

# SUPPLY-POLICY COORDINATION IN A MONETARY UNION

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*Resumen:* Se examina la forma en la que los estados miembros de una unión monetaria grande responden, tanto a perturbaciones específicas como a las procedentes del resto del mundo, utilizando políticas de oferta. Para ello desarrollamos un modelo de tres países, de los cuales dos constituyen una unión monetaria donde un banco central independiente controla la política monetaria y las políticas de oferta son determinadas por las autoridades a nivel nacional. En este contexto, analizamos en términos estratégicos cómo las autoridades pueden hacer frente a perturbaciones monetarias, reales y de oferta. Se discuten los aspectos de bienestar de la solución óptima, así como hasta que punto la coordinación de las políticas de oferta puede ser útil para hacer frente a dichas perturbaciones.

*Abstract:* This paper examines how the member countries of a large monetary union react to country-specific shocks, and to shocks from the rest of the world, using supply-side policies. We develop a three-country model in which two of the countries form a monetary union where an independent central bank to control monetary policy, and supply-side policies are determined by the authorities at the national level. In this framework, we analyse in strategic terms how the authorities can deal with monetary, real and supply shocks, and discuss the welfare aspects of the optimal solution and the extent to which a coordinated supply-side policy may be useful to deal with those shocks.

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## 1. Introduction

The costs of losing the exchange rate and monetary policy as instruments of macroeconomic stabilization acquire a special importance when deciding the convenience of forming a monetary union. Most of the theoretical and empirical studies conclude that these costs will depend on the asymmetry of the shocks. So, for instance, Bayoumi and Eichengreen (1993) find that the costs imposed by asymmetric shocks in the European monetary union will be larger, since these shocks require country-specific adjustment policies.

Another question broadly discussed is that, in the absence of fully flexible prices and wages, as well as labour mobility, as adjustment mechanisms, governments have to deal with shocks using mainly fiscal policy. But the disciplining effects of a monetary union may require some limitations on the use of fiscal policy. We can mention, as an example, the fiscal discipline imposed by the Pact for Stability and Growth in the European Monetary Union, EMU. Since fiscal policy in monetary unions may be inefficient, the possibility of fiscal policy coordination has been discussed; the conditions under which fiscal policy coordination may be desirable are derived in Díaz-Roldán, 2000a.

On the other hand, given the limitations of fiscal policy, it would be desirable to have alternative policies, among them, the possibility of using supply-side policies has been discussed (Jimeno, 1992; Viñals and Jimeno, 1998). From a different point of view, this possibility had been mentioned in the literature on optimum currency areas: countries with similar inflation rates would be good candidates to join a common currency area, this feature being related to the similarity of the institutional mechanisms of the labour market (Calmfors and Driffill, 1988). This argument could support the need for some harmonization of the institutional mechanisms governing the labour markets of the countries forming a monetary union, as an useful tool for reducing the cost of belonging to a common currency area.

The available literature has hardly studied supply-side policies. De Miguel and Sosvilla (2001) develop a two-country model in order to analyse the effects of macroeconomic policies in a monetary union with different wage rigidities. Supply-side policies are represented by changes in the employers' social security contributions, which has a direct impact on real wages. On the other hand, Sibert and Sutherland (1997) develop an intertemporal  $n$ -country model to study the role of long-run labour market reforms on the costs and benefits of monetary integration. They conclude that in a monetary union the degree of labour market reform required is lower than in other mone-

tary policy regimes. More recently, Díaz-Roldán (2002) analyses the scope of short-run labour market intervention by means of a two-country model, before and after forming a “small” monetary union. The results show that coordination of supply-side policies is desirable when the effects of the shocks are different in the economies involved. This is particularly true for all demand shocks within the no-monetary union case, and only for real shocks within the monetary union case, but in both cases when the shocks are transmitted through the *beggar-thy-neighbour* effect.

In this paper we examine how the member countries of a monetary union can react to shocks by using supply-side policies. To this end, we extend the two-country model developed by Díaz-Roldán (2002) to the three-country case where two of the countries form a monetary union and the variables of the third country (the rest of the world) are treated as endogenous. In this “large” monetary union an independent central bank controls monetary policy, there are some restrictions on fiscal policy, and supply policies are determined by the authorities at the national level. Next, we analyse in strategic terms how the authorities of each member country can deal with shocks using a supply-side variable which could be interpreted as institutional intervention in the labour market. The authorities can act individually or cooperatively and, in the rest of the paper, we identify cooperation among authorities with policy coordination.

