a fiscal dimension, but they do in fact. When the central bank sells interest-bearing government debt to absorb non-interest-bearing liabilities, it increases the level of current and future interest expenses and thereby requires expenditure cuts or tax increases. If the monetary authority's action is not backed up in this way by fiscal policy, it will not have the desired anti-inflationary effect.

An historical example here is instructive. From 1890 to 1894 in the US, gold reserves shrank rapidly. US paper currency supposedly backed by gold was being presented at the Treasury and gold was being requested in return. Grover Cleveland, then the president, repeatedly issued bonds for the purpose of buying gold to replenish reserves. This strategy eventually succeeded. From one point of view, it was simply an open market operation: sale of bonds to absorb high-powered money. But at the time, the US had no central bank. Cleveland issued the bonds under dubious legal authority, without consulting Congress, and there resulted a major legal and political dispute—luckily after the fact. The argument of Cleveland's opponents, which was surely correct in principle, was that while the issuance of the bonds was not directly a purchase of goods and services, it nonetheless imposed fiscal obligations, and Congress was constitutionally charged with deciding such issues.

Nowadays in the US at least, the legal situation is much clearer. There is a continually adjusted upper bound on US government debt, set by Congress, and the president could not exceed it without Congressional authority. It is therefore not a mere accounting fiction that the Federal Reserve holds US government debt on the asset side of its balance sheets. Sale of these bonds imposes fiscal obligations as surely as did Cleveland's bond sales, but it is understood that the Federal Reserve can sell or buy bonds routinely, without consulting Congress.

V. Exchange Rate Determination

There has been some controversy surrounding the application of FTPL to determination of exchange rates.[5] The main difficulty is that in a multi-country model, if the governments are given arbitrary decision rules like (13), (12) and (10), they need not end up satisfying "transversality conditions". That is, while we can be sure that optimizing individuals will not accumulate wealth indefinitely without spending it, non-optimizing governments might do so. But since doing so would reduce the welfare of their own citizens, equilibria in which this occurs are unappealing as descriptors of possible reality. The elements going in to this discussion are described clearly by Bergin (1998).

[5]See Bergin (1998), Woodford (1996) and Dupor (1997).

Once we accept the view that it is unrealistic to consider equilibria in which any government accumulates indefinitely large amounts of the debt issued by other governments, FTPL produces a simple message about exchange rate determination. In simple multicountry extensions of the model of section II, domestic price levels are determined by the ratio of nominal government liabilities to discounted future primary surpluses, and exchange rates are then determined by the ratios of price levels. If borrowing takes place both in foreign and domestic currency, fluctuations in the country's fiscal status are magnified, because it is the ratio of domestic debt to the primary surplus after dollar interest is subtracted that determines the price level. Foreign currency borrowing therefore acts as leverage in the FTPL relationship.

When we view exchange rate determination from the FTPL viewpoint, new possibilities arise for the type of speculative attack multiple equilibria that have now been widely studied in the international macroeconomics literature. That literature focuses mainly on the possibility that monetary policy could respond to an exchange rate change brought on by a speculative attack. But the possibility of a fiscal shift in response to a speculative attack can equally well produce multiple equilibria. Indeed one aspect of the recent Asian financial crises may be precisely such a mechanism: devaluation can lead to financial distress in large companies or banks and thereby to government bailouts that produce sudden increases in the liabilities of the government. Simple models demonstrating that this can lead to multiple equilibria with speculative attacks are displayed in Sims (1997).

VI. EMU: Monetary Policy without Fiscal Backing?

It is striking that the Maastricht accords spell out in great detail the institutional arrangements for a common monetary system while providing no correspondingly detailed structures for coordination of fiscal policy. The accords even seem to reflect a belief that eliminating relationships between fiscal authorities and the central bank guarantees monetary stability. The European Central Bank is designed to be "independent" of fiscal authorities in the sense of being disconnected from them. Yet the fiscal theory of the price level suggests that this is a mistaken definition of central bank independence. A truly independent central bank is one that can act, even under inflationary or deflationary stress, without any worry about whether the necessary fiscal backing for its actions will be forthcoming. What kind of problems is the Maastricht structure likely to engender?

