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When the Taylor principle is insufficient - A benchmark for the fiscal theory of the price level in a monetary union

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When the Taylor principle is insufficient - A benchmark for the fiscal theory of the price level in a monetary union

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Abstract

This paper derives restrictions on monetary and fiscal policies for determinate equilibria in a two-country monetary union with autarkic members. It finds that a central bank following the Taylor principle may not be sufficient for determinacy unless accompanied by one 'active' fiscal authority in the sense of Leeper (1991). Alternatively, both fiscal authorities can be 'active' while the central bank abandons the Taylor principle. The two determinate equilibria have significantly different implications for the transmission of fiscal and monetary shocks and for the fiscal theory of the price level in a monetary union.

Keywords: Fiscal theory, monetary union, policy coordination, indeterminacy
JEL classification: E31, E52, E62, E63

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1 Introduction

There has been a considerable amount of research on the fiscal theory of the price level (FTPL) in the context of monetary unions.[1] However, these analyses seem to be of limited relevance since they rest upon the assumption of a common price level. This assumption is generally rationalised by intensified trade within a currency union such that prices and hence inflation rates are perfectly aligned. Yet, this appears to be a particularly special case. Often enough, one does not observe the aforementioned alignment of inflation rates but instead persistent and significant differences, for example due to non-tradable goods. Via the abstraction from trade and thus introduction of country-specific price levels, this paper sheds light on the other extreme end of the spectrum. The results are threefold. First, the analysis shows that the central bank can be impotent in terms of stabilising inflation rates across both union countries. Second, it reveals which fiscal policy combinations support determinacy and how spillover effects from national fiscal shocks occur within the union. Lastly, it shows under which conditions fiscal inflation is unavoidable in a monetary union. The case of autarkic members of a monetary union can be seen as an extreme benchmark for the fiscal theory of the price level.
Section 2 presents a simple model of a monetary union with one central bank and two fiscal authorities while section 3 discusses parameter regions which yield determinate, indeterminate or unstable equilibria. Properties of the determinate equilibria are derived in section 4. Section 5 concludes.

2 The Model

The model is a simple cashless extension of Leeper's (1991) single closed endowment economy to a monetary union consisting of two autarkic countries, H(ome) of size n and F(oreign) of size $1-n$ with $n \in (0,1)$.[2] While monetary policy is common to both countries in the union, fiscal policies are country-specific. The absence of trade delivers a simple justification for country-specific price levels while preserving the possibility of identical inflation expectations across both countries.
Each country $i = H, F$ consists of a single household maximising expected lifetime utility derived from consumption C_t as in

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \log(C_t^i) \tag{1}$$

subject to

$$C_t^i + \frac{B_t^i}{P_t^i} + \tau_t^i = Y^i + R_{t-1}\frac{B_{t-1}^i}{P_t^i} \tag{2}$$

where R_t denotes the risk-free nominal interest rate set by the central bank, P_t^i the domestic price level and B_t^i bond holdings of the household of its domestic government.

[1] See for instance Woodford (1996), Sims (1997), Bergin (2000) and Leith and Wren-Lewis (2000).
[2] The results of the single economy in Leeper (1991) are nested in this analysis for $n \in [0;1]$

Each period each country is endowed with $Y^H = Y^F = Y$ units of the consumption good of which a constant fraction $G^H = G^F = G$ is consumed by the respective government.[3] The households' optimality conditions after imposing market clearing are

$$\frac{1}{R_t} = \beta \mathbb{E}_t \left[\frac{1}{\pi^H_{t+1}} \right] \qquad \text{and} \qquad \frac{1}{R_t} = \beta \mathbb{E}_t \left[\frac{1}{\pi^F_{t+1}} \right] \tag{3}$$

where $\pi^i_{t+1} = P^i_{t+1}/P^i_t$ denotes gross inflation. Evidently, inflation expectations are identical across countries. Importantly however, actual domestic inflation rates might differ due to country-specific disturbances.
Governments control domestic lump-sum taxes τ^i_t and issue debt to finance their expenses G in each period. The budget constraint for i's government reads

$$\frac{B^i_t}{P^i_t} + \tau^i_t = G + R_{t-1} \frac{B^i_{t-1}}{P^i_t} \quad . \tag{4}$$

