

# **Spillover Effects of Fiscal Policy in EMU: A Misconception behind the Stability Pact?**

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Florence HUART\*

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## Abstract

This paper extends the Mundell-Fleming model to a monetary union between two countries that are different with regard to the determinants of aggregate demand, demand for money, foreign trade, price and wage adjustment. Depending on these national disparities in structural parameters, a fiscal expansion in one country is not necessarily more effective in a monetary union than in a fixed exchange rate area, and its spillover effects are not bound to be negative. Thus, the results cast doubt on an underlying argument behind the Stability and Growth Pact in EMU.

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\* MÉDEE, Faculté des Sciences Économiques et Sociales, Université de Lille 1, 59650 Villeneuve d'Ascq, France. Phone: (33) 3 20 33 63 71. Fax: (33) 3 20 43 66 55. e-mail: florence.huart@univ-lille1.fr

## I. Introduction

Within the European monetary union, monetary policy is centralized while national fiscal policies are decentralized according to the subsidiarity principle (given the lack of a federal budget). Member countries must define their fiscal policies in accordance with the provisions of the Maastricht Treaty (article 104 and protocol on excessive public deficits) and the Stability and Growth Pact (SGP), which was adopted in order to strengthen fiscal discipline in EMU (Resolution of the European Council, Amsterdam, June 1997). They have committed themselves to avoid “excessive public deficits” and follow a “medium-term objective of budgetary positions close to balance or in surplus”. Countries running a public deficit above 3% of GDP will be sanctioned, except if the deficit is due to “exceptional circumstances” (such as an annual fall in real GDP of at least 0.75%).<sup>1</sup>

Why did the EU Member States set themselves such a strait jacket? The SGP is actually kind of a procedure of fiscal policy coordination (“stability programs” and multilateral surveillance) relying on four main objectives<sup>2</sup>:

- 1) to make sure that national fiscal policies will not threaten the price stability objective of the ECB;
- 2) to prevent negative spillover effects of too loose national fiscal policies on the other EMU countries;
- 3) to help adjustment to asymmetric shocks while keeping the budget balance below the reference value of 3% of GDP;
- 4) to face the challenge of an aging population.

The last two objectives are defensible whereas the first two objectives are debatable. One can also question the SGP’s constraints as being an appropriate device for reaching them.

Sound public finances are necessary to avoid the transfer of the debt burden to future generations, and face the challenge of financing pensions, public goods and social protection. But under the SGP, the European governments urged to comply with fiscal consolidation are losing their “political capital” for reforms of labour markets, with population being “tired” of fiscal restraints (Eichengreen and Wyplosz, 1998).

Budget surpluses would also allow EMU countries to use discretionary fiscal policy or let automatic stabilizers work to adjust to asymmetric shocks. This is a concern for countries that cannot rely on other adjustment mechanisms than the interest rate and exchange rate (price and wage flexibility, sectorial and regional factor mobility, federal budget or risk-sharing). However, the fiscal discipline of the SGP is not likely to leave room for fiscal flexibility during the transitional period (the early years of EMU when most countries still run public deficits). Indeed, an excessive deficit may well occur in the event of a severe recession and, thus, prevent countries from using fiscal policy as a stabilization tool (Buti, Franco and Ongena, 1997). In this respect, the economic downturn in 2001 worsened public deficits in Germany, France, Italy and Portugal. The European Commission sent an early warning to Germany and Portugal in January 2002, because of the risk of an excessive deficit. Yet the

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<sup>1</sup> European Commission (2000) details the provisions of the SGP.

<sup>2</sup> Based upon the statements made by the European Council (Resolution on the SGP), the European Commission (2001) and one central banker (Trichet, 2001). Eichengreen and Wyplosz (1998) question several possible justifications for the SGP.

worsening of the budget deficits was largely due to automatic stabilizers.<sup>3</sup> This episode shows that the SGP should apply to structural deficits instead of actual deficits. But the structural deficits of the four aforementioned countries are above the “safe structural deficit” target of less than 1% of GDP that makes fiscal discipline of the SGP consistent with the need of fiscal flexibility (Artis and Buti, 2000).

Concerning the first objective, the SGP can be seen as a device for securing the independence of the ECB in the event of conflicts between monetary policy and fiscal policies (Artis and Winkler, 1997), and stabilising inflation in EMU by reducing the average debt level (Beetsma and Uhlig, 1999). However, as pointed out by Canzoneri and Diba (2000), the SGP is not helpful to eliminate political pressures on the ECB to lead an inflationary policy, if governments’ motives deal with the need to reduce unemployment instead of debt burden.

This paper focuses on the second objective: the SGP was designed to correct stronger incentives of EMU countries to adopt too loose fiscal policies, which would have beggar-thy-neighbor effects. It asks whether this argument is persuasive: *is a national fiscal expansion very effective in a monetary union, and does it have important negative spillover effects?*

The underlying conception of the SGP obviously relies on the results of the Mundell-Fleming (MF) model applied to a fixed exchange rate area. Recall that, in this model, with fixed prices and perfect capital mobility, a fiscal expansion in a small country is very effective, because there is no crowding-out effect of private investment and exports (the interest rate is fixed at the level of the world interest rate, which is exogenous, and the real exchange rate is constant). Levin (1983) applied the fixed price version of the MF model to a two-country fixed exchange rate area, with joint floating exchange rates against the ROW, and showed that the fiscal expansion has beggar-thy-neighbor effects. This result must hold for a small area under perfect capital mobility, whatever the national structural economic parameters: the positive bilateral trade channel must be dominated by the negative exchange rate channel (real appreciation of national currencies) in order to maintain the area-wide money market in equilibrium.

Do these results apply to a monetary union? The effectiveness and spillover effects of fiscal policy have been analysed in different ways according to how this policy is undertaken, the exchange rate regime, the monetary policy rule, and trade linkages between countries.

In Ahlo (2001), the spillover effects of a national *tax policy* depend on whether the demand channel or the supply channel dominates in the effect of taxes on inflation. If a rise in domestic taxation decreases aggregate demand, then the lower inflation improves domestic competitiveness, which curbs foreign output and inflation. If the tax hike leads to a rise in nominal wages, then the higher inflation deteriorates domestic competitiveness, and the effects on foreign output and inflation are positive. In this case, the spillover effects are ambiguous, because if the domestic country is large, the ECB reacts to higher EMU average inflation by raising its interest rate. Thus, the SGP is not an effective device to prevent negative spillover effects.

Barrell *and al.* (2000), utilising NiGEM, find that an increase in government expenditures in the UK and Sweden would be more effective within EMU than outside EMU. This is straightforward since fiscal policy is not effective with flexible exchange rates. The

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<sup>3</sup> According to the European Commission Autumn 2001 forecasts.

appreciation of the currency and the rise in the interest rate are smaller inside the euro area than outside, given the small influence of each country on EMU aggregate variables.

Roeger and in't Veld (1997), using QUEST with perfect international capital mobility, explain that the negative spillover effects of an increase in government purchases in Germany are much smaller under EMU than under the EMS. The appreciation of the mark relative to the US dollar makes the other EMS countries raise their interest rates to keep the exchange rate fixed. The negative spillover effects are significantly smaller under EMU, given the weaker effect of the rise in German money demand on total EU money demand. The sign of the spillover effects also depend on the ECB monetary rule. Under interest rate targeting, it is positive since the interest rate is kept constant. Under money targeting, it is negative because the ECB raises the interest rate so as to meet its target. But it is positive for small EU countries for which trade linkages with Germany are very large (namely Austria, the Netherlands and Belgium benefit from higher exports).

Gros and Hobza (2001) compare the results of four multinational models (QUEST, MULTIMOD, Marmotte, NiGEM) concerning the spillover effects of an increase in German government purchases on the other euro area countries. These effects are uncertain and small, because the positive trade spillovers tend to be cancelled out by the negative spillovers through the higher common interest rate and the appreciation of the euro. This is also due to low fiscal policy multipliers (the models are based on intertemporal optimisation and rational expectations), especially in smaller EU countries where the degree of openness is high. Cross-border externalities are positive when fiscal expansion is implemented through a reduction in labour taxes. On the whole, the effects of a fiscal expansion are all the more uncertain since they depend on the way fiscal policy is executed and financed, the size of the country undertaking it, the strategy of the monetary authorities. The authors conclude that it is difficult to find a procedure of fiscal policy coordination that would benefit all countries.

