

Fiscal Solvency and Price Level Determination in a Monetary Union

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Abstract:

This paper applies the fiscal theory of price level determination to the case of a monetary union. A fiscal perspective suggests, first, that the focus of past studies on seigniorage, per se, may be misplaced. Second, a rise in the level of debt by one member government can raise the common price level throughout the union, suggesting a role for fiscal rules. Third, conditions are discussed under which fiscal solvency is not necessary for each member government in a monetary union.

Key words: monetary union, fiscal theory of the price level, fiscal rules

JEL classification: E31; E63; F36

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1. Introduction

Recent literature on price level determination has emphasized the role of fiscal policy. A fiscal theory of the price level has been developed in Leeper (1991), Sims (1994) and Woodford (1994 and 1995), and this has been extended to a various international contexts in Neumeyer and Yano (1996), Woodford (1996), Dupor (1997), and Sims (1997).¹ The purpose of this paper is to apply the fiscal theory to the case of a monetary union. This provides an interesting context for studying the fiscal theory, in that a monetary union implies that a common price level prevails among multiple nations with multiple fiscal policies.

A monetary union is also a particularly relevant context for studying the fiscal theory. A prominent hindrance in the development of the European Monetary Union has been various restrictions on national debts and deficits. These fiscal restrictions were justified politically on the grounds that large government debts might threaten the primary objective of price stability. However, there has been surprisingly little careful thinking about how government debt might be linked to the equilibrium price level in a monetary union. This paper contributes toward filling this gap.

There is already a well-developed literature analyzing certain types of interactions between monetary and fiscal policies in a monetary union. Canzoneri and Diba (1991), Sibert (1992 and 1994), and most recently Chari and Kehoe (1997) have demonstrated how a monetary union creates new incentives for national governments to increase debt as a means to acquire seigniorage revenue from the common central bank. While this literature is useful for characterizing the strategic interactions between fiscal and monetary authorities, it does not focus on the linkage between the increase in debt and the equilibrium price level. The fiscal theory is useful for characterizing this link, and this will be the focus of the present paper.

¹ Other discussions of the fiscal theory include Leeper (1993), Canzoneri, Cumby and Diba (1997), McCallum (1998), Schmitt-Grohé and Uribe (1997), and Cochrane (1998a and 1998b).

The fiscal theory suggests that the price level is determined by the need to set a real value for nominal household wealth that is consistent with equilibrium. The household intertemporal budget constraint then is regarded as the condition that determines the equilibrium price level. In a closed economy, this condition for the household is identical to the intertemporal budget constraint for the government. In a monetary union, however, there are multiple household budget constraints that must be satisfied in equilibrium, and there is no longer a direct correspondence between the household and government budget constraint in each country. Nevertheless, the government budget constraints together still can be viewed as jointly determining the price level.

One implication of the fiscal theory is that even if seigniorage is small, the inflation tax on nominal bonds may be large if member governments have large debts. This suggests the focus by preceding literature on the issue of seigniorage may have been misplaced.

A second implication is that because the price level is determined jointly by the budget constraints of member governments, a rise in debt unbacked by future taxes of just one member government has the ability to raise the price level throughout the monetary union. This suggests a motivation for fiscal rules limiting debts of member governments.

A third implication is that fiscal solvency of all member governments is not strictly necessary to maintain a stable price level. This results from the ability of one government's surplus to offset another's debt, and is a feature not observed in a single-country setting. However, this conclusion requires strong assumptions about international risk sharing. Further, because the fiscal theory focuses on household wealth rather than government debt per se, to guarantee an equilibrium with a stable price level, we must also consider the distribution of private wealth between countries.

The paper is organized as follows. The next section develops a simple model of a two-country monetary union. Section three draws several basic conclusions from examining the

intertemporal budget constraints in this model. Section four develops examples to illustrate implications for the equilibrium price level.

2. The Model

This section constructs a simple framework for analyzing a hypothetical monetary union, in which two distinct countries share a common central bank. One notable element is that households are not assumed to be able to insure perfectly against asymmetric shocks.² Recent research has highlighted the apparent lack of international risk sharing.³ Further, the perfect insurance assumption would severely limit the international character of the present model, in that it would blur the distinction between households across national borders.

Country one is populated by an infinitely-lived representative household, receiving a stochastic endowment of y_{1t} units of the common consumption good each period. The household chooses in period t a level of consumption, c_{1t} , nominal holdings of the common money, M_{1t} , and nominal bond holdings, B_{1t} . Bonds have gross nominal return, R_t . Real money balances, m_{1t} , are defined as the ratio of nominal money holdings to the common price level, p_t . The household pays τ_{1t} units of the consumption good in lump-sum taxes each period. Utility is discounted at the rate β .