Before I proceed, let me note that I am only going to describe what seem to me to be potential hazards and pressures on the system. I think it is unlikely that EMU can long survive with the degree of vagueness and weakness in the associated fiscal structure that currently characterize it. This does not mean, though, that the EMU cannot long survive. One possible response to pressures as they arise is that fiscal institutions can emerge and adapt as necessary in order that EMU survive.

VI.1. **The Fiscal Criteria as Passive Fiscal Policy.** The criteria for fiscal behavior set out in the treaty amount to a commitment that each country individually will follow a passive fiscal policy, raising the primary surplus by more than enough to offset the increased interest payments when real debt grows. As we noted in II, such a fiscal policy implies a unique stable price path when it is coupled with an active monetary policy, one that stabilizes a monetary aggregate or increases interest rates when the price level rises. However, this policy combination also allows unstable equilibria, in which a self-reinforcing, accelerating inflation wipes out the real value of the money stock while leaving the real value of the stock of interest-bearing debt unchanged. No amount of "commitment" or "credibility" on the part of the monetary authority can rule out such equilibria. What is required to rule them out is widespread belief in a fiscal commitment to a floor value for the currency.

Such a commitment is plausible in a country with a single monetary and a single fiscal authority. But in EMU, a coordination problem would arise. The commitment would after all require raising taxes to preserve the value of the currency. Any single country in the EMU might well worry that if it moves first with such a backup tax, it could end up carrying the burden for the rest of Europe. Indeed, there might be a question whether any single country, certainly among those with smaller economies, has the fiscal resources to credibly promise such a backup. To succeed, therefore, such an implicit or explicit fiscal backup commitment would have to involve coordination, with at least several countries jointly taking on the task. This would require political skill, and since it has not been done before and would not need to be done in equilibrium, it might be hard to convince the markets that this political process could carry forward with the required speed if an accelerating inflation did begin.

VI.2. **A Deflationary Depression Scenario.** As we have noted in sections II and III, the zero lower bound on interest rates can make the active-monetary, passive-fiscal policy combination untenable as deflation pushes interest rates toward zero. What is required to break out of such a situation is fiscal action that prevents continued rise in the real value of government liabilities and high real returns on them. This will mean reducing primary surpluses and convincing the public that these reductions will be long-lasting. Standard passive fiscal policy is counter to what is needed in this situation. The real value of government liabilities will be high and rising. With the economy generally in distress, policy-makers might not find it difficult to put the fact of rising real government liabilities aside and undertake fiscal expansion. But if the

Maastricht rules are taken seriously, they will point in precisely the wrong direction in such a situation.

Here what is a weakness of the EMU system in other circumstances—the fiscal free rider problem—would work toward resolving the difficulty. Even one country that is sufficiently fiscally expansive despite the Maastricht rules, could undo the liquidity trap, with the resultant reversal of deflation benefiting all members of the EMU. On the other hand, if the logical foundations of the need for fiscal coordination are not understood, the need to break the Maastricht rules in this situation could undermine adherence to them more generally.

VI.3. **Fiscal Free-Riding and Country Bankruptcy.** Some writing about EMU assumes that it will permanently eliminate nominal interest differentials across countries on government debt. Monetary policy under EMU is often described as decision-making on interest rates being made at the European Central Bank (ECB) and implementation of those decisions in individual countries being carried out by country central banks. If the rates are not truly to be uniform across countries, difficult questions of interpretation will arise in implementing the ECB rate decisions in individual countries.

