

# **Macroeconomic Tradeoffs in the United States and Europe: Fiscal Distortions and the International Monetary Regime \***

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## Abstract

This paper studies the impact of changes in the extent to which fiscal policy is distortionary on the short-run macroeconomic tradeoffs facing fiscal policymakers in an era of budget equilibrium. It does so in an open economy framework, that we use to interpret U.S.-European policy interactions. Our analysis features both fiscal and monetary policy to study how changes in the extent to which fiscal policy is distortionary affect the interaction between central banks and fiscal authorities, both intra- and internationally. In addition, strategic interactions among policymakers—and the tradeoffs they face—are affected by the exchange-rate regime.

When government spending is funded through distortionary taxes alone—a scenario that we call anti-Keynesian, changing spending moves both inflation and employment in the desired direction following a worldwide supply shock. Smaller and more open economies face a more favorable tradeoff than large relatively closed ones. Under a managed exchange rate regime, European governments face a better tradeoff than under flexible rates, but the improvement is more significant for the country that controls the exchange rate. When both European countries in our model join in a monetary union, the country that had control of the exchange rate under the managed exchange rate regime faces a worse tradeoff, while the tradeoff improves for the country that controlled money supply. In the fully Keynesian case, in which taxes are non-distortionary, all countries face the same positively sloped tradeoff regardless of the exchange-rate regime. Increases in spending cause both output and inflation to rise. When fiscal policy is neither fully anti-Keynesian nor fully Keynesian, the governments' tradeoffs lie in between the extreme cases, and the exact position depends on the extent to which fiscal policy is Keynesian. Under all European exchange-rate regimes, small increases in the fraction of firms that are subject to distortionary taxation at home are beneficial when the equilibrium is characterized by unemployment, while a less Keynesian fiscal policy abroad is harmful. Governments in the U.S. and Europe will want the ECB and the Fed to coordinate their reactions to an unfavorable supply shock, while monetary policymakers will have little incentive to do so. Intra-European fiscal cooperation can be counterproductive, whereas cooperation between governments and central banks inside each continent can be beneficial. Our study suggests that, if governments are concerned mainly about the relation between fiscal policy and the business cycle, maintaining some fiscal distortions may be optimal.

*Keywords:* Employment-inflation tradeoff; Exchange-rate regimes; Fiscal distortions; Fiscal policy; International cooperation; Monetary policy

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## 1. Introduction

While there exists a conventional view on how monetary policy affects output and inflation, a controversial decision one must make when modeling fiscal policy has to do with the output and employment effects of government spending. In the standard Keynesian model, increases in government spending have expansionary effects. Nonetheless, authors like Giavazzi and Pagano (1990, 1996) have argued that reductions in government spending or deficits can be expansionary under some circumstances.<sup>1</sup> If the taxes used to finance spending are highly distortionary, or if fiscal policy is on an unsustainable path, a decrease in spending can increase output and employment.

This paper studies the impact of changes in the extent to which fiscal policy is distortionary on the macroeconomic tradeoffs facing fiscal policymakers. It does so in an open economy framework, that we use to interpret U.S.-European policy interactions. Though many of our results can be replicated in a closed economy model, applying them to the issue of transatlantic interdependence is suggested by the recent trend of fiscal consolidation in the United States and Europe—and by the issues that come with it.

The effect of changes in government spending has been analyzed mainly in relation to the issue of fiscal consolidation, a problem that has been at the center of the policy debate during the run-up to Economic and Monetary Union (EMU) in Europe. There is, however, another dimension to the issue. Once fiscal consolidation has been achieved, countries face the problem of managing fiscal policy subject to a (more or less) balanced budget requirement. It is usually argued that fiscal consolidation should be coupled with the removal of fiscal distortions. Whether or not spending is financed via distortionary taxes makes a difference for the effects of changes in spending. It is thus legitimate to wonder if it is indeed optimal for countries that are subject to a balanced budget requirement to remove all fiscal distortions. If fiscal policy is to be used for stabilization purposes subject to a balanced budget constraint, it may be the case that retaining some distortion in the economy is optimal if the first best equilibrium is not feasible. In turn, changes in the degree to which taxation is distortionary affect the nature of the fiscal externalities that interdependent countries impose on one another. Given that budget equilibrium is the desired norm in the U.S. and Europe, what is the effect of changes in the nature of fiscal policy on transatlantic policy interactions?

When shocks affect economies, monetary policy is typically adjusted as well as fiscal policy—often more frequently than the latter. For this reason, our analysis will feature both fiscal and monetary policy. This will allow us to study how changes in the extent to which fiscal policy is distortionary affect the interaction between central banks and fiscal authorities, both intra- and internationally.

In addition, strategic interactions among policymakers—and the tradeoffs they face—are affected by the exchange-rate regime. Thus, we consider different monetary arrangements in Europe. On one side, this yields insights on the consequences of recent changes in the intra-European exchange-rate regime on transatlantic policy games. On the other side, as these changes may be repeated in the future for countries that currently are not members of EMU, our study sheds light on the possible consequences of similar regime changes in the years to come. Important issues we touch upon are the pros and cons of fiscal coordination in Europe and the prospects for transatlantic policy coordination.

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<sup>1</sup> See also Alesina and Ardagna (1998) and Alesina, Ardagna, Perotti, and Schiantarelli (1999).

In Eichengreen and Ghironi (1997), we made a start at analyzing transatlantic monetary and fiscal policy interactions in a formal framework. We used a modern three-country version of the time-honored Mundell-Fleming model of monetary interactions explored by Canzoneri and Henderson (1991), extended to include fiscal policy. We considered two completely opposite cases: the standard Keynesian case, in which taxes are non-distortionary and spending increases are expansionary, and a non-Keynesian—or “anti-Keynesian”—case, in which expansion is achieved through decreases in spending—and distortionary taxes.<sup>2</sup> The nature of fiscal policy was found to have important consequences for policymakers’ incentives: for example, following a negative supply shock to the world economy, the European Central Bank (ECB) and the Federal Reserve were willing to coordinate their policies only in the Keynesian environment.<sup>3</sup>

Our approach was limited by the assumption that fiscal policy had the same nature in all countries. In this paper, we extend the framework of Eichengreen and Ghironi (1997) in a way that allows us to study how fiscal policymakers’ tradeoffs change as the nature of fiscal policy varies in a continuum that goes from the entirely Keynesian to the anti-Keynesian case. We analyze the implications of changes in the extent to which domestic or foreign fiscal policy is distortionary for the stability of domestic output and inflation following a disturbance to the world economy. We do not relate the nature of fiscal policy to the fiscal consolidation issue. Rather, as suggested above, we address the question of the desirability of removing fiscal distortions in a second-best environment in which consolidation has been achieved.<sup>4</sup>

The model of this paper allows us to explore U.S.-European monetary and fiscal policy interactions and the incentives for transatlantic cooperation in the presence of cross-country asymmetries in the nature of fiscal policy. For example, while a relatively distortionary regime may be an accurate depiction of short-run reality for peripheral countries in EMU, it could be reasonably argued that government spending has more Keynesian effects in the U.S. and the core European economies.

Generalizing our 1997 model along the lines suggested above is relatively simple. If we assume that only a fraction of the firms in each country are subject to distortionary taxes, while the others are subject to lump-sum taxation, the economy moves from a Keynesian to a fully anti-Keynesian situation as this fraction varies between zero and one. Allowing the fraction of firms subject to distortionary taxes to be different across countries provides a simple way of characterizing the different nature that fiscal policy may have in different countries.

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<sup>2</sup> From now on, we will identify a situation in which government spending is mainly financed through non-distortionary taxes as Keynesian. The regime in which taxes are mainly distortionary will be labeled anti-Keynesian.

<sup>3</sup> This raised the possibility of conflict of interests between institutions, as governments—the fiscal policymakers—on both sides of the Atlantic favored monetary cooperation.

<sup>4</sup> Our exercise is closely related to Ghironi and Giavazzi’s (1998) analysis of the impact of country size and the exchange-rate regime on central banks’ tradeoffs, though our focus is different. Ghironi and Giavazzi (1997, 1998) rely on the same type of formal framework we use. Arguably, these traditional non-microfounded models are not appropriate if welfare analysis is the main objective. However, if the main thrust of the analysis is positive and focused on the short run, or if one believes that the volatility of inflation and output is a sufficient statistic for normative purposes, the loss from using a simpler model is limited. Woodford (1998) shows how to derive a traditional-type model as log-linear approximation to the equilibrium conditions of a general equilibrium model with sticky prices. A microfounded model of transatlantic interdependence in line with the recent developments of the so-called “new open economy macroeconomics” is developed in Ghironi (1999).

The rest of the paper is organized as follows. Section 2 gives an overview of our main results and underlying intuitions. The model is presented in Section 3. Section 4 is devoted to the analysis of fiscal tradeoffs and the consequences of changes in the exchange-rate regime and the nature of fiscal policy. Section 5 focuses on the relation between the extent to which fiscal policy is distortionary and the stability of the economy. Our numerical exercise is discussed in Section 6, and the issue of optimal fiscal reforms is touched upon in Section 7. Section 8 concludes.

## 2. Results

The nature of fiscal policy and the exchange-rate regime affect the employment-inflation tradeoff facing fiscal policymakers.<sup>5</sup> When fiscal policy is fully anti-Keynesian, changing taxes—and spending—moves both inflation and employment in the desired direction following a worldwide supply 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.<sup>6</sup> Smaller and more open economies face a more favorable tradeoff than large relatively closed ones: openness allows policy to be more effective via the exchange-rate channel. The two European economies in our model are fully symmetric and half the size of the U.S. Under flexible exchange rates in Europe, their governments face identical negatively sloped tradeoffs that are flatter than that facing the U.S. policymaker: for any decrease in inflation, policy moves employment closer to the equilibrium. Under the assumption that governments care more about employment than inflation, this amounts to facing a more favorable tradeoff. Changes in the intra-European monetary arrangement do not affect the U.S. tradeoff, though they alter the mechanism through which fiscal policy is transmitted in Europe, and thus the tradeoffs facing European fiscal policymakers. Under a managed exchange rate regime, both European governments face a better tradeoff than under flexible rates, but the improvement is more significant for the country that controls the exchange rate. Fiscal tradeoffs are again identical when both European countries join in a monetary union. The country that had control of the exchange rate under the managed exchange rate regime now faces a worse tradeoff, while the tradeoff improves for the country that controlled money supply.

In the fully Keynesian case, all countries face the same positively sloped tradeoff regardless of the exchange-rate regime. Increases in spending cause both output and inflation to rise.

When fiscal policy is neither fully anti-Keynesian nor fully Keynesian, the governments' tradeoffs lie in between the extreme cases, and the exact position depends on the extent to which fiscal policy is Keynesian.

Changes in the extent to which fiscal policy is distortionary at home or abroad affect output and inflation stabilization following a disturbance. Under all European exchange-rate regimes, small increases in the fraction of firms that are subject to distortionary taxation at home are beneficial when the equilibrium is characterized by unemployment, while a less Keynesian fiscal policy abroad is harmful. The intuition is as follows. The effectiveness of a given change in government spending—measured by the elasticity of employment and inflation to spending—is

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<sup>5</sup> Central banks' tradeoffs are affected by the exchange-rate regime but not by the nature of fiscal policy. For a discussion of the determinants of central banks' tradeoffs, see Ghironi and Giavazzi (1998).

<sup>6</sup> This may induce one to question the wording "tradeoff." 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. The recent increase in the price of oil, a typical example of worldwide supply shock, motivates our focus on this example.

not affected by changes in the fraction of domestic firms that are subject to distortionary taxes—as long as it remains strictly smaller than one. If this fraction increases, the effectiveness of a given change in taxes—which moves both inflation and employment in the desired direction—is increased. Hence, more stability is achieved. If fiscal policy becomes relatively more distortionary abroad, foreign fiscal policy becomes more effective relative to home's, with harmful consequences for the stability of the home economy.

Our results on fiscal tradeoffs, combined with those of Ghironi and Giavazzi (1998) on central banks' tradeoffs, provide the theoretical background for an analysis of alternative policymaking regimes and the prospects for transatlantic cooperation, which we perform with the aid of a numerical exercise. Most results reinforce the conclusions of our 1997 study. We find that, 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. Moreover, EMU enhances monetary rigor in Europe and stabilizes employment in the face of supply shocks, in striking contrast to popular fears. As in Eichengreen and Ghironi (1997), governments in the U.S. and Europe will want the ECB and the Fed to coordinate their policies, while monetary policymakers will have little incentive to do so.<sup>7</sup> Intra-European fiscal cooperation can be counterproductive, whereas cooperation between governments and central banks inside each continent can be beneficial. The latter result raises questions on the opportunity of extreme forms of central bank independence.

Comparing the results in this paper with those of our 1997 exercise yields insights on the consequences of large fiscal reforms, or large changes in the degree to which fiscal policy is distortionary. All policymakers benefit when fiscal policy in one country switches from Keynesian to anti-Keynesian, while the other countries remain in the Keynesian regime. The transition from an anti-Keynesian world to one in which policy is anti-Keynesian in only one country causes all policymakers to suffer. The domestic impact of such drastic fiscal reforms is larger than their external effect.

The analysis of this paper raises questions on the opportunity of reducing the extent to which fiscal distortions remain in the economy and points to the issue of optimal fiscal reforms. In fact, a change in the extent to which fiscal policy is Keynesian can be interpreted as a fiscal reform. The extent to which fiscal policy is distortionary is treated as exogenous in most of the paper. However, one must recognize that whether or not fiscal policy is Keynesian is indeed endogenous to the policymaking process. The fraction of firms that are subject to distortionary taxes is a parameter in the fiscal regime to which each country's government commits *ex ante*, *i.e.* without knowing the exact nature of the shocks it will face at a later stage—much as it commits to a given exchange-rate regime. In this paper, we focus on the constraints and incentives facing policymakers in a *given* decision making environment. For the shock we consider, relying more heavily on distortionary instruments is appropriate. Governments choose the tradeoff they will face by choosing the fraction of firms subject to distortionary taxation (and the exchange-rate regime) at the time when the commitment to a policymaking regime is made.<sup>8</sup> If governments are concerned mainly about the relation between fiscal policy and the business cycle, as it is the case in this paper, a move towards less distortionary systems than those now existing in some

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<sup>7</sup> However, the potential for institutional conflict is found to be more limited than in our previous exercise.

<sup>8</sup> Ghironi and Giavazzi (1998) treat the size of a currency area as an exogenous parameter in their analysis of central banks' tradeoffs and monetary interactions. The implicit—and realistic—assumption is that the size of the area for which monetary policy is managed is exogenous to the central bank's decision making.

