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# Transatlantic Trade-Offs in the Age of Balanced Budgets and European Monetary Union

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*Abstract*

We develop a model of monetary and fiscal policies appropriate for considering U.S.-European policy interactions in an era of near-balanced budgets and European monetary union. We study the determinants of policy trade-offs and incentives for central banks and governments across the Atlantic. Smaller, more open economies face more favorable trade-offs, since openness enhances policy effectiveness via the exchange-rate channel. Changes in Europe's monetary arrangements do not affect U.S. trade-offs, although they alter the trade-offs facing European policy-makers. Fiscal trade-offs depend crucially on the extent to which fiscal policy is distortionary. Changes in taxes and spending move both employment and inflation in the desired direction following a worldwide supply shock when spending is financed with distortionary taxes.

Transatlantic interdependence and policy coordination is an old issue, but the setting at the beginning of the 21st century is new. The chronic U.S. and European budget deficits that dominated the 1980s and 1990s, respectively, are arguably behind us. Europe's monetary union is a fact. What remain as determinants of transatlantic policy interactions are fiscal distortions and Europe's new monetary regime.

This paper therefore develops a model of monetary and fiscal policies appropriate for considering U.S.-European policy interactions in an era of near-balanced budgets and European monetary union. This allows us to study how fiscal distortions affect the interaction of central banks and governments within countries and between them.[1] It allows us to consider how strategic interactions are affected by Europe's exchange-rate regime.[2]

We made a start at analyzing transatlantic monetary and fiscal policy interactions in Eichengreen and Ghironi (1997). There we extended Canzoneri and

Henderson's (1991) canonical three-country model of monetary interactions to consider fiscal policy. We analyzed two polar cases: the standard Keynesian case in which taxes are non-distortionary and spending increases are expansionary and the non-Keynesian (or "anti-Keynesian") case, sometimes thought to apply in Europe, where decreases in spending and distortionary taxes have expansionary effects (see Giavazzi and Pagano, 1990, 1996[3]). Our analysis was limited by the assumption that fiscal policy had the same effects in all countries. In this paper, we extend that framework to show how policy-makers' trade-offs change as the nature of fiscal policy varies in a continuum that goes from Keynesian to the anti-Keynesian. And, we allow the effects of fiscal policies to vary across countries.

Our main findings are as follows. When fiscal policy is anti-Keynesian, changing taxes and spending is capable of moving both inflation and employment in the desired direction following a worldwide supply shock that raises inflation and unemployment. Lower taxes cause firms to demand more labor, and prices to decline because of the increased supply of goods.[4] Smaller, more open economies face more favorable policy trade-offs, since openness enhances the effectiveness of policy via the exchange-rate channel. Changes in Europe's monetary arrangement do not affect U.S. policy makers' trade-off, although they do alter the mechanism through which fiscal policy is transmitted in Europe and thus the trade-offs facing European fiscal policy-makers. In the Keynesian case, in contrast, all countries face the same positively-sloped trade-off regardless of the exchange-rate regime. Increases in spending stimulate both output and inflation.

A numerical exercise reinforces the conclusions of our 1997 study. While governments in the U.S. and Europe would like the European Central Bank (ECB) and the Federal Reserve to coordinate their policies following a supply shock, the monetary policy-makers themselves have little incentive to do so. Intra-European fiscal cooperation can be counterproductive, whereas cooperation between governments and central banks in each economy can be beneficial.

The rest of the paper is organized as follows. Section 1 presents the model. Section 2 analyzes policy trade-offs and the consequences of changes in the exchange-rate regime and the nature of fiscal policy. Section 3 focuses on the relationship between fiscal distortions and economic stability. Section 4 analyzes a numerical example, while Section 5 touches upon the issue of optimal fiscal reforms. Section 6 concludes.

## 1. The model

The model builds on Canzoneri and Henderson's (1991) setup, extended to include fiscal policy.[5] The world is divided into three countries. Two of these—Core and Periphery—together constitute Europe, which is symmetric in size to the Rest-of-the-World economy, the United States. All variables denote deviations from zero-disturbance values and are expressed in logarithms, except in the

case of interest rates, public expenditures, and taxes. Time subscripts are dropped where possible.

The outputs of the three countries are imperfect substitutes in consumption. Output $(y^j)$ in country $j$ $(j = US, C, P)$ is an increasing function of employment $(n^j)$ and a decreasing function of a world productivity disturbance $(x)$:

$$y^j = (1-\alpha)n^j - x, \tag{1}$$

where $0 < \alpha < 1$. The disturbance $x$ is identically and independently distributed with zero mean. Henceforth, $j = US, C, P$ unless otherwise noted.

The specification of fiscal policy builds on Alesina and Tabellini (1987) and Eichengreen and Ghironi (1997). A fraction $k^j$ of the firms in each country is subject to distortionary taxation of revenues, while a fraction $(1-k^j)$ is subject to lump-sum taxation. As $k^j$ increases, fiscal policy becomes increasingly non-Keynesian, while standard Keynesian results are more likely when $k^j$ is small. We allow the fraction of firms that are subject to distortionary taxes to be different across countries.

Each firm is a price taker in the output and labor market and is taxed on its total revenues. Optimal labor demand of country $j$'s firms that are subject to distortionary taxes is $n^j_{k^j} = (1/\alpha)[-\tau^j - (w^j - p^j) - x]$, where $\tau^j$ indicates the rate of taxation of revenues, $w^j$ is the nominal wage, and $p^j$ is the domestic producer price index. When taxes are lump sum, the $\tau$-term in the previous equation disappears and labor demand is $n^j_{1-k^j} = (1/\alpha)[-(w^j - p^j) - x]$. Total labor demand in country $j$ is given by $n^j = k^j n^j_{k^j} + (1-k^j)n^j_{1-k^j}$, which can be rewritten as:

$$w^j - p^j = -\alpha n^j - k^j \tau^j - x. \tag{2}$$

Consumer price indices $(q^j)$ are weighted averages of the prices of U.S., Core, and Periphery goods. American consumers allocate a fraction $\beta$ of their spending to European goods (half to each) so the U.S. CPI is:

$$q^{US} = (1-\beta)p^{US} + \frac{1}{2}\beta(p^C + e^1) + \frac{1}{2}\beta(p^P + e^2) = p^{US} + \frac{1}{2}\beta(z^1 + z^2): \tag{3}$$

where exchange rates $e^1$ and $e^2$ are the dollar prices of the Core and Periphery currencies, respectively, and $z^1$ and $z^2$ are the corresponding real exchange rates: $z^1 = e^1 + p^C - p^{US}$ and $z^2 = e^2 + p^P - p^{US}$.

European consumers allocate a fraction $\beta$ of their spending to the U.S. good and divide the rest equally between the two European goods. The European CPIs are:

$$\begin{aligned} q^C &= \frac{1}{2}(1-\beta)p^C + \frac{1}{2}(1-\beta)(p^P + e^2 - e^1) + \beta(p^{US} - e^1) \\ &= p^C - \beta z^1 - \frac{1}{2}(1-\beta)(z^1 - z^2), \end{aligned}$$

$$q^P = \frac{1}{2}(1-\beta)p^P + \frac{1}{2}(1-\beta)(p^C + e^1 - e^2) + \beta(p^{US} - e^2)$$
$$= p^P - \beta z^2 - \frac{1}{2}(1-\beta)(z^2 - z^1), \tag{4}$$

where the Periphery/Core real exchange rate is $z^1 - z^2$. We make the reasonable assumption $\beta < 1/2$: consumers allocate a larger fraction of their spending to goods produced in the continent where they reside.

Equilibrium conditions for the three goods are:

$$\begin{aligned}
2y^{US} &= \delta z^1 + \delta z^2 + 2(1-\beta)\varepsilon y^{US} + \beta\varepsilon(y^C + y^P) - 2(1-\beta)\nu r^{US} \\
&\quad - \beta\nu(r^C + r^P) + 2(1-\eta)g^{US} + \eta(g^C + g^P) + 2u, \\
y^C &= -\delta z^1 - \frac{1}{2}\delta(z^1 - z^2) + \beta\varepsilon y^{US} + \frac{1}{2}(1-\beta)\varepsilon(y^C + y^P) - \beta\nu r^{US} \\
&\quad - \frac{1}{2}(1-\beta)\nu(r^C + r^P) + \eta g^{US} + \frac{1}{2}(1-\eta)(g^C + g^P) - u, \\
y^P &= -\delta z^2 + \frac{1}{2}\delta(z^1 - z^2) + \beta\varepsilon y^{US} + \frac{1}{2}(1-\beta)\varepsilon(y^C + y^P) - \beta\nu r^{US} \\
&\quad - \frac{1}{2}(1-\beta)\nu(r^C + r^P) + \eta g^{US} + \frac{1}{2}(1-\eta)(g^C + g^P) - u.
\end{aligned} \tag{5}$$

Demands for all goods increase with output. Residents of all countries increase their spending by the same fraction $(0 < \varepsilon < 1)$ of increases in output. The marginal propensity to spend is equal to the average propensity to spend for all goods for residents of all countries. The Core's propensity to import from the Periphery is one-half of one minus the Core's propensity to import from the U.S. Demands for all goods fall with *ex ante* real interest rates $(r^j)$. Residents of each country decrease spending by the same amount $(0 < \nu < 1)$ for each percentage point increase in the *ex ante* real interest rate facing them. Real depreciation of a currency shifts world demand toward that country's good. The random disturbance $u$ shifts world demand from European to U.S. goods. It is identically and independently distributed with zero mean.

We assume that fiscal policies are subject to the exogenous constraint of a balanced budget. Although strong, the assumption is roughly consistent with the constraints that most fiscal policy-makers face in the age of Europe's Economic and Monetary Union (EMU). The government budget constraint is $G^j = \tau^j k^j P^j Y^j + T^j(1 - k^j)$, where $G$ is government spending, and $T$ is revenue from lump-sum taxes. As $k^j$ increases, the fraction of government spending that is financed through distortionary taxes increases. Instead, if $k^j = 0$, all spending is financed through lump-sum taxation. $g^j$ in (5) denotes the ratio $G^j/P^jY^j$. Similarly, $t^j \equiv T^j/P^jY^j$. Thus,

$$g^j = \tau^j k^j + t^j(1 - k^j). \tag{6}$$

Government spending falls entirely on goods (transfers are considered negative taxes) and obeys the same pattern as private spending, with the parameter

$\eta$ replacing $\beta$. We assume $\eta < 1/2$ to capture the fact that each government is likely to devote a greater fraction of its expenditure to goods produced in its own continent. Also, $\eta$ is presumably not greater than $\beta$, as governments are not likely to spend more than private agents on foreign goods. Note that the Core and Periphery's governments are assumed to have identical spending propensities. This assumption may be justified by noting that the Maastricht Treaty prohibits discrimination in public procurement.

