Fiscal Spillovers and Trade Relations in Europe[1]

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This paper explores the impact of openness, as measured by import penetration, on the size and duration of fiscal multipliers and spillovers across European Union members. The analysis is embedded in a macroeconomic model, NiGEM, to capture structural differences across countries, time and policy regimes. Panel estimation with PMG and CCE techniques is used to estimate trade relations. Our analysis indicates that fiscal multipliers and spillovers depend crucially on structural assumptions about policy and the formation of expectations. Fiscal policy has limited effects on the economies of Europe, and that the case for fiscal policy coordination is weak except in the short run. The case for coordination rests on spillovers which are likely to become ever smaller as financially liberalisation continues.

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Introduction

When countries undertake unilateral fiscal expansions output generally rises, and the impacts can be scaled by the multiplier (impact on GDP of a 1% of GDP impulse). Unilateral fiscal expansions have effects outside the home country, or spillovers. Arguments in favour of the international coordination of economic policies rest on the existence of spillovers, or externalities, between countries. If these spillovers are large, then there is a good case for coordinated action to deal with market failure. Our objective in this paper is to look at the channels through which fiscal policy changes in one country affect outcomes in another. The different approaches used by others to study spillovers between countries vary from purely theoretical General Equilibrium models lightly calibrated on data to reduced form and structural Vector Autoregressions (VARs) that summarise succinctly what happened in the past. The former makes untested assumptions about the world, whilst the latter fails to account fully for recent or expected changes in the structure of the economy. We choose to evaluate the scale of spillovers in a structural model that allows us to investigate the factors that affect their size. We examine the scale and duration of multipliers and spillovers in the context of varying monetary policy arrangements and in the presence of forward looking consumers.

The analysis presented here indicates that fiscal multipliers and spillovers change over time and these changes are related to the European integration process. Policy actions in one country affect the rest of the world through trade linkages and changes in exchange and interest rates associated with the response of financial markets. The size of multipliers and spillovers depends partly on trade patterns and exhibits strong correlation with measures of openness. European integration has intensified the role of policy spillovers within the EU, and especially within the Euro Area, because some of the normal shock absorbers have been removed by the formation of the common currency. The agreements on fiscal policy limit certain sorts of spillovers between members of the monetary union. Besides the European integration process, trade liberalisation and the resulting growth of import penetration and changes in export shares across countries, as well as financial market integration impact the magnitude and duration of fiscal spillovers.

Given that trade relationships are central to the nature of spillovers, we investigate the factors determining both exports and imports in the European Union, using panel data analysis. We present estimates of import and export relationships for a panel of 13 EU economies under three sets of assumptions. We first estimate single country equations,

allowing all parameters to vary across countries. Point estimates in single country estimation may suggest heterogeneity in country behaviour that is not statistically significant, particularly as regarding the price elasticity of exports. To abstract from this, our second set of estimates use panel data techniques to test for a common structure across countries. We compute Pooled Mean Group (PMG) estimates (see Pesaran, Shin and Smith (1999) and Pesaran and Smith (1995)), which allow us to derive an acceptable set of cross equation restrictions and identify significant differences in country behaviour. In our final set of estimates, we take account of unobservable factors that lead to Common Correlated Effects (CCE) errors using cross section means, as developed by Pesaran (2006).

Given the multitude of factors that impact the fiscal multipliers and spillovers across countries and over time, we embed the three sets of econometric estimates into a structural model, NiGEM. As a New Keynesian/DSGE model. NiGEM is structured around the national income identity and can accommodate forward looking consumer behaviour. Unlike a pure DSGE model, NiGEM is based on estimation using historical data, and thus strikes a balance between theory and data.

Although New Keynesian and DSGE models are frequently assumed to be the same, they incorporate distinct approaches which affect the underlying size and structure of fiscal impulses studied here. New Keynesian models involve few equations, estimated in a VAR and specified in logarithms. They describe output, price formation, the monetary feedback rule, the trade balance and the exchange rate and include forward looking behaviour. DSGE models are based on the national income identity, which links the optimising behaviour of individuals. In New Keynesian models, fiscal multipliers are inherently constant over time unless the parameters of the model are forced to be time dependent. DSGE models link logarithmic equations through linear identities, and hence multipliers do not directly link to parameters. The DSGE model can be seen as a more accurate description of the world, in that the multipliers can vary over time without any time variation in the estimated behavioural parameters of the model. In particular, increased openness reduces multipliers in a DSGE model, which corroborates past experience. Analyses of fiscal multipliers, such as those by Pesaran and Smith (2006) are based on New Keynesian models, in that conclusions are based on constant multipliers and spillovers, which represent the average of the data period used. This constancy may be misleading. We argue that multipliers have been falling over time and spillovers may also have been rising because European economies have become more linked through the

process of European integration. Such analysis cannot be carried out in VAR based models, which do not incorporate time varying structure-dependant fiscal multipliers.

We undertake a series of simulation experiments using our new trade equations in the NiGEM model to evaluate the differences produced by the alternative estimation techniques. Recovered estimates of policy spillovers between Euro Area economies inform the investigation of the impacts of unilateral versus coordinated fiscal policy moves. As much of the direct impact of spillovers comes from trade linkages, new equation estimates allow a more accurate understanding of behaviour within the Euro Area. The structural set up of NiGEM permits the analysis of policy feedbacks in scaling multipliers. As importantly, we examine whether and how potential changes in structure, such as an increase in forward looking behaviour, would change multipliers.

The rest of the paper is presented as follows. In Part I we provide an overview of the macroeconomic model, NiGEM, underlying our policy scenarios. In Part II we discuss in detail the structure of the trade equations, the estimation techniques adopted and the estimation results. In Part III we present the simulation results and contribute to the debate on fiscal spillovers. Conclusions can be found in Part IV.

Part 1. Overview of NiGEM

NiGEM is an estimated model, which uses a 'New-Keynesian' framework in that agents are presumed to be forward-looking but nominal rigidities slow the process of adjustment to external events. Most countries in the OECD are modeled separately. The rest of the world is modeled through regional blocks: Latin America, Africa, East Asia, Developing Europe, OPEC and a Miscellaneous group mainly in West Asia. All models contain the determinants of domestic demand, export and import volumes, prices, current accounts and net assets, and the OECD countries are more complex than those of the non-OECD countries.

Spillages and linkages in NiGEM take place through trade and competitiveness, interacting financial markets and international stocks of assets. The model is homogeneous in exchange rates, and exports demand equals imports across the world. Competitiveness acts as an important stabilising feedback on the model, as shifts in the domestic price level or exchange rate feed into relative trade prices, allowing net trade to offset shifts in domestic demand. There are also links between countries in their financial

markets as the model describes the structure and composition of wealth, emphasizing the role and origin of foreign assets and liabilities as well as the distinction between equity, bond and bank based assets, all of which are covered. Equilibrium output depends on the production function underlying the model, and the output gap is the deviation of actual from equilibrium output.

Most of the models of the OECD countries, including all those used in this paper, are more detailed than the other country and regional models. The core of each of these country models consists of a production function determining output in the long term; a wage-price block; a description of the government sector; consumption, personal income and wealth; international trade; and financial markets. We use a dynamic error-correction structure on the estimated equations, which allows the model to adjust gradually towards equilibrium in response to a shock. In some cases the speed of adjustment will depend on expectations as well as distance from equilibrium.

The NiGEM model allows forward-looking expectations in wages, consumption, exchange rates and equity prices. We assume forward-looking behaviour by default in most cases, except in the case of consumption where the evidence of forward-looking behaviour is less clear. Bond prices affect wealth and depend on long-term interest rates, which are the forward convolution of short-term interest rates, and equity prices, which depend on expected future profits, also affect wealth. A solution method is, therefore, needed that allows us to solve for their current and future values. We use the Extended Path Method of Fair and Taylor to obtain values for the future and current expectations and iterate along solution paths. Expectations are repeatedly recalculated until convergence is achieved. The model is solved far enough into the future so that the results are not affected by the terminal date, and terminal conditions are standard.

In order for the model to be theoretically coherent, there must not be any financial 'black holes' to absorb imbalances. Every export must be matched by an import, all liabilities must be matched by assets, all income flows from assets matched by outflows on liabilities and current accounts must add up across the world (to the normal degree of discrepancy). The model should be approaching an asset equilibrium by the terminal date. This in turn requires that the stock of government debt does not explode, and this is ensured by the no Ponzi games condition we discuss below.

The structure of the trade block ensures overall global consistency of trade volumes by ensuring that the growth of import volumes is equal to the growth of export volumes at the global level. Trade volumes and prices are linked by Armington (1969) matrices that

depend on trade shares. Price weights for export competitors vary over time as the pattern of trade changes. The demand indicator in the export volume equation is based on 2000 trade patterns, and hence our multipliers and spillovers will depend on current or recent trade patterns rather than the average of the last thirty years. The export demand variable is constructed as a weighted average of other countries' imports, which ensures approximate balance, and any discrepancy is allocated to exports in proportion to the country's share of world trade. Import prices depend on a weighted average of global export prices, and this ensures that the ratio of the value of exports to the value of imports remains at around its historical level. World flows of property income balance because all assets are matched by liabilities, revaluations of liabilities match those of assets and income flows match payments.

For a macroeconometric model to be useful for policy analyses, particular attention must be paid to its long-term equilibrium properties. At the same time, we need to ensure that short-term dynamic properties and underlying estimated properties are consistent with data and well-determined. As far as possible the same theoretical structure has been adopted for each of the major industrial countries, except where clear institutional or other factors prevent this. As a result, variations in the properties of each country model reflect genuine differences in data ratios and estimated parameters, rather than different theoretical approaches. The behavioural equations have been mostly estimated individually, although key equations have been estimated in a panel framework.

Production and price setting

The major country models rely on an underlying constant-returns-to-scale CES production function with labour-augmenting technical progress.

$$Q = \gamma\left[s(K)^{-\rho} + (1-s)(Le^{\lambda t})^{-\rho}\right]^{-1/\rho} \qquad (1)$$

where is Q is real output, K is the total capital stock, L is total hours worked and t is an index of labour-augmenting technical progress. This constitutes the theoretical background for the specifications of the factor demand equations, forms the basis for unit total costs and provides a measure of capacity utilization, which then feed into the price system.

Demand for labour and capital is determined by profit maximisation of firms, implying that the long-run labour-output ratio depends on real wage costs and technical progress, while the long-run capital output ratio depends on the real user cost of capital:

$$Ln(L) = [c \ln\{\beta(1 - s)\} - (1 - c)\ln(\gamma)] + \ln(Q) - (1 - c)\lambda t - c \ln(w/p) \qquad (2)$$

$$Ln(K) = [c \ln(\beta s) - (1 - c)\ln(\gamma)] + \ln(Q) - c \ln(c/p) \qquad (3)$$

where w/p is the real wage and c/p is the real user cost of capital. The user cost of capital is influenced by the forward-looking real long-run interest rate, as well as by corporate taxes and depreciation. The user cost of capital variable is calculated from data for the past, but individual firms take account of risk on their investments when undertaking projects. The risk premium can be varied in scenarios and forecasts. Business investment is determined by the error correction based relationship between actual and equilibrium capital stocks, where the speed of adjustment, for instance in the US, depends on Tobin's Q. Housing investment depends on real disposable income and real interest rates, and government investment depends upon trend output and the real interest rate in the long run.

Prices are determined as a constant mark-up over marginal costs in the long term. Our core price equations related the producer price to the unit total cost function implied by our production function. Import prices also feed into producer prices, while consumer prices are determined by producer prices, import prices and unit labour costs. The price equations are all statically homogenous. Capacity utilisation is determined by the production function and if output is above capacity producer prices rise more rapidly.

Labour market

We assume that employers have a right to manage, and hence the bargain in the labour market is over the real wage. Real wages, therefore, depend on the level of trend labour productivity as well as the rate of unemployment. We assume that labour markets embody rational expectations and that wage bargainers use model consistent expectations. The equations are estimated within a stylized version of the bargaining framework of Layard *et al* (1991). The dynamics of the wage market depend upon the error correction term in the equation and on the split between lagged inflation and forward inflation as well as on the impact of unemployment on the wage bargain.

