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MACROECONOMIC STABILIZATION THROUGH MONETARY AND FISCAL POLICY COORDINATION: IMPLICATIONS FOR EUROPEAN MONETARY UNION

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ABSTRACT

In a two-country model, we consider the implications of monetary and fiscal policy coordination for macroeconomic stabilization. We show that the optimal regime is one of monetary and fiscal policy coordination under flexible exchange rates. In the context of the European Community, this suggests that the desire to fix exchange rates may not be costless. In addition, we show that, under an asymmetric demand shock, fiscal coordination requires a relatively high degree of flexibility in fiscal policy. This suggests that limits on the flexibility of fiscal policies, as suggested in the Delors Report, may hinder macroeconomic stabilization.

Macroeconomic Stabilization Through Monetary and Fiscal Policy Coordination: Implications for European Monetary Union

Jay H. Bryson[1]

1. Introduction

Upon entering Stage Three on the road to monetary union, the member states of the European Community will enter an economic policy regime in which monetary policy, by necessity, will be coordinated, but fiscal policy may or may not be coordinated.[2] Because it is very likely that these economies will continue to experience stochastic disturbances, it would be useful to know the implications of simultaneous monetary and fiscal policy coordination for macroeconomic stabilization. Although the literature on macroeconomic policy coordination has become quite voluminous, it does not, to our knowledge, address these implications. The objective of this paper is to begin to fill this void and to use the results to address the implications of monetary and fiscal policy coordination for macroeconomic stabilization in the proposed European Monetary Union (EMU).

The early literature on policy coordination addressed either monetary coordination, ignoring fiscal considerations, or fiscal coordination, ignoring monetary considerations. The contributions of Canzoneri and Gray (1985) and Canzoneri and Henderson (1988, 1991) provide very useful insights into macroeconomic stabilization through monetary policy coordination; however, these contributions ignore fiscal policy considerations. Although eschewing monetary policy considerations, Kehoe (1987) and Turnovsky (1988) analyze the gains from fiscal coordination through very elegant deterministic neo-classical models. De Grauwe

[1] The author is a staff economist in the Division of International Finance. This paper represents the views of the author and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff. I would like to thank, without implicating, Dale Henderson, David VanHoose, Henrik Jensen and participants in the Division of International Finance Workshop at the Federal Reserve for helpful comments and suggestions.

[2] In Stage Three, exchange rates will become irrevocably fixed and a common currency may eventually replace individual country currencies. For a description of the different stages on the road to EMU see Commission of the European Communities (1989).

(1990) considers the stabilizing properties of fiscal policy coordination in a stochastic environment, but ignores the implications of monetary policy.

Some recent papers incorporate monetary and fiscal policies in the same model. Van der Ploeg (1992) considers the stabilizing properties of fiscal policy within various exchange rate regimes; however, monetary policy is exogenously specified and is not used as a stabilization tool. Sheen (1992) analyzes the stabilizing nature of monetary and fiscal policy coordination under various assumptions about supply behavior but does not consider both policies simultaneously. Bryson, Jensen, and VanHoose (1993) consider the implications of simultaneous monetary and fiscal policy coordination, but do so in a non-stochastic framework.

To address the implications of monetary and fiscal policy coordination for macroeconomic stabilization, we consider two interdependent economies that experience stochastic disturbances. Monetary and fiscal authorities in a domestic and foreign country choose their respective policies to minimize specified social loss functions. We consider two separate policy regimes under two separate exchange rate regimes. In the first policy regime, monetary policies are coordinated through the minimization of a joint social loss function. However, fiscal policies are chosen non-cooperatively. In the second policy regime, monetary and fiscal policies both are coordinated. We consider both of these policy regimes under a flexible exchange rate and under a fixed exchange rate. We then analyze the stabilizing properties of these four permutations not only in the face of a common productivity shock, the focus of much of the coordination literature, but also in the face of a demand shock that switches expenditure from the foreign country to the domestic country.[3] Thus, we consider eight separate cases.[4]

The results suggest three issues that are relevant for EMU. First, the social loss associated with a regime of monetary and fiscal policy coordination is always less than that

[3] Notable exceptions to the focus on common productivity shocks include von Hagen and Fratianni (1991) and Currie, Levine, and Pearlman (1992). Both papers consider asymmetric shocks.

[4] To keep the paper to a reasonable length and to focus on cases most relevant for EMU, we do not report results for a regime of insular monetary and fiscal policymaking. Our general conclusions are not altered by this omission.

associated with a regime in which only monetary policy is coordinated. This result suggests that the need for fiscal policy coordination that is emphasized in the Maastricht Accord is well-founded. Second, if monetary and fiscal policies are coordinated, the social loss associated with a fixed exchange rate is never less than that associated with a flexible exchange rate. This result suggests that the desire to fix exchange rates among EC member states may not be costless. Third, the stabilization of an asymmetric demand shock when monetary and fiscal policies are coordinated may require a relatively high degree of fiscal policy flexibility. This result suggests that limits on the flexibility of fiscal policies, as suggested in the Delors Report, may hinder macroeconomic stabilization.