Following Leeper (1991), fiscal authorities adjust their lump-sum taxes in response to last periods level of real debt $b^i_t = B^i_t/P^i_t$ according to

$$\tau^i_t \;=\; \gamma^i_0 + \gamma^i b^i_{t-1} + \psi^i_t \quad . \tag{5}$$

Union-wide inflation is defined as the weighted average of national inflation rates according to the respective country size such that

$$\pi^U_t = n\pi^H_t + (1-n)\pi^F_t \quad . \tag{6}$$

At the union level, the monetary authority sets R_t in response to union-wide inflation π^U_t as in

$$R_t \;=\; \phi_0 + \phi \pi^U_t + \theta_t \tag{7}$$

The country-specific fiscal shocks ψ^i_t and the common monetary policy shock θ_t are assumed to follow AR(1) processes of the form

$$\psi^i_t \;=\; \rho^i \psi^i_{t-1} + e^i_t, \quad \text{where} \quad |\rho^i| < 1, \quad e^i_t \sim \mathcal{N}(0, \sigma^2_i) \quad , \tag{8}$$

$$\theta_t \;=\; \rho \theta_{t-1} + e_t, \quad \text{where} \quad |\rho| < 1, \quad e_t \sim \mathcal{N}(0, \sigma^2) \quad . \tag{9}$$

These innovations represent unsystematic policy behaviour stemming from e.g. policy implementation errors or unmodeled economic disturbances. e^H_t, e^F_t and e_t are taken to be serially and mutually uncorrelated.

[3] A positive correlation between the endowment and country size does not alter the results.

3 Model solution and indeterminacy

The model's equations can be reduced to a recursive system in domestic inflation rates and real debt. Combining (3) with (7) and linearising yields

$$\mathbb{E}_t\left[\hat{\pi}^H_{t+1}\right] = \phi\beta[n\hat{\pi}^H_t + (1-n)\hat{\pi}^F_t] + \beta\theta_t \tag{10}$$

$$\mathbb{E}_t\left[\hat{\pi}^F_{t+1}\right] = \phi\beta[n\pi^H_t + (1-n)\pi^F_t] + \beta\theta_t \quad . \tag{11}$$

where hats denote deviations from the deterministic steady state.[4] Substitution of policy rules into the government budget constraints delivers laws of motion for real debt in H and F

$$\hat{b}^H_t = (1/\beta - \gamma^H)\hat{b}^H_{t-1} - \frac{b}{\pi\beta}\hat{\pi}^H_t + \frac{b\phi}{R\beta}\hat{\pi}^U_{t-1} - \psi^H_t + \frac{b}{R\beta}\theta_{t-1} \tag{12}$$

$$\hat{b}^F_t = (1/\beta - \gamma^F)\hat{b}^F_{t-1} - \frac{b}{\pi\beta}\hat{\pi}^F_t + \frac{b\phi}{R\beta}\hat{\pi}^U_{t-1} - \psi^F_t + \frac{b}{R\beta}\theta_{t-1} \quad . \tag{13}$$

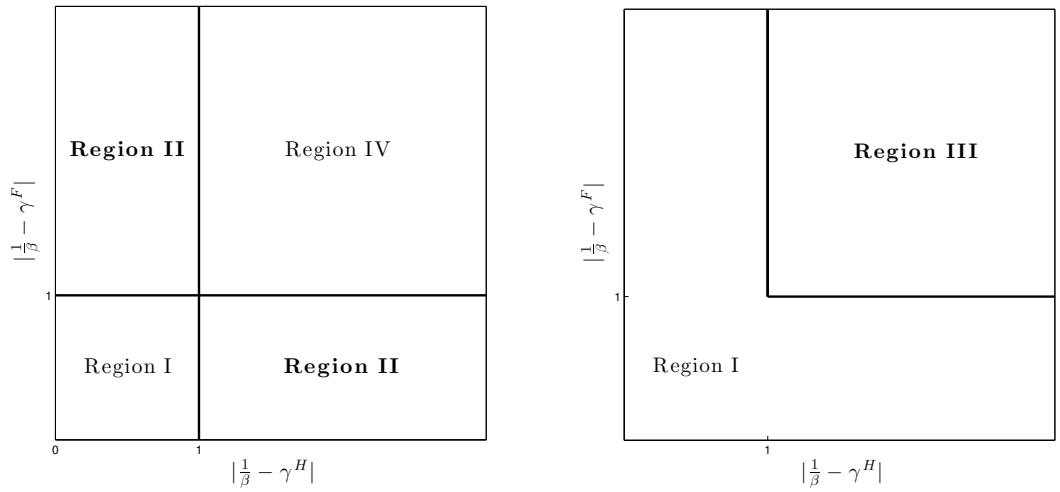
Since $\hat{\pi}^U_t$ can be substituted for, the system consists of two state ($\hat{b}^H_t$, $\hat{b}^F_t$) and two jumping ($\hat{\pi}^H_t$, $\hat{\pi}^F_t$) variables. According to Blanchard and Kahn (1980), the system requires two stable and two unstable roots in order to be determinate.

