The Effects of Fiscal and Monetary Policy in an Open Economy: A Case of EU, the USA and Japan

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Abstract

The content of the notes is mainly based on SLIM (**S**mall **L**inear **I**nterdependent **M**odel) by Douven and Plasmans (1996). We present a small estimated multicountry model of some EU member states, the USA and Japan, in which international linkages are directly modelled. Our starting point is a modified version of the theoretical two-country Mundell--Fleming model. This model is extended in three ways. First, it is extended to more than two countries using the principal trading pattern of each individual country. Second, we extended the model by including country specific labour market characteristics, wage--price spirals and long-term interest rates. Third, we included dynamic responses into the model which makes it possible to distinguish between short- and long-run behaviour of the economy. In each country direct linkages are modelled through outputs, prices, exchange rates and interest rates. For estimation we use annual data for the sample period 1960--91. Historical simulations and shock analysis are performed to show various properties of the model and the outcomes of the model are compared with those for existing models in literature. We get two main points: First, the effect of a **monetary expansion** on price is negative in all countries except for the price responses in the UK and Ireland, which are slightly positive in the short run. Second, a **fiscal expansion** in the USA has a large effect on the UK and German output and a small effect on the Italian output, but a large effect on Italian prices. We also introduce some current academic points of view after we have the European Central Bank (ECB).

Keywords: Multi country model, Direct linkages, Historical tracking performance

1. Introduction

The aim of this paper is to build a small linked multicountry model for the eight EU member states (Belgium, Denmark, France, Germany, Ireland, Italy, the Nederlands and UK), the USA and Japan. The model contains six linear behavioural equations for each country and is estimated using annual data for the sample period 1960-91.The eight EU member states represent economies in the European Union for which mutual economic activity is growing and for which the annual data used for estimation are (almost) completed available. The USA and Japan are included in the model because they are the most important countries outside the EU with the strongest impact on the EU countries. Due to the (transmission) effects (by which we mean the way in which a macroeconomic policy change in one country affects the macroeconomic performance of another will become more and more important. In the model we will focus our attention especially on these external effects, which are modelled through direct linkages. The links between the countries considered are of various types. We will include in variables such as interest and exchange rates, links between price variables such as consumer prices and GDP prices and links between volume variables such as output volumes. The economic functioning of the individual economies and their links will be explained in this paper by carrying out simulation experiments and fiscal and monetary shock analysis.

2. The theoretical model

The model based on conventional Mundell-Fleming framework, as defined in Table 1, refers to one (home) country. The equations for the second (foreign) country are similar. In the theoretical model, it is assumed that each country produces one (type of) good(s), which is imperfect substitute for the other country's (type of) good(s). Both (type of) goods are tradable.

Here we just simply explain the economic meanings of each equation in Table 1. The definitions of all variables are shown in the note of the table. The first equation is a standard *IS*-curve for aggregate demand with the real long-term interest. In equation 2 the output price level is explained by wage, foreign price and output gap. In Equation 3 consumer prices are assumed to be linear combination of domestic output prices and import prices. The labor demand function in equation 4 is determined by real wage costs, output and gap between foreign and domestic prices. Nominal per capita wages of the private sector are modelled in equation 5 by prices, output, and unemployment rate, which is defined by equation 7. Equation 6 explains the domestic long-term interest rate, which depends on domestic real short-term interest rate, the foreign long-term interest rate, the changes of government deficit and consumer price inflation. Note that the model excludes expectations, assumption of natural rate of unemployment, endogenous labor supply and exchange rate for simplicity.

Table 1 The theoretical model for one country[a]

$$Y = \alpha_1 (E + P_y^* - P_y) - \alpha_2 (RL - \Delta P_y) + \alpha_3 Y^* + \alpha_4 G - \alpha_5 T \quad (1)$$

$$P_y = \gamma_1 W + \gamma_2 (E + P_y^*) + \gamma_3 (Y - \overline{Y}) \quad (2)$$

$$P_c = \delta_1 P_y + \delta_2 (E + P_y^*) \quad (3)$$

$$N = -\eta_1 (W - P_y) + \eta_2 Y + \eta_3 (E + P_y^* - P_y) \quad (4)$$

$$W = \vartheta_1 P_c - \vartheta_2 (U - \vartheta_3 U_{-1}) + \vartheta_4 (Y - N) - \vartheta_5 (P_c - P_y) \quad (5)$$

$$RL = \beta_1 RL^* - \beta_2 RS + \beta_3 \Delta (G - T) + \beta_4 \Delta P_c \quad (6)$$

$$U = L - N \quad (7)$$

[a]Variables are defined as follows (* indicate foreign country variables and Δ indicates first differences; all variables, except *RS*, *RL* and *U* which are rates, are in logarithmic form): Y = real aggregate demand (equal to supply, measured by gross domestic product (GDP), $\overline{Y}$ = trend volume of real gross domestic product, G = real government expenditure, T = real taxes, *RS* = nominal short-term interest rate, *RL* = nominal long-term interest rate, E = exchange rate defined as the nominal price in price level, W = nominal wage per employee in the private sector, L = labour force (labour supply), N = employment and U = unemployment rate.

The model can be extended to handle more than two countries. That is, we have to specify how each country's model is linked to the other countries' models. Direct linkages appear in the two-country model through the *real exchange rate* ($E + P_y^* - P_y$), the *real foreign aggregate demand* (Y^*), the *foreign nominal long-term interest rate* (*RL**) and the *import prices* ($E + P_y^*$). In macroeconometric modelling, the standard approach for the extension to more than two countries is to consider trade linkages, where the impact of foreign countries is linked through import prices and export and import equations (eg, the QUEST model).