But a policy of eliminating cross-country rate differentials amounts to a policy of accommodating debt issue by fiscally expansive countries.[6] With such a policy in place, the benefits to a country of running a fiscal deficit unbacked by future taxes are greater than for a country not in a monetary union. The isolated country faces the full inflationary consequences of its unbacked fiscal expansion. The EMU member spreads the inflationary consequences over its EMU partners and, if not forced to undo the effects of its initial expansion by later fiscal contraction, attains a permanent increase in wealth at the expense of other EMU members.[7]

So if it is to succeed in maintaining uniform interest rates without generating fiscal imbalances, the EMU will have to find ways to enforce fiscal discipline on its member states, even when those states are under economic stress. The treaty language mentions the possibility of fines and required non-interest-bearing deposits for fiscally recalcitrant states. These measures do not seem likely to be widely useful. A state in such distress is not likely to have reached its condition through frivolous excess. More likely, it will have undergone unusual economic hardship. At such a juncture,

[6] The treaty language emphasizes that the ECB and the country central banks will not "directly" buy government debt. However, use of repurchase agreements with government debt as collateral seems definitely to be contemplated. In its effect on the market for government debt, a repurchase agreement is not very different from an outright purchase.

[7] A simple model laying this out is in Sims (1997).

trying to encourage greater fiscal stringency by adding an item to the expense side of the country's budget is likely to be counterproductive.

But one could take another view entirely of how the system will work—and one difficulty in understanding how it will work is that people seem to take both these contradictory views. The other view is that there is no need for the Maastricht criteria or for concern about fiscal discipline. The markets will take care of the fiscal discipline. The strict language forbidding the ECB to buy government debt suggests that interest rate uniformity may not be a central tenet of policy. Interest rate differentials across countries may persist, reflecting market judgments of the relative risks that the countries will default on their debts. US states, which have no independent monetary policies and have occasionally through history defaulted, are pointed to as an example.

This view seems to me naive, at least as it applies to the first decade or two after the EMU begins. Country default, if it occurs, will be a major blow to the defaulting country's economy and financial system. EMU members are all sovereign states with recent histories of having run their own monetary systems. They will all still have central banks, of a sort, and central bankers. If a country were in such distress that its interest rates rise substantially above those of other EMU members and that it thereby came to the brink of default, it seems very likely that it would leave the EMU and restart its independent monetary system. It would thereby revive the option of gentle, uniform, and partial default via inflationary finance and devaluation. If markets put some credence in this scenario, they will react to an EMU member's fiscal distress much the way they have historically reacted to a fragile commitment to a fixed exchange rate. Rising interest rates on debt will fuel speculation that drives the rates up even faster, increasing fiscal distress further, in a rapid spiral leading to crisis.

Even one such crisis would threaten the future of EMU, as it would likely breed contagion effects in other countries. It seems to me, therefore, that the EMU must pay attention to fiscal coordination and to attempts to keep interest rates uniform. Country bankruptcy may have to be contemplated as a remote possibility, but welcoming its threat as a source of fiscal discipline seems foolhardy.

VII. Inflationary Shifts in Demand for EMU Government Liabilities

Where is the EMU's Grover Cleveland? Presumably despite being forbidden to hold government debt, the country central banks and the ECB will strive to hold assets whose value is closely tied to their Euro-denominated liabilities. Very likely these will be government debt repurchase agreements, and very likely country central banks will tend to specialize in repurchase agreements for their own country's government debt.

There should therefore be adequate stocks of interest-bearing assets on hand to meet demand under sudden portfolio shifts.

Note, though, that this comforting thought is predicated on country default risk being a remote possibility. One type of shift in demand for EMU government liabilities might come from a widespread increase in concern about country default risk. Such concern would not divide itself evenly across countries, so the demand to exchange reserves for interest-bearing debt would vary across countries, and those most heavily hit would likely face rising interest rates if there were no automatic interest-smoothing mechanisms in place. Country default risk might therefore be associated with country central bank failure risk. Once this possibility came seriously to the fore, a coordinated fiscal mechanism to provide credit and/or recapitalization to the distressed bank or banks would be essential.

VIII. Conclusion

Human institutions are never perfect, and it is difficult to predict how they will actually work from their paper constitutions. Despite its emphasis on what could go wrong, this paper is not meant to be nihilistic. The EMU is more likely to succeed if those running it have thought carefully about all the ways it might fail. It seems to me that the FTPL is a useful tool to deploy in that enterprise.

Appendix A. Detailed Analysis of the Model

To consider questions of uniqueness and existence of equilibrium we have to complete the model. Here I present a simple, unrealistic model in which the central issues can be discussed. The model differs from that in Sims (1994) only in that this paper's model is in continuous time. It differs from that in Sims (1997) in that it incorporates money explicitly.

