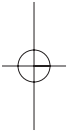
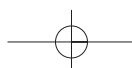


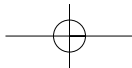
**“NORTHERN AND EASTERN ENLARGEMENT OF  
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*by Andrew Hughes Hallett,  
Svend E. Hougaard Jensen  
and Christian Richter*



SUERF – The European Money and Finance Forum  
Vienna 2004





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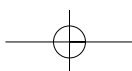
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## NORTHERN AND EASTERN ENLARGEMENT OF EMU:

### Do Structural Reforms Matter?<sup>1</sup>

*by Andrew Hughes Hallett<sup>2</sup>,  
Svend E. Hougaard Jensen<sup>3</sup>  
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#### Abstract

This paper studies the incentives to join or enlarge a monetary union under alternative assumptions about the extent of market reform within the union and in candidate countries. Lack of labour mobility, wage/price flexibility or fiscal reform brings costs for both new entrants and in the existing union. Countries will only want to join a union where there has been sufficient reform, and where markets are more flexible than their own. But existing members will want the same properties of their new partners as well. Fiscal restrictions, or a lack of fiscal flexibility, will exaggerate this incentive mismatch and may delay the necessary reforms.

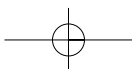
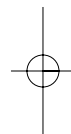
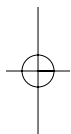
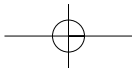
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<sup>2</sup> Vanderbilt University and CEPR

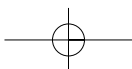
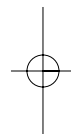
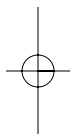
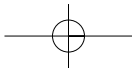
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## 1. The issues

While many countries in Central and Eastern Europe have expressed a strong desire to join the European Union (EU), including its Economic and Monetary Union (EMU), some existing EU members have been reluctant to introduce the single currency, even if they satisfy the criteria for doing so. On the other hand, the current members of the monetary union are not necessarily interested in allowing *any* candidate into the EMU. It seems as if the countries who want to join the EMU are those whom the existing members may not want to have admitted; and those countries whom the existing members would like to have join are exactly those who are unwilling to join. That has clearly complicated the enlargement process.

Several factors, including non-economic ones, may be critical for the decision to join or enlarge the EMU. In this paper we discuss the role of economic reform and labour market flexibility, focussing on whether a candidate country is sufficiently reformed to join an existing union; and on whether the existing members are reformed enough for an outsider to find it attractive to join.<sup>5</sup>

To pursue this analysis, we distinguish between three different categories of European countries here. First, there are the current members of the EMU, referred to as the Eurozone. Second, there are the countries which are able but possibly unwilling to join the EMU (typically the UK, Denmark and Sweden), referred to as the “N-countries”. Third, there are the countries willing but possibly unable to join (like Poland, Hungary and the Czech Republic), referred to as the “E-countries”. This distinction seems to be relevant not only with respect to recent labour market performance, but also in relation to the magnitude and speed of initiatives designed to improve the functioning of the labour market.

In fact, recent works by the OECD (see, e.g., Turner et al., 2001) provide evidence to support our claim that N-countries and the Eurozone differ. For example, when looking at estimates of the *level* of the NAIRU, there certainly is a difference between the Eurozone and N-countries: While the NAIRUs in

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<sup>5</sup> The role of structural reform has already received a lot of attention (see, e.g., Calmfors, 2001), and has generally been seen as a question of whether, or at what pace, a less reformed candidate country would be able to meet a certain set of entrance criteria before being let into a better reformed union (see, e.g., Ozkan et al., 1997).

## 8 The issues

1999 in Denmark, Sweden, Norway and the UK were estimated to, respectively, 6.3, 5.8, 3.7 and 7.0%, respectively, the corresponding numbers for France, Germany, Italy and the Euro area were, respectively, 9.5, 6.9, 10.4 and 9.0. Similarly, when comparing the *changes* in the NAIRU, it is remarkable that it has been falling in all N-countries except for Sweden in the 1990s, whereas it has been rising in all the major Eurozone countries.<sup>6</sup> And the natural rate of unemployment in France and Germany has almost certainly risen since those figures were published.

Some initial attempts to estimate the impact of labour market policies and institutions on the performance of labour markets in E-countries have been made. For example, Riboud et al. (2002) suggest that most of the E-countries have adopted labour market institutions similar to those in the EU and are, therefore, likely to have introduced rigidities similar to those in the existing EU. Overall, E-countries are found to be in the middle of the labour market flexibility scale when compared to current members of the EU.<sup>7</sup> Therefore, it may not be a lack of flexibility per se that explains the reservations by the Eurozone to admit E-countries. The Eurozone seems to be more concerned about factors such as monetary instability, inflation, fiscal irresponsibility, competition for structural funds, unemployment and poverty, mass migration, social dumping and delocalization. In fact, it could be argued that “mass migration and social dumping” are signals of labour market flexibility in some places and rigidities elsewhere. Therefore, the problem behind E-countries’ admission is not merely one of wage rigidity; but also of low productivity and competitiveness in the official sector and more widely.<sup>8</sup>

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<sup>6</sup> The *initiatives* taken to improve the labour market performance in Europe have also been monitored closely by the OECD (see, e.g., Elmeskov and Kohl, 1998, and Elmeskov et al., 1998). A comparison between the UK and Germany shows the point that the N-countries and the Eurozone also differ in that respect. For Germany the OECD listed 24 recommendations for changes in the area of labour market reforms, whereas for the UK only 6 recommendations were made. When assessing to what extent, and how, the two countries have reacted to those recommendations, it turns out that Germany took *no* action in 3 cases, and in 2 cases took an *opposite* action. And among the 19 remaining cases, only in 3 was the action considered sufficient. On the other hand, the UK acted on *all* the recommendations and, in half of the cases to an extent which, in the judgement of the OECD, was seen as sufficient.

<sup>7</sup> This is clearly a very broad picture. Indeed, as well as the different structures found within the EU, diversity in employment protection legislation, support to the unemployed, taxation on labour, strength of unions etc. are found within the E-countries.

<sup>8</sup> Burda (1998) argues that the transition from command to market economies in East and Central Europe has created an official sector with low competitiveness and an underground sector with low taxation, low social protection, tax evasion, wage flexibility and free entry and exit (migration). Unlike the official sector which retains many rigidities, the privatised and underground sectors could pose a serious threat to the existing EMU countries.

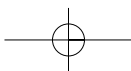
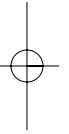
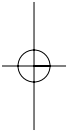
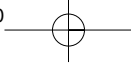


In order to establish how a labour market reform could affect a country's decision to join a monetary union, as well as a decision by the existing members whether to admit a new member, we need a formal model of the incentives to adopt a common currency. Our approach has been to perform a cost-benefit analysis – in the spirit of Bayoumi (1994) – of whether the adopting of a common currency is *net* beneficial, by calculating the changes in welfare for both parties if the candidate country does join, compared to the *status quo* if it does not (Hughes Hallett and Jensen, 2001, 2003, 2004). We show below that these gains depend on the size of the countries and their underlying disturbances; the correlation between those disturbances; the transaction costs between currencies; the degree of rigidity in the adjustment of nominal wages; the degree of rigidity in the use of fiscal policy; and the level of factor mobility across countries.

Our results suggest that the N-countries are unlikely to benefit from joining a Eurozone with limited market flexibility. Interestingly, introducing greater labour market flexibility does make joining the Eurozone more attractive in each case. But not by very much if there are significant restrictions on the use of fiscal policy. Correspondingly, we find that the Eurozone would always be more willing to have the N-countries join than the N-countries would be to join.

If the same steps are repeated with the data for the E-countries, we find that their losses, due to insufficient flexibility or reform, are indeed much smaller due to a reduced risk premium. Consequently, the existing EU would find accession by the E-countries less attractive (at any level of market flexibility) than the E-countries would find it to join.

From here the paper proceeds as follows. In Section 2 we provide an overview of a theoretical model, and in Section 3 we present some “orders of magnitude” calculations of the incentives for joining the EMU. Sections 4 and 5 then expand on our quantitative assessment, by providing a simulation study of the incentives to join and the incentives to reform using a large-scale multicountry model. Section 6 uses the same model to examine the interplay between structural reform and fiscal policy. Section 7 concludes.



