An Empirical Analysis of Monetary Policy Choices in the Pre-EMU Period

Ray Barrell*, Dawn Holland* and Kateøina Šmídková**

Abstract. We argue that the choice of exchange rate regime in the process of accession to the European Union and EMU can affect the growth rate of the economy in the medium term. We discuss the effects of exchange rate choice, and of the timing of transition to EMU on the core accession countries.

*National Institute of Economic and Social Research

**Czech National Bank

e-mail: dholland@niesr.ac.uk, rbarrell@niesr.ac.uk, Katerina.Smidkova@cnb.cz

---

This research was developed from work supported by the European Community's Phare ACE Programme 1997. The content of the publication and views expressed therein are the sole responsibility of the authors, and in no way represent the views of the Commission or the Czech National Bank.

I. Introduction

This paper considers two important issues facing the EU candidate countries in the run-up to EMU membership. The first issue is the choice of exchange rate regime in the period prior to EMU membership. The second issue is the timing of the transition from an independent monetary policy regime to one governed by the European Central Bank. In this study we focus on the fundamental choice between adopting a fixed exchange rate regime, as in Estonia, or a floating exchange rate regime, as adopted in Poland. In practice, most of the accession candidates have adopted something between these two extremes, in the form of a managed float. The undoubted benefits from a currency union, and from the reduction in exchange rate uncertainty have to be set off against the loss of flexibility and any impact of a transitional overvaluation if a fixed rate or EMU membership is chosen. We discuss these issues below, and many of them are addressed in Barrell (2002) and Pain (2002).

In this study, we consider five EU accession countries: Poland, Hungary, the Czech Republic, Estonia and Slovenia. The exchange rate in each of the five economies is closely tied to the euro, either formally or through strong trade linkages. A fixed nominal exchange rate provides stability to exporters and importers and can help to anchor domestic inflation expectations in tradable sectors. This is particularly important for small, open economies such as Estonia, where trade amounted to over 200 per cent of GDP in 2000. It may be of less importance to a large economy such as Poland. A credible fixed exchange rate regime also reduces the risk premium imposed on domestic financial assets. This may be particularly important for countries with a significant interest rate differential relative to the Euro Area, such as Poland, but is

less relevant for the Czech Republic where interest rates have already converged on those in the Euro Area. A fixed exchange rate also means losing monetary or exchange rate policy to cushion the economy against shocks. This may be particularly important where fiscal policy is restrained by a deficit that exceeds the Maastricht criteria limit of 3 per cent of GDP, such as in Poland or the Czech Republic. It may be less relevant for Estonia or Slovenia, where the fiscal position is close to balance.

Under each exchange rate regime, there must be an exit strategy to EMU. The exit strategy must consider both the timing of membership and the appropriate rate at which to fix the currency to the euro. The timing will depend on the ability of each economy to meet the Maastricht convergence criteria on exchange rate stability, inflation, interest rates and the fiscal position. The joining rate must be agreed with the Eurosystem of existing Member States. This rate will partly depend upon the timing of membership if a flexible exchange rate is adopted prior to EMU entry, as it should reflect the prevailing market rate at the time of entry.

There are fundamental issues that any exchange rate arrangement needs to handle. It is generally assumed that the real exchange rate will appreciate in all the candidate countries during the accession period, due to both rapid productivity growth and nominal price convergence. During a period of convergence of productivity on European Union levels faster productivity growth in more open sectors pushes wages up across the economy as a whole. This puts upward pressure on prices in the non-tradable sectors and hence observed inflation is higher the more rapid is productivity convergence. (This is the Balassa-Samuelson effect of productivity on the real exchange rate). The real appreciation associated with productivity can be seen as an equilibrium path, but the case for a real appreciation can also be supported on the

basis of disparities in Purchasing Power Parity that have to be removed to produce an equilibrium. The price of homogeneous goods, including transport costs, should be constant across countries. At an aggregate level, consumer price differentials can persist on a permanent basis between countries, reflecting permanent differences in the quality or variety of goods and services consumed. But assuming a minimal level of convergence towards the quality and variety of goods in the EU, prices in the transition economies should converge towards EU levels, implying a positive inflation differential when measured in a common currency. The anticipated developments in real exchange rates will play an important role in the results of this study, and are discussed further in the next section of this paper.

The analysis in this paper is undertaken using a global econometric macro-model, NiGEM, and the model is discussed in Section 4 below. The model used here has fully integrated descriptions of Hungary, the Czech Republic, Poland, Estonia and Slovenia. Model properties depend at least as much on the underlying structure of openness and of assets and liabilities as they do on the parameters. The economies we discuss here differ in important ways, as can be seen from Table 1 below, and we discuss the importance of these differences as we analyse policy choices. Poland is the least open, and Estonia is the most open. The latter country has the lowest stock of net financial wealth as a percent of GDP, and Hungary has the highest. This in part reflects the relative significance of public sector debt in these economies, and also the importance of bank deposits and equity market holdings. Differences in the privatisation process will have affected the stock of financial wealth in these countries.

Table 1 Key data ratios

Per cent

	Debt/GDP 2000	Trade/GDP 2000	Trade Balance/GDP 2000	Wealth/GDP 1999
Czech Republic	16.4	170.0	-7.0	33.8
Estonia	3.7	229.0	-9.7	22.2
Hungary	61.1	129.0	-1.8	48.9
Poland	44.0	75.3	-4.0	26.3
Slovenia	24.0	130.1	-3.9	29.6

Notes
Debt figures are based on EU estimates.
Trade to GDP is the ratio of the volume of export plus imports of goods and services to GDP.
Trade balance to GDP is the ratio of exports minus imports to GDP.
Financial wealth stock estimates are constructed by NIESR in collaboration with Central Bank staff from the relevant countries. Financial wealth includes bank deposits, equities and other holdings of financial assets including government bonds and all currencies less borrowing from banks and other financial institutions.

The appropriate choice of monetary regime in the pre-EMU period will depend on the initial degree of real exchange rate misalignment, the relative openness of the economy, the degree of fiscal consolidation required and the need for importing monetary stability. We simulate the response to different shocks under fixed and flexible exchange rate regimes in Hungary, the Czech Republic, Poland, Estonia and Slovenia. We consider the response under different regimes to a series of shocks that permanently shift the real exchange rates of these economies. There is clearly a trade-off between the credibility of a fixed exchange rate regime and the loss of the exchange rate as an automatic stabiliser. Under a fixed regime, the economy is expected to exhibit more cyclical behaviour, but the output response to a fiscal stimulus is expected to be stronger initially.

We next consider the shock of joining the Euro Area in Poland, Hungary and the Czech Republic. Relative to a baseline where the economies do not join the euro, we simulate scenarios with each of the three economies joining in 2005, 2006, 2007,

2008 and 2009[1]. At the time of joining, interest rates converge on those prevailing in the Euro Area and the exchange rate is permanently tied to the euro. The later a country joins, the more closely it has converged with the Euro Area, and the smaller the shock to the economy. After 2008, our simulations indicate that there is little to be gained by waiting further, as the most rapid period of convergence is expected to be completed. This should not, however, be taken as decisive in the timing of membership of EMU. There are other gains to be made from membership, and our analysis does not take into account the gains to welfare and output of greater competition as a result of increased price transparency, nor does it reflect the possible effects of an increase in investment that might follow from greater exchange rate certainty. This should also not be taken as an indication of feasibility. Specifically, model simulations cannot guarantee that the Maastricht criteria will be met by the specified date.

II. Real effective exchange rate movements

All five countries considered in this study have exhibited a strong real appreciation of the exchange rate during the transition period, as expected due to both the Balassa-Samuelson effect and Purchasing Power Parity condition discussed above. The real appreciation can be effected either through an appreciation of the nominal exchange rate or a positive inflation differential relative to a country's main trading partners. If the exchange rate is fixed, inflation is the only source of appreciation. There is, potentially, a trade-off between the monetary credibility gained from a fixed exchange rate regime and the loss of the exchange rate as a source of real appreciation. However, a flexible exchange rate can be associated with a higher risk premium, and this may weaken the exchange rate.

The Maastricht criteria for EMU membership require both a stable exchange rate against the euro and convergence in inflation rates with the Euro Area. This is incompatible with a real appreciation of the exchange rate, and has implications for the timing of EMU membership. In the medium-term, economies can expect to achieve an equilibrium real exchange rate, which should depend upon fundamentals[2]. But in the short term, joining with a real exchange rate that was below its long run sustainable value would cause inflation to be higher than required by the Treaty for some years and monetary conditions would appear loose. Hence early membership may be precluded by an undervalued exchange rate, as it will produce more inflation in the two years of stable exchange rates that are required before full membership.

