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The Timing of EU Expansion and the Real Exchange Rate in Europe
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Abstract

This paper analyses the impact of the timing of EU expansion on the real exchange rate between the accession countries’ currencies and the euro. I find that the real exchange rate response to EU accession is smaller in the case of a postponed accession, as postponement gives the regions more time to converge. However, early EU accession would contribute to reducing the real exchange rate response to asymmetric productivity shocks, as increased bilateral trade reduces the size of the non-tradable goods sector, making the real exchange rate less sensitive to productivity shocks.

Key words: economic integration, real exchange rate, international trade, productivity shocks.

1 Introduction

This paper studies the consequences of the Eastern enlargement of the European Union, with a special focus on the timing of accession. It attempts to shed some light on what the timing of EU accession could imply for the behaviour of the real exchange rate. While acknowledging that the decision on the expansion of the Union will be made primarily on non-economic grounds (political stability, international security), economic considerations should also play a role.

I analyse the development of the real exchange rate between the currencies of the candidate member states and the euro.\footnote{I consider the twelve countries that are currently involved in accession negotiations with the EU: Hungary, Poland, Czech Republic, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Romania, Bulgaria, Malta, Cyprus.} I start from the presumption that exchange rate stability is desirable, both for the current member states and for the new member states. Real exchange rate movements could lead to political and economic troubles in the extended European Union, either in the form of nominal exchange rate tensions or in the form of (temporary or persistent) inflation differentials between the accession countries and the current member states. I study the behaviour of the real exchange rate in order to provide some insight into the policy challenges facing the extended European Union and how the size of the challenges may be affected by the timing of EU accession.

The currencies of the new member states will most likely be tightly pegged to the euro shortly after accession. In case the nominal exchange rate is effectively fixed shortly after EU accession, either because candidate member states try to fulfill the Maastricht criterion for exchange rate stability against the euro, or because they adopt the single currency shortly after accession, any adjustment in relative prices between the accession countries and the existing member states needs to take place via domestic prices. This may give rise to temporary (or persistent) inflation differentials between both groups of countries. If the accession countries immediately join the monetary union, the European Central Bank would be required to set its policy so that price stability in the extended euro area is achieved, but this policy might be inappropriate from the viewpoint of the current member states (and possibly also for the new member states).

Upon EU accession, the new member states will join the Single Market. Formal trade barriers will be abolished, at least for industry products. In addition, EU accession will promote the harmonisation of product standards, which will further reduce the cost of cross-border transactions between cur-
rent and new member states. Therefore, in this paper, EU accession will be modeled as a reduction in trade costs between the EU and the candidate member states.

I employ the Ricardian model developed by Dornbusch, Fischer and Samuelson (1977), hereafter: 'DFS'. The DFS model contains many goods. The character of each good (tradable or non-tradable) is endogenously determined. The dynamic version of the model is due to Obstfeld and Rogoff (1996, chapter 4). The DFS model is a two-country model. I treat the European Union and the group of candidate member states each as one country. This can be justified by the similarity of the countries in each region compared to the dissimilarities between both regions.\(^3\)

The model is used to analyse several policy-relevant questions related to the expansion of the EU. First, I study whether the impact of EU accession on the real exchange rate depends on the extent to which productivity levels have converged. This is relevant for the question when the candidate member states should be admitted (assuming that there is a convergence of their productivity levels towards that of the existing EU member states). Next, I analyse whether the response of the real exchange rate to productivity shocks is different before and after EU accession. In order to do so, I introduce some extensions to the Obstfeld and Rogoff (1996) analysis. First, I allow for asymmetries in country size and the initial level of productivity between regions. Second, I analyse the impact of a reduction in trade costs.

I obtain the following results. First, the timing of EU accession affects the exchange rate response to accession. The real exchange rate of the candidate member states is predicted to appreciate by 1-2% upon accession. This seems large, given that this prediction is based on a decline in trade costs by only three percentage points and given that it does not take into account confidence effects. The real exchange rate appreciation is smaller in the case of postponed accession. Intuitively, the more productivity levels (and wages) of the current and new member states have converged before accession, the more price levels have converged and therefore the smaller the marginal impact of reducing trade costs on relative prices.

Second, productivity shocks are likely to be an important source of real exchange rate fluctuations during the convergence process. I find that the response of the real exchange rate to productivity shocks declines as a result of EU accession. Intuitively, the decline in trade costs stimulates bilateral

\(^3\)Substantial differences exist within each group. For instance, income per head in Luxemburg is several times higher than in Greece and income per head in Slovenia is several times higher than in Bulgaria. The two-country model is used for analytical simplicity.
trade between the existing and new member states. The reduced size of the non-tradable sector means that the real exchange rate becomes less sensitive to unanticipated productivity changes. Thus, EU accession itself will contribute to stabilising the real exchange rate between the accession countries and the existing EU member states.

The remainder of this paper is organised as follows. Section 2 presents the basic model and derives the equilibrium conditions. In section 3, I use comparative statics to study how the timing of the accession affects the exchange rate response to accession. Section 4 presents a dynamic version of the model, which is then used to study the response of the real exchange rate to productivity shocks and how this response changes after EU accession. Section 5 concludes.

2 The model

2.1 Technologies and preferences

The world consists of two countries, Home and Foreign, of population size \(n\) and \(1 - n\) respectively (the world population is normalised at 1). The world economy produces a continuum of goods, indexed by \(z \in [0, 1]\). The only factor of production, labour, is available in fixed quantities \(nL\) in the Home and \((1 - n)L^*\) in the Foreign country, where \(L\) and \(L^*\) are labour effort per individual in the Home and Foreign country.\(^4\) The asymmetry in country size is an extension of the model in Obstfeld and Rogoff (1996, chapter 4).