*Ex ante* real interest rates are: $r^j = i^j - E(q^j_{+1}) + q^j$, where $i^{US}, i^C$, and $i^P$ are nominal interest rates on bonds denominated in dollars, Core currency, and Periphery currency, respectively, and $E(\bullet_{+1})$ indicates the expected value of a variable tomorrow based on information available today.

Each country issues domestic-currency-denominated bonds. Investors regard bonds denominated in different currencies as perfect substitutes and hold positive amounts of all three bonds only when their expected returns measured in a common currency are equal: $i^{US} = i^C + E(e^1_{+1}) - e^1$ and $i^{US} = i^P + E(e^2_{+1}) - e^2$. It is easy to show that perfect capital mobility and identical spending patterns in Europe imply $r^C = r^P$.

Only its residents hold each country's currency. Demand for real money balances is:

$$m^j - p^j = y^j - \lambda i^j. \tag{7}$$

Substituting (1) into (7), solving for $p^j$, substituting into (2), and solving for employment, we obtain:

$$n^j = m^j - w^j - k^j \tau^j + \lambda i^j. \tag{8}$$

Nominal wages are predetermined according to contracts signed before the beginning of the current period by competitive unions and firms. Unions choose nominal wages to minimize the expected deviations of employment and the real wage from their zero-shock equilibrium values. We focus on the effects of fiscal distortions and international interactions, and thus we neglect the time inconsistency problems that may arise within each region in the interaction between authorities and the private sector. Besides, disturbances are unexpected. Under these assumptions, the expected values of all variables coincide with their no-disturbance equilibrium values, i.e., zero. Thus, optimal wage setting dictates $w^j = 0$. Substituting this into the expressions for employment and prices yields:

$$n^j = m^j - k^j \tau^j + \lambda i^j, \tag{9}$$

$$p^j = \alpha n^j + k^j \tau^j + x. \tag{10}$$

Each central bank chooses its instrument to minimize:

$$L^{cb^j} = \frac{1}{2}[a(q^j)^2 + (1-a)(n^j)^2], \tag{11}$$

where $0 < a < 1$ measures the weight central bankers attach to inflation relative to employment. The central bank's instrument can be either the money supply or a bilateral exchange rate depending on what exchange-rate regime we consider.

Given the budget constraint, governments have two instruments when $0 < k^j < 1$. We assume that these are the rate of distortionary taxation—$\tau$—and government spending—$g$. Lump-sum taxation—$t$—is determined residually. The government in each country chooses its instruments to minimize a quadratic loss function that depends on deviations of inflation, employment, and government spending from their equilibrium values. Country $j$'s government minimizes:

$$L^{gov^j} = \frac{1}{2}\{b_1[b_2(q^j)^2 + (1-b_2)(n^j)^2] + (1-b_1)(g^j)^2\}, \tag{12}$$

where $0 < b_1, b_2 < 1$. $b_1$ measures the degree of activism in the management of fiscal policy—the higher $b_1$, the higher the degree of activism. We assume that the volatility of spending is a cost for fiscal authorities to capture the idea that fiscal policy is difficult to fine tune relative to monetary policy. In addition, the assumption is required to avoid that a bliss equilibrium in which $q = 0$ and $n = 0$ is reached regardless of the policymaking regime. If $b_1 = 1$, governments face a 2-instruments-2-objectives situation whenever $0 < k^j < 1$. Appendix A shows that, if $b_1 = 1$ and $k^j = 0$ or $1$, $q = 0$ and $n = 0$ is the outcome of the strategic interaction between central bank and government inside each country.[6] $b_2$ measures the relative weight attached to inflation and employment by the fiscal authorities.

## 2. Fiscal distortions, exchange-rate regimes, and the government trade-off

### *2.1. Flexible exchange rates*

The solution of the model produces linear reduced forms for endogenous variables as functions of policy instruments and exogenous shocks. Under flexible exchange rates in Europe, European central banks control the respective money supplies, and the intra-European exchange rate is determined endogenously.[7] Here, we minimize on notation and provide information only on the sign of the policy multipliers and the impact of $k^j$. We assume that the restrictions on parameter values such that the policy multipliers have the signs shown below are satisfied. This happens for very reasonable parameter values. (More details on the reduced forms can be found in Eichengreen and Ghironi, 1999.)

The U.S. CPI is:

$$q^{US} = linear\left(\underset{+}{m^{US}}, \underset{=}{\frac{m^C + m^P}{2}}, \underset{+}{k^{US}}, \underset{+}{\tau^{US}}, \underset{+}{\frac{k^C\tau^C + k^P\tau^P}{2}}, \underset{+}{g^{US}}, \underset{+}{\frac{g^C + g^P}{2}}, \underset{+}{u}, \underset{+}{x}\right). \tag{13}$$

Policy multipliers for the effect of distortionary taxation are proportional to the corresponding $k^j$'s. U.S. inflation is an increasing function of the U.S. money supply, of U.S. and European distortionary taxes and government spending, and of the two shocks. It is a decreasing function of European money supplies. From the perspective of the U.S., the average stance of the policy instruments is all that matters as far as Europe is concerned. Monetary expansions in Europe cause U.S. inflation to decline by inducing an appreciation of the dollar. Increases in European taxes or spending generate excess demand for European goods by causing supply to fall relative to demand. European currencies appreciate in real terms, and U.S. inflation rises.

U.S. employment and Core inflation and employment are, respectively:

$$n^{US} = linear\left(\underset{+}{m^{US}}, \underset{-}{\frac{m^C + m^P}{2}}, \underset{-}{k^{US}\tau^{US}}, \underset{+}{\frac{k^C\tau^C + k^P\tau^P}{2}}, \underset{+}{g^{US}}, \underset{+}{\frac{g^C + g^P}{2}}, \underset{+}{u}, \underset{-}{x}\right), \tag{14}$$

$$q^C = linear\left(\underset{+}{m^C}, \underset{-}{m^P}, \underset{-}{m^{US}}, \underset{+}{k^C\tau^C}, \underset{+}{k^P\tau^P}, \underset{+}{k^{US}\tau^{US}}, \underset{+}{\frac{g^C + g^P}{2}}, \underset{+}{g^{US}}, \underset{-}{u}, \underset{+}{x}\right), \tag{15}$$

$$n^C = linear\left(\underset{+}{m^C}, \underset{+}{m^P}, \underset{-}{m^{US}}, \underset{-}{k^C\tau^C}, \underset{+}{k^P\tau^P}, \underset{+}{k^{US}\tau^{US}}, \underset{+}{\frac{g^C + g^P}{2}}, \underset{+}{g^{US}}, \underset{-}{u}, \underset{-}{x}\right). \tag{16}$$

Along with the effect of a change in aggregate European money supply on European employment, a monetary expansion in the Periphery affects employment in the Core through two interest-rate channels. On one side, it causes the average European interest rate to decrease relative to the U.S. This has a negative effect on employment in both European countries via money market equilibrium. On the other side, interest rates in the Core rise relative to the Periphery's, which tends to raise employment in the Core. If the intra-European effect is larger than the transatlantic one, a monetary expansion in the Periphery has a positive impact on employment in the Core. Higher taxes in the Periphery cause a real appreciation of its currency relative to the Core's. This generates inflation in the Core and demand for its goods. Only average European government spending matters for Core inflation and employment. Because European governments divide their spending evenly between Core and Periphery goods, their spending policies have no effect on the intra-European exchange rate.

Central bank trade-offs under this regime are defined by $(\partial q^j/\partial n^j)^{cb^j} \equiv (\partial q^j/\partial m^j)/(\partial n^j/\partial m^j)$. Ghironi and Giavazzi (1998) show that these trade-offs depend on the size of the economy for which the monetary policy-makers set their instruments. Central banks setting money supply for small and relatively open economies face steeper positively sloped trade-offs than authorities managing monetary policy for large economies. A steeper trade-off makes it possible to trade a larger reduction in inflation for any given decline in employment and

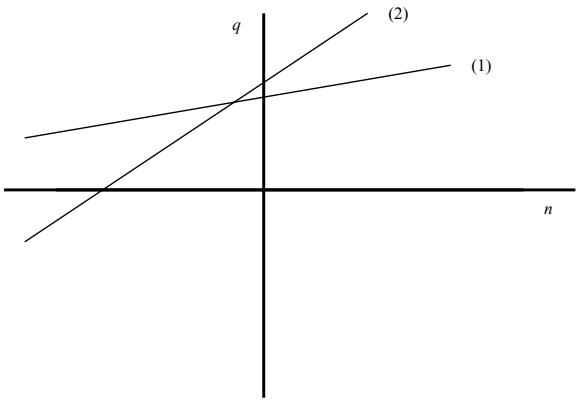


*Figure 1*. Central bank trade-offs. (1) Faced by: Fed, irrespective of exchange-rate regime in Europe; Core's central bank under managed exchange rates in Europe; ECB. (2) Faced by: Core's central bank under flexible exchange rates in Europe; Periphery's central bank under flexible and managed exchange rates in Europe.

is thus more favorable for relatively inflation-averse central banks. The intuition is simple. A relatively small economy consumes a large fraction of goods produced abroad. Hence, the fall in the CPI induced by, say, an exchange-rate appreciation is larger. At the same time, the impact of the appreciation on employment becomes smaller because foreign interest rates are less affected, while the domestic interest rate rises by more, thus reducing the fall in employment that is required to restore money market equilibrium. Given this result, and symmetry of European countries, under flexible exchange rates, both central banks in Europe face identical trade-offs, which are steeper than that facing the Federal Reserve (Fed). In Figure 1, and in the following figures, the trade-offs are centered in the disequilibrium situation generated by a positive realization of $x$, which causes inflation and unemployment in all countries.

The analysis of government trade-offs is easier if we start from the extreme cases. Suppose initially that $k^j = 1$ in all countries, so that we are in the fully anti-Keynesian case of Eichengreen and Ghironi (1997). In this case, governments face trade-offs defined by:

$$AK^j \equiv (\partial q^j/\partial n^j)^{gov^j}_{AK} \equiv (\partial q^j/\partial \tau^j)/(\partial n^j/\partial \tau^j). \tag{17}$$

These trade-offs are negatively sloped. A decrease in $\tau$ is expansionary and causes inflation to decline by increasing the supply of goods. Starting from the combination of inflation and unemployment induced by a negative supply shock, fiscal policy actually moves both variables in the desired direction. For unemployment-averse governments, a flatter trade-off is more favorable, as the economy moves closer to the situation of zero unemployment for any decrease in CPI inflation.