Table 2. Real effective exchange rate movements decomposed

Annual percentage change

		1993	1994	1995	1996	1997	1998	1999	2000	1992-2000*
Czech Republic	Real exchange rate	22.4	7.0	4.3	6.7	1.9	7.4	-0.2	2.9	63.7
	Nom. Exchange rate	6.4	0.9	-0.9	1.8	-2.5	0.0	-2.7	2.2	5.0
	Relative price	15.6	6.5	5.4	4.8	4.4	7.0	2.3	0.4	56.2
Estonia	Real exchange rate	101.9	35.4	22.7	18.6	4.9	8.2	1.1	-1.0	351.8
	Nom. Exchange rate	11.7	-2.7	0.2	-1.5	-2.5	1.4	-0.8	-2.2	2.9
	Relative price	82.4	39.3	22.5	20.4	7.5	6.6	1.9	1.1	342.2
Hungary	Real exchange rate	9.1	-0.4	-5.3	2.1	6.7	-1.0	2.8	2.8	17.4
	Nom. Exchange rate	-5.4	-13.5	-23.4	-15.4	-7.5	-11.2	-6.2	-4.4	-60.9
	Relative price	15.7	15.5	23.9	20.2	15.3	11.5	9.4	7.4	200.7
Poland	Real exchange rate	4.4	4.1	6.4	8.6	3.9	5.5	-3.8	11.5	47.7
	Nom. Exchange rate	-17.2	-21.8	-14.7	-7.2	-7.3	-3.8	-9.0	3.7	-56.8
	Relative price	26.2	33.0	24.3	16.9	12.0	9.4	5.5	7.4	239.0
Slovenia	Real exchange rate	0.4	1.1	9.4	-3.5	1.5	3.8	-0.6	-0.7	11.4
	Nom. Exchange rate	-20.8	-13.0	0.7	-10.2	-4.2	-2.0	-4.7	-6.8	-48.0
	Relative price	25.9	16.1	8.8	7.4	5.8	5.6	4.2	6.3	111.4

** Aggregate percentage change since 1992.*
Source: NiGEM database. Effective weights determined by 1994 trade weights.

[1] These are illustrative examples only, as currently no country is expected to join before 2006.
[2] These fundamentals may reflect PPPs, which depend on the relative prices of bundles of goods and services produced in the economy. However, even in small open economies PPP may be misleading because some markets will be imperfectly competitive and some products may not be easily

Table 2 reports the annual percentage change in the real effective exchange rate in the five countries covered by this study since 1993, decomposed into movements in the nominal effective exchange rate and relative prices. The bulk of this appreciation has been effected through relative prices, as one might expect if the Balassa Samuelson effect were very significant, which it must have been during the early years of transition. The nominal effective exchange rate has shown a modest tendency to appreciate in the Czech Republic[3] and Estonia[4], but the nominal effective exchange rates in Hungary, Poland and Slovenia have all depreciated by 50-60 per cent since 1992.

The real appreciation has been strongest in Estonia, where productivity is lowest relative to the EU average, and weakest in Slovenia, where productivity is closest to the EU average. This conforms to our expectations in light of the Balassa-Samuelson effect and quality convergence, as the larger the productivity gap the greater the opportunity for convergence. The strength of the real appreciation in the Czech Republic is less expected, as aggregate productivity has recorded only modest convergence on EU levels since 1993. In part this may reflect the fact that aggregate data cannot capture differences in productivity growth across sectors, which is in fact the driving force behind the Balassa-Samuelson effect. The real appreciations may also be capturing a correction of a temporary deviation of the real effective exchange rate from its equilibrium level. Smidkova *et al* (2002) suggest that in the first half of the 1990s real effective exchange rates were undervalued relative to their equilibrium level in all five economies. In order maintain a stable external balance, a real

comparable across countries. However, movements in PPPs may indicate movements in the sustainable real exchange rate.

[3] Monetary Policy has perhaps been more restrictive in this country than in other transition economies with flexible rates.

appreciation was therefore necessary. This may have played a more important role in the Czech Republic than in the other 4 economies.

Table 3. Productivity relative to EU average[5]

	1993	1994	1995	1996	1997	1998	1999	2000	2000/1993*
Czech Republic	52.2	52.4	51.4	53.1	54.7	53.8	53.3	53.9	3.2
Estonia	27.7	27.1	26.5	28.7	30.1	32.6	34.3	35.2	27.0
Hungary	47.8	50.1	51.8	52.7	53.2	54.6	55.8	55.9	16.8
Poland	31.7	33.5	34.8	36.2	37.5	39.0	39.9	42.5	34.1
Slovenia	61.9	63.8	66.4	68.2	70.4	72.7	74.4	76.3	23.4

** Aggregate percentage change since 1993.*
Source: NIESR estimates based on IMF WEO database

Table 3 reports aggregate labour productivity in the five countries relative to the EU average since 1993. Productivity is lowest in Estonia and highest in Slovenia. Poland has recorded the strongest rise in productivity since 1993, while the Czech Republic has recorded the weakest growth. However, aggregate productivity in the Czech Republic and Hungary remains somewhat stronger than in Poland. The argument for further appreciation of the real exchange rate in Slovenia is weaker than in the other economies, as productivity levels in Slovenia have already converged on those in EU countries such as Greece and Portugal, and price levels in Slovenia have also largely converged on those in the EU.

III. Real exchange rate realignments and Maastricht criteria

Upon accession to the EU, the new Member States will be expected to participate in the ERM II. They will not be offered an opt-out clause like Denmark or the UK, and will be expected to join the Euro Area when conditions allow. The timing will depend on the ability of each country to meet the Maastricht criteria on exchange rate, interest

[4] This reflects in part the devaluation of the Finnish markka before ERM membership and the weakness of the Swedish crown, both of which have significant weights in the Estonian effective exchange rate
[5] Productivity is measured as real GDP calculated at PPPs, as estimated by the IMF.

rate and inflation convergence and fiscal stability. According to the Maastricht criteria, inflation must not exceed the average of the three best performing Member States by more than 1.5 percentage points. The exchange rate requirements are to respect the normal fluctuation margins provided for by the Exchange Rate Mechanism of the European Monetary System without severe tensions for at least the last two years before the examination for entry into EMU. The fluctuation margins allow a deviation of ±15 per cent around the central rate, which permits a significant degree of flexibility. Throughout 2000 and 2001, exchange rates in all five countries have remained within a comparable band width. The Polish currency has exhibited the greatest fluctuation, within a band of about ±11.5 per cent around the average euro exchange rate over the past two years.

The third criterion is to target a balanced budget over the medium-term. In the short-term the deficit must not rise above 3 per cent of GDP. The deficit target should not pose a problem for Estonia or Slovenia, where finances are close to balance. However, the deficits in Poland, Hungary and the Czech Republic all exceeded 3 per cent of GDP in 2001, indicating that some degree of fiscal tightening will be necessary in the run-up to EMU membership. This may be incompatible with the extra expenditure needed to implement the acquis communitaire, as required for EU membership, and this may delay entry into EMU. However, the Commission has made it clear that it will sympathetically consider the case for deficit financed public investment in countries with low productivity and otherwise sound public finances. Only Hungary and Poland have noticeable debt stocks, as can be seen from Table 1, and hence the other countries may be allowed some flexibility in this area.

The Maastricht criteria also include targets on the government debt ratio and on long-term interest rates. The government debt target of 60 per cent of GDP will not pose a problem for any of the five countries covered by this study, as debt remains relatively low[6]. Long-term interest rates should take care of themselves if inflation expectations fall to levels compatible with the Maastricht criteria.

Given the flexibility allowed within the ERM II, some degree of real appreciation is possible within the Maastricht framework. The inflation criterion is more rigid, especially if the variance of inflation rates within the Euro Area rises. In January 2002, the average inflation rate in the three best performers was a full ½ percentage point lower than the EU average, suggesting that inflation may have to be maintained within 1 percentage point of the EU average to pass the Maastricht criteria. Monetary policy may be held tighter than necessary to ensure the inflation target is met.

An estimate of the expected appreciation in each country would allow us to assess the consequences of attaining the Maastricht criteria at a given time. De Broeck and Sløk (2001) find that a 1 per cent rise in relative productivity is associated with a 0.4 per cent real appreciation. If we expect productivity levels to converge towards those in Portugal, at a minimum, they should eventually attain a level of about 60 per cent of the EU average. Slovenia has already exceeded this level, so simple productivity differentials do not necessarily point to further convergence in this country. According to the De Broeck and Sløk estimates, the real exchange rates of the Czech Republic and Hungary should appreciate by a further 3½ per cent if aggregate productivity reaches 60 per cent of the EU average. The Polish real exchange rate should appreciate by about 18 per cent and the Estonian real exchange rate should

[6] Even if deficits remain above 3 per cent of GDP for several years, our projections suggest that the debt to GDP ratio will exceed 60 per cent in the Czech Republic or Poland, and will stabilise at 60-65

appreciate by about 28 per cent by these estimates. If convergence in productivity takes place at a steady pace over about 10 years, Estonia should experience an appreciation of about 2½ per cent per annum and Poland should experience an appreciation of about 1½ per cent per annum. Sinn and Reutter (2001) and Égert (2001) both expect the appreciation in Poland to be somewhat faster in the short-term, at 3-4 per cent per annum. Égert also expects stronger appreciation in Hungary than the productivity differential would suggest. Other estimates suggest that the Balassa-Samuelson effect will cause the real exchange rate to appreciate by about 1-2 percent per annum in the short to medium term.

Smidkova *et al* (2002) suggest that the fundamental real exchange rates appreciated by about 4-6 per cent per annum on average in the first half of the nineties. The fundamental appreciation then continued at a slower pace of around 1-2 per cent per annum until 2001. The rate of fundamental appreciation will fall over time as productivity levels converge on EU levels. By 2005, the equilibrium real appreciation is expected to fall to about 1 per cent per annum. The actual real appreciation expected depends on the current deviation of the real exchange rate from its fundamental level. By end-2001, the currencies of all five countries, with the exception of Slovenia, appeared to be somewhat overvalued, while Slovenia was close to its fundamental level. This suggests that the growth rates mentioned above over-estimate the real appreciation that we are likely to see. On our baseline scenario, the real effective exchange rate is expected to grow by 2-2.5 per cent per annum in Poland and Estonia between 2005 and 2010; by 0.5-1 per cent per annum in Hungary and the Czech Republic; and by 0-0.5 per cent per annum in Slovenia.

---

per cent in Hungary.

IV. Simulations under fixed and flexible regimes

Below we undertake a series of simulations to analyse the response to shocks under fixed and flexible exchange rate regimes. We first discuss the structure of the model, and investigate the implications of a technology shock in the Euro Area, a fiscal tightening in the Euro Area, and a shock to FDI inflows into the 5 transition economies. We then analyse the impact of the timing of EMU membership.