The paper is organized as follows: Section 2 presents a two-country model under flexible exchange rates and compares the stabilizing properties of the policy regimes in the face of two separate disturbances. Section 3 does the same for a fixed exchange rate. Section 4 compares outcomes between the flexible and fixed exchange rate regimes. Section 5 offers conclusions and some implications for stabilization policy under EMU.

2. Flexible Exchange Rate Regime

2.1 The Model

We consider an extension of the two-country model of Canzoneri and Henderson (1988). Each country is specialized in the production of one good, but consumers in both countries consume both goods. All variables are expressed in logarithmic form and time subscripts are suppressed where possible for notational convenience.

The supply curves, which are derived in the appendix, are given by

$$y = \alpha p + (1+\alpha)\chi \qquad (1)$$

$$y^* = \alpha p^* + (1+\alpha)\chi \qquad (1^*)$$

where y (y^*) is output of the domestic (foreign) good, p (p^*) is the price of the domestic (foreign) good, and χ is a white noise productivity shock common to both countries.

We assume that the only asset held by residents of each country is the money of that country[5] . The money market equilibrium conditions can be written

$$y + p = m \tag{2}$$

$$y^* + p^* = m^* \tag{2*}$$

where m (m^*) is the domestic (foreign) money supply. The equilibrium conditions for domestic and foreign goods are given by

$$y = \delta(p^* + e - p) + (1-\beta)y + \beta y^* + g + v \tag{3}$$

$$y^* = \delta(p - p^* - e) + (1-\beta)y^* + \beta y + g^* - v \tag{3*}$$

where e is the nominal exchange rate expressed in units of domestic currency per unit of foreign currency, g (g^*) is domestic (foreign) government spending on the domestic (foreign) good, v is a white noise demand shock that switches expenditure from the foreign good to the domestic good, hereafter referred to as an asymmetric demand shock, and β is the marginal propensity to import where $0 < \beta \leq 0.5$.[6]

By setting $p_{t-1} = p^*_{t-1} = e_{t-1} = 0$, CPI inflation is given by

$$\Psi = (1-\beta)p + \beta(p^* + e) \tag{4}$$

$$\Psi^* = (1-\beta)p^* + \beta(p - e) \tag{4*}$$

Employment, derived in the appendix, is given by

$$n = \alpha_1(p + \chi) \tag{5}$$

$$n^* = \alpha_1(p^* + \chi) \tag{5*}$$

Solving equations (1) - (3) yields the following semi-reduced-form expressions:

$$y = \alpha_0 m + \chi \qquad y^* = \alpha_0 m^* + \chi$$

$$p = (1-\alpha_0)m - \chi \qquad p^* = (1-\alpha_0)m^* - \chi$$

$$e = \frac{\delta(1-\alpha_0) + \alpha_0\beta}{\delta}(m - m^*) - \frac{1}{2\delta}(g - g^*) - \frac{1}{\delta}v \tag{6}$$

[5] In an earlier version of the paper, we assumed that residents hold the money of their country plus a bond that is perfectly substitutable for the bond in the other country. Under this assumption, the following money market and goods market equilibrium conditions are functions of the world interest rate. Because the qualitative nature of the following results do not change, we eschew interest rate considerations.

[6] Because bonds do not appear in the model, g could be thought of as a balanced budget change in government spending.

$$\Psi = \frac{\delta(1-\alpha_0) + \alpha_0\beta^2}{\delta} m - \frac{\alpha_0\beta^2}{\delta} m^* - \frac{\beta}{2\delta}(g - g^*) - \chi - \frac{\beta}{\delta} v$$

$$\Psi^* = -\frac{\alpha_0\beta^2}{\delta} m + \frac{\delta(1-\alpha_0) + \alpha_0\beta^2}{\delta} m^* + \frac{\beta}{2\delta}(g - g^*) - \chi + \frac{\beta}{\delta} v$$

$$n = m \qquad n^* = m^*$$

A domestic monetary expansion, which creates an excess supply of domestic money, raises the price of the domestic good and thereby increases domestic employment and output. The resulting excess supply of goods induces a nominal exchange rate depreciation to equilibrate the domestic goods market. The increase in the price of the domestic good and the exchange rate depreciation raise the domestic CPI. In this model, the effect of fiscal policy is confined to the goods market. A domestic fiscal expansion, which creates an excess demand for domestic goods, induces nominal exchange rate appreciation and thereby produces domestic (foreign) disinflation (inflation).[7]

A negative (positive) productivity shock, which by assumption affects both countries symmetrically, lowers (raises) output levels and raises (lowers) prices, but has no effect on the exchange rate. A negative (positive) productivity shock has no effect on employment because the resulting decrease (increase) in labor demand is offset by higher (lower) prices. An asymmetric demand shock, which appreciates the exchange rate, produces domestic (foreign) disinflation (inflation).