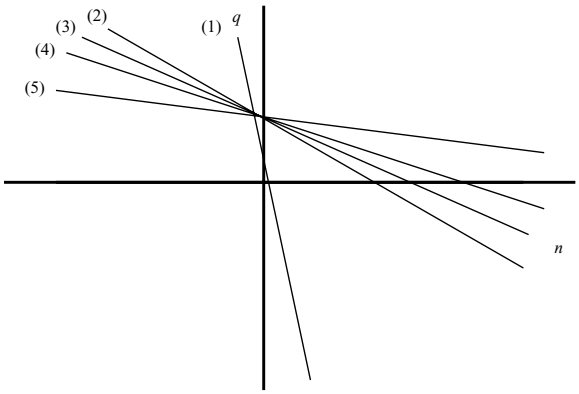


*Figure 2*. Government trade-offs, anti-Keynesian case: (1) Faced by U.S. government, irrespective of exchange-rate regime in Europe. (2) Faced by both Core and Periphery's governments under flexible exchange rates in Europe. (3) Faced by Core's government under managed exchange rates in Europe. (4) Faced by both European governments under Europe-wide EMU. (5) Faced by Periphery's government under managed exchange rates in Europe.

**Proposition 1.** *Under reasonable assumptions about parameter values, when* $k^j = 1$*, the governments of smaller and relatively open economies face flatter trade-offs than those of large ones.*

An intuitive proof is in Appendix B. Figure 2 displays the trade-offs facing governments in the anti-Keynesian case.

In the fully Keynesian case, in which $k^j = 0$ in all countries, governments face trade-offs:

$$K^j \equiv (\partial q^j/\partial n^j)^{gov^j}_K \equiv (\partial q^j/\partial g^j)/(\partial n^j/\partial g^j). \tag{18}$$

These trade-offs are positively sloped: increases in government spending cause both inflation and employment to increase. Following a shock that causes inflation and unemployment, fiscal policy moves only one variable in the desired direction. Nonetheless, a flatter trade-off remains more favorable because a larger employment gain can be traded for any given inflation loss.

**Proposition 2.** *Under our assumptions, governments face identical trade-offs when* $k^j = 0$*.*

An intuitive proof is in Appendix B.

We now turn to the intermediate situation in which $0 < k^j < 1$. In this case, governments control two policy instruments: spending and the rate of distortionary taxation, with lump-sum taxes determined residually. Hence, defining the trade-off facing the fiscal policy-maker is not straightforward. Each government faces a policy frontier that is a combination of the trade-off it would

face in the anti-Keynesian case and of that it would face in the fully Keynesian regime, and the exact position of which depends on the value of $k^j$. The overall trade-off can be defined as:

$$\left(\frac{\Delta q^j}{\Delta n^j}\right)^{gov^j} \equiv \left(\frac{\partial q^j}{\partial \tau^j} d\tau^j + \frac{\partial q^j}{\partial g^j} dg^j\right) \Big/ \left(\frac{\partial n^j}{\partial \tau^j} d\tau^j + \frac{\partial n^j}{\partial g^j} dg^j\right), \tag{19}$$

where $\Delta q^j$ and $\Delta n^j$ are different from the total differentials of $q^j$ and $n^j$, because we are holding other policy-makers' instruments constant. As $k^j$ approaches $0$, the trade-off approaches the positively sloped Keynesian line. When $k^j$ tends to $1$, the policy frontier approaches the negatively sloped anti-Keynesian line. Equation (19) says that, when the fiscal policy-maker can actively maneuver two instruments, the overall trade-off becomes endogenous to the policy choice. It is possible to verify that, if expression (19) is differentiated with respect to $k^j$, the sign of the resulting expression depends on the sign of $d\tau^j dg^j$. If both fiscal instruments are changed in the same direction, the slope of the overall trade-off increases with $k^j$, and the trade-off rotates counter-clockwise from the Keynesian to the anti-Keynesian position. Suppose, for example, that both $d\tau^j$ and $dg^j$ are positive. The numerator of (19) is positive. However, there exists a value of $k^j$—denoted by $\hat{k}^j$—such that the expansionary effect of an increase in spending is exactly counterbalanced by the contractionary effect of higher distortionary taxes, and fiscal policy has no effect on employment. When $k^j$ equals $\hat{k}^j$, the trade-off is vertical: fiscal policy has no effect on employment. As $k^j$ increases above $\hat{k}^j$, the contractionary impact of higher taxes more than offsets the expansionary effect of spending, and the slope of the trade-off becomes negative. When the slope becomes negative, being an increasing function of $k^j$ means that, if $k^j$ increases, the absolute value of the slope actually decreases, so that the line becomes flatter. These results are illustrated in Figure 3.

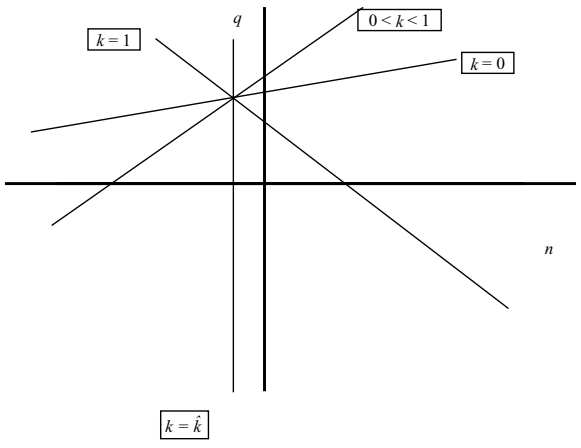


*Figure 3.* Government trade-off, $dg > 0, d\tau > 0$.

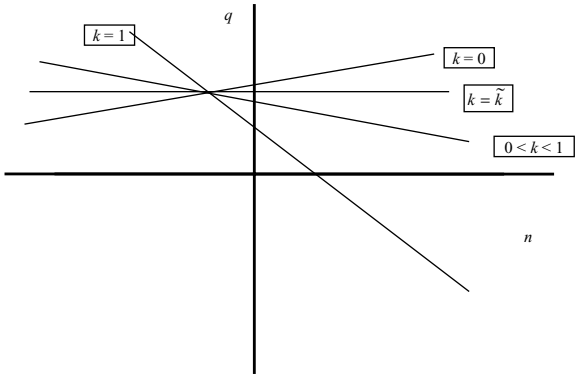


*Figure 4*. Government trade-off, $dg > 0, d\tau < 0$.

If the fiscal instruments are moved in different directions, the slope of the trade-off decreases with $k^j$. This means that the overall trade-off rotates clockwise from the Keynesian to the anti-Keynesian position. Suppose, for example, that $d\tau^j$ is negative and $dg^j$ is positive. In this case, the denominator of (19) is always positive, but there exists a value of $k^j$—denoted by $\tilde{k}^j$—such that the slope of the trade-off is zero. The inflationary effect of spending is exactly offset by the decrease in prices caused by lower taxes, and fiscal policy has no impact on inflation. As $k^j$ increases above the threshold $\tilde{k}^j$, the slope of the trade-off becomes negative, and its absolute value becomes larger the larger the fraction of firms that are subject to distortionary taxes. These results are illustrated in Figure 4.

Proposition 1 ensures that, for any value of $k^j$ such that $k^{US} = k^C = k^P$, European governments face more favorable overall trade-offs than the U.S.

### *2.2. Managed exchange rates in Europe*

Following Giavazzi and Giovannini (1989), we characterize an EMS-like monetary arrangement as a regime in which the Core central bank sets its money supply and the Periphery sets the Core/Periphery exchange rate.

The constraint to which monetary policy in the Periphery is subject under this regime can be written as:

$$m^P = linear\left(\underset{+}{m^C}, \underset{+}{e^1} - \underset{-}{e^2}, \underset{+}{k^P\tau^P} - \underset{-}{k^C\tau^C}\right). \tag{20}$$

Other things given, a monetary expansion in the Core causes money supply to increase in the Periphery. So does a devaluation of the Periphery's currency relative to the Core's. Instead, $k^P\tau^P > k^C\tau^C$ generates a decline in the Periphery's money supply.

Substituting Equation (20) into the reduced forms under flexible exchange rates yields reduced forms for this case. (see Eichengreen and Ghironi, 1999.) The asymmetry in the intra-European exchange-rate regime makes U.S. prices and employment sensitive to movements of the Periphery's currency against the Core's and to differences between weighted distortionary taxations in the two European economies. Because transatlantic effects have a larger impact on the U.S. economy than intra-European differences, higher distortionary taxes in the Core end up causing both U.S. inflation and employment to be higher. The following result holds.

**Proposition 3.** *U.S. trade-offs are not affected by changes in the intra-European exchange-rate regime.*

An intuitive proof is in Appendix B.

As we know from Ghironi and Giavazzi (1998), since it effectively sets the money supply for all of Europe (and since the U.S. and Europe are symmetric), the Core's central bank now faces the same employment-inflation trade-off as the Fed, worse than the trade-off it faced in the previous regime. The employment-inflation trade-off facing the Periphery's central bank under managed exchange rates is $(\partial q^P/\partial n^P)^{cb^P} \equiv [\partial q^P/\partial(e^1-e^2)]/[\partial n^P/\partial(e^1-e^2)]$. Because the change in regime does not affect the size of the economy for which the Periphery's central bank sets its instrument, nor the other determinants of the trade-off, this is identical to the trade-off the central bank faced under flexible exchange rates, and it is more favorable than that facing the Core's monetary authority (see Figure 1). The following results hold for European governments' trade-offs.

**Proposition 4.** *When $k^j = 1 (j = C, P)$, both European governments face flatter (more favorable) negatively sloped trade-offs under managed exchange rates than under flexible rates. The Periphery's government faces a flatter trade-off than the Core's.*

**Proposition 5.** *When $k^j = 0 (j = C, P)$, European governments' trade-offs are not affected by changes in the exchange-rate regime.*

Intuitive proofs are in Appendix B. Figure 2 illustrates also the results in Propositions 4 and 5. In the general case $0 < k^j < 1$, analogous conclusions to those reached before hold. The overall trade-off facing each government lies in between the Keynesian and the anti-Keynesian situation, with the exact position determined by the value of $k^j$. As before, the direction of rotation of the trade-off from the Keynesian to the anti-Keynesian position as $k^j$ varies between $0$ and $1$ depends on the sign of $d\tau^j dg^j$. If this is positive, the trade-off rotates counter–clockwise. Else, the rotation is clockwise. The following corollary follows immediately from Propositions 1–5.