The household solves the following problem:

$$\begin{aligned} \max \quad & E_0 \sum_{t=0}^{\infty} \beta^t U \left(c_{1t}, \frac{M_{1t}}{p_t} \right) \\ \text{s.t.} \quad & c_{1t} + \frac{M_{1t}}{p_t} + \frac{B_{1t}}{p_t} + \tau_{1t} = y_{1t} + \frac{M_{1t-1}}{p_t} + R_{t-1} \frac{B_{1t-1}}{p_t} \\ \text{where} \quad & M_{1t} \geq 0, c_{1t} \geq 0 \end{aligned} \tag{1}$$

Note that there is no non-negativity restriction on the level of household holdings of bonds. However, there is a non-negativity restriction on money, since this may be issued only by the

² This is in contrast to Woodford (1996).

³ See Baxter and Jermann (1997).

government in the present model. Negative consumption is ruled out as nonsensical.

Optimizing behavior requires households plan to fully utilize their lifetime wealth. This is summarized in the transversality condition:

$$\lim_{T \rightarrow \infty} \left(\prod_{j=t}^{T-1} R_j^{-1} \right) W_{1T} = 0 \quad (2)$$

where nominal beginning of period wealth is defined:

$$W_{1t} = R_{t-1} B_{1t-1} + M_{1t-1} \quad (3)$$

Violating (2) would contradict the assumption of optimizing behavior by households, by implying they could increase lifetime utility by consuming a portion of their unused wealth.⁴

If the single-period budget constraints for each period are summed over the infinite horizon, and we impose the transversality condition above, the result is the following household intertemporal budget constraint:

$$\frac{W_{1t}}{p_t} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) \left[c_{1s} + \tau_{1s} - y_{1s} + \frac{R_s - 1}{R_s} m_{1s} \right] \quad (4)$$

The real rate of return on bonds is represented by $r_t = R_t (p_t/p_{t+1})$.

The household optimization problem also implies the conditions:

$$U_{c_{1,t}} = \left(\frac{R_t}{R_t - 1} \right) U_{m_{1,t}} \quad (5)$$

$$U_{c_{1,t}} = \beta R_t E_t \left[\frac{p_t}{p_{t+1}} U_{c_{1,t+1}} \right] \quad (6)$$

⁴ More precisely, optimization implies a one-sided inequality: $\lim_{T \rightarrow \infty} \left(\prod_{j=0}^{T-1} R_j^{-1} \right) W_{1T} \leq 0$. For the optimization problem to have a well-defined budget set, it is necessary to impose the constraint that households not accumulate debt beyond their ability to pay back eventually: $\lim_{T \rightarrow \infty} \left(\prod_{j=0}^{T-1} R_j^{-1} \right) W_{1T} \geq 0$. Combining this no-Ponzi condition with the inequality above produces the transversality condition presented in the text.

The household of country two faces an analogous problem, with corresponding intertemporal budget constraint and optimality conditions.

Now consider each of the two national governments. They have no control over the creation of money, but they do have control over direct lump-sum taxes. In country one, for example, taxes (τ_{1t}) along with real transfers from the common central bank (v_{1t}) and issues of nominal government debt (D_{1t}) are used to finance the constant level of real government purchases each period (\bar{g}_1), all subject to the following budget constraint:

$$\bar{g}_1 + R_{t-1} \left(\frac{D_{1t-1}}{p_t} \right) = \tau_{1t} + v_{1t} + \left(\frac{D_{1t}}{p_t} \right) \quad (7)$$

An analogous condition applies to the government of country two.

The common central bank is distinct from each of the national governments. It can control the issue of new money, M_t , through open market purchases of bonds, B_{mt} . The central bank does not issue debt itself, nor does it levy taxes. It has operating expenditures, g_{mt} . As suggested by the charter of the European Central Bank, the common central bank here is modeled as returning its interest income back to the national governments, in the form of rebates v_{1t} and v_{2t} . The central bank's budget constraint is as follows:

$$\frac{B_{mt}}{p_t} + v_{1t} + v_{2t} + g_{mt} = R_{t-1} \left(\frac{B_{mt-1}}{p_t} \right) + \frac{M_t - M_{t-1}}{p_t} \quad (8)$$