European countries can only be justified formally as the result of the policymakers' minimization of expected losses relative to the parameter in question. Maintaining some distortions may be optimal, depending on the disturbances that affect the economy.

Our argument in favor of using distortionary instruments focuses only on business cycles and stabilization. We neglect political economy costs of distortionary taxes and the effects of the latter on growth, which admittedly weaken the case for distortions in the economy. Ideally, one would want to compare the potential volatility gains generated by using distortionary instruments to the steady-state losses implied by the distortions. We focus on volatility in this paper, and leave a formal comparison with the steady-state effects of distortions for future work. However, it is worth remarking here that the issue of long-run distortions has two dimensions. For substantial distortions to be imposed on the economy in the long run, the fraction of firms that are subject to distortionary taxes has to be large *and* the steady-state rate of distortionary taxation has to be significant.<sup>9</sup> Our results suggest that governments may want to keep the possibility of maneuvering distortionary instruments that affect a significant number of agents in the short run. But this does not necessarily imply that large distortions are imposed on the economy in the long run. If the steady-state rate of distortionary taxation is sufficiently low, the losses from subjecting a large number of agents to such taxation may well be small.

### 3. The Model

As in Eichengreen and Ghironi (1997), 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. In Eichengreen and Ghironi (1997), the two European countries were called Germany and France, respectively. We change names because the results of this paper can be interpreted in two ways. The intra-European exchange-rate regimes we will consider can be taken as a representation of the transition to EMU from the previous regimes of flexible and managed exchange rates.<sup>10</sup> Alternatively, one can think of the Core European country as the EMU area of today, and of the Periphery as the aggregate of the non-EMU countries, and interpret the alternative exchange-rate arrangements as connecting the euro to the “outsiders” currency.<sup>11</sup>

The outputs of the three countries are imperfect substitutes in consumption. We assume no time inconsistency problem because we want to focus on a different set of issues. All disturbances are unexpected.<sup>12</sup> Output in each country ( $y$ ) is an increasing function of employment ( $n$ ) and a decreasing function of a world productivity disturbance ( $x$ ):

$$y^j = (1 - \alpha)n^j - x, \quad j = US, C, P, \quad (3.1)$$

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<sup>9</sup> In this paper, we identify the extent to which fiscal policy is distortionary with the fraction of the economy that is subject to distortions. This identification, which neglects one aspect of the distortion issue, is justified by the fact that governments do rely actively on the distortionary instrument in our analysis if that instrument is available.

<sup>10</sup> This is the interpretation that was given in Eichengreen and Ghironi (1997). In this case, our results help understand how policymakers' incentives changed between the 1970s and 1999.

<sup>11</sup> This interpretation is consistent with Ghironi and Giavazzi (1997, 1998). In this case one is making the implicit assumption that fiscal policies are fully coordinated inside the monetary union, and that the outsider area is itself a monetary union with coordinated fiscal policies.

<sup>12</sup> 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.

where  $(1 - \alpha)$ , with  $0 < \alpha < 1$ , the elasticity of output with respect to employment, is the same in all countries. The productivity disturbance is identically and independently distributed with zero mean.

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 textbook 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.

For country  $j$ 's firms that are subject to distortionary taxes, labor demand is given by:

$$n_{k^j}^j = \frac{1}{\alpha} \left[ -\tau^j - (w^j - p^j) - x \right], \quad j = US, C, P, \quad (3.2)$$

where  $\tau$  indicates the rate of taxation of revenues.<sup>13</sup>

When taxes are lump sum, the  $\tau$ -term in the previous equation disappears and labor demand is:

$$n_{1-k^j}^j = \frac{1}{\alpha} \left[ -(w^j - p^j) - x \right], \quad j = US, C, P. \quad (3.3)$$

Total labor demand in country  $j$  is thus given by:

$$n^j = k^j n_{k^j}^j + (1 - k^j) n_{1-k^j}^j = \frac{1}{\alpha} \left[ -k^j \tau^j - (w^j - p^j) - x \right], \quad j = US, C, P,$$

which can be rewritten as:

$$w^j - p^j = -\alpha n^j - k^j \tau^j - x, \quad j = US, C, P. \quad (3.4)$$

Consumer price indices ( $q$ ) 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:

$$q^{US} = (1 - \beta) p^{US} + \frac{1}{2} \beta (p^C + e^1) + \frac{1}{2} \beta (p^P + e^2) = p^{US} + \frac{1}{2} \beta (z^1 + z^2); \quad (3.5)$$

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:

$$\begin{aligned} z^1 &= e^1 + p^C - p^{US}, \\ z^2 &= e^2 + p^P - p^{US}. \end{aligned} \quad (3.6)$$

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:

$$\begin{aligned} q^C &= \frac{1}{2} (1 - \beta) p^C + \frac{1}{2} (1 - \beta) (p^P + e^2 - e^1) + \beta (p^{US} - e^1) = p^C - \beta z^1 - \frac{1}{2} (1 - \beta) (z^1 - z^2), \\ q^P &= \frac{1}{2} (1 - \beta) p^P + \frac{1}{2} (1 - \beta) (p^C + e^1 - e^2) + \beta (p^{US} - e^2) = p^P - \beta z^2 - \frac{1}{2} (1 - \beta) (z^2 - z^1), \end{aligned} \quad (3.7)$$

where the Periphery/Core real exchange rate is  $z^1 - z^2$ .<sup>14</sup>

<sup>13</sup> Using upper-case letters to denote anti-logs, firms subject to distortionary taxation maximize

$Profit = (1 - \tau)PY - WN$ , subject to  $Y = N^{1-\alpha}/X$ . Each firm is a price taker in the output and labor market and is taxed on its total revenues. The first order condition for maximization with respect to  $N$  is  $(1 - \tau)P(1 - \alpha)N^{-\alpha}/X = W$ . Taking logs, approximating  $\ln(1 - \tau)$  with  $-\tau$ , and omitting unimportant constants, we obtain equation (3.2).

<sup>14</sup> 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.



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 ( $r$ ). 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.<sup>15</sup>

Denoting government spending as  $g$ , we have equilibrium conditions for the three goods:<sup>16</sup>

$$\begin{aligned}
2y^{US} &= \delta z^1 + \delta z^2 + 2(1-\beta)\varepsilon y^{US} + \beta\varepsilon(y^C + y^P) - 2(1-\beta)\nu r^{US} - \beta\nu(r^C + r^P) + \\
&+ 2(1-\eta)g^{US} + \eta(g^C + g^P) + 2u, \\
y^C &= -\delta z^1 - \frac{1}{2}\delta(z^1 - z^2) + \beta\varepsilon y^{US} + \frac{1}{2}(1-\beta)\varepsilon(y^C + y^P) - \beta\nu r^{US} - \frac{1}{2}(1-\beta)\nu(r^C + r^P) + \\
&+ \eta g^{US} + \frac{1}{2}(1-\eta)(g^C + g^P) - u, \\
y^P &= -\delta z^2 + \frac{1}{2}\delta(z^1 - z^2) + \beta\varepsilon y^{US} + \frac{1}{2}(1-\beta)\varepsilon(y^C + y^P) - \beta\nu r^{US} - \frac{1}{2}(1-\beta)\nu(r^C + r^P) + \\
&+ \eta g^{US} + \frac{1}{2}(1-\eta)(g^C + g^P) - u.
\end{aligned} \tag{3.8}$$

*Ex ante* real interest rates are:

$$r^j = i^j - E(q_{+1}^j) + q^j, \quad j = US, C, P, \tag{3.9}$$

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.

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 policymakers face in the EMU era. The government budget constraint is:

$$g^j = \tau^j k^j + t^j(1 - k^j), \quad j = US, C, P. \tag{3.10}$$

Government spending falls entirely on goods (transfers are considered negative taxes);  $g^j$  defines the ratio  $G^j/P^jY^j$ ,  $t^j$  is  $T^j/P^jY^j$ , where  $T^j$  is revenue from lump-sum taxes and government  $j$ 's

<sup>15</sup> The increase in demand due to a real depreciation depends on two factors: the common elasticity parameter  $\delta$  and the size of the country with respect to whose currency the domestic currency is depreciating. Thus, for example, if the Core currency depreciates against the dollar, the increase in demand for Core goods is twice as much as it would be were the Core currency depreciating against the Periphery currency, reflecting the fact that the U.S. economy is twice the Periphery in our model and that, under perfect mobility of goods, "depreciation against a larger market is more profitable." Alternatively, one could think of demand for European goods being more sensitive to changes in the transatlantic real exchange rates than in the intra-European ones because of the characteristics of the goods that are traded and the presence of impediments to perfect mobility of goods across the Atlantic. See also Ghironi and Giavazzi (1997, 1998).

<sup>16</sup> The random disturbance  $u$  is identically and independently distributed with zero mean and can shift world demand from European to U.S. goods.

budget constraint is:  $G^j = \tau^j k^j P^j Y^j + T^j(1 - k^j)$ ,  $j = US, C, P$ .<sup>17</sup> 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.

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:<sup>18</sup>

$$\begin{aligned} i^{US} &= i^C + E(e_{+1}^1) - e^1, \\ i^{US} &= i^P + E(e_{+1}^2) - e^2. \end{aligned} \quad (3.11)$$

Each country's currency is held only by its residents. Demands for real money balances are:

$$m^j - p^j = y^j - \lambda i^j, \quad j = US, C, P. \quad (3.12)$$

Substituting (3.1) into (3.12), solving for  $p^j$ , substituting into (3.4), and solving for employment, we obtain:

$$n^j = m^j - w^j - k^j \tau^j + \lambda i^j, \quad j = US, C, P. \quad (3.13)$$

Nominal wages are predetermined according to contracts signed before the beginning of the current period by competitive unions and firms.<sup>19</sup> The wage setting rule is:<sup>20</sup>

$$w^j = \omega E_{-1}(m^j + \lambda i^j - k^j \tau^j) + (1 - \omega) E_{-1}(q^j), \quad j = US, C, P. \quad (3.14)$$

Nominal wages are a weighted average of expected total labor costs of firms (because  $m^j + \lambda i^j - k^j \tau^j = w^j + n^j$ ), and of the expected CPI.<sup>21</sup>

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, random supply disturbances are unexpected. Under these assumptions, the expected values of all variables coincide with their no-disturbance equilibrium values, *i.e.* zero.<sup>22</sup> Thus, the wage setting rule simplifies to:

<sup>17</sup> Government spending 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.

<sup>18</sup> It is easy to show that perfect capital mobility and identical spending patterns in Europe imply  $r^C = r^P$ .

<sup>19</sup> A different source of asymmetry across countries, which we do not consider in this paper, could arise from asymmetric wage setting procedures (Artis and Gazioglu, 1987).

<sup>20</sup> This wage setting rule can be derived from the assumption that unions choose nominal wages to minimize the expected deviations of employment and real wage from their zero-shock equilibrium values, subject to the constraint given by equation (3.13). Unions thus solve:

$$\min_{w^j} \frac{1}{2} \left\{ \omega E_{-1} \left[ \left( m^j - w^j - k^j \tau^j + \lambda i^j \right)^2 \right] + (1 - \omega) E_{-1} \left[ \left( w^j - q^j \right)^2 \right] \right\}, \quad 0 < \omega < 1.$$

<sup>21</sup> If any of these components increases, the nominal wage increases as well, with a negative effect on employment. If expected distortionary taxation increases, the required nominal wage declines since this taxation hits the firms' revenues and does not affect labor income. Higher taxation reduces labor demand by firms; the higher the weight  $\omega$  of employment in the unions' loss functions, the greater the reduction in the nominal wages in response to the decreased labor demand.

<sup>22</sup> Reduced forms for the endogenous variables in each country are linear functions of the policy instruments and of the disturbances. As we shall see below, this implies that, when  $u = x = 0$ , zero values of the instruments ensure zero losses for all authorities, and proves the rationality of static expectations under the assumption that disturbances have zero mean.

$$w^j = 0, \quad j = US, C, P. \quad (3.14')$$

Plugging this into the expressions for employment and prices, we obtain:

$$n^j = m^j - k^j \tau^j + \lambda i^j, \quad (3.15)$$

$$p^j = \alpha n^j + k^j \tau^j + x, \quad j = US, C, P. \quad (3.16)$$

Each central bank chooses its instrument to minimize:

$$L^{cb^j} = \frac{1}{2} \left[ a(q^j)^2 + (1-a)(n^j)^2 \right], \quad 0 < a < 1, \quad j = US, C, P. \quad (3.17)$$

where  $a$  measures the weight central bankers attach to inflation relative to employment.<sup>24</sup>

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. 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.<sup>25</sup> Country  $j$ 's government minimizes:

$$L^{gov^j} = \frac{1}{2} \left\{ b_1 \left[ b_2 (q^j)^2 + (1-b_2)(n^j)^2 \right] + (1-b_1)(g^j)^2 \right\}, \quad 0 < b_1, b_2 < 1, \quad j = US, C, P. \quad (3.18)$$

$b_1$  measures the degree of activism in the management of fiscal policy—the higher  $b_1$ , the higher the degree of activism.  $b_2$  measures the relative weight attached to inflation and employment by the fiscal authorities.

#### 4. Fiscal Distortions, Exchange-Rate Regimes, and the Government Tradeoff

Equations (3.1)-(3.18) comprise the structural model.<sup>26</sup> In what follows, we discuss how changes in the intra-European exchange-rate regime and in the extent to which fiscal policy is anti-Keynesian affect the employment-inflation tradeoff facing fiscal policymakers.

Moreover, imposing  $E(\bullet_{+t})=0$  rules out speculative bubbles.

<sup>23</sup> Equation (3.16) can be rewritten as:  $p^j = \alpha m^j + (1-\alpha)k^j \tau^j + \alpha \lambda i^j + x$ . From this expression, we see that, leaving aside indirect effects through changes in the nominal interest rate, if  $k^j > \alpha/(1-\alpha)$ , distortionary taxation has a larger direct impact on the producer price level than monetary policy. Equation (3.15) shows that, so long as  $k^j < 1$ , the impact of distortionary taxation on employment is smaller than that of monetary policy. As we shall see below, the size of the impact of monetary policy on employment and of fiscal policy on prices is important for some of our results.

<sup>24</sup> The central bank's instrument can be either the money supply or a bilateral exchange rate depending on what exchange-rate regime we consider.