There is no explicit equation for sustainable employment in the model, but as the wage and price system is complete the model delivers equilibrium levels of employment and unemployment. An estimate of the NAIRU can be obtained by substituting the mark-up adjusted unit total cost equation into the wage equation and solving for the

unemployment rate[2]. The labour supply is determined by demographics and an exogenous participation rate.

Consumption, personal income and wealth

Consumption decisions are presumed to depend on real disposable income and real wealth in the long run, and follow the pattern discussed in Barrell and Davis (2007). Total wealth is composed of both financial wealth and tangible (housing) wealth where the latter data is available.

$$\ln(C) = \alpha + \beta \ln(RPDI) + (1 - \beta) \ln(RFN + RTW) \qquad (4)$$

where *C* is real consumption, *RPDI* is real personal disposable income, *RFN* is real net financial wealth and *RTW* is real tangible wealth. If we switch the model to forward-looking consumer behaviour, then we need to find a proxy for unobservable permanent income (the income stream from the net present value of human wealth). We assume that RPDI is a good indicator of permanent income in our long run estimation (although measured with error) and in some of our simulations we replace it with the variable for which it was a proxy. If incomes or interest rates change in the future in these specific simulations then the proxy variable will change and consumers will react to their permanent incomes[3]. Financial wealth depends on foreign and domestic equity and bond prices and on the accumulation of assets.

Where housing wealth is absent house prices play a separate role. The dynamics of adjustment to the long run are important in policy analysis and they are largely data based, and differ between countries to take account of differences in the relative importance of types of wealth and of liquidity constraints. Personal incomes are built up from components. Employment income comes from the labour market models. Taxes and transfers come from the public sector models. Rents, dividends and interest incomes are flows on the accumulated stocks of assets.

The evolution of gross financial assets and liabilities are modeled in the wealth blocks of the model. We have followed common modeling practice such as adopted by Masson *et al* (1990) and assume that the personal sector has ultimate ownership of all domestically held financial assets. Each country on the model has a stock of foreign assets and a stock of liabilities. These are linked to the stock of domestic financial assets and the stock of

[2] The labour market in NiGEM is discussed in more detail in Barrell and Dury (2003) and Barrell, Becker and Gottschalk (2004)

[3] This is of course an experimental convenience adopted to undertake one or two 'what if' experiments.

domestic private sector and public sector liabilities. A proportion of government debt is owned abroad, as are proportions of the national stock of equities and the stock of banking assets. Some national financial wealth is held in foreign equities and bonds as well as banks. Income flows from asset stocks are allocated in relation to ownership, and hence net property income from abroad depends on income receipts and payments on bonds, equity holdings and bank. The wealth and accumulation system allows for flows of saving onto wealth and for revaluations of existing stocks of assets in line with their prices determined as above. When foreign equity and bond prices change, domestically held assets change in value.

Financial markets

We generally assume that exchange rates are forward looking, and 'jump' when there is news. The size of the jump depends on the expected future path of interest rates and risk premia, solving an uncovered interest parity condition, and these, in turn, are determined by policy rules adopted by monetary authorities[4]:

$$RX(t) = RX(t-1)[(1+rh)/(1+ra)](1+rprx) \qquad (5)$$

where *RX* is the exchange rate, *rh* is the home interest rate, *ra* is the interest rate abroad and *rprx* is the risk premium. For the purposes of this paper it is assumed that the monetary authorities adopt a feedback rule the interest rate, r, of the form

$$r_t=\varphi_1(NOM_t/NOMT_t)+ \varphi_2(INF_t-INFT_t) \qquad (6)$$

where NOM is nominal GDP, NOMT is its target, INF is the inflation rate and INFT is the target. We use this rule because the ECB says that this is what it does. We assume that bond and equity markets are also forward looking, and long-term interest rates are a forward convolution of expected short-term interest rates. Forward looking equity prices are determined by the discounted present value of expected profits. The discount factor is made up of the nominal interest rate and the risk premium on equity holding decisions.

Public sector

Each country has a set of equations for the public sector. Both direct and indirect taxes depend upon their respective tax bases and on the tax rate. Government spending on current goods and services and investment spending depend in part on current plans, and by default rise with trend output. Transfer payments depend upon unemployment and the

[4] See Barrell and Dury (2000) for a discussion of monetary and fiscal policy rules in NiGEM.

dependency ratio as well as on policy. Government interest payments are determined by a perpetual inventory model based on the flow deficit and the stock of debt, with the appropriate structure of short and long-term interest payments on the debt stock.

Budget deficits are kept within bounds in the longer term through a targeted adjustment on income tax rates, much as described in Mitchell, Sault, and Wallis (2000)

$$Tax(t) = Tax(t-1) + \quad [GBR(t)^* - GBR(t)] \tag{7}$$

Where *Tax* is the direct income tax rate and *GBR* is the general government deficit as a share of nominal GDP and * denotes the targeted ratio. This simple feedback rule is important in ensuring the long run stability of the model. Another important feedback is related to the financing of the government deficit (BUD), which can be financed through either money (M) or bond finance (DEBT).

$$DEBT(t) = DEBT(t-1) - BUD(t) - \quad M(t) \tag{8}$$

The debt stock affects interest payments and forms part of private sector wealth. Without a solvency rule or a no Ponzi games assumption there is no necessary solution to a forward-looking model.

External trade

International linkages come from patterns of trade, the influence of trade prices on domestic price, the impacts of exchange rates and patterns of asset holding and associated income flows. The volumes of exports and imports of goods and services are determined by foreign or domestic demand, respectively, and by competitiveness as measured by relative prices or relative costs. The estimated relationships also include measures to capture globalization and European integration and sector-specific developments. It is assumed that exporters compete against others who export to the same market as well as domestic producers via relative prices; and demand is given by a share of imports in the markets to which the country has previously exported. Imports depend upon import prices relative to domestic prices and on domestic total final expenditure. As exports depend on imports, they will rise together in the model.

In this paper we discuss three approaches to modeling imports and exports in Europe. Each approach is then embedded into NiGEM to investigate spillovers and evaluate the gains from improved modeling techniques. We run a series of fiscal shocks in one

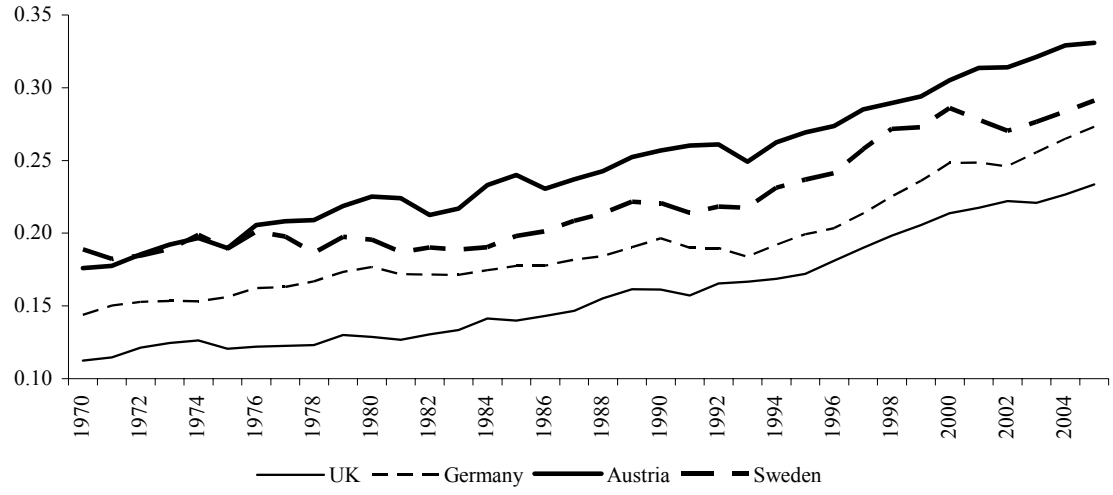
country at a time, and then in all Euro Area countries together, to look at multipliers and spillovers and also at coordinated versus unilateral fiscal policy. A fiscal expansion in one country affects export demand in its trading partners, affects interest rates and hence exchange rates if monetary authorities respond to the shock, and affects private sector wealth through its impact on debt and equity prices. So a fiscal expansion in Germany raises exports from Germany's main trading partners and raises foreign assets outside of Germany, but the expansionary impact with the Euro Area is offset by a rise in Euro Area interest rates and an appreciation of the euro relative to other currencies.

Part II: Estimating Trade Equations with different econometric techniques

In this section we discuss in detail the estimation of trade equations for European countries using a panel of 13 European Union countries. We highlight the changes in trade dynamics over the past several decades and explain the motivation for the chosen variable set. We test explicitly for common parameters across countries, constructing pooled mean group (PMG) estimates, and we extend our econometric analysis to allow for Common Correlated Effects (CCE) as in Pesaran, (2006) to obtain more precise parameter estimates. Following a comparison between coefficients obtains by OLS, PMG and CCE we find that CCE estimates perform best in NiGEM, although the estimates from all three methods yield similar results.

Chart II.1 Import Penetration in Select Countries

share of imports in total final expenditure

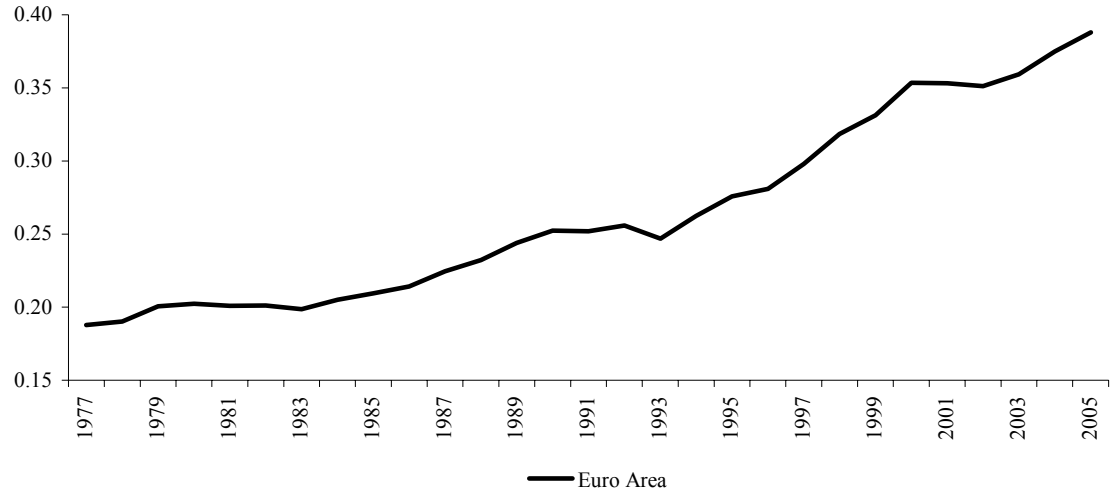


Sources: NiGEM database; authors' calculations

Patterns of trade and the degree of import penetration have changed noticeably over the last four decades. As can be seen in Chart 1, import penetration – defined as the ratio of import volumes over total final expenditure – has been rising broadly in a similar way over time, with smaller countries such as Austria and Sweden having higher levels of imports as a share of TFE than in the larger countries such as the UK or Germany. It is interesting to note that although Germany is (economically) larger than the UK it is more open. Import penetration has risen everywhere, as we can see from Chart II.2 which plots average imports into the Euro Area countries as a per cent of GDP, weighted together by country size.

Chart II.2 Average Import Penetration in the Euro Area

imports as share of Euro Area GDP



Sources: NiGEM database; authors' calculations

Several forces drove the changes in import penetration over the past several decades. A sequence of world trade liberalisation measures following the Kennedy, Tokyo, and Uruguay rounds reduced tariffs on goods and removed non-tariff barriers. European integration has deepened as the Common Market moved well beyond a free trade area to one where goods and factors are mobile, and competition rules and standards for production have become common to all countries. China embarked on a series of economic reforms which reduced non-tariff trade barriers and integrated China into the world economy. As importantly, rapid advancements in the Information and Communication Technology (ICT) industries changed the size and the production process of many traded goods. Light and highly portable goods are produced in long manufacturing 'strings' that do not need a common country location to link up together

into a production process (Arndt and Kierzkowsk, 2001). These processes have affected trade patterns since the 1970s.