It will be assumed that rebates are divided symmetrically between the two fiscal governments

$$v_{1t} = \frac{1}{2} (R_{t-1} - 1) \left(\frac{B_{mt-1}}{p_t} \right) \quad (9)$$

$$v_{2t} = v_{1t} \quad (10)$$

Finally, market clearing in the goods, money and bond markets require:

$$c_{1t} + c_{2t} + \bar{g}_1 + \bar{g}_2 + g_{mt} = y_{1t} + y_{2t} \quad (11)$$

$$M_{1t} + M_{2t} = M_t \quad (12)$$

$$B_{1t} + B_{2t} + B_{mt} = D_{1t} + D_{2t} \quad (13)$$

3. Fiscal Solvency and Household Transversality

A rational expectations equilibrium is here a collection of sequences $\{p_t, R_t, c_{1t}, c_{2t}, B_{1t}, B_{2t}, B_{mt}, D_{1t}, D_{2t}, M_{1t}, M_{2t}, M_t, \tau_{1t}, \tau_{2t}, v_{1t}, v_{2t}, g_{mt}, y_{1t}, y_{2t}\}$ that is consistent with 19 equilibrium conditions. These include the household intertemporal budget constraint (4) and its foreign counterpart, or equivalently, the household transversality condition in combination with the flow budget constraint (and foreign counterparts). Other equilibrium conditions are the fiscal policies of each fiscal government, the monetary policy of the common central bank, the two household optimality conditions (5 and 6) and foreign counterparts, the government flow budget constraint (7) and foreign counterpart, the budget constraint of the common central bank (8), the rebate allocation rules (9 and 10), market clearing for goods and money (11 and 12), and the exogenous sequence for outputs in the two countries and central bank expenditures (as well as the non-negativity restrictions).

Note first that the household intertemporal budget constraint (4) treats bonds and money equally as elements of nominal wealth. If price rises, the inflation tax paid by the home household would cover holdings of bonds as well as money, and would equal the left-hand side of (4) multiplied by the inflation rate. A common rationale to dismiss the fiscal implications of monetary union is to note that seigniorage is typically very small. But consider for the moment a case where the national governments receive no seigniorage nor any income from the central bank; that is, let $g_{mt} = \frac{M_t - M_{t-1}}{p_t}$ and $B_{mt} = v_{1t} = v_{2t} = 0$ for all t . Government one still benefits from an inflation tax, equal to $\frac{p_{t+1} - p_t}{p_t} D_{1t}$, which may be large for governments

with large nominal debt. Consequently, a high level of debt can create an incentive for national governments to lobby for inflation, regardless of the issue of seigniorage. This suggests that the focus of preceding monetary union research on the issue of seigniorage may have been misplaced.

Notice that while the household intertemporal budget constraints are necessary for equilibrium, no government intertemporal budget constraint or solvency condition is listed above as a necessary condition. Such a solvency condition for the government of country one would state that the present value of real outstanding government debt go to zero in the limit:

$$\lim_{T \rightarrow \infty} \left(\prod_{j=t}^{T-1} R_j^{-1} \right) D_{1T} = 0 \quad (14)$$

This solvency condition would imply a government intertemporal budget constraint, requiring the present discounted value of future tax and seigniorage revenues to cover expenditures and allow the government to pay back its outstanding debt:

$$R_{t-1} \left(\frac{D_{1t-1}}{p_t} \right) = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) [\tau_{1s} - \bar{g}_1 + v_{1s}] \quad (15)$$

The analogous intertemporal budget constraint for government two would be:

$$R_{t-1} \left(\frac{D_{2t-1}}{p_t} \right) = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) [\tau_{2s} - \bar{g}_2 + v_{2s}] \quad (16)$$

The common central bank then also would have an analogous condition, concerning the issue of currency and the disbursement of income earned from its holdings of debt issued by the national governments:

$$\frac{M_{t-1} - R_{t-1} B_{mt-1}}{p_t} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) \left[\frac{R_s - 1}{R_s} m_s - v_{1s} - v_{2s} - g_{ms} \right] \quad (17)$$

These three intertemporal government constraints are not explicit in the list of necessary conditions for equilibrium, but they are nevertheless implied in consolidated form. If the

household intertemporal budget constraint of country one (4) is summed with the analogous condition for the household in country two:

$$\frac{W_{2t}}{p_t} = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) \left[c_{2s} + \tau_{2s} - y_{2s} + \frac{R_s - 1}{R_s} m_{2s} \right] \quad (18)$$

the result is a condition that equals the sum of the intertemporal conditions for the three government entities (15, 16, and 17):

$$\left(\frac{R_{t-1} (B_{1t-1} + B_{2t-1}) + M_{t-1}}{p_t} \right) = \sum_{s=t}^{\infty} \left(\prod_{j=t}^{s-1} r_j^{-1} \right) \left[c_{1s} + c_{2s} + \tau_{1s} + \tau_{2s} - y_{1s} - y_{2s} + \frac{R_s - 1}{R_s} m_s \right] \quad (19)$$

where market-clearing conditions have been used to simplify terms.