The countries have different technologies for producing goods out of labour. Initially, let \(\frac{\nu_0(z)}{\nu^*_0(z)}\) be the number of goods \(z\) which can be produced by one unit of labour in the Home (Foreign) country, where \(\alpha(z)\) are commodity-specific technologies and \(\nu\) are economy-wide technologies. Obstfeld and Rogoff assume that, initially, \(\nu = \nu^*\). By contrast, I allow for asymmetry in productivity \((\nu \neq \nu^*)\) at any time. This is required in order to capture an important asymmetry between the EU and the accession countries in Central and Eastern Europe. The goods are indexed so that they are ranked in order of diminishing Home country comparative advantage, i.e.:

\[
\frac{\nu_0(z_i)}{\nu^*_0(z_i)} > \frac{\nu_0(z_j)}{\nu^*_0(z_j)}, \quad \text{for each } 0 < z_i < z_j < 1,
\]

\(^4\)The absence of capital in the model does not seem to be problematic, as earlier research suggests that the increase in labour productivity achieved in the more successful Central and Eastern European countries (CEECs) reflects increases in total factor productivity, rather than increases in the capital stock. See Doyle, Kuijs and Jiang (2001).
where an asterisk denotes the Foreign country. Note that the ranking of goods is not affected by economy-wide technologies.

Household preferences are defined by a simple intertemporal utility function:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} \log C_s,$$

(1)

where \(U\) is the lifetime utility of a representative household in the Home country, \(C\) is the real composite consumption index, \(\beta\) is the discount factor and \(s\) and \(t\) are time subscripts. Time subscripts will be suppressed whenever possible. In the remainder of this paper, Foreign variables have an asterisk (*). Apart from that, the mathematical expressions for Foreign variables are identical to those found for the Home country, unless explicitly stated otherwise.

The Home consumption index of the composite good is defined by

$$C = \exp \left[ \int_0^1 \log c(z) \, dz \right],$$

(2)

The consumption-based price index (defined as the lowest cost of purchasing one unit of composite real consumption, \(C\)) is:

$$P = \exp \left[ \int_0^1 \log p(z) \, dz \right],$$

(3)

where \(p(z)\) is the price of good \(z\) expressed in units of good 1 [the numeraire good: \(p(1) = 1\)].

Demand for good \(z\) is given by

$$c(z) = \frac{P}{p(z)} C.$$

(4)

This functional form of the demand function implies that the elasticity of substitution between all pairs of goods is unity. Each good has a constant share in total expenditure, i.e. \(\int_{z_i}^{z_j} p(z)c(z) \, dz = (z_j - z_i)PC\), for all \(0 < z_i < z_j < 1\).

The individual budget constraint for the representative Home individual (in nominal terms) is:

$$B_t = (1 + i_{t-1})B_{t-1} + W_t L_t - P_tC_t,$$

(5)

where \(W\) is the nominal wage rate, which is uniform across different industries in the same country, as labour is mobile within each country, \(L\) is
labour effort per individual, \( B_t \) is the stock of nominal bonds held by the representative household on date \( t \) and \( i_{t-1} \) is the nominal interest rate on bonds between \( t - 1 \) and \( t \).

Maximising utility function (1), subject to budget constraint (5) yields the Euler condition for intertemporal consumption smoothing:

\[
C_{t+1} = \beta (1 + r_t) C_t,
\]

where \( r_t \) is the real interest rate on bonds between \( t \) and \( t+1 \).\(^5\)

### 2.2 Trade costs and market equilibrium

For any internationally traded good \( z \), a fraction \( \tau \) melts away in transit, so that only a fraction \( 1 - \tau \) arrives at the destination. Intuitively, the ‘melting’ fraction can be interpreted as any kind of trade barrier which makes cross-border transactions more costly than domestic transactions.\(^6\)

Goods are produced only in Home if importing them would be more expensive, i.e. if \( p(z) < p^*(z)/(1 - \tau) \). Similarly, goods are produced in Foreign if it is more expensive to import these goods, i.e. if \( p(z)/(1 - \tau) > p^*(z) \). Figure 1 shows the pattern of international specialisation [where the curve labeled \( A \) is \( W/W^* = (1 - \tau)v\alpha/(v^*\alpha^*) \) and curve \( B \) is \( W/W^* = 1/(1 - \tau)v\alpha/(v^*\alpha^*) \)].

Home produces all goods to the left of \( z^H \) and Foreign produces all goods to the right of \( z^F \).\(^7\) For given wages \((W, W^*)\) and trade costs \((\tau)\), the cut-off points \( z^H \) and \( z^F \) are defined by

\[
P(z^H) = \frac{p^*(z^H)}{1 - \tau},
\]

\[
P(z^F) = \frac{p^*(z^F)}{1 - \tau}.
\]

Each good is produced under perfect competition, so firms price at marginal

\(^5\)Maximising (1) subject to (5) yields \( P_{j+1}C_{j+1} = \beta (1 + i_j)P_jC_j \), which can be rewritten as \( C_{j+1} = \beta \frac{P_j}{P_{j+1}}(1 + i_j)C_j = \beta (1 + r_j)C_j \).

\(^6\)See Wang (2001) for an analysis of trade barriers for a group of 70 countries. See Lejour, De Mooij and Nahuis (2001) for an estimate of barriers to trade in different industries in the EU and the candidate member states. See Fink (2001) for an extensive overview of non-tariff barriers to trade in the accession countries.