Table 2 Domestic countries and their most important trading partners

Domestic country	Most important trading partner
Belgium	Germany, France, Nederlands
Germany	France, Italy, USA, Japan
France	Germany, Italy, UK, USA
Denmark	Germany, UK, USA
UK	Germany, France, USA
Ireland	Germany, UK, USA
Italy	Germany, France, USA
Nederlands	Belgium, Germany, France, UK, USA
USA	Germany, Japan
Japan	Germany USA

One of the main drawbacks of these approaches is that the spillover effects among European countries, originating from a single-country European fiscal policy measure, are negligible.[1] The approach we select here is that we incorporate only those countries in the model which were (the most) important trading partners during the sample period 1960-91. Table 2 presents our choice of the foreign countries which will be considered as important countries for the domestic country and which will appear as * variables in the equations of the domestic country.

3. The Empirics

In general, the equilibrium specification in Table 1 will be made dynamic according to an error correction mechanism (ECM). Such an ECM can be written as[2]

$$\Delta y = \lambda(y_{t-1} - \alpha - \beta x_{t-1}) + \delta_0 \Delta x_t + \delta_1 \Delta x_{t-1} + \delta_2 \Delta x_{t-2} + ... + \gamma_1 \Delta y_{t-1} + \gamma_2 \Delta y_{t-2} + ... + \varepsilon_t \qquad (1)$$

Where λ is called the error correction parameter and $(y_{t-1} - \alpha - \beta x_{t-1})$ the error correction term.

We rewrite the long-run relationship in (1) as follows

$$\lambda(y_{t-1} - \alpha - \beta x_{t-1}) = \lambda_0 + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} \qquad (2)$$

The approach that we follow here is that we substitute (2) into (1) and then estimate equation (1) in one step.

Here we do not mention the details about econometric skills but the empirical results. We start our approach with the following general demand model for all countries

$$\begin{aligned} \Delta Y_t &= a_0 + a_1 Y_{t-1} + a_2 G_{t-1} + a_3 (RL_{t-1} - \Delta P_{y_t}) + a_4 \Delta G_t + a_5 \Delta (RL_{t-1} - \Delta P_{y_t}) + a_6 \Delta Y_{t-1} \\ &+ b_1 \Delta (E_t + P^{*1}_{y_t} - P_{y_t}) + ... + b_k \Delta (E_t + P^{*1}_{y_t} - P_{y_t}) + c_1 \Delta Y^{*1}_t + ... + c_1 \Delta Y^{*k}_t \\ &+ a_7 DUM7475 + a_8 DUM7576 + a_9 time \end{aligned} \qquad (3)$$

For each variable with an asterisk, indicating foreign countries, a foreign country denoted in Table 2 may appear in the equation. For Belgium, eg the general aggregate demand equation implies *k=3* because there are three countries of interest: Germany, France and the Nederlands. As level variables we include three (domestic) variables, Y_{t-1}, G_{t-1}, $RL_{t-1} - \Delta P_{y_t}$, assuming a long-run relationship between them. We include step dummies in the general equation: *DUM7475* is defined as one for the years 1960-73 and zero for the year 1974-91 and *DUM7576* is defined accordingly. These dummies belong to the long-run relationship of the general equation and are introduced to capture the oil price

[1] See Whitley (1992).

[2] Fuss and Sekkat (1993)

shock during the 1973-74 period. Furthermore, a time dummy is introduced to capture accelerated exogenous growth effects of domestic demand. We expect the sign of a_2, a_4, a_7, a_8, a_9, b_1,…, b_k, c_1,…, $c_k \geq 0$, and a_1, $a_3 \leq 0$.

The selected estimation results are presented in Table 3. As can be seen from our results, the level variables Y_{-1}, G_{-1}, $rl_{-1} = (RL_{-1} - \Delta P_{y_t})$, showed significant results in most cases. In the case of Japan we could not find any significant impact of the real interest rate. Difference variables of government expenditure appeared in all equations, except Japan. In the case of France, Italy, and the UK, the significance of this variable is rather low. Direct linkages are modelled in each equation; however, not all the countries indicated in Table 2 yielded significant results. As expected, Germany has a (direct) linkage with five other countries. In particular GDP growth of France is strong in the equation of Belgium, Germany and the UK. Real exchange rates effects are largest in the countries Belgium, France and the Nederlands and absent in the USA and Japan. Acomponent of foreign growth was found in every country. Large foreign growth effects were found in Belgium, Germany, UK and the Nederlands. In five countries one dummy, capture the oil exogenous growth, had a significant impact.

4. Analysis of fiscal and monetary Shocks

To show the dynamic properties of the model we applied several shocks to the model. The shocks are similar to the shocks Whitley (1992) applies to several large multicountry models. The model considered in Whitley are the EU's model (QUEST) as operated by the Deutsches Institut für Wirtschaftsforchung (DIW); the model of the National Institute of Economic and Social research and jointly operated with the London Business School (GEM); the model used by OFCE/CEPII (MIMOSA); the Oxford Economic Forecasting model (OEF); and the OECD's Interlink model (OECD). These models are much larger in size than our small multicountry model. We should first stress that the striking difference with our model and the large multicountry models is the representation of the aggregate demand equation, which in our model equals the aggregate supply.