## 2. A theoretical framework: An overview

In order to establish how a labour market reform could affect a country's decision to join a monetary union, as well as a decision by the existing members whether to admit a new member, we need a formal model of the incentives for either side to adopt a common currency. We have created such a model by adapting, and then extending, a model first suggested by Bayoumi (1994).<sup>9</sup>

The model is cast in a general equilibrium framework. Compared to most existing literature based on optimal currency areas, our model has stronger microfoundations, and therefore allows for assessments based on an explicit treatment of incentives and welfare comparisons. Thus, our methodological approach is to undertake a cost-benefit analysis of whether the adopting of a common currency is *net* beneficial, by calculating for both parties the changes in welfare if the candidate country does join, compared to the *status quo* if it does not.

The model has four main building blocks: (1) production; (2) wages; (3) exchange rates; and (4) aggregate demand. The main macroeconomic variables that enter the enlargement decision include:

- The interrelationship of aggregate demand between countries

This is captured in the form of expenditure shares, denoted by the parameter  $\beta_{ji}$ , which is the proportion of country  $j$ 's income spent on goods produced in country  $i$ . The  $\beta_{ji}$  parameters are subject to the normalisations  $\sum_i \beta_{ji} = 1$  and  $\sum_j \beta_{ji} = 1$ , to ensure that total income is spent and that aggregate demand exhausts income spent on each good.

- The size of countries

A country is characterized as “large” if it has a “large impact on the union”, and “large” can therefore be equated with being “open” with respect to the rest of the union. But the same economy may not be “large”

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<sup>9</sup> The formal details of our analytical framework are set out in Hughes and Jensen (2001, 2004). A detailed technical exposition is available upon request.



## 12 A theoretical framework: An overview

or “open” with respect to the rest of world. Similarly, “small” means having a small impact on the union, and hence possibly “closed” with respect to the union but not necessarily with respect to the rest of the world.

- The size of the underlying disturbances

We consider both supply and demand disturbances. The next section shows how these are handled in the empirical implementation.

- The correlation between the disturbances in different countries

For the empirical implementation we calculate standard deviations for the demand, supply and monetary disturbances in the N- and E-countries, and the correlations of each of those individual country shocks with the corresponding average for the core or periphery group of countries in the EU.

- The costs of transactions between different currencies

Each country has to choose its preferred *exchange rate* regime. They can either opt for a monetary union with a single currency, or they can choose separate currencies. In the latter case there is a transactions cost between the two currencies, implying that, in value terms, goods exported from country  $i$  “shrink” by a factor  $(1-\tau_i)$  when they arrive in country  $j$ . This is the usual Samuelson “iceberg” assumption. So rather than modelling a separate transportation sector, we simply assume that a fraction of a good shipped melts away in transit. For simplicity, we let  $\tau_i = \tau$  for all countries.

- The degree of rigidity in the adjustment of nominal wages

To incorporate wage rigidity, a so-called “normal” wage is defined to hold hold when there is full employment, when there are no shocks, when the initial level of prices is normalised at 1 for convenience, and when the exchange rate is at its parity value. If there is excess demand for labour when the wage is at its “normal” wage level, then wages will be raised until the excess demand falls to zero. But if there is excess supply of labour at the “normal” wage, then wages remain at this level and unemployment results. Very importantly, we assume that employment would always be at its full-employment level if the exchange rate is flexible.

- The level of factor mobility across countries

In the European Union with a single market, no one can prevent the unemployed trying to leave one country and seek employment in another country if they want to. However, this is not the same as saying that they actually *do* move in response to imbalances. Indeed, there is plenty of evidence of low labour mobility in Europe, at least compared to the US (see, e.g., Begg (1995) and Obstfeld and Peri (1998)). Here we simply assume that some initiative, of whatever kind, is taken to increase the degree of labour mobility such that enough flexibility is created to accept these movements in the excess supply of labour. This requires that country  $j$ 's markets have sufficient wage and price flexibility to absorb the additional workers from country  $k$ , or to reemploy them at home. And vice versa when the shocks hit country  $j$ .

At this stage it may be helpful to have a little intuition into why these factors are important for determining the extent of the adjustment costs and welfare losses in a monetary union. The key point in this model is that all the costs (welfare losses) are caused by rigidities in the labour markets that prevent wages, output and employment from adjusting as they should to clear the goods and labour markets around the cycle. By preventing adjustment in one place, those rigidities cause spillovers onto others via trade. Consequently, the more flexible each country's labour market ( $\delta_j, \delta_k$ ), the smaller the adjustment needed at home or in other countries. A higher  $\delta_j$  value means that more unemployed can migrate to country  $k$  or can get employment at lower wages at home in bad times; or, more plausibly, that wage rises will be moderated by inflows of labour or attempts at output stabilisation in boom periods. Hence the costs fall with  $\delta_j$  and  $\delta_k$ .

However, the costs (welfare losses) fall with the correlation between the shocks because there is then less need for each economy to adjust and absorb the unemployed from abroad; or have their unemployed absorbed when the domestic economy is in a downturn; or to contain wage inflation in an upturn – assuming, each time, that market flexibility is incomplete ( $\delta_j, \delta_k < 1$ ). Of course, if the markets are completely flexible,  $\delta_j = \delta_k = 1$ , then there are no costs irrespective of the degree of correlation involved.

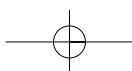
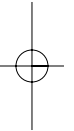
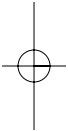
By contrast, the costs of adjustment will rise with the size of the shocks ( $\sigma_j^2, \sigma_k^2$ ), given a certain level of intercountry correlations. And the size of the adjustments will rise with the size of the spill-over effects, on one economy,



#### 14 A theoretical framework: An overview

from a disequilibrium in the other ( $\beta_{jk}, \beta_{kj}$ ) and the larger are the impacts of cyclical fluctuations at home ( $\beta_{jj}, \beta_{kk}$ ). Finally, since the adjustments all have to go through the labour market, the costs (losses) will be larger the larger the share of labour in national income ( $\alpha$ ), affected by the residual rigidities.

In the next section we present some “orders of magnitude” calculations to indicate the likely size of the incentives which the N-countries and the E-countries face for joining the EMU. At the same time we can calculate the corresponding incentives for the existing members of the union to accept new members from either group into the EMU.



### 3. A quantitative assessment: an “orders of magnitude” calculation

To demonstrate the empirical significance of the above-mentioned variables for the enlargement decision, we need to calculate the expected welfare gains/losses. Rather than presenting the specific formal details here, we refer the reader to Hughes Hallett and Jensen (2004). We clearly also need data for the macroeconomic variables, for each country or region, and again the reader is referred to Hughes Hallett and Jensen (2004) for details as to how we found those data. On the basis of the relevant theory and data, we are fully equipped to calculate a cost-benefit analysis for each candidate country. We first consider this from the perspective of N-countries.

**N-countries** Two questions need to be asked: First, “would the N-countries want to join the Eurozone?”, and, second, “would the Eurozone want to accept the N-countries?” In each case we have calculated the net benefit of joining or being joined under the 10 percent market flexibility and 50 percent market flexibility assumptions, and also when the candidate joins alone or as one of the group.

Our results show that none of the N-countries would benefit from joining the Eurozone on current data, with either limited market flexibility or with a stronger degree of labour market reform. Interestingly, greater labour market flexibility does make joining the Eurozone more attractive in each case. But it does not do so by very much. The degree of rigidity, as captured by our model, is simply too large.

In fact the degree of flexibility needed to reduce these welfare/utility losses to zero, if shared equally between the candidate country and the rest of the EU, runs from about 70 percent for Denmark, to 90 percent for the UK. That means substantial labour market reforms would need to be undertaken – enough in fact to reach the point at which wage and price flexibility (or labour mobility) would clear 70 percent to 90 percent of any unemployment or other macroeconomic disequilibria – before it would become worthwhile for these countries to join on economic grounds.

Such a strong liberalisation seems somewhat implausible in the current political environment. However, that said, the expected losses, at 1–2 percent



## 16 A quantitative assessment: an “orders of magnitude” calculation

*net* in utility units, are not huge and imply absolute losses which are roughly double the conventional estimates of the expected gains from adopting a single currency, see European Commission (1990). And Denmark is clearly the closest to wanting to join, while the UK is furthest away. Similarly, it makes very little difference if these countries join as a group. The net losses are slightly larger if they do so, since they then have to deal with the rigidities of their fellow N-countries as well as the rest of the Eurozone, but the extra costs are very small.