The domestic social loss function is

$$\Phi = (1/2)[\Psi^2 + \mu_1 n^2 + \mu_2 g^2] \tag{7}$$

and the foreign counterpart is

$$\Phi^* = (1/2)[(\Psi^*)^2 + \mu_1 (n^*)^2 + \mu_2 (g^*)^2] \tag{7*}$$

That is, we assume that deviations of CPI inflation, employment, and government spending from

[7] Fiscal policy would affect prices and the levels of employment and output if interest rates were added to money demand.

target levels, here normalized to zero, reduce social welfare.[8]

2.2 Productivity Shock

As discussed above, a negative productivity shock raises domestic and foreign CPI inflation but leaves domestic and foreign employment unaffected. In what follows, we consider two different policy regimes to respond to the disturbance: a regime of monetary coordination in which the monetary authorities optimize a joint social loss function but the fiscal authorities act in an insular fashion, and a "combined" coordination regime of monetary and fiscal policy coordination.[9]

Under monetary coordination, the domestic monetary authority chooses the domestic money supply so that

$$\partial\Phi/\partial m + \partial\Phi^*/\partial m = 0 \tag{8}$$

while the foreign monetary authority chooses the foreign money supply so that

$$\partial\Phi^*/\partial m^* + \partial\Phi/\partial m^* = 0 \tag{8*}$$

The domestic [foreign] fiscal authority chooses domestic [foreign] government spending to minimize (7) [(7*)]. The equilibrium policy choices and resulting reduced-form expressions for inflation and employment are (where MC implies monetary coordination)

$$m^{MC} = n^{MC} = m^{*MC} = n^{*MC} = \frac{(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\chi$$

$$g^{MC} = g^{*MC} = \frac{-\beta\mu_1}{2\delta\mu_2[(1-\alpha_0)^2 + \mu_1]}\chi \tag{9}$$

[8] The inclusion of CPI inflation and employment in the social loss function is standard in the stabilization literature. The inclusion of the third argument implies that there is some optimal level of government spending, here normalized to zero. Below this level, there is a social loss associated with say, insufficient spending on infrastructure, while above this level, excessive government spending could result in long-term solvency problems. This term also can serve as a proxy for the preoccupation with fiscal imbalances in the Delors Report and the subsequent Maastricht Accord. Cohen and Wyplosz (1989) and van der Ploeg (1992) also include government spending in the social loss function.

[9] Following Canzoneri and Henderson (1988), we assume that policymakers can credibly commit to coordinate macroeconomic policies.

$$\psi^{MC} = \psi^{*MC} = \frac{-\mu_1}{(1-\alpha_0)^2 + \mu_1}\,\chi$$

A negative productivity shock, which raises domestic and foreign CPI inflation, induces expansionary fiscal policies and contractionary monetary policies.[10] Although the money supply reductions contribute to less rapid inflation, they lower employment levels.

Under a regime of combined coordination, the monetary and fiscal authorities both optimize the joint social loss function.[11] Hence, monetary authorities continue to choose their respective money supplies to satisfy (8) and (8^*). The domestic fiscal authority chooses domestic government spending so that

$$\partial\Phi/\partial g + \partial\Phi^*/\partial g = 0 \tag{10}$$

and the foreign fiscal authority chooses foreign government spending so that

$$\partial\Phi^*/\partial g^* + \partial\Phi/\partial g^* = 0 \tag{10^*}$$

The equilibrium policy choices and resulting reduced-form expressions for inflation and employment are (where CC implies "combined coordination")

$$m^{CC} = n^{CC} = m^{*CC} = n^{*CC} = \frac{(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\,\chi$$

$$g^{CC} = g^{*CC} = 0 \tag{11}$$

$$\psi^{CC} = \psi^{*CC} = \frac{-\mu_1}{(1-\alpha_0)^2 + \mu_1}\,\chi$$

Comparing (11) to (9) reveals that $m^{CC} = m^{MC}$, $n^{CC} = n^{MC}$, $\psi^{CC} = \psi^{MC}$, and $g^{CC} < g^{MC}$. The domestic fiscal authority, which acts in an insular fashion in the MC regime, perceives an *ex ante* opportunity to export inflation to the foreign country through exchange rate appreciation that results from fiscal expansion. Likewise, the foreign fiscal authority perceives the same *ex ante* opportunity; however, *ex post*, the exchange rate remains unchanged

[10] It can be shown that monetary policies are less contractionary under monetary coordination than under a regime in which the monetary authorities act in an insular fashion. This result supports Canzoneri and Henderson (1988).