We postulate a representative agent who solves

$$\max_{C,M,B} \int_0^\infty e^{-\beta t} \frac{C^{1-\gamma}}{1-\gamma} dt \tag{14}$$

subject to

$$C \cdot (1 + \psi(V)) + \frac{\dot{M} + \dot{B}}{P} + \tau \leq rB + Y \ , \tag{15}$$

and

$$M \geq 0 \, , \qquad B + M \geq 0 \, . \tag{16}$$

The inequality (15) is a budget constraint of usual form, except perhaps for the term in V, which we define as velocity

$$V = \frac{PC}{M} \,. \tag{17}$$

The factor $1 + \psi(V)$ in front of C represents the effect of transactions costs on the amount of utility-yielding consumption obtained from a given amount of expenditure. It is natural to suppose $\psi(0) = 0$ — i.e. that transactions costs approach zero as real balances become arbitrarily large relative to consumption. It is also natural to assume $\psi' > 0$. Existence and uniqueness of equilibrium may depend on further restrictions on the form of ψ, which we will discuss further below.

The two constraints in (16) are, first, a statement that there is no such thing as negative money, and, second, a borrowing constraint. Even if the government does lend to the public, we assume it does insofar as the loan is backed by money holdings. While this form of the constraint is somewhat arbitrary, some such constraint, bounding borrowing, is required to make the consumers' problem well-defined.

To keep the model very simple, we assume the endowment stream Y is constant.

Note that the government budget constraint (8) and (15) together imply the social resource constraint

$$C \cdot (1 + \psi(V)) \leq Y \,. \tag{18}$$

Thus, if it could be arranged, it would be optimal to set $V = 0$ — i.e. to saturate the economy with money. Money balances in fact consume no resources, yet they provide transactions services. However, in any equilibrium with valued money, individuals perceive that they are sacrificing current consumption in refraining from consuming their money balances. This is an externality that cannot be removed. It can be made small by policies that make the real rate of return on money approach the discount rate β. This would require negative inflation rates. Our interest here, though, is not in optimal policy for this unrealistic model. It is in using this easily analyzed, simple model as a guide to understanding more realistic models in which positive inflation rates are the focus.

The first order conditions for an optimum for an agent maximizing (14) subject to (15) and (17) are, assuming an interior solution,

$$\partial C: \qquad U' = \lambda \cdot (1 + \psi' \cdot V + \psi) \tag{19}$$

$$\partial B: \qquad -\frac{\dot{\lambda}}{P} + \frac{\lambda \dot{P}}{P^2} + \frac{\lambda\beta}{P} = r\frac{\lambda}{P} \tag{20}$$

$$\partial M: \qquad -\frac{\dot{\lambda}}{P} + \frac{\lambda \dot{P}}{P^2} + \frac{\lambda\beta}{P} = \lambda\psi'\frac{V^2}{P} \,. \tag{21}$$

Equating the right-hand sides of (20) and (21) gives us the usual liquidity preference function

$$r = \psi' \cdot V^2 \,. \tag{22}$$

We can simplify (20) to the form

$$-\frac{\dot{\lambda}}{\lambda} = r - \beta - \frac{\dot{P}}{P} \,. \tag{23}$$

We can now collect a set of 6 equations in the six variables C, P, M, V, r, τ and b. The equations are (17), (8), (13) or (12), (10) or (11), (22), (23) and (18). Note that just two of these, (8) and (23), are differential equations, so that in principle the system can be reduced to a two-dimensional differential equation system.

