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External rebalancing is not just an exporters' story: Real exchange rates, the non-tradable sector and the euro

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Abstract:

Global and European trade balances have seen strong divergences combined with strong movements in the exchange rate. Trade balances and real effective exchange rates are related. Using different measures of the real effective exchange rate, we show that this long-run link hinges on the relative price of non-tradable to tradable goods and services in relation to their trading partners. An improvement in the trade balance is associated with a fall in the relative price of non-tradable goods and services. The elimination of nominal exchange rates with the euro does not change these relationships. Government consumption increases the relative price of non-tradable goods. The results highlight the importance of internal price adjustments for external balances, a point frequently overlooked in policy debates.

JEL: F31, F32, F41

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1. Introduction

Current account and trade balance deficits and surpluses have widened considerably since the mid 1990s on a global level. The US, the UK and Australia have been running large current account (CA) deficits and emerging market economies and commodity exporters posting significant surpluses. While the euro area as a whole has kept a broadly balanced CA with the rest of the world, the gap between surplus and deficit countries within the area has increased continuously and strongly during the last 10-15 years.[1] The increasing divergence in current accounts is generally associated with large real exchange rate divergences, which are likely to reverse when current accounts reverse.[2] The role played by the relative price of non-tradables in external adjustment processes has so far received little attention in the empirical literature despite the fact that the standard inter-temporal approach of the current account ascribes an important role to it.[3] Policy makers instead tend to focus on the capacity of exporting companies to compete on the world market.

Our paper shows that the non-tradable sector is important for trade balance adjustments. In a panel co-integrating framework, we find that the long-run relation between real exchange rates and the trade balance depends on the relative price of non-tradable to tradable goods and services. More specifically, only real effective exchange rate measures that include the prices of non-tradable goods are significantly connected to the trade balance in the long run. In contrast, narrow measures of the real effective exchange rate, which only include the relative prices of tradable export-goods, are not significantly connected to the trade balance in the long run. We also check whether belonging to EMU makes any differences. The relation between the trade balance and prices holds for euro-area Member States as well as other OECD countries and has not been altered by the introduction of the euro. In other words, although tradable prices may affect the trade balance in the short-run, a sustained improvement in the trade balance will be connected with a fall in the relative price of non-tradable goods and services

There are several reasons to pay particular attention to the role of non-tradables in external adjustment processes. First, increasing market integration both inside and outside EMU should have fostered convergence in traded goods' prices and increased co-movements of traded goods prices.[4] Non-tradable prices could thus have become a more important determinant of real exchange rates. Second, non-tradable prices are of particular importance for adjustment processes within the euro area. As discussed further in Section 3, the suppression of nominal exchange rate fluctuations within the euro area has entailed a rise in the share of the internal exchange rate (the relative price of non-tradables) in the fluctuations of the total real

[1] See Graphs 1 - 3 in the appendix. Greece, Spain and Portugal currently run deficits of 10 percent of GDP or more while Austria, Germany and the Netherlands have large surplus positions.
[2] See Graph 4 in the appendix. The G7 in their concluding statement of 21 April 2006 for example stress that exchange rates have a role to play in global adjustment. http://www.treas.gov/press/releases/js4199.htm.
[3] In the case of a two sector model (tradable and non-tradable), the assumption of purchasing power parity (PPP) in the tradable sector means that changes in the real exchange rate can only be due to changes in the relative price of non-tradables. See, for instance, Obstfeld and Rogoff (1996).
[4] In the case of the euro area, Rogers (2007) finds that traded goods price dispersion has fallen strongly in the years prior to the introduction of the euro.

exchange rate. In other words, with the euro, non-tradable goods' prices have become more important. This suggests that, to facilitate a current account adjustment, policy makers should think about measures aimed at improving the functioning of the non-tradable sector rather than concentrating solely on the health of the export sector.

The empirical literature has so far mostly approached the issue of non-tradable prices via their role as determinants of the exchange rate. Starting from the theory of the tradable and non-tradable determinants of inflation (Balassa (1964), Samuelson (1964) and earlier by Harrod (1939, Chapter IV))[5], a vast number of studies have endeavoured to assess the impact of changes in the relative productivity in the tradable and non-tradable sectors for the determination of the real exchange rate (see for instance: Egert et al 2006). Another strand of work, further discussed in Section 3, has focused on the respective importance of the internal exchange rate (i.e. the prices of non-tradables to tradables) and the external exchange rate (i.e. the relative prices of tradables) in explaining fluctuations in the overall exchange rate (see for instance Betts and Kehoe (2006) and Burstein et al. (2005)). Also in more formal models non-traded goods markets have received increasing attention, e.g. Dotsey and Duarte (2008). De Gregorio et al. (1994) provide some evidence that demand side factors are central to understanding relative prices of non-tradables. However, they do not investigate the impact of the trade balance on these prices.[6]

In contrast, the literature has so far remained relatively sparse when it comes to the link between non-tradable prices and the current account. The only relevant work that we are aware of is a set of papers by Obstfeld and Rogoff (2000, 2005 and 2007). On the basis of calibrated models, these papers explore the likely real exchange rate changes needed to unwind the US current account deficit and point to a potentially large role for non-tradable prices. The basic argument is simple: a reduction of the current account deficit requires a large cut in the US consumption of tradable goods. If the US economy is to avoid serious distortions, this requires a fall in the relative price of non-tradables. The authors' model simulations thus point to substantial changes in relative prices which will also, given a central bank that stabilizes CPI, lead to a nominal exchange rate adjustment. In empirical research, Lane and Milesi-Ferretti (2002) relate a broad measure of the REER to the trade balance, real relative GDP and the terms of trade and find a negative effect of the trade balance on the real exchange rate. An improvement in the trade balance is thus associated with a depreciation of the real exchange rate. They argue that this adjustment probably involves internal exchange rate adjustments.

[5] The Balassa-Samuelson hypothesis states that inflation of the non-tradable sector relative to tradable sector inflation should be inversely related to relative productivity growth.