[11] Because the domestic (foreign) monetary authorities have the same welfare function as the domestic (foreign) fiscal authorities, this regime is similar to a regime in which monetary and fiscal policies are coordinated not only across countries but also within countries.

due to the symmetry of the model. When fiscal policy is coordinated, this externality is internalized, thereby reducing the *ex ante* incentive for fiscal expansion. Indeed, the optimal fiscal policy response under fiscal policy coordination is zero due to the inability of fiscal policy to affect prices and employment levels.[12] Because CPI inflation and employment are equal in the two regimes but government spending is lower under CC, the social loss is unambiguously lower under CC than under MC.[13]

2.3 Asymmetric Demand Shock[14]

An asymmetric demand shock causes exchange rate appreciation thereby producing domestic (foreign) disinflation (inflation). Employment levels initially are unchanged. When monetary authorities coordinate but fiscal authorities act in an insular fashion, the equilibrium policy choices and reduced-form expressions are

$$m^{MC} = n^{MC} = -m^{*MC} = -n^{*MC} = \frac{2\beta\mu_2|\,\delta(1-\alpha_0)+2\alpha_0\beta^2\,|}{2\mu_2|\,\delta(1-\alpha_0)+2\alpha_0\beta^2\,|^2+\mu_1|\,\beta^2+2\delta^2\mu_2\,|}\,v$$

$$g^{MC} = -g^{*MC} = \frac{-\beta^2\mu_1}{2\mu_2|\,\delta(1-\alpha_0)+2\alpha_0\beta^2\,|^2+\mu_1|\,\beta^2+2\delta^2\mu_2\,|}\,v \qquad (12)$$

$$\psi^{MC} = -\psi^{*MC} = \frac{-2\beta\delta\mu_2\mu_1}{2\mu_2|\,\delta(1-\alpha_0)+2\alpha_0\beta^2\,|^2+\mu_1|\,\beta^2+2\delta^2\mu_2\,|}\,v$$

The optimal domestic (foreign) monetary response is expansionary (contractionary). An increase in the domestic money supply causes exchange rate depreciation, thereby offsetting the domestic (foreign) disinflation (inflation). Analogous reasoning holds for the

[12] This result was also found in an earlier version of the paper in which fiscal policy affected prices.
[13] The movement from a situation in which only a subset of players coordinate to a situation in which all players coordinate can explain this welfare improvement also.
[14] A symmetric demand shock could be completely offset with monetary policy in both regimes; consequently, there would be no gain (or loss) from fiscal coordination.

contractionary foreign response.[15] To induce exchange rate depreciation also, the domestic (foreign) fiscal authority lowers (raises) government spending.

Under a regime of combined coordination, the equilibrium policy choices and reduced-form expressions are

$$m^{CC} = n^{CC} = -m^{*CC} = -n^{*CC} = \frac{\beta\mu_2[\delta(1-\alpha_0)+2\alpha_0\beta^2]}{\mu_2[\delta(1-\alpha_0)+2\alpha_0\beta^2]^2+\mu_1[\beta^2+\delta^2\mu_2]}\nu$$

$$g^{CC} = -g^{*CC} = \frac{-\beta^2\mu_1}{\mu_2[\delta(1-\alpha_0)+2\alpha_0\beta^2]^2+\mu_1[\beta^2+\delta^2\mu_2]}\nu \qquad (13)$$

$$\psi^{CC} = -\psi^{*CC} = \frac{-\beta\delta\mu_2\mu_1}{\mu_2[\delta(1-\alpha_0)+2\alpha_0\beta^2]^2+\mu_1[\beta^2+\delta^2\mu_2]}\nu$$

It can be shown that $g^{CC} < g^{MC}$ ($g^{*CC} > g^{*MC}$), that is, domestic (foreign) fiscal policy is more contractionary (expansionary) under CC than under MC. Under MC, the domestic (foreign) fiscal authority, which sets its policy taking other policies as given, perceives an *ex ante* opportunity to export disinflation (inflation) to the foreign (domestic) country through exchange rate depreciation. Constraining the domestic (foreign) fiscal authority's desire to reduce (raise) domestic (foreign) government spending is the social cost of fiscal deviation. The *ex post* increase (decrease) in foreign (domestic) government spending produces more exchange rate depreciation, and therefore more exportation of disinflation (inflation), than the domestic (foreign) fiscal authority perceives *ex ante*. That is, from the standpoint of the domestic (foreign) authorities, the foreign (domestic) fiscal response pushes the exchange rate in the right direction.