We analyse the effects of a shock originating in a domestic country on the domestic variables of that country. In the case of a linear model, the outcomes of applying a certain shock are base independent. It therefore does not matter in which yea the shock is applied. We used for each shock the year 1963 as the starting point. We consider the following shocks:

(i) **Fiscal shock**:

A 1% of GDP shock to government expenditure. Expenditure is raised by 1% of GDP of its base

Table 3 Estimation results of the aggregate demand equation[a]

Belgium

$$\Delta Y_t^{Be} = -8.94 - 0.34\, Y_{-1}^{Be} + 0.14\, G_{-1}^{Be} - 0.38\, rl_{-1}^{Be} + 0.29\, \Delta G^{Be} + 0.17\, \Delta rl_{-1}^{Be}$$
$$(3.45)\quad (0.15)\quad (0.06)\quad (0.16)\quad (0.15)\quad (0.17)$$
$$+ 0.17\, \Delta\lambda^{BeNl} + 0.13\, \Delta Y^{Ge} + 0.47\, \Delta Y^{Fr} + 0.40\, \Delta Y^{Nl} + 0.026\, DUM\,7576 + 0.006\, time$$
$$(0.08)\quad (0.15)\quad (0.23)\quad (0.18)\quad (0.01)\quad (0.002)$$
$$\overline{R} = 0.80 \quad SE = 0.09 \quad t(\hat{\rho}) = -0.97$$

Germany

$$\Delta Y_t^{Ge} = -6.30 - 0.37\, Y_{-1}^{Ge} + 0.22\, G_{-1}^{Ge} - 0.33\, rl_{-1}^{Ge} + 0.51\, \Delta G^{Ge} - 0.42\, \Delta rl_{-1}^{Ge} + 0.26\, \Delta Y^{Us}$$
$$(2.16)(0.14)\quad (0.08)\quad (0.21)\quad (0.10)\quad (0.19)\quad (0.10)$$
$$+ 0.52\, \Delta Y^{Fr} + 0.09\, \Delta Y^{Ja} + 0.03\, \Delta\lambda^{GeUsl} + 0.031\, DUM\,7475 + 0.004\, time$$
$$(0.19)\quad (0.12)\quad (0.02)\quad (0.015)\quad (0.002)$$
$$\overline{R} = 0.82 \quad SE = 0.08 \quad t(\hat{\rho}) = -0.32$$

France

$$\Delta Y_t^{Fr} = -5.16 - 0.11\, Y_{-1}^{Fr} + 0.03\, G_{-1}^{Fr} - 0.33\, rl_{-1}^{Fr} + 0.12\, \Delta G^{Fr} + 0.28\, \Delta Y^{Uk} + 0.16\, \Delta Y^{Ge}$$
$$(2.53)(0.06)\quad (0.06)\quad (0.14)\quad (0.14)\quad (0.11)\quad (0.10)$$
$$+ 0.10\, \Delta\lambda^{FrGe} + 0.06\, \Delta\lambda^{FrUk} + 0.023\, DUM\,7475 + 0.003\, time$$
$$(0.04)\quad (0.03)\quad (0.010)\quad (0.02)$$
$$\overline{R} = 0.82 \quad SE = 0.06 \quad t(\hat{\rho}) = -0.73$$

UK

$$\Delta Y_t^{Uk} = -12.6 - 0.32\, Y_{-1}^{Uk} + 0.04\, G_{-1}^{Uk} - 0.17\, rs_{-1}^{Uk} + 0.05\, \Delta G^{Uk} - 0.08\, \Delta rs_{-1}^{uk} + 0.09\, \Delta\lambda^{UkGe}$$
$$(5.61)(0.13)\quad (0.05)\quad (0.13)\quad (0.07)\quad (0.08)\quad (0.04)$$
$$+ 0.61\, \Delta Y^{Fr} + 0.36\, \Delta Y^{Us} + 0.02\, DUM\,7475 + 0.008\, time$$
$$(0.24)\quad (0.36)\quad (0.02)\quad (0.004)$$
$$\overline{R} = 0.68 \quad SE = 0.15 \quad t(\hat{\rho}) = -0.34$$

Italy

$$\Delta Y_t^{It} = 0.64 - 0.11\, Y_{-1}^{It} + 0.06\, G_{-1}^{it} + 0.07\, \Delta G^{It} - 0.45\, \Delta rl_{-1}^{It} + 0.34\, \Delta Y^{Fr} + 0.06\, \Delta Y^{Us}$$
$$(0.49)(0.08)\quad (0.05)\quad (0.08)\quad (0.08)\quad (0.22)\quad (0.11)$$
$$+ 0.02\, \Delta\lambda^{ItUs} + 0.07\, \Delta\lambda^{GeIt}$$
$$(0.02)\quad (0.07)$$
$$\overline{R} = 0.46 \quad SE = 0.27 \quad t(\hat{\rho}) = 0.59$$

Nederlands

$$\Delta Y_t^{Nl} = -3.00 - 0.20\, Y_{-1}^{Nl} + 0.10\, G_{-1}^{Nl} - 0.31\, rl^{Nl} + 0.35\, \Delta G^{Nl} + 0.25\, \Delta rl_{-1}^{Nl} + 0.25\, \Delta Y^{Ge}$$
$$(2.41)(0.11)\quad (0.06)\quad (0.24)\quad (0.13)\quad (0.13)\quad (0.13)$$
$$+ 0.27\, \Delta Y^{Fr} + 0.46\, \Delta Y^{Be} + 0.21\, \Delta\lambda^{NlBe} + 0.13\, \Delta\lambda^{NlGe} + 0.02\, \Delta\lambda^{NlUs} + 0.002\, time$$
$$(0.26)\quad (0.18)\quad (0.07)\quad (0.12)\quad (0.02)\quad (0.002)$$
$$\overline{R} = 0.83 \quad SE = 0.08 \quad t(\hat{\rho}) = -0.57$$

USA

$$\Delta Y_t^{Us} = -7.36 - 0.50\, Y_{-1}^{Us} + 0.21\, G_{-1}^{Us} - 0.26\, rs_{-1}^{Us} + 0.31\, \Delta G^{Us} - 0.38\, \Delta rs_{-1}^{Us} + 0.39\, \Delta Y_{-1}^{Us}$$
$$(5.11)(0.18) \quad (0.12) \quad (0.21) \quad (0.23) \quad (0.24) \quad (0.15)$$
$$+ 0.33\, \Delta Y^{Ge} + 0.006\, time$$
$$(0.17) \quad (0.003)$$
$$\overline{R} = 0.64 \qquad SE = 0.19 \qquad t(\hat{\rho}) = 2.03$$