As an original contribution of this paper, first of all, we can mention that the model has been explicitly designed for a “large” monetary union, which is not frequent in the literature. Secondly, we analyse the role of supply-side policy, something that has also hardly been discussed in the literature. An important result derived from our analysis is that the desirability of supply-side policy coordination is not only related to the characteristics of the shocks, but also to the way in which their effects are transmitted among countries. In addition, the role played by the channel of transmission of the shocks will be determinant for the results. More precisely, the main result is that in a “large” monetary union, supply-side policy coordination would be desirable when dealing with real shocks which have their origin within the union’s country members, and which are transmitted through the *beggar-thy-neighbour* effect.

The paper is structured as follows. First, a theoretical model for a monetary union is developed, which will allow us to study the effects of shocks on the union’s member countries. Next, the possibilities for supply-side policy coordination among the monetary union’s member countries are analysed in strategic terms. Finally, section 4 concludes.

## 2. Theoretical Framework

We will consider a model of two symmetric economies: the monetary union and the rest of the world, with flexible exchange rates and perfect capital mobility between them. The monetary union is described by the following set of equations:

$$y = -\alpha r_w + \gamma g + \beta(e_w + p^* - p) + \delta y^* + f \quad (1)$$

$$m - p = \theta y - \psi r_w \quad (2)$$

$$p_c = (1 - \mu)p + \mu(p^* + e_w) \quad (3)$$

$$w - \varepsilon p_c = \phi prod - \eta u + z - v - t \quad (4)$$

$$p - w = -\phi prod - \varphi u \quad (5)$$

$$y = n + prod \quad (6)$$

$$u = l - n \quad (7)$$

All the variables are defined as rates of change, except  $r$  and  $u$ , which capture the instantaneous changes in the interest rate, and in the unemployment rate, respectively. All parameters, denoted by Greek letters, are nonnegative.

Equation (1) represents the goods market equilibrium condition. Output,  $y$ , depends on the world's interest rate  $r_w$ , the real exchange rate (defined from the nominal exchange rate,  $e_w$ , and the countries' relative prices  $p$  and  $p^*$ ), the other country's output, and a positive real shock  $f$ .

Equation (2) shows the money market equilibrium condition, where  $m$  denotes the money supply, and money demand depends on domestic output, and the world interest rate.

Equations (3) to (7) represent the aggregate supply of the economy, built along the lines of Layard, Nickell and Jackman (1991). First, equation (3) defines the consumer price index  $p_c$ , as a weighted average of the prices of domestic and imported goods in terms of the domestic currency.

Equation (4) shows that nominal wages,  $w$ , are determined by the degree of indexation with respect to the consumer price index, and depend on the parameter  $\varepsilon$ ; labour productivity,  $prod$ ; the unemployment rate,  $u$ ; wage pressure factors,  $z$ ; the error in expectations, captured by the variable  $v$ ; and the use, as a policy instrument, of a supply-side variable  $t$ , which could be used as a direct way of policy intervention on the labour market. Note that the parameter  $\varepsilon$  denotes the degree of wage rigidity, with  $0 \leq \varepsilon \leq 1$ ; we will assume here the intermediate case so that  $0 < \varepsilon < 1$ .

In equation (5), prices are set by adding a margin to wages, which depends on productivity,  $prod$ , and the unemployment rate,  $u$ . We also assume that the parameter  $\phi$  is the same as in the wage-setting equation (4). This assumption, which simplifies the analysis without altering the basic results, is commonly used in the literature, and is justified since in the long term productivity changes do not affect the unemployment rate (see *e.g.* Layard, Nickell and Jackman (1991)).

Finally, equation (6) defines changes in output as the sum of changes in employment,  $n$ , and productivity,  $prod$ . And equation (7) defines changes in the unemployment rate,  $u$ , in terms of active population,  $l$ , and employment,  $n$ .