**Corollary 1.** *For all values of* $k^j$ *such that* $0 < k^j \leq 1$ *and* $k^{US} = k^C = k^P$, *under managed exchange rates*, *the U.S. government faces the most unfavorable trade-off*, *while the Periphery's faces the most favorable*.

### *2.3. Europe-wide monetary union*

We now study the consequences of the transition to a monetary union that encompasses both European countries. Under this regime, the Core/Periphery nominal exchange rate is locked. The two countries' common monetary policy is managed subject to this constraint by a European Central Bank with preferences defined over aggregate European variables. The ECB chooses $m^{Eu} \equiv (m^C + m^P)/2$, the European money supply, to minimize:

$$L^{ECB} = \frac{1}{2}[a(q^{Eu})^2 + (1-a)(n^{Eu})^2], \tag{21}$$

where $q^{Eu} \equiv (q^C + q^P)/2$ and $n^{Eu} \equiv (n^C + n^P)/2$.

Reduced forms for U.S. inflation and employment are similar to those in Equations (13) and (14), with $m^{Eu}$ replacing the average of $m^C$ and $m^P$. Reduced forms for aggregate European inflation and employment can be obtained by symmetry.

Since the Maastricht Treaty does not require European governments to cooperate in the sense of jointly minimizing their loss functions, the Core and Periphery's governments can still play Nash and have preferences defined over national variables.[8] Following the same steps as in Eichengreen and Ghironi (1997), it is possible to show that $q^C = q^P = q^{Eu}$ under this regime. Differences in fiscal policies across European countries only affect employment. This can be seen by deriving the reduced forms for $n^C$ and $n^P$. From the reduced form for the Core/Periphery nominal exchange rate, $e^1 - e^2 = 0$ implies $m^P - m^C = linear(k^C\tau^C \underset{+}{-} k^P\tau^P)$. Another consequence of $e^1 - e^2 = 0$ is $i^C - i^P = 0$. Therefore, Equation (9) yields $n^P - n^C = m^P - m^C - (k^P\tau^P - k^C\tau^C) = linear(k^C\tau^C \underset{+}{-} k^P\tau^P)$. Differences between $k^C\tau^C$ and $k^P\tau^P$ imply differences in employment. (If fiscal policy had fully Keynesian effects in Europe, it would not affect the intra-European exchange rate. Therefore, Core and Periphery employment would be equalized.) Solving for $n^P$ and substituting the result into $n^C = 2n^{Eu} - n^P$ yields $n^C = n^{Eu} + linear(k^C\tau^C \underset{-}{-} k^P\tau^P)$. Finally, we obtain reduced forms for employment by taking the reduced form for $n^{Eu}$ into account. It is:

$$n^C = linear\left(m^{Eu}_{+}, m^{US}_{-}, k^C\tau^C_{-}, k^P\tau^P_{+}, k^{US}\tau^{US}_{+}, \frac{g^C + g^P}{2}_{+}, g^{US}_{+}, \underset{-}{u}, \underset{-}{x}\right). \tag{22}$$

The reduced form for $n^P$ follows from symmetry between Core and Periphery.

As pointed out above, the trade-offs facing the Fed and the U.S. government do not depend on the European exchange-rate regime. The ECB faces the

same trade-off as the Core's central bank under managed rates since both set monetary policy for the whole of Europe. The ECB's trade-off is therefore the same as that facing the Fed. Also, we know from the previous results that, when $k^j = 0$, all governments face identical trade-offs, and the common trade-off is the same as under managed exchange rates. The following result holds for the other extreme case.

**Proposition 6.** *When fiscal policies are anti-Keynesian under Europe-wide EMU, the European governments face identical negatively sloped trade-offs that are more favorable than the U.S. government's. The trade-off facing the Core's government is better than under managed exchange rates, while the trade-off facing the Periphery's government is worse (but still better than the trade-off it faced under float).*

An intuitive proof is in Appendix B. As under managed rates, when $k^j$ increases from $0$ to $1$, the trade-off rotates from the Keynesian to the anti-Keynesian line. For any given common value of $k^j$ between $0$ and $1$, the European governments continue to face identical trade-offs that are more favorable than the U.S. government's, as a consequence of country size and the exchange rate regime.

## 3. Economic stability and fiscal distortions

In this section, we analyze how small changes in the extent to which fiscal policy is distortionary at home or abroad affect policy-makers' losses after a negative supply shock that causes inflation and unemployment, such as an increase in the price of oil. We omit most technical details. They can be found in Eichengreen and Ghironi (1999).

We assume temporarily that central banks are tied to inaction, and governments are the only players actively involved in stabilization. This assumption will be motivated below. We focus on the case of noncooperative fiscal policies when $0 < k^j < 1$. Once the shock is observed, each government chooses the levels of its policy instruments $\tau$ and $g$ to minimize the loss function (12). Using (17), the first-order condition for the choice of $\tau^j$ is:

$$\tilde{q}^j/\tilde{n}^j = -(1 - b_2)/(b_2 A K^j), \tag{23}$$

where a tilde denotes (Nash) equilibrium levels of variables. Proposition 7 and its corollary follow immediately.

**Proposition 7.** *Knowledge of the trade-off the fiscal authority would face in the fully anti-Keynesian case and of the relative weight it attaches to inflation and employment in its loss function is sufficient to determine the equilibrium level of the inflation-employment ratio.*

**Corollary 2.** *Changes in the extent to which fiscal policy is Keynesian in any of the three countries have no impact on the equilibrium level of country $j$'s inflation-employment ratio.*

Relatively unemployment-averse governments prefer higher values of (the absolute value of) the inflation-employment ratio to lower ones. (When the ratio is high, employment is kept closer to its zero-shock equilibrium level for any given level of inflation.) Hence, as expected, governments prefer a relatively flat anti-Keynesian trade-off to a steep one.

Reasoning as for Proposition 7, it is also possible to show that changes in any of the three countries' $k$ inside the interval $(0, 1)$ have no impact on country $j$'s equilibrium spending-employment ratio.

Using these results, we can write the differential of government $j$'s loss function with respect to $k^l (l = US, C, P)$ as:

$$\partial \tilde{L}^{gov^j}/\partial k^l = \tilde{n}^j(\partial \tilde{n}^j/\partial k^l)\{b_1[b_2(\tilde{q}^j/\tilde{n}^j)^2 + 1 - b_2] + (1 - b_1)(\tilde{g}^j/\tilde{n}^j)^2\}. \quad (24)$$

The expression in curled brackets is unambiguously positive. $\tilde{n}^j$ can be either negative or positive. To determine the sign of $\partial \tilde{L}^{gov^j}/\partial k^l$, we need to determine the sign of $\partial \tilde{n}^j/\partial k^l$.

Consider the U.S. economy. Envelope theorem considerations ensure that marginal changes in $k^l$ have second-order effects on the equilibrium values of policy instruments, which can be neglected. The signs of policy multipliers (and the fact that governments react to a combination of inflation and unemployment by lowering taxes) make it possible to conclude that, *regardless of the European exchange-rate regime*: $\partial \tilde{n}^{US}/\partial k^{US} \cong (\partial \tilde{n}^{US}/\partial \tilde{\tau}^{US})(\tilde{\tau}^{US}/k^{US}) > 0$, $\partial \tilde{n}^{US}/\partial k^C \cong (\partial \tilde{n}^{US}/\partial \tilde{\tau}^C)(\tilde{\tau}^C/k^C) < 0$, and $\partial \tilde{n}^{US}/\partial k^P \cong (\partial \tilde{n}^{US}/\partial \tilde{\tau}^P)(\tilde{\tau}^P/k^P) < 0$. An increase in the extent to which U.S. fiscal policy is anti-Keynesian allows the U.S. government to achieve higher employment. When $\tilde{n}^{US} < 0$, this means better employment stabilization. Instead, in this case, larger fiscal distortions abroad are harmful. If $\tilde{n}^{US} > 0$, more employment means less stability around the zero-shock equilibrium value. In this case, higher $k^{US}$ is harmful, whereas larger fiscal distortions in Europe are beneficial. Analogous results hold for the European countries. We thus have the following proposition.

**Proposition 8.** *If $\tilde{n}^j < 0$, larger domestic fiscal distortions are beneficial for employment stabilization after a supply shock that causes inflation and unemployment, whereas increases in the foreign $k$'s are harmful, regardless of the exchange rate regime. Hence, governments suffer smaller (larger) losses when domestic (foreign) fiscal policy is more anti-Keynesian. Opposite conclusions hold if $\tilde{n}^j > 0$.*

In Section 2, we observed that flatter trade-offs are more favorable for governments, as they make it possible to achieve more employment stability for any

given change in inflation. Focus on the case $\tilde{n}^j < 0$. When governments react to the supply shock we consider here, they lower taxes and raise spending. Hence, as $k^j$ increases between $0$ and $1$, the overall trade-off facing government $j$ rotates clockwise from the Keynesian position to the anti-Keynesian. This means that when the slope of the overall trade-off becomes negative, further increases in $k^j$ actually make it steeper. This seems at odds with the finding that an increase in the extent to which domestic fiscal policy is anti-Keynesian is beneficial. However, this is only superficially so. Recall Proposition 7 and Corollary 2: given $b_2$, knowledge of the anti-Keynesian trade-off alone (as opposed to the overall trade-off) is sufficient to determine the equilibrium inflation-employment ratio. The latter is not affected by changes in any country's $k$, because these do not affect the anti-Keynesian trade-off. However, the equilibrium level of employment *is* affected by $k^j$. If domestic fiscal policy is more anti-Keynesian, the government gains even if, once negatively sloped, the overall trade-off is becoming steeper. Why is this so? Recall Equation (9). The distortionary fiscal instrument has a direct effect on employment that is proportional to the level of taxation, $k^j$ being the constant of proportionality. Government spending affects employment only indirectly. Thus, for given values of the anti-Keynesian and Keynesian trade-offs, governments favor situations in which they can rely more heavily on the instrument that is more effective for stabilization purposes. Ideally, as long as $b_2$ is sufficiently small, government $j$ would like to face a relatively flat anti-Keynesian trade-off (because this yields a more favorable inflation-employment ratio) and a relatively high value of $k^j$ (because this makes it possible to rely more heavily on the most effective instrument).

The intuition for the harmful effect of increases in foreign $k$'s is analogous. For given foreign anti-Keynesian and Keynesian trade-offs, higher $k$'s allow foreign governments to be more effective in their stabilization policies. In particular, they give them a strategic advantage in affecting exchange rates and exporting unemployment abroad.