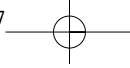
Our results also show that, at these levels of market flexibility, the Eurozone would be made *net* worse off if the N-countries were to join. The effect of the additional rigidities would outweigh the reduction in transactions costs and the gains in price stability. Moreover, the Eurozone countries would be more willing to have the N-countries join than the N-countries would be to join.

**E-countries** Repeating the same steps with the data for the E-countries shows that the losses for the E-countries due to insufficient flexibility or reform are indeed much smaller: typically one third to one tenth the size of the corresponding figure for the N-countries, at the same level of market inflexibility – with some net gains starting to appear when the degree of flexibility reaches the level where wage (or migration) adjustments can be relied on to eliminate half the E-countries’ unemployment.

Evidently, the Czech Republic, Hungary and Estonia are closer to being able to benefit at low levels of market flexibility or reform than Poland and Slovenia. On the other hand, and again as predicted, the existing EU would find accession by the E-countries a good deal less attractive (at any level of market flexibility) than the E-countries would find it to join. Two to four times less attractive in fact.

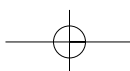
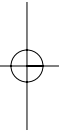
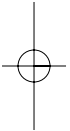
That contrasts with the results shown for the N-countries: the EU-12 would find it up to 50 percent more attractive to have the N-countries join, than the N-countries would find it advantageous to join. In other words, our theoretical model stands confirmed: those who have the largest incentive to join are the least acceptable, and those who might not wish to join are the most welcome. However, what our theoretical model did not show is the extent to which ordinary market rigidities can affect the incentives to join a single currency zone. Net benefits do not appear until the degree of flexibility has gone past the 40 percent mark. At that point nearly half of any unemployment problem can be cured by wage flexibility or migration. And for the N-countries, we need this flexibility index to rise above 70–90 percent. To put these numbers

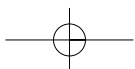
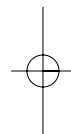
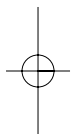




A quantitative assessment: an “orders of magnitude” calculation 17

in perspective, the 90 percent figure for the UK in table 3 would mean absorbing roughly twice as many emigrants from the EU as she has actually had in the past two decades; or establishing the wage flexibility necessary to create an equivalent number of jobs (roughly 2.7 m) over the same period.





#### 4. An extended empirical analysis: A simulation approach

The rest of this paper is concerned with a simulation study of the incentives for enlargement and for structural reform. At its simplest, this can be seen as an attempt at verification of the results we have obtained so far – in particular the Groucho Marx problem of incentives for enlargement, and our explanation for the lack of progress towards reform. We aim to get some empirical insight into why, in a world with asymmetries and differential rigidities in wages and prices:

- There is a serious enlargement problem – some want to join, and some do not.
- There is a structural reform problem – many agree that reforms are necessary, but few find the incentives to implement them.
- There is a “hold-up” problem, in which short run costs up front are perceived to outweigh the discounted sum of smaller or uncertain future benefits; and whether the current fiscal constraints effectively prevent the necessary reforms and exaggerate the Groucho Marx and disincentive effects identified above.

**The model:** We carry out the empirical evaluation using the Oxford Economic Forecasting (OEF) model, which is a traditional multi-country econometrically estimated model (Oxford Economic Forecasting, 2003). There are two reasons for choosing the OEF model. First, it is the only publicly available model which contains a full specification of all the regions we are interested in, that is, the N-, E- and Eurozone countries. Second, unlike the OECD’s Interlink and the IMF’s Multimod, the OEF model has a clear specification of the structural (supply-side) asymmetries that are the focus of this paper.

The OEF model contains a sequence of theory based empirical models covering all the OECD economies, 14 of the largest emerging markets economies, and six trading blocs covering the rest of the world economy. These country models are then linked by trade relations, world prices for

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tradables, intercountry capital flows, and hence interest rate and exchange rate links under different possible exchange rate regimes.<sup>10</sup>

The countries covered specifically then include the US, Canada and Japan, plus China and Russia outside the EU; the Eurozone countries, and the UK, Denmark and Sweden outside but in the EU; and Poland, Hungary and the Czech Republic among the new accession countries. Each of these country models is based on a traditional income-expenditure specification, plus a somewhat more detailed supply side specification to determine wages, prices and employment, and unit labour costs. There is also a government sector to conduct fiscal policy. Total government revenues are collected from a variety of sources, and the government has a number of different outlays. These fiscal policy variables may affect labour market behaviour (see below). Although the specification of each country is broadly similar, there are important differences both in the level of aggregation (larger countries contain more disaggregation, and more detailed financial sectors), and in terms of different responses to various shocks.

Since we are concerned about wage rigidities in general, and the supply side in particular, we note here the way in which wages and salaries are set. The OEF model incorporates short run nominal and real wage rigidities, which ensure the existence of “involuntary” unemployment and monetary effects on the real economy. In the long run the employment equation solves for a constant level of real unit labour costs, given by labour’s share in the production function, while the wage and price equations solve for the level of unemployment consistent with this labour share. With long run vertical Phillips and aggregate supply curves, monetary policy then determines the inflation rate, while structural, or supply side policy determines the unemployment rate (structural unemployment is possible). The equilibrium rate of unemployment is related to the gap between the total real cost of labour to employers, and the real value of post-tax wages received by employees.

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<sup>10</sup> There is also a monetary sector in the model containing a monetary equilibrium and a Taylor rule. The exchange rate regimes are floating for the dollar, euro, pound, yen and other major currencies; but a single currency within the Eurozone, and a strict exchange rate targeting arrangement for Denmark (ERM-II), and for the accession countries in Eastern Europe. It is important to note that the model also determines some world market variables (such as oil and commodity prices) and world aggregates (world GDP, industrial production) endogenously. A more detailed specification of each of the model’s expenditure blocs is provided in Appendix A.

**Short run rigidities:** Real wage rigidities are higher in some countries than others. In general, each country is modelled in terms of an *error correction model* (ECM), so that each equation contains short run deviations from the long run equilibrium – in this case, the natural rate of unemployment  $\bar{U}$ , or NAIRU. The smaller the adjustment parameter, the longer it will take to return to equilibrium after a shock occurs. Here we are interested in the difference between the labour market rigidities in the Eurozone, and those prevailing outside. Within the Eurozone, each country is expected to have similar structures, as captured the average earnings equation (AEE). By contrast, the asymmetry between the Eurozone countries and N-countries may be substantial. A comparison of the AEE in Britain and Germany serves to illustrate this point. The British AEE reads as follows

$$\begin{aligned}
 D \ln E = & 0.17 + D \ln P + 0.37978 \cdot D \ln Q^c - 0.01162 \cdot D \ln U_{-1}^a \\
 & + 0.13844 \cdot D \ln (P^c/P) - 0.54447 \cdot D \ln (P/P_{-1}) \\
 & - 0.11192 \cdot D \ln (P_{-1}/P_{-2})^e - 0.067024 \cdot D \ln (P_{-2}/P_{-3})^d \\
 & + 0.4553 \cdot D \ln (E/P)_{-1}^b \\
 & - 0.098497 \cdot [\ln((E/P)_{-1} \cdot Q_{-1})^c + 0.07 \cdot \ln(U/_U)_{-1}^a] \quad (1)
 \end{aligned}$$

where  $E$  is average earnings (in nominal terms),  $P$  is the deflator for GDP,  $P^c$  is the consumer price index,  $U$  is the unemployment rate,  $\bar{U}$  is the NAIRU,  $Q$  is productivity, and  $D$  is the difference operator. The German AEE, meanwhile, has the following structure:

$$\begin{aligned}
 D \ln E = & 0.5 \cdot D \ln E_{-1}^b + \bar{U}_{-1}^2 \cdot 0.050 \cdot D \ln P^c + 0.10 \cdot D \ln P_{-1}^c \\
 & + 0.10 \cdot D \ln P_{-2}^c + 0.15^d \cdot D \ln P_{-3}^c + 0.10^d \cdot D \ln P_{-4}^c \\
 & + 0.300 \cdot D \ln Q_{-1}^c - 0.0025 \cdot D \ln U_{-1}^a \\
 & - 0.10 [\ln E_{-1} - \ln Q_{-1} - \ln P_{-1} + 0.015 \cdot \ln(U/_U)_{-1}^a] \quad (2)
 \end{aligned}$$

While exactly the same variables appear in the two AEEs, there are some clear differences between the short term behaviour of labour markets in the two countries. First, average earnings in the UK depend relatively more on the previous unemployment rate and the ratio of the current unemployment rate to the natural rate (the terms marked  $a$ ) in (1) and (2)). This is perhaps the key difference. It implies that the Phillips curve is steeper in the UK than in Germany or the Eurozone, and explains why the UK would have to bear a greater part of the adjustment burden if she joined the Euro as a more flexible economy. In boom conditions (excess demand), the UK would find herself having to accept more inflation than her partners to re-establish equilibrium, because of the upward flexibility of her prices and wages.