In order to gain insight into how the system behaves, we specialize to the case of CRRA utility, i.e.

$$U(C) = \frac{C^{1-\gamma}}{1-\gamma} \tag{24}$$

and a particular choice of ψ, starting with $\psi(V) = \kappa V$. Consider first the case of fixed-M monetary policy, given by (12), accompanied by one of the fiscal policies (10) or (11) with $\phi_1 > \beta$. Our simplifications let us rewrite (23) as

$$\gamma\frac{\dot{C}}{C} + \frac{2\kappa\dot{V}}{1+2\kappa V} = \kappa V^2 - \beta - \frac{\dot{P}}{P} \,. \tag{25}$$

The social resource constraint (18) (with Y constant) lets us conclude that

$$\frac{\dot{C}}{C} = -\frac{\kappa\dot{V}}{1+\kappa V} \,, \tag{26}$$

and the definition of V together with the constancy of M (17) gives us

$$\frac{\dot{P}}{P} = \frac{\dot{V}}{V} - \frac{\dot{C}}{C} \,. \tag{27}$$

Using these relations in (25) produces

$$\frac{\dot{V}}{V}\left(1 + \frac{(1-\gamma)\kappa V}{1+\kappa V} + \frac{2\kappa V}{1+2\kappa V}\right) = \kappa V^2 - \beta \,. \tag{28}$$

So long as $\gamma \leq 3$, the expression in the large parenthesis in (28) is always positive. Thus in this case V has a unique, unstable, fixed point at $V = \bar{V} = \sqrt{\beta/\kappa}$. If at some initial date $t = 0$ we had $V(0) < \bar{V}$, $\dot{V}(0)$ would be negative, and V would drop toward zero. As V approached zero, $\dot{V}/V$ would approach $-\beta$. But with V approaching zero, C would have to approach Y (by the SRC (18)), and since M is constant, the only way for V to be approaching zero then is for P to approach zero. This would imply $M/P \to \infty$.

Under the fiscal policy (10) with $\phi_1 > \rho$, the real government budget constraint (8), with τ substituted out and using the fact that $\dot{M} = 0$, becomes

$$\dot{b} = -(\phi_1 - \rho)b + \phi_0 \, . \tag{29}$$

This equation is stable in b, so along any equilibrium path b is bounded. Thus the fact that if $P \to 0$, $M/P \to \infty$ implies that consumer net worth goes to infinity. This is incompatible with consumer optimization if (as it must) C remains bounded.

But if instead fiscal policy is given by (11), we can rewrite the government budget constraint (9), substituting out τ with the fiscal policy rule and r with the liquidity preference relation (22), as

$$\dot{b} + \dot{m} = -(\phi_1 - \rho)(b + m) + \phi_0 - \kappa \frac{C^2}{m} \, . \tag{30}$$

The boundedness of C and the fixity of M imply that as $P \to 0$, the last term in (30) also goes to zero, leaving the behavior of $b + m$ determined by a stable linear differential equation. Thus $b + m$ remains bounded even though $m \to \infty$. This can occur, because government can use primary surpluses to make b negative by purchasing private assets and lending to the public. But then the net worth of the representative consumer remains bounded, and paths with P approaching zero violate no transversality condition of private agents.

If initially $V(0) > \bar{V}$, $\dot{V}(0) > 0$, and V would increase without bound. By the social resource constraint (18), this would imply C shrinking toward zero and thus $P \to \infty$ very rapidly. It turns out that not only does $V \to \infty$, it increases so rapidly that it reaches ∞ in finite time. A plot of a typical time path, with $\gamma = 2$, $\kappa = .01$, $\beta = .05$, $V(0) = \sqrt{\beta/\gamma} + .1$ is displayed in Figure 1. There are no apparent incentives for individuals to trade so as to undermine the equilibrium represented by this path of V, despite the fact that it ends in finite time. At the end of the path, real balances have disappeared and the economy has been reduced to barter. This reduces C to zero, and utility either to 0 (if $0 < \gamma < 1$) or to $-\infty$ (if $\gamma \geq 1$), but it is not physically unsustainable. Thus if we maintain the assumption that fiscal policy sticks to its passive form (10) with $\phi_1 > \beta$, the initial price level is indeterminate. A fully credible commitment by the monetary authority to keep M constant cannot prevent an equilibrium in which inflation accelerates so rapidly as to make real balances disappear in finite time.