The second economy analysed is the rest of the world. As mentioned earlier, we develop a model for two symmetric economies; therefore, equations describing the rest of the world are equivalent to the monetary union's equations:

$$y^* = -\alpha r_w - \beta(e_w + p^* - p) + \delta y + f^* \quad (8)$$

$$m^* - p^* = \theta y^* - \psi r_w \quad (9)$$

$$p_c^* = (1 - \mu)p^* + \mu(p - e_w) \quad (10)$$

$$w^* - \varepsilon p_c^* = \phi prod^* - \eta u^* + z^* - v^* \quad (11)$$

$$p^* - w^* = -\phi prod^* - \varphi u^* \quad (12)$$

$$y^* = n^* + prod^* \quad (13)$$

$$u^* = l^* - n^* \quad (14)$$

Note that in the goods market equilibrium condition, we neglect the fiscal variable  $g^*$ , which is implicitly included in the real shock  $f^*$ . We also neglect the institutional variable  $t^*$ , implicitly included in the supply shock  $s^*$  (see below).

From equations (1) to (7) for the monetary union and (8) to (14) for the rest of the world, we can obtain the aggregate demand functions for each economy:

$$y^d = \frac{\alpha}{\psi + \alpha\theta}(m - p) + \frac{\beta\psi}{\psi + \alpha\theta}(e_w + p^* - p) + \frac{\delta\psi}{\psi + \alpha\theta}y^{*d} + \frac{\gamma\psi}{\psi + \alpha\theta}g + \frac{\psi}{\psi + \alpha\theta}f \quad (15)$$

$$y^{*d} = \frac{\alpha}{\psi + \alpha\theta}(m^* - p^*) - \frac{\beta\psi}{\psi + \alpha\theta}(e_w + p^* - p) + \frac{\delta\psi}{\psi + \alpha\theta}y^d + \frac{\psi}{\psi + \alpha\theta}f^* \quad (16)$$

Combining the definition of the consumer price index (3) with the aggregate supply equations, (4) to (7), we can obtain the monetary union's aggregate supply:

$$y^s = -\lambda(\varepsilon - 1)p - \lambda\varepsilon\mu(e_w + p^* - p) - \lambda z + \lambda v + \lambda t + l + prod$$

where  $\lambda = \frac{1}{\eta + \varphi}$ .

To simplify, we group all the exogenous supply shocks in a contractionary disturbance  $s$ :

$$s = z - v - \frac{1}{\lambda}l - \frac{1}{\lambda}prod$$

where  $s$  embodies the negative effect on output of an increase in the degree of wage pressure,  $z$ ; and the positive effects of increases in expectations errors,  $v$ ; active population,  $l$ ; and productivity,  $prod$ .

Then, the aggregate supply of the union will be:

$$y^s = -\lambda(\varepsilon - 1)p - \lambda\varepsilon\mu(e_w + p^* - p) - \lambda s + \lambda t \quad (17)$$

and, in a similar way, for the rest of the world:

$$y^{*s} = -\lambda(\varepsilon - 1)p^* + \lambda\varepsilon\mu(e_w + p^* - p) - \lambda s^* \quad (18)$$

where:

$$s^* = z^* - v^* - \frac{1}{\lambda}l^* - \frac{1}{\lambda}prod^*$$

### 2.1. *The Countries of the Union*

We assume that the monetary union is formed by two symmetric member countries denoted by 1 and 2.

The economic framework of the union's member countries is given by equivalent equations to those of (1) to (7), for both country 1 and country 2. However, in order to describe a monetary union, these two sets of equations are modified in the following way: first, the nominal exchange rate between countries 1 and 2 is made equal to zero; and, second, both countries replace each individual money market equilibrium condition by a common equilibrium condition, which can be written as follows:

$$m - \frac{1}{2}p_1 - \frac{1}{2}p_2 = \frac{\theta}{2}y_1 + \frac{\theta}{2}y_2 - \psi r_w \quad (19)$$

In equation (19),  $m$  denotes the union's money supply, so the demand for money depends on the output of the two countries, and the union's interest rate.

Note that, since the variables are in rates of change, the variables of the monetary union are equal to the weighted sum of the member countries' variables, and we can assume that their relative weights reflect the bargaining power of each country inside the union. That is, for any variable  $x$ :

$$x = \frac{Y_1}{Y}x_1 + \frac{Y_2}{Y}x_2$$

where  $x, x_1, x_2$  are the rates of change of variable  $x$  for the union, country 1, and country 2, respectively;  $Y, Y_1, Y_2$  are their levels of output, and  $Y_1 + Y_2 = Y$ . For convenience, we have assumed

$$\frac{Y_1}{Y} = \frac{Y_2}{Y} = \frac{1}{2}.$$

So, from the weighted sum of the equations for country 1 and 2, we can obtain equations (1), and (3) to (7) for the monetary union.