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Similarly, in the downturn, UK wages would have to fall disproportionately (or UK unemployment rise more than elsewhere to create the pressure for this wage disinflation). That, of course, is exactly the logic set out in the theory part of this paper (section 4). Interestingly, it is also the conclusion reached in the 6 numerical simulations conducted by the UK Treasury on this issue (HM Treasury, 2003).

Second, once a disturbance has set in, the German equation has more persistence, as reflected in a higher coefficient on the previous period's rate of change in average earnings (term b)). Third, the UK has more supply side sensitivity (term c)) if, for example, there is a negative productivity shock. Fourth, Germany has more persistent accommodation of price rises, out to  $P^c_{-4}$  instead of  $P_{-2}$  (term d)). Note also that  $P^c$ , unlike  $P$ , has import prices in it, and hence implies an additional source of inflationary stickiness in Germany. Finally,  $P$  is influenced by capacity utilisation which implies extra market sensitivity in the British equation (term e)).

**Long run rigidities:** In the long run, structural rigidities affect unemployment, and hence wages and economic performance. The equilibrium rate of unemployment is determined by the "tax wedge"  $W$ , which is defined as the gap between total cost of labour to employers – including social security contributions – and the real value of post tax wages received by employees, and by energy prices. Thus

$$\ln(\bar{U}) = \beta_0 + \beta_1 W + \beta_2 \ln(P^f/P) \quad (3)$$

where  $P^f$  are domestic fuel prices,  $P$  is the GDP deflator, and

$$W = \ln \left[ E(1 + \tau^p + T^{poc}/Y^{WS})/P \right] - \ln \left[ E(1 - \tau^a - \tau^s)/P^c \right] \quad (4)$$

where  $\tau^p$  is the payroll tax rate,  $T^{poc}$  is the personal sector other contributions,  $Y^{WS}$  are wages and salaries,  $\tau^a$  is the average personal income tax rate,  $\tau^s$  is the employee social security contribution rate, and  $E$  and  $P^c$  are as before. Notice that rigidities may vary between countries in the long run because the  $\beta$  coefficients in (3) differ; or because the components of the tax wedge (4) take different values in different places. Structural unemployment can therefore persist, and the choice of monetary regime may have long run effects through  $W$  (if not other channels).

## 5. EMU and structural reform

### 5.1 *A baseline solution*

We turn now to the importance of market inflexibilities in extending EMU, and their role in creating incentives to join or be joined. To assess that we have to create a counterfactual where there are no enlargements, no new flexibilities, and no additional fiscal constraints. This baseline solution would therefore not have the UK or Poland (as the representative N- or E-countries) joining EMU; it will not have the SGP's 3% deficit limit imposed on those countries; and will not have the current degree of labour market flexibility in Germany and France increased.

It is important to stress that the projections from such a scenario are not of great interest in themselves. But they are necessary, as a benchmark against which the benefits of an alternative scenario can be measured – Britain joins the euro; or national fiscal policies are restrained; or Germany succeeds in making her labour market more sensitive to market conditions. Consequently, it is not the baseline values themselves which matter in any of the subsequent comparisons, but whether the *deviations* from that baseline can be said to be favourable or unfavourable.

Indeed, as in any linear comparisons, the baseline values do not influence the results and conclusions we discuss. Since they are common to both sides of each comparison, they cancel out. In other words, if we were to increase the degree of market flexibility in one country (or decrease it in another), we would need to assess the results as favourable or unfavourable depending on whether the deviations from the baseline are now *more* favourable or *more* unfavourable than their counterparts in a previous simulation when those additional flexibilities or inflexibilities were not present.

In what follows, we focus on deviations of (i) output, (ii) unemployment and (iii) inflation from the baseline path. Table 1 contains the baseline simulation values for those variables for the countries highlighted in the comparisons which follow, averaged over the period 2002–2007 inclusive. They assume the absence of any extensions of EMU or major changes in market behaviour.

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**Table 1: Baseline Statistics: Economic Development in the Absence of Any New Enlargement, 2002–2007**

|                  | BRITAIN   | GERMANY    | FRANCE    | BELGIUM | POLAND  |
|------------------|-----------|------------|-----------|---------|---------|
| Inflation (%)    | 1.5       | 2.0        | 2.0       | 2.0     | 5.0     |
| GDP Growth (%)   | 2.5       | 1.8        | 3.0       | 2.8     | 4.4     |
| Unemployment (%) | 3.0 – 3.5 | 10.4 – 8.1 | 9.0 – 7.2 | 11 – 10 | 16 – 14 |

*Additional Figures:* UK interest rates fall from 5% to 4%; UK debt increases 8% over 4.5 years (the debt ratio therefore falls by 7% point over the same period); the Pound depreciates from €1.59 to €1.43, and the Dollar depreciates from \$0.85 to \$1.12 per Euro.

*Source:* Own Calculations

They show an uncontroversial future in which inflation and growth continue in the 1–2% and 2–3% ranges respectively; unemployment is falling but very slowly; and the euro appreciates against both the pound and the dollar very much as it has done during the 2002–3 period. The only exception to this is Poland, where inflation and growth has been a little higher in recent years.

Finally, it will be clear that our simulations are being conducted to obtain the medium term “steady state” consequences of joining or not joining under various degrees of market flexibility and reform. This will then imply the medium and long term incentives for membership. Of course, being dynamic, our calculations also show some of the costs and benefits along the way. We find that a horizon of 5 years or more is long enough to reach the steady state position of our theoretical analysis.

## 5.2 A Northern enlargement of the EMU

We first investigate the effects of a flexible country (Britain) joining a block of inflexible countries (the Eurozone). The framework for this simulation is that the government announces in advance that Britain would join the euro. Specifically, we assume that Britain would join EMU in the first quarter of 2005, and that this fact is announced in the third quarter of 2002. As a result, Britain adopts a “European” monetary policy from 2003 onwards; but the exchange rate is not completely fixed in the period 2002–2005. The exchange rate is then fixed at an entry level of €1.4316/£ at the first quarter of 2005 and does not change thereafter.<sup>11</sup> This assumption is consistent

<sup>11</sup> We have checked the sensitivity of the results of this assumption of the joining rate, and found our conclusions were not altered for a wide range of plausible joining rates from €1.60/£ down to €1.30/£. So the exact exchange rate value makes no difference. The particular value used here is the model’s equilibrium rate for the pound, and is very close to the market rate at the time of writing (€1.41/£, October 2003).



with the exchange rate criterion for joining EMU, and membership of ERM-II.