IV.1 The model and its properties.

A full description of the model can be found in Barrell *et al* (2002). Small macro-models of Poland, Hungary, the Czech Republic, Slovenia and Estonia have been incorporated into an existing global econometric model, NiGEM. NiGEM is a large-scale quarterly macroeconomic model of the world economy. The model is essentially New-Keynesian in its approach, in that agents are presumed to be forward-looking, at least in some markets, but nominal rigidities slow the process of adjustment to external events. It has complete demand and supply sides, and there is an extensive monetary and financial sector. Linkages between countries take place through trade, through interacting financial markets and through international stocks of assets. By incorporating the models into an existing global model, we ensure that growth projections are consistent with our estimates of world growth, and allow full feedbacks with the rest of the world in response to policy shifts.

As far as possible, the same theoretical structure is applied to all countries in NiGEM, except where clear institutional or other factors prevent this. As a result, variations in the properties of each country model reflect genuine differences emerging from estimation, rather than different theoretical approaches. One of the key differences between the models of the accession economies and the standard NiGEM structure is

the important role played by Foreign Direct Investment (FDI), which is modelled explicitly within the foreign asset system. FDI has been shown to play an important role in enterprise restructuring in transition economies. It has an impact on labour productivity, trade patterns, and the level of fixed investment. We have, therefore, incorporated a supply side model of FDI and modelled the effects of FDI on the domestic economy. In general FDI raises exports and labour productivity in similar ways across countries, although the impact on output from these channels would differ, as labour shares and export propensities differ. We also find a role for FDI in imports, as do Barrell and te Velde (2002) in the EU countries, but we find that the impact of FDI on imports is higher in Poland than elsewhere, and this colours our results below.

The underlying economic structure of the model is relatively standard. Domestic demand, aggregate supply and the external sector are linked together through the wage-price system, income and wealth, the financial sector, the government sector and competitiveness. The supply-side of the economy is centred around a CES production function that determines factor demands. Wages are determined by a simple bargaining process over the share of labour in total output. Domestic prices are determined as a mark-up over production costs, which are a weighted average of domestic production costs and import prices. The mark-up is based on the elasticity of demand, which is determined as a pro-cyclical function of the business cycle, captured by capacity utilisation. The wage-price system affects competitiveness and income and wealth. Competitiveness feeds into the external sector, while income and wealth feed into domestic demand through private consumption. The wage-price system also affects total government receipts and expenditure through indirect taxes and transfers to households.

The external sector feeds into domestic demand through the impact of net foreign assets and interest income on household income and wealth, while domestic demand feeds back into the external sector as a determinant of imports and FDI. FDI affects domestic demand through investment, aggregate supply through productivity and the external sector through both exports and imports. The financial sector affects domestic demand through the impact of interest rates on investment and consumption, and feeds into the government sector through interest payments on government debt. The government sector feeds into consumption through the stock of government debt, which affects household wealth, and income tax, which feeds into real disposable income.

In order to undertake effective policy analysis we have to be able to use the assumption that agents can look forward and that expectations are rational. This in turn requires that agents use the implications of the model in their expectations formation. The use of rational expectations for policy analysis requires that the modeller construct a coherent forward base of about 20 years to run off. It is also important that the model being used contains an equilibrium growth path and has the feedbacks to return to that real equilibrium.

The model can run under are a number of different monetary policy options. There are two main scenarios to choose from regarding exchange rate policy: fixed exchange rates or flexible exchange rates. Flexible exchange rates respond to expected changes in relative interest rates, to ensure the UIP condition holds, after allowing for an interest rate premium. We assume that there is a premium on accession country interest rates, to reflect higher levels of risk relative to the Euro Area. Expectations can be either forward-looking or backward-looking.

With a fixed exchange rate regime, the exchange rate path follows the euro:

$$RX = RX_{-1} * ELRX / ELRX_{-1} \tag{1}$$

where RX represents the domestic currency exchange rate relative to the dollar and ELRX represents the euro/dollar exchange rate.

Under a flexible regime, the exchange rate is no longer seen as an instrument of policy, but as an outcome from the interaction of fiscal policy, an inflation oriented monetary policy and the external environment. Forward-looking floating exchange rates solve the open arbitrage condition, allowing an interest rate premium (IPREM).

$$\begin{aligned} \ln(RX) = \; & \ln(RX_{+1} * ELRX / ELRX_{+1}) \\ & - 0.25 * \ln((100 + R3M) * 100 / ((100 + ELR3M) * (100 + IPREM))) \end{aligned} \tag{2}$$

where R3M is the short-term interest rate in the domestic economy and ELR3M is the short-term interest rate prevailing in the Euro Area.

Within a flexible exchange rate regime, we assume interest rates are determined by a rule-guided policy, as opposed to discretionary policy. The belief that rule-guided actions, based on clear and announced principles provides a better framework with which to conduct macro policy because prevalent during the 1980s-1990s in the market economies. We adopt simple policy rules, where the policy instrument is expressed as a function of the deviation of the target variable from its target value. Simple feedback rules limit the amount of information that is taken from the model and thereby reduce the complexity of the rule considerably.

The rule we adopt mimics the ECB's 2 pillar strategy for maintaining price stability[7]. The ECB sets an inflation target, which it aims to achieve within the constraints of a nominal target for the stock of money.

$$R3M_t = 0.75(\pi_t - \pi_t^*) + 50(PY_t - PY_t^*) \tag{3}$$

where R3M is the short term interest rate, π is the expected inflation rate, PY is the log of nominal GDP and * denotes target variables.

Within a fixed exchange rate regime, the interest rate is no longer seen as an instrument of policy, but adjusts to ensure that the UIP condition holds. We invert the exchange rate open arbitrage condition in equation (2). This allows the interest rate to jump in forward-looking mode:

$$R3M = (RX_{+1} / RX * ELRX / ELRX_{+1})^4 * (100 + ELR3M) \\ *(100 + IPREM) / 100 - 100 \tag{4}$$

IV.2 European technology shock

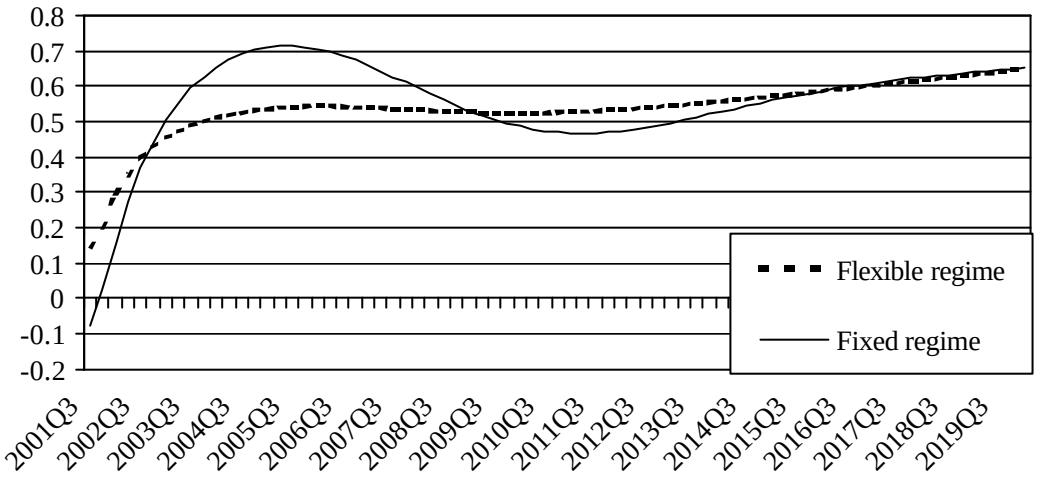
In the first set of simulations we raise the equilibrium level of output by 1% in the Euro Area permanently by raising the rate of technical progress for a limited period. The shock raises the level of the labour augmenting technology trend (but not its rate of growth) in all Euro Area countries, and the effects of this shift take time to feed through to the level of output[8]. This is a supply shock to the production function of all Euro Area countries. Technical progress raises labour productivity and feeds into the production function through the labour demand curve. The rise in technical progress raises output and incomes in the Euro Area and hence raises external demand in the

[7] See ECB (2000). The parameters we use do not reflect estimation. It does deliver the style of reaction we would expect form a stability oriented central bank in our model. We have discussed the react function with our user group, which includes the ECB, and there have been no major criticisms.
[8] We shift TECHL in all countries by approximately 1.5%, as the labour share is approximately 2/3rds.

accession countries. It also causes the real effective exchange rate of the Euro Area to depreciate. The technical progress shock means that more of the same goods are being produced at the same cost, and hence in an imperfectly competitive world their relative price has to fall. Inflation drops temporarily, leading to interest rate cuts in the Euro Area. In the long-run the price level in the Euro Area remains permanently below base[9].

Figure 1. Impact of EU technology shock on real exchange rate in Hungary

(% difference from base)



There is a corresponding appreciation of the real effective exchange rates in the accession countries, as they do not experience the same technology shock, and hence they are producing the same goods in the same quantities as in the past, and their relative price rises as more goods are produced elsewhere. Figure 1 illustrates the impact on the real effective exchange rate in Hungary under fixed and flexible exchange rates and Table 4 reports results for all five countries. Ultimately, the real exchange rate reaches the same level under both the fixed and flexible regimes. In Hungary the shock leads to an appreciation of the real exchange rate of approximately

[9] Further details of this style of shock can be found in Barrell, Dury and Holland (2001)

0.6 per cent. Under a flexible regime, this long-run level is achieved more quickly, as the exchange rate adjusts directly after ECB rates are reduced.