\(^7\)See DFS (1977, pp. 829-830) for a more detailed discussion of Figure 1.
cost: \( p(z) = W/\{v\alpha(z)\} \). Now, equations (7)-(8) can be rewritten as

\[
\frac{W}{W^*} = \frac{v\alpha(z^H)}{(1 - \tau)v^*\alpha^*(z^H)}. 
\] (9)

\[
\frac{W}{W^*} = \frac{(1 - \tau)v\alpha(z^F)}{v^*\alpha^*(z^F)}. 
\] (10)

Goods in \([0, z^F]\) are produced exclusively in Home and exported to Foreign, since the comparative advantage in producing these goods is sufficiently high to overcome the costs of international trade. Similarly, goods in \([z^H, 1]\) are produced exclusively in Foreign and exported to Home. Goods in \([z^F, z^H]\) are produced in both countries, but not traded internationally.

The market equilibrium conditions for Home-produced and Foreign-produced goods are:

\[
nWL = z^H nPC + z^F (1 - n) P^* C^*, 
\] (11)

\[
(1 - n) W^* L^* = (1 - z^H) nPC + (1 - z^F) (1 - n) P^* C^*. 
\] (12)

The international wage ratio and industry location are determined jointly by equations (9)-(10) and (11)-(12).

The law of one price fails to hold for any good. It holds neither for non-traded goods (since there is no arbitrage) nor for traded goods (since the price is \(1/(1 - \tau)\) times higher in the importing country than in the exporting country). The Home and Foreign price indices are

\[
P = \exp\left\{\int_0^{z^H} \log\left[\frac{W}{\nu\alpha(z)}\right]dz + \int_{z^H}^1 \log\left[\frac{W^*}{(1 - \tau)v^*\alpha^*(z)}\right]dz\right\}, 
\] (13)

\[
P^* = \exp\left\{\int_0^{z^F} \log\left[\frac{W}{(1 - \tau)v\alpha(z)}\right]dz + \int_{z^F}^1 \log\left[\frac{W^*}{v^*\alpha^*(z)}\right]dz\right\}. 
\] (14)
This section studies the timing of the accession and its implications for the real exchange rate. I use comparative statics to do so. I first solve the model for a steady state with a balanced trade account. The functional form of the model precludes the derivation of a reduced-form solution. Therefore, I use a numerical approach in order to assess the impact of the timing of EU accession. The decision on the timing of accession is exogenous in this model. I compare two scenarios: immediate and postponed accession. In the first scenario, EU accession (modeled as a reduction in trade costs) occurs when productivity in the candidate member states is at the current low level. In the second case, by contrast, EU accession occurs when productivity in the candidate member states has reached a higher level.

3.1 Steady state

In a steady state, all exogenous variables are constant. Steady-state values will be represented by overbars. Imposing the steady state restriction on the equations in the previous subsection, we obtain a system of 10 independent equations in 11 endogenous variables (see Appendix A). I impose the initial
condition of zero net foreign assets in order to close the model:

\[ \mathcal{E} = 0. \quad (15) \]

For notational simplicity, I impose that the production technologies have the following functional form (see Obstfeld and Rogoff, 1996, chapter 4):

\[
\begin{align*}
\alpha(z) & = \exp(-z), \quad (16) \\
\alpha^*(z) & = \exp(z - 1), \quad (17)
\end{align*}
\]

I also assume that labour effort per individual is equal to one \((L = L^* = 1)\), so that labour input is fully captured by population size: \(n vs 1 - n\). Then, from equations (5), (11) and (15):

\[
\frac{\overline{W}}{\overline{W}^*} = \frac{z^F (1 - n)}{1 - z^H n}. \quad (18)
\]

Substitute (16)-(17) into equations (9)-(10), take logarithms on both sides and combine:

\[
\begin{align*}
\log \frac{\overline{W}}{\overline{W}^*} - \log \frac{\overline{v}}{\overline{v}^*} & = 1 - z^F - z^H, \quad (19) \\
z^H - z^F & = -\log(1 - \tau). \quad (20)
\end{align*}
\]

Equations (18)-(20) jointly determine the relative wage \((\overline{W}/\overline{W}^*)\) and the pattern of international specialisation \((\overline{z}^H, \overline{z}^F)\).

First we analyse how the pattern of specialisation is affected by trade costs, country size and productivity. From equation (20), the share of non-tradable goods in output is increasing in trade costs. Under zero trade costs \((\tau = 0)\) all goods are tradable, so that the size of the non-tradable sector is zero \((z^H - z^F = 0)\). As trade costs increase, fewer goods are traded. Trade costs above 63% are prohibitive.\(^{10}\) I will henceforth assume that \(\tau < .63\).

From equations (18) and (19), if the Home country is relatively large \((n > \frac{1}{\tau})\), it will import a smaller range of goods than Foreign \((1 - z^H < z^F)\). The large country will export a wider range of goods.\(^{11}\) Intuitively,

\(^{10}\)When trade costs are small, \(-\log(1 - \tau)\) may be approximated by \(\tau\), so that the size of the non-tradable sector is proportional to trade costs \((z^H - z^F \approx \tau)\). As trade costs get larger, the size of the non-tradable sector increases more than proportionally. Trade costs of 63% are prohibitive, since \(-\log(1-.63)\approx -\log(1/e) = 1\). In this case, the non-tradable sector is 100% of the economy.

\(^{11}\)On the import side, \(z^F\) equals the range of goods imported by Foreign and also the share of Foreign income spent on imports in the steady state. However, on the export
given different production technologies for different goods, it is optimal for a country to specialise in the production of a few goods in which it is highly efficient. However, for a large country, a strong degree of specialisation is incompatible with equilibrium in the world market. A large country must be self-sufficient in a large range of goods.\textsuperscript{12} Similarly, if the Home country is more productive ($\overline{v} > \overline{v}^*$), it will, ceteris paribus, import a smaller range of goods than Foreign ($1 - \overline{z}^H < \overline{z}^F$). The more productive country will export a larger range of products. Intuitively, a low level of productivity reduces a country’s economic size in terms of output. Therefore, analogous to the previous case for country size, the less productive country will specialise in the production of a few goods. Thus, the model predicts that the production structure of large and highly productive countries will be relatively well-diversified.

