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Abstract

According to Bordo and James [2008, "A long term perspective on the Euro," *NBER Working Paper*, No. 13815], history shows that multinational monetary unions have dissolved mainly under the consequences of external shocks. This paper provides a theoretical model demonstrating their point.

Keywords: Monetary Union, Optimum Currency Areas, External Shocks.

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1 Introduction

According to Bordo and James (2008) who closely examine the demise of the Latin and Scandinavian monetary unions, multinational monetary unions have mainly dissolved due to exogenous external shocks, such as World War I. Hence, the considerations of external shocks should be put at the forefront in assessing the sustainability of a monetary union.

However, most of the traditional literature on Optimum Currency Areas (OCA) has focused on adjustment mechanisms occurring inside a monetary union and investigate what would happen after the introduction of a new currency should an asymmetric shock hit. The recent literature, following Frankel and Rose (1997, 1998), also states in general that countries not forming an optimum currency area ex ante could undergo a reorganization of production activities inside the union's borders, driving them closer to the reference point by reducing the asymmetry of real output movements. Thus, the literature has traditionally focused on what would happen *inside* the monetary union as a potential threat to its existence, whereas historical evidences point to the fundamental role of *external* shocks in the break-up of monetary unions.

In this paper, we offer a reductio ad absurdum argument to support historical evidences described in Bordo and James (2008). Specifically, we examine the condition under which a monetary union can survive the impacts of external shocks. Our model focuses on the different degrees of sensitiveness among union members towards common external shocks. The sources of such differing sensitivities have been listed by Dornbusch et al. (1998) for instance. In this note, we analytically account for their influences upon the sustainability of a monetary union.

This paper is organized as follows. Section 2 sets up the model upon which our argument rests. The following section describes several features of our monetary union, and Section 4 investigates the condition for the monetary union to be sustainable in the

presence of external shocks. Section 5 concludes.

2 The model

Our model basically consists of a description of the economic structure of a monetary union and specification of policy-making bodies' preferences. In this section, we first describe the situation under autonomy and compute each policy-maker's optimal interest rate as a function of each country's characteristics.

2.1 Economy

For the simplicity of exposition, we assume that the union consists of 2 economies, indexed by $j = 1, 2$. The aggregate demand of an economy j is described by the following equation:

$$y^d_{j,t} = -\alpha \left(i_t - \pi_{j,t} \right), \tag{1}$$

where $y^d_{j,t}, i_t$, and $\pi_{j,t}$ are respectively the aggregate demand, the interest rate and the inflation rate of this economy at time t, whereas α is a positive parameter.

On the other hand, each economy's aggregate supply is given by a Lucas-type supply function where unexpected inflation boosts its output:

$$y^s_{j,t} = \beta \left(\pi_{j,t} - \pi^e_t \right) + \omega_j \upsilon_t, \tag{2}$$

where $y^s_{j,t}$ and π^e_t are the aggregate supply and the expected inflation rate, while υ_t represents period t's supply shock, originating from the rest of the world, and ω_j is a positive parameter and signifies country j's sensitivity to this shock.[1] Also, β is a

[1] We do not consider national (or regional, or sectorial) shocks as well as any demand shocks. Incorporating them would make the algebra more tedious, without additional implications of great significance.

parameter with a positive value. In equilibrium, we have

$$\pi_{j,t} = \frac{1}{\beta - \alpha} \left(-\alpha i_t + \beta \pi_t^e - \omega_j \upsilon_t \right), \tag{3a}$$

$$y_{j,t} = \frac{\beta}{\beta - \alpha} \left(-\alpha i_t + \alpha \pi_t^e - \frac{\alpha}{\beta} \omega_j \upsilon_t \right). \tag{3b}$$

Here, we suppose $\alpha < \beta$ so as to rule out an unrealistic behavior of inflation in terms of its determinants. The two local economies differ from each other only with respect to their individual sensitivities to the rest-of-the-world shock. We suppose that the shock is normally distributed with a well-defined variance and a zero mean.

2.2 Policy-makers

In this model, monetary policy is decided by a federal college, consisting of country representatives, which we also refer to as "governors." In order to focus on the impact of shocks, we discard differences over their preferences, and thus suppose that representatives agree on the objectives to be followed. Namely, they all target the same inflation rate and the same output level.