As discussed above we model trade volume equations as demand relationships, where the total level of exports or imports depends on the level of a demand indicator for the relevant economies and on relative prices. This is the approach is developed for European trade equations in Barrell and te Velde (2002) who discuss standard macroeconomic demand relationships for estimating export and import volumes. We estimate both sets of equations in a panel of dynamic equilibrium corrections, with a long run embedded in an adjustment process.

The Armington approach to exports gives a structural demand equation where the goods produced in one country are imperfect substitutes for the goods produced elsewhere. We may write the long run equation as

$$XVOL = f(S, RPX) \quad (9)$$

where XVOL, the volume of exports of goods and services, depends on S, a country specific export market demand measure, and on RPX, export prices relative to prices in destination countries. The competitor group includes all exporters to the same market. Following Pain and Wakelin (1998), we assume the long run coefficient on S is equal to one, and thus equation (9) becomes a market share equation. However, estimating this equation freely we generally find that long run coefficient on the demand indicator is not one, with many European countries losing market share over the past several decades that cannot be fully explained by movements in relative export prices.

The widely used equivalent for imports can also be seen as a structural demand equation, with imported goods being imperfect substitutes for domestically produced goods. We may write the long run equation as

$$MVOL=g(TFE, RPM) \quad (10)$$

where MVOL is the volume of imports of goods and services, RPM is import prices relative to domestic prices and TFE is total final expenditure in the domestic economy. If one estimates simple relationships between TFE and import volumes one often finds that elasticities are high. Barrell and Dees (2005) estimate that the crude elasticity of imports

with respect to TFE in a large panel of countries is 1.52, but that the inclusion of other variables that explain import penetration reduces this estimate significantly. In this paper we concentrate on the factors that may have changed import penetration in Europe, and these include indicators of both European integration and of world trade liberalisation.

The estimation results are based on a large set of quarterly data which covers several decades, from 1968Q2 to 2004Q4. The sample period was shortened by several years for export volume estimation, due to data constraints. Reliable data on export prices for competitors outside Europe, particularly those in East Asia, is available only from the late 1970s. As a consequence, export equations are estimated over the period 1978Q1-2004Q4 period. The data on volumes, relative prices, demand and technology composition of output are computed in natural logarithms.

Our relative import prices include estimates of average tariffs, and they alone will capture a great deal of the tariff reduction effects of globalisation. These tariffs are observed not effective rates, and as such they will miss out many of the effects of their removal as effective protection differs significantly from that which might be presumed to exist from a given tariff. However, we see no reliable way to deal with this, and we use other indicators of trade liberalisation that should pick up these additional effects.

We augment the basic model structure to capture the impact of European regional integration, globalisation and technological advancement on trade. The new variables are constructed based on the processes discussed earlier in this section. The effect of the European Single Market (ESM) is captured by a variable equals to one prior to 1987Q2 gradually declines to zero in 1992Q4, the formal completion of the Single Market Programme. EMU is a dummy variable which equals to 1 from 1999Q1, with the official introduction of single currency in Europe and is zero before 1999.

Other globalisation variables are constructed in a similar manner with ATC modelling the impact of the formation of the World Trade Organisation and the Agreement on Textiles and Clothing which removed quotas on non-OECD exports of clothes and textiles into OECD countries. The WTO indicator is gradually reduced from one in 1995Q1 when the agreement came into effect, to zero by the end of the sample period, as all quotas and tariffs on textiles were formally abolished in January 2005. Of course the impact of the WTO on trade could continue beyond 2005, and it almost certainly has not been linear, but our approximation should suffice. The most important introduction of market based

trade in the last 40 years has been by China, and the variable representing this liberalisation (CHINA) is gradually reduced to zero from 1978Q1 when first trade reforms were implemented to 1991Q1 when mandatory export planning was abolished completely.

We include a measure of a country's technology intensity of output relative to the OECD average, TECHS, to capture the impact of the proliferation of new technologies as a determinant of export volumes. We use the share in total output of high and medium high technology output, as defined by the OECD, relative to the OECD average in order to pick up relative high technology specialisation.

Before we proceed to dynamic estimation, it is necessary to test whether we have a structurally stable long run relationship in our data. We first took export data and regressed the log of export volumes on demand and relative prices and checked to see if the relationships were cointegrated one country at a time using the t-statistics of Augmented Dickey-Fuller unit root tests on the errors by including intercept and 4 lags. We then included our set of trade liberalisation and globalisation indicators. We undertook the same set of exercises for imports, regressing the log of import volumes on an intercept, the log of relative prices and the log of TFE, and calculated the ADF 't' statistics.

The results of the cointegration tests for the two sets of import and export data are reported in Table II.1. We failed to find evidence of cointegration in the simple export equations for all countries except Austria. The same procedure for import equations suggested that about half the countries in the sample do not have a structurally stable long run relationship including only these variables. However, other factors have affected levels of trade, as we have argued above, and they need to be included in our long run structure. Including our measures of trade liberalisation in the cointegration tests suggests that all countries in the sample may have stable long run relationships and thus we can estimate structural export and import equations.

Table II.1 Cointegration tests on long run trade relationships

Augmented Dickey-Fuller tests

Exports

	Austria	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Neths	Portugal	Spain	Sweden	UK
Simple	*-3.01*	*-0.76*	*-2.32*	*-1.61*	*-1.53*	*-1.98*	*-1.83*	*-0.73*	*-1.09*	*-2.42*	*-2.24*	*-1.76*	*-0.93*
Simple & global variables	*-5.35*	*-2.92*	*-3.34*	*-4.50*	*-4.17*	*-4.80*	*-4.51*	*-4.47*	*-3.75*	*-5.09*	*-4.49*	*-4.09*	*-2.77*

Imports

	Austria	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Neths	Portugal	Spain	Sweden	UK
Simple	*-3.66*	*-3.32*	*-0.99*	*-2.51*	*-2.87*	*-1.53*	*-1.74*	*-2.93*	*-3.04*	*-3.39*	*-2.76*	*-2.82*	*-4.62*
Simple & global variables	*-4.70*	*-4.26*	*-3.71*	*-3.99*	*-4.16*	*-3.53*	*-3.81*	*-3.49*	*-4.71*	*-3.40*	*-2.96*	*-3.07*	*-4.65*

Note: critical values 5% 2.89 1% 3.50 For dates see tables II.2 and II.3

Given the evidence that there is a stable long run relationship we proceed using an equilibrium correction approach, with exports described by

$$\Delta\log(XVOL_t) = \beta_0 + \lambda[\log(XVOL_{t-1}) - \log(S_{t-1}) - \alpha_1 \log(RPX_{t-1}) - \alpha_2 ATC_{t-1} - \alpha_3 ESM_{t-1}$$

$$- \alpha_4 EMU_{t-1} - \alpha_5 CHINA_{t-1} - \alpha_6 \log_{(}TECHS_{t-1})] + \beta_1 \Delta\log(S_t) + \beta_2 \Delta\log(RPX_t) + \omega_t \quad (11)$$

where λ reflects the speed of adjustment in response to shifts in the long run relationship, and there are also dynamic effects from changes in demand and relative prices. Import volumes are modelled in a similar way:

$$\Delta\log(MVOL_t) = \beta_0 + \chi[\log(MVOL_{t-1}) - \alpha_1 \log(TFE_{t-1}) - \alpha_2 \log(RPM_{t-1}) - \alpha_3 ATC_{t-1} - \alpha_4 ESM_{t-1}$$

$$- \alpha_5 EMU_{t-1}] + \beta_1(1 - \beta_2 ESM_t)\,\Delta\log(TFE_t) + \varepsilon_t \quad (12)$$

where the change in the log of imports responds to the equilibrium correction term following the parameter χ and the rest of the dynamic adjustment process is described by the change in demand (TFE) and relative prices (RPM). The trade indicators are as discussed above, with the Single Market (ESM) variable potentially changing the speed with which imports react to demand.

Table II.2 reports the estimates for import equations obtained using ordinary least squares (OLS) to estimate all the equations together assuming no interdependence either between equations and errors. The long run TFE and RPM elasticities vary across countries. The long run TFE(-1) elasticities are generally larger in large and open countries, and the dynamic term in TFE also varies across countries. These results point to evidence of a significant impact of the single market on the speed at which imports adjust to changes in TFE in a number of countries, notably in France, Germany, the Netherlands and the UK. The competitiveness, (RPM) elasticities are relatively small in time series studies such as

this. The single country results obtained by OLS imply rather diverse impacts of changes in demand across European countries, both in the short term and in the long run. We test this proposition in the next specification because it matters for any analysis of policy changes. We do not report the trade policy related shift dummies in this paper for the sake of brevity, but they are included in the long run of our relationships.

Table II.2 Estimates of Import Equations using OLS

	Error Correction	TFE(-1)	RPM(-1)	DLTFE	ESM
Austria	*-0.281* *(-4.965)*	*1.58* *(30.187)*	*-0.021* *(-0.209)*	*2.42* *(9.971)*	*0.281* *(3.473)*
Belgium	*-0.171* *(-4.194)*	*1.471* *(54.272)*	*-0.016* *(-0.231)*	*1.912* *(34.08)*	-
Denmark	*-0.135* *(-3.4)*	*1.05* *(10.409)*	*-0.284* *(-2.05)*	*1.515* *(15.116)*	-
Finland	*-0.163* *(-4.384)*	*1.375* *(22.088)*	*-0.321* *(-2.111)*	*2.568* *(19.991)*	-
France	*-0.226* *(-5.521)*	*1.359* *(30.702)*	*-0.256* *(-2.754)*	*2.727* *(8.93)*	*0.753* *(12.738)*
Germany	*-0.214* *(-5.431)*	*1.655* *(39.914)*	*0.206* *(0.043)*	*1.975* *(9.43)*	*0.296* *(2.77)*
Ireland	*-0.072* *(-3.088)*	*1.467* *(24.476)*	*-0.12* *(-0.847)*	*1.676* *(23.265)*	*-0.289* *(-3.37)*
Italy	*-0.232* *(-5.628)*	*1.653* *(33.06)*	*-0.261* *(-3.274)*	*2.392* *(12.399)*	-
Netherlands	*-0.161* *(-3.767)*	*1.349* *(24.953)*	*-0.277* *(-2.4)*	*1.816* *(8.309)*	*0.36* *(3.672)*
Portugal	*-0.069* *(-2.758)*	*1.257* *(9.05)*	*-0.151* *(-0.694)*	*1.88* *(13.187)*	-
Spain	*-0.116* *(-4.141)*	*1.702* *(14.862)*	*-0.586* *(-3.402)*	*2.53* *(14.497)*	-
Sweden	*-0.116* *(-4.569)*	*1.369* *(22.155)*	*-0.30* *(-3.272)*	*2.394* *(14.351)*	*0.296* *(3.871)*
UK	*-0.366* *(-6.583)*	*1.571* *(23.692)*	*-0.158* *(-2.236)*	*2.437* *(7.169)*	*0.416* *(4.469)*

Note: estimation period 1968q2-2004q4; t-statistics in parentheses.

Table II.3 details the estimates from export equations using OLS and they exhibit less diversity than in imports, in part because we impose a unit coefficient on market demand (S). Relative price elasticities vary between countries, as does the need to include a dynamic term in relative prices. Error corrections vary noticeably. We find a significant role for the technology related production indicator, with increasing shares of high technology products in output being reflected in increases in export shares.