<sup>25</sup> If  $b_1 = 1$ , governments face a 2-instruments-2-objectives situation whenever  $0 < k^j < 1$ . Also, if  $b_1 = 1$  and  $k^j = 0$  or  $1$ ,  $q = 0$  and  $n = 0$  will be the outcome of the strategic interaction between central bank and government inside each country (see Appendix B).

<sup>26</sup> The solution procedure is analogous to Eichengreen and Ghironi (1997) and is omitted for reasons of brevity. Details are available from the authors upon request.

#### 4.a. Flexible Exchange Rates <sup>27</sup>

The solution of the model produces linear reduced forms for the endogenous variables as functions of the policy instruments. Under flexible exchange rates in Europe, both European central banks control the respective money supply, and the intra-European exchange rate is determined endogenously. Here, we minimize on notation and provide information only on the sign of the policy multipliers and the impact of  $k^j$  ( $j = US, C, P$ ). We assume that the restrictions on parameter values such that the policy multipliers have the sign shown below are satisfied. More details on the reduced forms can be found in Appendix A. The U.S. CPI is written as:

$$q^{US} = linear \left( m_+^{US}, \frac{m^C + m^P}{2}, k_+^{US} \tau^{US}, \frac{k^C \tau^C + k^P \tau^P}{2}, g_+^{US}, \frac{g^C + g^P}{2}, u_+, x_+ \right). \quad (4.1)$$

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.<sup>28</sup> European currencies appreciate in real terms, and U.S. inflation rises.<sup>29</sup>

U.S. employment is:

$$n^{US} = linear \left( m_+^{US}, \frac{m^C + m^P}{2}, k_-^{US} \tau^{US}, \frac{k^C \tau^C + k^P \tau^P}{2}, g_+^{US}, \frac{g^C + g^P}{2}, u_+, x_- \right). \quad (4.2)$$

The signs of the multipliers are intuitive.

The reduced form for each European variable  $X^j$  is such that:

$$X^j = linear \left( m^j, \frac{m^C + m^P}{2}, m^{US}, k^j \tau^j, \frac{k^C \tau^C + k^P \tau^P}{2}, k^{US} \tau^{US} \right), \quad j = C, P.$$

$$\left( m^C - m^P, k^C \tau^C - k^P \tau^P, \frac{g^C + g^P}{2}, g^{US}, u, x \right)$$

Domestic money supply and taxes have a direct effect on endogenous variables. Averages matter through their impact on transatlantic exchange rates, and differences do through their effect on the intra-European exchange rate. Note that only average European government spending matters. This is a consequence of the spending pattern. Because European governments divide their spending evenly between Core and Periphery goods, their spending policies have no effect on the intra-European

<sup>27</sup> 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-like bands. This makes it possible to provide an alternative interpretation for the results of this sub-section.

<sup>28</sup> Higher taxes generate excess demand by causing supply to drop.

<sup>29</sup> It is possible to show that, as long as  $\delta$  is sufficiently high and  $\beta$  is small, higher taxes in Europe cause the dollar to appreciate in nominal terms, notwithstanding the fact that a real depreciation will be observed. The impact of taxes on prices more than offsets that on the nominal exchange rate in the determination of real exchange rate behavior: because the supply of goods drops when taxes are raised, a real appreciation is required to re-equilibrate the market.

exchange rate. The only effect comes through the change in demand for European goods relative to U.S. and the exchange rate of the dollar.

Core inflation and employment are such that:

$$q^C = \text{linear} \left( m_+^C, m_-^P, m_-^{US}, k_+^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right), \quad (4.3)$$

$$n^C = \text{linear} \left( m_+^C, m_+^P, m_-^{US}, k_-^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right). \quad (4.4)$$

Higher taxes in the Periphery cause a real appreciation of its currency relative to the Core's.<sup>30</sup> This generates inflation in the Core and demand for its goods. A monetary expansion in the Periphery affects employment in the Core through two 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 the money market equilibrium condition. On the other side, interest rates in the Core rise relative to the Periphery's, and this 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. Given symmetry between the two countries, reduced forms for inflation and employment in the Periphery are symmetric to those for the Core.

Central banks tradeoffs under this regime are defined by:

$$\left( \frac{\partial q^j}{\partial n^j} \right)^{cbj} \equiv \frac{\partial q^j / \partial m^j}{\partial n^j / \partial m^j}, \quad j = US, C, P. \quad (4.5)$$

Ghironi and Giavazzi (1998) show that central banks' tradeoffs depend on the size of the economy for which the monetary policymakers set their instruments. Central banks setting money supply for small and relatively open economies face steeper positively sloped tradeoffs than authorities managing monetary policy for large economies. A steeper tradeoff makes it possible to trade a larger reduction in inflation for any given decline in employment, and is thus more favorable for relatively inflation-averse central banks. The intuition behind the result 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 equilibrium in the money market. Given this result—and symmetry of European countries, under flexible exchange rates, both central banks in Europe face identical tradeoffs, which are steeper than that facing the Federal Reserve. In Figure 1—and in the following figures, the tradeoffs 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 tradeoffs 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 tradeoffs defined by:

$$\left( \frac{\partial q^j}{\partial n^j} \right)_{AK}^{govj} \equiv \frac{\partial q^j / \partial \tau^j}{\partial n^j / \partial \tau^j}, \quad j = US, C, P. \quad (4.6)$$

<sup>30</sup> Although  $\delta > 1/2$  ensures that a nominal depreciation will accompany the real appreciation.

These tradeoffs 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 tradeoff is more favorable, as the economy moves closer to the situation of zero unemployment for any decrease in CPI inflation.

**Proposition 1.** Under reasonable assumptions about parameter values, when  $k^j = 1$  ( $j = US, C, P$ ), the governments of smaller and relatively open economies face flatter tradeoffs than those of large ones.

**(Intuitive) Proof.** From equation (3.15), 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 (3.15), it follows that the tax change will have a larger effect on Core employment. In addition, equation (3.16) 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 (4.6) is smaller the smaller the country in question.<sup>31</sup> Q.E.D.

The tradeoffs facing governments in the anti-Keynesian case are displayed in Figure 2.

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

$$\left( \frac{\partial q^j}{\partial n^j} \right)_K^{gov^j} \equiv \frac{\partial q^j / \partial g^j}{\partial n^j / \partial g^j}, \quad j = US, C, P. \quad (4.7)$$

These tradeoffs 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 tradeoff remains more favorable because a larger employment gain can be traded for any given inflation loss.

**Proposition 2.** Under our assumptions, governments face identical tradeoffs when  $k^j = 0$  ( $j = US, C, P$ ).

<sup>31</sup> For the result to hold in the Core-U.S. case it must be:

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

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

**(Intuitive) Proof.** 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 tradeoffs to differ. Because Europe as a whole is symmetric to the U.S., European tradeoffs are identical to the U.S. Q.E.D.

We now turn to the intermediate situation in which  $0 < k^j < 1$  ( $j = US, C, P$ ) and fiscal policy is neither fully Keynesian nor anti-Keynesian.

In this case, governments control two policy instruments: spending and the rate of distortionary taxation, with lump-sum taxes determined residually. Hence, defining the tradeoff facing the fiscal policymaker is not straightforward. Each government faces a policy frontier which is a combination of the tradeoff it would face in the anti-Keynesian case and of that it would face in the fully Keynesian regime, and whose exact position depends on the value of  $k^j$ . The overall tradeoff can be defined as:

$$\left( \frac{\Delta q^j}{\Delta n^j} \right)^{Gov^j} \equiv \frac{\frac{\partial q^j}{\partial \tau^j} d\tau^j + \frac{\partial q^j}{\partial g^j} dg^j}{\frac{\partial n^j}{\partial \tau^j} d\tau^j + \frac{\partial n^j}{\partial g^j} dg^j}. \quad (4.8)$$

As  $k^j$  approaches 0, the tradeoff approaches the positively sloped Keynesian line. When  $k^j$  tends to 1, the policy frontier approaches the negatively sloped anti-Keynesian line. Equation (4.8) says that, when the fiscal policymaker can actively maneuver two instruments, the overall tradeoff becomes endogenous to the policy choice. It is possible to verify that, if expression (4.8) 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 tradeoff increases with  $k^j$ , and the tradeoff 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 (4.8) 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 tradeoff 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 tradeoff 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.

If the fiscal instruments are moved in different directions, the slope of the tradeoff decreases with  $k^j$ . This means that the overall tradeoff 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 (4.8) is always positive, but there exists a value of  $k^j$ —denoted by  $\tilde{k}^j$ —such that the slope of the tradeoff 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

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<sup>32</sup>  $\Delta q^j$  and  $\Delta n^j$  are different from the total differentials of  $q^j$  and  $n^j$ , because we are holding other policymakers' instruments constant.

slope of the tradeoff 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  $k^l$  such that  $k^{US} = k^C = k^P$ , European governments face more favorable overall tradeoffs than the U.S.

#### 4.b. 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.<sup>33</sup>

The constraint to which monetary policy in the Periphery is subject under this regime can be written as:<sup>34</sup>

$$m^P = \text{linear} \left( m_+^C, e^1 - e^2, k^P \tau^P - k^C \tau^C \right). \quad (4.9)$$

Other things being 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. Equation (4.9) can be

substituted into the reduced forms obtained under flexible exchange rates.

U.S. CPI and employment become:

$$q^{US} = \text{linear} \left( \begin{array}{c} m_+^{US}, m_-^C, e^1 - e^2, k^P \tau^P - k^C \tau^C, k^{US} \tau^{US}, \\ \frac{k^C \tau^C + k^P \tau^P}{2}, g_+^{US}, \frac{g^C + g^P}{2}, u_+, x_+ \end{array} \right), \quad (4.10)$$

$$n^{US} = \text{linear} \left( \begin{array}{c} m_+^{US}, m_-^C, e^1 - e^2, k^P \tau^P - k^C \tau^C, k^{US} \tau^{US}, \\ \frac{k^C \tau^C + k^P \tau^P}{2}, g_+^{US}, \frac{g^C + g^P}{2}, u_+, x_- \end{array} \right). \quad (4.11)$$

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 reader can verify from Appendix A that the following result holds.

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

<sup>33</sup> What we have in mind is the choice of the central parity between the two European currencies rather than of the daily exchange rate. In this sense, assuming that realignments are noncooperative—as we do in our exercise—may be too strong, as realignments are a matter of common discussion under the EMS. However, we believe that the way cooperation is modeled in this paper also goes beyond what was observed.

<sup>34</sup> See Eichengreen and Ghironi (1997) for details in the case  $k = 1$  or 0.



**(Intuitive) Proof.** The reduced-form parameters determining the U.S. authorities' tradeoffs 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 implications 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. tradeoffs also when European countries are identical. Q.E.D.

Each endogenous European variable  $X^j$  is now such that:

$$X^j = \text{linear} \left( m^C, e^1 - e^2, m^{US}, k^j \tau^j, \frac{k^C \tau^C + k^P \tau^P}{2}, k^{US} \tau^{US}, \right. \\ \left. k^C \tau^C - k^P \tau^P, \frac{g^C + g^P}{2}, g^{US}, u, x \right), \quad j = C, P.$$

Specifically, Core and Periphery's CPI and employment are:

$$q^C = \text{linear} \left( m_+^C, e^1 - e^2, m_-^{US}, k_+^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right); \quad (4.12)$$

$$q^P = \text{linear} \left( m_+^C, e^1 - e^2, m_-^{US}, k_+^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right); \quad (4.13)$$

$$n^C = \text{linear} \left( m_+^C, e^1 - e^2, m_-^{US}, k_-^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right); \quad (4.14)$$

$$n^P = \text{linear} \left( m_+^C, e^1 - e^2, m_-^{US}, k_+^C \tau^C, k_-^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x} \right). \quad (4.15)$$

As we know from Ghironi and Giavazzi (1998), since it effectively sets the money supply for all of Europe<sup>35</sup> (and since the U.S. and Europe are symmetric), the Core's central bank now faces the same employment-inflation tradeoff as the Fed, worse than the tradeoff it faced in the previous regime. Under managed exchange rates, the employment-inflation tradeoff facing the Periphery's central bank is:

$$\left( \frac{\partial q^P}{\partial n^P} \right)^{cb^P} \equiv \frac{\partial q^P / \partial (e^1 - e^2)}{\partial n^P / \partial (e^1 - e^2)}.$$

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 tradeoff, this is identical to the one the central bank faced under flexible exchange rates, and it is more favorable than that facing the Core's monetary authority (see Figure 1).

<sup>35</sup> Recall equation (4.9).

As far as European governments' tradeoffs are concerned, the following results can be obtained.

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

**(Intuitive) Proof.** 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' tradeoffs 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 tradeoffs improves more than the Core's with the transition from flexible to managed exchange rates. Q.E.D.

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

**(Intuitive) Proof.** 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' tradeoffs.<sup>36</sup> Q.E.D.

The results in propositions 4 and 5 are illustrated in Figure 2.

In the general case  $0 < k^j < 1$  ( $j = US, C, P$ ), analogous conclusions to those reached before hold. The overall tradeoff 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 tradeoff 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 tradeoff rotates counterclockwise. Else, the rotation is clockwise. The following corollary follows immediately from Propositions 1-5.<sup>37</sup>

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<sup>36</sup> Asymmetry in the pattern of government spending across the Atlantic ensures that fiscal policies do affect the transatlantic exchange-rate regime also in a fully Keynesian world. Hence, changes in the transatlantic exchange-rate regime would affect governments' tradeoffs across the Atlantic.

<sup>37</sup> The proof is omitted.