In a one-country model, the household intertemporal budget constraint would be identical to the consolidated government intertemporal budget constraint, and government solvency would indeed be required for an equilibrium. However, in a monetary union, these solvency conditions appear in a form that consolidates and then divides them along different lines, by household rather than by government. This has several implications for equilibrium.

First, it is not strictly necessary in an equilibrium that each government be solvent. As has been pointed out by Woodford (1996), if one government is insolvent because it has a debt growing at a rate greater than the interest rate, this need not violate equilibrium if the other government has assets growing at the same rate. In other words, if the second government purchases the expanding debt of the first indefinitely, there is no net effect on the household intertemporal budget constraints, and thus no violation of the equilibrium conditions.

However, by buying limitless amounts of debt without eventual repayment, the second government in effect would be transferring wealth abroad at the expense of its own citizens. This is not problematic if one assumes perfect insurance between home and foreign house-

holds, as in Woodford (1996). Insurance payments would then offset the effects of any such transfer and maintain a constant wealth distribution. While the assumption of perfect insurance is convenient for solving the model, it conceals the fact that home and foreign households are distinct entities with distinct interests, a fact central to much of international economics. Sims (1997) points out that the political economy of such an equilibrium would be unsustainable under imperfect insurance. This point is taken up further in a later section.

Further, once any attempt is made to justify such a government policy in terms of some government objective, government optimization would introduce a corresponding transversality condition. This would imply the set of three distinct government intertemporal budget constraints listed previously as necessary conditions for equilibrium. It may be argued that we do in fact observe significant transfers of wealth from rich members of the European Union to poorer members. But the case of direct transfers such as these can be consistent with a set of government transversality conditions, unlike the case of limitless purchases of debt never to be repaid.

A second implication of this model is that apart from government debt, equilibrium requires conditions on the distribution of private wealth between countries. This results from the fact that each of the two household intertemporal budget constraints is listed separately as a necessary condition for equilibrium. Suppose households of one country become indebted to those of the other country to a point that, for one reason or another, the debt is not expected to be repaid in present value out of future disposable income. It is not sufficient that the private sector as a whole in the monetary union would be solvent. Such a condition, often called "external imbalance," would violate each of the household transversality conditions taken separately.

4. Some Examples

The intertemporal budget constraints analyzed above have a significance beyond their role as

necessary conditions for equilibrium; it is often useful to regard them as the conditions that determine the equilibrium price level. Some implications for the price level can be demonstrated by considering an example. Consider a quadratic utility function for households in country one:

$$U(c_{1t}, m_{1t}) = \left(c_{1t} - \frac{a}{2}c_{1t}^2\right) + \gamma \left(m_{1t} - \frac{b}{2}m_{1t}^2\right) \quad (20)$$

where $c_{1t} < \frac{1}{a}$ and $m_{1t} < \frac{1}{b}$ for all t ⁵. The optimality conditions (5 and 6) then become:

$$(1 - ac_{1t}) = \gamma \left(\frac{R_t}{R_t - 1}\right) (1 - bm_{1t}) \quad (21)$$

$$(1 - ac_{1t}) = \beta R_t E_t \left[\frac{p_t}{p_{t+1}} (1 - ac_{1t+1}) \right] \quad (22)$$

To highlight the role of imperfect insurance, consider the presence of transitory asymmetric output shocks. For simplicity, suppose these are offsetting across countries, so that there are no shocks to aggregate output:

$$y_{1t} = \bar{y}_1 + \varepsilon_t \quad (23)$$

$$y_{2t} = \bar{y}_2 - \varepsilon_t \quad (24)$$

$$\varepsilon_t \sim N(0, \sigma^2) \quad (25)$$

4.1 Case 1: One Bad Apple

It first will be demonstrated that fiscal irresponsibility by just one government can lead to a rise

⁵ The satiation point is assumed to be sufficiently far away so as to not interfere with the transversality arguments made later.

in the price level throughout the monetary union. Suppose that the government in country two is "fiscally responsible" in the following sense: it adjusts taxes, τ_{2s} , as necessary to guarantee its own solvency and satisfy (16) for any given value of central bank rebates, v_{2s} . On the other hand, suppose government one adopts a fiscal policy that pegs its tax at a given level, $\tau_{1s} = \bar{\tau}_1$, for each period s after the initial period t . This policy is regarded as "irresponsible," inasmuch as the government cannot guarantee its own solvency. Next suppose a monetary policy in which the common central bank pegs the nominal interest rate $R_t = \bar{R}$.⁶ For simplicity, suppose a constant level of operating expenditures for the central bank, $g_{mt} = \bar{g}_m$.