Three economic parameters have been put forward so far in the literature in order to explain the various spillover effects among countries: country size, degree of openness and bilateral trade. We shall extend the analysis by insisting on a broad range of national structural parameters. To do so, we extend the MF model to a two-country monetary union. Countries may differ with regard to *the marginal propensity to consume, the sensitivity of investment to the interest rate, the money demand, the price and income elasticities of foreign trade, the geographic structure of foreign trade, the influence of import prices on the consumer price index, the degree of wage indexation*. In contrast to Levin (1983), we assume that capital mobility is not perfect between the monetary union and the ROW, and introduce price and wage adjustment. First, the common interest rate in the monetary union is now an endogenous variable. This enables us to focus on the influence of national structural disparities in the explanation of the effects of higher public spending in one country. We find that the effectiveness of fiscal policy may be weak in monetary union, and the spillover effects may even be positive. Second, we want to show how differences in price and wage adjustments influence the effects of fiscal policy. That's why we shall examine three cases of wage indexation on consumer prices: no indexation, full indexation, no indexation in one country and full indexation in the other. This latter case is interesting since the influence of consumer prices on wages differs in the EU countries (Barrell and Dury, 2001). From the point of view of global economic activity in the monetary union, we find that it is better a fiscal expansion be undertaken in the country where there is no indexation.

The paper is organized as follows. Section 2 explains why the implicit assumptions of the SGP concerning the spillover effects of fiscal policy in EMU should be modified. It also justifies our different assumptions. Section 3 sets the structure of the model. Section 4 details the effects of a national fiscal expansion under the three different cases of wage indexation. Section 5 concludes.

## **II. Spillover effects, capital mobility and national economic disparities**

As explained in the introduction, one argument for the SGP was to prevent negative spillover effects of too loose national fiscal policies on other EMU countries. It was obviously derived from the Mundell-Fleming (MF) model of a two-country fixed exchange rate area with perfect capital mobility. However, a monetary union differs from a fixed exchange rate area, and disparities in national structural parameters should be taken into account.

First, the effects of fiscal policy in a small two-country monetary union are the same as those in a small two-country fixed exchange rate area as long as international capital mobility is assumed perfect. Only adjustments to clear the money market differ. To explain this, it is helpful to recall one result of Levin (1983). The two-country fixed exchange rate area is small so that variables of the ROW are exogenous. The exchange rate of the national currencies floats against the currency of the ROW. Given perfect capital mobility, the interest rate in the area is fixed at the world interest rate. A fiscal expansion in country 1 is very potent and it reduces country 2's income, whatever the value of the parameters in the behavioral functions of national economies. Indeed, for given interest rate and money stock, the adjustment towards a new equilibrium in the area-wide money market implies that an increase in country 1's money demand is exactly offset by a fall in country 2's money demand. Consequently, country 2's income must fall. Specifically, the adjustment is realized through changes in foreign exchange reserves: an increase in country 1 and a fall in country 2 (both central banks intervene to prevent country 1's currency from appreciating against country 2's currency). Hansen, Heinrich and Nielsen (1991) applied Levin's model to a small two-country monetary union with a common money supply and a common currency. Keeping the assumption of perfect international capital mobility, they got the same result as Levin's, no matter the disparities in national parameters. The only difference concerns the adjustment in the money market, which directly works through the appreciation of the common currency (the negative effect of this appreciation on country 2's income must exceed the positive effect of bilateral trade).

On the contrary, we shall assume that international capital mobility is imperfect but high. A review of empirical works (Obstfeld, 1994) goes against the idea of perfect capital mobility and substitutability of financial assets at the world level. Our assumption means that the common interest rate in the monetary union is not fixed at the world interest-rate level. It is an endogenous variable. As a consequence, the spillover effects of a fiscal expansion are not bound to be negative, because they fundamentally depend on the structural characteristics of national economies.

In the nineties, the EMU project gave rise to debates on its viability because the EU countries have heterogeneous economies and do not form an optimal currency area (see, for example, Masson and Taylor, 1993; de Grauwe, 1997), so that fiscal policy remains the main

stabilization tool. We thus seek to grasp the implications of a monetary union between heterogeneous economies. In our model, the national disparities concern the marginal propensity to consume, the interest rate elasticity of investment, the income and interest-rate elasticities of money demand, the price and income elasticities of imports and exports, the degree of wage indexation and the influence of import prices on the consumer price index (CPI). Empirically, this structural heterogeneity of the European economies is obvious (see tables below).<sup>4</sup>

- The marginal propensity to consume is high in small EU countries (except the Netherlands), low in France and Italy (table 1). This parameter influences the effectiveness of fiscal policy.
- The sensitivity of investment to the interest rate would also be low in France and Italy, high in the Netherlands, Austria and Germany (table 2). This parameter measures the crowding-effect of fiscal policy on private investment.
- The income elasticity of money demand would be high in Finland and the Netherlands, very low in Austria and Italy (table 3). We will show that it is a key variable for the sign of spillover effects. The higher this elasticity in the expanding country, the higher the rise in the common interest rate for given country size.

**Table 1. Short-run income elasticity of private consumption**

Austria	Belgium	Finland	France	Germany	Ireland	Italy	Netherlands	Portugal	Spain
0.72	0.53	0.66	0.32	0.61	0.75	0.44	0.35	0.59	0.59

Source: Barrell and Pina (2000).

**Table 2. Elasticity of fixed investment relative to long term interest rates**

Austria	France	Germany	Italy	Netherlands	United Kingdom
-0.59	-0.24 ~	-0.50	-0.18 ~	-0.93 ~	-0.44 ~

~ Means the variable is lagged one period.

Source: Fair (1994), estimates updated in 2001 (<http://fairmodel.econ.yale.edu>).

**Table 3. Short term income elasticity of money demand**

	Austria	Finland	France	Germany	Italy	Netherlands	United Kingdom
Income	0.01	0.44	na	0.17	0.07	0.43	0.15

Source: see table 2.

- The price elasticities of imports and exports of goods and services are the highest in Greece and Portugal, the lowest in Sweden and Italy (table 4). The income elasticities are very high in Italy, rather low in the UK. Elasticities of foreign trade are key determinants of the sign and extent of spillover effects: all else equal, the higher the price elasticities, the higher the negative spillover effects due to the impact of the appreciation of the single currency on net exports, whereas the higher the income elasticities, the higher the positive trade channel.

<sup>4</sup> Admittedly, the monetary union represents a change in the monetary regime and EMU membership might bring about changes in economic behaviors, notably a convergence of national economic structures and preferences.

**Table 4. Short-term elasticities of imports and exports of goods and services**

	Price elasticities (Roeger and in't Veld, 1997) <sup>a</sup>		Income elasticities (Hervé, 2001)	
	Imports	Exports	Imports	Exports
Austria	0.24	0.28	1.16	0.80
Belgium	0.23	0.18	1.29	0.53
Denmark	0.17	0.25	2.03	0.11 <sup>b</sup>
Finland	0.24	0.16	1.22	0.64
France	0.21	0.27	1.65	0.20 <sup>c</sup>
Germany	0.22	0.23	2.19	0.87
Greece	0.51	0.92	1.17	0.65
Ireland	0.15	0.28	1.57	0.14 <sup>b</sup>
Italy	0.12	0.25	3.93	1.63
Netherlands	0.24	0.16	1.45	0.88
Portugal	0.21	0.54	1.59	0.65 <sup>c</sup>
Spain	0.26	0.21	1.86	0.72
Sweden	0.22	0.14	1.89	0.93
United Kingdom	0.23	0.34	1.18	0.57

a) Income elasticities of imports and exports are restricted to unity in QUEST.

b) No statistical significance.

c) Statistical significance at the 10 % level.

- The degree of openness is the greatest in Benelux and Ireland, the lowest in Greece, Italy and France (table 5). Concerning bilateral trade (table 6), Ireland trades heavily with the UK; the euro area countries hardly trade with Greece; Germany is the main customer of Benelux, Denmark and Greece; France is the main trading customer of Germany and Spain, and also the main supplier of these countries. The share of intra-EU trade in total trade is the smallest in Germany and the UK. The geographic structure of foreign trade is one factor that determines the extent of positive spillover effects.