Next, consider how the relative wage rate is affected by country size, productivity and trade costs. From equations (18)-(20), the Home relative wage ($W^*/W^*_{\text{H}}$) is decreasing in Home’s relative country size ($\frac{n}{1-n}$). Large countries must produce a larger range of goods (see above) and are therefore less able to exploit their comparative advantage in the production of specific goods. An economy-wide productivity increase in Foreign (a decline in $\overline{v}/\overline{v}^*$) leads to a decline in Home’s relative wage rate. However, productivity differences are less than fully reflected in wages. The intuition for the latter is that a more productive country must produce a larger range of goods in equilibrium, so it is less able to exploit its comparative advantage in the production of specific goods. The impact of a decline in trade costs ($\tau \downarrow$) on the relative wage rate is ambiguous.

From equations (13) and (14), the steady state real exchange rate ($\overline{P}/\overline{P}^*$) is given by (see appendix A for the derivation):

$$\log \frac{\overline{P}}{\overline{P}^*} = (\overline{z}^H - \overline{z}^F)[\log \frac{W}{W^*} - \log \frac{\overline{v}}{\overline{v}^*}]. \quad (21)$$

In the absence of trade costs ($\tau = 0$), all goods are tradable ($\overline{z}^H - \overline{z}^F = 0$) and goods arbitrage implies that the law of one price must hold. The Home and Foreign price levels are equalised and the real exchange rate is

\textsuperscript{12}Note that this pattern of international specialisation has nothing to do with economies of scale in production.
equal to unity \( \frac{\bar{P}}{\bar{P}^*} = 1 \). With positive trade costs, some goods are non-tradable and the real exchange rate is determined by relative unit labour costs \[ \frac{\bar{W}}{\bar{v}}/\left[ \frac{\bar{W}^*}{\bar{v}^*} \right] \] times the size of the non-tradable goods sector \( \zeta^H - \zeta^F \), which is equal to \(- \log(1 - \tau)\).

An economy-wide productivity increase in Foreign (a decline in \( \bar{v} / \bar{v}^* \)) causes a decline in unit labour costs in the Foreign non-tradable sector, despite that \( \bar{W} \) goes down as well. The decrease in unit labour costs results in a depreciation of the Foreign real exchange rate. A decline in trade costs has an ambiguous impact on the exchange rate. On the one hand, it reduces the size of the non-tradables sector \( \zeta^H - \zeta^F \), thus limiting the scope for price differences. On the other hand, it causes wage equalisation, so that productivity differences between countries are more strongly reflected in different price levels for non-tradable goods [which becomes visible in the term \( \log(\bar{W} / \bar{W}^*) - \log(\bar{v} / \bar{v}^*) \)].

Combining the steady-state version of equation (5) and its Foreign counterpart with equations (15) and (21) yields

\[
\log \frac{\bar{C}}{\bar{C}^*} = (\zeta^H - \zeta^F) \log \frac{\bar{v}}{\bar{v}^*} + [1 - (\zeta^H - \zeta^F)] \log \frac{\bar{W}}{\bar{W}^*}. \tag{22}
\]

Equation (22) shows that the relative consumption level \( \frac{\bar{C}}{\bar{C}^*} \) is a weighted average of relative productivity levels (weighted by the size of the non-tradable goods sector) and relative wage rates (weighted by the size of the tradable goods sector). Intuitively, in autarky (no trade), relative consumption per capita is determined by relative productivity, whereas in a fully open economy, relative consumption per capita is determined by relative wages (purchasing power).

Equations (18)-(22) form a system of five independent equations in five endogenous variables: \( \zeta^H, \zeta^F, \frac{\bar{C}}{\bar{C}^*}, \frac{\bar{P}}{\bar{P}^*} \) and \( \bar{W} / \bar{W}^* \). The functional form of these equations precludes the presentation of a reduced-form solution.

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13 An economy-wide increase in Foreign productivity causes \( P^* \) to decline relative to \( P \). In other words, the Foreign real exchange rate depreciates. This prediction is opposite to the well-known Balassa-Samuelson effect. The reason for this difference is that the current model presumes that productivity catch-up is economy-wide, rather than concentrated in the tradable goods sector.

14 Note that \( \zeta^H - \zeta^F \) (the size of the non-tradable sector) and \( 1 - (\zeta^H - \zeta^F) \), i.e. the size of the tradable sector, are both between zero and one for all admissible parameter values.
3.2 Immediate versus postponed accession

Next, I make some tentative calculations on the impact of the timing of EU accession on the real exchange rate between the EU and the accession countries. Quick or postponed accession: what does it mean for the exchange rate effects of EU accession? The goal is to draw qualitative conclusions from this exercise. As the model is relatively simple, the quantitative results serve no more than an illustrative purpose.

I impose that EU accession has the following stylised form: upon accession, trade costs are reduced from 50% to 47%.\textsuperscript{15} I compare two scenarios: immediate accession versus postponed accession. Under both scenarios, I simply compare the steady-state equilibrium before and after accession. The scenarios differ in the extent to which real convergence has taken place before accession. I assume that the productivity gap between the candidate member states and the current member states is reduced over time and that the timing of accession has no impact on the pace of productivity growth in either region. Thus, the productivity ratio $\frac{v^*}{v}$ increases exogenously over time. Currently, productivity in the candidate member states is only 13% of productivity in the EU. Therefore, under immediate accession, a reduction in trade costs takes place at the moment that real convergence has not yet taken place: $\frac{v^*}{v} = 0.13$.\textsuperscript{16} Under postponed accession, by contrast, productivity in the candidate member states has reached a higher level relative to the current EU member states. In this case, I use $\frac{v^*}{v} = 0.34$. This