Table 4. Impact of EU technology shock

		Price level		Real exchange rate	
		Flexible	Fixed	Flexible	Fixed
Czech Republic	**After 1 year**	0.08	0.14	0.34	0.30
	After 2 years	0.11	0.17	0.46	0.55
	After 5 years	0.16	0.00	0.56	0.75
	After 10 years	0.23	-0.35	0.57	0.52
Estonia	**After 1 year**	0.13	0.23	0.41	0.38
	After 2 years	0.17	0.26	0.51	0.62
	After 5 years	0.21	0.02	0.56	0.70
	After 10 years	0.22	-0.32	0.57	0.46
Hungary	**After 1 year**	0.11	0.22	0.40	0.37
	After 2 years	0.15	0.24	0.49	0.59
	After 5 years	0.22	0.01	0.54	0.69
	After 10 years	0.30	-0.31	0.53	0.47
Poland	**After 1 year**	0.02	0.21	0.53	0.32
	After 2 years	0.00	0.29	0.61	0.60
	After 5 years	-0.11	0.16	0.71	0.78
	After 10 years	-0.40	-0.06	0.84	0.69
Slovenia	**After 1 year**	0.08	0.19	0.38	0.33
	After 2 years	0.09	0.23	0.46	0.58
	After 5 years	0.10	-0.03	0.53	0.66
	After 10 years	0.14	-0.33	0.55	0.49

Even after 10 years, the real exchange rate under a fixed regime remains below the long-run level given by the flexible regime in all five countries, as Table 4 shows. If the exchange rate in the accession countries is fixed to the euro, the nominal exchange rate follows that in the Euro Area. In this case the entire adjustment of the real effective exchange rate must be effected through the price level, while the nominal effective exchange rate will actually move in the opposite direction, as the euro depreciates.

Since prices adjust more gradually than exchange rates, and the nominal effective exchange rate pulls in the opposite direction when it is fixed, a cyclical effect is introduced into the model under a fixed exchange rate regime. In addition, under floating rates the initial impact of the shock on the real exchange is larger in the least open economy, Poland, than elsewhere. The price levels in the more open economies are more influenced by import prices than that in Poland, and even under floating rates their real exchange rates adjust rapidly.

Figure 2. Net impact of fixed exchange rates on output

(% difference from flexible regime)

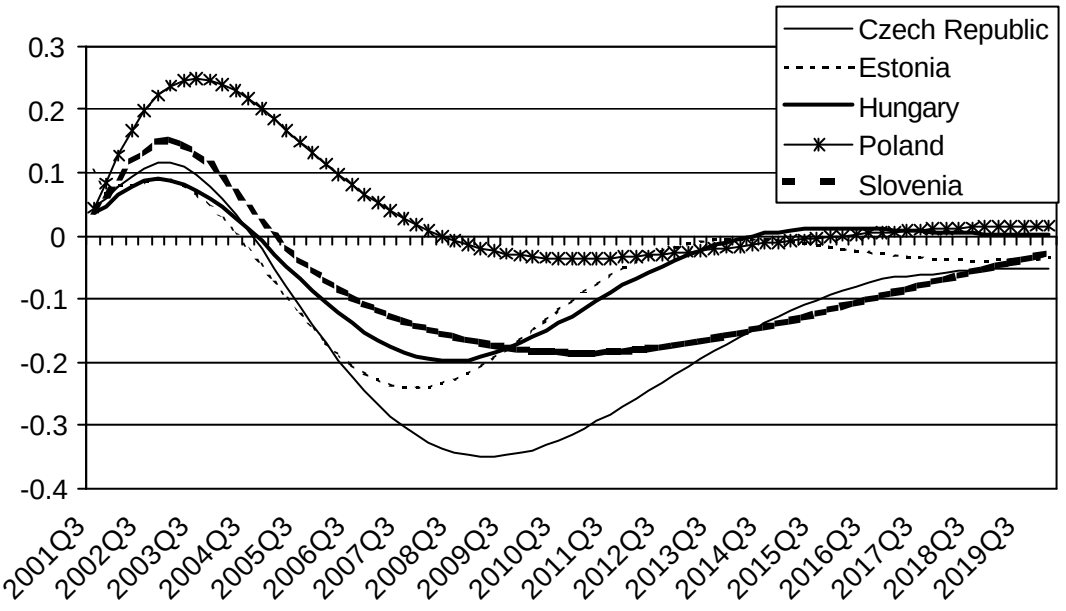


Figure 2 illustrates the cyclical impact of the fixed regime on GDP. We plot the percentage difference of GDP under the fixed regime relative to the flexible regime. Initially, output is higher under the fixed regime, but after about 4 years output is lower under the fixed regime in most countries. In the long-run, the choice of regimes does not affect the level of output. The relative advantage of fixed rates is greater for the closed economy, Poland, as it allows the real exchange rate to adjust more slowly,

producing a relatively smaller effect on output. Market economies have many stabilising mechanisms, and the most important involve the rapid adjustment of the economy to changes in relative prices. A small open economy like Estonia has strong feedbacks, and returns to equilibrium relatively quickly. The more important financial wealth is in the economy the more quickly the economy responds to a price shock. When prices rise, real wealth falls, and this reduces consumption, and hence output and income adjust more rapidly to equilibrium. Hungary has the largest wealth stock and this is a major factor behind its relatively rapid adjustment. The automatic stabilisers of the market through wealth and competitiveness are less strong in the Czech Republic and Slovenia than in the Hungary and Estonia.

Our results suggest that most countries, in particular the Czech Republic and Slovenia, benefit from a flexible exchange rate regime in the face of a technology shock in the Euro Area that is not matched in the accession countries. The negative impact on output in the long-run outweighs the short-term positive impact on output. However, in Poland, the results suggest that a fixed regime may be preferable, as there is a strong positive impact on output under the fixed regime relative to the flexible regime. In Hungary and Estonia the gross impact on output is roughly neutral under both scenarios. However, the cyclical behaviour under the fixed regime is likely to raise uncertainty and increase the risk premium in these countries, suggesting that a flexible regime may be preferable in the face of such a shock.

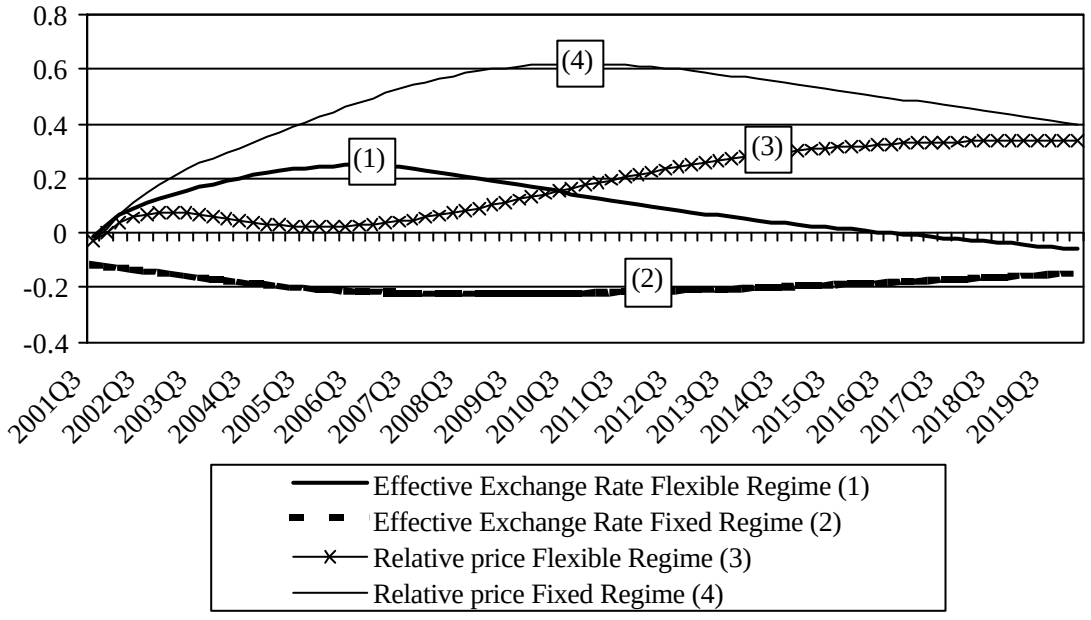
IV.3 European fiscal tightening

In the next set of simulations, we reduce the rate of growth in the Euro Area for a sustained period of time by introducing a permanent fiscal tightening. We increase the budget target by 1 percentage point of GDP, which is financed through a rise in income tax. The deficit in all countries is reduced by 1% of GDP permanently after a

process of adjustment. This reduces external demand in the accession countries for a number of years. It also lowers the equilibrium real interest rate in all economies, as a fiscal tightening allows interest rates to fall. There is a significant impact on world savings and investment flows from this fiscal change. As in the previous simulation, the real effective exchange rate of the Euro Area depreciates. Since the shock occurs in the Euro Area, interest rates in this region fall first and to a greater degree than in other regions. As real interest rates fall in the Euro Area more than elsewhere, the UIP condition requires a depreciation of the nominal euro exchange rate.

Figure 3. Impact of an EU fiscal tightening on Slovenia

(% difference from base)



There is a corresponding appreciation of the real effective exchange rates in the accession countries. Under a fixed exchange rate regime the currency depreciates in line with the euro, and the real appreciation is effected through a rise in prices. Interest rates in the Euro Area are cut to counterbalance the fiscal tightening, and this stimulates inflation in the accession countries. Under a flexible exchange rate regime there is some nominal appreciation of the exchange rate, and relative prices do not

rise as much as under the fixed regime. Figure 3 illustrates the impact on the nominal effective exchange rate and relative prices in Slovenia under fixed and flexible exchange rates. Table 5 reports the results for all five countries.