2.2. *The Transmission of the Shocks*

From equations (1) to (7) and (8) to (14), and assuming equilibrium in the goods market:  $y^s = y^d = y$  and  $y^{*s} = y^{*d} = y^*$ , we can obtain the reduced forms for the monetary union and the rest of the world:<sup>1</sup>

$$y = a_y m \pm b_y m^* + c_y g + d_y f \pm h_y f^* - i_y s - j_y s^* + i_y t \quad (20)$$

$$y^* = a_y m^* \pm b_y m \pm k_y g + d_y f^* \pm h_y f - i_y s^* - j_y s + j_y t \quad (21)$$

$$p = a_p m \pm b_p m^* + c_p g + d_p f + h_p f^* + i_p s + j_p s^* - i_p t \quad (22)$$

$$p^* = a_p m^* \pm b_p m + k_p g + d_p f^* + h_p f + i_p s^* + j_p s - j_p t \quad (23)$$

Equations (20) to (23) show the interdependence between the two economies, given by the interaction of the variables. On the other hand, given that the variables of the monetary union are equal to the weighted sum of the member countries' variables, and that the interaction taking place between them is equivalent to the interaction between the union and the rest of the world, we could also rewrite the preceding equations as follows:

$$\begin{aligned} y_1 = & a_y m \pm b'_y m^* + c'_y g_1 \pm c''_y g_2 + d'_y f_1 \pm d''_y f_2 \\ & \pm h'_y f^* - i'_y s_1 - i''_y s_2 - j'_y s^* + i'_y t_1 + i''_y t_2 \end{aligned} \quad (24)$$

$$\begin{aligned} y_2 = & a_y m \pm b''_y m^* + c'_y g_2 \pm c''_y g_1 + d'_y f_2 \pm d''_y f_1 \\ & \pm h''_y f^* - i'_y s_2 - i''_y s_1 - j''_y s^* + i'_y t_2 + i''_y t_1 \end{aligned} \quad (25)$$

$$y^* = a_y m^* \pm b_y m \pm k'_y g_1 \pm k''_y g_2 + d_y f^* \pm h'_y f_1$$

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<sup>1</sup> The detailed derivation of all the equations in the paper, together with the definition of the coefficients, can be seen in Díaz-Roldán (2000b).



$$\pm h_y'' f_2 - i_y s^* - j_y' s_1 - j_y'' s_2 + j_y' t_1 + j_y'' t_2 \quad (26)$$

$$\begin{aligned} p_1 = & a_p m \pm b_p' m^* + c_p' g_1 + c_p'' g_2 + d_p' f_1 + d_p'' f_2 \\ & + h_p' f^* + i_p' s_1 + i_p'' s_2 + j_p' s^* - i_p' t_1 - i_p'' t_2 \end{aligned} \quad (27)$$

$$\begin{aligned} p_2 = & a_p m \pm b_p'' m^* + c_p' g_2 + c_p'' g_1 + d_p' f_2 + d_p'' f_1 \\ & + h_p'' f^* + i_p' s_2 + i_p'' s_1 + j_p' s^* - i_p' t_2 - i_p'' t_1 \end{aligned} \quad (28)$$

$$\begin{aligned} p^* = & a_p m^* \pm b_p m + k_p' g_1 + k_p'' g_2 + d_p f^* + h_p' f_1 \\ & + h_p'' f_2 + i_p s^* + j_p' s_1 + j_p'' s_2 - j_p' t_1 - j_p'' t_2 \end{aligned} \quad (29)$$

The reduced form given by equations (24) to (29) shows the interaction between the two countries of the union and the rest of the world. As can be seen, we have two kinds of monetary shocks: the monetary policy instrument of the union's monetary authority ( $m$ ) and monetary shocks from the rest of the world ( $m^*$ ). On the other hand, regarding real and supply shocks, we can observe shocks from each country of the union ( $f_1, f_2, s_1, s_2$ ), and the rest of the world ( $f^*, s^*$ ).

We find that a negative supply shock affecting one of the countries of the union ( $s_1, s_2 > 0$ ) or the rest of the world ( $s^* > 0$ ), leads to an output fall and a rise in prices, both in the union and in the rest of the world. This effect is independent of the channel of transmission and the origin of the shock. Regarding the institutional supply variables of the union's member countries ( $t_1, t_2$ ), their effects have the same absolute value but the opposite sign as supply shocks.