Similar results hold for central banks. It is possible to show that, if $\tilde{n}^j < 0$, central banks are better off if domestic fiscal policy is marginally more anti-Keynesian; they are worse off if foreign fiscal policy is more anti-Keynesian. Opposite conclusions hold if $\tilde{n}^j > 0$.

We now motivate the assumption of this section that monetary policy-makers are inactive. The reader can easily verify that if country $j$'s central bank reacts to the shock and the government is maneuvering two instruments, the only solution of the stabilization game is one in which country $j$'s policy-makers achieve a bliss situation of zero losses. The only case in which this does not happen is the interaction between the ECB and European governments in the Europe-wide EMU regime, as long as $k^C \neq k^P$. If the nature of fiscal policy differs across countries in the monetary union, the assumption of central bank's inaction is actually not necessary to avoid a trivial bliss situation. This is because the ECB's loss function is defined over *aggregate* European inflation and employment, whereas European governments are concerned about *national*

employment. Their nationalistic concern prevents them—and the ECB—from achieving a bliss point![9,10] The following propositions summarize this argument.

**Proposition 9.** *If country $j$'s government and central bank are both active, if their loss functions are defined over the same measures of inflation and employment, and if $0 < k^j < 1$, both authorities reach their bliss points regardless of country size, the exchange-rate regime, and the value of $k^j$.*

**Proposition 10.** *Under Europe-wide EMU, if both monetary and fiscal policy are active in Europe and $0 < k^j < 1 (j = C, P)$, European policy-makers reach their bliss points if $k^C = k^P$.*

The latter proposition suggests that *harmonization* of fiscal policies in Europe may prove more profitable than coordination arrangements that could still fall short of yielding the first best equilibrium.

## 4. European monetary regimes and the prospects for cooperation

In this section, we analyze policy-makers' optimal reactions to a supply side disturbance that causes inflation and unemployment in all countries with the aid of a numerical example. We assume the same consensus values for structural parameters and the weights attached to targets in policy-makers' loss functions as in Eichengreen and Ghironi (1997). Table 1 displays parameter values.

Our choices are reasonable based on empirical evidence. $(1-\alpha)$, for instance, corresponds to the share of labor in a Cobb-Douglas production function, and a share of capital equal to 1/3 is not unrealistic. (An implicit assumption of our model is that capital remains at its zero-disturbance equilibrium level in the short run.) Consumers and governments have a strong preference for goods produced in their own continent. We assume a relatively high value for $\delta$ to capture a potentially high sensitivity of trade flows to the real exchange rate. $\varepsilon$ is the fraction of increases in output by which consumers in all regions increase their planned spending, a value of .8 does not seem far from reality. The value of $\nu$ is significantly lower because interest income can be thought of as less relevant in affecting consumption. It could be argued that the value of $\lambda$ is relatively high for a short-run model such as ours, although .5 would be the value suggested by a standard Baumol-Tobin model of money demand. Our parameter choice has the advantage of generating a significant impact of the supply shock on employment and a non-negligible external effect of domestic policies on foreign employment under flexible exchange rates. Central banks (governments) care more about inflation (employment). The penalty for volatile fiscal policy is substantial. Although numerical results can be sensitive to the choice of parameter values, the findings of our exercise will be consistent with the general theoretical intuition from the policy-makers' trade-offs. This lends robustness to the exercise.

*Table 1.* Structural parameters, target weights, and numerical values, reduced forms.

| | | | | |
|---|---|---|---|---|
| $\alpha = .34$ | $\beta = .1$ | $\delta = .8$ | $\varepsilon = .8$ | $\nu = .4$ |
| $\eta = .1$ | $\lambda = .6$ | $a = .9$ | $b_1 = .2$ | $b_2 = .1$ |

(a) Flexible exchange rates

$$q^{US} = .26m^{US} - .02(m^C + m^P)/2 + .18g^{US} + .09g^C + .11\tau^P + .93x;$$
$$n^{US} = .75m^{US} - .03(m^C + m^P)/2 + .64g^{US} + .22g^C + .24\tau^P - .21x;$$
$$q^C = .39m^C - .13m^P - .02m^{US} + .09g^C + .29\tau^P + .19g^{US} + .93x;$$
$$n^C = .72m^C + .03m^P - .03m^{US} + .32g^C + .27\tau^P + .43g^{US} - .21x;$$
$$q^P = .39m^P - .13m^C - .02m^{US} + .09g^C + .46\tau^P + .19g^{US} + .93x;$$
$$n^P = .72m^P + .03m^C - .03m^{US} + .32g^C - .83\tau^P + .43g^{US} - .21x.$$

(b) Managed exchange rates

$$q^{US} = .26m^{US} - .02m^C - .02(e^1 - e^2) + .18g^{US} + .09g^C + .11\tau^P + .93x;$$
$$n^{US} = .75m^{US} - .03m^C - .03(e^1 - e^2) + .64g^{US} + .22g^C + .25\tau^P - .21x.$$
$$q^C = .26m^C - .02m^{US} + .09g^C + .33\tau^P + .19g^{US} - .24(e^1 - e^2) + .93x;$$
$$q^P = .26m^C - .02m^{US} + .09g^C + .33\tau^P + .19g^{US} + .75(e^1 - e^2) + .93x;$$
$$n^C = .75m^C - .03m^{US} + .32g^C + .26\tau^P + .43g^{US} + .06(e^1 - e^2) - .21x;$$
$$n^P = .75m^C - .03m^{US} + .32g^C - 1.07\tau^P + .43g^{US} + 1.38(e^1 - e^2) - .21x.$$

(c) Europe-wide EMU

$$q^{US} = .26m^{US} - .02m^{Eu} + .18g^{US} + .09g^C + .11\tau^P + .93x;$$
$$n^{US} = .75m^{US} - .03m^{Eu} + .63g^{US} + .22g^C + .24\tau^P - .21x;$$
$$q^{Eu} = .26m^{Eu} - .02m^{US} + .09g^C + .38\tau^P + .19g^{US} + .93x;$$
$$n^{Eu} = .75m^{Eu} - .03m^{US} + .32g^C - .28\tau^P + .43g^{US} - .21x;$$
$$n^C = .75m^{Eu} - .03m^{US} + .32g^C + .38\tau^P + .43g^{US} - .21x;$$
$$n^P = .75m^{Eu} - .03m^{US} + .32g^C - .94\tau^P + .43\tau^{US} - .21x.$$

We assume that fiscal policy is entirely Keynesian in the U.S. and in the Core European country—$k^{US} = k^C = 0$—whereas it is entirely anti-Keynesian in the Periphery—$k^P = 1$. On one side, this assumption allows us to keep the analysis simple. On the other side, fiscal adjustment in the U.S. and in core European countries has been such that fiscal policy is more likely to have Keynesian effects there, while non-Keynesian features may be a better depiction of reality for more peripheral European countries. We refer the reader to our 1997 paper "How Will Transatlantic Policy Interactions Change with the Advent of EMU?" for the cases in which policy is either fully anti-Keynesian or fully Keynesian in all countries. Central banks are active players. $k^j$ being either $0$ or $1$ prevents any player from reaching a bliss point. Table 1 presents the key reduced form equations for the exchange rate regimes we consider. Numerical values of the trade-offs facing policy-makers are in Table 2. Equilibrium values of policy instruments, endogenous variables, and loss functions are in Tables 3–5, respectively.

*Table 2*. The players' trade-offs.

| | Federal Reserve | Core's CB | Periphery's CB | ECB, Europe-wide EMU |
|---|---|---|---|---|
| Flexible rates | .3534 | .5449 | .5449 | |
| Managed rates | .3534 | .3534 | .5449 | |
| Europe-wide EMU | .3534 | | | .3534 |
| | U.S. gov. | Core's gov. | Periphery's gov. | |
| Flexible rates | .0276 | .0276 | −.5542 | |
| Managed rates | .0276 | .0276 | −.3084 | |
| Europe-wide EMU | .0276 | .0276 | −.3990 | |

*Table 3*. Optimal values of the policy instruments[a].

| | Flexible rates | Managed rates | Europe-wide EMU | EMU-A | EMU-B | EMU-C | EMU-D |
|---|---|---|---|---|---|---|---|
| $m^{US}$ | $-1.9649x$ | $-1.9252x$ | $-1.9443x$ | $-1.9069x$ | $-2.0193x$ | $-1.9786x$ | $-.7289x$ |
| $m^{C}$ | $-2.2205x$ | $-1.8485x$ | | | | | |
| $m^{P}$ | $-2.2432x$ | | | | | | |
| $m^{Eu}$ | | | $-1.8805x$ | $-1.8411x$ | $-1.9786x$ | $-1.9369x$ | $-.8216x$ |
| $g^{US}$ | $.2141x$ | $.2133x$ | $.2134x$ | $.2098x$ | $.2145x$ | $.2107x$ | $.0398x$ |
| $g^{C}$ | $.1244x$ | $.1062x$ | $.1081x$ | $.1061x$ | $.2016x$ | $.1978x$ | $.0309x$ |
| $\tau^{P}$ | $-.2765x$ | $-.3227x$ | $-.2557x$ | $-.2512x$ | $-.1564x$ | $-.1538x$ | $-.4999x$ |
| $e^{1}-e^{2}$ | | $-.1991x$ | | | | | |

[a]EMU-A = Europe-wide EMU with cooperation between the ECB and the Fed;
EMU-B = Europe-wide EMU with fiscal cooperation in Europe;
EMU-C = Europe-wide EMU with fiscal cooperation in Europe and cooperation between the ECB and the Fed;
EMU-D = Europe-wide EMU with cooperation between central banks and governments inside each continent.