\begin{itemize}
\item The value for $\tau$ is exogenous. Trade costs (which include all kinds of trade barriers, including a lack of harmonisation in product standards) are not directly observable. Calibration of the model (appendix B) suggests that the current level of trade costs between the EU and the candidate member states is 50%. Cavelaars (2001) finds an estimated value of 40% for the current intra-EU level of trade costs. Therefore, I use 40% as the estimated long-run level for trade costs between EU and accession countries. I assume that almost one third of this reduction (from 50% to 47%) takes place upon accession, when the remaining formal trade barriers are abolished. The remainder of the reduction in trade costs (from 47% to 40%) happens gradually over the decades following EU accession, mainly as a result of the harmonisation of standards. The assumption that one-third of the reduction in trade costs is related to the abolition of formal trade barriers, whereas two-thirds is related to the harmonisation of standards is in line with the findings of Lejour, De Mooij and Nahuis (2001, Tables 4.1 and 4.3).
\end{itemize}

\textsuperscript{15}This value has been derived as follows. The population size of the twelve accession countries together is 30% of the EU countries and income per capita in the accession countries is 17% of the EU level. See Eurostat (2001). Exports to the EU make up 29% of accession countries’ GDP, whereas exports to accession countries is 1.4% of the EU GDP. Therefore, initially, $(1-n)/n = 0.3$, $W^*/W = 0.17$, $z^F = 0.29$ and $1 - z^H = 0.014$. It follows from equation (19) that, initially, $\frac{v^*}{v} = 0.13$ and from equation (20) that $\tau = 0.50$. 

15
16
value for the productivity ratio corresponds to the current productivity gap between the most advanced candidate member states (Slovenia and Cyprus) and the EU average. Accidentally, this number is also roughly equal to the current productivity gap between the poorest EU member states (Portugal and Greece) and the EU average. See appendix B.

First consider the case of early accession. The impact of accession on the main variables is shown in Table 1. Wages converge \((\bar{W}^*/\bar{W})\) moves closer to one. The bilateral trade share increases by 20% for both countries.\(^{17}\) There is a relative increase in the price level in the accession countries, which means that their real exchange rate \((P^*/P)\) appreciates by 1.6%.\(^{18}\)

In the case of late accession, the average level of productivity of the candidate member states has extra time to increase relative to the EU average. The productivity increase in the accession countries causes industry migration from the EU to the candidate member states. The EU sheds its least efficient industries. The candidate member states expand the range of domestically-produced goods. This leads to a decline in the accession countries’ import share \((z^F)\) and an increase in the EU’s import share \((1-z^H)\) before the moment of accession. As a result of the reduction in trade costs at the moment of accession, wages converge and the bilateral trade share increases by roughly 20%. The real exchange rate of the accession countries appreciates, but the exchange rate appreciation is smaller than in the case of early accession. Intuitively, the more that productivity levels and wages have converged before accession, the smaller the difference in the price level and the smaller the price impact of reducing trade costs.\(^{19,20}\)

\(^{17}\) Accession countries’ imports \((z^F)\) and EU imports \((1-z^H)\) increase by 20% (from 29% to 35% of output and from 1.5% to 1.8% of output, respectively).

\(^{18}\) Notably, this estimate does not take into account the possible impact of confidence effects (i.e. EU accession affects the expectations of private agents with respect to the economic performance of the candidate member states) on the exchange rate.

\(^{19}\) In the extreme case of fully symmetric countries, reducing trade costs would have no impact on the real exchange rate at all.

\(^{20}\) There is no simple answer to the question whether immediate accession is to be preferred over postponed accession or not. From a welfare point of view, the current model will surely generate the result that EU accession produces welfare benefits for all countries, which would lead to the conclusion that sooner accession is always better. However, a simple welfare approach does not take into account risks of instability, distributional issues and other factors. The normative issue whether immediate or postponed accession is to be preferred falls outside the scope of this paper.
4 Exchange-rate response to productivity shocks

This section studies the response of the real exchange rate between the euro and the candidate member states’ currencies to productivity shocks and how this response changes after EU accession.\(^{21}\) I first discuss the nature of productivity shocks in the candidate member states, then I present the dynamic version of the model and I compare the real exchange rate response to productivity shocks under different regimes (early/late EU accession). Under the early accession scenario, trade costs are assumed to be reduced before productivity shocks occur. Under the late accession scenario, trade costs are still at the current (higher) level when productivity shocks occur.

4.1 Productivity shocks

The Central and Eastern European countries (CEECs) are likely to experience a relatively quick rise in productivity. Such a productivity catch-up can be expected based on the current level of productivity in the CEECs, which is relatively low. See Barro and Sala-i-Martin (1992).

The accession process is likely to accelerate this process of real convergence. It does so in several ways. First, (the prospect of) EU membership

\(^{21}\)The euro is not the currency of the European Union, but only of those countries participating in EMU. However, this distinction is neglected in this paper.
improves the creditworthiness of the new member states and thus gives them better access to international capital markets. This will make it possible, for instance, to further upgrade the physical infrastructure in the countries involved. Second, the screening conducted by the European Commission will contribute to an improvement of institutions. One example is enhanced banking supervision, which will promote a more efficient allocation of financial resources in the economy. Third, new management techniques and business strategies can be transferred, possibly through partnerships with foreign companies. Fourth, capital accumulation will be promoted directly by the EU structural funds and the investment of foreign firms. The accelerated productivity rise in the new member states can be regarded as a positive side-effect of the accession process.