In turn, positive demand shocks ( $m, m^*, g_1, g_2, f_1, f_2, f^* > 0$ ) lead to positive effects on the output and prices of the country of origin of the shock. But when the shock is transmitted between the countries of the union, and between each member country and the rest of the world, the sign of the coefficients depends on which channel of transmission prevails. In our model, the channels of transmission of the demand shocks are aggregate demand, the interest rate, the real exchange rate between the union and the rest of the world, and the monetary union's relative prices.

As mentioned before, when aggregate demand prevails, the result is the *locomotive effect*: the effects on output and prices of the country of origin of the shock are transmitted to the rest of the economies with

the same sign. We find that an aggregate demand expansion with an output expansion and a rise in prices in all the economies involved. But when changes in the interest rate and the real exchange rate prevail, the result is the *beggar-thy-neighbour effect*: the effects on the output and prices of the country of origin of the shock are transmitted to the rest of the economies with the opposite sign. The reason is that a real exchange rate depreciation (appreciation) in an economy leads to an aggregate demand expansion (contraction) in that economy, and to a contraction (expansion) in the other, given that a depreciation (appreciation) in one economy, implies an appreciation (depreciation) in the other.

We have just shown the way in which macroeconomic shocks affecting the monetary union and supply-side policies adopted by the member countries' governments are transmitted between the countries of the monetary union and the rest of the world. The purpose of the next section will be to show how international policy coordination may internalize the potential spillover effects.

### 3. Supply Policy Coordination in a Monetary Union

The theoretical arguments supporting policy coordination are based on the idea that cooperation internalizes the effects of economic interdependence. In this way, we need to take into account the strategic behaviour of the authorities, so we will use the Game Theory approach in order to study how the authorities can deal with shocks.

We assume that countries 1 and 2 are represented by their authorities, which face the problem of minimizing their loss functions:

$$L_1 = y_1^2 + \sigma_1 g_1^2 + \pi_1 p_1^2 \quad (30)$$

$$L_2 = y_2^2 + \sigma_2 g_2^2 + \pi_2 p_2^2 \quad (31)$$

where the target variables are the rates of change of output ( $y_1, y_2$ ), of the budget deficit ( $g_1, g_2$ ), and also of prices ( $p_1, p_2$ ). For this purpose, the authorities will use as a policy instrument an institutional variable ( $t_1, t_2$ ), affecting the process of wage setting. We also assume  $\sigma_1 \neq \sigma_2$  and  $\pi_1 \neq \pi_2$ , so we consider asymmetric preferences. On the other hand, the quadratic form of the loss function implies that any change, positive or negative, in the variables will represent a loss of utility. So, each country will minimize its loss function when all the objectives become equal to zero:  $y_1 = y_2 = 0$ ,  $g_1 = g_2 = 0$ , and  $p_1 = p_2 = 0$ .

The fact that the disciplining effects of a monetary union imply some restrictions on fiscal policy allows us to include the budget deficit as an objective of the authorities. An example of this situation is the European monetary union, where each member country has to fulfil the budget deficit requirements of the Pact for Stability and Growth. In this context, the price objective captures the cost of authorities' intervention in terms of inflation.

### 3.1. *Welfare Aspects of the Optimal Solution*

From a theoretical point of view, the cooperative solution is Pareto improving since it internalizes the spillover effects arising from economic interdependence. These externalities,

$$\frac{\partial L_1}{\partial t_2} \text{ and } \frac{\partial L_2}{\partial t_1},$$

show how the loss function of a country changes in response to changes in the other country's instrument.