*Table 4*. Endogenous variables.

| | Flexible rates | Managed rates | Europe-wide EMU | EMU-A | EMU-B | EMU-C | EMU-D |
|---|---|---|---|---|---|---|---|
| $q^{US}$ | $.4750x$ | $.4732x$ | $.4736x$ | $.4823x$ | $.4759x$ | $.4850x$ | $.7068x$ |
| $q^{C}$ | $.3568x$ | $.4714x$ | | | | | |
| $q^{P}$ | $.2978x$ | $.2722x$ | | | | | |
| $q^{Eu}$ | | | $.4259x$ | $.4363x$ | $.4474x$ | $.44575x$ | $.5479x$ |
| $n^{US}$ | $-1.5108x$ | $-1.5052x$ | $-1.5062x$ | $-1.4811x$ | $-1.5136x$ | $-1.4873x$ | $-.8207x$ |
| $n^{C}$ | $-1.7497x$ | $-1.4992x$ | $-1.5245x$ | $-1.4968x$ | $-1.5269x$ | $-1.4989x$ | $-.9684x$ |
| $n^{P}$ | $-1.4606x$ | $-1.3350x$ | $-1.1847x$ | $-1.1630x$ | $-1.3190x$ | $-1.2945x$ | $-.3040x$ |
| $n^{Eu}$ | | | $-1.3546x$ | $-1.3299x$ | $-1.4230x$ | $-1.3967x$ | $-.6362x$ |

*Table 5*. Values of the loss functions.

| | Flexible rates | Managed rates | Europe-wide EMU | EMU-A | EMU-B | EMU-C | EMU-D |
|---|---|---|---|---|---|---|---|
| $L^{Fed}$ | $.2157x^2$ | $.2141x^2$ | $.2143x^2$ | $.2144x^2$ | $.2165x^2$ | $.2164x^2$ | $.2585x^2$ |
| $L^{cb^C}$ | $.2103x^2$ | $.2124x^2$ | | | | | |
| $L^{cb^P}$ | $.1466x^2$ | $.1224x^2$ | | | | | |
| $L^{ECB}$ | | | $.1734x^2$ | $.1741x^2$ | $.1913x^2$ | $.1917x^2$ | $.1553x^2$ |
| $L^{gov^{US}}$ | $.2260x^2$ | $.2243x^2$ | $.2246x^2$ | $.2174x^2$ | $.2269x^2$ | $.2192x^2$ | $.0662x^2$ |
| $L^{gov^C}$ | $.2830x^2$ | $.2090x^2$ | $.2156x^2$ | $.2080x^2$ | $.2281x^2$ | $.2200x^2$ | $.0878x^2$ |
| $L^{gov^P}$ | $.1991x^2$ | $.2028x^2$ | $.1543x^2$ | $.1489x^2$ | $.1684x^2$ | $.1624x^2$ | $.1113x^2$ |

### *4.1. Toward Europe-wide EMU*

***4.1.1. Flexible exchange rates.*** We assume that authorities do not cooperate with one another either internationally or within countries. Reacting to a shock that causes inflation and unemployment, fiscal policies are expansionary and monetary policies are contractionary. The Core government does not internalize the expansionary impact of its policy on employment in the Periphery, and so its expansion falls short of the U.S. government's, even if the two governments face identical trade-offs. The Periphery's government lowers taxes to sustain employment directly and by trying to achieve a real depreciation. The Core and Periphery's central banks face identical trade-offs and act aggressively, trying to export inflation to one another. Because it faces a less favorable trade-off, the Fed is not as aggressive. Inflation is higher in the U.S. than in Europe, and it is higher in the Core than in the Periphery because the latter's fiscal policy helps the central bank stabilize inflation. Monetary aggressiveness causes unemployment to rise substantially in the Core, and the fiscal stimulus is not sufficient to compensate for this. Hence, unemployment in the Core is higher than in the U.S. and in the Periphery, which benefits from facing a more favorable trade-off.

***4.1.2. Managed exchange rates in Europe.*** The Core's central bank faces the same trade-off as the Fed. Hence, its monetary policy is substantially less aggressive than in the previous regime. This stabilizes employment in the Core, but has adverse consequences for inflation. Because monetary policy is less aggressive, less government activism is observed, notwithstanding the incentives for more action brought about by an improved trade-off. The Periphery's central bank acts aggressively on the exchange rate, trying to export inflation to the Core. The government faces a better trade-off than before and reacts to the change in its constraints and the monetary contraction by lowering taxes more actively. This improves inflation and employment stability in the Periphery. U.S. authorities react to developments in Europe by being more aggressive, the Fed more so. Inflation and unemployment turn out to be higher.

***4.1.3. Europe-wide EMU.*** No significant changes are observed in U.S. and Core fiscal policies, consistent with the unchanged trade-offs and preferences. The transition to EMU significantly stabilizes fiscal policy in the Periphery. This is due to the worsening of its government's trade-off, which discourages fiscal activism. This result is analogous to our 1997 finding, though somehow stronger: even when the monetary union comprises countries in which the nature of fiscal policy is different, the transition to EMU stabilizes fiscal policy in European countries outside the Core, in striking contrast to popular fears.

The ECB's policy is significantly more contractionary than the Core central bank's under managed exchange rates. Both authorities face identical trade-offs and have identical degrees of inflation aversion. But now the ECB faces the inflationary consequences of a smaller employment-friendly tax cut in the Periphery. Hence, it acts more aggressively, which induces the Fed to react by tightening. Thus, in contrast to fears, the ECB's stance may be more contractionary than the Core central bank's under the EMS when reacting to the same type of disturbance. Inflation in Europe may be lower than Core inflation under the EMS thanks to the removal of monetary aggressiveness from the Periphery. Although inflation rises in the Periphery, monetary policy-makers in the Core benefit from a Europe-wide EMU. Note that, with anti-Keynesian fiscal policy in all countries, the transition to EMU would improve the trade-off facing the Core government, causing it to be more active. This would have a stabilizing impact on inflation and induce the ECB to be less aggressive. Our finding is in striking contrast with the popular arguments according to which asymmetries in the nature of fiscal policy should be the reason of *less* and not more monetary discipline and fiscal stability.

Although the change in regime generates a slight increase in Core unemployment, the absence of an aggressive domestic monetary contraction significantly stabilizes employment in the Periphery, so that EMU stabilizes European employment in the face of supply shocks, again in contrast with popular fears.[11]

### *4.2. Policy coordination in the EMU era*

***4.2.1. Transatlantic monetary cooperation.*** When the Fed and the ECB cooperate, they jointly minimize an average of their respective loss functions with weights equal to 1/2.[12] Both central banks now refrain from trying to export inflation across the Atlantic. They behave as a single policy-maker managing monetary policy for the aggregate of the U.S. and Europe (and thus facing a flatter trade-off than the Fed and the ECB did individually), and they move their instruments less aggressively. In turns, this causes governments to be less active. Inflation rises and employment is more stable in all countries. The ECB and the Fed suffer marginally higher losses. Government gains are slightly more significant. As in Eichengreen and Ghironi (1997), governments will want central banks to coordinate their policies, while monetary policy-makers will not be attracted by the cooperative option.[13]

***4.2.2. Intra-European fiscal cooperation.*** It has been widely argued that EMU should be coupled with strengthened fiscal coordination in Europe (Chari and Kehoe, 1998; Huber, 1998). To address the issue, we now assume that the two European governments cooperate but the ECB and Fed do not. The European governments minimize the average of their respective loss functions.

In this scenario, the Core government internalizes the expansionary impact of its spending policy on the Periphery and raises spending by more. Analogously, the Periphery government internalizes the contractionary impact of its lower taxes on the Core and acts less aggressively. More spending in the Core and a smaller decrease in the Periphery's taxes tend to destabilize European inflation. The ECB reacts by tightening money supply more sharply, which induces the Fed to react in similar fashion. Inflation and unemployment increase in all countries, leaving all players worse off. Thus, intra-European fiscal cooperation can be counterproductive for all policy-makers as in Eichengreen and Ghironi (1997).[14]

***4.2.3. EMU and intra-national policy coordination.*** In all policy regimes analyzed thus far, the impact of fiscal policy on inflation and of monetary policy on employment had relevant consequences on the equilibrium of the stabilization game and on policy-makers' preferences over different regimes. Throughout, we have maintained the assumption of no cooperation between central banks *and* governments. We did so because this seems consistent with central bank independence. Nonetheless, our results suggest that cooperation between the Fed and the U.S. government and between the ECB and European governments may turn out to be more desirable than international policy coordination. Thus, in this sub-section we remove the assumption of Nash behavior in the central bank-government relationship: monetary and fiscal authorities act cooperatively in the management of economic policy. We assume that central banks do not cooperate with one another to focus on the consequences of cooperative determination of monetary and fiscal policy within the U.S. and Europe. For the U.S. economy, this means that the Fed and the U.S. government choose $m^{US}$ and $g^{US}$ jointly to minimize$(1/2)L^{Fed}+(1/2)L^{gov^{US}}$, where symmetry in the two authorities' positions motivates the choice of the weights attached to the loss functions. In Europe, the ECB manages monetary policy for the whole continent, whereas governments control fiscal policy for the respective countries. We assume that the three policy-makers choose $m^{Eu}$, $g^{C}$, and $\tau^{P}$ jointly to minimize a weighted average of the ECB's loss function and of an average of the two national governments' losses: $(1/2)L^{ECB}+(1/2)[(L^{gov^{C}}+L^{gov^{P}})/2]$.

When governments and central banks jointly manage economic policy in each continent, inflation and employment levels are consistent with central bankers' and government officials' positions on the question of monetary independence, and with our intuition on the effects of monetary (fiscal) policy on employment (prices). Inflation is significantly higher and unemployment significantly lower than when "central bank independence" is preserved. Intra-continental

cooperation results in less monetary aggressiveness and less spending activism in the U.S. and in the Core, but more active fiscal policy in the Periphery. This is consistent with the trade-offs facing policy-makers. When all European authorities act together, they maneuver taxes in the Periphery more aggressively because that significantly stabilizes inflation in the entire monetary union and employment in the Periphery. The policy-makers then rely on the reduced monetary aggressiveness to keep employment stable in the rest of the continent. Monetary tightening is milder in the U.S. too, and government policy is less active because there is less need to sustain employment. Notwithstanding the higher inflation, all European policy-makers, including the ECB, suffer smaller losses. The U.S. government's loss drops substantially. The Fed is the only player who is left unhappy by the outcome of this regime: the inflation loss more than offsets the employment gain. Our exercise suggests that governments may have much more to gain from asking central bankers to cooperate with them than by pushing reluctant monetary authorities to cooperate with one another. This result seems consistent with the current policy debate in Europe. In fact, it seems more likely that governments will try to pressure the ECB to adopt a cooperative attitude towards them than that they will make use of the loopholes of the Maastricht Treaty to force the central bank into cooperative arrangements with the Federal Reserve.

### *4.3. Fiscal reforms and policy-makers' losses*

The results of Section 3 tell us that, if the equilibrium of the stabilization game is characterized by unemployment, governments are better (worse) off when domestic (foreign) fiscal policy is marginally more anti-Keynesian. The numerical exercises performed in Eichengreen and Ghironi (1997) and here allow us to draw some conclusions on the consequences of *large* changes in the nature of fiscal policy. Comparing losses in the Keynesian and anti-Keynesian scenarios in our 1997 paper shows that governments were consistently better off in the non-Keynesian world. Even if going from the Keynesian to the anti-Keynesian scenario implied equal increases in all countries' $k$'s from zero to one, all governments were able to benefit from facing a negatively sloped trade-off in all policymaking regimes. Comparing the results of this paper to the 1997 results for the fully Keynesian case makes it possible to give insights on the consequences of a large increase in the degree of anti-Keynesianism in only one country. Similarly, a comparison with the anti-Keynesian case sheds some light on the consequences of the transition to significantly less distortionary fiscal regimes in two out of three economies in our model.