Japan

$$\Delta Y_t^{Ja} = 0.52 - 0.12\, Y_{-1}^{Ja} + 0.09\, G_{-1}^{Ja} + 0.42\, \Delta Y^{Ge} + 0.06\, DUM\,7475$$
$$(0.22)(0.05) \quad (0.04) \quad (0.17) \quad (0.02)$$
$$\overline{R} = 0.73 \qquad SE = 0.29 \qquad t(\hat{\rho}) = 0.79$$

[a]The real exchange rate between two countries, eg Belgium and the Nederlands in the first equation, λ^{BeNl} is defined as $E + P^{Nl} - P^{Be}$, where E is the exchange rate between belgiumand the Nederlands, defined as the amount of Belgian francs for one Dutch guilder. The real long-term interest rate is defined as $rl_{-1} = RL_{-1} - \Delta P_y$ and the real short-term rate as $rs_{-1} = RS_{-1} - \Delta P_y$

value in the years 1963-91. The simulation is carried out with fixed real interest rate. The results are shown in Table 4. First, the four countries, Germany, France, Italy and the UK are presented, as listed in Whitley's paper (1992). The outcomes of our model are presented under the heading SLIM. At the end of Table 4 we have listed the results for the other countries of our model. In our model, expanding *G* raises aggregate demand/output. This rise in output will raise prices, wages and employment. In most countries, the long-term interest rate depends on the consumer price inflation which implies that that the long-term interest rate also increases for those countries (tightening monetary policy).

In all simulations output increases and almost all results show in year 6 an effect which is higher than 0.3. Exceptions are the OECD model of Germany, the GEM model in the UK and Ireland in the SLIM model. In our model the effect of a 1% increase of government expenditure is highest in the three major economies, Germany, USA and Japan. Weak responses are found for France, the UK and Italy. A negative effect in Year 5 and 6 is found for Ireland. This effect is easy to explain if we go back to the estimation result of this equation. Ireland is the only country where we could not find any evidence of a positive effect of the level variable *G*. This aspect clarifies that there is, even, an undershooting effect of the baseline in year 5 and 6. Simulation shows that in the long run this effect will peter out and become zero for GDP in Ireland. A possible explanation for this result might be that the Irish economy has done relatively well in the second half of the 1990s in spite of considerable fiscal consolidation. The zero effect in year 1 of GDP in Denmark and Japan is explained by the fact that we could not find a significant effect of ΔG in our estimated equation. In all countries, except Ireland, output will be raised permanently, because the level variable *G* occurs in the GDP equation. The development of prices looks adequate and more or less coincides with the findings of the large models. If we compare for each country the ratio of GDP price response and GDP response we find in our model relatively high figures for Italy and France.

(ii) **Monetary Shock**:

A 1% nominal short-term interest rate shock. The nominal short-term interest rate is raised by 1% point, throughout the period 1963-91. The results of this experiment are shown in Table 5. If we look at our estimated results, we see that a rise in the nominal short-term interest rate directly affects output in the UK, Ireland and the USA. In the other countries the influence of short-term nominal interest rates on output is indirect. A rise in the nominal short-term interest rates raises the long-term interest rate and this affects output. In our model, as in most large multicountry models, a rise in the nominal short-term interest rates lowers output. If we look at the responses on output we find, with the exception of France in year 6, figures which are between 0 and –1. The differences between the countries are modest and certainly not as large as in the government expenditure experiment. We find no effect at all for Japan, because interest rate were not included in the GDP equation for Japan.

In general the effect on price is ambiguous in the first three years and negative in years 5 and 6. An outlier is again Ireland, which has a positive price development. The reason for this can be found in the GDP inflation equation for Ireland, where we found a very strong negative effect of the change in output minus output trend. The UK starts initially with an overshooting effect, but in the long-run the effects on prices are negative. The positive effect in the short-run can be traced back to the wage equation where we found a strong negative effect of a change in lagged labour productivity. Note that in most cases the values in year 6 cannot be interpreted as long-run values, because most effects have not settled down after year 6. Remark that also for the large multicountry models there is no clear evidence that a rise in the nominal interest rate should lower prices. For all the four major EU economies, there is at least one model which predicts a rise in prices.

(iii) **Internatinal Linkages**: A case of a fiscal shock USA

In Table 6 we show the results of a fiscal shock in the USA and compare them with the outcomes of the large-scale models. It is remarkable that economies in our model show cyclical behaviour in the GDP, which is due to the cyclical output response of the USA. In our model , the first year effect of an increase in government expenditure in the USA on the foreign countries lies between 0.12% and 0.46% of USA GDP-output. The UK profits most, and Italy least.

The development of the prices is qualitatively also comparable with the outcomes of the other models. Most price responses are lower than 1% in year 6 which is explained by the low output response in the medium term, which suppresses the price development.

Table 4 Fiscal shock single country simulations, and increase of government expenditure by 1% of GDP, and fixed interest rates.