**Table 5. Imports and exports in 1998 (% of GDP at current prices)**

	Imports of goods and services	Intra EU-15 imports of goods	Extra EU-15 imports of goods	Exports of goods and services	Intra EU-15 exports of goods	Extra EU-15 exports of goods
Austria	45.4	22.2	9.6	44.9	17.9	10.8
Belgium	71.5	43.3*	18.2*	75.6	48.1*	18.1*
Denmark	33.2	18.7	7.6	35.0	15.9	11.7
Finland	30.1	16.2	8.9	39.0	18.2	15.3
France	23.3	12.1	7.4	25.6	13.0	7.5
Germany	27.2	12.0	9.9	29.1	14.3	10.9
Greece	25.5	14.1	7.7	17.8	4.4	4.4
Ireland	72.7	28.0	24.1	85.9	50.8	24.3
Italy	22.6	11.0	7.0	25.1	11.3	8.9
Netherlands	55.3	24.6	18.5	60.5	37.9	10.7
Portugal	40.3	25.6	8.9	30.9	17.6	4.9
Spain	26.8	15.3	7.5	27.3	13.4	5.4
Sweden	37.5	19.2	8.4	43.8	20.0	15.0
United Kingdom	27.5	11.8	10.4	26.6	11.0	8.2

\* Belgium/Luxemburg.

Source: European Commission (1999), "The EU Economy: 1999 Review", *European Economy* n° 69.

**Table 6. Bilateral trade in 1994**

(% of total exports)

<i>Exports of</i>												
<i>to</i>	B/L	DK	GE	GR	SP	FR	IR	IT	NL	PO	UK	EU-12
B/L	-	1.9	6.7	1.6	2.8	8.5	3.9	3.0	13.9	3.7	5.5	6.0
DK	0.9	-	1.8	0.8	0.6	0.9	1.1	0.8	1.6	2.3	1.4	1.3
GE	20.8	23.0	-	21.1	13.4	17.7	14.1	19.0	28.6	18.7	12.9	13.6
GR	0.6	0.7	0.8	-	0.9	0.7	0.5	1.8	1.0	0.5	0.7	0.9
SP	2.9	1.8	3.2	2.2	-	6.9	2.3	4.6	2.5	14.3	3.8	3.8
FR	19.3	5.6	12.0	5.4	19.0	-	9.2	13.1	10.6	14.7	10.2	10.6
IR	0.4	0.5	0.5	0.3	0.4	0.6	-	0.3	0.6	0.5	5.4	1.1
IT	5.2	4.0	7.6	13.9	8.7	9.8	3.9	-	5.5	3.3	5.1	6.1
NL	13.0	4.3	7.5	2.5	3.6	4.5	5.5	2.9	-	5.2	7.1	5.7
PO	0.8	0.5	0.9	0.4	7.4	1.4	0.4	1.3	0.8	-	1.0	1.3
UK	8.3	8.8	8.0	5.9	7.6	9.8	27.5	6.5	9.6	11.7	-	7.7
Total intra EC trade	72.1	51.2	48.9	54.2	64.5	60.7	70.0	53.4	74.7	75.1	54.1	58.4
United States	4.9	5.5	7.9	4.8	4.6	7.0	8.1	7.8	4.0	5.3	12.0	7.3
Japan	1.3	4.0	2.6	1.0	1.1	1.9	3.1	2.1	1.0	0.8	2.3	2.1

(% of total imports)

<i>Imports of</i>												
<i>from</i>	B/L	DK	GE	GR	SP	FR	IR	IT	NL	PO	UK	EU-12
B/L	-	3.7	7.1	3.8	3.9	10.3	1.6	4.7	10.7	3.5	4.6	6.2
DK	0.6	-	1.9	1.5	0.8	1.0	0.7	1.0	1.1	0.8	1.4	1.2
GE	18.9	21.8	-	16.4	15.3	20.4	7.0	19.2	20.9	14.0	14.2	13.4
GR	0.1	0.2	0.5	-	0.3	0.2	0.1	0.8	0.1	0.1	0.2	0.3
SP	1.6	1.2	2.8	3.1	-	6.0	0.9	3.8	1.6	19.8	2.4	3.2
FR	15.2	5.4	11.3	8.1	18.0	-	3.4	13.6	6.9	12.7	9.8	9.5
IR	1.0	0.8	1.1	0.9	0.9	1.3	-	0.9	1.1	0.7	4.7	1.5
IT	4.1	4.2	8.4	16.7	8.9	9.9	2.0	-	3.4	8.5	4.9	5.2
NL	17.0	6.9	10.5	7.5	4.5	6.5	3.3	5.7	-	4.4	6.5	7.5
PO	0.5	1.3	0.9	0.4	2.8	1.1	0.3	0.8	0.5	-	0.8	0.9
UK	9.1	6.7	6.3	6.2	8.0	8.2	41.2	6.1	8.5	6.7	-	6.8
Total intra EC trade	68.1	52.1	50.7	64.4	63.5	65.0	63.3	56.2	54.8	71.4	49.9	57.0
United States	5.9	4.3	5.9	3.2	6.2	7.3	16.9	4.6	8.7	3.6	12.8	7.4
Japan	2.7	3.1	4.8	3.8	2.8	2.5	4.3	2.4	4.4	2.8	5.9	3.9

Source: European Commission (1999), "The EU Economy: 1999 Review", *European Economy* n° 69.

- Barrell and Dury (2001) find that, in the wage bargaining process, inflation expectations play no role in Germany, Portugal, Belgium, Austria and the Netherlands, but a great role in Italy, Finland, the UK, Spain and Ireland (table 7). Under wage indexation, we will show that the influence of import prices on the CPI becomes a key factor of spillover effects. In the QUEST model, this influence is measured by the share of imports in total domestic demand, which was, on average in the nineties, 30% in the UK and 26% in Germany (Roeger and in't Veld, 1997). However, in the MULTIMOD model, the effect of a 1 percent increase in import prices on the CPI is half in the UK than in Germany be it estimated from input-output tables (import contents of both intermediate and final goods) or econometric estimates of CPI equations (Laxton *and al.*, 1998). There is therefore clearly a need to estimate these effects in all EU individual countries.



**Table 7. Degree of nominal wage flexibility**

	Inflation in period $t$	Inflation in period $t - 1$	Inflation in period $t + 1$
AU	0.534	0.466	
BE	0.444	0.556	
FI			0.583
FR		0.635	0.364
GE	0.624		
IR			0.339
IT			0.604
NL	0.534	0.466	
PO	0.534	0.466	
SP			0.348
UK			0.394

Source: Barrell and Dury (2001).

Finally, the use of the MF model enables us to explain how disparities in national structural parameters influence the effects of fiscal policy in a monetary union. Despite its simple structure, our assumptions of non-identical countries and imperfect international capital mobility complicate the analysis of the various economic interdependences between countries. That's the reason why we only focus on the three channels of spillover effects: the positive trade channel and the two negative channels through real interest rate and real exchange rate. We ignore other sources of spillover effects stemming from the accumulation of public debt (Beetsma and Uhlig, 1997) and the dynamic effects of fiscal policy through the intertemporal budget constraint (Roeger and in't Veld, 1997). We also neglect the outcomes of strategic interactions between governments and the ECB under different policy rules and various shocks. These issues are addressed in Ahlo (2001), Buti, Roeger and in't Veld (2001), Beetsma, Debrun and Klassen (2001), under the assumptions that EMU is a closed region and countries are identical though.

### III. The model

The model is an extension of Levin (1983) to a two-country monetary union with price-wage adjustment and imperfect capital mobility between the monetary union and the ROW. The latter is called the foreign country whose variables are exogenous. The exchange rate between the single currency and the foreign currency is floating. Inflation and exchange rate expectations are not considered. Both countries are identified with indices  $i, j = (1, 2)$  and  $j \neq i$ . Foreign variables are asterisked. The equations of the model describe equilibrium conditions of the national goods and labour markets, the common money market and the foreign exchange market. All variables are in logarithms (except for the interest rate  $r$ ) and all parameters are positive.