Table II.3 Estimates of Export Equations using OLS

	Error Correction	RPX(-1)	DLRPX	LTECHS(-1)
Austria	*-0.183*	*-0.273*	*-0.186*	*0.08*
	(-3.720)	*(-2.854)*	*(-3.804)*	*(1.032)*
Belgium	*-0.314*	*-0.665*	-	*0.31*
	(-5.059)	*(-3.587)*		*(1.877)*
Denmark	*-0.280*	*-0.405*	-	*0.28*
	(-4.639)	*(-3.485)*		*(2.751)*
Finland	*-0.599*	*-0.439*	-	*0.623*
	(-6.54)	*(-3.998)*		*(8.599)*
France	*-0.584*	*-0.481*	*-0.109*	*0.22*
	(-9.559)	*(-14.943)*	*(-2.721)*	*(6.060)*
Germany	*-0.552*	*-0.378*	-	*0.274*
	(-8.689)	*(-9.917)*		*(5.803)*
Ireland	*-0.166*	*-1.082*	-	*0.72*
	(-4.263)	*(-2.812)*		*(15.455)*
Italy	*-0.279*	*-0.986*	*-0.495*	-
	(-3.661)	*(-6.235)*	*(-5.114)*	
Netherlands	*-0.541*	*-1.194*	*-0.109*	*0.263*
	(-7.519)	*(-3.917)*	*(-2.443)*	*(4.117)*
Portugal	*-0.145*	*-1.196*	-	*0.584*
	(3.931)	*(-2.968)*		*(2.695)*
Spain	*-0.329*	*-1.117*	-	*0.499*
	(-5.419)	*(-11.623)*		*(1.628)*
Sweden	*-0.557*	*-0.273*	-	*0.358*
	(-7.642)	*(-4.958)*		*(7.85)*
UK	*-0.226*	*-0.721*	*-0.267*	*0.380*
	(-4.446)	*(-4.263)*	*(-5.42)*	*(4.144)*

Note: estimation period 1978q1-2004q4; t-statistics in parentheses.

The estimates obtained by OLS can be used in our structural model of the world economy, and this was a common approach to modelling in the past. However, some of the diversity it implies may be misleading for policy problems. If exports grow at the same rate as imports on average, as they must, then either GDP growth differentials or changes in relative prices must keep the current account in balance if import demand elasticities differ between countries. Relative prices must be a stationary variable in the long run and hence growth differentials could help create balance but then in the long run we would not have a steady state in the world economy[5]. Hence we use panel data techniques to test whether a common structure exists both in the imports and exports equations. In particular we utilise the suggestions for dynamic panels in Pesaran and Smith (1995) using Pooled Mean Group (PMG) estimation.

For exports in particular there is little reason to presume that coefficients differ across countries. Cross-country data provides additional information and therefore more precise

[5] This proposition is equivalent to that in Krugman (1989)

estimates if they are acceptable. We do not impose common parameters across countries, but test for them using PMG and Common Correlated Effects (CCE) techniques. We report PMG tests only for imports, as there may be more reason for the coefficients to differ, and we report CCE tests for exports and imports. We then test the panels for cointegration both in the final form and in the long run structure. The following results are based on a system of equations for Y of the form:

$$dlog(Y_{it}) = a_i + \lambda_i [log(Y_{it-1}) - \mathbf{b}_i log(\mathbf{X}_{it-1})] + \mathbf{c}_i dlog(\mathbf{X}_{it}) + \omega_{it} \quad (5)$$

where i varies from 1 to n, the number of elements of the cross section and t varies from 1 to T, the last time period, and **X** represents a vector of determining variables. Common panel estimates would look for commonalities in the parameter estimates of λ_i, and the vectors $\mathbf{b}_i$ and $\mathbf{c}_i$, whilst PMG estimates look for commonalities in the parameter estimates of λ_i, and $\mathbf{b}_i$, whilst allowing $\mathbf{c}_i$, to vary between countries. Rather than impose common λ_i, we test for it. PMG and common panel estimates are based on the assumption that the structure of the variance covariance matrix of the ω_{it} is relatively simple whilst the CCE estimates allow for a different set of restrictions on cross-country correlations of ω_{it}. In particular common factors in the cross equation covariances can be removed.

To test for common coefficients in the imports equations, we estimate an imports panel using a Seemingly Unrelated Regression (SURE) framework and average the single equation coefficients $\mathbf{b}_i$ and λ_i to arrive at the pooled mean group (PMG) estimates. We then test the PMG estimates against those obtained directly from estimation with the cross-equation restrictions imposed. The Wald test results in Table II.4 indicate that TFE and RPM parameters can be imposed to be the same across countries.

Table II.4 Tests of common long run coefficients in imports using PMG estimates

	PMG		
	Average	**Pooled**	**Wald test**
TFE(-1)	*1.4393*	*1.4634*	pass
RPM(-1)	*-0.2222*	*-0.2377*	pass

We also test the restriction of common error corrections, but this is rejected by the Wald test, pointing to significant differences in the speed of adjustment across countries, as it is shown in Table II.5. The common long run TFE elasticity is similar to the average coefficient, as is the competitiveness elasticity, and hence both are easy to impose. Error

corrections vary from the rapidly responding UK to the more inertial small countries. All error correction mechanism (ECM) estimates are relatively well defined, which suggests that the variables in our long run specification may be part of a cointegrating set.

Table II.5 Import Equation Error Correction Coefficients

UK	France	Austria	Italy	Spain	Finland	Germany	Neths	Belgium	Sweden	Portugal	Ireland	Denmark
-0.324	*-0.259*	*-0.254*	*-0.173*	*-0.156*	*-0.146*	*-0.14*	*-0.133*	*-0.113*	*-0.109*	*-0.067*	*-0.113*	*-0.048*
(-6.944)	*(-7.215)*	*(-5.404)*	*(-4.923)*	*(-6.042)*	*(-4.541)*	*(-5.432)*	*(-3.581)*	*(-4.241)*	*(-4.612)*	*(-3.676)*	*(-4.241)*	*(-3.391)*

Note: t-statistics in parentheses For dates see table II.2

Large cross section-time series panels may have cross correlations between errors on equations ω_{it} for panel members. Estimating the covariance structure of ω_{it} is difficult. Even if we assume there are no common auto correlations the number of covariances rise with n(n-1)/2 where n is the number of members of the cross section. The number of parameters to estimate in an unrestricted covariance matrix rises quickly under any form of Generalised Least Squares (GLS), and the panel becomes impossible to estimate. The SURE estimates reported above impose a restricted covariance matrix, which allows for cross-section heteroskedasticity and contemporaneous correlations. We may wish to allow a more general specification, based on a set of unobserved common factors across cross-sections. Pesaran (2006) suggests using cross section means of select variables as regressors to remove any associated covariances from the error matrix.

The next set of estimates is augmented with cross section means of select variables. We initially include contemporaneous cross section mean terms in the imports panel and drop the change in relative import prices because it is not significant. This leaves us with the mean over i =1, n of dlog(mvol)_t. Tests of common coefficients in the import equations are reported in Table II.6. The test of common long-run elasticities on TFE and RPM was accepted, but common error correction coefficient could not be imposed. The full equations are reported in Table II.7. All include the trade policy shift dummies.

Table II.6 Tests of common long run coefficients using PMG and CCE

	CCE		
	Average	**Pooled**	**Wald test**
TFE(-1)	*1.4653*	*1.4896*	pass
RPM(-1)	*-0.1652*	*-0.1848*	pass

Table II.7 Estimates from import equations using PMG and CCE techniques

	Error Correction	TFE(-1)	RPM(-1)	DLTFE	ESM
Austria	*-0.252* *(-5.158)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.165* *(9.309)*	*0.271* *(3.167)*
Belgium	*-0.120* *(-4.125)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.762* *(30.938)*	-
Denmark	*-0.042* *(-3.073)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.317* *(15.282)*	-
Finland	*-0.131* *(-4.109)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.484* *(20.295)*	-
France	*-0.235* *(-6.397)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.526* *(9.018)*	*0.713* *(12.469)*
Germany	*-0.138* *(-5.118)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.944* *(10.452)*	*0.427* *(5.171)*
Ireland	*-0.064* *(-3.656)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.561* *(27.302)*	*-0.279* *(-4.051)*
Italy	*-0.179* *(-5.125)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.111* *(11.866)*	-
Netherlands	*-0.112* *(-3.226)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.642* *(8.5)*	*0.333* *(3.485)*
Portugal	*-0.067* *(-3.949)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*1.892* *(15.388)*	-
Spain	*-0.143* *(-5.816)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.216* *(16.056)*	-
Sweden	*-0.103* *(-4.487)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.164* *(16.002)*	*0.296* *(4.617)*
UK	*-0.300* *(-6.242)*	*1.490* *(92.463)*	*-0.185* *(-6.794)*	*2.398* *(7.716)*	*0.440* *(5.193)*

Note: estimation period 1968q2-2004q4; t-statistics in parentheses.

We proceed with estimating export panel coefficients following the same methodology used in the imports panel. The results reported in Table II.8 indicate that a common long run coefficient can be imposed only in a sub group of countries, Spain, Portugal and Ireland. These three countries are thought to have undergone rapid industrialisation during the sample period. Our analysis indicates that common error correction coefficients could not be imposed across the panel. We used cross section means for relative prices as well as for the dependent variable as these were both significant and seemed to have economic content.

Table II.8 Tests of common long run coefficients in export panel using PMG and CCE (for Spain, Portugal, and Ireland only)

	Average	Pooled	Wald test
RPX(-1)	-1.3094	-1.2475	pass
TECHS(-1)	0.7242	0.7684	pass

Table II.9 Estimates from export equations using PMG and CCE techniques

	Error Correction	RPX(-1)	DLRPX	LTECHS(-1)
Austria	*-0.224* *(-4.854)*	*-0.355* *(-4.004)*	*-0.178* *(-3.937)*	*0.166* *(2.318)*
Belgium	*-0.374* *(-7.482)*	*-0.56* *(-4.449)*	-	*0.317* *(2.826)*
Denmark	*-0.242* *(-4.458)*	*-0.437* *(-3.487)*	-	*0.268* *(2.525)*
Finland	*-0.581* *(-7.104)*	*-0.473* *(-4.59)*	-	*0.61* *(8.99)*
France	*-0.547* *(-8.973)*	*-0.528* *(-12.958)*	*-0.122* *(-3.072)*	*0.214* *(5.278)*
Germany	*-0.554* *(-9.365)*	*-0.4* *(-10.667)*	-	*0.274* *(6.122)*
Ireland	*-0.167* *(-6.472)*	*-1.248* *(-12.674)*	-	*0.768* *(18.203)*
Italy	*-0.262* *(-3.889)*	*-1.012* *(-6.487)*	*-0.407* *(-4.72)*	-
Netherlands	*-0.542* *(-8.6)*	*-0.239* *(-4.811)*	*-0.085* *(-2.175)*	*0.222* *(3.763)*
Portugal	*-0.158* *(5.892)*	*-1.248* *(-12.674)*	-	*0.768* *(18.203)*
Spain	*-0.293* *(-6.659)*	*-1.248* *(-12.674)*	-	*0.768* *(18.203)*
Sweden	*-0.568* *(-9.002)*	*-0.278* *(-5.82)*	-	*0.395* *(9.925)*
UK	*-0.281* *(-6.42)*	*-0.639* *(-5.681)*	*-0.222* *(-6.04)*	*0.287* *(4.182)*

Note: estimation period 1978q1-2004q4; t-statistics in parentheses.

The relative export prices are more likely to have common effects than relative import prices as they involve the export prices of other countries, whereas the relative import prices use only data from the country in question. Table II.9 presents the estimation results.