[6] In countries that are member of the European Monetary System (EMS), there is stronger evidence for relative PPP for tradables than outside EMS. The relatively high degree of co-movement of tradable prices in fixed exchange rate regimes thus suggests that nominal exchange rates matter. Moreover, the authors also show that for non-tradables a somewhat similar pattern can be observed with core members of EMS having higher correlations than countries outside EMS. The striking difference between the two sets of countries could be explained by the fact that countries are inside EMS because they experience more similar productivity and demand shocks. However, de Gregorio et al. (1994) show that this is not a likely explanation when comparing the results with pre-EMS data (1971-78).

The remainder of the paper is structured as follows. The next section illustrates the possible role of the prices of non-tradable goods' and services' in a simple model. Section 3 discusses the available evidence on the increased importance of non-tradable prices for fluctuations of real exchange rates. Section 4 outlines our empirical approach to investigate the long-run relationship between relative prices and the trade balance. Section 5 provides and discusses the estimation results while the final section concludes with some policy considerations.

2. The real exchange rate and tradable and non-tradable goods' and services' prices – a framework

Obstfeld and Rogoff (2000) develop a stylized model to show the relevance of the internal exchange rate for current accounts. The model assumes fixed endowments in a tradable and non-tradable sector and consumers who derive utility from the consumption of tradables C_T and non-tradables C_{NT} according to Equation 1.

$$U = \left[\gamma^{1/\theta} C_T^{\theta-1/\theta} + (1-\gamma)^{1/\theta} C_{NT}^{\theta-1/\theta} \right]^{\theta/\theta-1} \tag{1}$$

From the consumer optimization problem, it follows that the relative prices of NT and T can be described as Equation 2.

$$p = \frac{P_{NT}}{P_T} = \left(\frac{1-\gamma}{\gamma} \right)^{1/\theta} \left(\frac{C_T}{Y_{NT}} \right)^{1/\theta} \tag{2}$$

The exact consumer price index expressed in terms of the tradable good is given by Equation 3:

$$P = \left(\gamma + (1-\gamma) p^{1-\theta} \right)^{1/1-\theta} \tag{3}$$

Equation 2 can be used to compute the implied change of the relative price of non-tradables to tradables that a reduction in consumption in tradables entails. For simplicity, assume that the current account is equal to the trade balance which is given by the difference between the endowment of tradables and the consumption of tradables. A reduction in the consumption of tradables will have to be accompanied by a substantial decrease in the price of non-trdadables, as the results in Table 1 reveal. The central reason for this is that consumers increasingly dislike giving up the consumption of a tradable good in favour of the imperfect substitute of a non-tradable consumption good. Accordingly, as scenario B of the table shows, a lower elasticity of substitution would lead to a larger required price adjustment for consumption to adjust. In contrast, if factors of production can move to the tradable sector, the required price change to close the current account deficit is smaller as tradable consumption has to fall by less (column C).

Table 1: **Simulation results: price adjustment required to close current account.**

	A	B	C
Theta (elasticity of substitution)	1	**0.5**	1
CT (tradable consumption)	**30**	30	**30 → 27.5**
YN (non-tradable goods endowment)	100	100	100 → 97.5
YT (tradable goods endowment)	25	25	25 → 27.5
Initial current account deficit in percent of GDP	-4.3	-4.7	-4.3
p NT in terms of T	0.9	0.81	0.9
p NT in terms of T after adjustment	0.75	0.56	0.85
implied change of relative price non-tradable	**-16.67**	**-30.56**	**-5.98**

Notes: Simulation results are based on Equation 2 in the text. Current account deficit amounts to 5 units of tradable goods, resulting in roughly 4.5% current account deficit.

The simple model thus predicts that changes in the trade balance will be linked with the relative price of tradable and non-tradable goods and services. Obstfeld and Rogoff (2004) extend this simple model to a symmetric two country case, in which foreign produced tradables are imperfect substitutes to domestically produced tradables. Under plausible values for substitution elasticities, in particular when the elasticity of substitution between foreign and home produced tradables is larger than between tradable and non-tradable goods, they show that the central factor for changing current accounts is not the relative price of home produced tradables relative to foreign produced tradables but the internal relative prices of tradable and non-tradables.

3. Decomposing the real effective exchange rate into a tradable and a non-tradable component

Measures of the real effective exchange rate (REER) based on broad price/cost indicators such as the CPI, unit labour costs or the GDP deflator can be decomposed into a tradable and a non-tradable component or, in other words, into an internal and an external component. The REER can be defined as:

$$REER = e \times P/P^* \quad (4)$$

where P and P* are the domestic and world prices indices and e is the nominal exchange rate.

With the T and NT subscripts denoting tradables and non-tradables, the standard formula can be rewritten as:

$$REER = REER_T \times REER_{NT} \quad (5)$$

with:

$$REER_T = e \times P_T/P^*_T \quad (5a)$$

$$REER_{NT} = [(P/ P_T) / (P^* /P^*_T)] \quad (5b)$$

$REER_T$ is the real exchange rate for tradable goods and services whereas $REER_{NT}$ is the non-tradable (internal) component of the real exchange rate. The latter can be further re-defined in terms of the relative prices of tradables and non-tradables (rather than the ratio of total prices to tradable prices). This will depend, however, on the way the aggregate index is calculated. For instance, assuming that the price index is constructed as a geometric mean, $REER_{NT}$ can be re-written as:

$$REER_{NT} = (P_{NT}/P_T)^{(\alpha)} / (P^*_{NT}/ P^*_T)^{(\beta)} \qquad (5c)$$

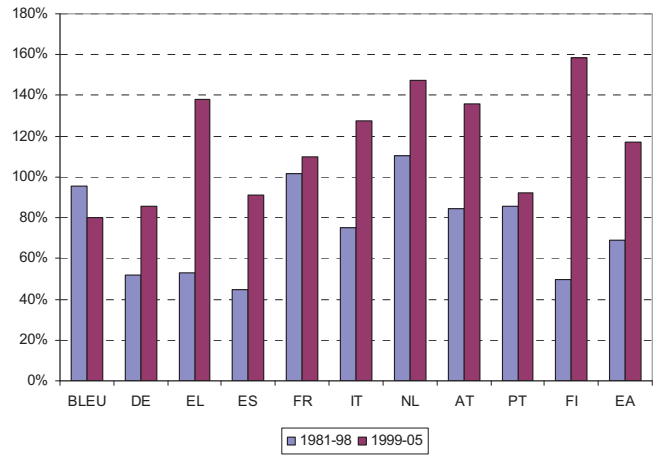
with:

$$P= P_T^{(1-\alpha)} \times P_{NT}^{(\alpha)}$$
$$P^*= P^*_T{}^{(1-\beta)} \times P^*_{NT}{}^{(\beta)}$$