**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 tradeoff, while the Periphery's faces the most favorable.

#### 4.c. 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  $m^{Eu}$ , the European money supply, to minimize:

$$L^{ECB} = \frac{1}{2} \left[ a(q^{Eu})^2 + (1-a)(n^{Eu})^2 \right]. \quad (4.16)$$

Reduced forms for aggregate European and U.S. inflation and employment are now:

$$q^{Eu} = \frac{q^C + q^P}{2} = \text{linear} \left( m_+^{Eu}, m_-^{US}, \frac{k^C \tau^C + k^P \tau^P}{2_+}, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2_+}, g_+^{US}, \underline{u}, \underline{x}_+ \right); \quad (4.17)$$

$$n^{Eu} = \frac{n^C + n^P}{2} = \text{linear} \left( m_+^{Eu}, m_-^{US}, \frac{k^C \tau^C + k^P \tau^P}{2_-}, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2_+}, g_+^{US}, \underline{u}, \underline{x}_- \right); \quad (4.18)$$

$$q^{US} = \text{linear} \left( m_-^{Eu}, m_+^{US}, \frac{k^C \tau^C + k^P \tau^P}{2_+}, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2_+}, g_+^{US}, \underline{u}, \underline{x}_+ \right); \quad (4.19)$$

$$n^{US} = \text{linear} \left( m_-^{Eu}, m_+^{US}, \frac{k^C \tau^C + k^P \tau^P}{2_+}, k_-^{US} \tau^{US}, \frac{g^C + g^P}{2_+}, g_+^{US}, \underline{u}, \underline{x}_+ \right). \quad (4.20)$$

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.<sup>38</sup> Following the same steps as in Eichengreen and Ghironi (1997), it is possible to show that under this regime  $q^C = q^P = q^{Eu}$ . Locking the nominal exchange rate between European currencies implies that Core and Periphery inflation rates are equalized *ex ante*. Differences in fiscal policies across European countries only affect employment. This can be shown 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:

$$m^P - m^C = \text{linear} \left( k^C \tau^C - k^P \tau^P \right). \quad (4.21)$$

Another consequence of  $e^1 - e^2 = 0$  is  $i^C - i^P = 0$ . (3.15) therefore becomes:

$$n^P - n^C = m^P - m^C - (k^P \tau^P - k^C \tau^C) = \text{linear} \left( k^C \tau^C - k^P \tau^P \right). \quad (4.22)$$

<sup>38</sup> When the results of the previous sub-sections were interpreted as referring to EMU-*ins* versus *outs*, one was making the implicit assumption of fiscal coordination inside the monetary union. This assumption is no longer necessary here.

From (4.22), differences between  $k^C \tau^C$  and  $k^P \tau^P$  imply differences in employment.<sup>39</sup> Solving for  $n^P$  and plugging the result into  $n^C = 2n^{Eu} - n^P$  yields:

$$n^C = n^{Eu} + \text{linear}\left(k^C \tau^C - k^P \tau^P\right). \quad (4.23)$$

Finally, plugging the reduced form equation for  $n^{Eu}$  into this equation, we obtain reduced forms for employment:

$$n^C = \text{linear}\left(m_+^{Eu}, m_-^{US}, k_-^C \tau^C, k_+^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x}\right); \quad (4.24)$$

$$n^P = \text{linear}\left(m_+^{Eu}, m_-^{US}, k_+^C \tau^C, k_-^P \tau^P, k_+^{US} \tau^{US}, \frac{g^C + g^P}{2}, g_+^{US}, \underline{u}, \underline{x}\right). \quad (4.25)$$

As pointed out above, the tradeoffs facing the Fed and the U.S. government do not depend on the European exchange-rate regime. The ECB faces the same tradeoff as the Core's central bank under managed rates.<sup>40</sup> Also, we know from the previous results that, when  $k^j = 0$ , all governments face identical tradeoffs, and the common tradeoff 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 tradeoffs that are more favorable than the U.S. government's. The tradeoff facing the Core's government is better than under managed exchange rates, while the tradeoff facing the Periphery's government is worse (but still better than the tradeoff it faced under float).<sup>41</sup>

**(Intuitive) Proof.** European governments' tradeoffs 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 tradeoffs is split evenly between Core and Periphery: the Periphery's tradeoff does not improve as much as when going from flexible to managed rates, and the tradeoff 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.<sup>42</sup> 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 tradeoff. 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,

<sup>39</sup> 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 *ex ante*.

<sup>40</sup> Since both set monetary policy for the whole of Europe. The ECB's tradeoff is therefore the same as that facing the Fed.

<sup>41</sup> See Figure 2.

<sup>42</sup> The expansionary effect of lower taxes more than offsets the contractionary effect of smaller spending under reasonable assumptions about parameters.

the tradeoff 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 tradeoff between its policy objectives improves following the transition to a monetary union with the Periphery. Q.E.D.

As under managed rates, when  $k^j$  increases from 0 to 1, the tradeoff 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 tradeoffs more favorable than the U.S. government's, as a consequence of country size and the exchange rate regime.

## 5. 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 a country's policymakers' losses after a negative supply shock that causes inflation and unemployment, such as the recent increase in the price of oil. 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 non-cooperative fiscal policies in the general case  $0 < k^j < 1$  ( $j = US, C, P$ ). Once the shock is observed, each government chooses the levels of its policy instruments to minimize the loss function (3.18). The first-order conditions for government  $j$  are:

$$b_1 \left[ b_2 \frac{\partial q^j}{\partial g^j} q^j + (1-b_2) \frac{\partial n^j}{\partial g^j} n^j \right] + (1-b_1)g^j = 0; \quad (5.1)$$

$$b_2 \frac{\partial q^j}{\partial \tau^j} q^j + (1-b_2) \frac{\partial n^j}{\partial \tau^j} n^j = 0; \quad j = US, C, P. \quad (5.2)$$

Letting  $AK^j$  denote country  $j$ 's *anti-Keynesian* tradeoff, condition (5.2) can be rewritten as:

$$\frac{\tilde{q}^j}{\tilde{n}^j} = -\frac{1-b_2}{b_2 AK^j}, \quad (5.3)$$

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

**Proposition 7.** Knowledge of the tradeoff 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.<sup>43</sup> Hence, as expected, governments prefer a relatively flat anti-Keynesian tradeoff to a steep one.

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<sup>43</sup> When the ratio is high, employment is kept closer to its zero-shock equilibrium level for any given level of

Letting  $K^j$  denote country  $j$ 's *Keynesian* tradeoff, equation (5.1) can be rewritten as:

$$\frac{\tilde{g}^j}{\tilde{n}^j} = -\frac{b_1}{1-b_1} b_2 \frac{\partial q^j}{\partial g^j} \left( \frac{\tilde{q}^j}{\tilde{n}^j} + \frac{1-b_2}{b_2 K^j} \right). \quad (5.4)$$

This equation—combined with (5.3) and the reduced forms for  $q^j$  under the three monetary regimes we consider—yields the following result.

**Proposition 8.** Changes in any of the three countries'  $k$  inside the interval  $(0, 1)$  have no impact on country  $j$ 's equilibrium spending-employment ratio.

Because  $AK^j$  is negative, the equilibrium inflation-employment ratio is positive. In the  $(\tilde{n}^j, \tilde{q}^j)$  space, equilibrium employment and inflation will be determined by the intersection of the positively sloped line through the origin defined by (5.3) and a line with slope  $AK^j$  that goes through the point to which the economy is moved by the shock, the optimal choice of  $g^j$ , and the foreign governments' actions. The level of employment implied by the government's reaction to the shock can be either positive or negative. In Appendix C we show that, in the absence of actions by foreign governments,  $\tilde{n}^j > 0 \Leftrightarrow \partial q^j / \partial x > AK^j (\partial n^j / \partial x)$ . If  $\tilde{n}^j > 0$ , then  $\tilde{q}^j > 0$ , and equation (5.4) implies that it will be  $\tilde{g}^j < 0$ . In order to reach a positive level of employment, distortionary taxes are decreased to a level such that the government finds it optimal to reduce spending as well. Instead, if  $\tilde{n}^j < 0$ , then  $\tilde{q}^j < 0$  and  $\tilde{g}^j > 0$ .

Government  $j$ 's loss function can be rewritten as:

$$\tilde{L}^{gov j} = \frac{\tilde{n}^{j^2}}{2} \left\{ b_1 \left[ b_2 \left( \frac{\tilde{q}^j}{\tilde{n}^j} \right)^2 + 1 - b_2 \right] + (1 - b_1) \left( \frac{\tilde{g}^j}{\tilde{n}^j} \right)^2 \right\}. \quad (5.5)$$

Differentiating this expression with respect to  $k^l$  ( $l = US, C, P$ ), and making use of the results obtained above, yields:

$$\frac{\partial \tilde{L}^{gov j}}{\partial k^l} = \tilde{n}^j \frac{\partial \tilde{n}^j}{\partial k^l} \left\{ b_1 \left[ b_2 \left( \frac{\tilde{q}^j}{\tilde{n}^j} \right)^2 + 1 - b_2 \right] + (1 - b_1) \left( \frac{\tilde{g}^j}{\tilde{n}^j} \right)^2 \right\}. \quad (5.6)$$

The expression in curled brackets is unambiguously positive. We know that  $\tilde{n}^j$  can be either negative or positive. In order 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 the policy multipliers presented in Section 4—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 exchange-rate regime in Europe*:

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inflation.

$$\frac{\partial \tilde{n}^{US}}{\partial k^{US}} \equiv \frac{\partial \tilde{n}^{US}}{\partial \tilde{\tau}^{US}} \frac{\tilde{\tau}^{US}}{k^{US}} > 0;$$

$$\frac{\partial \tilde{n}^{US}}{\partial k^C} \equiv \frac{\partial \tilde{n}^{US}}{\partial \tilde{\tau}^C} \frac{\tilde{\tau}^C}{k^C} < 0;$$

$$\frac{\partial \tilde{n}^{US}}{\partial k^P} \equiv \frac{\partial \tilde{n}^{US}}{\partial \tilde{\tau}^P} \frac{\tilde{\tau}^P}{k^P} < 0.$$

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.<sup>44</sup> If instead  $\tilde{n}^{US} > 0$ , more employment means less stability around the zero-shock equilibrium value. Conversely, when  $\tilde{n}^{US} < 0$ , larger fiscal distortions abroad are harmful for the stability of U.S. employment. They are beneficial if  $\tilde{n}^{US} > 0$ .

As the reader can verify easily, analogous results hold for the European countries. We thus have the following proposition.

**Proposition 9.** If  $\tilde{n}^j < 0$  ( $j = US, C, P$ ), 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 4, we had observed that flatter tradeoffs are more favorable for governments, as they make it possible to achieve more employment stability for any given change in inflation. When governments react to the supply shock we consider here, they lower taxes and raise spending.<sup>45</sup> Hence, as  $k^j$  increases between 0 and 1, the overall tradeoff facing government  $j$  rotates clockwise from the Keynesian position to the anti-Keynesian. This means that, when the slope of the overall tradeoff 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 tradeoff alone—as opposed to the overall tradeoff—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 tradeoff. 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 tradeoff is becoming steeper. Why is this so? Recall equation (3.15): 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 tradeoffs, governments favor situations in which they can rely more heavily on the instrument that is more effective for stabilization purposes. Ideally, as

<sup>44</sup> Starting from a situation in which  $n^{US}$  is negative,  $\partial \tilde{n}^{US} / \partial k^{US} > 0$  means that the deviation of employment from its zero-shock equilibrium level becomes smaller as  $k^{US}$  increases.

<sup>45</sup> We are focusing on the case  $\tilde{n}^j < 0$  ( $j = US, C, P$ ).

long as  $b_2$  is sufficiently small, government  $j$  would like to face a relatively flat anti-Keynesian tradeoff—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 tradeoffs, 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.

How do changes in  $k$  affect the equilibrium values of central banks' losses?

Country  $j$ 's central bank's loss function can be written as:

$$\tilde{L}^{cbj} = \frac{\tilde{n}^{j2}}{2} \left[ a \left( \frac{\tilde{q}^j}{\tilde{n}^j} \right)^2 + 1 - a \right], \quad j = US, C, P.$$

Differentiation of this expression with respect to  $k^l$  ( $l = US, C, P$ ) shows that the conclusions are analogous to those obtained for government losses. The inflation-employment ratio is independent of  $k^l$ , and the results obtained above imply that the following proposition is true:

**Proposition 10.** If  $\tilde{n}^j < 0$  ( $j = US, C, P$ ), 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  $\tilde{n}^j > 0$ .

Having shifted the focus to central banks' losses, we now motivate the assumption made in this section that monetary policymakers are inactive. The reason is 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 policymakers achieve a bliss situation of zero losses. In fact, the first-order condition for the central bank's optimal policy choice can be written as:

$$aq^j \frac{\partial q^j}{\partial inst^{cbj}} + (1-a)n^j \frac{\partial n^j}{\partial inst^{cbj}} = 0,$$

where  $inst$  is the instrument controlled by the policymaker. Denoting the tradeoff facing the central bank by  $CB^j$ , this equation can be rearranged as:

$$\frac{\tilde{q}^j}{\tilde{n}^j} = -\frac{1-a}{aCB^j},$$

This condition determines the equilibrium inflation-employment ratio as a function of the central bank's tradeoff and of the relative weight the central bank attaches to inflation and employment.<sup>46</sup> However, equation (5.3) says that the inflation-employment ratio is determined by the government's anti-Keynesian tradeoff and the relative weight the government attaches to inflation and employment. The two ratios are generally different. If  $0 < k^j < 1$  and both central bank and government of country  $j$  are playing actively, the solution of the game is such that  $\tilde{q}^j = \tilde{n}^j = 0$ . Only in this case, both the central bank's first-order condition and the first-order condition for the government's optimal choice of  $\tau^j$  are satisfied. Authorities are able to reach their bliss point. The

<sup>46</sup> See Ghironi and Giavazzi (1998).



specification of the loss functions is such that two policy instruments—the central bank’s instrument and  $\tau^j$ —are used to stabilize inflation and employment perfectly. Of course, the government will also find it optimal to choose  $\tilde{g}^j = 0$ . Note that this does not happen when the interaction between the ECB and European governments in the Europe-wide EMU regime is concerned, 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!<sup>47 48</sup> The following propositions summarize this argument:

**Proposition 11.** 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  $0 < k^j < 1$  ( $j = US, C, P$ ), both authorities reach their bliss points regardless of country size, the exchange-rate regime, and the value of  $k^j$ .

**Proposition 12.** Under Europe-wide EMU, if both monetary and fiscal policy are active in Europe and  $0 < k^j < 1$  ( $j = C, P$ ), European policymakers 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.<sup>49</sup>

## 6. European Monetary Regimes and the Prospects for Policy Cooperation

In Eichengreen and Ghironi (1997) we analyzed the consequences of the transition to (Europe-wide) EMU and the prospects for international policy coordination under the assumption that fiscal policy was either anti-Keynesian or fully Keynesian in all countries. We relied on a numerical exercise, backed by theoretical results on policymakers’ incentives. For the anti-Keynesian case, we found that, in contrast to popular fears, EMU may enhance fiscal discipline in Europe and stabilize employment in the face of supply shocks without harming monetary rigor. The ECB and the Fed were found to have little incentive to coordinate their responses to such shocks. Governments favored monetary cooperation, but central banks did not share their interest. Governments and central banks on both sides of the Atlantic were worse off when the European

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<sup>47</sup> 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 the symmetry between Core and Periphery. Combined with  $q^C = q^P = q^{Eu}$  *ex ante*, 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 B.