Table 5. Impact of fiscal tightening in Euro Area

		Relative Prices		Nominal effective exchange rate	
		Flexible	**Fixed**	**Flexible**	**Fixed**
Czech Republic	**After 1 year**	0.04	0.09	0.07	-0.13
	After 2 years	0.03	0.15	0.13	-0.16
	After 5 years	0.11	0.45	0.14	-0.21
	After 10 years	0.41	0.65	-0.11	-0.21
Estonia	**After 1 year**	0.16	0.23	0.01	-0.19
	After 2 years	0.18	0.34	0.03	-0.22
	After 5 years	0.21	0.54	-0.04	-0.28
	After 10 years	0.38	0.44	-0.23	-0.28
Hungary	**After 1 year**	0.14	0.22	0.05	-0.17
	After 2 years	0.16	0.33	0.08	-0.20
	After 5 years	0.27	0.60	0.03	-0.26
	After 10 years	0.54	0.65	-0.21	-0.26
Poland	**After 1 year**	0.02	0.18	0.28	-0.18
	After 2 years	0.00	0.33	0.37	-0.22
	After 5 years	-0.12	0.64	0.61	-0.28
	After 10 years	-0.33	0.89	1.04	-0.29
Slovenia	**After 1 year**	0.07	0.15	0.11	-0.14
	After 2 years	0.07	0.26	0.17	-0.16
	After 5 years	0.03	0.48	0.25	-0.22
	After 10 years	0.21	0.62	0.11	-0.22

In the Czech Republic, Estonia and Hungary, the impact on relative prices and the nominal effective exchange rate is approximately the same in the long-run. These economies are all relatively open and relatively flexible and adjustment comes through the price level and not so much the exchange rate. Relative prices rise by slightly less under the flexible regime and the exchange rate depreciates by slightly less in the long-run. The impact feeds through more gradually under the flexible regime. In Slovenia and Poland, the nominal exchange rate appreciates in the long-

run, and relative prices remain much lower under the flexible regime. Poland is the least open of these economies, and the required real appreciation comes through the operation of the financial markets rather than through prices rising. Slovenia is a relatively slowly responding economy, and hence a nominal increase in the exchange rate is also more likely. In all cases, the impact on the real effective exchange rate is equivalent in the long-run under both the flexible and fixed regimes.

Figure 4. Net impact of fixed exchange rates on output

(% difference from flexible regime)

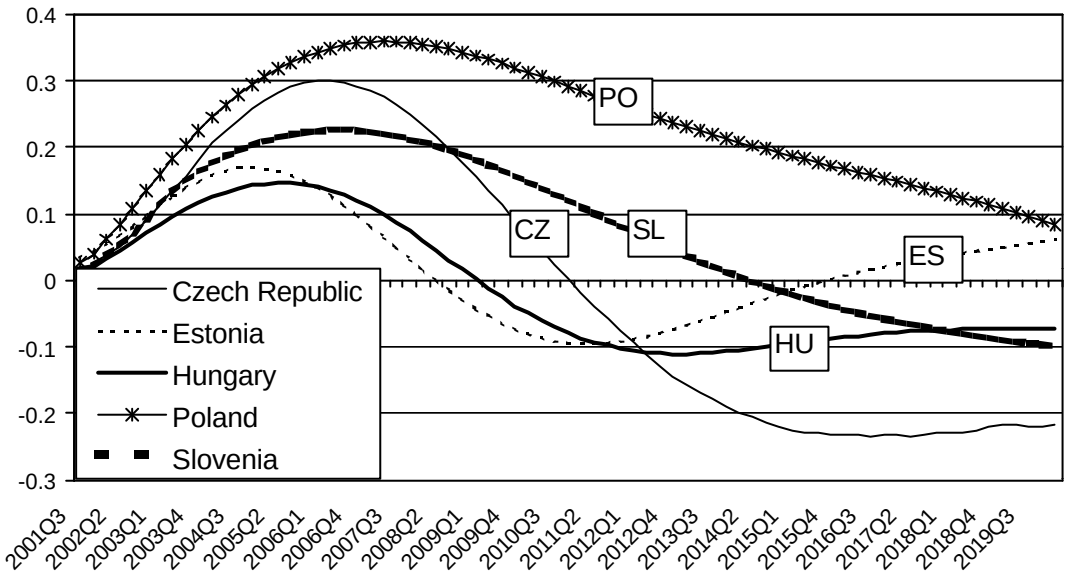


Figure 4 illustrates the gross impact on GDP of the fixed regime relative to the flexible regime. As in the previous simulation, initially output is higher under the fixed regime, responding to the cut in interest rates. But after about 8-10 years output is lower under the fixed regime in most countries. Again, Poland stands out from the others, in that GDP is always higher under the fixed regime. This is another argument in favour of a fixed exchange rate regime in Poland if fiscal tightening is anticipated in the Euro Area. An expansionary fiscal policy in the Euro Area would obviously

have the opposite effect, and if this were anticipated a flexible regime would be favoured. A flexible regime would limit volatility in all countries, and this may reduce the interest rate premium, which offers support for a flexible regime.

IV.4 Increased FDI inflows

In the next set of simulations we raise productivity and net trade in the accession countries through an increase in FDI inflows. This shock differs from the technical progress shock in the EU described above, as FDI feeds directly into the trade equations as well as into the production function. As such, it effectively acts as an increase in the variety or quality of goods produced, filling what Romer (1993) terms 'idea gaps'. As discussed in the Introduction above, this should normally put upward pressure on the real exchange rate when real output expands, which is the reverse of the impact of the technology shock in the Euro Area, where quality and variety were unchanged. However, the overall impact of the shock will depend upon the parameters in the model and on the ratios of exports and imports to GDP. If the impact of FDI on imports, both directly and through the impact on the level of output is greater than its impact on exports then GDP may not rise. This can happen either because the elasticity on exports is low relative to demand effects, or because exports are markedly smaller than imports.

We raise the level of FDI in each country 30 percent progressively over 15 years, and then leave the rate of growth of the stock the same as on our baseline, and hence the stock of FDI is 30% higher than it would have been in the medium term. Figures 5 and 6 illustrate the impact on the real effective exchange rate and GDP in the Czech Republic and Table 6 reports the impact on the real exchange rate and GDP in all five economies.

Figure 5. Impact of FDI shock on real exchange rate in the Czech Republic

(% difference from base)

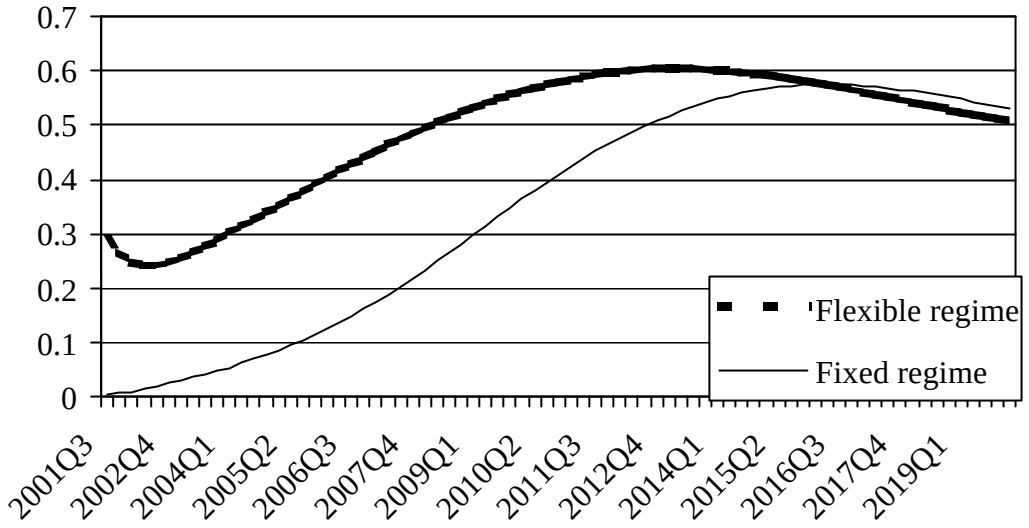
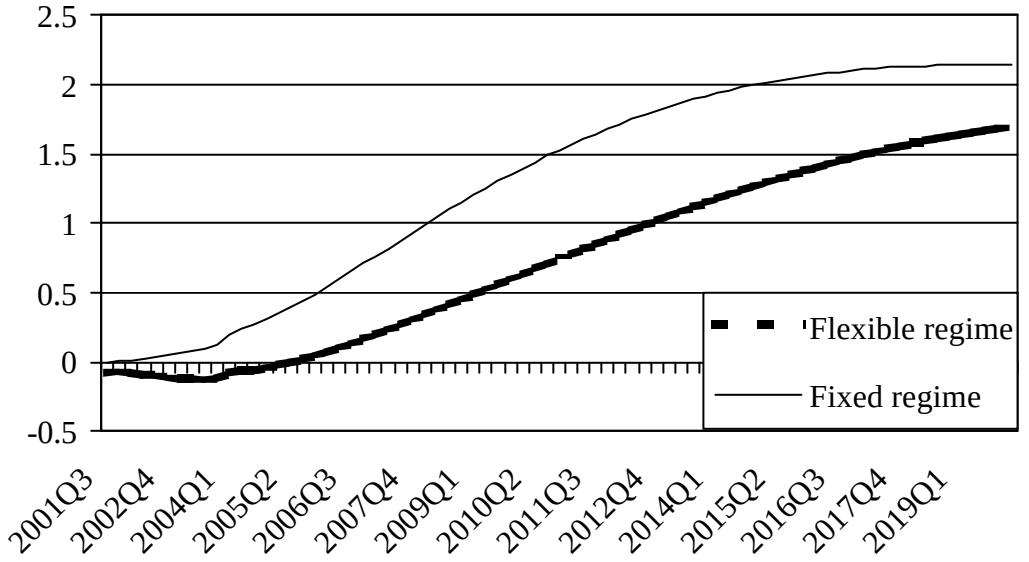


Figure 6. Impact of FDI shock on GDP in the Czech Republic

(% difference from base)



As discussed above, the coefficients on FDI in exports and technology are the same in all countries, and hence the long run impacts here will differ only because of the different ratios of exports to GDP, FDI to GDP and the labour share in output on our

baseline. Different starting values and projections for these ratios would give different impacts of the shock. The coefficient on FDI in imports in Poland is noticeably higher than in the other countries, which all have the same coefficient. This alone will mean that the results for Poland are markedly different from other countries in the long run.