#### *The goods and labour markets*

$$y_i^d = c_i y_i - i_i r + g_i + [-b_i y_i + b_{ij} y_j + b_{i*} y^* + b_{iq} (e + p^* - p_i) + b_{ip} (p_j - p_i)] \quad (1)$$

$$n_i^d = -\frac{1}{1 - u_i} (w_i - p_i) \quad (2)$$

$$y_i^s = -\frac{u_i}{1-u_i}(w_i - p_i) \quad (3)$$

$$n_i^s = z_i(w_i - \bar{p}_i) \quad (4)$$

$$\bar{p}_i = a_i p_i + a_{iq}(e + p^*) + a_{ij} p_j \quad (5)$$

$$w_i = h_i \bar{p}_i \quad (6)$$

$$y_i^d = y_i^s \quad (7)$$

where  $y_i^d$  is the real aggregate demand for goods,  $y_i^s$  the real aggregate supply of goods,  $y$  the output,  $r$  the interest rate,  $g_i$  the government expenditures (fiscal policy),  $e$  the exchange rate of the single currency against the foreign currency (units of single currency per unit of foreign currency),  $p$  the price of produced goods,  $n_i^d$  the demand for labour,  $n_i^s$  the supply of labour,  $w_i$  the wage rate,  $\bar{p}_i$  the CPI.

Equation 1 defines the aggregate demand. Equations (2)-(6) represent the aggregate supply side. Equation (7) is the equilibrium condition for output.

The aggregate demand is a positive function of domestic output ( $c_i$  being the marginal propensity to consume), a negative function of the interest rate ( $\zeta_i$  being the sensitivity of private investment to the interest rate), a positive function of government expenditures and net exports (expressed in square brackets). Coefficients  $b_i$ ,  $b_{ij}$ ,  $b_{i*}$ ,  $b_{iq}$  and  $b_{ip}$  are the elasticities of demand for net exports to respectively domestic income  $y_i$ , partner country's income  $y_j$ , foreign income  $y^*$ , real exchange rate  $e + p^* - p_i$  (external price competitiveness)<sup>5</sup> and relative prices in the monetary union  $p_j - p_i$  (internal price competitiveness).

With a fixed capital stock, the supply of goods is determined by the quantity of labour employed ( $y_i^s = u_i n_i$  where  $u_i$  is the output elasticity of labour). Demand for labour is determined by equalizing the marginal product of labour and the real wage rate (first order condition of profit maximization):  $\log u_i - (1 - u_i)n_i = w_i - p_i$ , where in equation 2, we ignore the term  $\log u_i/(1 - u_i)$ . Supply of goods is derived from this demand for labour (equation 3).

Equation 4 describes labour supply as an increasing function of the real wage rate defined as the nominal wage rate deflated by the CPI, which is a weighted average of domestic and import prices (equation 5). Coefficients  $a_i$ ,  $a_{ij}$  and  $a_{iq}$  respectively measure the influence on the CPI of prices of domestically produced goods  $p_i$ , prices of goods imported from the partner country  $p_j$ , and prices of foreign imports  $p^*$  expressed in terms of the single currency (with  $a_i = 1 - a_{ij} - a_{iq}$ ). The nominal wage rate  $w_i$  is defined as a function of the current CPI (equation 6), with  $h_i$  the degree of wage indexation on consumer prices ( $0 < h_i < 1$ ).

Under constant nominal wage rate (with  $h_i = 0$ ), the supply of goods is simply a positive function of the price of domestic output (equation 3). The equilibrium of goods markets (equation 7) and labour markets ( $n_i^d = n_i^s$ ) can be obtained by price adjustment. Alternatively, under wage indexation ( $h_i = 1$ ), the supply of goods is derived from equations (3), (5) and (6):

$$y_i^s = \frac{u_i}{1-u_i} \left[ \log u_i + (1 - h_i a_i) p_i - h_i a_{iq} (e + p^*) - h_i a_{ij} p_j \right] \quad (8)$$

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<sup>5</sup> The Marshall-Lerner condition is supposed to hold.

It is determined by the relative prices in the monetary union and the real exchange rate. For instance, it must fall if the rise in domestic prices is lower than the rise in the real exchange rate (real depreciation of the single currency) and the rise in the prices of imported goods from the partner country. Indeed, higher import prices raise consumer prices and hence wages. The real wage rate received by the workers remains constant, but the real wage rate paid by the producers rises. A new equilibrium is reached in the goods market with a lower level of output. However, it implies an excess supply in the labour market as far as the demand for labour is determined by the equilibrium supply of goods. To keep the goods market in equilibrium, we shall therefore assume that the level of employment is determined by the demand for labour ( $n_i = n_i^d$ ). In other words, under wage indexation, unemployment may arise due to a rise in the real wage rate that reduces output.

### ***The money market***

$$m = (p_1 + p_2) + l_{1y}y_1 + l_{2y}y_2 - (l_{1r} + l_{2r})r \quad (9)$$

The money stock  $m$  is exogenous, set by the common central bank. The union-wide money demand is given by the sum of national demands for real balances ( $m - p_1 - p_2$ ), which are conventionally assumed to be a positive function of output and a negative function of the interest rate, with  $l_{iy}$  the income elasticity of money demand and  $l_{ir}$  the interest-rate semi-elasticity of money demand.<sup>6</sup> The interest rate adjusts the money market.

### ***The foreign exchange market***

$$\begin{aligned} & [-b_{1y}y_1 + b_{12}y_2 + b_{1s}y^* + b_{1q}(e + p^* - p_1) + b_{1p}(p_2 - p_1)] \\ & + [-b_{2y}y_2 + b_{21}y_1 + b_{2s}y^* + b_{2q}(e + p^* - p_1) + b_{2p}(p_1 - p_2)] + f(r - r^*) = 0 \end{aligned} \quad (10)$$

The union-wide balance of payments is in equilibrium when national trade balances and the union capital account sums to zero.<sup>7</sup> The first two terms in square brackets in equation 10 are net exports of each country. The third term expresses net capital inflows, with the parameter  $f$  representing the degree of international capital mobility. We shall assume that its value is high (near unity).

### ***Global equilibrium conditions***

The model consists of a system of six equations with six endogenous variables ( $y_1, y_2, r, e, p_1, p_2$ ):

$$y_1 = c_1y_1 - i_1r + g_1 - b_{1y}y_1 + b_{12}y_2 + b_{1s}y^* + b_{1q}(e + p^* - p_1) + b_{1p}(p_2 - p_1) \quad (11)$$

$$y_2 = c_2y_2 - i_2r + g_2 - b_{2y}y_2 + b_{21}y_1 + b_{2s}y^* + b_{2q}(e + p^* - p_2) + b_{2p}(p_1 - p_2) \quad (12)$$

$$m = (p_1 + p_2) + l_{1y}y_1 + l_{2y}y_2 - (l_{1r} + l_{2r})r \quad (13)$$

<sup>6</sup> Money balances are deflated by the price of domestic output instead of the consumer price level. We will come back on this hypothesis in the comments of the results.

<sup>7</sup> Within the monetary union, individual countries do not have an equilibrium constraint of their own balance of payments. Perfect financial integration allow them to finance their current accounts.

$$-(b_1 - b_{21})y_1 - (b_2 - b_{12})y_2 + (b_{1*} + b_{2*})y^* + b_{1q}(e + p^* - p_1) + b_{1p}(p_2 - p_1) + b_{2q}(e + p^* - p_2) + b_{2p}(p_1 - p_2) + f(r - r^*) = 0 \quad (14)$$

$$y_1 = (1 - h_1 a_1) p_1 - h_1 a_{1q}(e + p^*) - h_1 a_{12} p_2 \quad (15)$$

$$y_2 = (1 - h_2 a_2) p_2 - h_2 a_{2q}(e + p^*) - h_2 a_{21} p_1 \quad (16)$$

Equations (11) and (12) express the equality between aggregate demand and output in country 1 and country 2 respectively. Equations (13) and (14) describe the equilibrium conditions of the union-wide money market and balance of payments respectively. Equations (15) and (16) represent the equality between aggregate supply and output in country 1 and country 2 respectively. They are derived from the equation 8, by neglecting the terms  $u_i$ . An annex reproduces the reduced form of the model, the expression of the determinant of the system (positive assuming small values of the coefficients  $a_{iq}$ ) and the solutions for each case of wage indexation: no wage indexation ( $h_1 = h_2 = 0$ ); full wage indexation ( $h_1 = h_2 = 1$ ); no wage indexation in country 1 and full wage indexation in country 2 ( $h_1 = 0; h_2 = 1$ ).

#### IV. Fiscal policy

A fiscal expansion in country 1 (an increase in government purchases of domestic goods) is not very effective within the context of a high international capital mobility, flexible prices and a floating exchange rate of the single currency. To some conditions, it is less detrimental to the partner country under full wage indexation than under no indexation.