If linearized around a symmetric, deterministic steady state and considered under the monetary policy rule, the ex-ante form of the household intertemporal budget constraint in country one (4) may be written:

$$\begin{aligned} \frac{\widetilde{W}_{1t}}{\bar{W}_1} - \frac{\widetilde{p}_t}{\bar{p}} &= \left(\frac{\bar{W}_1}{\bar{p}} \right)^{-1} E_t \sum_{s=t}^{\infty} \beta^{s-t} [(\widetilde{c}_{1s} + \widetilde{\tau}_{1s} + (1 - \beta) \widetilde{m}_{1s} - \widetilde{y}_{1s}) \\ &\quad + (1 - \beta) \left(\frac{\bar{W}_1}{\bar{p}} \right) \sum_{j=t}^{s-1} \left(\frac{\widetilde{p}_{j+1}}{\bar{p}} - \frac{\widetilde{p}_j}{\bar{p}} \right)] \end{aligned} \quad (26)$$

where overbars indicate steady state values, and tildes indicate deviations in levels from steady state. If we use the linearized form of the money demand optimality condition (21), \widetilde{m}_t may be written in terms of \widetilde{c}_t for each period. Then using the linearized intertemporal optimality condition (22), which expresses $E_t(\widetilde{c}_s)$ for $s > t$ as a function of \widetilde{c}_t , it is possible to solve recursively for current consumption: (See the appendix for details.)

$$\widetilde{c}_{1t} = \bar{\Phi} \left[\frac{\bar{W}_1}{\bar{p}} \left(\frac{\widetilde{W}_{1t}}{\bar{W}_1} - \frac{\widetilde{p}_t}{\bar{p}} \right) + E_t \sum_{s=t}^{\infty} \beta^{s-t} (\widetilde{y}_{1s} - \widetilde{\tau}_{1s}) \right] \quad (27)$$

⁶ This reaction function could be viewed as arising from an optimizing central bank that has strong preferences for interest rate smoothing, as discussed in Barro (1989).

where

$$\bar{\Phi} = (1 - \beta) \left(1 + \frac{a}{b\gamma} (1 - \beta)^2 \right)^{-1}$$

This condition states that changes in consumption are a function of changes in the household's expected intertemporal wealth, which is comprised of initial holdings of assets as well as the present discounted value of output net of taxes. In summary, the consumption decision is influenced by the relationship between outstanding government debt and anticipated future tax obligations.

To find the equilibrium, we sum the consumption functions of both countries (27 and its foreign counterpart), and impose the goods market clearing condition that joint consumption is constant. This produces:

$$\frac{\tilde{p}_t}{\bar{p}} = \frac{\tilde{W}_t}{\bar{W}} - \left(\frac{\bar{W}}{\bar{p}} \right)^{-1} E_t \sum_{s=t}^{\infty} \beta^{s-t} (\tilde{\tau}_{1s} + \tilde{\tau}_{2s}) \quad (28)$$

where $W_t = W_{1t} + W_{2t}$, and likewise for steady state values.

Imposing the fiscal rules stated above for $\tilde{\tau}_{1s}$ and $\tilde{\tau}_{2s}$, and assuming that the economy starts at steady state in period $t - 1$, the percent change in the price level in the period of the shock, t , may be written:

$$\frac{\tilde{p}_t}{\bar{p}} = - \left(\frac{\bar{W}_1}{\bar{p}} \right)^{-1} \tilde{\tau}_{1t} \quad (29)$$

(See the appendix for details.) Consider an experiment in which the government of country one temporarily lowers taxes in period t , holding taxes fixed for periods $s > t$ as specified by the fiscal rule above. Condition (29) suggests the percentage rise in the price level will be proportional to the fall in taxes, the proportion depending on the initial wealth of the household in country one. The consumption function (27) suggests the following interpretation.⁷ Without a

⁷ This argument is outlined in Woodford (1996).

price level rise, household wealth would rise in country one. Since the corresponding condition suggests consumption in household two would not fall, overall there would be excess demand in the goods market. A rise in the price level is needed to lower the real value of wealth to be consistent with goods market equilibrium.

Using the flow budget constraint of government one (7) and the definition of central bank rebates (9), condition (29) may also be written:

$$\frac{\tilde{p}_t}{\bar{p}} = \frac{\tilde{D}_{1t}}{\bar{D}_1} \quad (30)$$

This states that under the preceding assumptions, the percent rise in price would equal the percent rise in outstanding debt of the fiscally "irresponsible" government. This makes clear that a rise in government debt in one country can lead directly to a rise in the overall price level throughout the monetary union.

Since consumption in country one is derived above using the household intertemporal budget constraint (26), it is simple to verify that this budget constraint holds not only jointly with the foreign counterpart, but also separately as required for equilibrium. The foreign counterpart must residually hold separately as well.