Table 6. Impact of FDI shock on real exchange rates and GDP

		Real exchange rate		GDP	
		Flexible	Fixed	Flexible	Fixed
Czech Republic	**After 1 year**	0.24	0.02	-0.10	0.04
	After 2 years	0.28	0.04	-0.13	0.10
	After 5 years	0.43	0.15	0.13	0.65
	After 10 years	0.59	0.45	0.85	1.64
Estonia	**After 1 year**	0.03	0.01	-0.02	0.00
	After 2 years	0.03	0.00	-0.02	0.02
	After 5 years	0.04	0.01	0.06	0.12
	After 10 years	0.09	0.06	0.18	0.28
Hungary	**After 1 year**	0.25	0.02	-0.10	0.04
	After 2 years	0.28	0.05	-0.10	0.11
	After 5 years	0.45	0.12	0.25	0.67
	After 10 years	0.84	0.61	1.72	2.38
Poland	**After 1 year**	-0.13	0.00	0.04	0.00
	After 2 years	-0.15	-0.02	0.04	-0.02
	After 5 years	-0.31	-0.15	0.02	-0.10
	After 10 years	-0.84	-0.44	-0.03	-0.19
Slovenia	**After 1 year**	0.28	0.02	-0.10	0.06
	After 2 years	0.29	0.05	-0.06	0.17
	After 5 years	0.46	0.22	0.24	0.62
	After 10 years	0.85	0.57	1.01	1.72

The shock increases the stock of FDI by about 30 per cent after 15 years. Under a flexible regime, the nominal exchange rate jumps in the first quarter of the simulation. The real exchange rate, therefore, initially exhibits a stronger appreciation under the flexible regime than under the fixed regime in the Czech Republic. In the long-run the impact is the same, with a real appreciation of about 0.5 per cent. Output is higher under a fixed regime over the simulation period, although the long run impact will be the same in both regimes. The faster appreciation of the real exchange rate restrains

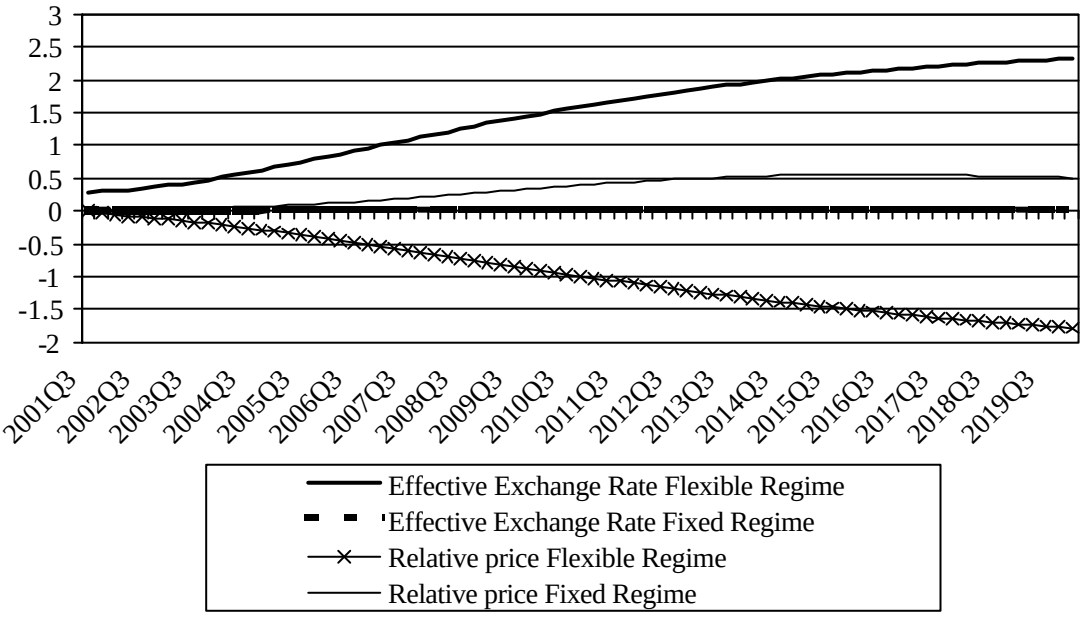
export growth under the flexible regime. Productivity improvement take longer to feed through than trade responses, so the initial impact on output is even negative under the flexible regime. The long-run impact on output is higher in Hungary than in the Czech Republic and Slovenia. Hungary benefits in part on our model because it has the smallest trade deficit amongst the 5 countries and therefore the net impact on exports minus imports is the greatest, and this does seem to reflect its relative experience over the last decade.

There is virtually no impact on the real exchange rate or GDP in Estonia, while there is a strong negative impact in Poland. This reflects a negative impact on the trade balance in these economies, and this is explained by the starting values on Table 1 for the trade balance in both countries. In Estonia this negative trade balance effect reflects the noticeably higher ratio of imports to GDP as compared to exports to GDP, or put another way, the scale of the trade deficit in 2000 and in our baseline projection. This means that higher imports counter-balance the positive impact on productivity. In Poland the negative trade balance outweighs any positive impact on productivity because of both the higher trade deficit and the greater impact of FDI on imports. This reflects the nature of FDI and relocation in Poland, where processing rather than production is a major feature of foreign firms. If the import content of FDI related production can be reduced whilst leaving incentives to invest and to raise productivity, Poland could benefit in the same way as the other economies. These differences may also reflect the relatively low levels of education and skills in the Polish economy, and policies to address these problems would help improve the impact of FDI on productivity as well as raise it directly.

Figure 7 and Table 7 decompose the real exchange rate movements into the impact on the nominal exchange rate and relative prices. Under a fixed exchange rate regime, the nominal exchange rate is unchanged, of course, so the change to the real exchange rate is effected entirely through relative prices. Under a flexible regime, the nominal exchange rate appreciates as the external balance improves. This is counterbalanced by a fall in the inflation differential relative to the main trading partners. Similar patterns can be observed for all countries, as can be seen in Table 7.

Figure 7. Impact of FDI shock on the Czech Republic

(% difference from base)



Under the flexible regime, the nominal exchange rate in Poland depreciates by 1.5 per cent after 10 years. Rather than an indication of the appropriate exchange rate regime, we interpret this as an indication that the government should try to target a different type of FDI. The FDI that has flowed into Poland has had little impact on export growth or productivity growth. The FDI in Hungary has been the strongest at

promoting growth, followed by Slovenia. The impact on GDP is stronger under the fixed regime in all countries with the exception of Poland.

Table 7. Impact of FDI shock on nominal exchange rates and prices

		Nominal effective exchange rate		Relative prices	
		Flexible	Fixed	Flexible	Fixed
Czech Republic	**After 1 year**	0.34	0.01	-0.10	0.01
	After 2 years	0.45	0.01	-0.17	0.04
	After 5 years	0.92	0.01	-0.49	0.14
	After 10 years	1.69	0.02	-1.08	0.44
Estonia	**After 1 year**	0.05	0.01	-0.02	0.00
	After 2 years	0.07	0.01	-0.04	0.00
	After 5 years	0.16	0.01	-0.11	0.02
	After 10 years	0.35	0.02	-0.22	0.08
Hungary	**After 1 year**	0.46	0.01	-0.21	0.01
	After 2 years	0.62	0.01	-0.34	0.04
	After 5 years	1.46	0.01	-0.99	0.11
	After 10 years	3.38	0.02	-2.45	0.59
Poland	**After 1 year**	-0.21	0.01	0.08	-0.01
	After 2 years	-0.28	0.01	0.13	-0.03
	After 5 years	-0.58	0.01	0.27	-0.16
	After 10 years	-1.55	0.02	0.73	-0.46
Slovenia	**After 1 year**	0.46	0.01	-0.18	0.01
	After 2 years	0.60	0.01	-0.31	0.05
	After 5 years	1.16	0.01	-0.69	0.20
	After 10 years	2.45	0.02	-1.57	0.55

IV.5 Timing of EMU membership

In the next set of simulations, we consider the timing of EMU membership. We look at the impact on the real exchange rate, GDP and inflation in Poland, Hungary and the Czech Republic if they join in one of 2005, 2006, 2007, 2008 and 2009. We do not repeat these tests in Estonia, where the exchange rate is already directly tied to the euro, or in Slovenia, where the argument for a future appreciation of the real exchange rate is weak. We also do not look at the inevitable gains that would come from greater competition and price transparency as a result of EMU, nor do we look at the impacts on trade. As Pain (2002) suggests, these impacts can be large, and could easily offset any transitional problems.

Membership of the Euro Area requires that interest rates in the country joining the Union fall to the EMU level, and that the exchange rate subsequently moves in line with the euro. We implement this change to our baseline in each of the years and countries mentioned above. The difference in the outcome is highly dependent upon our baseline assumptions, which have interest rates and exchange rates converging toward Euro Area rates gradually over time. The most rapid period of convergence is expected to take place by 2008, and this is reflected in steady reduction in the risk premium associated with each country prior to 2008.

Figures 8-10 illustrate the impact on the real exchange rate in each of the three countries at different joining times and rates. All entry rates produce the same real exchange rate in the long run in our model. In the short-run, there is a much stronger appreciation of the real exchange rate the earlier a country joins.