Under CC, the fiscal authorities internalize this externality and recognize *ex ante* the welfare gain from further policy action. For the domestic (foreign) fiscal authority, the marginal gain from further exportation of disinflation (inflation) outweighs the marginal

[15] It can be shown that monetary policies are more responsive under monetary coordination than under a regime in which the monetary authorities act in an insular fashion. This result holds because a coordinating monetary authority internalizes the beneficial effect its policy has on the inflation rate of the other country. Note the contrast with a common productivity shock where monetary coordination induces less monetary policy activism.

cost of further fiscal deviation. Therefore, the domestic (foreign) fiscal authority contracts (expands) more under CC than under MC. Consequently, $\Psi_t^{MC} < \Psi_t^{CC}$ (i.e. more domestic disinflation occurs under MC) and $\Psi_t^{*MC} > \Psi_t^{*CC}$ (i.e. more foreign inflation occurs under MC).

In addition, it can be shown that $m^{CC} < m^{MC}$ ($m^{*CC} > m^{*MC}$), and hence, $n^{CC} < n^{MC}$ ($n^{*CC} > n^{*MC}$). That is, domestic (foreign) monetary policy is less expansionary (contractionary) under CC than under MC due to the greater fiscal response under CC. Substitution of the above expressions into the welfare functions shows that the social loss is unambiguously higher under MC than under CC.

3. Fixed Exchange Rate Regime

3.1 The Model

Under a fixed exchange rate regime, the supply curves continue to be given by (1). The equilibrium conditions for the domestic and foreign goods become

$$y = \delta(p^* - p) + (1-\beta)y + \beta y^* + g + v \qquad (14)$$

$$y^* = \delta(p - p^*) + (1-\beta)y^* + \beta y + g^* - v \qquad (14^*)$$

The only difference between (14) and (3) is the exclusion of the exchange rate in the former. The money market equilibrium conditions are

$$y + p = d + r \qquad (15)$$

$$y^* + p^* = - r \qquad (15^*)$$

where d is the domestic credit component of the monetary base and r is foreign exchange reserves. The expressions in (15) reflect the fact that only one central bank can have an independent monetary policy under a fixed exchange rate.

Solving equations (1), (14), and (15) yields the following semi-reduced-form expressions:

$$y = \frac{\alpha_0}{2} d + \frac{\alpha_0}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) + \chi + \frac{\alpha_0}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$y^* = \frac{\alpha_0}{2} d - \frac{\alpha_0}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) + \chi - \frac{\alpha_0}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$p = \frac{(1-\alpha_0)}{2} d + \frac{(1-\alpha_0)}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) - \chi + \frac{(1-\alpha_0)}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$p^* = \frac{(1-\alpha_0)}{2} d - \frac{(1-\alpha_0)}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) - \chi - \frac{(1-\alpha_0)}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$r = -\frac{1}{2} d + \frac{1}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) + \frac{1}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v \qquad (16)$$

$$\Psi = \frac{(1-\alpha_0)}{2} d + \frac{(1-\alpha_0)(1-2\beta)}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) - \chi + \frac{(1-\alpha_0)(1-2\beta)}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$\Psi^* = \frac{(1-\alpha_0)}{2} d - \frac{(1-\alpha_0)(1-2\beta)}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) - \chi - \frac{(1-\alpha_0)(1-2\beta)}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$n = \frac{1}{2} d + \frac{1}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) + \frac{1}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

$$n^* = \frac{1}{2} d - \frac{1}{4[\alpha_0\beta + \delta(1-\alpha_0)]}(g - g^*) - \frac{1}{2[\alpha_0\beta + \delta(1-\alpha_0)]} v$$

An expansion of domestic credit creates an excess supply of domestic money that raises the domestic price, thereby increasing domestic employment and output. In addition, the excess supply of domestic money creates a domestic balance-of-payments deficit, and therefore a foreign balance-of-payments surplus that induces identical effects on foreign variables.

A domestic fiscal expansion creates an excess demand for the domestic good that raises its price, thereby increasing domestic employment and output. The domestic price increase creates a domestic excess demand for money that induces a balance-of-payments surplus that reduces the foreign price, which in turn reduces foreign employment and output. A foreign fiscal expansion has exactly converse effects. Therefore, fiscal expansion is a beggar-thy-neighbor policy.

The effects of a productivity shock under a fixed exchange rate are identical to those under a flexible exchange rate, but the effects of a demand shock differ between the two regimes. Whereas a demand shock under a flexible exchange rate causes domestic (foreign) disinflation (inflation) but leaves real variables unaffected, a demand shock under a fixed exchange rate creates domestic (foreign) inflation (disinflation) and raises (lowers) the levels of domestic (foreign) employment and output.