##### *No wage indexation*

Higher government spending expands domestic aggregate demand. The rise in the demand for money in country 1 leads to a rise in the common interest rate. Under the assumption of high international capital mobility, the pressures on the appreciation of the single currency, due to capital inflows, are greater than those on its depreciation (due to higher imports of foreign goods). The higher aggregate demand causes an increase in prices, a fall in the real wage rate and a rise in output.

The rise in the interest rate and the fall in the exchange rate are more pronounced if the following conditions hold:

- the income elasticity of money demand is greater in the expanding country than in the partner country ( $l_{1y} > l_{2y}$ );
- the income elasticities of exports in bilateral trade ( $b_{12}$  and  $b_{21}$ ) are higher than the income elasticities of imports in total trade ( $b_1$  and  $b_2$ );
- country 1's net exports are little sensitive to the real exchange rate ( $b_{1q}$ ) and relative prices in the union ( $b_{1p}$ ), because the loss of price competitiveness does not weaken the rise in country 1's income, nor the rise in the interest rate;
- country 2's net exports are very sensitive to relative prices ( $b_{2p}$ ), because the improved price competitiveness has a greater positive influence on country 2's income, and on the interest rate.

These conditions weaken the increase in country 1's income ( $y_1$ ) if investment is sensitive to the interest rate ( $i_1$ ). The rise in  $y_1$  is also weakened if the domestic economy is much influenced by the loss of internal and external price competitiveness (though, in this case, the rise in the common interest rate and the appreciation of the single currency are smaller).

The effects on country 2's economy are ambiguous. All else equal, aggregate demand declines in country 2 if the income elasticity of money demand in country 1 ( $l_{1y}$ ), the interest elasticity of investment in country 2 ( $i_2$ ) and the price elasticity of country 2's exports to the ROW ( $b_{2q}$ ) are sufficiently high. This negative impact is mitigated if the elasticity of exports of country 2 to country 1's income is high ( $b_{21}$ ), because country 2 benefits from higher exports to country 1. In this respect, a high degree of trade interdependence between both countries is favourable to the expansion of both economies, but it reinforces the rise in the common interest rate (depending on the income elasticity of money demands) and the appreciation of the single currency.

Concerning the adjustment of markets towards a new equilibrium, it works as follows. Since the money stock is constant and the rise in  $y_1$  and  $p_1$  is not proportional to the change of  $y_2$  and  $p_2$ , the interest rate must rise in order to restore the money market equilibrium. In the particular case of a fall in  $y_2$ , the interest rate rises if  $l_{1y} > l_{2y}$ . In the foreign exchange market, country 1's trade deficit (due to higher imports and a loss of price competitiveness) is not exactly offset by country 2's trade surplus (in case  $y_2$  falls). The capital account surplus more than offsets the union-wide trade deficit. The appreciation of the single currency worsens the trade balances so that the union-wide balance of payments surplus is corrected. In the labour markets, the increase in  $p_1$  allows a decrease in real wages and a rise in output in country 1. For country 2, if the conditions of a fall in  $y_2$  are fulfilled, then the rise in real wages translates into a fall in the output. In the goods markets, country 1 benefits from a higher level of output, and to some conditions, there is a higher or lower level of output in country 2. The union-wide price level is higher if country 2's aggregate demand increases, and lower if the fall in country 2's aggregate demand is stronger than the rise in country 1's aggregate demand.

To summarize, the effectiveness of fiscal expansion is low if:  $l_{1y} > l_{2y}$ , because the rise in  $r$  is greater; there are high values of  $i_1$  and  $b_{1q}$ , because the increase in  $y_1^d$  is lower; there are high values of  $b_{ij}$  and  $b_{2p}$ , because the rise in  $y_2$  creates a greater rise in  $r$  and a stronger appreciation of the single currency; there are low values of  $b_i$  relative to  $b_{ij}$ , because the appreciation is reinforced. Fiscal policy is less effective in a monetary union with imperfect international capital mobility and flexible prices than in a fixed exchange-rate area with perfect capital mobility and fixed prices (the implicit model behind the SGP) because there is a loss of domestic price competitiveness against the partner country and the ROW (stronger real appreciation), and there is a stronger rise in the interest rate (fall in the real money stock). As regards the spillover effects, they depend on the values of:  $l_{1y}$  (influence on  $r$ );  $b_{ij}$  and  $b_{2p}$  (positive effects of bilateral trade);  $i_2$  and  $b_{2q}$  (financial negative effects). They may be positive for country 2 if the income elasticity of demand for money is lower in country 1; the net exports of country 2 are very sensitive to changes in country 1's income and more sensitive to the gain in internal price competitiveness than the loss in external price competitiveness (though the real appreciation is less strong for country 2); country 2's economy is little sensitive to the rise in the interest rate. There is, therefore, a need to estimate the income and price elasticities of bilateral trade between countries of the monetary union in order to assess the spillover effects of fiscal policy in EMU.

When demands for money are deflated by the CPI instead of the producer prices, the rise in the interest rate is moderate. Admittedly, the interest rate may fall because the appreciation of the single currency lowers the CPI, depending on the relative influence of prices of imported goods from the ROW on the CPI (coefficients  $a_{iq}$ ).<sup>8</sup> In this case, fiscal policy can be more effective and its spillover effects can be positive.

### *Full wage indexation*

Besides the conditions on the values of the parameters that were underlined in the previous case of no wage indexation, the fiscal expansion in country 1 is here more or less potent and more or less detrimental to the partner country depending on the relative influence of import prices from the partner country ( $a_{ij}$ ) and from the ROW ( $a_{iq}$ ) on the CPI.

Both countries experiment a real appreciation of the single currency that influences the real wage rate paid by the producers whereas the real wage rate received by the workers remains unchanged. In country 1, the real wages paid by the producers fall. Indeed, given the real appreciation of the single currency, nominal wages, which are indexed on the CPI, raise less than the domestic prices. This fall in real wages is reinforced and thus the rise in output is stronger, if prices fall in country 2 (negative effects of the fiscal expansion on country 2's aggregate demand), and if the impact of lower import prices on the CPI ( $a_{12}$  and  $a_{1q}$ ) is high. Given the assumption of relatively low values of coefficients  $a_{iq}$ , the effectiveness of fiscal policy will depend on the influence on the domestic economy of the evolution of prices in the partner country.

In country 2, the real appreciation may cause a fall in real wages paid by the producers. This is possible provided that the influence of prices of imported goods from the ROW on the CPI ( $a_{2q}$ ) is relatively higher than that of the prices of imported goods from country 1 ( $a_{21}$ ), and provided that the rise in country 1's prices is moderate. But considering again low value of coefficients  $a_{iq}$ , this fall in real wages would be small. The impact of country 1's fiscal expansion on country 2's output would then depend on the influence of the evolution of country 1's prices on country 2's economy.

On the whole, the fiscal expansion is very little effective if the values of the coefficients  $a_{1q}$  and  $a_{12}$  are very low. The spillover effects may be positive with low inflation in country 1 and  $a_{2q} > a_{21}$ . In case they are negative, they would be weaker than under no wage indexation, because the real appreciation of the single currency causes a smaller rise in real wages in country 2.

Overall effects depend on the mutual influence of inflation in both countries. Thus, there is a need to estimate the impact on the CPI of an increase in prices of goods imported from EMU countries and from the ROW. Without these estimates, one cannot conclude that the fiscal expansion is more effective under wage indexation than under no wage indexation. Our analysis contrasts with one result of the MF model applied to a small country under wage indexation: Argy (1994) found that fiscal expansion is more effective with flexible exchange rates than with fixed exchange rates. Indeed, the fall in real wages is stronger when the exchange rate is flexible (due to the real appreciation of the domestic currency), whereas import prices are fixed when the exchange rate is fixed.

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<sup>8</sup> The single currency appreciates if the rise in country's 1 money demand first translates into upward pressures on the common interest rate, which in turn induce capital inflows.

### *Disparities in wage indexation*

We now look into the case of no wage indexation in country 1 ( $h_1 = 0$ ) but full wage indexation in country 2 ( $h_2 = 1$ ). We want to assess the effects of a fiscal expansion depending on whether it is undertaken in country 1 or in country 2.