Figure 8. Impact on real exchange rate in the Czech Republic

(% difference) from base)

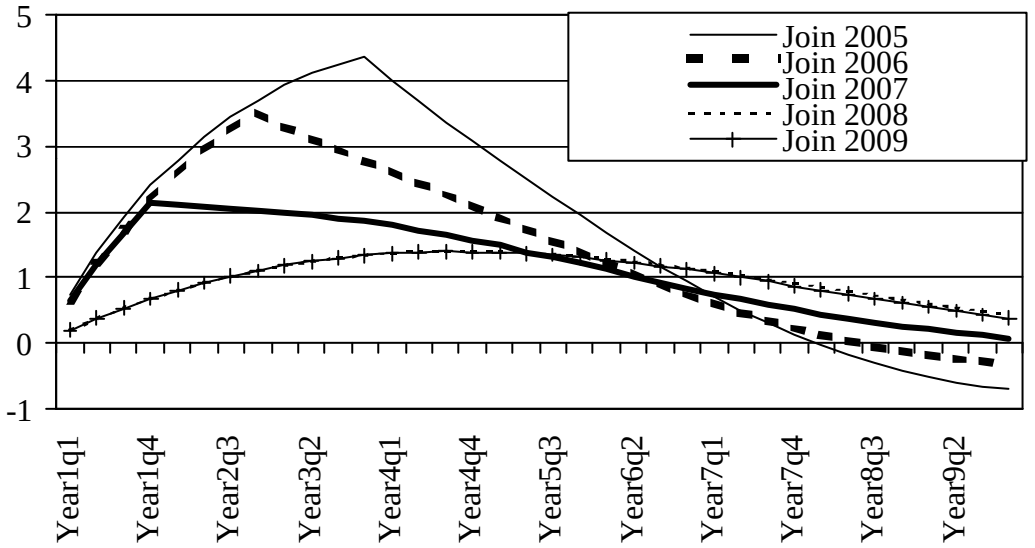


Figure 9. Impact on real exchange rate in Hungary

(% difference from base)

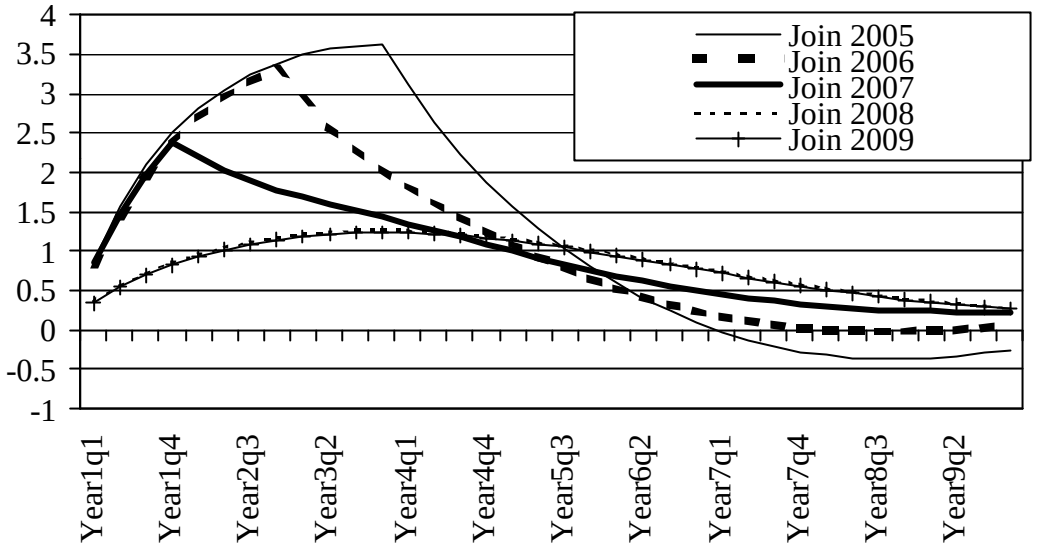
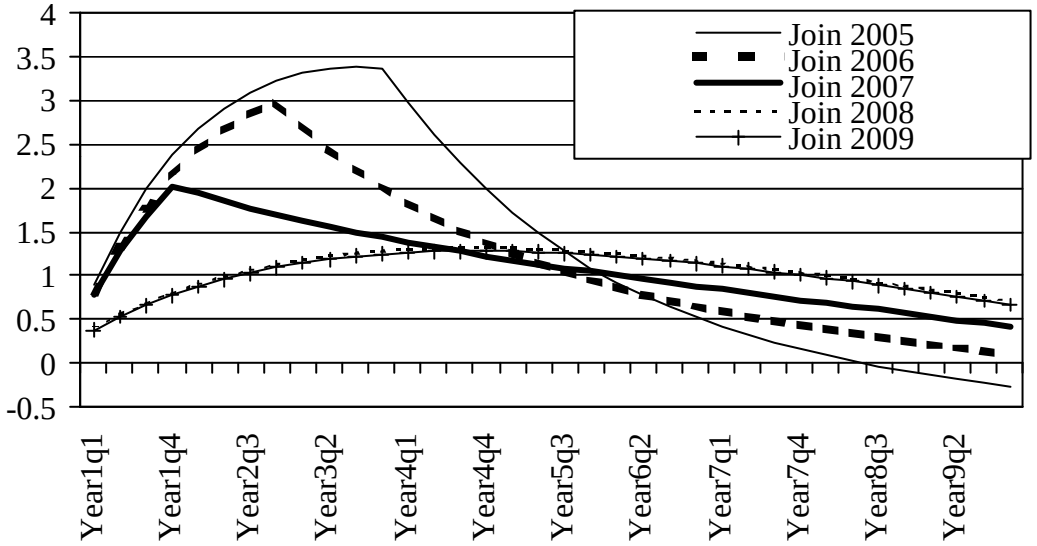


Figure 10. Impact on real exchange rate in Poland

(% difference from base)



The removal of the interest rate differential involves a fall in rates, which induces a depreciation, and a removal of the risk premium, which induces an appreciation. The later effect is stronger in these simulations, and hence we see a sharper appreciation of

the nominal exchange rate relative to our baseline scenario the earlier the country joins. There is little perceptible difference between joining in 2008 and joining in 2009, as the risk premium is expected to stabilise after this date. There is still a shock to the economy of joining in 2009, as joining EMU is expected to reduce the risk premium associated with transition country assets.

Table 8. Impact real effective exchange rate

		Join 2005	Join 2006	Join 2007	Join 2008
Czech Republic	**After 1 year**	2.40	2.18	2.13	0.68
	After 2 years	3.71	3.51	2.02	1.10
	After 5 years	1.95	1.40	1.21	1.32
	After 10 years	-0.76	-0.35	-0.01	0.24
Hungary	**After 1 year**	2.51	2.36	2.37	0.85
	After 2 years	3.38	3.31	1.78	1.17
	After 5 years	0.80	0.66	0.76	1.01
	After 10 years	-0.03	0.17	0.25	0.22
Poland	**After 1 year**	2.37	2.13	2.02	0.80
	After 2 years	3.22	2.97	1.69	1.12
	After 5 years	1.09	0.95	1.04	1.27
	After 10 years	-0.43	-0.06	0.24	0.52

Table 9. Impact on nominal exchange rate

		Join 2005	Join 2006	Join 2007	Join 2008
Czech Republic	**After 1 year**	-3.28	-3.04	-3.03	-1.07
	After 2 years	-6.07	-5.83	-3.94	-2.00
	After 5 years	-10.48	-8.46	-6.61	-4.72
	After 10 years	-14.63	-12.69	-10.91	-9.10
Hungary	**After 1 year**	-3.28	-3.04	-3.03	-1.07
	After 2 years	-6.07	-5.84	-3.94	-2.00
	After 5 years	-10.48	-8.46	-6.61	-4.72
	After 10 years	-14.63	-12.69	-10.91	-9.10
Poland	**After 1 year**	-3.28	-3.04	-3.03	-1.07
	After 2 years	-6.07	-5.83	-3.94	-2.00
	After 5 years	-10.48	-8.46	-6.61	-4.72
	After 10 years	-14.63	-12.69	-10.91	-9.10

Tables 8-11 report the impact on the real effective exchange rate, the nominal exchange rate against the US$, inflation and GDP of joining at different times. The

impact on the nominal exchange rate is the same in all countries, as our baseline scenario assumes a constant risk premium across the three economies. The initial impact on inflation and output is strongest in Poland, which has the greatest interest rate differential with the Euro Area. The initial impact on inflation and output is initially weakest in the Czech Republic, where interest rates have essentially converged on Euro Area rates. The Hungarian economy on our model adjusts more rapidly to shocks than the Czech economy and model, and after 10 years the impact on inflation in Hungary falls below that in the Czech Republic. This in part reflects the impact of the stabiliser produced by the relatively high wealth stock in Hungary. Higher inflation reduces real wealth and hence consumer demand, causing real output and prices to adjust more quickly.