In what follows, monetary coordination will imply a situation in which the domestic monetary authority optimizes the joint social loss function.[16] That is, the domestic monetary authority chooses domestic credit so that

$$\partial\Phi/\partial d + \partial\Phi^{*}/\partial d = 0 \tag{17}$$

The reserve flows between the domestic and foreign country that are induced by the change in domestic credit will insure that the change in the foreign money supply equals the change in the domestic money supply, thereby keeping the exchange rate fixed.

3.2 Productivity Shock

A negative productivity shock raises domestic and foreign CPI inflation but leaves domestic and foreign unemployment unaffected. When the domestic monetary authority optimizes the joint social loss function but fiscal authorities act in an insular fashion, the equilibrium policy choices and reduced-form expressions are

$$d^{MC} = \frac{2(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\chi$$

$$g^{MC} = g^{*MC} = \frac{-(1-\alpha_0)\beta\mu_1}{2\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]\,[(1-\alpha_0)^2 + \mu_1]}\chi \tag{18}$$

$$\psi^{MC} = \psi^{*MC} = \frac{-\mu_1}{(1-\alpha_0)^2 + \mu_1}\chi$$

[16] In the context of EMU, this could represent a common monetary policy that is determined by the ECB which is mindful of each member's welfare.

$$n^{MC} = n^{*MC} = \frac{(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\chi$$

To offset the inflationary impact of the shock, the domestic monetary authority reduces domestic credit thereby creating a domestic balance-of-payments surplus which in turn reduces the foreign money supply. The money supply reductions cause the employment levels to fall in each country. To offset lower employment, fiscal authorities raise government spending in their respective countries.

Under monetary and fiscal policy coordination, the equilibrium policy choices and reduced-form expressions are

$$\begin{aligned} d^{CC} &= \frac{2(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\chi \\ g^{CC} &= g^{*CC} = 0 \\ \psi^{CC} &= \psi^{*CC} = \frac{-\mu_1}{(1-\alpha_0)^2 + \mu_1}\chi \\ n^{CC} &= n^{*CC} = \frac{(1-\alpha_0)}{(1-\alpha_0)^2 + \mu_1}\chi \end{aligned} \tag{19}$$

Comparing (18) to (19) reveals that $d^{CC} = d^{MC}$, $n^{CC} = n^{MC}$, $\psi^{CC} = \psi^{MC}$, and $g^{CC} < g^{MC}$. In the MC regime, the domestic fiscal authority perceives an *ex ante* opportunity to offset lower employment resulting from monetary contraction. Likewise, the foreign fiscal authority perceives the same *ex ante* opportunity; however, due to the beggar-thy-neighbor effect of fiscal policy the *ex post* employment levels remain depressed. When fiscal policy is coordinated, this externality is internalized, thereby causing the *ex ante* fiscal response to equal zero. Because inflation and employment are equal in the two regimes but government spending is lower under CC, welfare is unambiguously higher under CC than under MC.

3.3 Asymmetric Demand Shock

By switching expenditure from the foreign good to the domestic good, an asymmetric demand shock creates domestic inflation and raises the level of domestic employment while causing converse changes in foreign variables. When the domestic monetary authority optimizes the joint social loss function but fiscal authorities act in an insular fashion, the equilibrium policy choices and reduced-form expressions are

$$d^{MC} = 0$$

$$g^{MC} = -g^{*MC} = \frac{-[(1-\alpha_0)^2(1-2\beta)^2 + \mu_1]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 8\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v$$

$$\psi^{MC} = -\psi^{*MC} = \frac{4\mu_2(1-\alpha_0)(1-2\beta)[\alpha_0\beta + \delta(1-\alpha_0)]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 8\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v \qquad (20)$$

$$n^{MC} = -n^{*MC} = \frac{4\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 8\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v$$

Because the demand shock has identically opposite effects on domestic and foreign variables, the optimal response by the domestic monetary authority, who optimizes the joint social loss function, is to keep domestic credit unchanged. To offset higher (lower) employment, the domestic (foreign) fiscal authority reduces (increases) government spending.