It turns out that under all policymaking regimes considered in both essays all governments are better off in the intermediate world of this paper than in the fully Keynesian world, whereas they are all worse off than in the fully anti-Keynesian regime. A drastic increase in the degree of anti-Keynesianism in the Periphery ends up being beneficial for all governments, and not only for the

Periphery. Drastically less anti-Keynesian policies in the U.S. and in the Core are harmful for all governments, including the Periphery's. Significant changes in the equilibrium values of policy instruments triggered by drastic changes in the trade-offs facing one or more policy-makers cause the difference in results from the prediction of the analysis in Section 3.

All central banks benefit when fiscal policy in the Periphery switches from Keynesian to anti-Keynesian. They all suffer when fiscal reforms in the U.S. and in the Core make their policies change from anti-Keynesian to Keynesian. These switches do not affect the inflation-employment ratio. However, in the first case the reform has a positive impact on employment, whereas the effect is negative in the latter example.

## 5. Optimal fiscal reforms?

So far, our discussion has taken $k^j$ as an exogenous parameter. We focused on policymaking in a given fiscal regime, and treated changes in the extent to which policy is Keynesian—fiscal reforms—as exogenous. Nonetheless, the fraction of firms that are subject to distortionary taxes is a parameter in the government's choice set. In our analysis, we have implicitly assumed that governments have committed to a specific choice of $k^j$ in advance of the stabilization game they play with other policy-makers. Our results point to the issue of the optimal choice of $k^j$: what is the level of $k$ to which a country's government should commit?

The government commits to a certain policy trade-off rather than another by committing to a level of $k$ (and to an exchange-rate regime). In the case of a shock that causes inflation and unemployment, a high value of $k$ is optimal. It allows governments to rely heavily on an instrument that moves both inflation and employment in the desired direction. When faced with negative supply shocks, governments may regret the decision of moving towards less distortionary fiscal regimes. However, this conclusion holds only for shocks that move the economy to the Northwest or Southeast quadrants in the $(n, q)$ space. In those situations, governments will be happy to face overall policy frontiers that are close to (or coincident with) the negatively sloped anti-Keynesian trade-off. When shocks bring the economy to the Northeast or Southwest quadrants, a positively sloped trade-off is preferred.

Suppose that we have a positive realization of $u$: the shock shifts demand for goods away from European goods and in favor of U.S. ones. Europe faces deflation: the consumer price index declines and unemployment rises. U.S. inflation and employment are above their equilibrium levels. In this case, governments will want to rely more heavily on an instrument that causes both employment and inflation to move in the same direction.

Given probability distributions for the shocks that hit the economy, governments will choose the value of $k$ to which they commit by minimizing the expected value of their losses relative to the parameter in question. In the

context of our model, a move toward less distortionary fiscal systems can only be justified as the outcome of such optimization process—say, because demand shocks are more likely than supply ones. Because we focus on the role of fiscal policy for stabilization purposes, we neglect political economy and growth-related costs of fiscal distortions, whose presence of course weakens the case for making use of distortionary instruments.[15] In a model that accounts also for the steady-state losses generated by distortionary taxation, the optimal choice of fiscal distortions would weigh the potential short-run gains from using distortionary instruments against the long-run losses. Our analysis here focuses only on one side of the question. However, the long-run losses caused by subjecting a large number of agents to distortionary taxation will be small if the steady-state rate of distortionary taxation is sufficiently small.

Because the *ex post* optimality of the trade-off facing a government depends on the realizations of the shocks, the issue of the credibility of the government's commitment to a fiscal (or exchange-rate) regime arises. We abstract from this issue here, and assume that the commitment is made credible by the presence.

When country $j$'s government minimizes unconditional expected losses with respect to $k^j$, holding the levels of spending and taxation at home and abroad exogenous, the first-order condition for the optimal value of $k^j$—$\widehat{k}^j$—defines the latter as a function of the variances of the disturbances to supply and demand, $\sigma_x^2$ and $\sigma_u^2$, respectively: $\widehat{k}^j = linear(\underset{-}{\sigma_u^2}, \underset{+}{\sigma_x^2})$. Because shocks have zero expected value, the likelihood of realizations that are different from the mean is higher the higher the variance. For the reasons discussed above, governments will be more (less) inclined to commit to a high value of $k^j$ if the variance of the supply (demand) shock is larger.

## 6. Conclusions

We have analyzed how fiscal distortions and the exchange-rate regime affect policy interactions between the U.S. and Europe in the EMU era. When fiscal policy is fully anti-Keynesian, changing taxes moves both inflation and employment in the desired direction following a shock that causes inflation and unemployment. Lower taxes cause firms to demand more labor, and prices to decline because of the increased supply of goods. Smaller, more open economies face more favorable trade-offs. Changes in intra-European monetary arrangements do not affect U.S. trade-offs, although they alter the mechanism through which fiscal policy is transmitted in Europe and thus the trade-offs facing European fiscal policy-makers. In the fully Keynesian case, all countries face the same positively-sloped trade-off regardless of the exchange rate regime. Increases in spending then cause both output and inflation to rise. When fiscal policy is neither fully anti-Keynesian nor fully Keynesian, the governments' trade-offs lie in between the extreme cases.

When we solve the model numerically after a global supply shock, we find that the advent of EMU stabilizes fiscal policy in European countries outside the Core. In contrast to popular fears, EMU also enhances monetary rigor in Europe and stabilizes employment in the face of supply shocks. Although governments in the U.S. and Europe want the ECB and the Fed to coordinate their policies in the face of such shocks, the monetary policy-makers themselves have little incentive to do so. Intra-European fiscal cooperation can be counterproductive, whereas cooperation between governments and central banks in each continent can be beneficial. This suggests that governments are more likely to pressure the ECB to adopt a more cooperative attitude towards them than to cajole it into a regime that limits the flexibility of the euro-dollar exchange rate.

We see these results as a logical starting point for more work on transatlantic interdependence in the EMU era.

## Appendix A: Unconstrained fiscal activism yields bliss

Suppose authority 1—say, the central bank—in any country sets the level of the policy instrument *inst*1 to minimize the loss function $L_1 = (1/2)(aq^2 + bn^2)$. Authority 2—say, the fiscal authority—chooses *inst*2 to minimize $L_2 = (1/2)(cq^2 + dn^2)$. This situations generalizes the framework we would have in our paper if it were $b_1 = 1$ in the governments' loss functions and $k^j = 0$ or $1$, i.e., if governments could maneuver their instrument at no cost.

Suppose the two authorities act independently of one another. The first-order conditions for the two problems are $aq(\partial q/\partial inst1) + bn(\partial n/\partial inst1) = 0$ and $cq(\partial q/\partial inst2) + dn(\partial n/\partial inst2) = 0$. These conditions imply equilibrium inflation-employment ratios $(\tilde{q}/\tilde{n})_1 = -b/(aTR_1)$ and $(\tilde{q}/\tilde{n})_2 = -d/(cTR_2)$, where $TR_1$ and $TR_2$ are the policy trade-offs facing authorities $1$ and $2$, respectively.

Because $a \neq b \neq c \neq d$ and $TR_1 \neq TR_2$ (unless in very special cases), the two authorities' first-order conditions can both be satisfied only if $\tilde{q} = \tilde{n} = 0$, i.e., if a bliss equilibrium with zero losses is achieved. If this were not the case, it would be $(\tilde{q}/\tilde{n})_1 \neq (\tilde{q}/\tilde{n})_2$, which cannot be true. The *Nash* interaction between the two policy-makers yields a zero-losses equilibrium regardless of the international policymaking regime. This is a consequence of the specification of the policy-makers' loss functions, which generates a 2-targets-2-instruments situation in the game between central bank and government inside each country. To avoid this situation, we constrain fiscal activism in our paper by setting $b_1 < 1$.

## Appendix B: Intuitive proofs, Propositions 1–6

### Proposition 1

From Equation (9), we see that a change in taxes affects employment in two ways: directly, via its impact on labor demand, and indirectly, through its

effect on the interest rate. Suppose taxes are raised marginally in the Core and consider the Core-Periphery interest differential: $i^C - i^P = e^1 - e^2$. Under the assumption $\delta > 1/2$, an increase in Core taxes causes the Core currency to depreciate. Hence, the interest differential shrinks. When the economies have comparable size, this happens via movements of both interest rates: $i^C$ decreases and $i^P$ rises. If the Core were much smaller than the Periphery, instead of exactly symmetric, its actions would have no impact on $i^P$, and the narrowing of the interest differential would be achieved entirely via a decrease in $i^C$. Hence, the smaller the Core, the larger the drop in its interest rate that is caused by a given increase in taxes. From Equation (9), it follows that the tax change will have a larger effect on Core employment. In addition, Equation (10) implies that the larger employment drop causes the tax change to have a smaller effect on domestic prices. Because the impact of the policy change on exchange rates is not affected by country size, it follows immediately that the effect of taxation on CPI inflation is smaller the smaller the Core economy. These results, which can be stated similarly for the Core-U.S. pair, allows us to conclude that the absolute value of the ratio in Equation (17) is smaller the smaller the country in question.[16]

**Proposition 2**

Remember that European governments have identical spending propensities in our model. As a consequence, fiscal policies have no impact on the intra-European exchange rate. This removes the channel through which differences in size between the two European countries—if we had assumed them—could have caused the trade-offs to differ. Because Europe as a whole is symmetric to the U.S., European trade-offs are identical to the U.S.

**Proposition 3**

The reduced-form parameters determining the U.S. authorities' trade-offs are independent of the relative size of the two European countries (Ghironi and Giavazzi, 1998). If Europe consisted of one large country symmetric to the United States and a small open economy with no impact abroad, intra-European exchange-rate arrangements would have no consequence for the U.S. By implication, since changes in the relative size of European countries do not affect the relevant parameters, the nature of the intra-European regime must have no impact on U.S. trade-offs also when European countries are identical.