Accordingly, the objective of each representative central banker (governor) is to minimize the following loss function:

$$G_{j,t} = \frac{1}{2} \left(\pi_{j,t} - \pi^* \right)^2 + \frac{\lambda}{2} \left(y_{j,t} - y^* \right)^2, \tag{4}$$

where we assume that the desired inflation rate and output level (π^* and y^*) are identical

Moreover, focusing on the federal supply shock reinforces the link between our setup and historical evidences on some monetary unions demises, principally triggered by a price variation in an oversea commodity market, for instance. On the other hand, demand shocks can probably be considered safely as originating (and be managed) mostly from within a union, notably through the use of fiscal instruments.

across all the governors.[2] Moreover, we suppose exactly the same preference for the monetary delegates (identical λ), for the sake of simplicity. The assumption of a common inflation objective across the union does not seem too unrealistic for countries sharing (or considering to share) the same currency. Thus, we can normalize these desired values as $\pi^* = y^* = 0$.[3]

To complete the model, the timing of policy-making decisions has to be specified. Here, we consider that private agents form their expectations first, and the values of the shock is subsequently revealed. Then, the monetary authority sets its policy rate. Finally, transactions take place, which determines the levels of output and inflation.

2.3 Optimal policy under autonomy

We start by deriving our benchmark case, i.e., what happens if a country lives outside the monetary union? Even such an autonomous case does not indicate autarky and the country is not immune from rest-of-the-world shocks. Moreover, it may suffer from even larger shocks than when it is a member of the monetary union since the relative size of the outside world increases when staying out. In order to simplify the discussion here, we assume that the sensitivity to external shocks under autonomy is the same as when being inside the monetary union.

To determine each policy-maker's optimal interest rate, it suffices to notice that the model is fully symmetric around zero. Therefore, the expected inflation rate can only be equal to zero. For each local economy, the preferred policy is therefore obtained by

[2]Alternatively, y^* can be considered as the difference between the desired and the natural output growth rates. Here, this would simply mean that, while economies may have different natural output growth rates, the policy-makers try to minimize the gap between the actual and the optimal growth rates.

[3]Note that, as we are interested solely in computing the parameter conditions for a monetary union to be sustainable, this simplification about structurally deterministic components is inocuous while it simplifies the algebra significantly.

minimizing her loss function over $i_{j,t}$, while assuming that the expected inflation rate is equal to zero. This is the interest rate that that governor would choose to implement if monetary policy was independently decided. Inserting this interest rate in equations (3a) and (3b), one obtains

$$\pi^A_{j,t} = -\frac{\lambda\beta}{1+\lambda\beta^2}\omega_j \upsilon_t, \tag{5a}$$

$$y^A_{j,t} = \frac{1}{1+\lambda\beta^2}\omega_j \upsilon_t, \tag{5b}$$

where the subscript A signifies "autonomy."

It is obvious from (5a) and (5b) that an external shock affects different countries differently, depending on the degrees of sensitivity, ω_j. Hence, even though we assume that the countries have similar preferences and objectives, monetary policy would need to be tailored to their individual needs, due to the differentiated impacts of external shocks, which are asymmetrically felt between the respective member states. An example of the situation we have in mind is the effects of an oil shock, which would be symmetric at origin but felt differently across nations, depending on a country's import dependence, industrial structures, climate, and so on.

The existence of this idiosyncratic part of the common shocks implies that each member economy of a union could suffer from a common monetary policy. The following section investigates this possibility.

3 Life in a monetary union

In a monetary union, the decisions over the interest rate are made by a monetary policy body that is interested not just in the situation of any single country in particular but also in the union's welfare as a whole. Such a body's preference is described by the following

loss function:

$$G_t^f = \frac{1}{2}\left(\pi_t^f - \pi^*\right)^2 + \frac{\lambda}{2}\left(y_t^f - y^*\right)^2, \tag{6}$$

where π_t^f and y_t^f are respectively the weighted averages of the member countries' inflation rates and output levels,[4] and the superscript f indicates the case where the interest rate is chosen by a (federal) policy-maker with a union-wide objective. In the two-country situation, we can write these as

$$\pi_t^f = \rho\pi_{1,t} + (1-\rho)\,\pi_{2,t}, \tag{7a}$$

$$y_t^f = \rho y_{1,t} + (1-\rho)\,y_{2,t}, \tag{7b}$$

where ρ ($\rho \in [0,1]$) is the relative weight assigned to country 1.