We need to test the final panel for the stationarity of the error process in order to ensure that we have produced a structurally reasonable description of the data, and we report the results in Table II.10. We first test the cointegration of the errors on the full panel, but this could conflate non-cointegration in the long run with non-stationary dynamic terms. Hence we also test the long run structure, including trade variables in our tests for

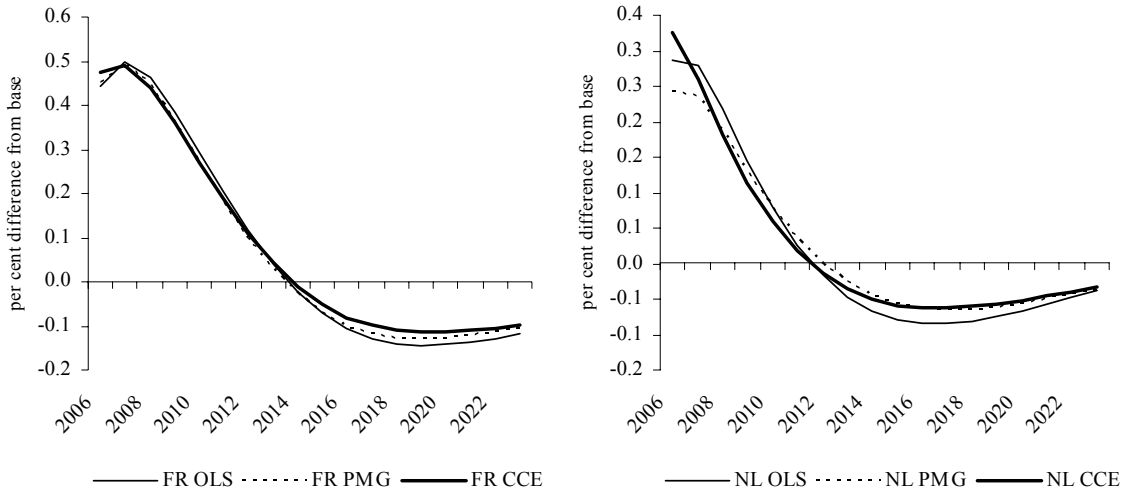
cointegration, as in the OLS tests above. In the tests for long run cointegration the dynamic terms are stripped and errors tested. We assume a single cointegrating vector behind the panel even when coefficients differ marginally between countries, and we present Im, Pesaran, Shin tests on panel and individual countries, and we conclude that both the full dynamic panels and the long run structures under them cointegrate. Cointegration tests of the long run relationships only can be found in Breitung (2005).

Table II.10 Results of cointegration tests on final panel estimates

	Import volumes		**Export volumes**	
	full panel	*long run*	*full panel*	*long run*
Austria	*-5.065*	*-4.784*	*-5.580*	*-3.308*
Belgium	*-5.108*	*-5.218*	*-3.987*	*-2.836*
Denmark	*-6.865*	*-3.914*	*-6.259*	*-3.254*
Finland	*-3.896*	*-2.939*	*-4.426*	*-4.277*
France	*-4.982*	*-3.292*	*-4.980*	*-4.276*
Germany	*-5.236*	*-3.173*	*-4.365*	*-3.184*
Ireland	*-4.271*	*-4.251*	*-4.262*	*-2.805*
Italy	*-5.976*	*-5.519*	*-5.424*	*-3.978*
Netherlands	*-4.525*	*-3.819*	*-4.489*	*-3.426*
Portugal	*-8.374*	*-3.950*	*-4.231*	*-3.448*
Spain	*-6.206*	*-3.522*	*-4.023*	*-3.405*
Sweden	*-6.081*	*-2.960*	*-4.178*	*-4.183*
UK	*-4.637*	*-3.998*	*-3.414*	*-3.483*
Im Pesaran Shin W-statistic	*-16.357*	*-10.077*	*-12.864*	*-11.146*

Note: critical values 5% 2.89 1% 3.50 For dates see Tables II.2 and II.3

Chart II.3 GDP response to a 1% increase in government spending



	GE			FR			IT			SP		
	OLS	PMG	CCE	OLS	PMG	CCE	OLS	PMG	CCE	OLS	PMG	CCE
2006	0.479	0.443	0.475	0.443	0.449	0.474	0.581	0.608	0.639	0.342	0.423	0.464
2007	0.359	0.340	0.353	0.499	0.495	0.491	0.544	0.572	0.585	0.357	0.474	0.485
2008	0.245	0.233	0.235	0.463	0.446	0.440	0.415	0.454	0.458	0.305	0.433	0.432
2009	0.134	0.118	0.114	0.386	0.362	0.360	0.247	0.290	0.291	0.216	0.341	0.334
2010	0.046	0.017	0.013	0.295	0.269	0.272	0.090	0.128	0.129	0.107	0.220	0.212
	NL			BG			OE			FN		
2006	0.286	0.242	0.325	0.153	0.144	0.199	0.299	0.311	0.368	0.361	0.358	0.362
2007	0.280	0.236	0.260	0.216	0.184	0.210	0.410	0.428	0.442	0.432	0.407	0.397
2008	0.218	0.188	0.182	0.227	0.194	0.202	0.402	0.415	0.417	0.410	0.384	0.371
2009	0.146	0.131	0.114	0.217	0.186	0.184	0.359	0.357	0.357	0.343	0.324	0.314
2010	0.080	0.079	0.060	0.200	0.168	0.160	0.306	0.285	0.286	0.259	0.251	0.246
	IR			PT			SD			DK		
2006	0.290	0.300	0.330	0.458	0.420	0.446	0.363	0.392	0.419	0.552	0.556	0.592
2007	0.211	0.212	0.226	0.446	0.398	0.415	0.407	0.414	0.4273	0.590	0.525	0.556
2008	0.134	0.126	0.126	0.389	0.335	0.342	0.366	0.369	0.3784	0.562	0.465	0.491
2009	0.069	0.052	0.042	0.321	0.265	0.265	0.292	0.298	0.3094	0.501	0.393	0.414
2010	0.017	-0.008	-0.022	0.255	0.199	0.195	0.206	0.218	0.2334	0.421	0.314	0.330

A comparison of the economic impacts of a shock using the different estimates obtained by different econometric techniques is revealing. We embed the three different sets of trade equations in our structural macroeconomic model, NiGEM. The differences are perhaps small, but there are differences in the dynamic pattern of response in the whole model when we change these equations. Chart II.3 illustrates the changes in GDP from a 1 per cent increase in government spending under trade parameters obtained from three different estimation procedures. Table II.9, which immediately follows, extends the comparison to all countries in the sample. At the same time, the results suggest that trade parameters obtained from CCE estimation perform slightly better as compared to the OLS and PMG estimates.

Part III. Fiscal spillovers in NiGEM

Using the estimated trade parameters detailed in the previous section, we turn to the analysis of spill-overs from a fiscal expansion in Europe. This subject has received much attention in academic literature, but the debate on the magnitude and direction of spill-overs and the need for fiscal policy coordination is far from over. In a recent study, Beetsma, Giuliodori and Klaassen (2006) find large and positive spill-overs via trade from a fiscal expansion in Europe, not only in the short-term, but after 5 years. The authors suggest that after 2 years, there is a 2.2% gain in annual bilateral exports by EU trading partners for each 1% of GDP additional demand in Germany. The study combines a panel VAR model with a panel trade model to calculate the full effect of a fiscal impulse on bilateral foreign exports. The panel VAR calibrates the fiscal shocks and

computes the output responses to these shocks, which then are fed into the panel trade model (based on the gravity model of trade) to calculate the effect of output on bilateral foreign exports. Since their analysis abstracts from adjustments in monetary policy and real exchange rates, their findings may have described Europe in the absence of a monetary union, as their parameters are estimated over 1965-2004 period. By contrast, Wieland (1996) uses a structural macroeconomic model to find negative spill-overs after 2 years, because movements in the real exchange rates caused by the fiscal expansion overwhelm positive trade effects from increased demand. Our findings corroborate this conclusion and are detailed below.

As we discussed in Part 1 of this paper, a fiscal expansion in one country affects export demand in its trading partners, affects interest rates and hence exchange rates if monetary authorities respond to the shock, and affects private sector wealth through its impact on debt and equity prices. In this section of the paper, we run a series of model simulations to look at fiscal spillovers within the EU and coordinated versus unilateral fiscal policy.

The fiscal multipliers depend on whether the expansion is temporary or permanent and on our assumptions regarding the monetary policy response. In each of the simulations we raise government consumption expenditure by 1 per cent of GDP permanently. In the first set of scenarios, which we denote as 'full effect' we allow default model policies to remain in place, so monetary authorities respond straight away to the fiscal expansion, and tax rates adjust to bring the deficit quickly back to base. In the second set of simulations, we allow a permanent fiscal loosening and a permanent rise in the government debt stock. The budget target is adjusted by the same per cent of GDP as the increase in spending, reducing the adjustment to tax rates to offset the rise in expenditure. Interest rates are held fixed for two years, but then do respond in line with the chosen monetary targeting regime. The third set of simulations postpones any monetary and fiscal adjustment for 2 years, so interest rates and tax rates are held fixed for 2 years. After 2 years, we allow monetary policy to be determined by our standard feedback rule, which targets inflation and a nominal aggregate, and tax rates adjust to bring the government budget balance back to base.

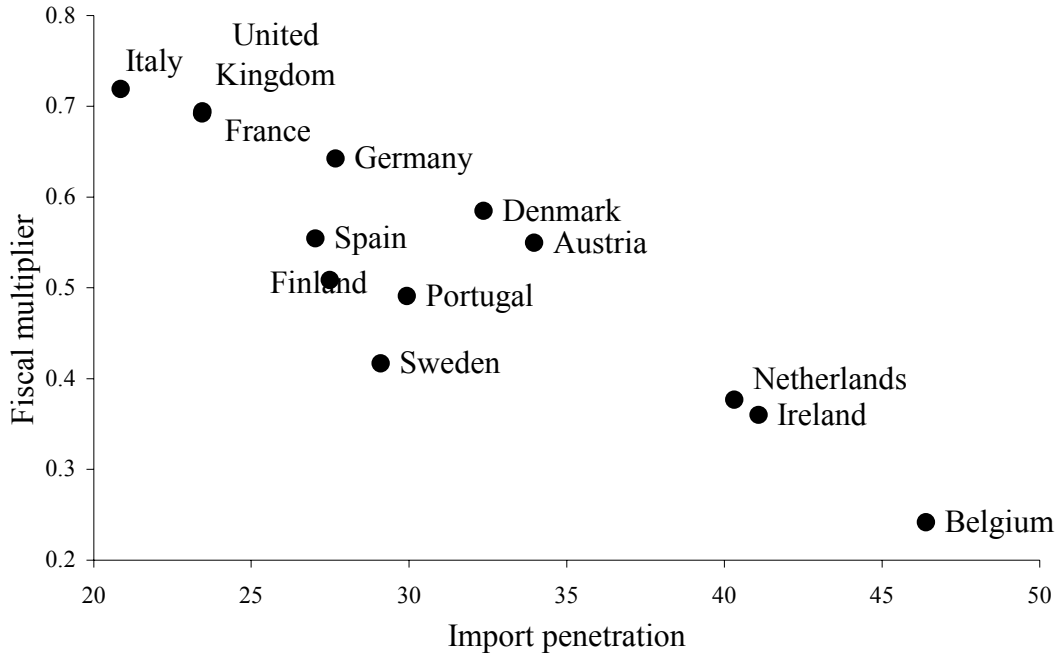
Even when fiscal and monetary responses do not take place immediately, the model is forward looking, so equity, bond and exchange rate markets all react to expected developments. If short-term interest rates are increased or expected to rise, then the long rate will increase in the first year of the shock and bond prices will fall. Since equity prices are the discounted present value of future profits, an increase in activity will raise

profits and hence share prices may rise in the short term. But this is offset by the negative impact of higher long rates, and in the second year of the shock equity prices tend to fall. The exchange rate will appreciate immediately in anticipation of expected future rises in interest rates. All three of these financial market developments will help crowd out the impact of the increase in spending.

The fiscal multipliers are highly negatively correlated with import penetration ratios, measured as import volumes as a share of total final expenditure. Chart III.1 plots fiscal multipliers two years after the single country shocks with postponed policy response against this measure of import penetration. With higher import penetration, the fiscal multiplier is lower, as a greater share of the rise in government spending is offset by import leakages. This is seen clearly for the smaller and very open economies of Belgium, Ireland and the Netherlands. Fiscal multipliers are larger in Italy, the UK and France, where import penetration is relatively low. Since openness is highly correlated to economic size, as measured by gross domestic product (GDP), the size of fiscal multipliers is also positively correlated with a country's GDP. Indeed, the five largest European economies are depicted in the upper left hand corner on Chart III.1. In all cases multipliers are less than one as spillovers and negative feedbacks offset the impacts of increases in spending.