Based on equation (5), a number of researchers have sought to analyse empirically the respective contributions of tradable and non-tradable prices to fluctuations in real exchange rate. Early works on the US have tended to find only a very limited role for the non-tradable component (see Engels 1999 and Chari et al. (2002)). Nevertheless, subsequent studies have nuanced considerably this conclusion. For instance, Betts and Kehoe (2006) report that, in the case of the US, the contribution of non-tradable prices depends on the trade partners considered and is significant in the case of neighbouring counties such as Mexico and Canada. Similarly, Burstein et al. (2005) analyse a sample of OECD countries and argue that variations in the relative price of non-tradables account for more than half of cyclical fluctuations in the REER for some measures of tradable prices.

It is easy to see from equations (5) and (5a) why participation in a monetary union may alter the relative contribution of non-tradable prices to changes in the total exchange rate. The nominal exchange rate only enters in the external exchange rate (5a). Fixing the nominal exchange rate, as in the case of intra-euro-area measures of the REER, is likely to reduce the size of fluctuations in the external exchange rate unless PPP holds, i.e. unless fluctuations in the nominal exchange rate had exactly offset fluctuations in tradable prices prior to the euro. As a result, changes in the relative price of non-tradables are likely to account for a larger part of the changes in the total real exchange rate for the countries which have adopted the euro.

Graph 1: **Relative volatility of the domestic and the external components of the intra-area REER** (1), **euro-area Member States** (in %)



(1) Ratio of the volatility of the domestic and external components of the intra-area real REER. The external component is the export-deflator based REER. The domestic component is the ratio of the GDP-deflator based and the export-deflator based REER. Volatility is measured by the standard deviations of the annual changes in the corresponding components.
Source: Commission services.

Chart 1 provides evidence of the increased importance of internal exchange rates euro-area Member States. We use intra-euro-area REER estimates calculated by the European Commission. The Commission REER estimates, which we also use in our econometric analysis, present two major advantages.[7] First, they are available for a relatively long time span and therefore provide some historical perspective (and sufficient room for econometric analysis). Second, they are calculated for a range of price and cost indicators both of the broad (unit labour cost, GDP deflator, consumption deflator) and narrow type (export deflator). The price and cost indicators are all drawn from national account statistics and are therefore fully consistent and directly comparable. Chart 1 shows the ratio of the standard deviation of the domestic REER to the total REER both before and after the adoption of the euro.[8] In all Member States but one, the adoption of the euro has been associated

[7] The Commission REER indicators can be downloaded from the following website: http://ec.europa.eu/economy_finance/db_indicators/db_indicators8642_en.htm
REER are calculated either relative to other euro-area partners (intra-euro-area REER) or relative to broader groups of trading partners (24, 36 and 41 countries)

[8] The domestic REER is calculated on the basis of equation (5) with the GDP-deflator intra-euro-area REER being used as total real exchange rate. The external REER is proxied with the intra-euro-area REER based on export deflators. An obvious limitation to this approach is that the REER based on the export deflator is not a measure of the relative price of domestic and foreign tradables as required in equation (5a). The indicator is indeed calculated as the ratio of the domestic export price and of an average of the export prices in the main trading partners. This entails two types of problems. i) The domestic export price obviously does not cover domestically produced tradable goods that are consumed locally. As a result, the calculated domestic REER contains some 'residual' elements of tradable. ii) The denominator of the external REER is only a proxy for the price of foreign tradables on the domestic market as it is based on export deflators in trading partners rather than prices of foreign goods on the domestic market. As a robustness check, we also constructed intra-area real exchange rate indicators for euro-area Member States based on genuine tradable and non-tradable prices calculated on the basis of sectoral data (EU KLEMS database). Results are similar, showing a significant increase in the relative size of fluctuations in the domestic REER in most Member States after the adoption of the euro (see Annex).

with an increase in the relative size of fluctuations in the domestic part of the intra-euro-area REER. We interpret this result as a sign that non-tradable prices may now matter more for external adjustment processes within the euro area and see it as justification for improving our understanding of the link between non-tradable prices and the current account.

4. Empirical approach

To assess the link between the trade balance and the real effective exchange rate, we resort to a panel co-integration framework consisting of EU 15 countries plus a number of rich industrial countries, namely AU, CA, CH, JP, NZ, and the US from 1973 to 2007. We do not use the full OECD sample in order to avoid introducing too much heterogeneity in the sample by including emerging market economies. The data are taken from the European Commission's AMECO data base and are measured at an annual frequency.

As a first step, we investigate the time series properties of our panel variables. The results, which are detailed in the appendix, indicate that the variables are non-stationary and co-integrated. A co-integration analysis is therefore warranted. The super-consistency property of the co-integration relationship assures that endogeneity concerns can be disregarded and the estimated coefficients reflect the "true" long-term relation among the variables.

As a co-integration framework is appropriate, we perform the estimation by dynamic ordinary least squares with one lead and one lag (DOLS(-1,1)). Dynamic OLS was originally developed by Stock and Watson (1993); Kao and Chiang (2000) analyse its properties in a panel context. More specifically, the regression equation is

$$\log(reer_{it}) = \alpha_i + \beta_1 tb_{it} + \beta_2 yd_{it} + \beta_3 prod_{it} + \beta_4 oil_{it} + \rho_{11}\Delta tb_{it-1} + \rho_{12}\Delta tb_{it+1} + \rho_{21}\Delta yd_{it-1} + \rho_{22}\Delta yd_{it+1} + \rho_{31}\Delta prod_{it-1} + \rho_{32}\Delta prod_{it+1} + \rho_{41}\Delta oil_{it-1} + \rho_{42}\Delta oil_{it+1} + \varepsilon_{it}$$