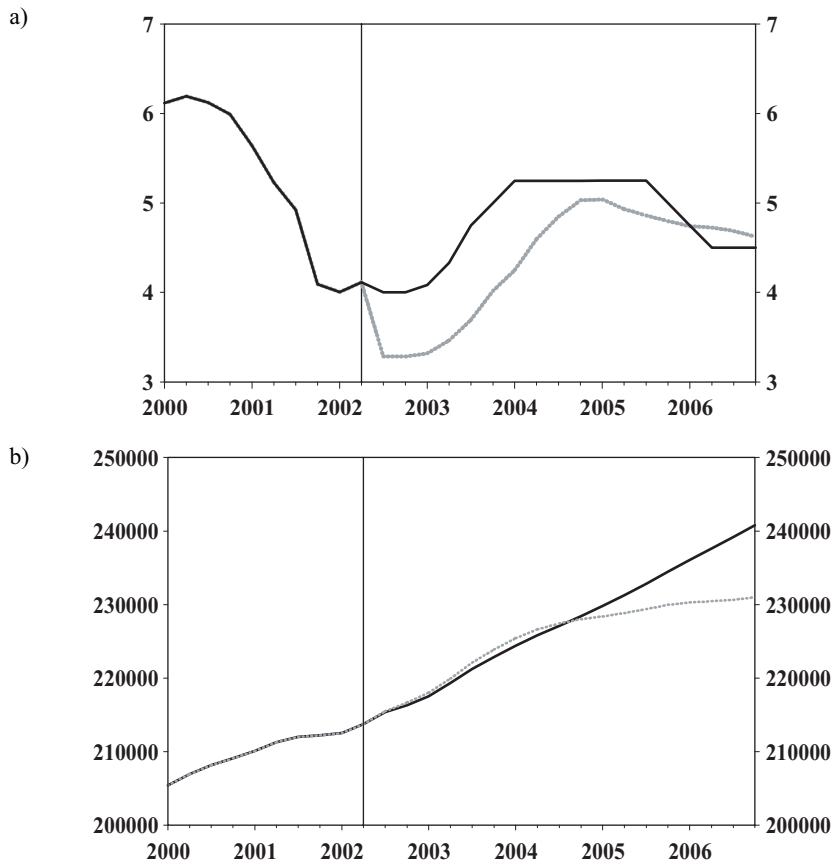
What happens? As a result of joining, Britain enjoys a lower short term interest rate (Figure 1a) over the entire simulation period.<sup>12</sup> The lower interest rate is a result of the relatively low degree of capital utilisation in the Eurozone. One would expect this lower interest rate would increase real GDP, together with the implied depreciation of the pound from €1.59/£ in 2002 (2nd qtr) to €1.4316/£ in 2005 (1st qtr).

But this expansionary effect does not take place (Figure 1b). It is true that lower interest rates and the depreciation of the pound have led to a small increase in output at the beginning of the simulation. However, by the time Britain joins the euro, the real GDP growth rate is well below the baseline: that is, from 2005 on. This reduction is driven by the economic state of the (less flexible) Eurozone. Since Germany and the other Eurozone countries are performing poorly (see below), and since Britain is now linked with the Eurozone via a fixed exchange rate, there is a stronger negative spillover effect onto Britain than before which can no longer be offset by monetary policy.

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<sup>12</sup> In Figure 1 - and all subsequent figures - the solid schedule refers to the baseline, and the dotted schedule refers to the simulation.

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**Figure 1: Britain in EMU and Flexible:  
Short-Term Interest Rate (a) and Real GDP (b); 3% Deficit Criterion**

The reason for the reduction in the GDP growth rate is that, towards the end of the sample, the euro appreciates against the dollar. Of course, the depreciation of the pound at the time Britain joins the euro has had an expansionary effect. But, given the British trade structure, the subsequent euro appreciation (with Britain as a member) makes Britain worse off again. So the current account worsens, and therefore GDP. That spills over into lower employment in the private sector and a rise in unemployment (Figure 2a).

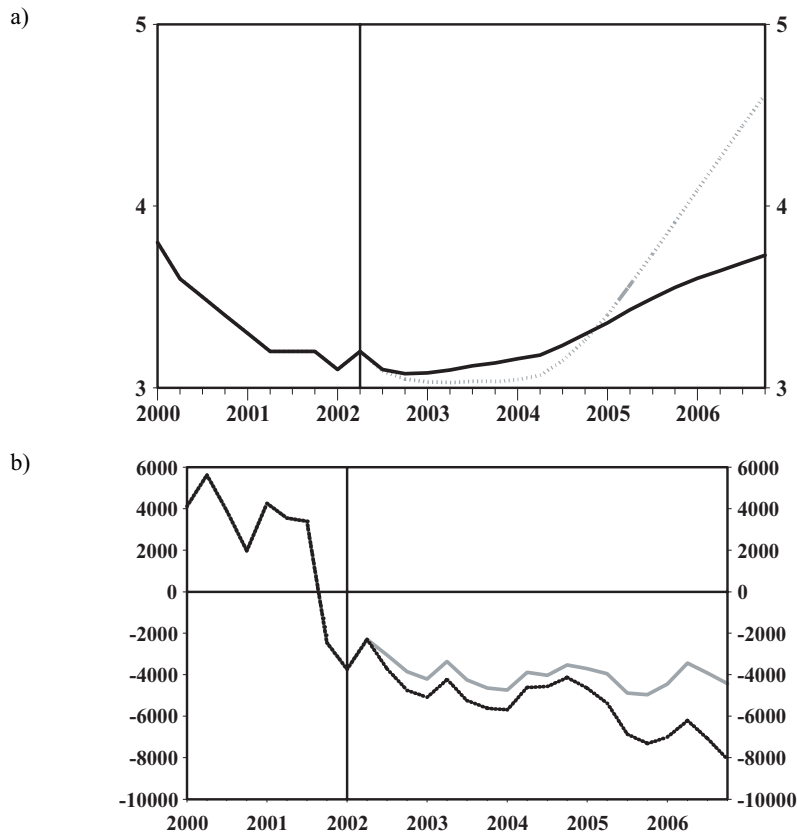


Figure 2: Britain joining EMU, Unemployment Rate (a) Government Debt (b)

That lower employment then has the effect of lowering average earnings, which in turn reduces the GDP deflator, and that then reduces the demand for labour in the private sector somewhat further.

At this point one would expect increasing competitiveness to have an effect. Unfortunately, the time horizon in these diagrams is too short to show the full effect of these adjustments on economic performance after 2007. However, at that stage falling average earnings do start to increase competitiveness again. Output and employment then expand, and continue to do so as long as expenditure cuts do not force the budget deficit to decline at the same time.<sup>13</sup> Here we have a clear example of a regime change creating short run costs but

<sup>13</sup> In fact, we find that the larger British deficit is caused by lower revenues, rather than by higher expenditures. Hence, it is expenditure cuts which cause the problems; revenues being already low. Raising revenues instead would be another option to clear the deficit.

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long run benefits. But whether those benefits will turn out to dominate the short run costs will depend very much on the size of the fiscal burden (debt) being created at the same time, and whether that burden would then trigger fiscal restrictions which hinder the improved economic performance and hence reduce the scope of those future benefits. It appears that the latter is a real possibility.

The reason is as follows: Britain's unemployment rate behaves as the analogue of GDP, and rises as GDP falls. This has a knock on effect on government debt which rises sharply (Figure 2b). At this point we would have to take into account that, if Britain were to join the euro, she would be subject to the SGP's 3% deficit criterion. That would trigger sharper cuts in public expenditures, and hence larger falls in GDP (and larger rises in unemployment) than we observe here.

We also had a look at inflation, which is similar to what we observe in the baseline and is not reported. The same holds for the impact, on Germany, of Britain joining the Eurozone. German GDP improves slightly, as does the unemployment rate. The bottom line is, therefore, that a more flexible Britain is made worse off by joining, and a less flexible Germany is made better off – exactly as our theoretical results had predicted. The reason is as stated earlier. In a boom period, the flexible economy gets the wage and price rises. In a recession, it carries the extra unemployment and debt.

### ***5.3 Regime changes in the presence of rigidities***

There remains a question of why the choice of exchange rate regime matters. The model shows each labour market suffers real and nominal rigidities in the short term; but no nominal rigidities in the long term. The choice of exchange rate should therefore have no effect.

The exchange rate regime, however, does have real effects, partly through the labour market and partly outside that market. We saw that structural unemployment could be created because unit labour costs did not solve for a level of unemployment consistent with the market clearing rate of unemployment – these markets being imperfectly competitive; or because policy or falling domestic competitiveness alters that natural rate via the tax wedge  $W$ . To the extent that the combination of exchange rate and market rigidities can affect either unit labour costs or the real exchange rate, then the exchange rate does matter. If deflationary pressures and a falling currency

widen the wedge via the price terms in (4), then long run unemployment will be higher and GDP lower. This is what happens to the UK in figures 2 and 3. That effect can be offset if average tax rates fall with growth, or if increasing wage competition lowers unit labour costs and raises aggregate incomes. The UK's losses then stabilise.

Outside the labour markets, if market rigidities cause deflation in the short term, government revenues will fall and expenditure rise. The deficit then widens as we have shown; with the result that debt and interest payments increase. In that case, Ricardian equivalence, even if imperfect, means that consumption and investment expenditures must fall in anticipation of tax increases – which means those aggregate demand components will remain “below trend” so long as the deficit remains unresolved.