Let's put that the domestic fiscal expansion has first negative effects on the partner country's aggregate demand, and causes a fall in prices in this country. We then obtain the following comparative results:

- $g_2 > 0 \Rightarrow p_1 < 0 \Rightarrow$  higher real wages paid by the producers of country 1 (nominal wages are not indexed)  $\Rightarrow$  lower level of output in country 1;
- $g_1 > 0 \Rightarrow p_2 < 0 \Rightarrow$  small rise or fall in real wages in country 2 (the real appreciation of the single currency brings about a fall in nominal wages which are indexed) according to the respective influence on the CPI of prices of imported goods from the ROW ( $a_{2q}$ ) and from country 1 ( $a_{21}$ ), and according to the extent of the rise in prices in country 1.

The rise in real wages in the partner country appears to be greater when fiscal expansion is led in country 2 than in country 1. It follows that, all else equal, overall economic activity in the monetary union would increase more in case of a fiscal expansion in country 1. From this point of view, it seems preferable that, in a currency union, a fiscal expansion be led in the country where there is no wage indexation. This result is opposite to Argy and Salop (1983). But their analysis applies to two countries with floating exchange rates (and perfect capital mobility): a fiscal expansion in country 1 translates into a fall in country 2's output (the real depreciation of country 2's currency leads to a rise in real wages), whereas a fiscal expansion in country 2 benefits both countries (the depreciation of country 1's currency allows a rise in aggregate demand, and a rise in prices, which lowers real wages).

Note that in the case of a fiscal contraction in our model, it would be preferable that it be led in the country where there is full wage indexation. There would be contractionary effects on aggregate demands spread by lower bilateral trade flows, which could be compensated for by a lower common interest rate and a real depreciation of the single currency. But under wage indexation, a fiscal contraction in country 1 could much occur at the expense of country 2's output, according to the relative influence of prices of imported goods from the ROW on the CPI (the wage indexation would then lead to higher real wages). On the other hand, in case of a fiscal contraction in country 2, such an effect would not affect the aggregate supply in country 1 (where there is no wage indexation).

## **V. Conclusions**

The paper shows that a fiscal expansion is not more effective in a monetary union than in a fixed exchange rate area, and it does not necessarily cause a fall in the partner country's income, because it depends on specific structural parameters of national economies. The positive spillover effects depend on the extent of bilateral trade between EMU countries (hence the key role of the geographic structure of foreign trade and the income elasticities of exports in bilateral trade within EMU). The negative spillover effects work through the rise in the common interest rate (hence the key role of the income elasticity of money demand and the sensitivity of investment relative to the interest rate), and the real appreciation of the

single currency (hence the key role of the price elasticities of foreign trade with the ROW, and the relative influence of import prices from the ROW and from the partner country on the national CPIs). We also found that if there are national disparities in the degree of wage indexation, it is better that the fiscal expansion be led in the country where there is no indexation.

On the whole, there is no clear-cut conclusion on the effects of fiscal policies in a monetary union, because of the various economic interdependences between EMU countries and various sensitivities among countries to economic changes in the ROW. There is, therefore, one misconception behind one argument of the SGP. Furthermore, if some countries of the euro area commit themselves towards restrictive fiscal policies, then the contractionary impact will be, all else equal, particularly strong in other countries where wage indexation is high and the influence of prices of goods imported from the ROW is strong on the CPI.

The ambiguous effects of fiscal policy in a monetary union also imply that governments' fiscal decisions and ECB's monetary decisions are bound to be quite difficult to coordinate. One possible extension of the model is to introduce monetary and fiscal rules, and analyse the outcomes under cooperation and no-cooperation between national fiscal authorities and between the latter and the ECB, taking into account heterogeneity in national structures and preferences.

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## Annex

### Reduced form of the model

$$y_1 = \frac{1}{|A|} [\alpha k_1 g_1 + \beta k_2 g_2 + \gamma m + \delta y^* + \epsilon f r^* + Z_1 p^*]$$

$$y_2 = \frac{1}{|A|} [\eta k_1 g_1 + \theta k_2 g_2 + \lambda m + \mu y^* + \rho f r^* + Z_2 p^*]$$

$$r = \frac{1}{|A|} [\sigma k_1 g_1 + \tau k_2 g_2 + \phi m + \chi y^* + \psi f r^* + Z_3 p^*]$$

$$e = \frac{1}{|A|} [\xi k_1 g_1 + \omega k_2 g_2 + \pi m + \zeta y^* + \kappa f r^* + Z_4 p^*]$$

$$p_1 = \frac{1}{|A|} [Z_5 k_1 g_1 + Z_6 k_2 g_2 + Z_7 m + Z_8 y^* + Z_9 f r^* + Z_{10} p^*]$$

$$p_2 = \frac{1}{|A|} [Z_{11} k_1 g_1 + Z_{12} k_2 g_2 + Z_{13} m + Z_{14} y^* + Z_{15} f r^* + Z_{16} p^*]$$

$$\text{with } k_i = \frac{1}{1 - c_i} > 1$$

### Determinants and solutions

With full wage indexation, the determinant of the system  $|A|$  comprises negative terms associated with the coefficients  $a_{iq}$ . We shall assume that the latter have low values so that the determinant is strictly positive. To determine the sign of the solutions, one must bear in mind that the value of the parameter  $f$  is assumed to be high, and since each country may import products both from the partner country and the ROW, we have  $b_i > b_{ji}$ . Finally, we simplified some expressions using the relationship between the coefficients in the CPI:

$$(1 - a_i) = a_{iq} + a_{ij}.$$

## I. No wage indexation

$$|A|_I = (l_{1r} + l_{2r}) \left[ b_{1q} [1 + k_2 b_2 + k_1 b_{21} + (k_1 + k_2)(b_{2p} + b_{2q})] + b_{2q} [1 + k_1 b_1 + k_2 b_{12} + (k_1 + k_2)b_{1p}] \right] \\ + k_1 (1 + l_{1y}) \left[ k_2 (i_1 + i_2 + f) [b_{1q} (b_{2p} + b_{2q} + b_2) + b_{2q} (b_{1p} + b_{12})] + (i_1 + f) b_{1q} + i_1 b_{2q} \right] \\ + k_2 (1 + l_{2y}) \left[ k_1 (i_1 + i_2 + f) [b_{1q} (b_{2p} + b_{2q} + b_{21}) + b_{2q} (b_{1p} + b_1)] + i_2 b_{1q} + (i_2 + f) b_{2q} \right]$$

$$\alpha = (l_{1r} + l_{2r}) [b_{1q} + b_{2q} + k_2 b_{1q} (b_{2p} + b_{2q} + b_2) + k_2 b_{2q} (b_{1p} + b_{12})] + k_2 (1 + l_{2y}) [i_2 b_{1q} + (i_2 + f) b_{2q}] > 0$$

$$\eta = k_2 (l_{1r} + l_{2r}) [b_{1q} (b_{2p} + b_{2q} + b_{21}) + b_{2q} (b_{1p} + b_1)] - k_2 (1 + l_{1y}) [i_2 b_{1q} + (i_2 + f) b_{2q}]$$

$$\sigma = (1 + l_{1y}) [b_{1q} + b_{2q} + b_{1q} k_2 (b_{2p} + b_{2q} + b_2) + b_{2q} k_2 (b_{1p} + b_{12})] + k_2 (1 + l_{2y}) [b_{1q} (b_{2p} + b_{2q} + b_{21}) + b_{2q} (b_{1p} + b_1)] > 0$$

$$\xi = (l_{1r} + l_{2r}) [b_1 - b_{21} + b_{1p} + b_{1q} - b_{2p} + k_2 [(b_1 b_2 - b_{12} b_{21}) + b_{1q} (b_{2p} + b_{2q} + b_2) + b_{2q} (b_{1p} + b_1) + b_{1p} (b_2 - b_{21}) + b_{2p} (b_1 - b_{12})]] \\ - (1 + l_{1y}) [f + k_2 [(i_2 + f) (b_{2p} + b_{2q} + b_2) - i_2 (b_{1p} + b_{12})]] - k_2 (1 + l_{2y}) [(i_2 + f) (b_{2p} + b_{21}) - i_2 (b_{1p} + b_{1q} + b_1)]$$