where reer are different measures of the real effective exchange rate, ***tb*** is the balance of goods and services measured in percent of GDP, ***yd*** is the log of GDP per capita in PPP relative to the euro area, ***oil_int*** is the the log of the product of real oil prices (in domestic currency) and the oil intensity and ***prod*** is the log of relative labour productivity (domestic productivity divided by a weighted average of productivity in the main trading partners). The inclusion of leads and lags of the first difference of the regressors improves the efficiency in estimating the co-integration vector, which is given by (-1, β_1, β_2, β_3, β_4). It is important to note that Kao and Chiang (2000) show that ε_{it} is by definition auto-correlated. When estimating equation (1), appropriate correction for the autocorrelation needs to be performed. We employ the correction of Newey and West (1994). Moreover, our standard errors are robust with respect to arbitrary heteroskedasticity. Finally, the estimation results presented constrain the short as well as the long-run dynamics to be the same across the countries. However, as a robustness check, we also allowed for the coefficients

on the leaded and lagged first differences, i.e. the short run dynamics, to differ across countries. The main results were unaffected when estimating the less restrictive model. Moreover, the model includes country dummies. As an additional robustness check, we also estimated the above equation including, besides country, also time fixed effects. The main results remain unaffected.

To assess whether movements in the trade balance are related to the internal real exchange rate, we resort to a direct test. We test, whether the trade balance is significantly related to the REER based on the GDP deflator. The measures include prices of tradable as well as non-tradable goods. We then compare the estimation results with the REER based on export prices, which is a measure that only includes prices of tradable goods. If the broad exchange rate is linked to the trade balance while the export price based exchange rate is not, then the relative price of non-tradable goods and services has to be a key factor in the relation of the current account and the exchange rate. If, in contrast, the main channel of trade balance adjustment were via the price of exports, then a strong relationship between the balance of goods and services and the export price based REER should be found. Moreover, in line with accounting identity presented in the previous section, we use the difference between the broad and the narrow REER measure to capture the effect of the trade balance on the internal exchange rate.

As a further way of assessing the importance of the relative price of T to NT, we turn to a more direct measure of the relative price of T vs NT. To do so, we directly use the deflator of industry goods relative to service goods as a proxy for the relative price of T to NT. We investigate how far this relative price in the home country is related to the balance of goods and services of the home country. This part of our analysis therefore abstracts from the respective relative prices in the trading partner countries. This makes a direct comparison with the other measures of the REER difficult, but it allows a direct assessment of the importance of the home relative price.[9]

It is important to control in the regressions for other major determinants of the real effective exchange rate. Controlling for determinants of the relative price of tradable goods and services is indispensable in our approach. According to the Balassa-Samuelson hypothesis, changes in the tradable relative to the non-tradable sector productivity are the main driver of relative prices. An increase in the relative productivity should lead to an appreciation since the prices of non-tradables increase. The relative price of tradable goods should fall. We therefore include the domestic productivity of the industry sector relative to the total economy as a variable in the estimations in which the dependent variable is the domestic relative sectoral prices, see also Canzoneri et al (1999). In the regressions with the real effective exchange rate as a dependent variable, we control for the relative development by including relative GDP per capita as a variable. We expect an increase in relative GDP per capita to lead to an appreciation of the exchange rate.

[9] From a strict accounting point of view, the REER can be decomposed into a tradable component (basically a ratio of domestic tradable prices to foreign tradable prices) and a relative NT price component (basically a ratio of the relative prices of NT to T in the domestic economy divided by the relative prices of NT to T in the foreign economy). Such a decomposition is, however, not available.

This measure should capture Balassa-Samuelson effects and is often employed in the literature, e.g., in the work of Lane and Milesi-Ferretti (2002). Moreover, we employ a measure of productivity relative to the trading partners.[10] This measure should capture Balassa-Samuelson effects to the extent that the productivity shocks of the economy are concentrated in the tradable sector. We note, however, that a shock to domestic total productivity may affect the real effective exchange rate in the opposite direction if increased productivity is not entirely offset by higher wages. Moreover, productivity increases during the last decades have been substantial in the NT sector as well.

Finally, to capture the effect of exogenous changes of commodity import prices on the domestic economy, we employ the log of the product of real oil prices multiplied by the net oil intensity of the economy. Our measures of the real effective exchange rate compares domestic prices with prices in a group of 24 mostly advanced economies. It is therefore unlikely to be substantially affected by commodity price although the trade balance will certainly be.[11] To avoid biasing our estimates we therefore need to control for commodity prices.[12]

To assess the impact of the euro on the fundamental equilibrium relationship, we tried to detect structural breaks in time as well as across countries. We relied on several different approaches, which gave very similar results, see also appendix for robustness. In the main results sections, we successively tested, whether potential breaks might actually reflect things other than EMU. For real per capita GDP, we could identify the statistically strongest break in the year 1992 for all countries. Adding to a regression with a structural break in 1992 a further break variable for EMU (equal to one when a country has the euro) does not allow identifying any further euro dimension for GDP. In contrast, allowing for a structural break for all countries in 1992 on the effects of the balance of goods and services shows no significant change at that time. Moreover, if one adds on top of this a structural break for EMU, we find a statistically significant change for the balance of goods and services in some of the regressions. The last regression presented therefore includes both, a structural break on GDP for all countries in 1992 and an EMU break on the balance of goods and services for the time of the introduction of the euro.

[10] Indeed, only idiosyncratic, i.e., country specific, shocks should affect the real exchange rate, while global productivity shocks should not influence exchange rates.

[11] The size of the effect on the trade balance will depend on the country's oil exposure which explains why we control for both oil prices and exposure (measured as the expenditure on oil relative to GDP). Instead of the exposure to oil consumption, we also used exclusively the real oil price. The results do not change and are presented in the appendix.

[12] In our approach we cannot employ the terms of trade (ToT) as a control variable as is sometimes done in the literature (see for instance Lane and Milesi-Ferretti, 2002). First of all, we want to test the export price based REER as a dependent variable and this variable may to some extent be seen as contained in the ToT variable. Second, ToT are truly exogenous only under very strict assumptions, which are unlikely to be fulfilled in practice.