	Year1	Year3	Year5	Year6	Year1	Year3	Year5	Year6
GDP					GDP prices			
Germany								
DIW/QUEST	1.61	0.83	0.63	0.75	0.03	1.17	1.83	1.98
GEM	0.87	0.62	0.57	0.56	0.06	0.35	0.52	0.58
OECD	0.60	0.18	0.10	0.05	0.55	1.37	2.00	2.17
OEF	0.77	0.80	0.77	0.72	0.34	0.92	1.06	1.07
MIMOSA	1.07	0.90	0.66	0.61	0.14	0.90	1.60	1.92
SLIM	1.82	1.44	1.36	1.43	-0.01	0.83	1.21	1.35
France								
DIW/QUEST	1.50	1.74	1.48	1.40	-0.55	-0.58	-0.12	0.05
GEM	0.58	0.63	0.62	0.61	0.14	0.32	0.54	0.63
OECD	0.50	0.87	0.82	0.71	0.19	0.68	1.29	1.59
OEF	0.98	1.02	0.96	0.89	-0.24	0.25	0.86	1.20
MIMOSA	1.04	1.13	1.10	1.09	-0.13	-0.20	-0.02	0.14
SLIM	0.40	0.34	0.33	0.33	0.08	0.33	0.65	0.77
Italy								
DIW/QUEST	1.20	1.11	0.86	0.85	-0.10	1.48	2.74	3.12
GEM	0.48	0.57	0.56	0.53	0.06	0.30	0.50	0.60
OECD	0.73	0.53	0.47	0.48	0.30	0.89	1.10	1.12
OEF	1.17	0.97	0.75	0.67	0.47	1.70	2.26	2.42
MIMOSA	1.07	1.41	1.34	1.28	0.03	0.39	1.49	2.22
SLIM	0.21	0.47	0.65	0.71	0.10	0.73	1.67	2.18
UK								
DIW/QUEST	1.41	1.17	1.03	1.17	-0.08	1.03	1.58	1.61
GEM	0.50	0.34	0.27	0.29	0.09	0.68	0.89	0.88
OECD	0.55	0.73	0.47	0.45	0.16	1.04	1.94	2.21
OEF	0.98	1.50	1.24	1.18	0.29	1.72	3.01	3.10
MIMOSA	0.79	0.73	0.57	0.46	0.28	0.84	1.30	1.48
SLIM	0.18	0.29	0.31	0.31	-0.10	0.09	0.30	0.38
SLIM								
Belgium	1.10	1.05	1.02	1.00	0.12	1.10	1.65	1.82
Denmark	0.00	0.77	1.02	1.03	0.00	0.02	0.78	1.35
Ireland	0.71	0.05	-0.21	-0.07	-0.22	-0.05	0.14	0.11
Nederlands	1.13	0.96	0.87	0.86	0.00	0.61	1.06	1.24
USA	1.23	1.89	1.35	1.27	0.00	0.51	1.13	1.38
Japan	0.00	0.94	1.59	1.88	0.00	0.35	1.13	1.51

Table 5 Monetary shock single country simulations: shock of 1% rise in the nominal short-term interest rate for 6years (percentage difference from base)

	Year1	Year3	Year5	Year6	Year1	Year3	Year5	Year6
GDP					GDP prices			
Germany								
DIW/QUEST	-0.18	-0.92	-0.55	0.36	0.00	-0.19	-0.76	-0.93
GEM	-0.24	-0.99	-1.37	-1.50	-0.01	-0.25	-0.65	-1.22
OECD	-0.50	-0.42	-0.64	-0.53	-0.32	-1.59	-1.87	-1.83
OEF	-0.28	-0.50	-0.64	-0.71	-0.08	-0.32	-0.05	0.16
MIMOSA	-0.38	-0.71	-0.68	-0.65	0.07	0.18	0.36	0.51
SLIM	0.00	-0.44	-0.50	-0.48	0.00	-0.07	-0.27	-0.35
France								
DIW/QUEST	-0.19	-0.50	-0.52	-0.53	0.06	0.20	0.16	0.14
GEM	-0.09	-0.36	-0.52	-0.58	-0.02	-0.14	-0.30	-0.40
OECD	-0.31	-0.47	-0.58	-0.61	-0.04	-0.13	-0.12	-0.07
OEF	-0.03	-0.07	-0.06	-0.06	0.01	-0.01	-0.05	-0.07
MIMOSA	-0.21	-0.21	-0.20	-0.20	0.12	0.24	0.28	0.27
SLIM	0.00	-0.36	-0.81	-1.03	0.00	-0.11	-0.52	-0.88
Italy								
DIW/QUEST	-0.08	-0.29	-0.10	-0.12	0.00	-0.15	-0.44	-0.49
GEM	-0.07	-0.54	-0.88	-0.99	0.00	-0.15	-0.46	-0.65
OECD	-0.07	-0.48	-0.62	-0.73	0.06	0.08	0.17	0.23
OEF	-0.12	-0.52	-0.66	-0.74	-0.02	-0.50	-0.67	-0.53
MIMOSA	0.06	0.14	0.17	0.18	0.07	0.56	1.30	1.70
SLIM	0.00	-0.20	-0.36	-0.23	0.00	-0.35	-1.04	-1.24
UK								
DIW/QUEST	-0.07	-0.41	-0.29	-0.25	0.00	-0.07	-0.37	-0.42
GEM	-0.20	-0.77	-0.89	-0.87	-0.02	-0.60	-1.60	-2.00
OECD	-0.20	-0.61	-0.56	-0.57	-0.05	-0.52	-0.84	-0.70
OEF	-0.26	-1.17	-1.42	-1.36	-0.01	-0.34	-1.28	-1.69
MIMOSA	-0.02	-0.05	-0.05	-0.07	0.07	0.33	0.64	0.78
SLIM	0.00	-0.43	-0.53	-0.55	0.00	0.06	-0.31	-0.49
SLIM								
Belgium	0.00	-0.25	-0.60	-0.73	0.00	-0.07	-0.41	-0.65
Denmark	0.00	-0.15	-0.24	-0.26	0.00	0.00	-0.15	-0.27
Ireland	0.00	-0.53	-0.65	-0.60	0.00	0.18	0.25	0.20
Nederlands	0.00	-0.10	-0.33	-0.45	0.00	0.00	-0.09	-0.18
USA	0.00	-0.99	-0.62	-0.46	0.00	-0.12	-0.44	-0.55
Japan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6 USA fiscal shock government spending: shock of +2% of GDP rise in government expenditure, fixed real interest rate (percentage difference from base)