Chart III.1 Fiscal multipliers and import penetration

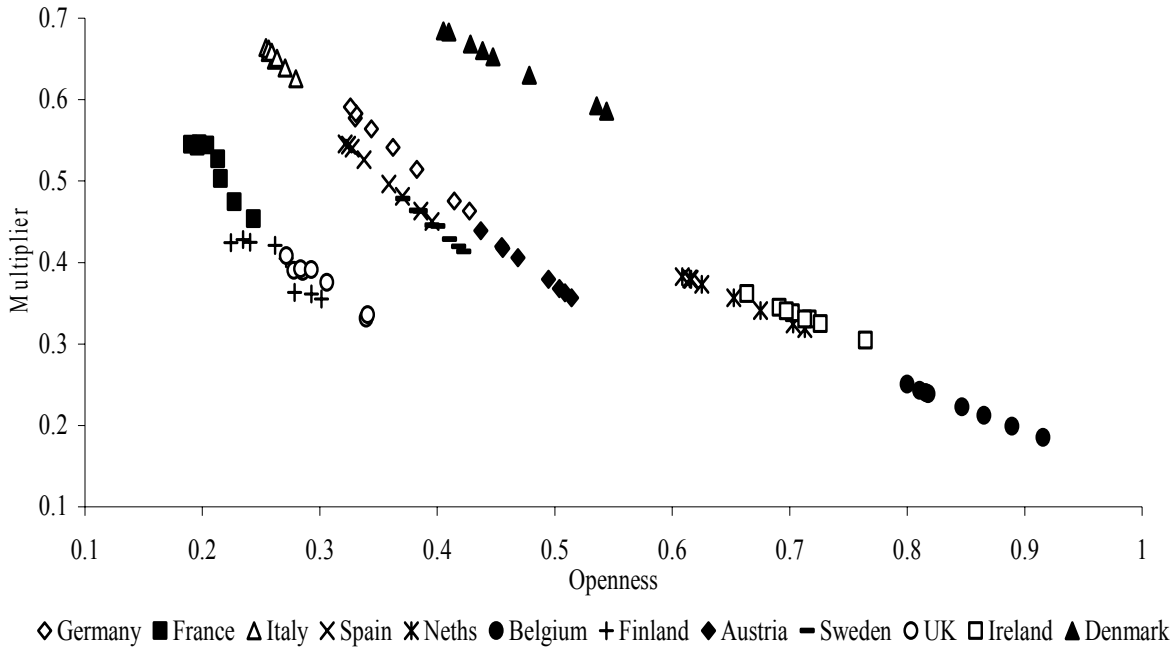
GDP impact after two years, a 1 % of GDP rise in government spending, interest rates and tax rates fixed for two years



Fiscal multipliers are not fixed over time, as we can see from Chart III.2, which plots the multipliers from one of our experiments repeated for each year from 2000 to 2007 against openness, as measured by imports as a share of GDP, in the year in which the innovation takes place. We can distinguish three groups of economies. The core of Germany, Italy, Austria, Sweden and Spain exhibit declining multipliers with increasing openness is a very similar way. As compared to this group, Denmark, Netherlands, Belgium and Ireland all have rather higher multipliers than their openness would indicate. This is not surprising as in each case a noticeable amount of their imports are destined for re-export and hence do not represent leakages[6]. The UK, France and Finland all have smaller multipliers than might be expected from openness, and this reflects the relative importance of equity based wealth in these economies (see Al Eyd Barrell and Holland 2006). The interest rate response to the shock reduces financial wealth in all countries, and it has a greater impact in these three than in Germany, Spain, Italy, Austria or Sweden. It is impossible to evaluate the time variation in multipliers in this way using VAR based analysis such as that in Pesaran and Smith (2006)

Chart III.2 Changing patterns of fiscal multipliers and openness

GDP impact in year one, 1% of GDP increase in spending, policy responses present immediately



[6] The simple Keynesian multiplier can be written as dy =dg/((1-c+m)) where dy is the change in come, dg is the impulse, c is the marginal propensity to consume and m is the marginal propensity to import, sometimes described as leakages. The higher the import propensity the lower the multiplier

Table III.1 reports the impact on GDP in 13 EU countries of the three simulation experiments described above. The size of the fiscal multipliers clearly depends on the response of macroeconomic policy. Fiscal multipliers are noticeably larger in the absence of monetary or fiscal adjustment, and highest in response to a permanent fiscal loosening.

Table III.1 Fiscal Multipliers in Europe

	full effect			no monetary response for 2 years					
				permanent increase in gov't borrowing			no fiscal adjustments for 2 years		
	1 year	2 years	5 years	1 year	2 years	5 years	1 year	2 years	5 years
Belgium	0.199	0.210	0.160	0.160	0.246	0.313	0.160	0.244	0.258
Denmark	0.592	0.556	0.330	0.576	0.673	0.745	0.560	0.635	0.536
Finland	0.362	0.397	0.246	0.411	0.588	0.719	0.400	0.556	0.443
France	0.474	0.491	0.272	0.494	0.725	0.888	0.494	0.686	0.454
Germany	0.475	0.353	0.013	0.595	0.686	0.581	0.563	0.614	0.132
Ireland	0.330	0.226	-0.022	0.328	0.338	0.267	0.326	0.329	0.102
Italy	0.639	0.585	0.129	0.611	0.681	0.457	0.608	0.653	0.188
Netherlands	0.325	0.260	0.060	0.308	0.391	0.408	0.308	0.383	0.204
Austria	0.368	0.442	0.286	0.323	0.530	0.750	0.320	0.511	0.498
Portugal	0.446	0.415	0.195	0.473	0.546	0.649	0.470	0.529	0.416
Sweden	0.419	0.427	0.233	0.392	0.481	0.419	0.373	0.444	0.298
Spain	0.464	0.485	0.212	0.380	0.453	0.399	0.353	0.417	0.230
UK	0.330	0.240	-0.053	0.250	0.193	0.118	0.340	0.320	0.028

Charts III.3 and III.4 highlight the role of an independent monetary policy in offsetting the fiscal stimulus in the UK. We show the fiscal multipliers reported in Table III.1 against an alternative set of scenarios with UK monetary policy shadowing the ECB. In the short-run, there is a much stronger fiscal stimulus when the UK shadows the ECB, as the interest rate response is small relative to an independent monetary policy. But in the long-run, there is an offsetting negative impact on output. This impact is exaggerated when the policy response is delayed compared to the full effects scenario.

Chart III.3 Full effect multipliers, in and out of EMU

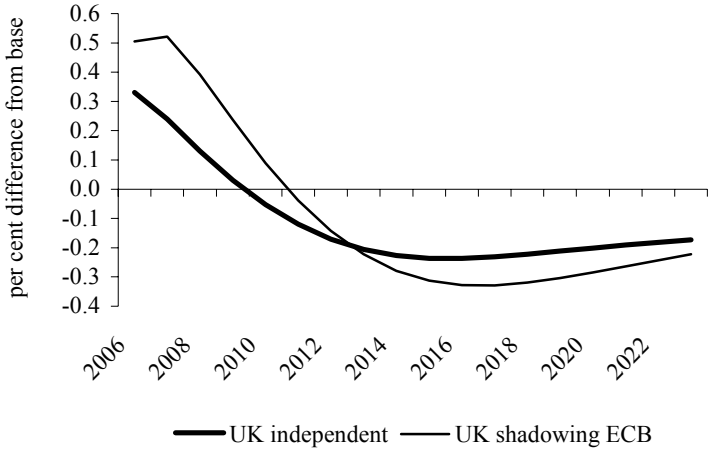
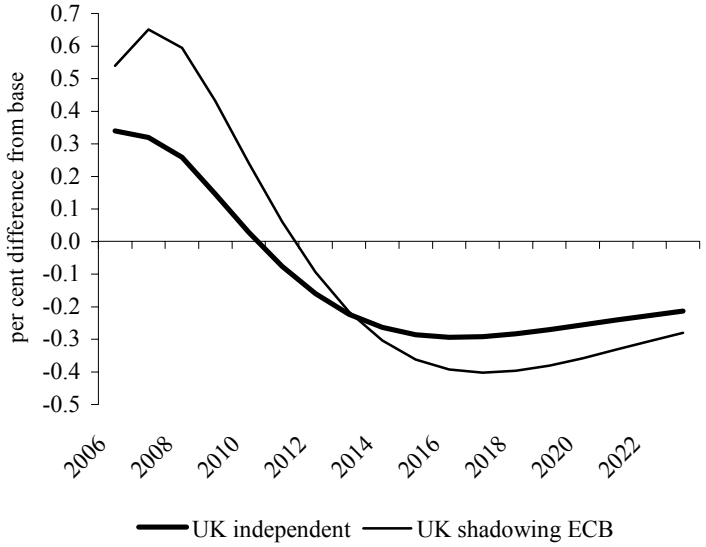


Chart III.4 Delayed policy adjustment multipliers, in and out of EMU



Spillovers from fiscal expansions

Table III.2 shows the spillovers from fiscal expansions in Germany to the other EU economies covered in this paper and Table III.3 shows spillovers from a fiscal expansion in France. An increase in spending in one country in a monetary union raises interest rates and the exchange rate everywhere, but by different amounts depending on the policy assumptions we make. While the spillovers are positive in the first 1-2 years, after 5 years the impact is negative everywhere except Austria in the case of Germany and Belgium in the case of France, reflecting the close linkages between these countries. Fiscal spillovers with an immediate tax feedback (full effects scenario) are larger in the short-term, as long-rates and the exchange rate do not rise as much as in the other scenarios.

Table III.2 Spillovers from Germany

	full effects			permanent fiscal loosening; no monetary adjustment for 2 years			no monetary & fiscal adjustments for 2 years		
	1 year	2 years	5 years	1 year	2 years	5 years	1 year	2 years	5 years
Belgium	0.053	0.029	-0.023	0.050	0.072	0.027	0.052	0.074	-0.011
Denmark	0.060	0.015	-0.048	0.029	-0.031	-0.114	0.058	0.040	-0.065
Finland	0.036	-0.002	-0.028	-0.002	-0.069	-0.129	0.036	0.011	-0.048
France	0.025	-0.009	-0.049	-0.008	-0.096	-0.227	0.027	-0.012	-0.102
Germany	-	-	-	-	-	-	-	-	-
Ireland	0.009	0.007	-0.019	-0.015	-0.028	-0.052	0.009	0.015	-0.017
Italy	0.025	-0.002	-0.033	-0.001	-0.064	-0.114	0.027	0.003	-0.059
Netherlands	0.101	0.048	-0.037	0.080	0.048	-0.033	0.102	0.099	-0.036
Austria	0.068	0.086	0.020	0.059	0.108	0.116	0.064	0.120	0.054
Portugal	0.042	0.006	-0.033	0.039	0.001	-0.066	0.055	0.034	-0.059
Sweden	0.019	-0.022	-0.051	-0.017	-0.077	-0.125	0.019	-0.011	-0.083
Spain	-0.012	-0.028	-0.022	-0.048	-0.113	-0.114	-0.017	-0.036	-0.023
UK	0.039	0.032	-0.022	0.030	0.020	-0.030	0.041	0.047	-0.023

Table III.3 Spillovers from France

	full effects			permanent fiscal loosening; no monetary adjustment for 2 years			no monetary & fiscal adjustments for 2 years		
	1 year	2 years	5 years	1 year	2 years	5 years	1 year	2 years	5 years
Belgium	0.055	0.036	0.005	0.049	0.068	0.061	0.053	0.072	0.028
Denmark	0.015	-0.022	-0.043	-0.012	-0.074	-0.140	0.012	-0.025	-0.075
Finland	0.011	-0.021	-0.036	-0.009	-0.063	-0.122	0.010	-0.023	-0.062
France	-	-	-	-	-	-	-	-	-
Germany	0.023	-0.017	-0.043	0.002	-0.056	-0.097	0.030	-0.008	-0.058
Ireland	0.003	-0.001	-0.018	-0.006	-0.016	-0.041	0.004	0.004	-0.018
Italy	0.019	-0.005	-0.029	0.010	-0.030	-0.075	0.023	-0.001	-0.044
Netherlands	0.052	0.012	-0.029	0.035	-0.005	-0.070	0.051	0.026	-0.045
Austria	0.012	-0.004	-0.046	0.007	-0.013	-0.092	0.014	0.008	-0.053
Portugal	0.039	0.010	-0.016	0.042	0.015	-0.021	0.052	0.030	-0.024
Sweden	0.003	-0.029	-0.042	-0.016	-0.063	-0.097	0.004	-0.027	-0.059
Spain	-0.008	-0.019	-0.024	-0.026	-0.056	-0.070	-0.008	-0.020	-0.022
UK	0.029	0.022	-0.013	0.022	0.011	-0.015	0.031	0.028	-0.012

One of the major negative feedbacks comes from the effects of changes in real exchange rates. In Charts III.5 and III.6 we show the impacts of the German and French fiscal expansions on the overall Euro Area real exchange rate and on the real effective exchange rates in key economies. The expanding economy suffers a loss of competitiveness, as the fiscal expansion pushes prices up relative to elsewhere. The negative impact on the trade balance offsets the rise in domestic demand, and this force helps bring GDP below base in the medium-term. Austria benefits from a small rise in competitiveness in response to the German expansion, due to the strong linkages between Germany and Austria, and this helps explain the positive spillovers in Austria following a German fiscal expansion.