$$Z_5 = \alpha > 0$$

$$Z_{11} = \eta$$

## II. Full wage indexation

$$|A|_{II} = 2k_1 k_2 (i_1 + i_2 + f) [b_{1q} [b_{2p} + b_{2q} + (1 - a_2) b_2 + a_{12} b_{21}] + b_{2q} [b_{1p} + (1 - a_1) b_1 + a_{21} b_{12}] + a_{1q} (b_{2p} b_1 - b_{1p} b_{21}) + a_{2q} (b_{1p} b_2 - b_{2p} b_{12})] \\ + 2k_1 (i_1 + f) [(1 - a_2) b_{1q} + a_{2q} b_{1p}] + 2k_2 (i_2 + f) [(1 - a_1) b_{2q} + a_{1q} b_{2p}] + 2k_1 i_1 (a_{21} b_{2q} - a_{2q} b_{2p}) + 2k_2 i_2 (a_{12} b_{1q} - a_{1q} b_{1p}) \\ + 2 [a_{1q} (1 - a_2) + a_{2q} a_{12}] [k_1 k_2 (i_1 + i_2 + f) (b_1 b_2 - b_{12} b_{21}) + k_1 i_1 (b_1 - b_{21}) + k_2 i_2 (b_2 - b_{12}) + f (1 + k_1 b_1 + k_2 b_2)]$$

$$\alpha = 2k_2 (i_2 + f) [(1 - a_1) b_{2q} + a_{1q} b_{2p}] + 2k_2 i_2 (a_{12} b_{1q} - a_{1q} b_{1p}) + 2 [a_{1q} (1 - a_2) + a_{2q} a_{12}] [k_2 i_2 (b_2 - b_{12}) + f (1 + k_2 b_2)] > 0$$

$$\eta = -2k_2 (i_2 + f) [a_{21} b_{2q} - a_{2q} b_{2p}] - 2k_2 i_2 [(1 - a_2) b_{1q} + a_{2q} b_{1p}] - 2k_2 [a_{1q} (1 - a_2) + a_{2q} a_{12}] [i_2 (b_1 - b_{21}) - f b_{21}]$$

$$\sigma = 2b_{1q} [k_2 (b_{2p} + b_{2q} + a_{12} b_{21}) + (1 - a_2) (1 + k_2 b_2)] + 2b_{2q} [k_2 [b_{1p} + (1 - a_1) b_1] + a_{21} (1 + k_2 b_{12})] \\ + 2 [a_{1q} (1 - a_2) + a_{2q} a_{12}] [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21})] + 2a_{1q} k_2 (b_{2p} b_1 - b_{1p} b_{21}) + 2a_{2q} [b_{1p} (1 + k_2 b_2) - b_{2p} (1 + k_2 b_{12})] > 0$$

$$\xi = (l_{1r} + l_{2r}) \left[ b_{1q} [k_2 (b_{2p} + b_{2q} + a_{12} b_{21}) + (1 - a_2) (1 + k_2 b_2)] + b_{2q} [k_2 (b_{1p} + (1 - a_1) b_1) + a_{21} (1 + k_2 b_{12})] + a_{1q} k_2 (b_{2p} b_1 - b_{1p} b_{21}) \right] \\ + [a_{1q} (1 - a_2) + a_{2q} a_{12}] [(l_{1r} + l_{2r}) [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21}) + k_2 i_2 [l_{2y} (b_1 - b_{21}) - l_{1y} (b_2 - b_{12})] - f [l_{1y} (1 + k_2 b_2) + l_{2y} k_2 b_{21}]] \\ + k_2 i_2 [b_{1q} [1 - a_{12} l_{1y} + (1 - a_2) l_{2y}] + b_{1p} (2 + a_{1q} l_{1y} + a_{2q} l_{2y}) + (b_1 - b_{21}) (1 - a_1 + a_{12}) - (b_2 - b_{12}) (1 - a_2 + a_{21})] \\ - k_2 (i_2 + f) [b_{2q} [1 + (1 - a_1) l_{1y} - a_{21} l_{2y}] + b_{2p} (2 + a_{1q} l_{1y} + a_{2q} l_{2y})] - f [(1 + k_2 b_2) (1 - a_2 + a_{21}) + k_2 b_{21} (1 - a_1 + a_{12})]$$

$$Z_5 = (l_{1r} + l_{2r}) \left[ b_{1q} [k_2 (b_{2p} + b_{2q} + a_{12} b_{21}) + (1 - a_2) (1 + k_2 b_2)] + b_{2q} [k_2 (b_{1p} + (1 - a_1) b_1) + a_{21} (1 + k_2 b_{12})] + a_{1q} k_2 (b_{2p} b_1 - b_{1p} b_{21}) \right] \\ + [a_{1q} (1 - a_2) + a_{2q} a_{12}] [b_{1p} (1 + k_2 b_2) - b_{2p} (1 + k_2 b_{12})] \\ + [a_{1q} (1 - a_2) + a_{2q} a_{12}] [(l_{1r} + l_{2r}) [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21}) + k_2 i_2 [l_{2y} (b_1 - b_{21}) - l_{1y} (b_2 - b_{12})] - f [l_{1y} (1 + k_2 b_2) + l_{2y} k_2 b_{21}]] \\ + k_2 i_2 [b_{1q} [1 - a_{12} l_{1y} + (1 - a_2) l_{2y}] + b_{1p} (a_{1q} l_{1y} + a_{2q} l_{2y}) + a_{1q} (b_1 - b_{21}) + a_{2q} (b_2 - b_{12})] \\ + k_2 (i_2 + f) [b_{2q} [1 - (1 - a_1) l_{1y} + a_{21} l_{2y}] - b_{2p} (a_{1q} l_{1y} + a_{2q} l_{2y})] + f [a_{2q} (1 + k_2 b_2) - a_{1q} k_2 b_{21}] > 0$$

$$Z_{11} = (l_{1r} + l_{2r}) \left[ b_{1q} [k_2 (b_{2p} + b_{2q} + a_{12} b_{21}) + (1 - a_2) (1 + k_2 b_2)] + b_{2q} [k_2 (b_{1p} + (1 - a_1) b_1) + a_{21} (1 + k_2 b_{12})] + a_{1q} k_2 (b_{2p} b_1 - b_{1p} b_{21}) \right] \\ + [a_{1q} (1 - a_2) + a_{2q} a_{12}] [b_{1p} (1 + k_2 b_2) - b_{2p} (1 + k_2 b_{12})] \\ + [a_{1q} (1 - a_2) + a_{2q} a_{12}] [(l_{1r} + l_{2r}) [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21}) + k_2 i_2 [l_{2y} (b_1 - b_{21}) - l_{1y} (b_2 - b_{12})] - f [l_{1y} (1 + k_2 b_2) + l_{2y} k_2 b_{21}]] \\ - k_2 i_2 [b_{1q} [1 + a_{12} l_{1y} - (1 - a_2) l_{2y}] - b_{1p} (a_{1q} l_{1y} + a_{2q} l_{2y}) + a_{1q} (b_1 - b_{21}) + a_{2q} (b_2 - b_{12})] \\ - k_2 (i_2 + f) [b_{2q} [1 + (1 - a_1) l_{1y} - a_{21} l_{2y}] + b_{2p} (a_{1q} l_{1y} + a_{2q} l_{2y})] - f [a_{2q} (1 + k_2 b_2) - a_{1q} k_2 b_{21}]$$

### III. No wage indexation in country 1 and full wage indexation in country 2

$$\begin{aligned} |A|_{III} = & (1_{1r} + 1_{2r}) \left[ b_{1q} [(1 - a_2)(1 + k_2 b_2 + k_1 b_{21}) + k_2 (b_{2p} + b_{2q})] + b_{2q} [a_{21}(1 + k_1 b_1 + k_2 b_{12}) + k_2 b_{1p}] \right] \\ & + k_1 (2 + 1_{1y}) \left[ k_2 (i_1 + i_2 + f) [b_{1q} (b_{2p} + b_{2q} + (1 - a_2) b_2) + b_{2q} (b_{1p} + a_{21} b_{12})] + (1 - a_2) (i_1 + f) b_{1q} + a_{21} i_1 b_{2q} \right] \\ & + k_2 (1 + a_{21} 1_{2y}) \left[ k_1 (i_1 + i_2 + f) (b_{1q} b_{21} + b_{2q} b_1) + i_2 b_{1q} + (i_2 + f) b_{2q} \right] + k_2 a_{2q} 1_{2y} \left[ k_1 (i_1 + i_2 + f) b_{1q} b_{21} + i_2 b_{1q} \right] \\ & + a_{2q} \left[ k_1 k_2 (i_1 + i_2 + f) [b_1 b_2 - b_{12} b_{21} + (2 + 1_{1y}) (b_{1p} b_2 - b_{2p} b_{12}) - 1_{2y} (b_{2p} b_1 - b_{1p} b_{21})] + k_1 i_1 (b_1 - b_{21}) + k_2 i_2 (b_2 - b_{12}) + f(1 + k_1 b_1 + k_2 b_2) \right] \\ & + k_1 (2 + 1_{1y}) [(i_1 + f) b_{1p} - i_1 b_{2p}] + k_2 1_{2y} [i_2 b_{1p} - (i_2 + f) b_{2p}] + (1_{1r} + 1_{2r}) [b_{1p} (1 + k_2 b_2 + k_1 b_{21}) - b_{2p} (1 + k_1 b_1 + k_2 b_{12})] \end{aligned}$$