4.2 Case 2: Maastricht Scenario

If the common central bank wishes to maintain price stability as its sole objective, it could specify the monetary policy rule $\tilde{p}_t = 0$. Under this policy rule, it can be shown that the deviations in the nominal interest rate will be zero for all periods, and the household intertemporal budget constraint in country one (4) may be written:

$$\frac{\tilde{W}_{1t}}{\bar{W}_1} = \left(\frac{\bar{W}_1}{\bar{p}} \right)^{-1} E_t \left[\sum_{s=t}^{\infty} \beta^{s-t} (\tilde{c}_{1s} + \tilde{\tau}_{1s} + (1 - \beta) \tilde{m}_{1s} - \tilde{y}_{1s}) \right] \quad (31)$$

As in case 1 above, the Euler conditions may be used to substitute out money and solve

recursively for consumption, and the consumption equations may be summed over both households and the goods market-clearing condition imposed. Note that since changes in total consumption and hence real money holdings are zero, under the current monetary policy rule so are changes in nominal money and hence central bank holdings of government debt. The result is:

$$\frac{1}{\beta} \left(\tilde{D}_{1t-1} + \tilde{D}_{2t-1} \right) = \left(\frac{\overline{W}}{\overline{p}} \right)^{-1} E_t \sum_{s=t}^{\infty} \beta^{s-t} (\tilde{\tau}_{1s} + \tilde{\tau}_{2s}) \quad (32)$$

This condition requires that the two national governments be jointly fiscally responsible, as defined previously. Any change in the sum of outstanding government debt must be covered in present value terms by future joint tax revenues, without the need of additional transfers from the central bank.

Clearly one way to satisfy this condition is to require each government to set taxes so as to maintain its own solvency, satisfying (15) and (16) respectively. This conclusion offers some justification for the fiscal restrictions specified in the Maastricht Treaty for the European Monetary Union and in subsequent agreements. Note however that the condition of solvency in principle is much less restrictive than the debt ceilings imposed in practice.

Secondly, the usefulness of fiscal restrictions derives solely from their effect on household expectations about the future. Since price stability is a matter of household expectations about intertemporal wealth, neither tight monetary nor fiscal policies at the current time can guarantee price stability. What is needed is the ability to convince households that such policies will be maintained indefinitely in the future. For example, consider again the experiment of the previous section: a temporary cut in current taxes by government one with no offsetting change in future taxes. Even if the central bank pledges to maintain price stability, if the lack of tax response by fiscal authorities causes households to doubt such a tax response will come

eventually, this will generate pressure for the current price level to rise.⁸

4.3 Case 3: Fiscal Bailout

An equilibrium can be specified in which fiscal solvency is not necessary for each government individually. Consider a case in which the fiscal policy of each country fixes its tax rate, $\tau_{1t} = \bar{\tau}_1$ and $\tau_{2t} = \bar{\tau}_2$, and where the central bank pegs the nominal interest rate, $R_t = \bar{R}$. The possibility of such an equilibrium was noted first by Woodford (1996). The equilibrium resembles that for case one discussed previously: the joint household intertemporal budget constraint (26) holds, as do the consumption equation (27) and condition (28). But because of the new fiscal policy in country two, the equilibrium price conditions (29 and 30) pertaining to the period of the shock, t , are altered slightly to include the taxes and debt of country two:

$$\frac{\tilde{p}_t}{\bar{p}} = - \left(\frac{\bar{W}}{\bar{p}} \right)^{-1} (\tilde{\tau}_{1t} + \tilde{\tau}_{2t}) \quad (33)$$

$$\frac{\tilde{p}_t}{\bar{p}} = \frac{\tilde{D}_{1t} + \tilde{D}_{2t}}{\bar{D}_1 + \bar{D}_2} \quad (34)$$

Consider again the fiscal experiment of the previous sections, involving a temporary tax cut and deficit which increases nominal debt of government one. Condition (34) implies the price level will rise enough to hold the aggregate level of real government debt constant. But this means the real value of debt of government one has risen, while that of government two has fallen in an offsetting way. In particular, substituting the price change from (33) into the linearized flow budget constraint of government one and assuming a symmetric steady state,

⁸ In a richer environment there could be other possible resolutions to this dilemma, such as default by the irresponsible fiscal authority. Default could be viewed as another type of tax, levied on holders of debt.

the change in government one debt may be written:

$$\left(\frac{\tilde{D}_{1t}}{\bar{D}_1} - \frac{\tilde{p}_t}{\bar{p}} \right) = -\frac{1}{2} \left(\frac{\bar{D}_1}{\bar{p}} \right)^{-1} \tilde{\tau}_{1t} \quad (35)$$

So the tax cut raises the real debt of government one, despite the fact it is deflated using a higher price level.