	Year1	Year3	Year5	Year6	Year1	Year3	Year5	Year6
GDP					GDP prices			
Germany								
DIW/QUEST	0.42	0.62	0.37	0.47	0.01	0.40	0.99	1.18
GEM	0.42	0.26	0.15	0.14	0.00	0.28	0.58	0.73
OECD	0.31	0.14	0.13	0.13	0.34	1.13	2.34	3.06
OEF	0.21	0.63	0.77	0.80	0.01	0.31	0.70	0.92
MIMOSA	1.12	0.74	0.76	1.06	0.06	0.92	1.57	1.98
SLIM	0.87	0.42	-0.20	-0.14	0.00	0.45	0.44	0.36
France								
DIW/QUEST	0.27	0.61	0.44	0.47	-0.10	-0.13	0.22	0.30
GEM	0.14	0.13	0.09	0.09	0.04	0.35	0.69	0.85
OECD	0.14	0.22	0.27	0.29	0.11	0.54	1.30	1.83
OEF	0.08	0.23	0.28	0.29	0.05	0.40	0.77	0.97
MIMOSA	0.88	0.75	0.91	1.17	-0.12	0.18	0.79	1.28
SLIM	0.42	0.19	-0.20	-0.20	0.07	0.40	0.77	0.82
Italy								
DIW/QUEST	0.26	0.54	0.40	0.40	-0.01	0.42	1.23	1.51
GEM	0.16	0.18	0.19	0.20	0.07	0.35	0.62	0.77
OECD	0.24	0.10	0.09	0.06	0.16	0.78	1.65	2.22
OEF	0.09	0.24	0.24	0.20	0.02	0.40	0.94	1.23
MIMOSA	0.69	0.74	0.79	1.00	-0.34	0.05	0.95	1.46
SLIM	0.28	0.21	-0.02	-0.02	0.14	0.80	1.09	1.08
UK								
DIW/QUEST	0.23	0.32	0.10	0.21	-0.04	0.33	0.85	0.95
GEM	0.17	0.01	-0.08	-0.04	0.05	0.79	1.32	1.47
OECD	0.24	0.33	0.30	0.34	0.08	0.67	1.46	1.92
OEF	0.11	0.48	0.66	0.71	-0.02	0.43	1.15	1.43
MIMOSA	0.38	0.54	0.79	0.94	-0.10	0.13	0.79	1.27
SLIM	1.18	0.62	-0.23	-0.18	-0.67	0.95	1.25	0.85
USA								
DIW/QUEST	4.07	2.38	2.34	2.51	0.05	2.59	4.10	5.00
GEM	1.62	1.23	1.03	0.98	0.52	1.72	2.62	2.98
OECD	1.80	1.20	1.07	0.90	0.83	2.84	5.25	6.40
OEF	2.83	3.55	3.20	3.00	0.01	0.63	1.56	1.92
MIMOSA	4.97	4.58	4.99	5.35	0.22	3.57	9.23	12.94
SLIM	2.43	3.76	2.68	2.52	0.00	1.01	2.23	2.74
SLIM								
Belgium	0.54	-0.17	-0.31	-0.12	0.06	0.44	0.19	0.10
Denmark	0.73	-0.13	-0.41	-0.20	-0.15	0.53	0.80	0.61
Ireland	0.51	0.39	-0.40	-0.30	-0.24	0.24	1.00	0.89
Nederlands	0.60	-0.13	-0.40	-0.19	-0.02	0.52	0.57	0.45
Japan	0.37	0.09	-0.17	-0.12	0.06	0.34	0.23	0.09

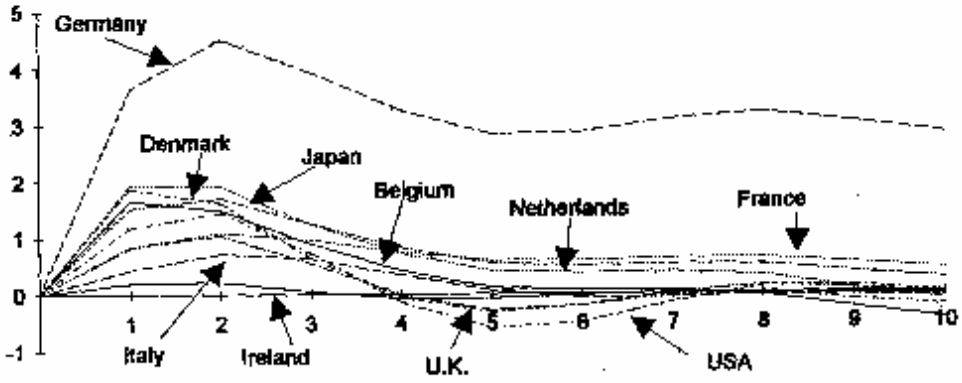

Fig. 1. Output responses after German government expenditure shock.

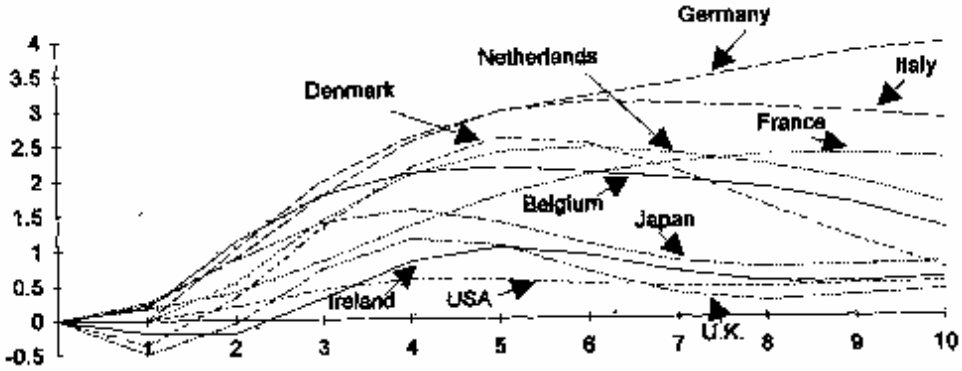

Fig. 2. GDP price responses after German government expenditure shock.