The rising euro, meanwhile, produces a trade deficit and also smaller capital inflows from smaller interest rate differentials in the UK. Consequently investment falls ( $S-I$  gap turns positive) which means that capacity output is lower, unit labour costs higher, and the subsequent pressure on prices implies tighter monetary policies. Again, the losses will persist. But notice that each of these problems would get fixed if tax revenues could be increased in the earlier growth phase, so as to work off the budget deficit and import surplus. And given that incomes would then be higher, average tax rates (including payroll taxes) would eventually fall; and hence structural unemployment and unit labour costs with them. The UK economy would then return to base – which is exactly what we see when taxes are increased in figures 8a and 8b below. That is the case in which the exchange rate regime is neutral.

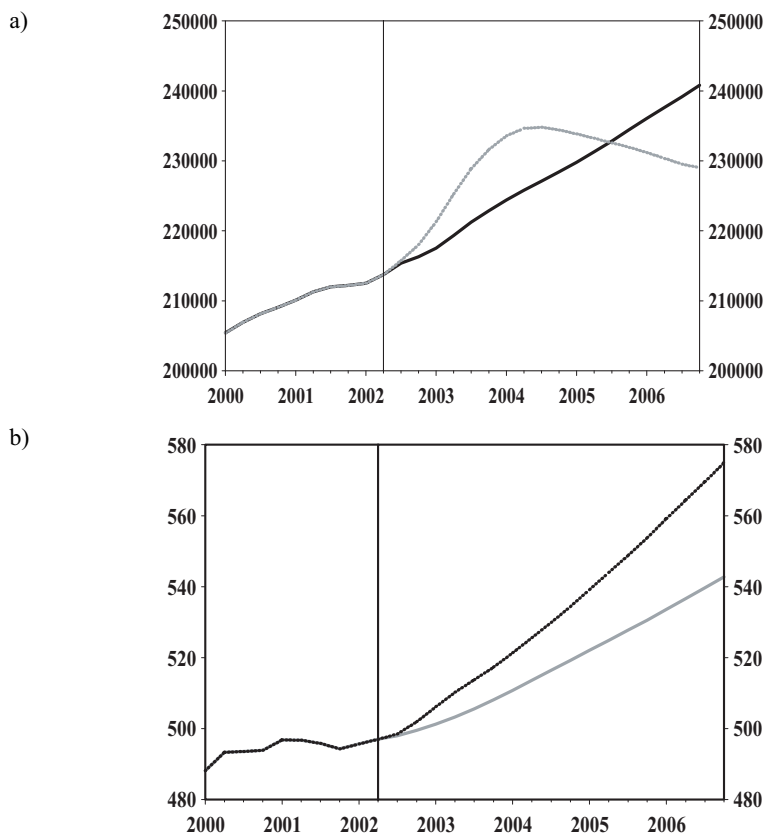
#### ***5.4 More flexibility in the Eurozone?***

Would the story be modified if Germany adopted British flexibilities? To examine this question we assume that Germany has the same average earnings equation as Britain. As before, Britain joins EMU at an exchange rate of €1.4316/£ at the first quarter of 2005, but Britain adopts European monetary policies from 2002. That immediately lowers British interest rates, which benefits growth. Moreover, since German demand is now higher than before, there is a new positive trade effect for Britain. However, when the exchange rate is ultimately fixed in 2005 (1st qtr), a negative current account effect kicks in. By fixing to the euro, Britain faces an appreciation against the dollar. This appreciation reduces British competitiveness in the US and elsewhere and, given that nearly 50% of British exports go to the US or dollar



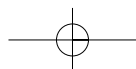
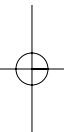
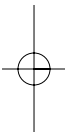
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based currencies, that has a significant negative effect on the British current account. This, in turn, reduces British employment and British demand (figure 3a). British GDP therefore rises more at the start in this simulation, but ends up in the same place.



**Figure 3: Britain Joins EMU, but Germany Adopts British Labour Market Flexibility: British GDP (a), German GDP (b)**

The more interesting question is what happens to Germany in this case? As figure 3b demonstrates, by making German wages as flexible as the British ones, Germany is made much better off than before. It should be mentioned that we are comparing two deterministic solutions here. There is no shock affecting Germany: everything else has stayed the same as far as Germany is concerned. So we can conclude that the results of this scenario are indeed driven by making the German labour market more flexible, not by the value of the Euro. This suggests that one condition for Britain joining the Euro



might be that Germany (and others) should reform their labour markets. The issue then is whether increased competition in the euro area would produce sufficient incentives to undertake such reforms. What we see here is that, even if it did, joining the euro still implies an appreciating exchange rate for the UK. That problem can only be resolved if Britain reduces her export dependence on US-dollar markets so that she can avoid going into recession. Hence different market structures and different patterns of trade matter as well.

Finally, we had to look at the Eurozone inflation rate and found that introducing British flexibilities into the German labour market has led to a lower inflation rate. Again, flexibility matters. The burden previously placed on Britain has been transferred back to Germany.

### ***5.5 Eastern enlargement of the EMU***

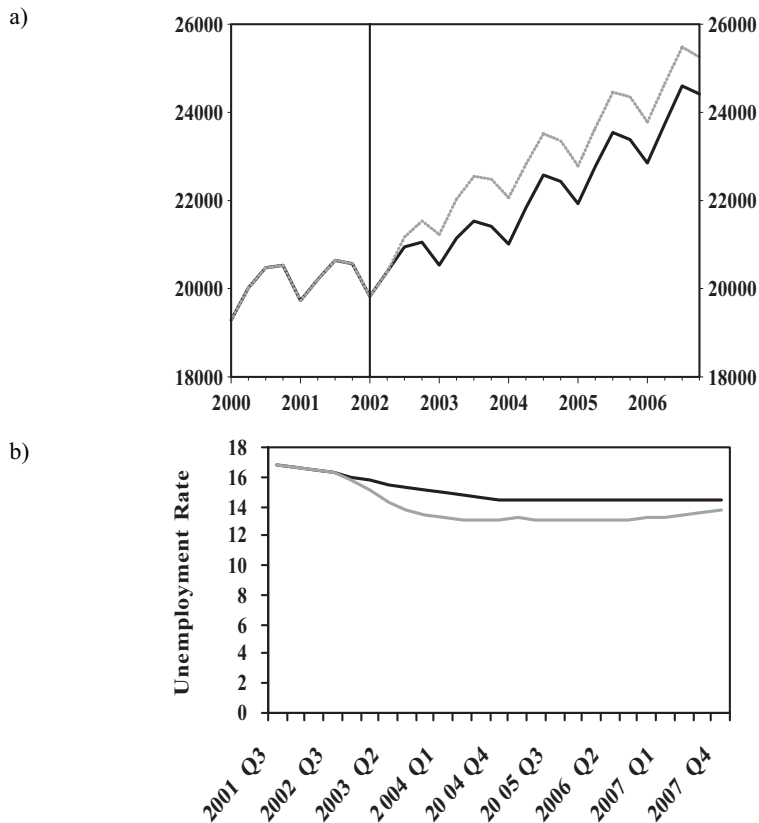
We now turn to analyse the effects of another kind of expansion: one in which one of the E-countries, Poland, joins EMU. We also looked at the effect of this on the Eurozone countries, but it turned out – unsurprisingly, as we note below – that there was no appreciable impact on any of the EU countries. So we do not report any of those results.

For the effects on Poland, we have assumed that Poland would enter the EU and also the Eurozone in 2005. As with the British simulation, the exchange rate is fixed at that point in time, but European monetary policy is adopted before hand (from 2002). The result is that, in terms of national incomes, Poland gains with GDP 5% after joining the euro (Figure 4a). This is very robust to the exchange rate value at the time of joining. We tried several entry rates and each provided an improvement in Polish GDP.<sup>14</sup> This higher GDP growth of Polish GDP is driven by the much lower European interest rate and extra trade. And as a result, the Polish unemployment rate decreases (Figure 4b).

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<sup>14</sup> The results reported here assume that Poland joins at an exchange rate of Z15/€1.

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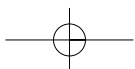
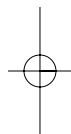
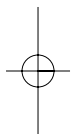
**Figure 4: Poland is joining the EU at Z15/€1:  
Real GDP (a), Unemployment Rate (b)**

There is, therefore, a clear incentive for Poland to join EMU. In order to make sure that we are not producing a negative (inflationary) output gap here, we need to check on the Polish inflation rate. It turns out that Polish inflation rate is slightly increasing, but the changes are very small. Poland therefore clearly gains from joining the EU.