5. Estimation results

5.1 Main results

Table 2 presents our main regression results. In column A, the coefficient on the trade balance is significant, indicating that an increase in the trade surplus (reduction in the trade deficit) is associated with a depreciation of the real effective exchange rate based on the GDP deflator. In contrast, the narrow real effective exchange rate based on export prices is not significantly affected by the trade balance (Column C). We take this first of all as evidence that export prices themselves are not a key variable related to trade in the long-run. Moreover, the broad measure of the real effective exchange rate includes the prices of non-tradable goods and services while the export price based measure does not. This suggests that the relative price of non-tradable to tradable goods and services of a country in relation to the trading partners is the main variable related to the trade balance. In contrast, movements in the external exchange rate do not seem to matter for the trade balance unless they are backed by similar movements in the internal exchange rate.

In regression E, we take the log difference of the GDP-based REER and the export price-based REER. As shown in Equation 5 above, this difference should reflect the internal exchange rate, i.e. the relative price of non-tradable to tradable goods relative to trading partners. Results show a very clear and significant effect of the trade balance on this new measure of the internal exchange rate. Column F takes a similar approach but, here, the broad measure of the REER is regressed on the narrow one, allowing the coefficient to differ from one in contrast to regression E, where the coefficient implicitly is constrained to be one. The results show that the coefficient is statistically not significantly different from one. Again, we find our results confirmed, in particular that of a significant movement of the broad exchange rate to the trade balance after controlling for the narrow measure of the exchange rate.

In regressions G and H we show more directly that the domestic internal exchange rate is linked to the trade balance by replacing measures of the REER by a measure of domestic relative prices, i.e. the ratio of industrial to total prices. An increase in the trade surplus is connected to an increase in the relative price of the more tradable industrial goods all others things equal. In other words, improvements in the trade balance require a shift of domestic absorption to the non-tradable sector which is achieved via a decrease in the relative price of non-tradable goods and services.

We also test possible effects of EMU but find relatively little evidence of changes due to the inception of the euro. For the broad-based real exchange rate measures, the coefficient on the trade balance does not increase significantly after the adoption of the euro (Column B). For the narrow based measure, we find a significant increase of the coefficient but the overall effect remains insignificant in the euro area (Column D). This suggests that tradable prices within EMU may have become slightly more reactive to changes in the trade balance thanks to the euro but still do not reach significance. Looking at domestic relative prices, we do not find any

changes due to the introduction of the euro (Column H). Overall, the results indicate that the adoption of the euro has not altered substantially the relationship between the trade balance and prices in euro-area countries. More generally, tests with various dummy variables show that this relationship is similar for euro-area countries and for other advanced economies both before and after the launch of the euro (see Appendix).

Table 2: **Panel estimates of determinants of the real effective exchange rate and the relative deflator in OECD countries (1973-2007)**

	REER based on GDP deflator		REER based on export price deflator		Differ-ence (1)	REER based on GDP deflator	Industry sector deflator relative to entire economy deflator	
	A	B	C	D	E	F	G	H
Balance of goods and services	**-0.009**	**-0.009**	**0.000**	**0.002**	**-0.010**	**-0.009**	**0.010**	**0.011**
	-3.58	-3.25	0.2	0.67	-5.41	-5.31	4.38	4.59
EMU* balance of goods and services (2)		**-0.003**		**-0.006**				**0.000**
		-1.2		-2.49				0.1
log of relative real per capita GDP	**1.159**	**1.151**	**0.627**	**0.608**	**0.532**	**0.647**	**-0.230**	**-0.127**
	7.91	9.03	5.37	5.47	5.69	6.01	-1.79	-1.08
relative productivity (3)	**0.001**	**0.001**	**-0.002**	**-0.002**	**0.003**	**0.003**		
	0.45	0.71	-2.52	-2.64	3.58	3.08		
relative productivity of industry to services (4)							**-0.859**	**-0.763**
							-18.57	-10.61
Oil exposure	**-0.008**	**-0.004**	**-0.008**	**-0.004**	**0.000**	**-0.001**	**0.012**	**0.010**
	-2.39	-1.19	-2.46	-1.29	-0.03	-0.37	4.29	3.28
sample92 *log of relative real GDP pc (5)		**-0.351**		**-0.190**				**0.156**
		-6.04		-3.94				2.46
sample92 (5)		**0.045**		**0.036**				**-0.051**
		3.35		3.39				-4.23
EMU (2)		**-0.039**		**-0.011**				**-0.021**
		-3.08		-0.57				-1.31
Log of REER based on export price deflator						**0.87**		
						13.81		
N	504	504	504	504	504	504	485	485
r2	0.62	0.66	0.54	0.58	0.63	0.85	0.86	0.88

(1) Difference is the log difference between the broad and the narrow measure of the REER. (2) EMU is a dummy variable equal to one if a country has the euro in a given year. (3) Productivity of the economy relative to trading partners. (4) Domestic productivity of the industrial relative to the service sector. (5) Sample92 is a dummy that takes the value of 1 as of 1992 for all countries. T-values below the coefficient.

The effect of the control variables is worthwhile discussing in some detail: An increase in relative GDP per capita leads to an appreciation of the real exchange rate in all specification. This result is in line with the hypothesis that price levels increase with the level of development of an economy. GDP increases lead to a decrease in the domestic relative price of industrial goods (Column G). In this regression, we already control for the relative productivity in the two sectors. The negative coefficient on the GDP variable could therefore indicate factors other than Balassa Samuelson effects, such as increased preference for the consumption of non-tradable

goods with rising income and increased product quality. The effect of relative GDP increases has, however, become weaker in the later parts of the sample. This could be an indication that the competitive edge in terms of product quality that more advanced economies have traditionally enjoyed has been eroded with increasing trade and technology integration.