As in Leeper (1991) a policy is active (passive) if the respective authority is unconstrained (constrained) by budgetary conditions such that the associated eigenvalue with this policy is greater (smaller) than one in absolute values. The two eigenvalues associated with fiscal policy parameters are $\frac{1}{\beta} - \gamma^H$ and $\frac{1}{\beta} - \gamma^F$ and identical to Leeper's one-country case. The eigenvalue associated with monetary policy is $\phi\beta$ while the last eigenvalue of the system is zero. The zero-eigenvalue is a finding independent of the size parameter n and implies that monetary policy can only fix one jumping variable.

Figure 1 illustrates parameter regions of eigenvalues associated with fiscal policies dependent on the monetary policy regime being active or passive. Region I is characterised by having three to four stable roots such that equilibria in this region are indeterminate. In figure 1a in region II, the combination of active monetary policy and one active fiscal authority which refuses to adjust taxes strongly to domestic debt yields exactly enough stable roots for determinacy. Similarly in region III in figure 1b, two active fiscal policies in conjunction with passive monetary policy provide the system with two unstable and two stable roots. In region IV in figure 1b however, three active authorities generate three unstable roots preventing the existence of an equilibrium.

The striking result is that an active monetary policy following the Taylor principle via ϕ fails to determine uniquely an equilibrium unless accompanied by one active fiscal policy as displayed by region I in figure 1a. Mathematically, equations (6), (10) and (11) form a subsystem in three variables which does not deliver a unique solution as has been

[4] Due to almost linearity of the model, linearisation is a reasonably accurate approximation.



(a) Active monetary policy ($|\phi\beta| > 1$) (b) Passive monetary policy ($|\phi\beta| < 1$)

Figure 1: Parameter regions

already indicated by the zero-eigenvalue of the full system. Active monetary policy alone is not able to resolve the inherent indeterminacy. The economic intuition for this result is straightforward. The central bank has one policy instrument at hand with which she can uniquely determine union-wide inflation. But due to the isolation of each country within the union, country-specific inflation rates are not uniquely tied together. So even if the weighted average $\hat{\pi}_t^U$ is determined by monetary policy, its components, $\hat{\pi}_t^H$ and $\hat{\pi}_t^F$, may drift apart. Thus, active monetary policy on the union level combined with two passive fiscal policies necessarily renders the equilibrium indeterminate.

4 Equilibrium properties

The following section derives properties of the two determinate equilibria to illustrate differences in shock transmission mechanisms and the possibility of fiscal inflation across equilibria.

4.1 Region II equilibrium

When monetary policy is active ($|\phi\beta| > 1$) one can solve for $\hat{\pi}_t^U$ after combining (10) and (11) to

$$\hat{\pi}_t^U = \frac{\beta}{\rho - \phi\beta}\theta_t \quad . \tag{14}$$

Union-wide inflation is entirely determined by monetary policy shocks θ_t while country-specific fiscal shocks have no impact.

When fiscal policy in H is active ($|1/\beta - \gamma^H| > 1$), its respective budget constraint has the forward solution

$$\hat{b}_t^H = \frac{\rho^H}{1/\beta - \gamma^H - \rho^H}\psi_t^H \tag{15}$$

where debt solely depends on domestic fiscal shocks. Substitution back into the budget constraint yields country H's inflation rate

$$\hat{\pi}_t^H = -\frac{\pi\beta}{b^H}\left(\frac{1/\beta - \gamma^H}{1/\beta - \gamma^H - \rho^H}\right)\psi_t^H + \frac{\pi\beta}{b^H}(1/\beta - \gamma^H)\hat{b}_{t-1}^H + \phi\beta\hat{\pi}_{t-1}^U + \beta\theta_{t-1} \quad . \tag{16}$$

The inflation rate under an active fiscal regime depends on domestic fiscal shocks as well as past monetary policy shocks. Under active fiscal policy, domestic fiscal shocks cause a wealth effect for domestic residents explaining the dependence of $\hat{\pi}_t^H$ on ψ_t^H revealing the scope for fiscal inflation. In the absence of domestic fiscal shocks, $\hat{\pi}_t^H$ is pegged to expected union-wide inflation since the last two expressions in equation (16) represent $\mathbb{E}_{t-1}[\hat{\pi}_t^U]$.