The subsequent dynamics of real debt may be written using the flow budget constraint updated one period:⁹

$$E_t \left(\frac{\tilde{D}_{1t+1}}{\bar{D}_1} - \frac{\tilde{p}_t}{\bar{p}} \right) = \frac{1}{\beta} \left(\frac{\tilde{D}_{1t}}{\bar{D}_1} - \frac{\tilde{p}_t}{\bar{p}} \right) \quad (36)$$

Since the value in parentheses on the right is positive, we know the portion of real government debt in excess of the steady state level is growing explosively at the rate $\frac{1}{\beta}$. This violates the solvency condition and intertemporal budget constraint for government one, but neither is a necessary condition for equilibrium. Likewise, it may be shown that debt in country two changes according to:

$$\left(\frac{\tilde{D}_{2t}}{\bar{D}_2} - \frac{\tilde{p}_t}{\bar{p}} \right) = \frac{1}{2} \left(\frac{\bar{D}_2}{\bar{p}} \right)^{-1} \tilde{\tau}_{1t} \quad (37)$$

The tax cut thus makes government two debt fall under the same conditions that it rises for government one. Since its dynamics are analogous to (36), its debt grows at the negative explosive rate $-\frac{1}{\beta}$.

Since the changes in government debt offset each other, there is no change in total household wealth, $\widetilde{W}_t = 0$, and the joint household solvency condition is satisfied. It is again simple to show that the conditions for each household are also satisfied separately.

An interesting feature of this equilibrium is that the fiscal experiment affects the distribution of household wealth between the countries and thereby the individual levels of consump-

⁹ This uses the fact that price is not expected to move after the initial period of the fiscal shock.

tion. Using the consumption function (27), consumption in country one rises after the tax cut by:

$$\tilde{c}_{1t} = -\bar{\Phi} \frac{1}{2} \tilde{\tau}_{1t} \quad (38)$$

Using the goods market equilibrium condition, it is clear that consumption in country two falls by this same amount.

While the case above does describe an equilibrium, the implications for consumption call into question the government policies that underlie it. The equilibrium implies that government two purchases limitless amounts of government one debt without any future repayment. This government policy lowers the wealth of households in country two, and consequently their consumption and welfare. If one views government policy as arising from a desire to optimize the welfare of a country's households, the policy described above is difficult to justify. As pointed out in Sims (1997), political pressure from households would surely discourage a government from pursuing such a policy.

4.4 Case 4: External Imbalance

The present model with imperfect insurance offers one example where the distribution of private wealth could become unsustainable. Consider the effect of an asymmetric shock to output. A significant amount of research related to the European Monetary Union has analyzed the implications of such asymmetric output shocks for the objective of output stabilization. But the fiscal theory's focus on household wealth suggests that such shocks may have implications for the objective of price stabilization as well.

It has been argued widely that if output shocks are highly asymmetric across countries, the inability to tailor monetary policy to country-specific needs is costly. The present model implies that even without perfect insurance or independent monetary policy, households can

smooth their consumption levels quite well. Consider a temporary shock to output in country one by amount ε_t . For simplicity we consider the case where national shocks are offsetting, so total output in the monetary union is unaffected. Assume the monetary and fiscal policies of case one discussed previously, so the equilibrium conditions there hold also here. In particular, the consumption function (27) implies that consumption in periods t and $t + 1$ are:

$$\tilde{c}_{1t} = \bar{\Phi} \varepsilon_t \quad (39)$$

$$E_t \tilde{c}_{1t+1} = \bar{\Phi} E_t \left[\frac{\bar{W}_1}{\bar{p}} \left(\frac{\tilde{W}_{1t+1}}{\bar{W}_1} - \frac{\tilde{p}_{t+1}}{\bar{p}} \right) \right] \quad (40)$$

Since $\bar{\Phi}$ is small for β close to unity, the impact on the household's consumption is small relative to the size of the shock. Consumption is smoothed by borrowing abroad, and thereafter consumption adjusts to the resulting change in household wealth.