We find clear evidence of Balassa-Samuelson effects in specifications G and H, confirming findings of Canzoneri et al (1999). An increase in the relative productivity of industrial goods relative to services lowers the relative price of industrial goods. The coefficient is close to one as would be expected. General productivity increases – i.e. without distinguishing between the tradable and non-tradable sectors - of the economy relative to the main trading partners appreciate the internal relative exchange rate (Column E) and depreciate the export price based real exchange rate (Column C). In a clear departure from the PPP hypothesis, productivity improvements relative to the trading partners appear to lead to somewhat lower prices of export goods (Column C). This is in line with the rejection of PPP in Canzoneri et al (1999) as well as Engel (1999). However, general productivity increases do not have a statistically significant effect on the GDP based REER (Column A). Apparently, the positive impact on non-tradable prices is just offset by the negative effect on export prices. Finally, regarding the effect of changes in the exposure to oil, we find that an increase in the oil exposure is associated with a depreciation of the exchange rate in those countries which post higher oil dependence.[13]

5.2 Additional results

In this section, we present additional results to underpin our findings. Column A of Table 3 repeats the result of the main table for convenience (Column A in Table 2), while regression B restricts the sample to those countries with a low correlation between the broad and narrow measure of the exchange rate. We know from Table 2 that export prices alone do not matter for the trade balance after controlling for the oil exposure. However, fluctuations in export prices could still matter when they reinforce fluctuations in the internal measure of the real exchange rate. If this is true, we expect the broad exchange rate to react more strongly to the trade balance in a sample in which the export price based REER moves less in line with the broad exchange rate than in the entire sample as the entire burden of adjustment remains with the non-tradable relative price. Indeed, we find a coefficient on the trade balance that is almost twice as large as the one in the full sample. This suggests that in countries where broad and narrow measures co-move little, the non-tradable part of the real exchange rate has to move more in response to a given trade balance shock.

[13] The sample consists of non-oil exporting countries; only the US and Australia are significant producers of primary energy. The US is, however, clearly a net importer of oil.

Table 3: **Additional results**							
Variable	Log of REER based on GDP deflators					Log of REER based on export deflator	Difference (1)
	A	B	C	D	E	F	G
Balance of goods and services	**-0.009**	**-0.015**	**-0.002**	**-0.006**	**-0.005**	**0.003**	**-0.008**
	-3.58	-4.55	-0.58	-2.11	-2.52	1.29	-4.39
log of relative real per capita GDP	**1.159**	**0.340**	**0.062**	**0.527**	**1.032**	**0.450**	**0.583**
	7.91	1.78	0.49	5.12	7.5	3.19	6.09
Relative productivity (2)	**0.001**	**-0.007**	**0.003**	**-0.004**	**-0.003**	**-0.004**	**0.001**
	0.45	-3.81	1.51	-2.24	-1.76	-2.65	0.99
government consumption					**0.025**	**0.018**	**0.008**
					6.57	4.79	2.49
Oil exposure	**-0.008**	**-0.002**	**-0.008**	**-0.018**	**-0.006**	**-0.006**	**-0.001**
	-2.39	-0.83	-1.45	-4.08	-2.35	-1.68	-0.34
Sample restricted to	full	be, ca, de, nl	CA>0	CA<0			
N	504	120	242	376	429	429	429
r2	0.62	0.75	0.51	0.64	0.68	0.55	0.66

(1) Difference is the log difference between the broad and the narrow measure of the REER. (2) Productivity of the economy relative to trading partners. Sample in regression B is restricted to the 4 countries with lowest correlation between broad and narrow REER, correlation below 0.75. T-values below the coefficient.

In a further regression step, we want to assess, whether the response of prices to the trade balance differs in external surplus and deficit countries. If prices exhibit downward rigidities, we expect the real exchange rate to respond more strongly to a trade deficit (i.e. situations of upward price pressures) than to a trade surplus (i.e. situations of downward price pressures). Indeed, the regression results presented below indicate that prices react to changes in the trade balance in deficit countries whereas the coefficient on the trade balance becomes insignificant in the case surplus countries. Ideally, we would like to distinguish countries with falling current accounts from countries with increasing ones. However, such a distinction renders the estimation of coefficients in a co-integrating framework difficult. Still, our results suggest that trade balance adjustments of deficit countries towards balanced trade balances might be rendered more difficult due to downward rigidities of prices.

In a further set of regressions, we study the importance of fiscal policy. Government consumption may lead to an appreciation of the real exchange rate. As government consumption is mostly composed of non-tradable goods and services, a rise of the share will entail a rise in the non-tradable content of domestic demand.[14] As demand

[14] We are assuming here that the rise in consumption is fully financed by increased taxes. There is obviously an additional channel through which fiscal policy can affect the relation between the current account and the exchange rate: if the demand impact of a rise in budget deficit is not fully offset by Ricardian effects, it will be associated with a drop in the current account. Nevertheless, this is a cyclical short-term effect that cannot be captured in our medium term equation. Froot and Rogoff (1991) argue that increases in government consumption tend to increase the relative price of non-tradables, since government consumption is concentrated on non-tradables.

for tradable drops and for non-tradables increases, the relative price of non-tradables could increase.[15] We therefore expect government consumption to have a stronger effect on the broad based REER than on the narrow one. The regression results indicate that a higher government consumption share is associated with an appreciated real exchange rate. The relationship is larger for the broad than for the narrow measure of the real exchange rate (regressions C and D) and statistically significant in both. Moreover in the final column of the table we show that government consumption indeed has an effect on the difference between the broad and the narrow measure of the exchange rate, which indicates that government consumption increases the relative price of non-tradable goods and services.

5.3 Robustness checks

We performed numerous regressions to test the robustness of our results. Table 4 shows that the estimation results are not affected if one uses instead of the GDP based real effective exchange rate other broad measures based on consumer prices or on unit labour costs.[16] Further robustness checks are provided in the appendix.

Table 4: **Robustness checks**

	HICP		ULC	
	A	B	C	D
Balance of goods and services	**-0.010**	**-0.009**	**-0.014**	**-0.012**
	-4.13	-3.77	-5.56	-4.72
EMU*balance of g&s (1)		**-0.001**		**-0.004**
		-0.48		-1.8
log of relative real per capita GDP	**0.903**	**0.902**	**1.058**	**1.111**
	6.74	7.32	7.23	8.93
Relative productivity (2)	**0.001**	**0.002**	**0.001**	**0.001**
	1.03	1.27	0.48	0.47
oil exposure	**-0.007**	**-0.005**	**-0.008**	**-0.005**
	-2.58	-1.56	-2.76	-1.4
sample92*log of real GDP (3) pc		**-0.301**		**-0.293**
		-5.5		-5.46
sample92 (3)		**0.037**		**0.045**
		3.05		3.48
EMU (1)		**-0.037**		**-0.059**
		-3.04		-4.21
N	504	504	504	504
R 2	0.60	0.64	0.64	0.68

(1) EMU is a dummy variable equal to one if a country has the euro in a given year. (2) Productivity of the economy relative to trading partners. (3) Sample92 is a dummy that takes the value of 1 as of 1992 for all countries. T-values below the coefficient.