Now we come to the effect on the existing Eurozone members of an eastward expansion. As the OEF model treats German exports as chiefly dependent on the growth of world GDP, there is very little impact of Poland, the Czech Republic or Hungary on German exports. Although the Polish, Czech, and Hungarian GDP increase significantly, these increases not big enough to change the world GDP or the German current account very much (or the current accounts of the other euro countries for that matter).



The other way the E-countries could affect the existing union is through inflationary pressures. However, there is also no visible impact on Eurozone inflation in these simulations. This comes from the fact that all three countries are small, so that the Eurozone interest rates do not have to change when these countries join. Hence there is no appreciable impact on the monetary conditions in the Eurozone countries. However, this is not to say that there is no impact at all. If German trade could have been broken down to specific countries then a change in her bilateral balances would have no doubt been visible. But to examine changes at that level of detail is a task for future research.



## 6. Is there a link between fiscal constraints and structural reform?

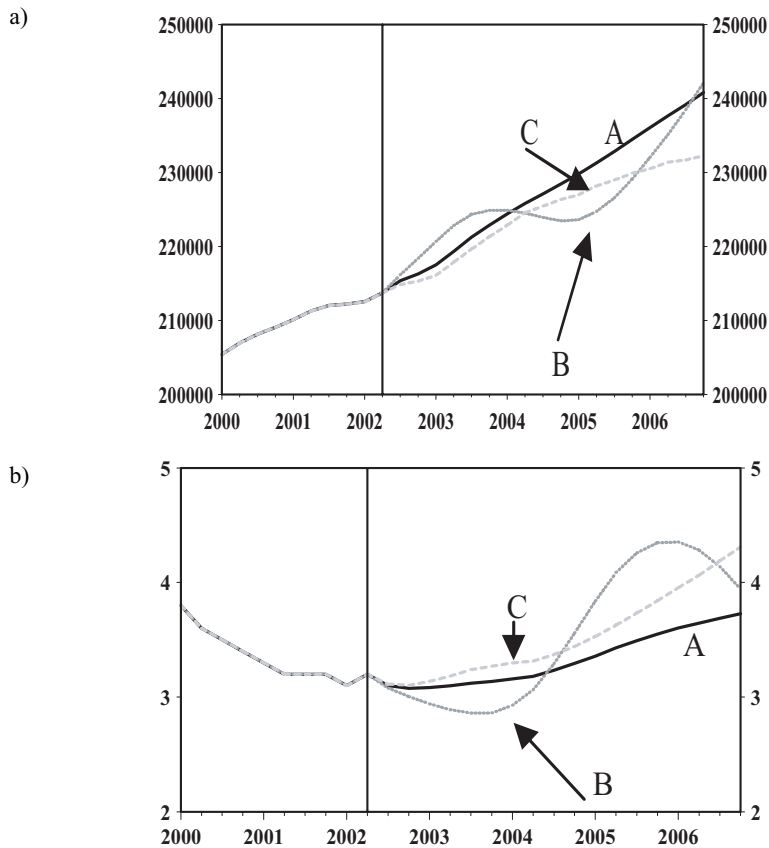
We now investigate empirically the impact of fiscal policy on the incentives for structural reform and the incentive to join. We assume that the British government decides it needs to reduce public sector debt further. As a unilateral action the British government limits its fiscal deficit to 0.3% of GDP. Although this is not strictly a representation of the SGP, it is in line with the SGP's requirement that countries should remain "close to balance or in surplus". It also corresponds to the official target for Britain's cyclically adjusted budget, as set out in her Stability and Convergence Programme agreed with the European Commission. However, public expenditures are to be kept at the same level as before, so that the government has to increase taxes.

As Figure 5 shows, a much clearer business cycle now emerges. Compared to figures 2 and 3, Britain is better off joining EMU in the short term (schedule B).<sup>15</sup> But towards the end of the sample she is worse off. These are standard results for an expansionary fiscal contraction: in the short term the economy appears to improve, but performance begins to deteriorate again in the longer term as unemployment increases (Barry and Devereux, 1995). Indeed, figure 5 shows that unemployment is behaving as an analogue of GDP, without discernable effects on the inflation rate.

<sup>15</sup> In figures 5 and 6, "schedule A" shows the baseline; "schedule B" the outcomes when taxes are increased; and "schedule C" the outcomes when expenditures are cut.



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**Figure 5: Britain joining EMU:**  
**GDP (constant prices) in Britain (a), Unemployment Rate (b 0.3% Deficit Criterion; A = baseline, B = tax revenues increased, C = public expenditures cut**

Interestingly, the effects on Germany are also much stronger in this simulation (Figure 6, schedule B). Fiscal prudence in Britain evidently has a significant impact on Germany. In particular, Germany is now better off in the short run than she is worse off in the long run. Again we have a short run vs. long run conflict – but this time larger short run benefits vs. smaller long run costs. That shows the incentive effect of wanting a more flexible partner. Evidently, fiscal restrictions without expenditure cuts throw more of the burden of adjustment onto the more flexible partner – the UK in this case.



Is there a link between fiscal constraints and structural reform? 37

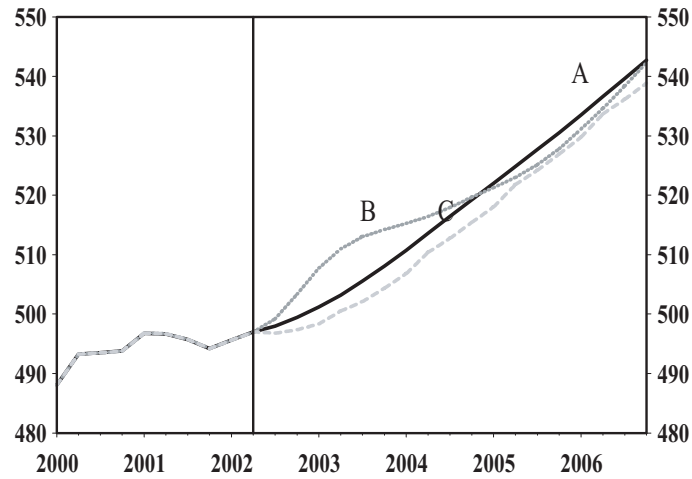
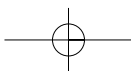
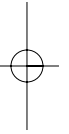
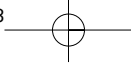


Figure 6: Britain in EMU, Real GDP in Germany, 0.3% Deficit Criterion

So overall, Germany is better off if Britain restricts fiscal policy to reduce her deficit, but keeps her expenditures at a constant level. That however, comes at considerable extra (long term) cost to Britain and implies that (contrary to conventional wisdom) fiscal spillovers do matter.



## 7. Concluding remarks

Labour market reform is one among several important aspects of the enlargement debate in Europe. Indeed, labour market reform is widely regarded as a necessary part of a policy programme for a country which strives to satisfy the Maastricht criteria.<sup>16</sup> Formally, however, labour market reform is *not* a criterion for admission to the EMU, and existing members cannot be excluded from the EMU even if their labour markets are far from well-functioning. Moreover, the assessment made by existing members of a candidate country's labour market performance is in principle irrelevant to EMU enlargement.

We have investigated a “Groucho Marx theorem” from our earlier work which showed the vital role played by structural reforms in making the Eurozone into a currency union worth joining; and the accession countries into suitable candidates for joining. We used a large multi-country model to evaluate the effect of joining under different circumstances. By doing so, we could provide empirical evidence of what would happen if these countries were to join.

Although not all current “outs” will be the same – and we found that Denmark for example is significantly closer to wanting to join than the UK – we find that those countries which the Eurozone would like to join are reluctant to do so, unless labour market reforms have taken place. On the other hand, we have shown that those countries which are keen to join will benefit from joining EMU, but the existing members will not be better off if they do. We also found that there is an incentive and a need within the Eurozone countries to undertake structural reforms if economic growth is to be stimulated. Structural reforms would therefore make everybody better off.

We have also shown that too strict an application of the SGP has severe spillover effects, especially when market rigidities are in place. Too tight a fiscal policy combined with market rigidities will slow down economic growth in the Eurozone and make structural reform unlikely, if not

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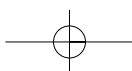
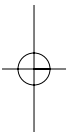
<sup>16</sup> More generally, it is widely argued that structural reform is a prerequisite for a successful EMU, see Delors Committee (1989). It is mainly based on the analytic and empirical evidence of a negative relationship between (real) wage rigidity and economic performance, see, e.g., Bruno and Sachs (1985) and Nickell (1997). For a useful recent overview of the theoretical, empirical and policy aspects of structural reforms, see Van Bergeijk, Van Sinderen and Vollaard (1999).