Under monetary and fiscal policy coordination, the equilibrium policy choices and reduced-form expressions are

$$d^{CC} = 0$$

$$g^{CC} = -g^{*CC} = \frac{-[(1-\alpha_0)^2(1-2\beta)^2 + \mu_1]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 4\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v$$

$$\psi^{CC} = -\psi^{*CC} = \frac{2\mu_2(1-\alpha_0)(1-2\beta)[\alpha_0\beta + \delta(1-\alpha_0)]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 4\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v \qquad (21)$$

$$n^{CC} = -n^{*CC} = \frac{2\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]}{(1-\alpha_0)^2(1-2\beta)^2 + \mu_1 + 4\mu_2[\alpha_0\beta + \delta(1-\alpha_0)]^2}\,v$$

It can be shown that $g^{CC} < g^{MC}$ ($g^{*CC} > g^{*MC}$), that is, domestic (foreign) fiscal policy is more contractionary (expansionary) under CC than under MC. Under MC, the domestic fiscal

authority perceives an *ex ante* opportunity to reduce inflation and employment through fiscal contraction. Likewise, the foreign fiscal authority perceives an *ex ante* opportunity to reduce disinflation and unemployment through fiscal expansion. Constraining each fiscal authority is the social cost of fiscal deviation. The beggar-thy-neighbor effect of fiscal policy causes more *ex post* reduction in domestic (foreign) inflation (disinflation) and employment (unemployment) than perceived *ex ante*. Analogous to combined coordination under flexible exchange rates, the foreign (domestic) fiscal response pushes the domestic (foreign) price in the right direction from the standpoint of the domestic (foreign) authorities .

Under CC, the fiscal authorities internalize this externality and recognize *ex ante* the welfare gain from further policy action. For the domestic (foreign) fiscal authority, the marginal gain from further inflation (disinflation) and employment (unemployment) reduction outweighs the marginal cost of further fiscal deviation. Therefore, domestic (foreign) fiscal policy is more contractionary (expansionary) under CC than under MC. Consequently, $\Psi_t^{MC} > \Psi_t^{CC}$ and $\Psi_t^{*MC} < \Psi_t^{*CC}$. In addition $n^{MC} > n^{CC}$ and $n^{*MC} < n^{*CC}$. Substituting the expressions in (20) and (21) into the welfare functions shows that the social loss is unambiguously higher under MC than under CC.

4. Exchange Rate Regime Comparisons

In the above analysis, we held the exchange rate regime constant and compared outcomes between policy regimes. To ascertain the implications of the exchange rate regime choice, we now hold the policy regime constant and compare outcomes between exchange rate regimes.

Consider the case of a common productivity shock. Comparison of (9) with (18) reveals that in the absence of fiscal policy coordination a flexible exchange rate will yield the same inflation rate and employment level but more fiscal expansion than a fixed exchange rate. Under a flexible exchange rate, each fiscal authority perceives an *ex ante* opportunity to export inflation through exchange rate appreciation. Under a fixed exchange rate, the

incentive for fiscal expansion is dampened due to its inflationary effect. Consequently, fiscal policy under a fixed exchange rate is less expansionary than under a flexible exchange rate. Because the only difference between the two exchange rate regimes is more fiscal expansion under a flexible exchange rate, the social loss is lower under a fixed exchange rate when fiscal policies are not coordinated.[17]

Under combined coordination, fiscal authorities internalize their respective policy externality. Regardless of the exchange rate regime, fiscal policy will be unresponsive to the common productivity shock as inspection of (11) and (19) confirms. In addition, the exchange rate regimes produce the same inflation and employment outcomes. Consequently, the exchange rate regimes are equivalent under combined coordination.[18]

From the results of Sections 2 and 3 we can conclude that regardless of the exchange rate regime, a regime of combined coordination dominates a regime in which only monetary policy is coordinated. Given that combined coordination is the optimal policy regime, the choice of exchange rate regime becomes immaterial due to their equivalence. Therefore, the optimal regime in the face of a common productivity shock is one of combined coordination with the choice of exchange rate regime being immaterial.

Now consider the case of an asymmetric demand shock. It can be shown that in the absence of fiscal policy coordination, domestic (foreign) fiscal policy is more contractionary (expansionary) under a fixed exchange rate regime. As discussed above, under a fixed exchange rate the optimal response by the domestic monetary authority, who optimizes the joint social loss function, is to keep domestic credit unchanged. Therefore, fiscal policy must carry the entire stabilization burden.

Comparison of the inflation and employment outcomes in (12) and (20) are in general ambiguous. However, it can be shown that as $\beta \rightarrow 1/2$, that is as the economy becomes more

[17] This result supports Canzoneri and Gray (1985) and Laskar (1993) who show that in the face of a symmetric shock a fixed exchange rate regime, in which monetary coordination is implicit, is welfare-superior to a flexible exchange rate regime in which monetary policies are chosen noncooperatively. However, our result depends on the different endogenous response of fiscal policy between the two exchange rate regimes rather than on the behavior of monetary authorities.