<sup>48</sup> 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 tradeoff and preferences. It is easy to verify that Proposition 11 still holds.

<sup>49</sup> For example, we will show below that harmonization towards a situation in which fiscal policy is fully anti-Keynesian in all countries in the absence of fiscal cooperation would yield a better outcome than fiscal coordination in Europe for the specific example we consider.

governments cooperated. The results for the Keynesian case were different: EMU may reduce monetary discipline more significantly, the ECB and central banks outside Europe were willing to coordinate their response to supply shocks, and the ECB wanted European governments to coordinate their policies.

To facilitate comparison with these findings, we focus again on policymakers' optimal reactions to a supply side disturbance that causes inflation and unemployment in all countries.<sup>50</sup> As in our 1997 paper, because some reduced form parameters have ambiguous sign in the absence of restrictions on structural parameter values, the game among central banks and governments is solved numerically. We assume the same consensus values for structural parameters and the weights attached to targets in policymakers' loss functions as in Eichengreen and Ghironi (1997) (see Table 1). Although numerical results can be sensitive to the choice of parameter values, the findings of our exercise are shown to be consistent with the theoretical intuition from the behavior of players' tradeoffs. This lends robustness to the exercise. 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, the asymmetry we introduce relative to the analysis of Eichengreen and Ghironi (1997) seems sufficient to capture some features of reality. 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, such as the U.K. and Sweden. Central banks are active players.  $k^j$  being either 0 or 1 prevents any player from reaching a bliss point. Under our assumption about the nature of fiscal policy in the three countries, reduced forms can be easily related to those in Eichengreen and Ghironi (1997). Policy multipliers for U.S. and Core instruments are as in the fully Keynesian case of that paper, whereas the multipliers of Periphery instruments are as in the anti-Keynesian case (Table 1).

This section is divided in three parts. In the first part, we focus on three policymaking scenarios: flexible exchange rates, managed exchange rates, and Europe-wide EMU. If Core and Periphery are interpreted as two European countries in the pre-EMU era, these scenarios can be taken as an illustration of the consequences of the transition to EMU from the previous regimes. If Core and Periphery are interpreted as EMU-*ins* and *outs*, the scenarios can be taken as an illustration of the consequences of EMU enlargement in the absence of intra-EU fiscal cooperation. In the second part of the section, we address the issue of cooperation among policymakers in the EMU era. We consider three scenarios, which we think are the most interesting given the current policy debate: transatlantic monetary cooperation, intra-European fiscal cooperation, and cooperation between central banks and governments inside each continent. The third part offers some reflections on the consequences of large changes in the nature of fiscal policy.

## 6.a. Towards Europe-Wide EMU

### 6.a.1. Flexible Exchange Rates

Numerical values of the tradeoffs facing policymakers are displayed in Table 2. We assume that authorities do not cooperate with one another either internationally or within countries. Solving the central banks' minimization problems yields the first-order conditions:

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<sup>50</sup> The results of our 1997 numerical exercise are displayed in Appendix D for the reader's convenience.

$$aq^j \frac{\partial q^j}{\partial m^j} + (1-a)n^j \frac{\partial n^j}{\partial m^j} = 0, \quad j = US, C, P. \quad (6.1)$$

Solving the fiscal authorities' minimization problems yields their reaction functions. Equation (5.1) dictates government behavior in the U.S. and in the Core. The Periphery's government chooses policy according to:

$$b_1 \left[ b_2 q^P \frac{\partial q^P}{\partial \tau^P} + (1-b_2)n^P \frac{\partial n^P}{\partial \tau^P} \right] + (1-b_1)\tau^P = 0, \quad (6.2)$$

because  $g^P = \tau^P$  when  $k^P = 1$ . Numerical values of the policy instruments, endogenous variables, and loss functions are displayed in tables 3, 4, and 5.

Reacting to the consequences of 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 tradeoffs. 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 tradeoffs and act aggressively, trying to export inflation to one another. Because it faces a less favorable tradeoff, 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 its 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 tradeoff.

Monetary policies are more aggressive than in the fully anti-Keynesian world of Eichengreen and Ghironi (1997). Relative to that situation, the U.S. and Core governments face worse tradeoffs.<sup>51</sup> Their actions no longer help stabilize inflation, and this triggers the central banks' reaction, with adverse consequences on employment. Instead, when results are compared to the fully Keynesian case of our 1997 paper, monetary policy is less aggressive in all countries. Relative to that case, the Periphery's government faces a better tradeoff. Its action now helps stabilize inflation. This causes the Periphery's central bank to be less aggressive. In turn, this dampens the reaction by the Fed and the Core's central bank, and employment and inflation are more stable in all countries. A large increase in the degree of anti-Keynesianism of fiscal policy in the Periphery, which triggers large policy adjustments, is thus beneficial for all countries, in contrast to the prediction of the analysis of small changes in the fiscal regime performed in Section 5. We will return to these results at the end of this section, when we briefly discuss the consequences of large fiscal reforms.

### 6.a.2. Managed Exchange Rates in Europe

As for the previous regime, we assume no cooperation either internationally or within countries. The Fed and the Core's central bank continue to choose their policies according to equation (6.1). The Periphery's central bank now minimizes its loss function with respect to  $e^1 - e^2$ , yielding:

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<sup>51</sup> We identify the Core economy in this paper with Germany in our 1997 exercise, the Periphery with France.

$$aq^P \frac{\partial q^P}{\partial (e^1 - e^2)} + (1-a)n^P \frac{\partial n^P}{\partial (e^1 - e^2)} = 0.$$

(5.1) and (6.2) rule government behavior.

When the Periphery's central bank sets the Core/Periphery exchange rate, the Core's central bank faces the same tradeoff 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 tradeoff. The Periphery's central bank acts aggressively on the exchange rate, trying to export inflation to the Core. The government faces a better tradeoff 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.

Comparing the results to those in Eichengreen and Ghironi (1997) yields conclusions that are similar to those obtained above. Monetary policies are more aggressive than in the fully anti-Keynesian world, and inflation and employment are less stable. The U.S. and Core's monetary policies are less aggressive than in the Keynesian world, although the revaluation chosen by the Periphery's central bank is larger. The Periphery's government activism is beneficial for inflation in all countries. This reduces the need for monetary aggressiveness and, in turns, has a positive impact on employment.

### 6.a.3. Europe-Wide EMU

Under (Europe-Wide) EMU the first-order condition for the ECB is:

$$aq^{Eu} \frac{\partial q^{Eu}}{\partial m^{Eu}} + (1-a)n^{Eu} \frac{\partial n^{Eu}}{\partial m^{Eu}} = 0. \quad (6.3)$$

First-order conditions for the other policymakers are as above.

Whereas no significant changes are observed in U.S. and Core fiscal policies, consistent with the unchanged tradeoffs and preferences, the transition to EMU significantly stabilizes fiscal policy in the Periphery. This is due to the worsening of its government's tradeoff, 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 intuition lies in our results on governments' tradeoffs: as shown in Section 4, the change in monetary regime alters the constraints facing fiscal policymakers in peripheral countries in a way that discourages them from making active use of their instruments.

In Eichengreen and Ghironi (1997), the ECB's stance was slightly less contractionary than the Core central bank's in the anti-Keynesian case. The weakening of the monetary stance was more pronounced when fiscal policy was Keynesian in all countries. Here, the ECB's policy is significantly more contractionary than the Core central bank's under managed exchange rates. Both authorities face identical tradeoffs 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 without the support of a more active anti-Keynesian fiscal policy in the Core. Hence, it acts more aggressively, and this induces the Fed to react by tightening.

This is another important result, which reinforces the weaker findings of Eichengreen and Ghironi (1997). 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 policymakers in the Core benefit from a Europe-wide EMU. The asymmetry in the nature of fiscal policy between the two European countries is at the core of the differences in policy adjustments that the transition to this regime entails, and thus of our result. When fiscal policy was anti-Keynesian in all countries, the transition to EMU improved the tradeoff facing the Core government, causing it to be more active. This had a stabilizing impact on inflation and induced 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 we have again Eichengreen and Ghironi's (1997) result that EMU may stabilize European employment in the face of supply shocks, again in contrast with popular fears.<sup>52</sup>

## 6.b. Policy Coordination in the EMU era

### 6.b.1. Transatlantic Monetary Cooperation

When the Fed and the ECB cooperate, they jointly minimize a linear convex combination of their respective loss functions with weights equal to 1/2. The first-order conditions can be found in Appendix E. Governments' behavior is still governed by equations (5.1) and (6.2).

Both central banks now refrain from trying to export inflation across the Atlantic. They behave as a single policymaker managing monetary policy for the aggregate of the U.S. and Europe—and thus facing a flatter tradeoff 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 policymakers will not be attracted by the cooperative option. However, the potential for institutional conflict is more limited here, as the increase in central banks' losses is smaller than when fiscal policy is anti-Keynesian in all countries. Although non-Keynesian fiscal policy in just one European country can re-create a conflict of interests that does not exist in the fully Keynesian case of Eichengreen and Ghironi (1997), the prospects for cooperation between the ECB and the Fed improve relative to the non-Keynesian scenario analyzed there.<sup>53</sup>

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<sup>52</sup> Average European employment under managed exchange rates is  $n^{Eu} = -1.4171x$ .

<sup>53</sup> 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. The adjustment in

### 6.b.2. Intra-European Fiscal Cooperation

It has been widely argued that EMU should be coupled with strengthened fiscal coordination in Europe.<sup>54</sup> In Eichengreen and Ghironi (1997), we found that fiscal cooperation in Europe was counterproductive for all players in an anti-Keynesian world. 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 (see Appendix E). The choices of the Fed and the ECB are governed by equations (6.1) and (6.3), respectively. The U.S. government chooses spending according to equation (5.1).

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, we find again that intra-European fiscal cooperation can be counterproductive for all policymakers, although anti-Keynesian fiscal policy in the Periphery alone is sufficient to generate the result.<sup>55</sup>

### 6.b.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 policymakers' 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 appear to 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 in order 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 solve:

$$\min_{m^{US}, g^{US}} \frac{1}{2} L^{Fed} + \frac{1}{2} L^{gov^{US}},$$

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monetary policy implied by the move from a non-cooperative to a cooperative setting could be interpreted as intervention that stabilizes the exchange rate by removing the part of its changes that was due to monetary "aggressiveness."

<sup>54</sup> For example, Chari and Kehoe (1998) and Huber (1998) find that fiscal coordination within a monetary union is beneficial.

<sup>55</sup> When intra-European fiscal cooperation is coupled with transatlantic monetary cooperation, central banks are less aggressive than in the previous scenario. 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.

where symmetry in the two authorities' positions motivates the choice of the weights attached to the loss functions. First-order conditions are in Appendix E.

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 policymakers jointly minimize a weighted average of the ECB's loss function and of an average of the two national governments' losses:

$$\min_{m^{Eu}, g^C, \tau^P} \frac{1}{2} L^{ECB} + \frac{1}{2} \left( \frac{L^{gov^C} + L^{gov^P}}{2} \right).$$

This formulation is equivalent to combining cooperation between the two European governments with cooperation between the coalition of the two governments and the ECB, attaching equal weights to the losses of the latter and of the governments' coalition.<sup>56</sup> First-order conditions for the European policymakers' problem can be found in the Appendix E.

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 entirely consistent with the tradeoffs facing policymakers. 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 policymakers 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 policymakers—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 consistently 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.

### 6.c. Fiscal Reforms and Policymakers' Losses

The results of Section 5 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

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<sup>56</sup> Considering cooperation between the ECB and the two governments separately—*i.e.* in the absence of cooperation among them—would have raised an existence problem for the equilibrium of the game. The coalition ECB-Core government would have played Nash against the coalition ECB-Periphery's government. In a sense, the ECB would have played Nash against itself, leading to non-existence of an equilibrium.

nature of fiscal policy. Comparing governments' 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 tradeoff 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. As we pointed out elsewhere in the text—and as the reader can easily check, significant changes in the equilibrium values of policy instruments triggered by drastic changes in the tradeoffs facing one or more policymakers cause the difference in results from the prediction of the analysis in Section 5. There, second-order effects of marginal changes in policy instruments were neglected. One observation emerges, though. If the values of the loss functions are compared, it is evident that the increase in the degree of anti-Keynesianism in the Periphery benefits the Periphery's government in any given policy scenario much more than it benefits governments in the Core and in the U.S. Analogously, the reform that changes the fraction of firms subject to distortionary taxes in the U.S. and in the Core from 1 to 0 ends up being much more harmful for the U.S. and Core governments than it is for the Periphery's. Not surprisingly, the impact on the domestic government's losses of a large fiscal reform is larger than its external effect.

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. As for the governments, fiscal reforms have a larger impact on the domestic central bank's loss function.

## 7. Optimal Fiscal Reforms?

So far, our discussion has taken  $k^j$  ( $j = US, C, P$ ) 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 policymakers. 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? In this section we offer a brief intuitive discussion of the issue.

We focus on *commitment* to a value of  $k$  before the stabilization game, *i.e.* from an *ex ante* perspective, because the choice of the fiscal regime is typically made for several periods. It sets the characteristics of the environment in which fiscal policymaking—in the sense of choosing the



levels of spending and taxation—will take place. By committing to a level of  $k$ —and to an exchange-rate regime, the government commits to a certain policy tradeoff rather than another.

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 North-West or South-East 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 tradeoff. When shocks bring the economy to the North-East or South-West quadrants, a positively sloped tradeoff 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 towards 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.<sup>57</sup> 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, as pointed out in Section 2, 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 tradeoff facing a government depends on the realizations of the shocks, the issue of the credibility of the government’s commitment to a fiscal regime arises. If the government has committed to a high value of  $k$  and an unfavorable demand shock happens, the policymaker will have an incentive to renege on the commitment and re-optimize relative to  $k$ . The problem is analogous to that of the credibility of the commitment to an exchange-rate regime that differs from free float—or to policy cooperation. We abstract from this issue here, and assume that the commitment is made credible by the presence of significant costs of changing the fiscal regime too often.

When country  $j$ ’s government minimizes 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 choice of  $k^j$  can be written as:

$$E \left[ b_2 q^j \frac{\partial q^j}{\partial k^j} + (1 - b_2) n^j \frac{\partial n^j}{\partial k^j} \right] = 0, \quad (7.1)$$

where  $E(\bullet)$  denotes the unconditional expectation operator. The government chooses the fiscal regime when “the economy is born.” The derivative of  $q^j$  ( $n^j$ ) with respect to  $k^j$  is proportional to

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<sup>57</sup> See Saint-Paul (1998a, b).