#### 40 Concluding remarks

impossible. Therefore, if structural reform is seen as important, there is little incentive to obey to the SGP.

Finally, it should be stressed that although the focus of this paper has been on the role of labour market reform for the enlargement of a monetary union, it is evident that other factors also play a role. For example, for countries that already fulfill the Maastricht criteria, typically the N-countries, the decision about joining the EMU may be based on cost-benefit elements other than strictly economic ones, including issues related to national sovereignty. For other countries, typically the E-countries, the costs of joining the EMU may well be represented by the costs of fulfilling the Maastricht criteria, but these may involve a broader set of policies than labour market reform *per se*.





## A. Appendix: Details of the Oxford Economic Forecasting (OEF) model

The structure of each country model is based on the income-expenditure national accounting framework. However, the models also have a coherent treatment of supply. In the long run, each economy has a one sector Cobb-Douglas production technology. In addition countries have a natural growth rate beyond the power of governments to alter, which is driven by population and productivity growth. Output cycles around a deterministic trend, which defines potential output corresponding to the natural rate of unemployment. Firms are assumed to set prices given output and the capital stock, and – crucially to this paper – the labour market is imperfectly competitive. Firms bargain with workers over wages, but are able to choose the level of unemployment. Countries with high real wages therefore get high unemployment relative to the natural rate.

Inflation is a monetary phenomenon in the long run. All the models have vertical long run Phillips curves, so expansionary demand policies put upward pressure on inflation. Unchecked, these pressures would cause the price level to accelerate away without bound. In order to prevent this, the model has an endogenised monetary policy. For some (such as the US and UK), monetary policy is summarised in an inflation targeting rule, and interest rates are assumed to move up whenever inflation is above target rate, and/or output is above potential (a so-called “Taylor rule”). In others (e.g. in the Eurozone) the authorities are assumed to act as though they target a monetary aggregate. The coefficients in the interest rate reaction function, as well as inflation target itself allow for different levels of hawkishness.

On the demand side, consumption is a function of real incomes, real financial wealth, real interest rates and inflation. Investment expenditures are determined by Tobin’s  $q$  (current and future expected revenues), and by its opportunity cost, after taking taxes and allowances into account. Countries are assumed to be “small”, in the sense that exports are determined by demand (import demands elsewhere) and a country cannot ultimately determine its own terms of trade. Consequently, exports are a function of world demand and the real exchange rate, and the world trade matrix ensures adding-up consistency across countries. Imports are determined by real domestic demand and competitiveness.

## 42 Appendix: Details of the Oxford Economic Forecasting (OEF) model

Each model also contains a financial sector, which includes variables of direct relevance to financial market participants. This block forecasts total rates of return on cash, stocks and, bonds. Private sector asset holdings have been broken down to personal and corporate components. In the public sector, general government debt is now identified for all countries, and both net overseas assets and net investment flows are derived by residual.

Model variables are divided into demand and supply, core and non-core. Coverage of core variables is standard across all country models; non-core coverage varies across countries depending on data availability and country-specific requirements. Core demand variables include all the aggregate expenditure components, at constant and current prices, monetary policy variables and the financial variables. The non-core element disaggregates consumption and investment, as well as important indicator variables such as retail sales and car sales. Core supply consists of variables determining the natural levels of output, unemployment and real wages. Prices are also disaggregated in the core supply block. Non-core supply disaggregates employment and nominal earnings. Separate blocks build up the government, personal and corporate sector flow accounts.

### ***A.1 Consumption***

The equations take the form:

$$\Delta c = a_1 a_2 \Delta u - a_3 c_{-1} - a_4 y_{-1} - (1 - a_4) W_{-1} + a_5 R_{-1} \quad (A1)$$

where  $c$ ,  $y$  and  $u$  are consumption, real income and unemployment respectively, while  $W$  and  $R$  refer to the financial wealth-income ratio and real interest rates. These error-correction formulations appear to mimic consumption smoothing in a number of countries very well.

### ***A.2 Investment***

The equations for business investment are based on Tobin's  $q$ . Capital is time-consuming to install and adjustment costs drive a wedge between the post-tax marginal product of capital and its marginal costs. Profit maximising firms invest when the marginal return is greater than the replacement cost ( $q > 1$ ), and reduce investment when the reverse holds. In the long run, the capital

stocks reaches its desired level,  $q = 1$  and the familiar marginal productivity relationship holds. The equations take the following form:

$$\Delta i = a_1 q - a_2 i_{-1} - k_{-1} + a_3 \Delta y \quad (\text{A2})$$

where  $i$  is private sector business fixed investment,  $k$  is the equivalent capital stock and  $y$  is GDP. Finally,  $q$  is defined as the post tax marginal product of capital relative to the real interest rate. There are also short term accelerator effects from changes in output, reflecting the possibility that some companies are credit-constrained.

Personal sector housing investment is determined analogously to consumption, by real income, wealth and interest rates, since it is considered part of a portfolio of spending decisions taken by households. Government investment is exogenous.

### ***A.3 International trade***

Exports and imports are demand determined:

$$\Delta x = \Delta wt - a_1 cu - a_2 \Delta wcr - a_3 x_{-1} - w_{-1} - a_4 trx \quad (\text{A3})$$

$$\Delta m = b_1 \Delta tfe + b_2 \Delta wcr - b_3 \Delta m_{-1} - tfe_{-1} - b_4 wcr_{-1} - b_5 cu_{-1} \quad (\text{A4})$$

where  $x$  refers to exports of non-fuel goods;  $m$  to equivalent imports,  $wt$  is world trade;  $tfe$  total final expenditure;  $wcr$ , relative unit labour costs; and  $cu$ , capacity utilisation as measured by the output gap. Trade competitiveness elasticities are typically between 0.3 and 0.6; and most country models satisfy the Marshall-Lerner conditions, so that an improvement in competitiveness will lead to an improvement in the trade balance in the long-run. The equations for trade in services are analogous to those for non-fuel goods, while imports of fuel meet the gap between domestic and export demand, and domestic production. All trade prices are a weighted average of domestic and world prices.

### ***A.4 The supply side***

The key relationship here is a production function for each country relating output to employment. From that production function we can derive the marginal product of labour, which in equilibrium equals real wage. That

## 44 Appendix: Details of the Oxford Economic Forecasting (OEF) model

relationship would then imply a demand for labour ( $nd$ ) at each real wage level. Given a predetermined labour supply ( $ns$ ), the intersection of  $ns$  and  $nd$  generates an equilibrium real wage consistent with no involuntary unemployment at full capacity output. The latter is the long run aggregate supply level.

In the short run, however, relatively rigid real wages generate involuntary unemployment ( $nd \neq ns$ ), while nominal inertia means that that is a short run relationship between real wages and the price level. Short run changes in labour demand then trace out a positively sloped short run aggregated supply curve (AS), ensuring that any changes in aggregate demand (AD) translate into short run changes in prices and output, although the long-run effects are felt on prices alone. Thus the employment equation defines a level of real unit labour costs (real wages/productivity) which is constant in the long run. Consistent with this level of real unit labour costs are natural levels of output and employment. When the economy is away from these natural levels, inflation and interest rates move to bring the economy back towards equilibrium. The larger are nominal and real rigidities, the larger and longer-lived are real disequilibria.

In the long run, the employment equation solves for real unit labour costs, given labour's share of national income implied by the level of national output; while the wage and price equations solve for the level of unemployment consistent with this labour share. In the short run, both wage and price equations incorporate nominal and real wage rigidity, which ensure the existence of "involuntary" unemployment and monetary effects on the real economy. Thus, with vertical Phillips and aggregate supply curves in the long run, monetary policy determines the inflation rate, while short term structural rigidities determine the unemployment rate and hence the short run variations in wages. The NAIRU (non-accelerating inflation rate of unemployment) is related to the so-called "tax wedge" (the gap between the total real cost of labour to employers, including social security contributions, and the real value of post-tax wages received by employees), and to real prices.

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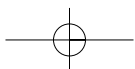
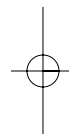
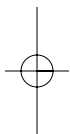
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