Productivity increases may be concentrated in the tradable goods sector. This is the standard assumption underlying the Balassa-Samuelson effect. The latter could manifest itself as a relatively high level of inflation, as an appreciation of the nominal exchange rate, or a combination of both. Another possibility, however, is that productivity increases occur economy-wide, rather than mainly in the tradable sector. For instance, Kopits (1999) points out that major reforms in education, health care, pension systems, public administration, as well as infrastructure investment in transportation, communications, create the conditions for balanced productivity improvements across all sectors. The possibility of economy-wide productivity increases is also underlined by Jakab and Kovács (1999). Because of the limitations of the model used in this paper, I restrict myself to economy-wide productivity increases.

The productivity catch-up is likely to happen in a bumpy manner, rather than smoothly. Temporary positive and negative deviations from the upward productivity trend in the new member states will occur. Temporary productivity shocks are likely to be an important source of real exchange

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23 They argue that, in the case of Hungary, productivity increased faster in the tradable sector early in the transition, due to extensive lay-offs and foreign and domestic investments which were mainly concentrated in the tradables sector, but that Hungary has now entered a next phase, as the non-tradable sector attracts new investments, mainly in the banking and retail sector.

24 The character of each good (tradable or non-tradable) is determined endogenously. Therefore, sector-specific productivity shocks can give rise to inconsistencies in the model.
rate fluctuations during the process of real convergence.\textsuperscript{25} Therefore, it is important to know whether the response of the real exchange rate to such temporary productivity shocks will be affected by EU accession.

In order to study the exchange-rate response to the productivity shocks which may occur during the transition process, I use a dynamic version of the model.

\textbf{4.2 The loglinearised model}

The DFS model is a flex-price model, which fits the purpose of this paper. The horizon for the completion of the convergence process is several decades.\textsuperscript{26} Therefore, there is no short-run price rigidity in the dynamic version of the model and the ‘short run’ should be interpreted as lasting several years (i.e. beyond the normal duration of nominal rigidities).

Variables with hats denote percentage deviations from the initial steady state ($\hat{P} = dP/P_0$). Variables without hats denote initial steady state values (for notational simplicity, initial steady state values are written as $z^H$ rather than $z^H_0$, et cetera). The full loglinearised model is derived in appendix C. The most insightful way to present the model is by rewriting it in terms of country differences. Here, the main equations are presented.

The pattern of international specialisation is determined by the difference in unit labour costs:

\begin{equation}
 dz^H + dz^F = - (\hat{W} - \hat{W}^*) + (\hat{v} - \hat{v}^*). \tag{23}
\end{equation}

An increase in productivity in Foreign ($\hat{v}^* > 0$), keeping trade costs unchanged, will cause some industries to migrate from Home to Foreign ($z^H$ and $z^F$ move to the left in figure 1). The Foreign wage increases relative to the Home wage, but Foreign still experiences a decline in unit labour costs relative to Home [$W^*/v^*$ declines relative to $W/v$; also see the discussion below equations (18)-(20)].

The relative size of the non-tradables sector ($z^H - z^F$) is increasing in trade costs ($\tau$):

\begin{equation}
 dz^H - dz^F = \frac{d\tau}{1 - \tau}. \tag{24}
\end{equation}

\textsuperscript{25}Jakab and Kovács (1999) find that productivity shocks were the main determinant of relative price adjustments between non-tradable and tradable goods in Hungary during 1991-98.

\textsuperscript{26}According to recent estimates, the process of real convergence will take about thirty years to be completed. See Fischer, Sahay and Végh (1998) or Doyle, Kuijs and Jiang (2001).
The marginal impact of a change in trade costs is larger if trade costs are high, initially (in that case, $1 - \tau$ is low).

The inflation difference (or equivalently, the change in the real exchange rate) is

$$\hat{P} - \hat{P}^* = (z^H - z^F) \left[ \hat{W} - \hat{W}^* - (\hat{\nu} - \hat{\nu}^*) \right] + (1 - z^H - z^F) \frac{d\tau}{1 - \tau}. \quad (25)$$

The inflation difference between both countries is determined by price increases in the non-tradable goods sector in both countries (which are determined by wage and productivity developments), multiplied by the size of the non-tradable goods sector. The inflation difference also depends on trade costs. A reduction in trade costs lowers the price of imported goods in both countries. The impact on the general price level will be larger in the country with the largest share of imports. For instance, if the import share in Foreign is larger than in Home (i.e. $z^F > 1 - z^H$), then a reduction in trade costs will lead to a positive inflation differential between Home and Foreign ($\hat{P} - \hat{P}^* > 0$).

Equations (23)-(25) are valid both for long-run and short-run deviations from the steady state. Henceforth, however, I will distinguish between long-run and short-run changes. Short-run deviations from the steady state will be denoted by hatted variables and long-run steady state changes are indicated by hatted overbarred variables. The short-run current account balance of the Home country is determined by the change in output (reflected in real income $\hat{W} - \hat{P}$) and spending ($\hat{C}$), i.e. $\frac{d\hat{B}}{\hat{PC}} = \hat{W} - \hat{P} - \hat{C}$, which can be rewritten in terms of country differences as (see appendix C):

$$\frac{d\hat{B}}{\hat{PC}} = \frac{1 - z^H}{1 - z^H + z^F} \left[ \hat{W} - \hat{W}^* - (\hat{P} - \hat{P}^*) - (\hat{C} - \hat{C}^*) \right],$$

(26)

where the ratio $(1 - z^H)/(1 - z^H + z^F)$ is a measure for the relative size of both countries’ imports. Note that this ratio equals $\frac{1}{2}$ if the import shares are equal $(1 - z^H = z^F)$. It is smaller than $\frac{1}{2}$ if Home’s import share is relatively small $(1 - z^H < z^F)$. Intuitively, a current account surplus $d\hat{B}$ is less important in terms of Home income per capita $\frac{\hat{PC}}{\hat{C}}$ if the Home country is large and rich. The latter is reflected in a relatively small Home import share.