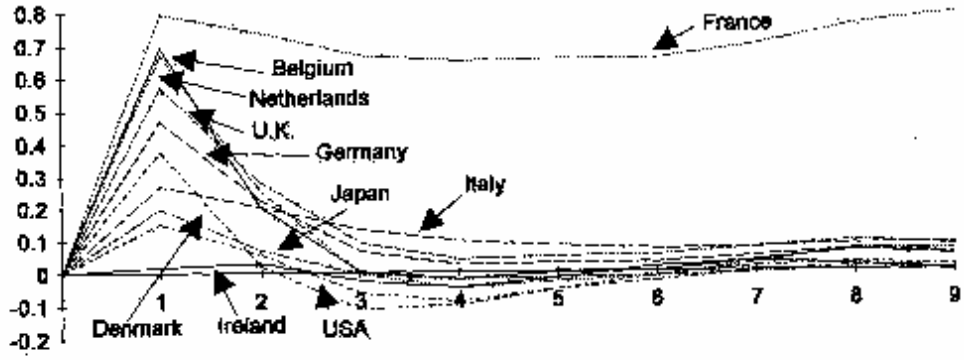

Fig. 3. Output responses after a French government expenditure shock.

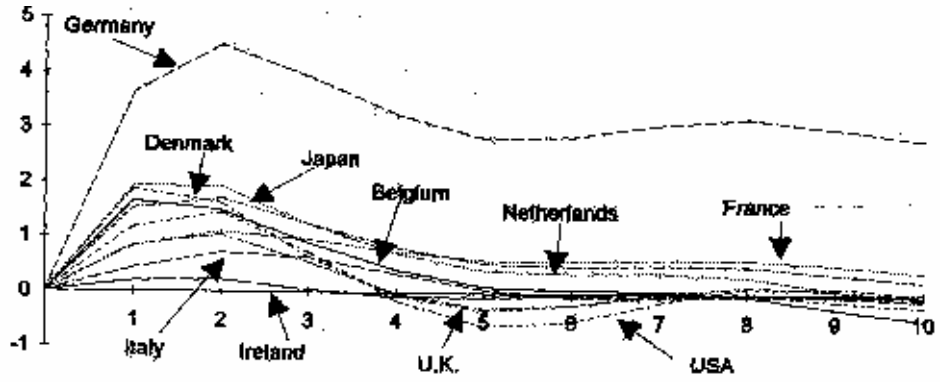

Fig. 1. Output responses after German government expenditure shock.

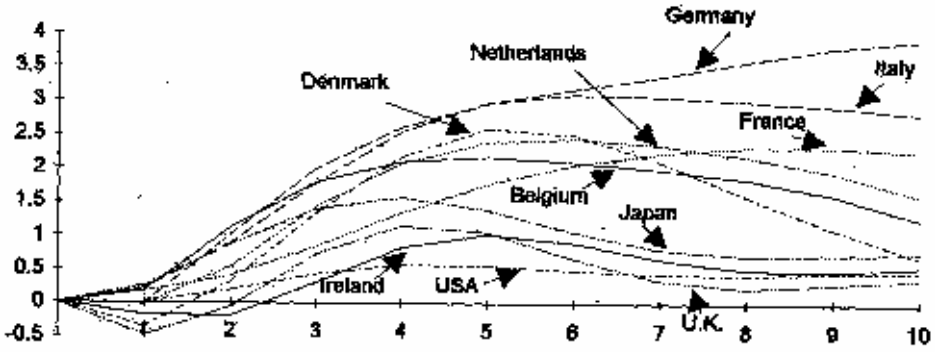

Fig. 2. GDP price responses after German government expenditure shock.

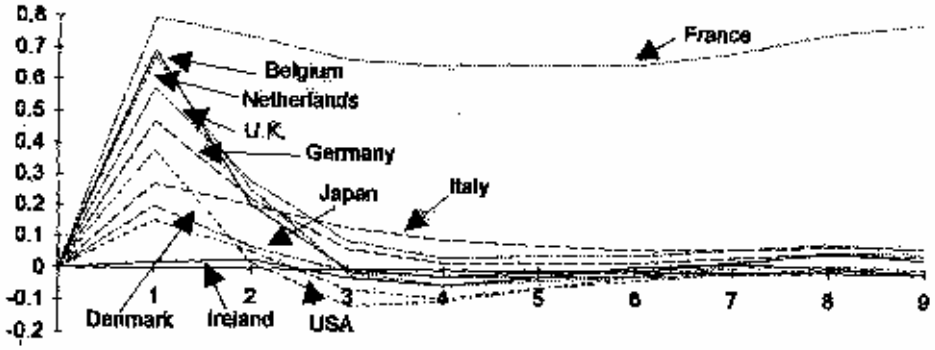

Fig. 3. Output responses after a French government expenditure shock.

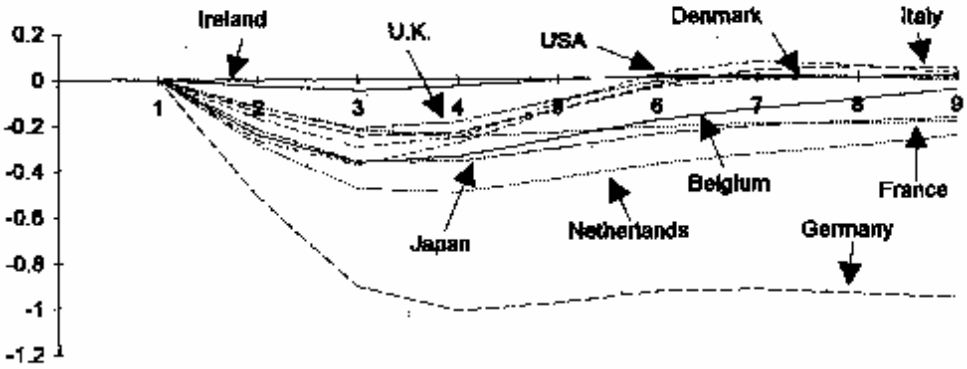

Fig. 4. Output responses after an increase in the German short term interest rate.