$$\begin{aligned} \alpha = & k_2 (1_{1r} + 1_{2r}) \left[ (b_{1p} + b_{1q}) b_{2q} + b_{2p} b_{1q} \right] + k_2 [i_2 b_{1q} + (i_2 + f) b_{2q}] + [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r})(1 + k_2 b_2) + k_2 i_2 1_{2y}] \\ & + (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r})(1 + k_2 b_{12}) + k_2 (i_2 + f) 1_{2y}] + a_{2q} [k_2 i_2 (b_2 - b_{12}) + f(1 + k_2 b_2)] > 0 \end{aligned}$$

$$\begin{aligned} \beta = & k_1 (1_{1r} + 1_{2r}) \left[ (b_{1p} + b_{1q}) b_{2q} + b_{2p} b_{1q} \right] - k_1 [(i_1 + f) b_{1q} + i_1 b_{2q}] + k_1 [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r}) b_2 - (i_1 + f) 1_{2y}] \\ & + k_1 (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r}) b_{12} - i_1 1_{2y}] - k_1 a_{2q} [i_1 (b_2 - b_{12}) - f b_{12}] \end{aligned}$$

$$\eta = k_2 [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r}) b_{21} - i_2 (2 + 1_{1y})] + k_2 (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r}) b_1 - (i_2 + f) (2 + 1_{1y})] - k_2 a_{2q} [i_2 (b_1 - b_{21}) - f b_{21}]$$

$$\begin{aligned} \theta = & [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r})(1 + k_1 b_{21}) + k_1 (i_1 + f) (2 + 1_{1y})] + (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r})(1 + k_1 b_1) + k_1 i_1 (2 + 1_{1y})] \\ & + a_{2q} [f(1 + k_1 b_1) + k_1 i_1 (b_1 - b_{21})] > 0 \end{aligned}$$

$$\begin{aligned} \sigma = & k_2 (2 + 1_{1y}) \left[ (b_{1p} + b_{1q}) b_{2q} + b_{2p} b_{1q} \right] + k_2 (b_{1q} b_{21} + b_{2q} b_1) + [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(2 + 1_{1y})(1 + k_2 b_2) + 1_{2y} k_2 b_{21}] \\ & + (a_{21} b_{2q} - a_{2q} b_{2p}) [(2 + 1_{1y})(1 + k_2 b_{12}) + 1_{2y} k_2 b_1] + a_{2q} [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21})] > 0 \end{aligned}$$

$$\begin{aligned} \tau = & k_1 (2 + 1_{1y}) \left[ (b_{1p} + b_{1q}) b_{2q} + b_{2p} b_{1q} \right] + b_{1q} (1 + k_1 b_{21}) + b_{2q} (1 + k_1 b_1) + [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(2 + 1_{1y}) k_1 b_2 + 1_{2y} (1 + k_1 b_{21})] \\ & + (a_{21} b_{2q} - a_{2q} b_{2p}) [(2 + 1_{1y}) k_1 b_{12} + 1_{2y} (1 + k_1 b_1)] + a_{2q} [b_2 - b_{12} + k_1 (b_1 b_2 - b_{12} b_{21})] > 0 \end{aligned}$$

$$\begin{aligned} \xi = & k_2 (b_{2p} + b_{2q}) [(1_{1r} + 1_{2r})(b_{1q} + b_1) - (i_2 + f) (1 + 1_{1y})] + k_2 b_{1p} [(1_{1r} + 1_{2r})(b_{2q} - b_{21}) + i_2 (2 + 1_{1y})] - (i_2 + f) k_2 (b_{2p} + b_{21}) + i_2 k_2 (b_{1q} + b_1) \\ & + [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r})(1 + k_2 b_2) + k_2 i_2 1_{2y}] + (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r})(1 + k_2 b_{12}) + k_2 (i_2 + f) 1_{2y}] \\ & + (1 - a_2) [k_2 i_2 1_{2y} (b_1 - b_{21}) - (1 + 1_{1y}) (b_2 - b_{12})] - f [(1 + 1_{1y})(1 + k_2 b_2) + 1_{2y} k_2 b_{21}] + (1_{1r} + 1_{2r}) [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21})] \\ & - a_{21} [f(1 + k_2 b_2) + k_2 i_2 (b_2 - b_{12})] \end{aligned}$$

$$\begin{aligned} \omega = & (b_{2p} + b_{2q}) [(1_{1r} + 1_{2r}) k_1 b_{1q} + (1 + k_1 b_1)] + k_1 i_1 (1 + 1_{1y}) + b_{1p} [(1_{1r} + 1_{2r}) k_1 b_{2q} - (1 + k_1 b_{21})] - k_1 (i_1 + f) (2 + 1_{1y}) \\ & - f - (i_1 + f) k_1 (b_{1q} + b_1) + i_1 k_1 (b_{2p} + b_{21}) + k_1 a_{21} [i_1 (b_2 - b_{12}) - f b_{12}] \\ & + k_1 [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r}) b_2 - (i_1 + f) 1_{2y}] + k_1 (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r}) b_{12} - i_1 1_{2y}] \\ & + (1 - a_2) [k_1 i_1 [(1 + 1_{1y}) (b_2 - b_{12}) - 1_{2y} (b_1 - b_{21})] - f [(1 + 1_{1y}) k_1 b_{12} + 1_{2y} (1 + k_1 b_1)] + (1_{1r} + 1_{2r}) [b_2 - b_{12} + k_1 (b_1 b_2 - b_{12} b_{21})] \end{aligned}$$

$$Z_5 = \alpha > 0$$

$$Z_6 = \beta$$

$$\begin{aligned} Z_{11} = & k_2 b_{2q} [(1_{1r} + 1_{2r}) (b_{1p} + b_1) - (i_2 + f) (1 + 1_{1y})] + k_2 b_{1q} [(1_{1r} + 1_{2r}) (b_{2p} + b_{2q} + b_{21}) - i_2 (1 + 1_{1y})] \\ & + [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r})(1 + k_2 b_2) + k_2 i_2 1_{2y}] + (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r})(1 + k_2 b_{12}) + k_2 (i_2 + f) 1_{2y}] \\ & + a_{2q} [k_2 i_2 1_{2y} (b_1 - b_{21}) - (1 + 1_{1y}) (b_2 - b_{12})] - f [(1 + 1_{1y})(1 + k_2 b_2) + 1_{2y} k_2 b_{21}] + (1_{1r} + 1_{2r}) [b_1 - b_{21} + k_2 (b_1 b_2 - b_{12} b_{21})] \end{aligned}$$

$$\begin{aligned} Z_{12} = & b_{2q} [(1_{1r} + 1_{2r}) k_1 b_{1p} + (1 + k_1 b_1)] + k_1 i_1 (1 + 1_{1y}) + b_{1q} [(1_{1r} + 1_{2r}) k_1 (b_{2p} + b_{2q}) + (1 + k_1 b_{21})] + k_1 (i_1 + f) (1 + 1_{1y}) \\ & + k_1 [(1 - a_2) b_{1q} + a_{2q} b_{1p}] [(1_{1r} + 1_{2r}) b_2 - (i_1 + f) 1_{2y}] + k_1 (a_{21} b_{2q} - a_{2q} b_{2p}) [(1_{1r} + 1_{2r}) b_{12} - i_1 1_{2y}] \\ & + a_{2q} [k_1 i_1 [(1 + 1_{1y}) (b_2 - b_{12}) - 1_{2y} (b_1 - b_{21})] - f [(1 + 1_{1y}) k_1 b_{12} + 1_{2y} (1 + k_1 b_1)] + (1_{1r} + 1_{2r}) [b_2 - b_{12} + k_1 (b_1 b_2 - b_{12} b_{21})] \end{aligned}$$