Chart III.3 Impacts of a German fiscal expansion on real exchange rates

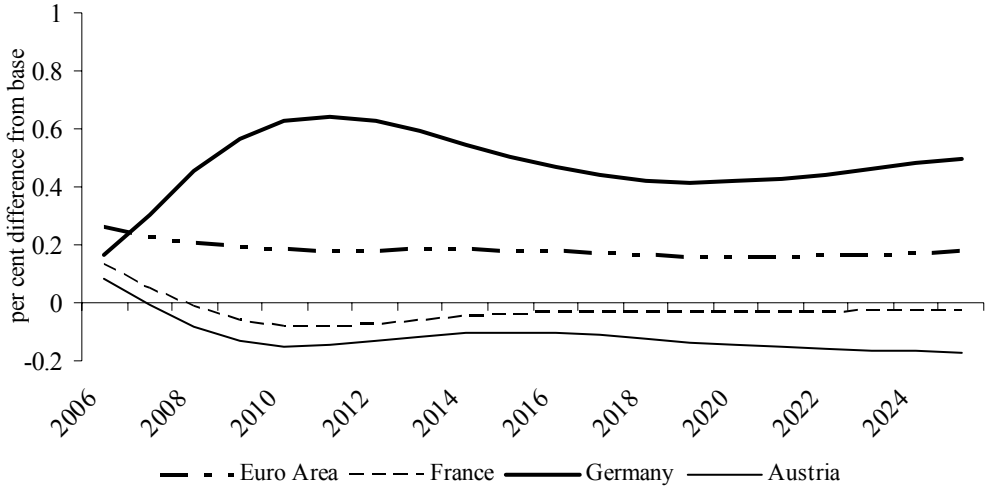
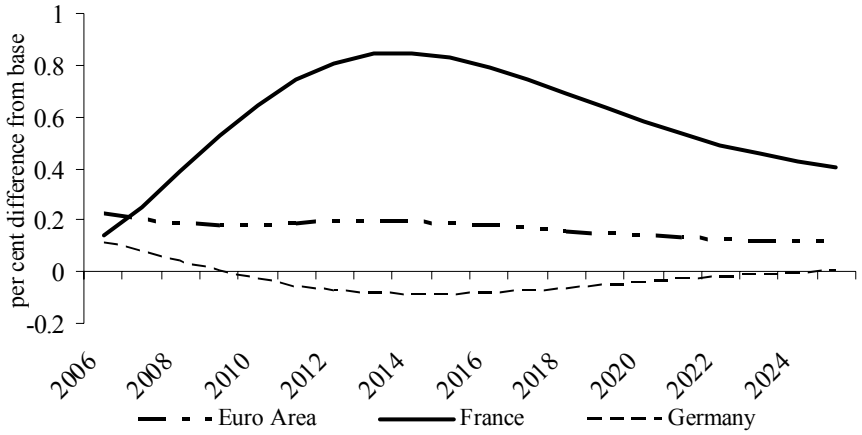


Chart III.6 Impacts of a French fiscal expansion on real exchange rates



Clearly, a fiscal expansion in one Euro Area country temporarily raises output in the rest of the Euro Area, as the expanding country demands more imports, thus raising exports from the rest of the key trading partners. The expanding country also loses competitiveness as prices rise, and so loses some export market share to the advantage of the rest of the world. The fiscal multipliers in response to a coordinated fiscal expansion should be expected to be higher in the short-term relative to a unilateral expansion. The major impact of this comes through trade, but some will come through cross holdings of equities and other financial assets.

Chart III.7 Euro Area-wide versus unilateral fiscal multipliers

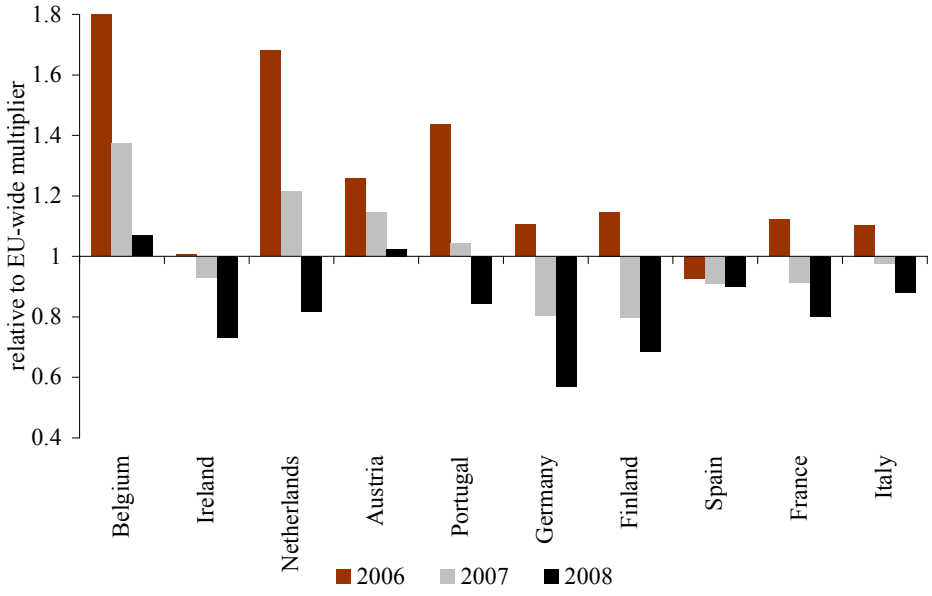


Chart III.7 illustrates the size of the multiplier in each country in response to a Euro Area-wide fiscal expansion relative to a unilateral fiscal expansion for the first three years of the shocks. This can be thought of as a measure of spillovers from the rest of the Euro Area, where a figure greater than 1 indicates that the multiplier is larger in response to the Area-wide shock. Spillovers tend to be positive in the first year of the shock. However, the effects of co-ordinated fiscal expansion begin to dissipate after one year, and the fiscal multipliers are smaller in all countries with the exception of Belgium by year 3. The limited scale of spillovers in response to coordinated expansions reflects the significantly stronger interest rate response, and hence exchange rate increase, when all countries expand at the same time, and different sensitivities of the Euro Area economies to interest rates. The countries in Chart III.7 are ordered from the most open, and there is clearly some correlation between openness and the size of the spillovers in the short term. The more open economies benefit more from spillovers in the form of stronger export demand from the other expanding Euro Area countries. Those that conduct a higher share of trade within the Euro Area benefit more, and this is clear from the relatively small level of spillovers in Ireland, whose main trading partners are the US and the UK.

Table III.4 Spillovers and indicators of size and openness: correlations

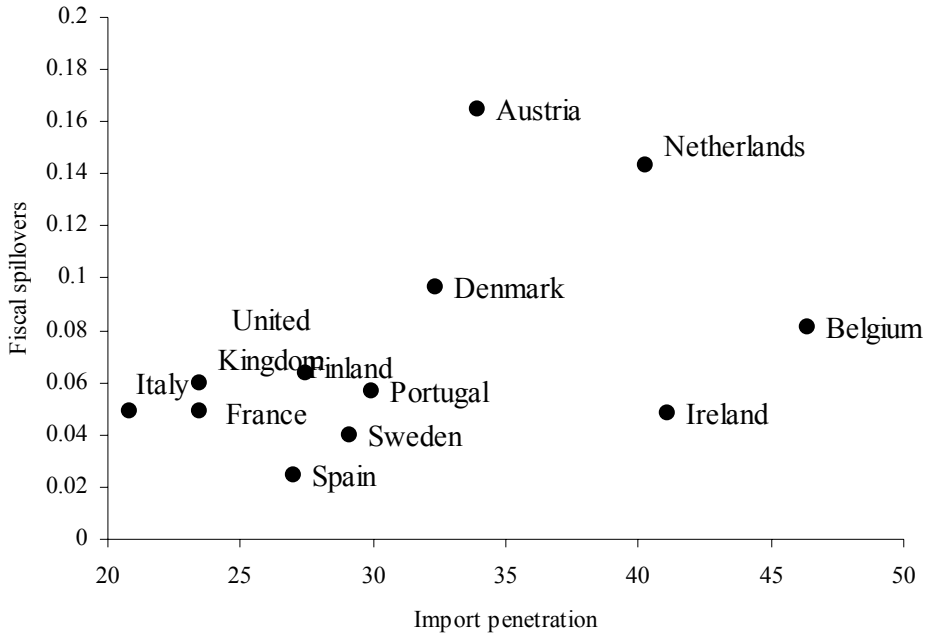
Correlations

	Openness with fiscal multipliers		Size of the country with fiscal multipliers	
	1 year	2 years	1 years	2 years
Belgium	0.389	0.488	0.031	0.056
Denmark	0.009	0.031	-0.194	-0.193
Finland	0.077	0.108	-0.250	-0.277
France	0.405	0.540	0.081	0.171
Germany	0.431	0.453	-0.334	-0.303
Ireland	0.179	0.113	0.136	0.260
Italy	0.178	0.203	0.284	0.350
Netherlands	0.413	0.633	0.014	-0.001
Austria	0.066	0.063	0.370	0.462
Portugal	-0.074	-0.164	0.388	0.267
Sweden	0.047	0.047	-0.320	-0.311
Spain	-0.061	-0.017	-0.099	-0.066
United Kingdom	0.386	0.676	-0.097	-0.178

The relationship between fiscal spillovers, openness and size is less pronounced than might have expected given the discussion in Beetsma *et al* (2006) and elsewhere. In Table III.4 we present correlations between the size of countries and the scale of spillovers from a fiscal innovation in the named country. There appears to be little relationship between the size of the reacting country and the scale of spillovers,

whichever country originates the impulse. This is probably because the scale effect, which may be present, is overwhelmed in each case by the impact of the strength of bilateral trade relationships. Our analysis suggests that the correlation between fiscal spillovers and GDP is negative for large European countries such as Germany and the UK, but positive for smaller European countries, who tend to have strong trade links with a single large country. Thus, spillovers from Austria, Portugal and Ireland display positive correlations with country size, measured by GDP.

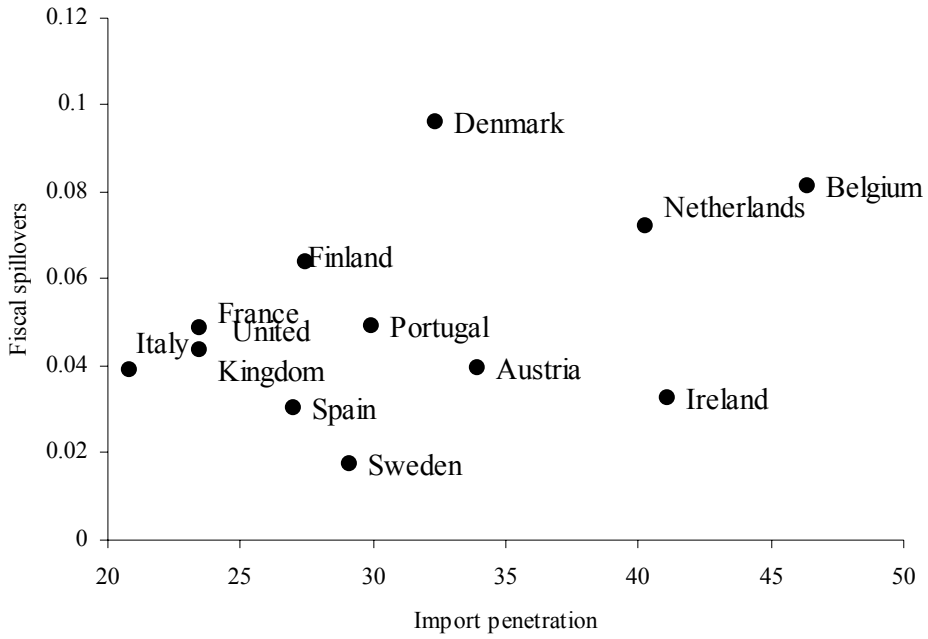
Chart III.8 Spillovers from Germany and import penetration



There are more patterns visible in Table III.4 when we correlate openness to trade and the scale of spillovers. The core Europeans, UK, France, Germany, Belgium and the Netherlands, do appear to demonstrate a correlation between spillovers from these countries and the openness of the reacting country. However, the three Nordic countries and two Iberian countries we include seem to have a low or negative correlation between the openness of the reacting country and the scale of spillover they receive from one of these originating countries. Charts III.8 and III.9 show the relationship between fiscal spillovers from an increase of 1 per cent of GDP in government spending in Germany and France and trade openness in the reacting countries. There is a positive correlation (correlation coefficients of 0.43 in the case of Germany and 0.41 for France) between spillovers from these countries and the reacting country's openness. This correlation

cannot be extended to the relationship between the size of fiscal spillovers and GDP because factors, such as country specific trade patterns may be more important.