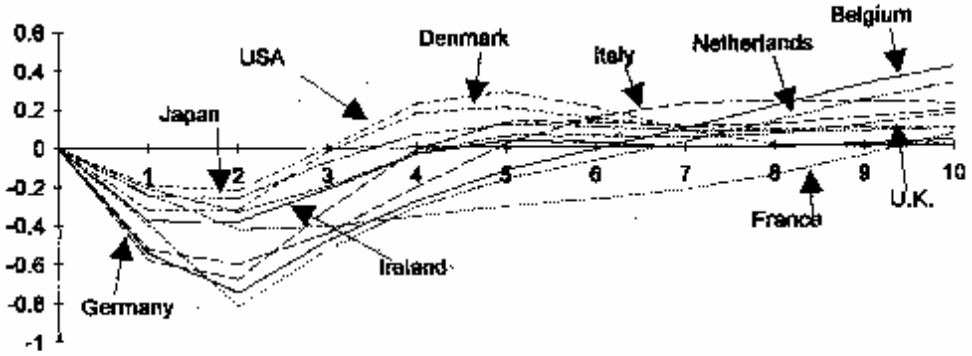

Fig. 5. Output responses after a depreciation of the US Dollar by 10% against all currencies.

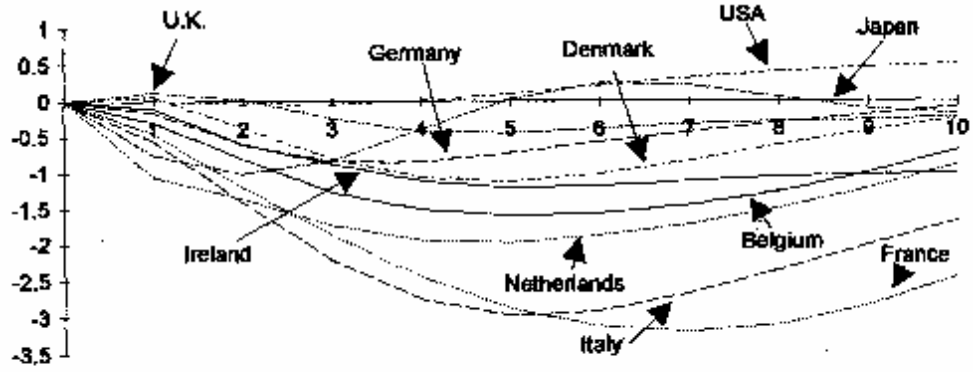

Fig. 6. GDP price responses after a depreciation of the US Dollar by 10% against all currencies.

5. How about the situation after we have the ECB? Some recent research

Monetary union is a hot topic, to which many economists pay attention, especially after the European Central Bank and Euro launch successfully. Here we just concentrate on issues closely related to macroeconomic policy coordination.

(i). **European Central Bank (ECB) and its monetary policy**

It seems that ECB may not totally give up the Bundesbank style (monetary targeting) to get the reputation of anti-inflation.[3] On the other hand, some "outs" have adopted the inflation targeting as its monetary policy rule.[4] That is, all "ins" loose the monetary independence but still care about other targeting variables, such as inflation, output gap, unemployment, and government spending; the ECB has the right to direct the single monetary policy to control inflation, output gap, unemployment, money growth, and exchange rate stability. Alternatively, "outs" have similar economic structures to the EUM members have, and still have their independent monetary policies to achieve their own targets. Readers are invited to check recent work by Svensson (2000a, b), Ball (1999, 2000), Aksoy (2000), Nadal De-Simone (1997) about inflation targeting and monetary policy of the ECB.

(ii) **Fiscal and monetary policies coordination between authorities and ECB**

It is not an easy task to find recent empirical evidence about the policy coordination after the EUM launches because of the data limitation, the literatures discuss the issue of policy coordination using different approaches. Cecchetti et al. (2000) study price level convergence among United States cities, which could be a reference for the ECB. D'Amico (1999) discusses convergence of interest rate in post-Euro era, another important condition for the EMU. From the 1980s the dynamic game approach becomes a popular method to analyze the interaction among different policy-makers, which is still realistic after the EMU starts in 1999. A series of work, including Miller and Salmon (1985), Currie and Levine (1985), Levine and Brociner (1994), Douven and Plasmans (1996a, b), Engwerda (1998, 2000), Engwerda and Douven (1996), Engwerda et al. (1999, 2001), Weeren (1995), and Van Aarle et al. (2000, 2001), explore the convergence issues of the EMU using a dynamic game approach extended by Başar and Olsder (1999). The dynamic game approach should be also appropriate in Asian situation because of the fact of the so-called "decentralized" policy decisions.

6. Conclusion

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[3] See Svensson (2000b).

[4] For instance, the United Kingdom and Sweden.

In this paper we presented SLIM, a small linear interdependent model of EU economies, the USA and Japan. Through shock analysis our model is compared with five multicountry models as operating in 1992 at several EU institutions. With our simple linear model, it is possible to generate (more or less) the same outcomes of some of the main key macroeconomic variables as modelled in large multicountry models. Here we summarize country specific arguments, which appear to be striking in our model:

(i) An expansion domestic fiscal policy seems to be favourable for the larger economies, the USA, Japan and Germany.

(ii) The effect of a monetary expansion on price is negative in all countries, except for the price responses in the UK and Ireland, which are slightly positive in the short run.

(iii) The small open economies Belgium, Denmark, the Nederlands profit most from a shock originating in Germany. Belgium, the Nederlands and the UK profit most from a shock originating in France.

(iv) A fiscal expansion in the USA has a large effect on the UK and Germany output and a small effect on the Italian output, but a large effect on Italian prices.

Note that the model with small size and linearity we present in this paper is useful for the dynamic game applications (See Section 5), a popular approach to research the future policy coordination of the ECB.

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