[15] For more discussions on this see Blanchard (2007).

[16] Indeed, as Figure 5 in the appendix shows, the correlation between the different broad measures is very high, while Figure 6 shows that the correlation between the broad and narrow REER measure is relatively low. Moreover, Figure 7 shows that the exchange rate variation across euro-area countries moves in tandem with the overall exchange rate. As a further robustness check, we ran all the regressions using the current account instead of the balance of goods and services without seeing our central results affected.

6. Conclusions

In this paper, we document that the relative price of tradable to non-tradable goods and services is significantly connected to the trade balance. Broad measures of the real effective exchange rate are significantly affected by the trade balance even after controlling for export price based real exchange rates. In contrast, no significant relationship between the real exchange rate based on purely tradable prices and the trade balance can be found. Moreover, the introduction of a common currency, i.e. the elimination of the nominal exchange rate, has not fundamentally altered these relationships. Government consumption is found to be a significant determinant of the exchange rate and affects in particular the non-tradable part of the exchange rate. From a policy perspective, these results suggest that closing the large current account deficits observed in some countries both inside the euro area and in the rest of the OECD will be associated with significant relative price changes and real exchange rate depreciations. Facilitating these relative price changes will reduce the costs of adjustment. The issue is particularly relevant for euro-area countries which are known to suffer from significant price rigidities. Our results suggest that policy makers would be well-advised to keep a close eye on the non-tradable sector when looking for ways to adjust to external imbalances.

References

Balassa, B. (1964),"The Purchasing Power Parity Doctrine: A Reappraisal", *Journal of Political Economy*, 72, 584-596.

Betts, C. and T. Kehoe (2006), 'U.S. real exchange rate fluctuations and relative price fluctuations', *Journal of Monetary Economics*, vol. 53(7), pp. 1297-1326.

Blanchard, O. (2007), 'Current account deficits in rich countries', *NBER working paper*, No. 12925

Blanchard, O. and F. Giavazzi (2002), 'Current account deficits in the euro area: the end of the Feldstein-Horioka puzzle?' *Brookings Papers on Economic Activity*, Vol 2002, 147-186.

Burstein, A., M. Eichenbaum and S. Rebelo (2005), 'The importance of nontradable goods prices in cyclical real exchange rate fluctuations', CEPR discussion paper No. 5306, October.

Canzoneri, M.., and R. Cumby and B. Diba (1999), 'Relative labor productivity and the real exchange rate in the long run: evidence for a panel of OECD countries', *Journal of International Economics*, 47(2), 245-266.

Canzoneri, M., and R. Cumby and B. Diba and G. Eudey (2002), 'Productivity trends in Europe: Implications for real exchange rates, real interest rates, and inflation', *Review of International Economics*, 10(3), 497-516.

Chari, V., P. Kehoe and E. McGrattan (2002), 'Can sticky price models generate volatile and persistent real exchange rates?', *Review of Economic Studies*, 69, pp. 533-563.

Cheung, Chinn, Fujii (2007), 'The overvaluation of Renminbi undervaluation', *Journal of International Money and Finance.*

Chin, M.D. and E.S. Prasad (2003), 'Medium-term determinants of current accounts in industrial and developing countries: an empirical exploration', *Journal of International Economics*, 59, 47-76.

De Gregorio, J. and A. Giovannini and H.C. Wolf (1994), 'International evidence on tradables and nontradables inflation', *European Economic Review*, 38, 1225-1244.

Devereux, M.B. and C. Engel (2002), 'Exchange rate pass-through, exchange rate volatility, and exchange rate disconnect,' *Journal of Monetary Economics*, 49(5), pages 913-940.

Dotsey, M. and M. Duarte (2008), 'Nontraded goods, market segmentation, and exchange rates', *Journal of Monetary Economics*, 55, 1129-42.

Egert, B. and L. Halpern and R. MacDonald (2006), *Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues,* Journal of Economic Surveys, 20(2), 257-324.

Engel, C. (1999), 'Accounting for US real exchange rate changes", *Journal of Political Economy*, 107, pp. 507-38

Engel, C (2002), ' Expenditure Switching and Exchange Rate Policy', NBER working paper, No. 9016.

Fischer, C. (2007), 'An assessment of the trends in international price competitiveness among EMU countries', Deutsche Bundesbank Discussion Paper, 08-2007.

Frankel, J.A. and A.K. Rose, 1999, 'Empirical research on nominal exchange rates', in *Handbook of International Economics*, 3, ed. By Gossman and Rgoff, Amsterdam, North-Holland.

Froot, Kenneth and Kenneth Rogoff (1991), "The EMS, the EMU, and the Transition to a Common Currency," *NBER Macroeconomics Annual* 6, 269-317.

Hadri, K. (2000), 'Testing for stationarity in heterogeneous panel data', *Econometrics Journal*, 3, 148-161.

Harrod, R. F. (1939), International Economics, Cambridge University Press

Kao, C., M-H. Chiang and B. Chen, (1999), 'International R&D spillovers: An application of estimation and inference in panel cointegration', *Oxford Bulletin of Economics and Statistics*, 61(4). 693-711.

Kao, C. and M.H. Chiang(2000), 'On the estimation and inference of a cointegrated regression in panel data', in: Baltagi B. (ed.), 'Nonstationary panels, panel cointegration, and dynamic panels', *Advances in Econometrics*, Vol. 15, Amsterdam: JAI Press, 179-222

Lane, P.R. and G. Milesi-Ferretti (2002), 'External wealth, the trade balance, and the real exchange rate', *European Economic Review*, 46, 1049-1071.

Lane, P.R. and G. Milesi-Ferretti, (2004), 'The transfer problem revisited: net foreign assets and real exchange rates', *Review of Economics and Statistics*, 86(4), 841-857.

Meese, R.A. and K. Rogoff, 1983, 'Empirical exchange rate models of the seventies: do they fit out of sample?', *Journal of International Economics*, 14, 3-24

Obstfeld, M and K. Rogoff (1996), 'Foundations of International Economics', MIT Press.

Obstfeld, M and K. Rogoff (2000), 'Perspectives on OECD capital market integration: Implications for U.S current account adjustment', in Federal Reserve Bank of Kansas City, *Global economic integration: opportunities and challenges*, March, pp. 169-208.