Finally, via (6) the inflation rate in F can be determined to be

$$\begin{aligned}\hat{\pi}_t^F = &\frac{1}{1-n}\frac{\beta}{\rho - \phi\beta}\theta_t \\ &+ \frac{n}{1-n}\left[\left(-\frac{\pi\beta}{b^H}\right)\left(\frac{1/\beta - \gamma^H}{1/\beta - \gamma^H - \rho^H}\right)\psi_t^H + \frac{\pi\beta}{b^H}(1/\beta - \gamma^H)\hat{b}_{t-1}^H + \phi\beta\hat{\pi}_{t-1}^U + \beta\theta_{t-1}\right] \quad .\end{aligned} \tag{17}$$

Inflation in F responds to fiscal shocks of H but not to own fiscal shocks. These fiscal shock spillovers are of such magnitude that $\hat{\pi}_t^U$ remains at its steady state due to the active monetary policy. Fiscal shocks in F do not affect $\hat{\pi}_t^F$ since its fiscal stance ensures domestic debt stability, i.e. they do not cause a wealth effect. Hence, fiscal inflation is not present in F.

Lastly, the debt stock in F evolves according to the backward solution of its government budget constraint

$$\hat{b}_t^F = \sum_{k=0}^{\infty}(1/\beta - \gamma^F)^k\left(\frac{-b^F}{\pi\beta}\hat{\pi}_{t-k}^F + \frac{b^F}{R\beta}\left(\frac{\rho}{\rho - \phi\beta}\right)\theta_{t-1-k} - \psi_{t-k}^F\right) \quad . \tag{18}$$

4.2 Region III equilibrium

Under passive monetary policy both its associated eigenvalues are smaller than one. Consequently, determinacy requires both fiscal policies to be active such that both government budget constraints have a forward solution

$$\hat{b}_t^H = \frac{\rho^H}{1/\beta - \gamma^H - \rho^H}\psi_t^H \tag{19}$$

$$\hat{b}_t^F = \frac{\rho^F}{1/\beta - \gamma^F - \rho^F}\psi_t^F \quad . \tag{20}$$

Equilibrium real debt depends on the respective fiscal shock of the country but is unaffected by monetary policy shocks. As before, one can substitute $\hat{b}_t^i$ back into the respective government budget constraint to determine individual inflation rates

$$\hat{\pi}_t^H = -\frac{\pi\beta}{b^H}\left(\frac{1/\beta-\gamma^H}{1/\beta-\gamma^H-\rho^H}\right)\psi_t^H + \frac{\pi\beta}{b^H}(1/\beta-\gamma^H)\hat{b}_{t-1}^H + \phi\beta\hat{\pi}_{t-1}^U + \beta\theta_{t-1} \quad (21)$$

$$\hat{\pi}_t^F = -\frac{\pi\beta}{b^F}\left(\frac{1/\beta-\gamma^F}{1/\beta-\gamma^F-\rho^F}\right)\psi_t^F + \frac{\pi\beta}{b^F}(1/\beta-\gamma^F)\hat{b}_{t-1}^F + \phi\beta\hat{\pi}_{t-1}^U + \beta\theta_{t-1} \quad .(22)$$

Inflation in i depends on its domestic fiscal shock meaning that both countries exhibit scope for fiscal inflation. Contrary to region II, there are no direct spillovers of domestic fiscal shocks to the other country in the union. As before, by behaving actively a fiscal authority pegs its national inflation rate to the expected union-wide inflation.
Finally, by combining (21) and (22) one obtains the expression for union-wide inflation

$$\begin{aligned}\hat{\pi}_t^U = {} & n\left[-\frac{\pi\beta}{b^H}\left(\frac{1/\beta-\gamma^H}{1/\beta-\gamma^H-\rho^H}\right)\psi_t^H + \frac{\pi\beta}{b^H}(1/\beta-\gamma^H)\hat{b}_{t-1}^H\right] \\ & + (1-n)\left[-\frac{\pi\beta}{b^F}\left(\frac{1/\beta-\gamma^F}{1/\beta-\gamma^F-\rho^F}\right)\psi_t^F + \frac{\pi\beta}{b^F}(1/\beta-\gamma^F)\hat{b}_{t-1}^F\right] \\ & + \phi\beta\hat{\pi}_{t-1}^U + \beta\theta_{t-1} \quad .\end{aligned} \quad (23)$$

which is no longer shielded from country-specific fiscal disturbances. Similar to a one-country case, a passive monetary authority loses the ability to determine its associated inflation rate on its own.

5 Conclusion

This paper finds that a central bank may fail to stabilise inflation across autarkic member countries of a monetary union. This result calls into question the universal validity of the Taylor principle. Additionally, the findings have implications for the FTPL in a monetary union as they show how an active or irresponsibly acting fiscal policy might be necessary for determinacy and how it leaves room for fiscal inflation.

Because it addresses the extreme case of autarky across union member countries, the results serve as a benchmark and motivate a deeper analysis of multiple equilibria and fiscal inflation in multi-country settings with trade in goods and financial assets. Future research should focus on the inclusion of these features and analyse how different policy coordination schemes in a monetary union alter equilibrium characteristics.

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