$\tau^j$ . Inflation and employment are linear functions of the policy instruments (and of the shocks). Hence, (7.1) implicitly defines the optimal value of  $k^j$  as a function of the variance of  $\tau^j$ , and of its covariances with the shocks and the other domestic and foreign policy instruments. Because policy instruments are moved only when non-zero realizations of the *i.i.d.* shocks  $u$  and  $x$  happen, this amounts to saying that the optimal value of  $k^j$ — $\widehat{k}^j$ —is a function of the variances of the disturbances to supply and demand— $\sigma_x^2$  and  $\sigma_u^2$ , respectively:

$$\widehat{k}^j = \text{linear} \left( \begin{array}{c} \sigma_u^2, \sigma_x^2 \\ - \quad + \end{array} \right).$$

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.

## 8. Conclusions

We have proposed a model to analyze how changes in the extent to which fiscal policy is distortionary and in the exchange-rate regime affect fiscal policymakers' incentives and constraints at home and abroad. The model has been used to address questions regarding policy interactions between the U.S. and Europe in the EMU era. Our results can be summarized as follows.

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 and more open economies face a more favorable tradeoff than large relatively closed ones. Changes in the intra-European monetary arrangement do not affect the U.S. tradeoff, though they alter the mechanism through which fiscal policy is transmitted in Europe, and thus the tradeoffs facing European fiscal policymakers. Under a managed exchange rate regime, both European governments face a better tradeoff than under flexible rates, but the improvement is more significant for the country that controls the exchange rate. Fiscal tradeoffs are again identical when both European countries join in a monetary union. The country that had control of the exchange rate under the managed exchange rate regime now faces a worse tradeoff, while the tradeoff improves for the country that controlled money supply. In the fully Keynesian case, all countries face the same positively sloped tradeoff regardless of the exchange rate regime. Increases in spending cause both output and inflation to rise. When fiscal policy is neither fully anti-Keynesian nor fully Keynesian, the governments' tradeoffs lie in between the extreme cases. Under all European exchange-rate regimes, increases in the fraction of firms that are subject to distortionary taxation at home are beneficial if the equilibrium of the stabilization game is characterized by unemployment, while a less Keynesian fiscal policy abroad is harmful.

When the model is solved numerically to analyze transatlantic interactions, the transition to EMU is found to stabilize fiscal policy in European countries outside the Core. Moreover, EMU enhances monetary rigor in Europe and stabilizes employment in the face of supply shocks, in striking contrast to popular fears. Governments in the U.S. and Europe will want the ECB and the Fed to coordinate their policies, while monetary policymakers will have little incentive to do so. Intra-European fiscal cooperation can be counterproductive, whereas cooperation between governments and central banks inside each continent can be beneficial. The latter result raises questions on the opportunity cost of extreme forms of central bank independence. It also 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 or the euro-dollar exchange rate. All policymakers benefit when fiscal policy in one country switches from Keynesian to anti-Keynesian, while the other countries remain in the Keynesian regime. The transition from an anti-Keynesian world to one in which policy is anti-Keynesian in only one country causes all policymakers to suffer. The domestic impact of such drastic fiscal reforms is larger than their external effect.

The analysis of this paper raises questions on the opportunity of reducing the extent to which fiscal distortions remain in the economy and points to the issue of optimal fiscal reforms in an environment in which fiscal policy can be used for stabilization purposes only subject to a (more or less) balanced budget requirement. For the shock we consider, relying more heavily on distortionary instruments is appropriate. Our findings suggest that a move towards less distortionary systems than those now prevailing in some European countries can only be justified formally as the result of the policymakers' minimization of expected losses relative to the parameter in question. Our analysis focuses on the role of fiscal policy for stabilization purposes. Hence, it neglects political economy and growth-related costs of fiscal distortions, whose presence of course weakens the case for making use of distortionary instruments. If governments care about the long run, the steady-state losses implied by fiscal distortions may outweigh the benefits from business cycle stabilization. For the potential short-run gains from subjecting a large number of agents to distortionary taxes to prevail, an appropriately low steady-state rate of distortionary taxation will have to be chosen.<sup>58</sup>

Research on transatlantic economic interdependence and policy interactions in the EMU era is faced with many questions. We take the results of this paper as a starting point for more work. A new theoretical paradigm has been developing in the literature on macroeconomic interdependence, one that relies on rigorously microfounded intertemporal models. This makes it possible to tackle issues that we have left out of our analysis, such as the implications of events in Europe for the U.S. and European current accounts.<sup>59</sup> The results of this paper contribute to strengthening the foundations upon which new theoretical and empirical developments will build to further our understanding of the functioning of the international monetary system.

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<sup>58</sup> A formal comparison of the potential volatility gains from distortionary fiscal policy to the steady-state costs is left for future work.

<sup>59</sup> See Ghironi (1999).

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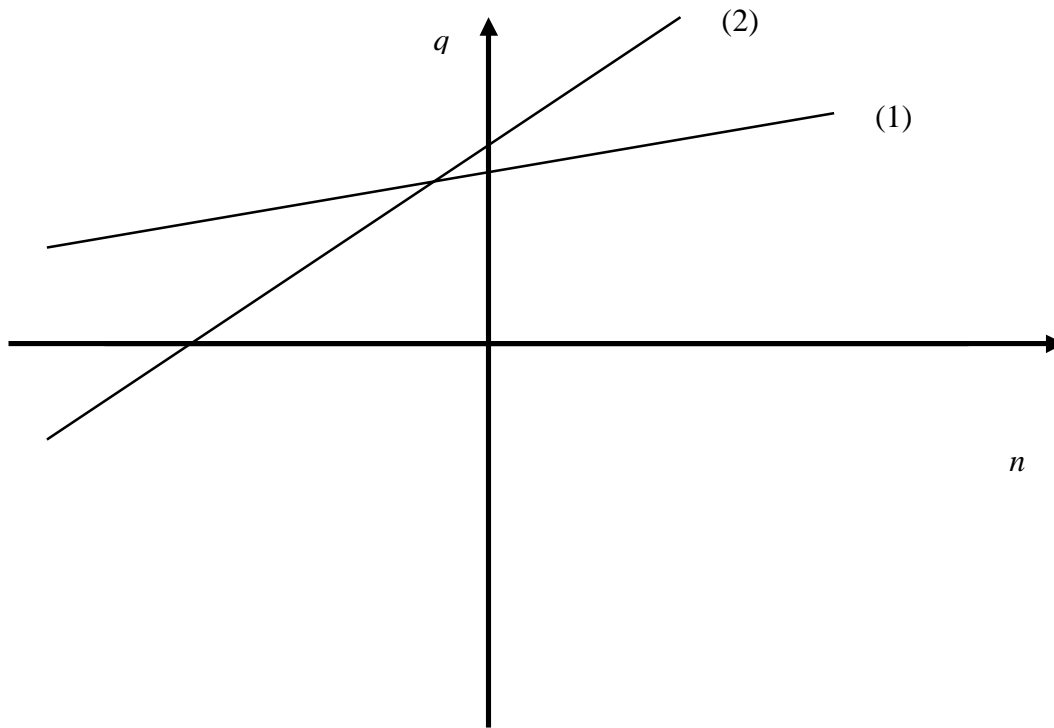
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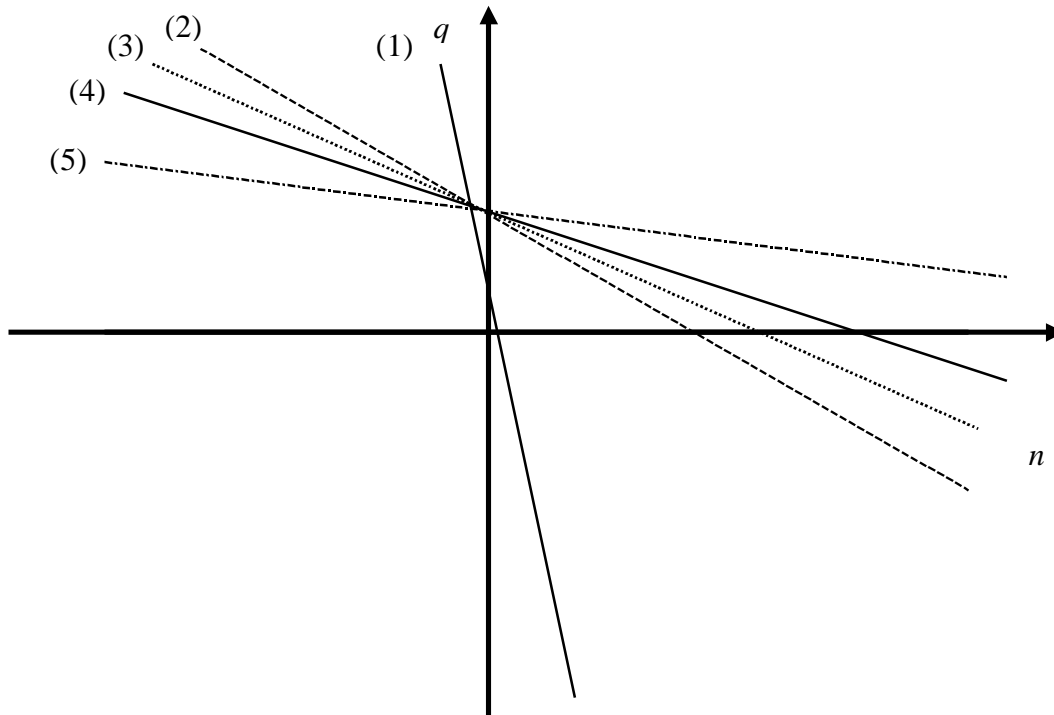
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## Figures



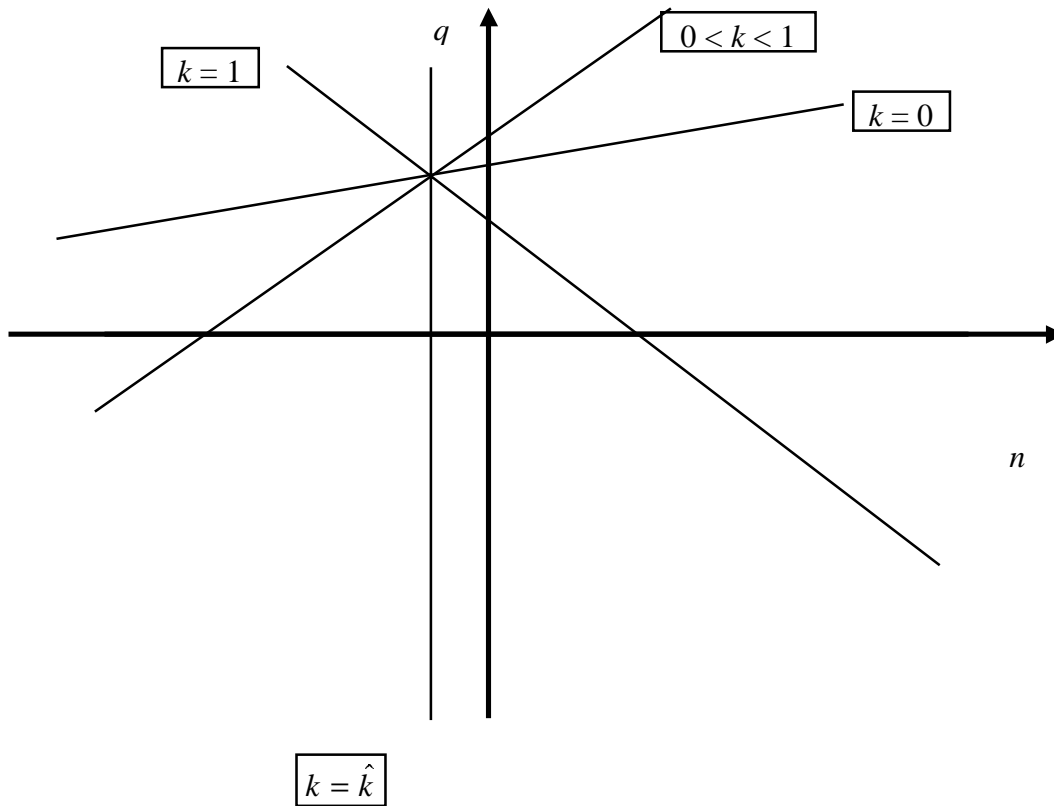
**Figure 1.** Central banks' tradeoffs

- (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.



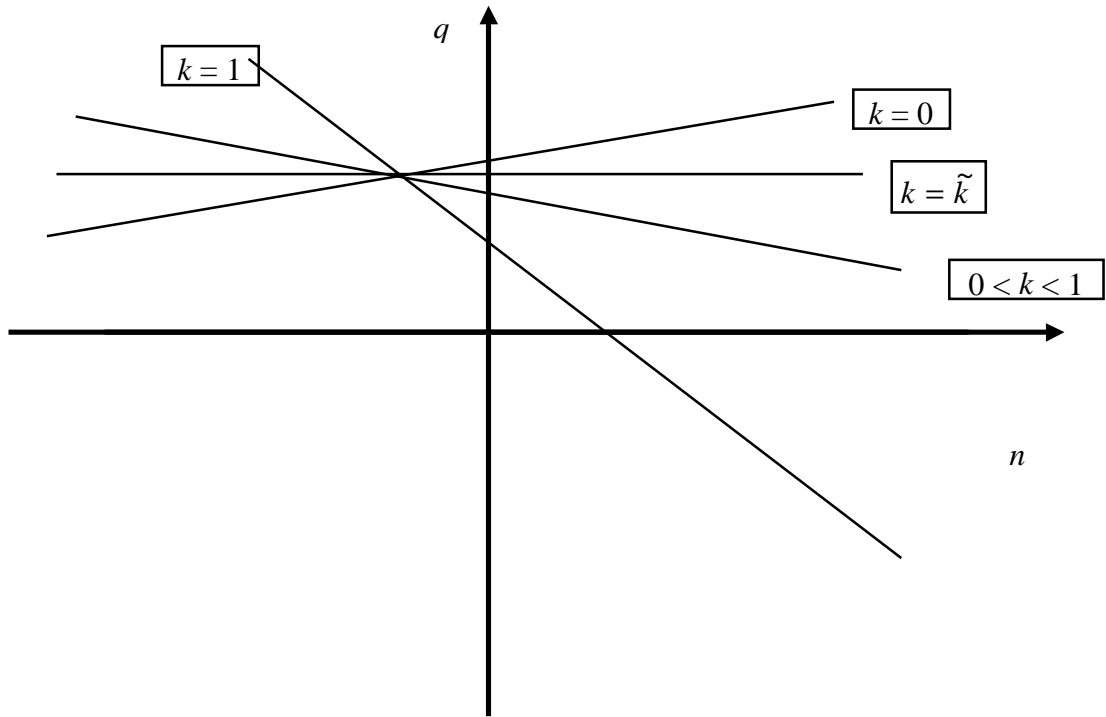
**Figure 2.** Governments' tradeoffs, anti-Keynesian case

- (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.