Table 10. Impact on inflation[10]

		Join 2005	Join 2006	Join 2007	Join 2008
Czech Republic	**After 1 year**	-0.40	-0.36	-0.37	-0.12
	After 2 years	-1.38	-1.33	-1.08	-0.43
	After 5 years	-2.23	-1.73	-1.33	-1.01
	After 10 years	-1.05	-1.02	-1.07	-1.17
Hungary	**After 1 year**	-0.46	-0.42	-0.43	-0.15
	After 2 years	-1.94	-1.85	-1.57	-0.58
	After 5 years	-2.10	-1.59	-1.28	-1.11
	After 10 years	-0.74	-0.83	-0.93	-1.03
Poland	**After 1 year**	-0.31	-0.31	-0.34	-0.08
	After 2 years	-1.60	-1.56	-1.32	-0.42
	After 5 years	-2.21	-1.56	-1.17	-0.95
	After 10 years	-1.22	-1.20	-1.21	-1.24

The shock has a contractionary impact on output in the Czech Republic and Hungary, but an expansionary impact on output in Poland. This reflects the relative openness of the three economies as well as their initial policy settings. The real appreciation of the exchange rate has a strong negative impact on the trade balance, while falling interest

[10] According to our baseline projections, these estimates do not imply deflation in any country.

rates and inflation boosts domestic demand. Domestic demand accounts for a much larger share of GDP in Poland than in the other economies, and interest rates fall more in Poland. Hence there is a much larger impact on demand than elsewhere, and the offset from lost competitiveness is not great. The very open Czech and Hungarian economies are much more affected by the fall in competitiveness, and its effects on the trade balance and output are compounded by the impact of overvaluation on FDI. Lower growth and worse competitiveness reduces FDI inflows and this reduces both productive capacity and the ability to export. Hence the economies face a period of potentially slow growth if they join EMU at overvalued exchange rates, much as Barrell and Pain (1999) discuss.

Table 11. Impact on GDP Growth

		Join 2005	Join 2006	Join 2007	Join 2008
Czech Republic	**After 1 year**	-0.88	-0.81	-0.81	-0.22
	After 2 years	-2.64	-2.53	-1.98	-0.78
	After 5 years	-7.42	-5.90	-4.43	-3.03
	After 10 years	-5.98	-5.41	-5.12	-5.02
Hungary	**After 1 year**	-0.21	-0.15	-0.13	0.41
	After 2 years	-1.41	-1.32	-0.80	0.14
	After 5 years	-3.46	-2.43	-1.60	-1.00
	After 10 years	-1.11	-1.09	-1.17	-1.28
Poland	**After 1 year**	1.81	1.88	1.96	2.45
	After 2 years	1.37	1.59	2.16	3.16
	After 5 years	0.27	1.77	3.10	4.28
	After 10 years	4.08	5.01	5.71	6.19

In the very long run in this model there are no irreversibilities, unlike in the Barrell and Pain (1999) discussion, and hence output will return to its equilibrium trajectory. However, this depends upon competitiveness reaching its equilibrium and then the stock of FDI increasing to reach the value it would otherwise have achieved. These processes take a long while. The inertial Czech economy could have output below where it would have otherwise have been for a long period if it joined EMU in 2005

and there were none of the gains discussed in Pain (2002). The more rapidly reacting Hungarian economy might have output below where it would otherwise have been for only 10 to 15 years if it joined in 2005 and there are no significant gains from EMU membership. Early membership involves a more marked real appreciation on joining, and hence a larger negative impact on output through both trade and technology absorption via FDI flows.

Our results suggest that the Czech Republic and Hungary have something to gain from postponing EMU entry until the economies are more fully converged. The results for Poland, on the other hand, do not point to significant gains from postponing entry. However, Poland, like the Czech Republic and Hungary, may be constrained by its excessive budget deficit from achieving early entry.

V. Conclusions

Although we can draw conclusions from the discussion above, it is important to keep in mind what is missing from this analysis. We cannot in this analysis take account of all shocks, and we cannot fully evaluate the impact of a fixed exchange rate and a common currency on growth. However, we can point to other research on these topics, such as Barrell and Dury (2000) on the role of shocks in the evaluation of regimes, or Frankel and Rose (2002) on the impact of monetary unions on trade and growth. The latter paper argues that monetary union can raise trade between members by 60 percent of GDP, and this increases competition, specialisation and flows of knowledge. As a result in can be argued that in a country with a significant productivity gap with its partners output might rise by as much as 20 percent over the medium term if it joins a monetary union with them.

The first three sets of simulations lead to appreciations of the real exchange rates in most countries. These shocks were chosen specifically because we expect to see a real appreciation of the exchange rates in most countries over the next several years. In general we find that a flexible regime offers greater stability in the face of these shocks, as cyclical behaviour is introduced with a fixed regime. These cycles are larger the less flexible the economies, and in particular, the less open and financially advanced they are (at least as measured by the stock of financial wealth). This is particularly important if shocks cause the nominal exchange rate to move in the opposite direction to the equilibrium, or long term real exchange rate path.

The appropriate regime depends on the "anticipated" shocks. In general our study seems to suggest that a fixed exchange rate regime is preferable in Poland. Poland performs better in response to both external demand and supply shocks under a fixed regime. Estonia and Hungary are more flexible economies, and there is little trade-off between the two regimes in these economies, and hence little to put against the case for ultimate membership. For them timing is important. There is some argument in favour of a flexible regime in the Czech Republic and Slovenia, particularly where external supply shocks are expected. External supply shocks under a fixed regime cause the nominal exchange rate to move in the opposite direction to the equilibrium real exchange rate path, which requires inflation to overcompensate for the exchange rate. In the face of domestic supply shocks, the nominal exchange rate is not pulled in the wrong direction by EMU membership, and all economies perform better with a fixed regime.

However, choosing monetary regimes requires an evaluation of the ability of the regime to absorb shocks. Regime choices cannot be based purely on results from a

few scenario analyses, as it is important to consider all the shocks that might arise. Stochastic simulations have been used for this purpose in studies of the UK in Barrell and Dury (2000) and Barrell (2002) suggest that joining EMU reduces inflation and price level variability and raises output variability in the UK. The reduction in inflation variability stems largely from the removal of exogenous shocks to the €/£ exchange rate. Higher risk premia attached to accession countries suggest that the potential gains from EMU membership are higher. The results we present in this paper can act as a basic guide to the appropriate monetary policy choice in the five countries covered by this study. There seems to be some argument for postponing membership of EMU in the Czech Republic and Slovenia, and perhaps in and Hungary until further convergence is achieved.

Our evidence on the significant costs the Czechs and Hungarians might face if they are early joiners would indicate that they should delay membership of EMU until several years after they become members of the European Union. However, once the process of price level adjustment and increasing productivity is well advanced then the case for joining is strong. In the short to medium term membership would imply an overvaluation of the exchange rate (partly to ensure the inflation criterion is met) that would discourage FDI inflows and hence reduce the rate of growth of technical capacity and of exports. These losses would probably be large enough, especially if membership came early, to offset the slowly emerging gains from EMU in the early years of membership. However, for Poland the case for early fixing and early membership is strengthened, as there are no real losses involved, in part because the appreciation that would be required would not particularly reduce output through reduced FDI, and lower interest rates would stimulate domestic demand.

The choice of regime depends in part on the nature of shocks anticipated in the future as well as on the structure of the economies we are studying. If external supply shocks were prevalent then the Czechs and the Slovenes would have their case for joining weakened unless they were able to make their economies respond more quickly. If external demand shocks were prevalent then all countries would have their case for membership of EMU strengthened. If internal supply shocks were common then the case for membership would be strengthened in all cases but Poland, and they have the strongest case anyway on the basis of our results. If internal demand shocks were common and unavoidable then independence is probably best unless the gains from the use of a common currency are great enough to offset the impact of higher volatility. However, shocks are not independent of institutions, and policy makers can work to produce a more flexible economic system with small internal shocks. Indeed, this is a sensible course of action whether EMU membership is contemplated of not. Many internal shocks are generated or at least encouraged by the policy framework, and hence it is within the hands of policy makers to change matters, as experience in the UK in the last decade has demonstrated.

References

Barrell R. and Karen Dury (2000) 'Choosing the Regime: Macroeconomic effects of UK entry into EMU' *Journal of Common Market Studies*, Vol. 30 (4)

Barrell, R Dury, K, and Holland, D, (2001) 'Macro-Models and the Medium Term: The NIESR experience with NiGEM' presented at the EU/ULB/AEA conference, Brussels, July

Barrell, R, and te Velde, D. W., (2002) 'European integration and manufactures import demand, an empirical investigation of 10 European countries. Forthcoming in *German Economic Review*

Barrell, R, D Holland, N Pain, Z Jakab, M Kovacs, U Sepp, K Smidkova and U Cufer (2001), "An Econometric Macromodel of Transition: Policy Choices in the Pre-Accession Period", presented at Macromodels 2001, Krag, December.

Barrell, R. and Pain, N. (1999), 'European growth and integration: domestic institutions, agglomerations and foreign direct investment in Europe', *European Economic Review*, April, pp 925 -935

Barrell, R., 'The UK and EMU: Choosing the Regime' *National Institute Economic Review No. 180* April 2002

Barrell, R., Dury, K, Hurst, I, and Pain, N (2001) 'Modelling the World Economy: The NIESR model NIGEM' presented at an ENEPRI workshop, Paris, July

De Broeck, M and T Sløk, (2001), "Interpreting Real Exchange Rate Movements in Transition Countries", BOFIT Discussion Papers, 7/2001.

ECB (2000) 'The Two Pillars of the ECB's Monetary Policy Strategy' *ECB Monthly Bulletin*, November pp 318 - 40

Égert, B, (2001), "Estimating the Impact of the Balassa-Samuelson Effect on Inflation during the Transition: Does It Matter in the Run-Up to EMU?", presented at East European Transition and EU Enlargement: A Quantitative Approach, Gdansk, June.

Frankel, J. and Rose, A., (2002) 'An estimate if the effect of common currencies on trade and income' *Quarterly Journal of Economics* Vol. 116 May

Pain, N., 'EMU, Investment and Growth' *National Institute Economic Review No. 180* April 2002

Romer, P. (1993), 'Idea gaps and object gaps in economic development', *Journal of Monetary Economics*, 32, pp. 543-573.

Sinn, H and M Reutter, (2001), "The minimum inflation rate for euroland", NBER Working Paper No. 8085.

Smidkova, K, R Barrell and D Holland, (2002), "Estimates of Fundamental Real Exchange Rates for the Five EU Accession Countries", Czech National Bank Working Paper No. 3.