On the one hand, the first-order conditions from which we would obtain the Nash Equilibrium are

$$\frac{dL_1}{dt_1} = 0 \text{ and } \frac{dL_2}{dt_2} = 0.$$

But for these points

$$\frac{\partial L_1}{\partial t_2} \neq 0 \text{ and } \frac{\partial L_2}{\partial t_1} \neq 0.$$

Given that we can write the social planner loss function in terms of the countries' authorities loss functions,

$$\mathbf{L} = \left[ \frac{1}{2}L_1 + \frac{1}{2}L_2 \right],$$

the first-order conditions of the minimization problem would be:

$$\frac{\partial \mathbf{L}}{\partial t_1} = \frac{1}{2} \left( \frac{\partial L_1}{\partial t_1} + \frac{\partial L_2}{\partial t_1} \right) = 0 \quad (32)$$

$$\frac{\partial \mathbf{L}}{\partial t_2} = \frac{1}{2} \left( \frac{\partial L_1}{\partial t_2} + \frac{\partial L_2}{\partial t_2} \right) = 0 \quad (33)$$

From these conditions it is clear that

$$\frac{\partial L_1}{\partial t_1} = -\frac{\partial L_2}{\partial t_1} \quad \text{and} \quad \frac{\partial L_2}{\partial t_2} = -\frac{\partial L_1}{\partial t_2}$$

which shows how the cooperative solution internalizes externalities. But the desirability of the cooperative solution will depend on the nature of the externality. If the externality has the same sign as the shock, the externality reinforces the effects of the shock. Subsequently, the cooperative solution requires a greater change of the policy instrument than the competitive solution. On the contrary, when the externality shows a different sign than the shock, the cooperative solution is the solution that requires the lowest change.

In order to avoid the spillover effects of their policies, the countries' authorities will try to minimize the use of the supply side variable. In this sense, they identify stabilization with avoiding changes in the policy instrument. In particular, we have modelled a loss function in which any change in the variables implies a loss of utility. Since the target variables are linear in the policy instruments, the solution that requires the smallest change in the supply side variable would be the optimal solution. So, in a first step, authorities will minimize their loss functions, and, in a second step, they will choose the solution (competitive or cooperative) leading to the lowest absolute value of the instrument:

$$t_i = \min \{ |t_{N,i}|, |t_{C,i}| \} \quad \forall i = 1, 2$$

### 3.2. *Desirability of Coordination*

Now we will show the effects of the authorities' decisions when coping with shocks. Each country of the monetary union has to minimize its loss function by choosing the optimal rate of change of the institutional variable, subject to the restrictions imposed by the international economic framework. In accordance with Game Theory literature, we will focus our analysis on the comparison between the competitive solution and the cooperative solution. In any case, the solutions will depend on the prevailing channel of transmission: the aggregate demand leading to the *locomotive effect*, or the interest rate and the real exchange rate leading to the *beggar-thy-neighbour effect*.

After analysing the solutions for the two alternatives, we obtain that (see Díaz-Roldán (2000b) for details):

*a)* For the *locomotive effect* case, if the authorities act individually, the solution requires a lower change in the institutional variable than if they coordinate. This result holds for real and monetary shocks, independently of the origin of the shock (from a country of the union, i.e.: a country-specific shock; or from the rest of the world). The reason is that the use of the institutional variable as a policy instrument leads to externalities with the same sign as the shock. In these cases, cooperation would be undesirable because it would reinforce the effects of the disturbance when internalizing externalities.

For supply shocks, supply policy coordination would be undesirable when shocks have their origin either within the two countries of the monetary union simultaneously, or in the rest of the world. But when the shock has its origin in only one of the countries of the monetary union, cooperation would be desirable but only for the country where the shock appears. Note that, in this case, cooperation would be also undesirable in general terms; in other words, cooperation would not be Pareto-optimal.

*b)* For the *beggar-thy-neighbour effect*, for all the shocks from the rest of the world, as well as monetary shocks originating within the union, externalities have the same sign as shocks. In those cases, the cooperative solution requires a greater change in the institutional variable than competitive solution; thus, cooperation would be undesirable, since it would reinforce the effects of the shock when internalizing externalities. In turn, for supply shocks from the monetary union, we obtain the same result as in the *locomotive effect* case: when the shock has its origin in only one of the countries of the monetary union, cooperation would be desirable but only for the country where the shock appears.

On the contrary, in the case of real shocks from the monetary union, cooperation would be desirable since externalities have the opposite sign as the shocks. In those cases, the cooperative solution requires a smaller change in the institutional variable than competitive solution.

To summarise, we can conclude that, if the monetary union's authorities include the budget deficit as an objective in their loss function, supply policy coordination would be desirable only when dealing with real shocks originating within the union, and when changes in the interest rate and the real exchange rate prevail as the channel of transmission. In Díaz-Roldán (2000a), we can find the opposite results for fiscal policy coordination, in that paper, coordination was

found to be desirable only when monetary and supply shocks originated within in the union, as well as for any kind of shock from the rest of the world.