A different situation arises if $\gamma > 3$. Then the term in the large parenthesis in (28) becomes negative for V above some critical value $\bar{\bar{V}}$. If $V(0) > \bar{\bar{V}}$, V decreases rapidly toward $\bar{\bar{V}}$. If $V(0) < \bar{\bar{V}}$, V increases rapidly, reaching $\bar{\bar{V}}$ in finite time. A plot of such a path appears in Figure 2. These solutions to (28) cannot be equilibria of the economy, however. At the time, say $t = T$, at which V reaches $\bar{\bar{V}}$, $\dot{V}(T) = \infty$

is required to make individuals satisfied with real balances as small as implied by this high level of V. But if V actually continues growing, it crosses into the region in which $\dot{V}$, and hence $\dot{P}$, becomes negative. So V cannot in fact grow, and thus in turn P cannot grow as fast as required. This reverses the growth of P, and if this reversal is anticipated, it creates an incentive to speculation that will undermine any potential equilibrium that begins with $V(0) > \bar{V}$. Thus with $\gamma > 3$, there is a unique equilibrium $P(0)$, given by

$$\bar{P} = (1 + \kappa\bar{V})\frac{\bar{M}\bar{V}}{Y} \,. \tag{31}$$

The drastic behavior of the economy when $V(0) > \bar{V}$ in these examples depends on the fact that they assume transactions costs are capable of driving C to zero, while Y remains constant.[8] Under the more moderate assumption that there is a non-zero level of C attainable with $M/P = 0$, we get different results. For example, if

$$\psi(V) = \frac{\kappa V}{1 + V} \,, \tag{32}$$

the analogue of equation (28) becomes

$$\frac{\dot{V}}{V} \cdot \left(1 + \frac{\kappa V}{(1+V)(1+(1+\kappa)V)} + \frac{2\kappa V}{(1+V)(1-\kappa+2V+(1+\kappa)V^2)}\right) = \frac{\kappa V^2}{(1+V)^2} - \beta \,. \tag{33}$$

As can be seen from the right-hand side of (33), there will be no steady-state value of V in this economy if $\kappa < \beta$, i.e. if transactions costs are a small fraction of output in barter equilibrium, so money is not very important to the economy. For large γ and κ, the term in the large parenthesis in (33) may change signs at some positive value of V, which makes analysis of the economy's behavior complicated. But at levels of risk aversion γ usually taken to be realistic, there is a single steady state $\bar{V}$ for V. Values of $V(0)$ less than $\bar{V}$ imply steady shrinkage of V toward zero, which is inconsistent with optimizing behavior just as in the case with $\psi(V) = \kappa V$ that we have already discussed. Values of $V(0)$ above $\bar{V}$, however, now lead to steady growth of V (and therefore also P), with the exponential growth rate eventually approaching $\kappa - \beta$. Thus the economy smoothly approaches barter equilibrium as real balances shrink

[8]More precisely, the drastic behavior arises from the insufficiently rapid rate of decline of ψ' as $V \to \infty$. The distinction between economies that can smoothly approach $V = 0$ over an infinite time span and those in which upward-explosive paths for V are either unsustainable as equilibria or last a finite time is only approximately the distinction between economies with and without barter equilibria.

toward zero over an infinite time span. This occurs without galloping inflation—just a steady, possibly (if $\kappa - \beta$ is small) even slow, inflation that eats away at the value of real balances. Since this is true whatever the initial value of V, the initial price level is indeterminate, regardless of which of the two fiscal rules (10) or (11) is being followed.

No such cases of price level indeterminacy arise if monetary policy, instead of fixing M, fixes $r = \bar{r}$, while fiscal policy, instead of making τ respond to b, fixes $\tau = \bar{\tau}$. Then the fixed-r policy fixes V at a constant level by the liquidity preference relation (22).[9] Then the social resource constraint (18) determines a constant C and the definition of V (17) in turn fixes a constant level of real balances $M/P = \bar{m}$. The first-order conditions (23) and (19), together with the constancy of C and V, imply that the inflation rate $\dot{P}/P$ is constant at $\bar{r} - \beta$. This means that we can write the government budget constraint (9) as

$$\dot{b} = \beta b - (\bar{\tau} + (\bar{r} - \beta)\bar{m}) . \tag{34}$$

This is an unstable equation in b, with the unique constant solution

$$b = \bar{b} = \frac{\bar{\tau} + (\bar{r} - \beta)\bar{m}}{\beta} . \tag{35}$$

Given the initial $B(0)$, this unique b determines a unique initial $P(0)$, which will in equilibrium remain constant.