Chart III.9 Spillovers from France and import penetration

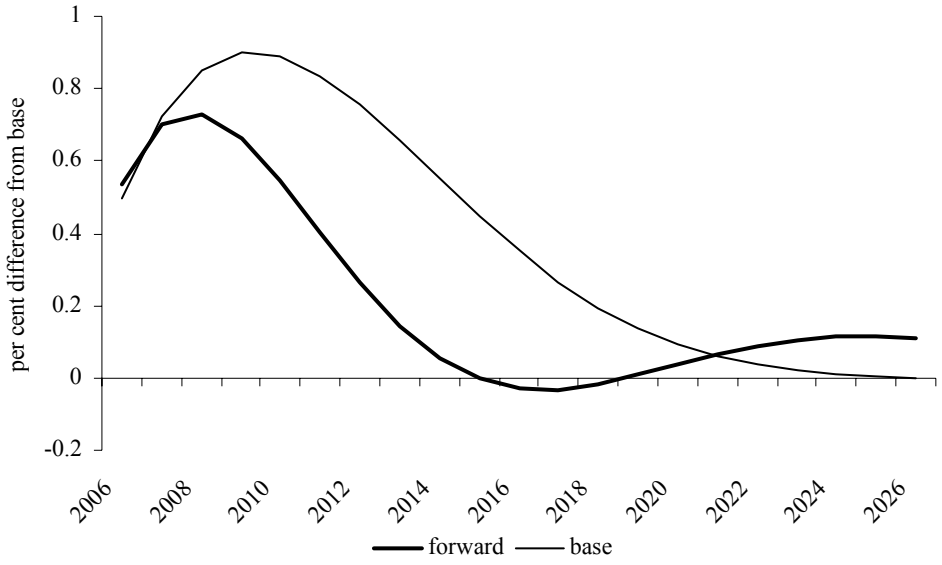


Rational consumers and Spillovers

The scale of multipliers and spillovers will depend on the structure of the world in which we expect them to take place. Over the last 30 years financial liberalisation and the build up of stocks of personal sector wealth have changed the way consumers behave, as Barrell and Davis (2007) show. If consumers are liquidity constrained it is difficult for them to change their behaviour in response to expectations and events outside their immediate control area. However, if consumers are free to maximize their welfare over time, and perceive that an increase in government spending now may raise their tax liabilities in the future, then they may change their actions now to accommodate the increase in taxes. It is important to be able to analyse multipliers and spillovers when consumers are fully forward looking and react in relation to their perceived permanent incomes. We do this below, not because it is the only description of the world we can imagine (or that comes out of the data) but because it is one possible future pattern that must be investigated even if it could not be uncovered by reduced form or VAR based analysis of multipliers.

Chart III.10 Fiscal multipliers for France – a permanent increase in borrowing

Forward looking and base model consumers



We present an illustrative simulation based on the largest sustained multiplier in Table III.1 with backward looking consumers. This involves a permanent one per cent of GDP increase in spending in France financed by a permanent one per cent of GDP increase in borrowing, and we plot the full multiplier in Chart III.10 below along with the multiplier we would see if consumers were forward looking. We assume in the second simulation that consumers in France and in other European countries (bar Italy where there is little evidence of its relevance) look forward and spend in relation to their properly evaluated permanent incomes, but that in the short term liquidity constraints and adjustment costs have some impact, inducing some inertia into consumption. The impact of a fiscal impulse is much less sustained if we assume that consumers look forward in relation to the net present value of their future incomes (and taxes). In neither case is there a permanent impact on the level of output either in France or in the Euro Area (the relevant monetary area) as we can see from Charts III.10 and III.11. The fiscal multipliers with forward looking consumers in all the Euro Area countries are noticeably smaller and less sustained than with our base model consumers who react to current income and wealth.

The Euro Area impacts with forward looking consumers are such that the average spillovers are clearly low and after 10 years they are zero as France and the Euro Area show no impacts from the impulse. This general view is confirmed by looking at the impacts of the permanent French fiscal expansion on three neighbours, Belgium, the Netherlands and Germany. The increase in the Euro Area exchange rate and in interest

rates that a monetary feedback produces in forward looking simulations 'crowds out' all the demand expansion within two quarters or so in Germany and the Netherlands, as we can see from Chart III.12. The effects are more sustained in Belgium because of its closer trade links with France.

Chart III.11 Fiscal multipliers for the Euro Area after a fiscal expansion in France – a permanent increase in borrowing

Forward looking and base model consumers

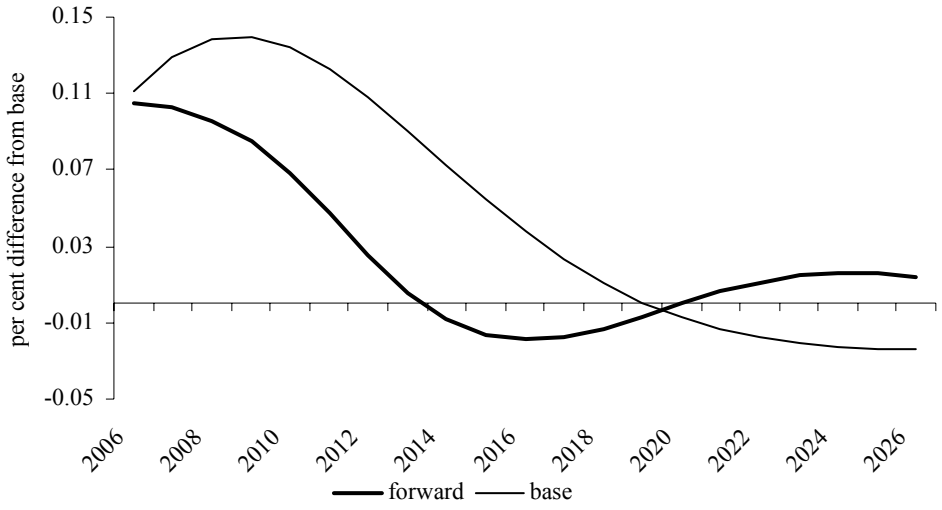
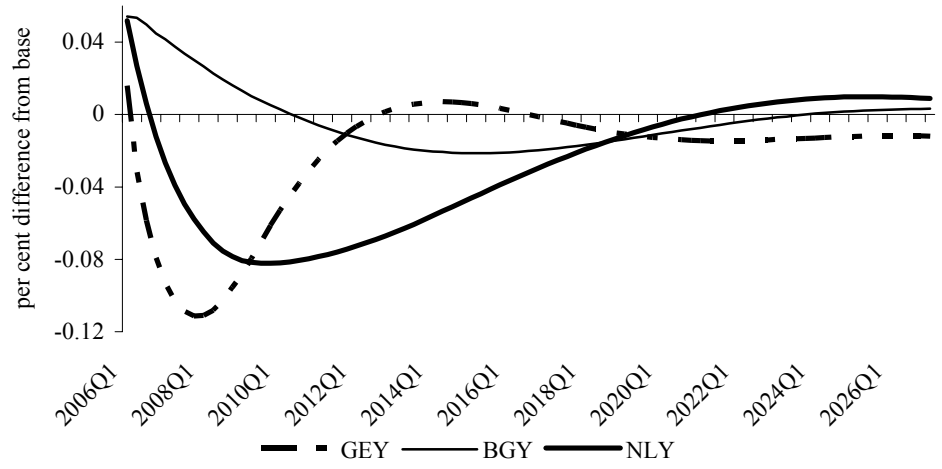


Chart III.12 Fiscal spillovers in the Euro Area after a fiscal expansion in France – a permanent increase in borrowing

Forward looking and base model consumers



Part IV Conclusions

In this paper we have used a structural model, NiGEM, to evaluate fiscal multipliers and spillovers from fiscal policy in Europe. Our conclusions have two dimensions. Policy analysis is best done with properly constructed structural models, as they give us both a better understanding of the economies we are looking at and a greater ability to change the assumptions we make in that policy analysis. Part of the process of proper construction of such a model is to investigate whether there are significant differences between economies, as irrelevant differences may cloud our analysis. Use of techniques such as panel analysis with PMG and CCE tests are important in the construction of these models. Our analysis indicates that fiscal multipliers and spillovers depend crucially on structural assumptions about policy and the formation of expectations The other dimension to our conclusion is that fiscal policy has limited effects on the economies of Europe, and that as a result the case for fiscal policy coordination is weak except in the very short run. The case for coordination rests on spillovers that we suspect are largely absent, and as the world becomes more financially liberalised they will become even smaller than our central estimates based on historical data suggest.

As an accurate description of trade patterns is central to the analysis of spillovers in Europe we began with a detailed discussion of trade equations. We compared estimates of the parameters of export and import equations under the assumptions that all countries differ (OLS), that there are testable and observable commonalities especially in long run structure (PMG) and that there are common effects missing from our equations that might influence our results (CCE). Trade parameters obtained from CCE estimates perform best in NiGEM, both in the sense that they are econometrically easier to defend and that they improve model properties, albeit in a minor way.

Fiscal multipliers depend on structural factors such as financial structure, openness, pattern of trade and the macroeconomic policy environment. A country's openness to trade, as measured by its import penetration, is inversely related to the size of its fiscal multiplier, as the impulse from fiscal policy spills over to other countries through imports. It also reflects the fact that more open economies are more susceptible to the impact of the negative feedbacks that monetary policy and the financial environment induce. A fiscal expansion in the Euro Area would precipitate an increase in interest rates and hence long term interest rates (and the cost of capital) would rise, as would the exchange rate of the Euro Area against other countries. All countries would suffer

competitiveness losses that would reduce the impact of any fiscal impulse, and countries like Ireland with strong trade links outside the area are likely to be more strongly affected than are more Euro Area trade oriented countries such as Spain.

A structural model enables us to investigate the scale of multipliers under different policy assumptions. The size of fiscal multipliers is affected by both the speed of response of the monetary authorities and by the need for the government to keep borrowing in check, i.e. to raise taxes to finance spending. Initially, multipliers are larger when a fiscal impulse is coordinated across countries, indicating that spillovers are positive. However, if we assume that consumers look forward and take account of their future tax liabilities, both multipliers and spillovers become smaller, and spillovers can quickly become negative within the year in this situation. Even in a world with 'myopic' consumers spillovers from trade become negative after 2 years.

Our results indicate that fiscal policy co-ordination may have a positive impact for a short while, but that the case for sustained fiscal impulse in a coordinated fashion is weak. It is widely thought that small countries would argue more strongly for coordinated policies, as spillovers to these countries are larger, and their multipliers are smaller. Our analysis suggests that openness, rather than size is the important factor determining the need for coordination. Thus, the core Europeans would see more reason for coordination than would Denmark, Sweden, Finland, Portugal or Spain because of the pattern of spillovers from these countries. Germany is noticeably more open as measured by import penetration than France, the UK and Italy, and hence would have a stronger reason to argue for coordination than do the countries in the former group.

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