Sustainability requires that Home runs a long-run trade deficit (spending in excess of output: $\hat{C} > \hat{W} - \hat{P}$) if, and only if, it has a net claim on Foreign $(d\hat{B} > 0)$, i.e. $\hat{C} = \tau d\hat{B}/[PC] + \hat{W} - \hat{P}$. The corresponding equation in terms
of country differences is:

$$\widehat{C} - \widehat{C}^* = \frac{1 - z^H + z^F \tau dB}{1 - z^H} \widehat{PC} + \widehat{W} - \widehat{W}^* - (\widehat{P} - \widehat{P}^*). \quad (27)$$

### 4.3 Exchange-rate response before and after EU accession

I have argued that productivity shocks are likely to be an important source of real exchange rate movements between the new and existing EU member states.

The question arises whether the size of the real exchange rate movements is affected by the 'membership regime', i.e. whether the response of the real exchange rate to productivity shocks differs before and after EU accession. The answer to this question will indicate whether EU accession itself reduces or magnifies the volatility of the real exchange rate between the accession countries and the existing member states, which is relevant information for policymakers in the decision on the timing of EU accession. In this paper, EU accession is modeled as the reduction in trade costs related to the new member states’ participation in the European Union’s single market. Therefore, we may rephrase the above question as: does the response of the real exchange rate to productivity shocks depend on the level of trade costs? First, I consider permanent shocks, then I turn to temporary shocks.

#### 4.3.1 Permanent productivity shocks

In order to study permanent productivity shocks, set $\widehat{v} = \widehat{v}^*$ and $\widehat{v}^* = \widehat{v}^*$. Unanticipated permanent shocks have no current-account effects in the model ($dB = 0$). Given the absence of nominal rigidities, the economy immediately goes to the new steady state equilibrium (see Obstfeld and Rogoff, 1996, p. 244). Thus, short-run changes are equal to long-run changes for each variable. A permanent increase in relative Foreign productivity ($\widehat{v} - \widehat{v}^* < 0$) causes a real depreciation of the Foreign currency ($\widehat{P} - \widehat{P}^* > 0$):

$$\widehat{P} - \widehat{P}^* = \widehat{P} - \widehat{P}^* = -(z^H - z^F)(\widehat{v} - \widehat{v}^*). \quad (28)$$

Intuitively, the change in the real exchange rate is equal to the change in the price of non-tradable goods.\(^{27}\) An economy-wide permanent increase in Foreign productivity leads to a decline in the relative price of Foreign

\(^{27}\)The relative price of tradable goods does not change, since trade costs are assumed to be constant here.
non-tradable goods.\footnote{In this model, an increase in Foreign productivity causes a real \textit{depreciation} of the Foreign currency, as the productivity increase is assumed to be economy-wide. If the productivity increase would be concentrated in the tradables sector only, the real exchange rate response would be dominated by the nominal wage increase in Foreign, which would cause an \textit{increase} in relative prices in the Foreign non-tradable goods sector and therefore a real \textit{appreciation} of the Foreign currency, in line with the Balassa-Samuelson effect.} The real exchange rate response is higher if the size of the non-tradable sector \((z^H - z^F)\) is larger.\footnote{Note that I consider small shocks. Therefore, even in the case of a permanent shock, the new steady state value of all variables are (approximately) equal to their value in the initial steady state.} Recall that the size of the non-tradable sector is increasing in trade costs [equation (20)]. Therefore, the lower the level of trade costs, the smaller (the absolute level of) the real exchange-rate movement in response to a productivity increase in Foreign.

Table 2 illustrates the size of the real exchange rate response to a one percent permanent increase in Foreign productivity.

<table>
<thead>
<tr>
<th>Trade costs</th>
<th>Size of non-tradable goods sector</th>
<th>Exchange rate response</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\tau)</td>
<td>(z^H - z^F)</td>
<td>(d(\hat{P} - \hat{P}^<em>)/d\hat{v}^</em>)</td>
</tr>
<tr>
<td>0</td>
<td>0.000</td>
<td>0.00%</td>
</tr>
<tr>
<td>.1</td>
<td>0.105</td>
<td>0.11%</td>
</tr>
<tr>
<td>.2</td>
<td>0.223</td>
<td>0.22%</td>
</tr>
<tr>
<td>.3</td>
<td>0.357</td>
<td>0.36%</td>
</tr>
<tr>
<td>.4</td>
<td>0.511</td>
<td>0.51%</td>
</tr>
<tr>
<td>.5</td>
<td>0.693</td>
<td>0.69%</td>
</tr>
<tr>
<td>.6</td>
<td>0.916</td>
<td>0.92%</td>
</tr>
</tbody>
</table>

4.3.2 Temporary productivity shocks

When studying the response of the real exchange rate to temporary productivity shocks, set \(\hat{v} = \hat{v}^* = 0\). Unanticipated temporary productivity shocks give rise to current-account changes. Hence, I need to distinguish between the short-run and long-run effect of a temporary productivity shock.