Invoking the assumptions of $\pi^* = y^* = 0$, the minimization of this loss function under the constraint of the expressions in (7a, b), which determines the union's inflation rate and output level, leads to the following optimal interest rate:

$$i_t^f = -\frac{1+\lambda\alpha\beta}{\alpha\left(1+\lambda\beta^2\right)}\left(\rho\omega_1 + (1-\rho)\,\omega_2\right)\upsilon_t. \tag{8}$$

Hence, the union's monetary policy reacts to the external shocks, considering its members' idiosyncrasies, and weighting them accordingly. By plugging this interest rate into the expression of each country's inflation rate and output level, we can describe the impact of the union's policy on the economy of the union as follows:

[4]This assumption is relatively standard in the literature as a union's objective. For different formulations, see Aaron-Cureau and Kempf (2006), for example.

$$\pi_t^f = -\left(\rho\omega_1 + (1-\rho)\,\omega_2\right)\frac{\alpha\lambda\beta}{(1+\lambda\beta^2)}\upsilon_t, \tag{9a}$$

$$y_t^f = \left(\rho\omega_1 + (1-\rho)\,\omega_2\right)\frac{\alpha}{1+\lambda\beta^2}\upsilon_t. \tag{9b}$$

4 Sustainability condition

When does remaining inside a monetary union turn out to be unbearable for one of its member countries? In order to answer this question, one has to compare the welfare of a monetary union member to what would happen if that country had not entered the union in the first place. Adopting country 1's point of view, the following condition has to be met for a monetary union to be beneficial:

$$E(G_1^f) < E(G_1^A). \tag{12}$$

That is, the expected loss incurred under a monetary union needs to be smaller than the one under autonomy. Based on this condition, we can derive the following proposition:

Proposition. *The relatively more sensitive country to external shocks is better off by remaining in the monetary union.*

Proof. From equations (5, a and b) and (9, a and b), we can derive that (12) is equivalent to the following condition for country 1:[5]

$$\left(\rho\omega_1 + (1-\rho)\,\omega_2\right)^2 < \left(\omega_1\right)^2 \Leftrightarrow \omega_2 < \omega_1$$

[5]Note that we restrict our attention to only positive ω's.

From the last inequality, the proposition above readily follows. **Q.E.D.**

Proposition above immediately leads to the following statement:

Corollary. *As the above condition has to hold for each candidate country, a monetary union is inherently unsustainable under external shocks.*

Proof. The condition, $\omega_1 < \omega_2$, must be met for country 2 to remain in the monetary union. Obviously, the two conditions for respective nations cannot be satisfied simultaneously. **Q.E.D.**

It needs to be added that this result depends partly on the simplicity of our model: (i) countries share exactly the same preferences, (ii) the members' economies are hit only by external shocks, and (iii) monetary policy is the only stabilization instrument. Moreover, even if a country is worse off by remaining inside a monetary union with respect to external shocks alone, its expected net benefit from forming a monetary union can still be positive when other benefits, such as a decrease in transaction costs, overwhelm the effects of external shocks.

Yet, when our assumptions hold true in general, the outlook of a union is quite gloomy. The proposition indicates that the more open economy will profit more from the stabilizing impact of monetary policy, and wish to share the currency of the less exposed economy. As this cannot be true for all the member nations, our argument reveals the inherent difficulty in maintaining a monetary union against external shocks.

5 Conclusion

In this paper, we show that the sustainability of a multinational monetary union must face an inherent problem as far as external shocks are concerned, which offers a theoretical foundation to Bordo and James's (2008) historical argument. It has to be noted that this result is not a restatement of McKinnon's (1963) criterion, as we here consider the sensitivity against the external shocks, not the degree of openness. These two concepts are quite different: a country which is very open to the rest of the world, such as Belgium, conducts the larger part of its international trade with the European Union, yet it is still very sensitive to the variations of oil prices. Hence, in order to be sustainable, a monetary union should gather nations whose sensitivity to external shocks from the rest of the world is relatively low. This can also be interpreted as a generalization of Kenen's (1969) diversification criterion to include sensitivities to external shocks of member nations. It also offers an criterion for nations that are considering to join existing multilateral monetary unions, such as the European Monetary Union, or prospective unions, such as the Gulf Cooperation Council.

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