**Figure 3.** Government tradeoff,  $dg > 0$ ,  $d\tau > 0$





**Figure 4.** Government tradeoff,  $dg > 0$ ,  $d\tau < 0$

## Tables

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

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

(a) Flexible exchange rates

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

(b) Managed exchange rates

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

(c) Europe-wide EMU

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

**Table 2.** The players' tradeoffs

	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<sup>60</sup>

	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					

<sup>60</sup> 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 <sup>2</sup>	.2141x <sup>2</sup>	.2143x <sup>2</sup>	.2144x <sup>2</sup>	.2165x <sup>2</sup>	.2164x <sup>2</sup>	.2585x <sup>2</sup>
$L^{Ccb}$	.2103x <sup>2</sup>	.2124x <sup>2</sup>					
$L^{Pcb}$	.1466x <sup>2</sup>	.1224x <sup>2</sup>					
$L^{ECB}$			.1734x <sup>2</sup>	.1741x <sup>2</sup>	.1913x <sup>2</sup>	.1917x <sup>2</sup>	.1553x <sup>2</sup>
$L^{US gov.}$	.2260x <sup>2</sup>	.2243x <sup>2</sup>	.2246x <sup>2</sup>	.2174x <sup>2</sup>	.2269x <sup>2</sup>	.2192x <sup>2</sup>	.0662x <sup>2</sup>
$L^{C gov.}$	.2830x <sup>2</sup>	.2090x <sup>2</sup>	.2156x <sup>2</sup>	.2080x <sup>2</sup>	.2281x <sup>2</sup>	.2200x <sup>2</sup>	.0878x <sup>2</sup>
$L^{P gov.}$	.1991x <sup>2</sup>	.2028x <sup>2</sup>	.1543x <sup>2</sup>	.1489x <sup>2</sup>	.1684x <sup>2</sup>	.1624x <sup>2</sup>	.1113x <sup>2</sup>

## Appendix A. Reduced Forms

### A.1. Flexible Exchange Rates

Using upper-case Greek letters to denote parameters, reduced forms under flexible exchange rates can be written as:<sup>61</sup>

$$q^{US} = Am^{US} - B \frac{m^C + m^P}{2} + Ek^{US} \tau^{US} + \Gamma \frac{k^C \tau^C + k^P \tau^P}{2} +$$

$$+ E' g^{US} + \Gamma' \frac{g^C + g^P}{2} + Ku + Hx; \quad (A.1)$$

$$n^{US} = (1 - \lambda\Lambda)m^{US} + \lambda\Theta \frac{m^C + m^P}{2} - (1 - \lambda\Omega)k^{US} \tau^{US} + \lambda\Psi \frac{k^C \tau^C + k^P \tau^P}{2} +$$

$$+ \lambda\Omega' g^{US} + \lambda\Psi' \frac{g^C + g^P}{2} + \Phi u - \Sigma x; \quad (A.2)$$

$$q^C = \alpha m^C + (A - \alpha) \frac{m^C + m^P}{2} - Bm^{US} + (1 - \alpha)k^C \tau^C +$$

$$+ [E - (1 - \alpha)] \frac{k^C \tau^C + k^P \tau^P}{2} + \Gamma k^{US} \tau^{US} + M(m^P - m^C) +$$

$$- N(k^P \tau^P - k^C \tau^C) + E' \frac{g^C + g^P}{2} + \Gamma' g^{US} - Ku + Hx; \quad (A.3)$$

$$n^C = m^C - \lambda\Lambda \frac{m^C + m^P}{2} + \lambda\Theta m^{US} - k^C \tau^C + \lambda\Omega \frac{k^C \tau^C + k^P \tau^P}{2} +$$

$$+ \lambda\Psi k^{US} \tau^{US} + \lambda\Omega(m^P - m^C) - \lambda Z(k^P \tau^P - k^C \tau^C) +$$

$$+ \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x; \quad (A.4)$$

$$q^P = \alpha m^P + (A - \alpha) \frac{m^C + m^P}{2} - Bm^{US} + (1 - \alpha)k^P \tau^P +$$

$$+ [E - (1 - \alpha)] \frac{k^C \tau^C + k^P \tau^P}{2} + \Gamma k^{US} \tau^{US} - M(m^P - m^C) +$$

$$+ N(k^P \tau^P - k^C \tau^C) + E' \frac{g^C + g^P}{2} + \Gamma' g^{US} - Ku + Hx; \quad (A.5)$$

$$n^P = m^P - \lambda\Lambda \frac{m^C + m^P}{2} + \lambda\Theta m^{US} - k^P \tau^P + \lambda\Omega \frac{k^C \tau^C + k^P \tau^P}{2} +$$

$$+ \lambda\Psi k^{US} \tau^{US} - \lambda\Omega(m^P - m^C) + \lambda Z(k^P \tau^P - k^C \tau^C) +$$

$$+ \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x. \quad (A.6)$$

<sup>61</sup> The reader must not be confused by the notation used for reduced forms here and in Eichengreen and Ghironi (1997). For example, when  $k^{US} = k^C = k^P = 1$ , it turns out that  $E + E' = E^{eg}$ , where  $E^{eg}$  stands for E in Eichengreen and Ghironi (1997).

## A.2. Managed Exchange Rates in Europe

Reduced forms for U.S. employment and CPI are:

$$q^{US} = Am^{US} - Bm^C - \frac{B}{2\phi}(e^1 - e^2) - \frac{B\xi}{2\phi}(k^P\tau^P - k^C\tau^C) + Ek^{US}\tau^{US} + \Gamma \frac{k^C\tau^C + k^P\tau^P}{2} + E'g^{US} + \Gamma' \frac{g^C + g^P}{2} + Ku + Hx; \quad (A.7)$$

$$n^{US} = (1 - \lambda\Lambda)m^{US} + \lambda\Theta m^C + \frac{\lambda\Theta}{2\phi}(e^1 - e^2) + \frac{\lambda\Theta\xi}{2\phi}(k^P\tau^P - k^C\tau^C) + -(1 - \lambda\Omega)k^{US}\tau^{US} + \lambda\Psi \frac{k^C\tau^C + k^P\tau^P}{2} + \lambda\Omega'g^{US} + \lambda\Psi' \frac{g^C + g^P}{2} + \Phi u - \Sigma x. \quad (A.8)$$

German and French CPIs and employment are:

$$q^C = Am^C - Bm^{US} + (1 - \alpha)k^C\tau^C + [E - (1 - \alpha)] \frac{k^C\tau^C + k^P\tau^P}{2} + \Gamma k^{US}\tau^{US} + + \left( \frac{A - \alpha}{2\phi} + \frac{M}{\phi} \right) (e^1 - e^2) + \left[ \frac{\xi(A - \alpha)}{2\phi} + \frac{M\xi}{\phi} - N \right] (k^P\tau^P - k^C\tau^C) + + E' \frac{g^C + g^P}{2} + \Gamma' g^{US} - Ku + Hx; \quad (A.9)$$

$$q^P = Am^C - Bm^{US} + (1 - \alpha)k^P\tau^P + [E - (1 - \alpha)] \frac{k^C\tau^C + k^P\tau^P}{2} + \Gamma k^{US}\tau^{US} + + \left( \frac{A + \alpha}{2\phi} - \frac{M}{\phi} \right) (e^1 - e^2) + \left[ \frac{\xi(A + \alpha)}{2\phi} - \frac{M\xi}{\phi} + N \right] (k^P\tau^P - k^C\tau^C) + + E' \frac{g^C + g^P}{2} + \Gamma' g^{US} - Ku + Hx;$$

$$n^C = (1 - \lambda\Lambda)m^C + \lambda\Theta m^{US} - k^C\tau^C + \lambda\Omega \frac{k^C\tau^C + k^P\tau^P}{2} + \lambda\Psi k^{US}\tau^{US} + + \frac{\lambda}{2} \left( 1 - \frac{\Lambda}{\phi} \right) (e^1 - e^2) - \frac{\lambda\Lambda\xi}{2\phi} (k^P\tau^P - k^C\tau^C) + \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x;$$

$$n^P = (1 - \lambda\Lambda)m^C + \lambda\Theta m^{US} - k^P\tau^P + \lambda\Omega \frac{k^C\tau^C + k^P\tau^P}{2} + \lambda\Psi k^{US}\tau^{US} + + \left[ \frac{1}{\phi} - \frac{\lambda}{2} \left( 1 + \frac{\Lambda}{\phi} \right) \right] (e^1 - e^2) + \frac{\xi}{\phi} \left( 1 - \frac{\lambda\Lambda}{2} \right) (k^P\tau^P - k^C\tau^C) + \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x. \quad (A.10)$$

### A.3. Europe-Wide EMU

European aggregates are:

$$\begin{aligned}
 q^{Eu} &= \frac{q^C + q^P}{2} = Am^{Eu} - Bm^{US} + E \frac{k^C \tau^C + k^P \tau^P}{2} + \Gamma k^{US} \tau^{US} + \\
 &+ E' \frac{g^C + g^P}{2} + \Gamma' g^{US} + Ku + Hx; \\
 n^{Eu} &= \frac{n^C + n^P}{2} = (1 - \lambda\Lambda)m^{Eu} + \lambda\Theta m^{US} - (1 - \lambda\Omega) \frac{k^C \tau^C + k^P \tau^P}{2} + \lambda\Psi k^{US} \tau^{US} + \\
 &+ \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x.
 \end{aligned} \tag{A.11}$$

The reduced form equations for U.S. variables can be rewritten as:

$$\begin{aligned}
 q^{US} &= Am^{US} - Bm^{Eu} + Ek^{US} \tau^{US} + \Gamma \left( \frac{k^C \tau^C + k^P \tau^P}{2} \right) + \\
 &+ E' g^{US} + \Gamma' \frac{g^C + g^P}{2} + Ku + Hx; \\
 n^{US} &= (1 - \lambda\Lambda)m^{US} + \lambda\Theta m^{Eu} - (1 - \lambda\Omega) k^{US} \tau^{US} + \lambda\Psi \left( \frac{k^C \tau^C + k^P \tau^P}{2} \right) + \\
 &+ \lambda\Omega' g^{US} + \lambda\Psi' \frac{g^C + g^P}{2} + \Phi u - \Sigma x.
 \end{aligned} \tag{A.12}$$

Core and Periphery employment are:

$$\begin{aligned}
 n^C &= (1 - \lambda\Lambda)m^{Eu} + \lambda\Theta m^{US} - \frac{1}{2} \left( 2 - \lambda\Omega - \frac{\xi}{\phi} \right) k^C \tau^C - \frac{1}{2} \left( \frac{\xi}{\phi} - \lambda\Omega \right) k^P \tau^P + \\
 &+ \lambda\Psi k^{US} \tau^{US} + \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x.
 \end{aligned} \tag{A.13}$$

$$\begin{aligned}
 n^P &= (1 - \lambda\Lambda)m^{Eu} + \lambda\Theta m^{US} - \frac{1}{2} \left( 2 - \lambda\Omega - \frac{\xi}{\phi} \right) k^P \tau^P - \frac{1}{2} \left( \frac{\xi}{\phi} - \lambda\Omega \right) k^C \tau^C + \\
 &+ \lambda\Psi k^{US} \tau^{US} + \lambda\Omega' \frac{g^C + g^P}{2} + \lambda\Psi' g^{US} - \Phi u - \Sigma x.
 \end{aligned} \tag{A.14}$$

## Appendix B. Unconstrained Fiscal Activism Yields Bliss

Suppose authority 1—say, the central bank—in any country sets the level of the policy instrument  $inst1$  to minimize the loss function:

$$L_1 = \frac{1}{2}(aq^2 + bn^2).$$

Authority 2—say, the fiscal authority—chooses  $inst2$  to minimize:

$$L_2 = \frac{1}{2}(cq^2 + dn^2).$$

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:

$$aq \frac{\partial q}{\partial inst1} + bn \frac{\partial n}{\partial inst1} = 0,$$

$$cq \frac{\partial q}{\partial inst2} + dn \frac{\partial n}{\partial inst2} = 0.$$

These conditions imply equilibrium inflation-employment ratios:

$$\left( \frac{\tilde{q}}{\tilde{n}} \right)_1 = -\frac{b}{aTR_1},$$

$$\left( \frac{\tilde{q}}{\tilde{n}} \right)_2 = -\frac{d}{cTR_2},$$

where  $TR_1$  and  $TR_2$  are the policy tradeoffs 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 strategic *Nash* interaction between the two policymakers yields a zero-losses equilibrium regardless of the international policymaking regime. This is a consequence of the specification of the policymakers' 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 C. Equilibrium Employment

Omitting country superscripts, in the absence of actions by foreign governments, domestic inflation can be written as:

$$\tilde{q} = AK\tilde{n} + \left( \frac{\partial q}{\partial x} - AK \frac{\partial n}{\partial x} \right) x + \left( \frac{\partial q}{\partial g} - AK \frac{\partial n}{\partial g} \right) \tilde{g}.$$

Combining this expression with  $\tilde{q} = -[(1 - b_2)/b_2 AK] \tilde{n}$  and rearranging yields:



$$\tilde{n} \left[ AK + \frac{1-b_2}{b_2 AK} - \frac{b_1 b_2}{1-b_1} \frac{\partial q}{\partial g} \left( \frac{1-b_2}{b_2 K} - \frac{1-b_2}{b_2 AK} \right) \left( \frac{\partial q}{\partial g} - AK \frac{\partial n}{\partial g} \right) \right] = - \left( \frac{\partial q}{\partial x} - AK \frac{\partial n}{\partial x} \right) x.$$

The expression in square brackets on the left-hand side of this equation is negative under the assumptions of this paper. Hence, when foreign governments remain inactive and  $x > 0$ ,  $\tilde{n} > 0 \Leftrightarrow \partial q / \partial x > AK(\partial n / \partial x)$ , as argued in the text.