Ruling out the unstable solutions to (34) requires assuring ourselves that explosively increasing or decreasing b is not consistent with equilibrium. The explosively increasing solutions are ruled out by the fact that they would require individuals to maintain constant consumption despite unboundedly large real wealth (including the negative component of wealth from anticipated future taxes, which here remains constant). This cannot be optimal, and if individuals thought they were starting on such a path, they would try to increase their consumption, thereby raising the price level and bringing initial b back toward $\bar{b}$.

Explosively decreasing solutions would require b at some point to become less than m, though we have assumed that individuals know that they are constrained not to borrow more than this from the government. Individuals would see such paths as infeasible, therefore. They would involve projecting constant consumption despite the fact that the individual's income and wealth are not sufficient to sustain the constant level of consumption. An individual who thought he was starting down such a path

[9] Note, though, that there will be an upper bound on feasible r's, given by κ. An attempt to set $\bar{r} > \kappa$ in this model leads to nonexistence. The fixed-M policy leads to non-existence when the equilibrium r it requires, which is $r = \beta$, is too high relative to κ.

would cut back consumption in an attempt to get back on a sustainable path, and this would tend to reduce prices and bring $b(0)$ back up toward $\bar{b}$.

That this model produces much better results from a policy of $r \equiv \bar{r}$, $\tau \equiv \bar{\tau}$ than from conventionally "responsible" policies that set $M \equiv \bar{M}$ and make τ respond to the level of real debt does not mean that the conventional policies are wrong. Uniqueness of equilibrium can be attained with conventional policies if they are understood as nonlinear, so that at very high or low price levels policy would change. The equilibria with explosive inflation can be eliminated by a "backstop" fiscal policy of taxing to guarantee some minimum real value for government nominal liabilities. Furthermore, once such a backstop policy is in place and understood by the public, it is never invoked in equilibrium.

The cases of non-existence of equilibrium with fixed M that arise with low κ in our example with bounded ψ can be eliminated by a policy that commits to cutting the interest rate to a fixed level less than κ if real balances reach some high trigger level. The switch in monetary policy of course would have to be accompanied by a corresponding switch in fiscal policy. In this kind of deflationary scenario, the switch would involve committing not to further increase taxes if deflation created further rises in b. This is not really a "backstop" policy, however, since instead of eliminating the bad behavior of the economy without ever being invoked in equilibrium, it does so by being invoked with certainty.