**Proposition 4**

Under both floating and managed exchange rates, the Core and Periphery's governments set taxes only for the domestic economy. But as we move from one

intra-European exchange-rate arrangement to another, the structural features of the economies that determine the governments' trade-offs are affected. Under flexible exchange rates, the Periphery/Core exchange rate is endogenous and taxes affect the endogenous variables through their direct supply and demand-side impacts. But changes in the exchange rate also feed back through prices and employment, providing an *indirect* channel for fiscal impulses. With the transition from floating to the managed exchange rates regime, the Periphery's money supply becomes endogenous with respect to not just the Core's money supply but also both European governments' policies. Instead of having an *indirect* effect on prices and employment via the exchange rate, another *direct* channel for fiscal impulses is added through what was the direct impact of $m^P$ on the economies. Since the Periphery's money supply has a larger impact on the Periphery's economy under flexible exchange rates, this new channel of direct transmission of fiscal policy is more effective for the Periphery, which explains why its government's trade-off improves more than the Core's with the transition from flexible to managed exchange rates.

**Proposition 5**

In the fully Keynesian case, identical patterns of government spending across European countries ensure that fiscal policies have no impact on the Periphery/Core exchange rate. Hence, changes in the intra-European exchange-rate regime do not affect the position of the governments' trade-offs.[17]

**Proposition 6**

European governments' trade-offs follow from the symmetry of the monetary union regime. Consider the change from flexible exchange rates to symmetrically fixed exchange rates, as under this regime. The endogeneity constraint on monetary policy with respect to taxation is now a constraint on the difference of $m^C$ and $m^P$ rather than $m^P$ alone. As a consequence, the improvement in government trade-offs is split evenly between Core and Periphery: the Periphery's trade-off does not improve as much as when going from flexible to managed rates, and the trade-off facing the Core's government is better than in that case. The following example further clarifies this intuition. Say that the Periphery's government wants to stimulate employment under managed rates; they cut spending. (The expansionary effect of lower taxes more than offsets the contractionary effect of smaller spending under reasonable assumptions about parameters.) But the cut in government spending must be coupled with an increase in money supply for any given exchange rate chosen by the Periphery's central bank, reinforcing the expansionary employment effect and improving the government's trade-off. With the transition to monetary union, a cut in Periphery's spending now provokes both an increase in the Periphery's money supply and a reduction in the Core's. Because the induced change in the

Periphery's money supply is smaller than under managed rates, the trade-off faced by the Periphery's government is worse (a given change in taxes and spending produces smaller employment gains). The same logic runs in reverse for the Core's fiscal authority: the trade-off between its policy objectives improves following the transition to a monetary union with the Periphery.

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## Notes

1. Chari and Kehoe (1999) survey the literature on optimal monetary and fiscal policy in closed economy, microfounded models. Dixit and Lambertini (2000) focus on the effect of fiscal discretion on monetary policy commitments. Our approach differs from either of these in that we focus on strategic interactions between monetary and fiscal policy-makers in a multi-country world.
2. As the regime changes of the recent years may be repeated in the future for countries that are not currently members of Europe's monetary union, our study sheds light on the possible consequences of similar regime changes in the years to come.
3. See also Alesina and Ardagna (1998) and Alesina et al. (2002).
4. This may induce one to question the wording "trade-off." However, if we considered a different type of shock—say, one that causes deflation—changes in taxes would cause only one of the relevant variables to move as desired.
5. Recent years have seen the advent of fully microfounded, intertemporal models as the standard tool for academic analysis of open economy issues. Lane (2001) surveys this literature. The standard Canzoneri-Henderson-type setup is still quite popular in policy circles.
6. Dixit and Lambertini (2002) obtain a similar result.
7. If deviations of variables from equilibrium values are small, the flexible rates solution can be taken as consistent with daily exchange-rate behavior in wide EMS bands.
8. When the results of the previous sub-sections are interpreted as referring to EMU member countries (the European Core) versus non-members (the Periphery), one is making the implicit assumption of fiscal coordination inside the monetary union. This assumption is no longer necessary here.
9. If it were $k^C = k^P$, the equilibrium of the stabilization game would be characterized by $n^C = n^P = n^{Eu}$, i.e., employment levels in Europe would be equalized *ex post* because of symmetry between Core and Periphery. Combined with $q^C = q^P = q^{Eu}$, this would imply that authorities in Europe reach their bliss point even if the loss functions are defined over different variables. This point can be proved using the same approach as in Appendix A.
10. Of course, the central bank-inaction assumption is not necessary to avoid a trivial bliss point solution when $k^j = 0$ or $k^j = 1$, as long as $b_1 < 1$. In this case, the inflation-employment ratio is

determined by the central bank's trade-off and preferences. It is easy to verify that Proposition still holds.

11. The conclusions for different types of shocks, including asymmetric shocks in Europe, may differ. The model can be easily extended to allow for such shocks. We leave it (and the analysis of asymmetric world demand shocks) to the reader as an exercise.
12. The possibility of limiting the flexibility of the euro-dollar exchange rate has been raised in the policy debate. The likelihood of a fixed exchange rate regime across the Atlantic seems extremely low (see Begg, Giavazzi, and Wyplosz, 1997). In this paper, such regime could be modeled as ECB-Fed cooperation subject to a fixed exchange rate constraint. Cooperation between the ECB and the Fed without this constraint seems a more realistic possibility, one that goes halfway between free float and a truly fixed exchange rate regime.
13. It is a standard game-theoretic result that cooperation that is limited to a subset of players can be counterproductive for one or more players relative to the situation in which all players act noncooperatively. Rogoff (1985) is another example. Monetary cooperation is counterproductive there because it exacerbates time-inconsistency problems in monetary policy. Obstfeld and Rogoff (2002) argue that lack of monetary coordination is a second-order problem in a dynamic, microfounded model. Benigno (2001) and Corsetti and Pesenti (2001) instead maintain that cooperation can be beneficial. All of these papers focus only on monetary policy.
14. When intra-European fiscal cooperation is coupled with transatlantic monetary cooperation, central banks are less aggressive. Inflation is higher and unemployment is smaller. Losses are fairly close to those in the absence of monetary cooperation. This cooperative scenario remains dominated by the EMU-no-cooperation case for all players, except the U.S. government. See Beetsma and Bovenberg (1998) for another example of counterproductive fiscal cooperation in EMU.
15. See Saint-Paul (1998, 2001).
16. For the result to hold in the Core-U.S. case it must be:

$$2\delta + (1-2\beta)^2\nu > 2\eta - 1 + (1-\alpha)[1-(1-2\beta)\varepsilon].$$

A combination of sufficiently high $\delta$ and low $\beta$ ensures that this condition is satisfied.

17. Asymmetry in the pattern of government spending across the Atlantic ensures that fiscal policies affect the transatlantic exchange rate also in a fully Keynesian world.

## References

Alesina, Alberto and Silvia Ardagna (1998) "Tales of Fiscal Adjustment." *Economic Policy* 27:487–545.

Alesina, Alberto et al. (2002) "Fiscal Policy, Profits, and Investment." *American Economic Review*; forthcoming.

Alesina, Alberto and Guido Tabellini (1987) "Rules and Discretion with Noncoordinated Monetary and Fiscal Policy." *Economic Inquiry* 25:619–630.

Beetsma, Roel M.W.J. and A. Lans Bovenberg (1998) "Monetary Union without Fiscal Coordination May Discipline Policy-Makers." *Journal of International Economics* 45:239–258.

Begg, David, Francesco Giavazzi, and Charles Wyplosz (1997) "Options for the Future Exchange Rate Policy of the EMU." CEPR Occasional Paper No. 17.

Benigno, Pierpaolo (2001) "Price Stability with Imperfect Financial Integration." CEPR Discussion Paper No. 2854.

Canzoneri, Matthew B. and Dale W. Henderson (1991) *Monetary Policy in Interdependent Economies: A Game-Theoretic Approach*. Cambridge: MIT Press.

Chari, V.V. and Patrick J. Kehoe (1998) "On the Need for Fiscal Constraints in a Monetary Union." Working Paper 589, Federal Reserve Bank of Minneapolis, vol. 1C, pp. 1671–1745.

—— (1999) "Optimal Fiscal and Monetary Policy." In John B. Taylor and Michael Woodford (eds.), *Handbook of Macroeconomics*. Amsterdam: Elsevier Science.

Corsetti, Giancarlo and Paolo Pesenti (2001) "International Dimensions of Optimal Monetary Policy." NBER Working Paper No. 8230.

Dixit, Avinash K. and Luisa Lambertini (2000) "Fiscal Discretion Destroys Monetary Commitment." unpublished manuscript; Princeton University and UCLA.

—— (2002) "Symbiosis of Monetary and Fiscal Policies in a Monetary Union." *Journal of International Economics*, forthcoming.

Eichengreen, Barry and Fabio Ghironi (1997) "How Will Transatlantic Policy Interactions Change with the Advent of EMU?" In Barry Eichengreen (ed.), *European Monetary Unification: Theory, Practice, and Analysis*. Cambridge: MIT Press, pp. 271–322.

—— (1999) "Macroeconomic Trade-Offs in the United States and Europe: Fiscal Distortions and the International Monetary Regime." Working Paper 467, Department of Economics, Boston College.

Ghironi, Fabio and Francesco Giavazzi (1998) "Currency Areas, International Monetary Regimes, and the Employment-Inflation Trade-Off." *Journal of International Economics* 45:259–296.

Giavazzi, Francesco and Alberto Giovannini (1989) *Limiting Exchange Rate Flexibility: The European Monetary System*. Cambridge: MIT Press.

Giavazzi, Francesco and Marco Pagano (1990) "Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries." NBER Working Paper 3372.

—— (1996) "Non-Keynesian Effects of Fiscal Policy: More International Evidence and the Swedish Experience." NBER Working Paper 5332.

Huber, Bernd (1998) "Credibility, Seignorage, and Government Debt." In Guillermo Calvo and Mervyn King (eds.), *The Debt Burden and its Consequences for Monetary Policy*. New York: St. Martin's Press.

Lane, Philip R. (2001) "The New Open Economy Macroeconomics: A Survey." *Journal of International Economics* 54:235–266.

Obstfeld, Maurice and Kenneth Rogoff (2002) "Global Implications of Self-Oriented National Monetary Rules." *Quarterly Journal of Economics* 117:503–536.

Rogoff, Kenneth (1985) "Can International Monetary Cooperation Be Counterproductive?" *Journal of International Economics* 18:199–217.

Saint-Paul, Gilles (1998) "The Political Consequences of Unemployment." *Swedish Economic Policy Review* 5:259–296.

—— (2001) "The Dynamics of Exclusion and Fiscal Conservatism." *Review of Economic Dynamics* 4:275–302.