## Appendix D. Eichengreen-Ghironi (1997) Results <sup>62</sup>

**Table D.1.** Numerical values, reduced form equations in an anti-Keynesian world

### (a) Flexible exchange rates

$$\begin{aligned} q^{US} &= .26m^{US} - .02(m^C + m^P)/2 + .75\tau^{US} + .22(\tau^C + \tau^P)/2 + .93x; \\ n^{US} &= .75m^{US} - .03(m^C + m^P)/2 - .56\tau^{US} + .49(\tau^C + \tau^P)/2 - .21x; \\ q^C &= .39m^C - .13m^P - .02m^{US} + .46\tau^C + .29\tau^P + .22\tau^{US} + .93x; \\ n^C &= .72m^C + .03m^P - .03m^{US} - .83\tau^C + .27\tau^P + .49\tau^{US} - .21x. \end{aligned}$$

### (b) Managed exchange rates

$$\begin{aligned} q^{US} &= .26m^{US} - .02m^C - .02(e^1 - e^2) + .75\tau^{US} + .11\tau^C + .11\tau^P + .93x; \\ n^{US} &= .75m^{US} - .03m^C - .03(e^1 - e^2) - .56\tau^{US} + .24\tau^C + .25\tau^P - .21x. \\ q^C &= .26m^C - .02m^{US} + .42\tau^C + .33\tau^P + .22\tau^{US} - .24(e^1 - e^2) + .93x; \\ q^P &= .26m^C - .02m^{US} + .42\tau^C + .33\tau^P + .22\tau^{US} + .75(e^1 - e^2) + .93x; \\ n^C &= .75m^C - .03m^{US} - .82\tau^C + .26\tau^P + .49\tau^{US} + .06(e^1 - e^2) - .21x; \\ n^P &= .75m^C - .03m^{US} + .51\tau^C - 1.07\tau^P + .49\tau^{US} + 1.38(e^1 - e^2) - .21x. \end{aligned}$$

### (c) Europe-wide EMU

$$\begin{aligned} q^{US} &= .26m^{US} - .02m^{Eu} + .75\tau^{US} + .22(\tau^C + \tau^P)/2 + .93x; \\ n^{US} &= .75m^{US} - .03m^{Eu} - .56\tau^{US} + .49(\tau^C + \tau^P)/2 - .21x; \\ q^{Eu} &= .26m^{Eu} - .02m^{US} + .75(\tau^C + \tau^P)/2 + .22\tau^{US} + .93x; \\ n^{Eu} &= .75m^{Eu} - .03m^{US} - .56(\tau^C + \tau^P)/2 + .49\tau^{US} - .21x; \\ n^C &= .75m^{Eu} - .03m^{US} - .94\tau^C + .38\tau^P + .49\tau^{US} - .21x; \\ n^P &= .75m^{Eu} - .03m^{US} + .38\tau^C - .94\tau^P + .49\tau^{US} - .21x. \end{aligned}$$

<sup>62</sup> For the reader's convenience, the notation in the tables that follow has been made consistent with that in the rest of the paper.

**Table D.2.** Optimal values of the policy instruments in an anti-Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$m^{US}$	-1.4443x	-1.4280x	-1.4335x	-1.4086x	-1.5000x	-1.4717x
$m^C$	-1.6941x	-1.4174x				
$m^P$	-1.6941x					
$m^{Eu}$			-1.4023x	-1.3759x	-1.5000x	-1.4717x
$\tau^{US}$	-.1671x	-.1668x	-.1668x	-.1646x	-.1676x	-.1652x
$\tau^C$	-.2588x	-.2269x	-.2488x	-.2451x	-.1676x	-.1652x
$\tau^P$	-.2588x	-.3055x	-.2488x	-.2451x	-.1676x	-.1652x
$e^1 - e^2$		-.1217x				

**Table D.3.** Endogenous variables in an anti-Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$q^{US}$	.3988x	.3981x	.3979x	.4064x	.3999x	.4091x
$q^C$	.2789x	.3793x				
$q^P$	.2789x	.2577x				
$q^{Eu}$			.3633x	.3730x	.3999x	.4091x
$n^{US}$	-1.2685x	-1.2660x	-1.2657x	-1.2474x	-1.2719x	-1.2519x
$n^C$	-1.3675x	-1.2065x				
$n^P$	-1.3675x	-1.2637x				
$n^{Eu}$			-1.1554x	-1.1375x	-1.2719x	-1.2519x

**Table D.4.** Values of the loss functions in an anti-Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$L^{Fed}$	.1520x <sup>2</sup>	.1514x <sup>2</sup>	.1514x <sup>2</sup>	.1521x <sup>2</sup>	.1529x <sup>2</sup>	.1537x <sup>2</sup>
$L^{Ccb}$	.1285x <sup>2</sup>	.1375x <sup>2</sup>				
$L^{Pcb}$	.1285x <sup>2</sup>	.1097x <sup>2</sup>				
$L^{ECB}$			.1261x <sup>2</sup>	.1273x <sup>2</sup>	.1529x <sup>2</sup>	.1537x <sup>2</sup>
$L^{US gov.}$	.1576x <sup>2</sup>	.1569x <sup>2</sup>	.1569x <sup>2</sup>	.1525x <sup>2</sup>	.1584x <sup>2</sup>	.1536x <sup>2</sup>
$L^{C gov.}$	.1959x <sup>2</sup>	.1530x <sup>2</sup>	.1462x <sup>2</sup>	.1419x <sup>2</sup>	.1584x <sup>2</sup>	.1536x <sup>2</sup>
$L^{P gov.}$	.1959x <sup>2</sup>	.1817x <sup>2</sup>	.1462x <sup>2</sup>	.1419x <sup>2</sup>	.1584x <sup>2</sup>	.1536x <sup>2</sup>

**Table D.5.** Numerical values, reduced form equations in a Keynesian world(a) Flexible exchange rates

$$q^{US} = .26m^{US} - .02(m^C + m^P)/2 + .18g^{US} + .19(g^C + g^P)/2 + .93x;$$

$$n^{US} = .75m^{US} - .03(m^C + m^P)/2 + .64g^{US} + .43(g^C + g^P)/2 - .21x;$$

$$q^C = .39m^C - .13m^P - .02m^{US} + .09g^C + .09g^P + .19g^{US} + .93x;$$

$$n^C = .72m^C + .03m^P - .03m^{US} + .32g^C + .32g^P + .43g^{US} - .21x.$$

(b) Managed exchange rates

$$q^{US} = .26m^{US} - .02m^C - .02(e^1 - e^2) + .18g^{US} + .19(g^C + g^P)/2 + .93x;$$

$$n^{US} = .75m^{US} - .03m^C - .03(e^1 - e^2) + .64g^{US} + .43(g^C + g^P)/2 - .21x.$$

$$q^C = .26m^C - .02m^{US} + .09g^C + .09g^P + .19g^{US} - .24(e^1 - e^2) + .93x;$$

$$q^P = .26m^C - .02m^{US} + .09g^C + .09g^P + .19g^{US} + .75(e^1 - e^2) + .93x;$$

$$n^C = .75m^C - .03m^{US} + .32g^C + .32g^P + .43g^{US} + .06(e^1 - e^2) - .21x;$$

$$n^P = .75m^C - .03m^{US} + .32g^C + .32g^P + .43g^{US} + 1.38(e^1 - e^2) - .21x.$$

(c) Europe-wide EMU

Reduced forms for  $q^{US}$  and  $n^{US}$  are as in (a), with  $m^{Eu}$  replacing  $(m^C + m^P)/2$ . Reduced forms for  $q^{Eu}$  and  $n^{Eu}$  can be recovered by symmetry.  $n^C = n^P = n^{Eu}$  *ex ante* in the fully Keynesian world.

**Table D.6.** Optimal values of the policy instruments in a Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$m^{US}$	-2.1332x	-2.1112x	-2.0907x	-2.0461x	-2.1671x	-2.1212x
$m^C$	-2.5075x	-2.1531x				
$m^P$	-2.5075x					
$m^{Eu}$			-2.0804x	-2.0363x	-2.1671x	-2.1212x
$g^{US}$	.2166x	.2160x	.2156x	.2115x	.2165x	.2124x
$g^C$	.1307x	.1126x	.1087x	.1067x	.2165x	.2124x
$g^P$	.1307x	.1260x	.1087x	.1067x	.2165x	.2124x
$e^1 - e^2$		-.1382x				

**Table D.7.** Endogenous variables in a Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$q^{US}$	.4806x	.4794x	.4783x	.4880x	.4804x	.4901x
$q^C$	.3748x	.4997x				
$q^P$	.3748x	.3615x				
$q^{Eu}$			.4826x	.4921x	.4804x	.4901x
$n^{US}$	-1.5284x	-1.5247x	-1.5213x	-1.4930x	-1.5281x	-1.4997x
$n^C$	-1.8380x	-1.5892x				
$n^P$	-1.8380x	-1.7729x				
$n^{Eu}$			-1.5348x	-1.5064x	-1.5281x	-1.4997x

**Table D.8.** Values of the loss functions in a Keynesian world

	Flexible rates	Managed rates	Europe-wide EMU	EMU-A	EMU-B	EMU-C
$L^{Fed}$	.2207x <sup>2</sup>	.2196x <sup>2</sup>	.2187x <sup>2</sup>	.2186x <sup>2</sup>	.2206x <sup>2</sup>	.2205x <sup>2</sup>
$L^{Ccb}$	.2321x <sup>2</sup>	.2386x <sup>2</sup>				
$L^{Pcb}$	.2321x <sup>2</sup>	.2160x <sup>2</sup>				
$L^{ECB}$			.2226x <sup>2</sup>	.2225x <sup>2</sup>	.2206x <sup>2</sup>	.2205x <sup>2</sup>
$L^{US gov.}$	.2313x <sup>2</sup>	.2302x <sup>2</sup>	.2292x <sup>2</sup>	.2209x <sup>2</sup>	.2312x <sup>2</sup>	.2229x <sup>2</sup>
$L^{C gov.}$	.3123x <sup>2</sup>	.2349x <sup>2</sup>	.2191x <sup>2</sup>	.2112x <sup>2</sup>	.2312x <sup>2</sup>	.2229x <sup>2</sup>
$L^{P gov.}$	.3123x <sup>2</sup>	.2905x <sup>2</sup>	.2191x <sup>2</sup>	.2112x <sup>2</sup>	.2312x <sup>2</sup>	.2229x <sup>2</sup>

## Appendix E. First-Order Conditions for the Cooperative Scenarios

### E.1. Transatlantic Monetary Cooperation

The Fed and the ECB solve:

$$\min_{m^{US}, m^{Eu}} \frac{1}{2} L^{Fed} + \frac{1}{2} L^{ECB}.$$

The first-order conditions are:

$$aq^{US} \frac{\partial q^{US}}{\partial m^{US}} + (1-a)n^{US} \frac{\partial n^{US}}{\partial m^{US}} + aq^{Eu} \frac{\partial q^{Eu}}{\partial m^{US}} + (1-a)n^{Eu} \frac{\partial n^{Eu}}{\partial m^{US}} = 0; \quad (E.1)$$

$$aq^{US} \frac{\partial q^{US}}{\partial m^{Eu}} + (1-a)n^{US} \frac{\partial n^{US}}{\partial m^{Eu}} + aq^{Eu} \frac{\partial q^{Eu}}{\partial m^{Eu}} + (1-a)n^{Eu} \frac{\partial n^{Eu}}{\partial m^{Eu}} = 0. \quad (E.2)$$

### E.2. Intra-European Fiscal Cooperation

European governments solve:

$$\min_{g^C, \tau^P} \frac{1}{2} L^{gov^C} + \frac{1}{2} L^{gov^P}.$$

The first-order conditions are:

$$b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^C} + (1-b_2)n^C \frac{\partial n^C}{\partial g^C} \right] + (1-b_1)g^C + b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^C} + (1-b_2)n^P \frac{\partial n^P}{\partial g^C} \right] = 0; \quad (E.3)$$

$$b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial \tau^P} + (1-b_2) n^C \frac{\partial n^C}{\partial \tau^P} \right] + b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial \tau^P} + (1-b_2) n^P \frac{\partial n^P}{\partial \tau^P} \right] + (1-b_1) \tau^P = 0. \quad (\text{E.4})$$

### E.3. EMU and Intra-National Policy Coordination

The first-order conditions for the U.S. authorities' problem are:

$$a q^{US} \frac{\partial q^{US}}{\partial m^{US}} + (1-a) n^{US} \frac{\partial n^{US}}{\partial m^{US}} + b_1 \left[ b_2 q^{US} \frac{\partial q^{US}}{\partial m^{US}} + (1-b_2) n^{US} \frac{\partial n^{US}}{\partial m^{US}} \right] = 0; \quad (\text{E.5})$$

$$a q^{US} \frac{\partial q^{US}}{\partial g^{US}} + (1-a) n^{US} \frac{\partial n^{US}}{\partial g^{US}} + b_1 \left[ b_2 q^{US} \frac{\partial q^{US}}{\partial g^{US}} + (1-b_2) n^{US} \frac{\partial n^{US}}{\partial g^{US}} \right] + (1-b_1) g^{US} = 0. \quad (\text{E.6})$$

The first-order conditions for European policymakers are:

$$a q^{Eu} \frac{\partial q^{Eu}}{\partial m^{Eu}} + (1-a) n^{Eu} \frac{\partial n^{Eu}}{\partial m^{Eu}} + \frac{1}{2} \left\{ b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial m^{Eu}} + (1-b_2) n^C \frac{\partial n^C}{\partial m^{Eu}} \right] + b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial m^{Eu}} + (1-b_2) n^P \frac{\partial n^P}{\partial m^{Eu}} \right] \right\} = 0; \quad (\text{E.7})$$

$$a q^{Eu} \frac{\partial q^{Eu}}{\partial g^C} + (1-a) n^{Eu} \frac{\partial n^{Eu}}{\partial g^C} + \frac{1}{2} \left\{ b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^C} + (1-b_2) n^C \frac{\partial n^C}{\partial g^C} \right] + (1-b_1) g^C + b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^C} + (1-b_2) n^P \frac{\partial n^P}{\partial g^C} \right] \right\} = 0; \quad (\text{E.8})$$

$$a q^{Eu} \frac{\partial q^{Eu}}{\partial g^P} + (1-a) n^{Eu} \frac{\partial n^{Eu}}{\partial g^P} + \frac{1}{2} \left\{ b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^P} + (1-b_2) n^C \frac{\partial n^C}{\partial g^P} \right] + b_1 \left[ b_2 q^{Eu} \frac{\partial q^{Eu}}{\partial g^P} + (1-b_2) n^P \frac{\partial n^P}{\partial g^P} \right] + (1-b_1) g^P \right\} = 0. \quad (\text{E.9})$$