Solving the system of equations yields that the size of the current-account effect is increasing in the size of the non-tradable goods sector \((z^H - z^F)\)
The short-run effect is that a temporary increase in relative Foreign productivity \((\hat{v}^* - \hat{v} > 0)\) causes a real depreciation of the Foreign currency:

\[
\hat{P} - \hat{P}^* = -\frac{1}{(1 + \tau)} \left[ \frac{1}{1 - (z^H - z^F)^2} + \tau \right] (z^H - z^F)(\hat{v} - \hat{v}^*). \tag{29}
\]

Intuitively, the change in the real exchange rate is equal to the change in the price of non-tradable goods.\(^{30}\) An economy-wide increase in Foreign productivity leads to a less than proportional increase in the Foreign wage rate, so that the relative price of Foreign non-tradable goods declines. As before, the real exchange rate response is higher if the size of the non-tradable sector \((z^H - z^F)\) is larger.\(^{31}\)

A temporary increase in Foreign relative productivity leads to a real long-run appreciation of the Foreign currency:

\[
\hat{P} - \hat{P}^* = \frac{\tau}{1 + \tau} \left[ \frac{(z^H - z^F)^3}{1 - (z^H - z^F)^2} \right] (\hat{v} - \hat{v}^*). \tag{30}
\]

Note that the long-run change in the relative price has the opposite sign as the short-run change. The intuition is that a positive productivity shock in Foreign leads to a short run surplus on the Foreign current account. The productivity shock is assumed to be temporary, so the only long-run effect is that Foreign can afford to produce less than it requires for consumption (due to its ownership of net foreign assets). The excess demand for goods in Foreign in the long run causes a real appreciation of the Foreign exchange rate. Again, the larger the size of the non-tradable sector \((z^H - z^F)\), the larger the long-run real exchange rate response to a productivity increase in Foreign.

Table 3 illustrates the size of the real exchange rate response to a one percent increase in Foreign productivity, which is reversed in the next period. In Table 3, I have assumed \(\tau = .03\). Note that the short-run response is

\(^{30}\)The relative price of tradable goods does not change, since trade costs are assumed to be constant here.

\(^{31}\)Compare equations (28) and (29) and note that \(1/\left[1 - (z^H - z^F)^2\right] > 1\). This shows that the short-run response of the real exchange rate to temporary shocks is larger than its response to permanent shocks. This difference is caused by the current-account effect which occurs in the case of temporary shocks.
much larger than the long-run response, as might be expected in case of a temporary shock.\footnote{It can easily be shown from equations (29)-(30) that, in absolute terms, the short-run inflation differential is at least $1/\tau$ times as large as the long-run inflation differential.}

### Table 3  Real exchange rate and temporary productivity shock

<table>
<thead>
<tr>
<th>trade costs</th>
<th>size of N sector $z^H - z^F$</th>
<th>short-run $d(\tilde{P} - \tilde{P}^<em>)/d\tilde{v}^</em>$</th>
<th>long-run $d(\tilde{P} - \tilde{P}^<em>)/d\tilde{v}^</em>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.000</td>
<td>0.00%</td>
<td>-0.00%</td>
</tr>
<tr>
<td>.1</td>
<td>0.105</td>
<td>0.11%</td>
<td>-0.00%</td>
</tr>
<tr>
<td>.2</td>
<td>0.223</td>
<td>0.23%</td>
<td>-0.00%</td>
</tr>
<tr>
<td>.3</td>
<td>0.357</td>
<td>0.41%</td>
<td>-0.00%</td>
</tr>
<tr>
<td>.4</td>
<td>0.511</td>
<td>0.69%</td>
<td>-0.01%</td>
</tr>
<tr>
<td>.5</td>
<td>0.693</td>
<td>1.32%</td>
<td>-0.02%</td>
</tr>
<tr>
<td>.6</td>
<td>0.916</td>
<td>5.57%</td>
<td>-0.14%</td>
</tr>
</tbody>
</table>

To summarise this section: EU accession (and the ensuing decline in trade costs) implies that the real exchange rate between new and existing EU member states will become less responsive to productivity shocks. This is true for both permanent and temporary productivity shocks. Intuitively, the decline in trade costs stimulates bilateral trade between the existing and new member states. The reduced size of the non-tradable sector means that the real exchange rate becomes less sensitive to productivity changes. Thus, EU accession itself will contribute to reducing movements in the real exchange rate between the accession countries and the existing EU member states.\footnote{The acceleration in the real convergence process is probably caused by the accession process (which has already started) rather than by EU membership as such. Therefore, there is no a priori reason to assume that productivity shocks will be much different after EU membership. As a consequence, my results of the lower real exchange rate response to productivity shocks implies more real exchange rate stability.}

## 5 Conclusion

The timing of the accession of the current twelve candidate member states to the European Union is an issue where political considerations play an
important role. This paper attempts to shed some light on what the timing of EU accession might imply for the behaviour of the real exchange rate. Avoiding large shocks in the real exchange rate is in the interest of new and current member states.

I have employed the Ricardian model developed by Dornbusch, Fischer and Samuelson (1977) and the dynamic version of this model, which is due to Obstfeld and Rogoff (1996, chapter 4). I have introduced some extensions to the model. First, I have allowed for asymmetries in country size and the initial level of productivity between regions. Second, I have analysed the impact of EU accession, which has been modeled as a reduction in trade costs, on the real exchange rate.

I have obtained the following results. First, the timing of EU accession affects the real exchange rate response to accession. The real exchange rate of the candidate member states is predicted to appreciate by 1-2% upon accession (based on a three percentage points decline in trade costs and not taking into account confidence effects). The real exchange rate appreciation is smaller in the case of postponed accession. Intuitively, the more productivity levels (and wages) of the current and new member states have converged before accession, the more price levels have converged and therefore the smaller the marginal impact of reducing trade costs on relative prices.

Second, productivity shocks are likely to be an important source of real exchange fluctuations (in case of a fixed nominal exchange rate: non-zero inflation differentials) during the convergence process. I find that the response of the real exchange rate to productivity shocks declines as a result of EU accession. Intuitively, the decline in trade costs stimulates bilateral trade between the existing and new member states. The reduced size of the non-tradable sector means that the real exchange rate becomes less sensitive to unanticipated productivity changes. Thus, EU accession itself will contribute to stabilising the real exchange rate (in case of a fixed nominal exchange rate regime: reducing the inflation differentials) between the accession countries and the existing EU member states.

The policy implications of this paper are ambiguous in the sense that the first result is an argument against early accession, whereas the second result is an argument in favour of early accession of the candidate member states to the European Union.
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