Summarising the results obtained so far, the conditions under which coordination of supply policies would be desirable are shown in table 3.1. We can conclude that the results are determined not only by whether or not the shocks is country-specific, but also by its nature (monetary, real or supply-side), and the channel of transmission. In the case of supply shocks, cooperation between the member countries of the union is always undesirable, but when dealing with demand shocks, the channel of transmission proves to be determinant.

**Table 3. 1.**  
*Desirability of Supply Policy Coordination  
in a Monetary Union*

<i>Shock</i>	<i>Cooperation</i>
Monetary ( $m, m^*$ )	<b>Undesirable</b>
Real ( $f_1, f_2, f^*$ )	<ul style="list-style-type: none"> <li>• <i>Locomotive effect</i>: <b>undesirable</b>,</li> <li>• <i>Beggar-thy-neighbour effect</i>: <b>desirable</b>, when the shock has its origin within the monetary union, and <b>undesirable</b> for the rest of the cases.</li> </ul>
Supply ( $s_1, s_2, s^*$ )	<b>Undesirable</b>

#### 4. Conclusions

In this paper we analyse how the member countries of a monetary union can deal with shocks using coordinated supply-side policies, in the absence of an independent monetary policy and with restrictions in the use of fiscal policy. In order to offset the effects of the shocks, the authorities use as a policy instrument an institutional variable which could be interpreted as a way of harmonizing labour market institutions.

We have developed a three-country model in which two of the countries form a monetary union, and where a common independent central bank controls monetary policy. Next, we have used the Game Theory approach to analyse the authorities' strategic behaviour when deciding how to deal with shocks.

In our model, supply shocks had unambiguous effects on output and prices. On the contrary, the effects of demand shocks depended on the prevailing channel of transmission: when aggregate demand dominated, we had the *locomotive effect*, whereas if changes in the interest rate and the real exchange rate dominated, we had the *beggar-thy-neighbour effect*.

After analysing the solutions for the different cases, we concluded that in a monetary union with some restrictions on fiscal policy, supply policy coordination would be desirable only when the probability of suffering from real shocks originated within the union is higher, and providing that changes in the interest rate and the real exchange rate prevail as the channel of transmission. In other words, coordination would be desirable when facing shocks requiring a different policy response in each country, i.e., asymmetric shocks.

Linking this conclusion with that obtained by Díaz-Roldán (2002), we can conclude that the “size” of the monetary union (small or large) is not relevant for the results. In that article, supply-policy coordination was desirable only when dealing with country-specific real shocks originated within the small monetary union, and leading to different effects in each country, i.e., when shocks lead to the *beggar-thy-neighbour effect*. The same conclusion holds in this paper (see table 3.1), since in a large monetary union we add the shocks from the rest of the world, which affect the monetary union in a symmetric way. In other words, the desirability of supply-side intervention in a monetary union does not change when taking into account shocks from the rest of the world.

To conclude, the country-specific origin of the shocks would not be the only relevant characteristic in deciding whether to coordinate economic policies: the nature (demand or supply) and the channel of transmission of the shocks would be also relevant to determine the asymmetry of the shock. For this reason, it would be crucial to know what would be the channel of transmission and the kind of disturbances actually prevailing in a particular monetary union. Note that allowing for not-fully-anticipated shocks would lead to a stochastic version of the model. In general, the results above would hold even under this new assumption, though associated to the probability of occurrence of the shock.

A further extension to this paper might be to analyse the dynamic implications of flexible exchange rates. In Bajo-Rubio and Díaz-Roldán (2003), the traditional Mundell-Fleming plus aggregate supply model is modified in several ways, including a dynamic version of the model presented in this paper. In the dynamic model, perfect

capital mobility is defined in terms of the uncovered interest parity, so that interest rates are linked through changes in the exchange rate. Regarding demand shocks, the results would be equivalent to those obtained for the *beggar-thy-neighbour* effect in the static version of this paper. On the other hand, the results obtained for supply-side shocks show that the effects on prices would be ambiguous. Therefore, the most remarkable implication of introducing dynamics seems to be the reinforcement of the *beggar-thy-neighbour* effect, since during the transition dynamics, variations on the exchange rate lead to changes in the interest rate and so on. For that reason, the interest rate and the exchange rate would tend to dominate as channel of transmission.

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