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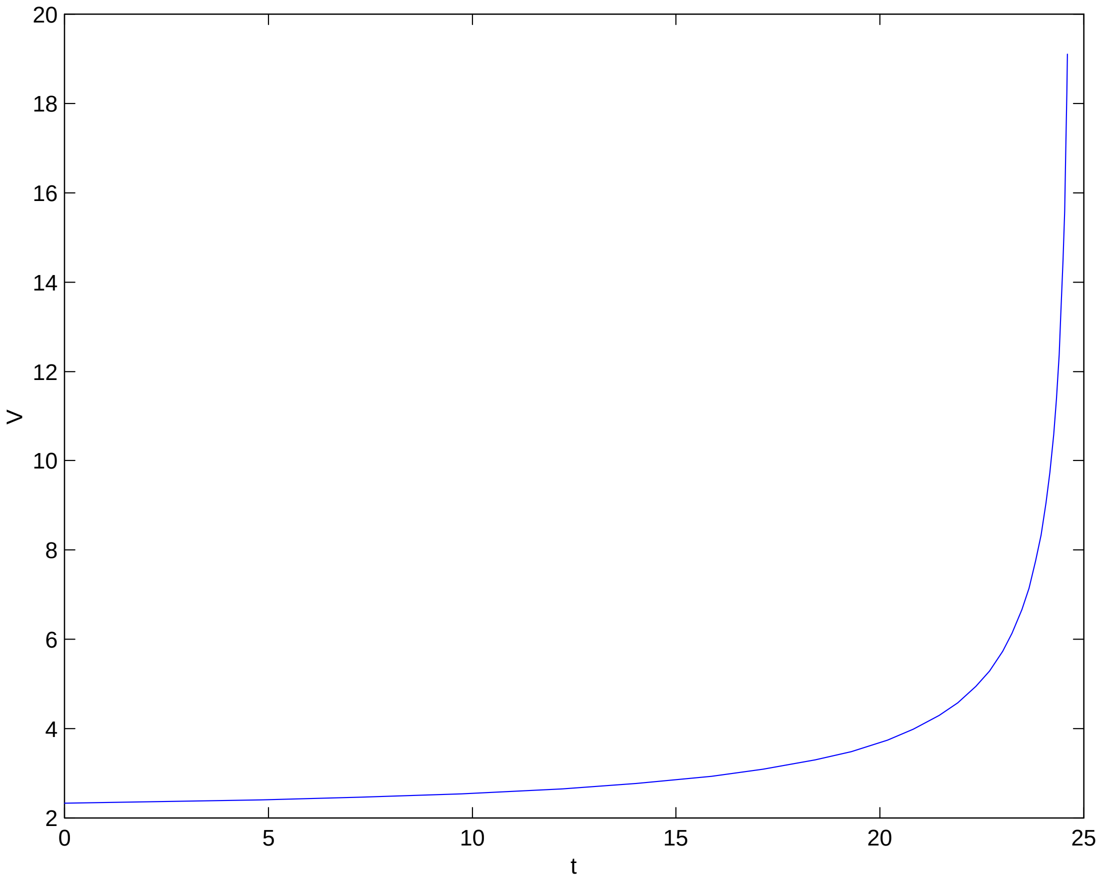

Figure 1. Time Path of V with $\gamma = 2$

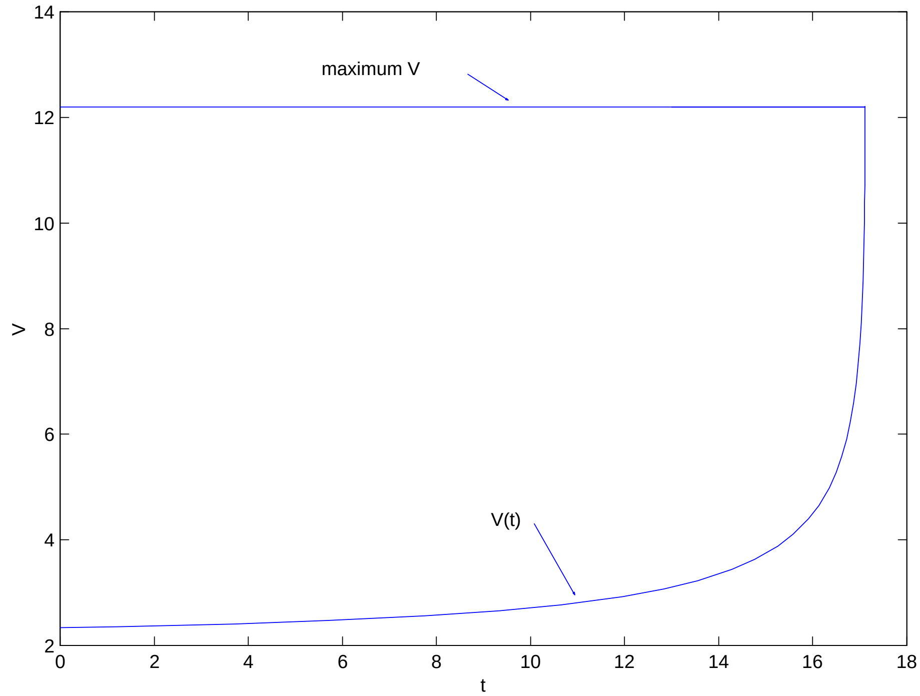

FIGURE 2. Time Path of V with $\gamma = 5$