[18] This result supports Laskar (1993) who finds that monetary coordination under a flexible exchange rate is equivalent to a fixed exchange rate.

open, the variance of inflation is higher under a flexible exchange rate. This is due to the identically opposite effect that the demand shock under a fixed exchange rate has on the domestic and foreign price. When $\beta = 1/2$, the lower foreign price just offsets the higher domestic price so that the consumer price indices are unchanged. In addition, as $\beta \rightarrow 1/2$ the variance of employment is higher under a fixed exchange rate regime. Substituting the expressions in (12) and (20) into the social loss functions reveals that the social loss is higher under a fixed exchange rate. Therefore, a flexible exchange rate is the optimal exchange rate regime in the absence of fiscal policy coordination.

The comparisons discussed above hold also under combined coordination. Therefore, we can conclude that regardless of the policy regime, a flexible exchange rate dominates a fixed exchange rate. This makes intuitive sense given that the shock is asymmetric. Given that a flexible exchange rate is the optimal exchange rate choice, combined coordination dominates a regime in which only monetary policy is coordinated. Therefore, the optimal regime in the face of an asymmetric demand shock is one of combined coordination under flexible exchange rates.

5. Conclusion

In the above analysis, we employed a simple model to further our understanding of the optimal stabilization policy when two countries can credibly commit to monetary and fiscal policy coordination. Our general conclusion is that given the exchange rate regime and given the stochastic disturbance, a regime of monetary and fiscal policy coordination between symmetric countries should always be chosen over a regime in which only monetary policy is coordinated. However, given the choice of monetary and fiscal policy coordination, the desirability of the exchange rate regime depends on the stochastic disturbance. If the disturbance is a common supply shock, the choice of exchange rate regime is immaterial. However, if the disturbance is an asymmetric demand shock, a flexible exchange rate should be

chosen over a fixed exchange rate. Therefore, as the prevalence of asymmetric shocks increases, the more desirable a flexible exchange rate becomes.

In the context of the European Community, Bayoumi and Eichengreen (1992) show that the shocks affecting EC countries are significantly more idiosyncratic than the shocks affecting the United States. The above analysis suggests that monetary and fiscal policy coordination under a flexible rate may be the optimal stabilization policy for EC countries. However, the desire to fix exchange rates among EC countries is based on many considerations other than optimal stabilization policy. Now that the Maastricht Treaty has been ratified by all twelve EC member states, the inexorable march toward fixed exchange rates will continue although as the recent widening of fluctuation bands suggest, the journey may be far from smooth.

Given that exchange rates among EC countries inevitably will be fixed, the above analysis holds other relevance for EMU. If fiscal policies are coordinated under fixed exchange rates and if the shocks that hit EC countries are mainly common productivity shocks, then fiscal policy flexibility is relatively unnecessary; the common monetary policy can act as the common stabilization policy. However, if the shocks that hit EC countries are mainly asymmetric demand shocks, fiscal policy flexibility is desirable. Moreover, fiscal policy coordination, which the Maastricht Accord explicitly mandates, requires even more policy flexibility than insular fiscal policymaking. Therefore, limits on the flexibility of fiscal policies, as suggested in the Delors Report, may hinder macroeconomic stabilization.

Appendix: Derivation of Employment and Supply Curves

The production function is

$$Y_t = N_t^{(\alpha_0)} X_t \qquad 0 < \alpha_0 < 1 \tag{A1}$$

where capital letters represent the level of a variable. Setting the marginal productivity of labor equal to the real wage and rearranging yields approximately the demand for labor

$$n_t = \alpha_1 (p_t - w_t + \chi_t) \qquad \alpha_1 = 1/(1-\alpha_0) \tag{A2}$$

The supply of labor is

$$n_t = \lambda (w_t - c_t) \qquad \lambda > 0 \tag{A3}$$

where c_t, the consumer price index, can be written

$$c_t = (1-\beta) p_t + \beta (p_t^* + e_t) \qquad 0 < \beta \leq 0.5 \tag{A4}$$

where e_t is the nominal exchange rate expressed in units of domestic currency per unit of foreign currency. Equating (A2) and (A3) and rearranging yields the market-clearing wage

$$w_t = p_t + \frac{\lambda\beta}{\alpha_1 + \lambda} z_t + \frac{\alpha_1}{\alpha_1 + \lambda} \chi_t \tag{A5}$$

where z_t is the real exchange rate. We assume that in time period t-1 workers and firms negotiate the wage rate that will prevail in time period t to be the expected market-clearing rate. Workers will then supply whatever labor is demanded at that wage rate. Because we assume all shocks are white noise, the negotiated wage rate is

$$w_t = 0 \tag{A6}$$

Substituting (A6) into (A2) yields employment

$$n_t = \alpha_1 (p_t + \chi_t) \tag{A7}$$

and substituting (A7) into the logarithmic transformation of (A1) yields the supply function given in the text where $\alpha = \alpha_0/(1-\alpha_0)$. An analogous derivation produces the foreign supply curve.

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