The implications for household wealth in the periods after the shock may be derived from the linearized flow budget constraint of the household (1):

$$E_t \left(\frac{\tilde{W}_{1t+1}}{\bar{W}_1} - \frac{\tilde{p}_{t+1}}{\bar{p}} \right) = \left(\frac{\bar{W}_1}{\bar{p}} \right)^{-1} \varepsilon_t \quad (41)$$

$$E_t \left(\frac{\tilde{W}_{1t+2}}{\bar{W}_1} - \frac{\tilde{p}_{t+2}}{\bar{p}} \right) = E_t \left(\frac{\tilde{W}_{1t+1}}{\bar{W}_1} - \frac{\tilde{p}_{t+1}}{\bar{p}} \right) \quad (42)$$

These imply that a stochastic fall in current output of one country leads to a fall in the wealth of its households, and that any such change in wealth is expected to be permanent. The private debt in each country follows a random walk, implying that eventually private debt in one country could become so large that the solution to the consumption equation (27) would require a value of consumption less than zero.¹⁰ If the non-negativity restriction on consumption is not

¹⁰ Such a situation could be ruled out if precautionary saving were sufficiently strong; this is not true for quadratic utility.

to be violated, the households will not be expected to be able to repay their debt in present value out of future income. This is a stylized example of how an unsustainable cross-country distribution of private wealth could undermine an equilibrium.

5. Conclusion

When applied to a monetary union, the fiscal theory of the price level suggests that the focus of past research on seigniorage is misplaced. Regardless of seigniorage, if government debt is large, a rise in the common price level can have large implications for government finance and household wealth through the inflation tax. Further, in the context of a monetary union the fiscal theory takes on some new dimensions not observed in closed-economy contexts. For example, fiscal solvency may not be necessary for individual member governments. However, as long as international risk sharing is imperfect, this case is unlikely to arise. Future work could further explore the implications of imperfect insurance by considering explicitly optimizing governments and their strategic interactions in this context.

6. Appendix

Listed here are omitted steps in the solution for equilibrium in Case 1. Under the monetary policy that $R_t = \bar{R} = \frac{1}{\beta}$, a linear approximation of the money demand condition (21) implies:

$$\tilde{m}_{1t} = (1 - \beta) \frac{a}{b\gamma} \tilde{c}_{1t} \quad (43)$$

where tildes indicate deviations from a steady state. This condition is used to substitute money balances out of the household intertemporal constraint (26).

Again under the monetary policy rule, the intertemporal optimality condition (22) may be linearized:

$$a\tilde{c}_{1t} + (1 - a\bar{c}_1) \frac{\tilde{p}_t}{\bar{p}} = aE_t\tilde{c}_{1t+1} + (1 - a\bar{c}_1) E_t \frac{\tilde{p}_{t+1}}{\bar{p}} \quad (44)$$

where overbars indicate steady state values. An analogous condition applies to the household in country two. Summing over (44) and the foreign counterpart, and imposing the linearized goods market clearing condition

$$\tilde{c}_{1t} + \tilde{c}_{2t} = 0 \quad (45)$$

produces:

$$E_t \frac{\tilde{p}_{t+1}}{\bar{p}} = \frac{\tilde{p}_t}{\bar{p}} \quad (46)$$

This condition implies that no future price changes are expected after the initial period, and it allows the term $E_t \sum_{s=t}^{\infty} \beta^{s-t-1} \left(\frac{\tilde{p}_{s+1}}{\bar{p}} - \frac{\tilde{p}_s}{\bar{p}} \right)$ in (26) to be eliminated.

Further, substituting (46) back into (44) implies:

$$\tilde{c}_{1t} = E_t \tilde{c}_{1t+1} \quad (47)$$

Recursive substitution of (47) into (26) produces the solution for current consumption shown

in (27) in the text.

Next, sum this consumption function with its foreign counterpart, imposing goods market-clearing (45) and the fact that $E_t \tilde{y}_{1s} = 0$, for $s > t$, to produce (28) in the text. The fiscal rule for country one implies $E_t \sum_{s=t}^{\infty} \beta^{s-t} (\tilde{\tau}_{1s}) = \tilde{\tau}_{1t}$. Since the government of country two guarantees its own solvency, the present value of its stream of taxes is specified using the linearized government intertemporal budget constraint (16):

$$\sum_{s=t}^{\infty} \beta^{s-t} (\tilde{\tau}_{2s}) = \frac{1}{\beta} \left(\frac{\overline{D}_2}{\overline{p}} \right) \left(\frac{\tilde{D}_{2t-1}}{\overline{D}_2} - \frac{\tilde{p}_t}{\overline{p}} \right) - \sum_{s=t}^{\infty} \beta^{s-t} (\tilde{v}_{2s}) \quad (48)$$

The last term in the expression above may be found using the linearized intertemporal budget constraint of the central bank (17):

$$\sum_{s=t}^{\infty} \beta^{s-t} (\tilde{v}_{2s}) = -\frac{1}{2\overline{p}} \left[\tilde{M}_{t-1} - \frac{1}{\beta} \tilde{B}_{mt-1} - \left(\overline{M} - \frac{1}{\beta} \overline{B}_m \right) \frac{\tilde{p}_t}{\overline{p}} \right] \quad (49)$$

Substituting (48) and (49) into (28) and regrouping terms produces expression (29) in the text.

7. References

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