Obstfeld, M and K. Rogoff (2004), 'The unsustainable current account revisited', NBER working paper, 10869.

Obstfeld, M and K. Rogoff (2005), 'Global current account imbalances and exchange rate adjustments', Brookings Papers on Economics Activity, 1:2005, pp. 67-146.

Obstfeld, M and K. Rogoff (2007), 'The unsustainable US current account position revisited', in R. Clarida (ed.), *G7 current account imbalances: sustainability and adjustment*, University of Chicago Press.

Pedroni, P. (1999), 'Critical values for cointegration tests in heterogeneous panels with multiples regressors', *Oxford Bulletin of Economics and Statistics*, 61, 653-678.

Pesaran, M. and R. Hashem and Smith, (1995), 'Estimating long-run relationships from dynamic heterogeneous panels', *Journal of Econometrics*, 68(1), 79-113.

Rogers, J. H. (2007), 'Monetary union, price level convergence, and inflation: How close is Europe to the USA?', *Journal of Monetary Economics*, 54(3), 785-796.

Rogoff, K. (1992), 'Traded Goods Consumption Smoothing and the Random Walk Behavior of the Real Exchange Rate', NBER Working Papers No 4119.

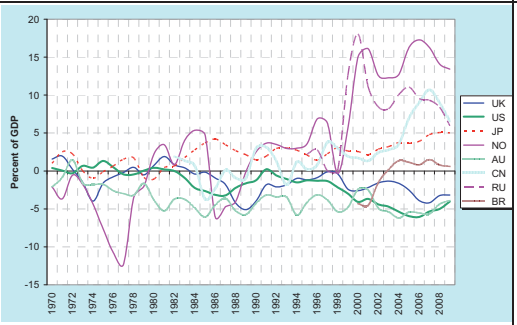
Rogoff, K. (1999), 'Monetary models of dollar/yen/euro nominal exchange rates: dead or undead?' *Economic Journal*, 109, F655-59.

Samuelson, P. (1964), Theoretical Notes on Trade Problems, *Review of Economics and Statistics*, 23.

Stock, J. and M. Watson (1993), 'A simple estimator of cointegrating vectors in higher order integrated systems', *Econometrica*, 61(4), 783-820.

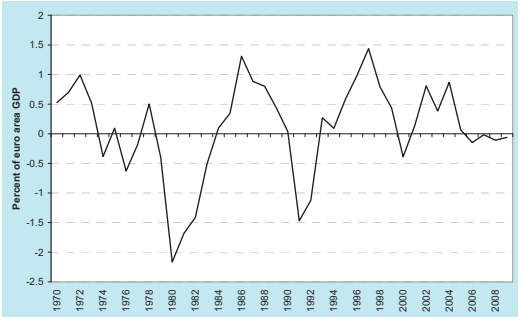
A. Appendix

Graph 1: **Current accounts, selected non-euro-area countries** (% of GDP – 1970-2006)



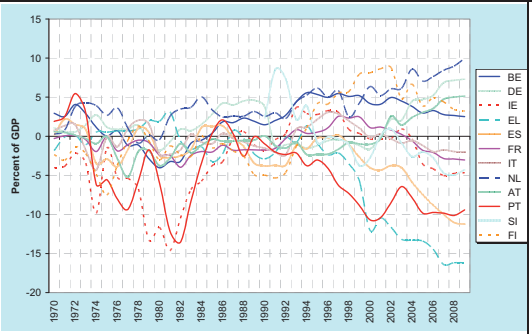
Source: Commission services.

Graph 2: **Euro-area current account**(% of GDP – 1970-2006)



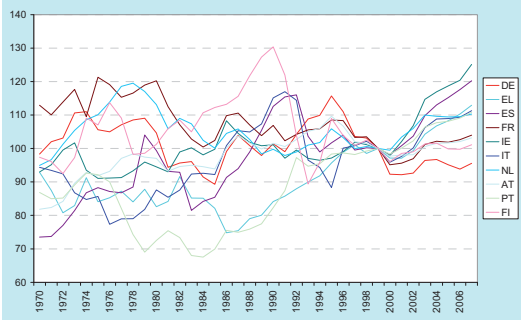
Source: Commission services.

Graph 3 **Current account in percent of GDP of euro area countries** (1970-2006) (1)



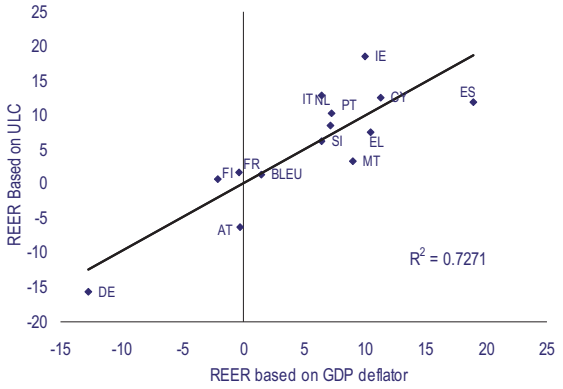
(1) excluding Luxembourg, Malta, Cyprus
Source: Commission services.

Graph 4: **Real effective exchange rate of euro-area countries**.(1970-2006) (1)



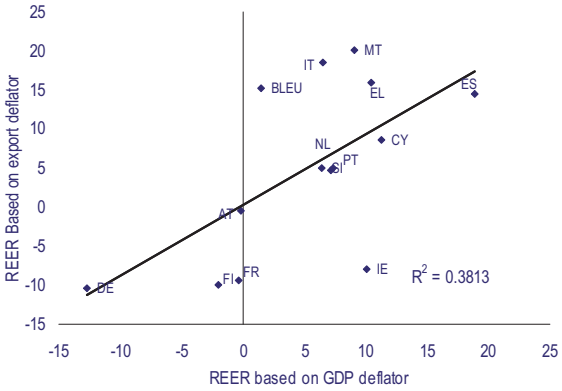
(1) REER is GDP based, relative to a basket of 24 countries, 1999 = 100.
Source: Commission services.

Graph 5: **Broad measures of the REER, euro-area Member States** (1)
(change 1999Q1-2008Q4 in %)



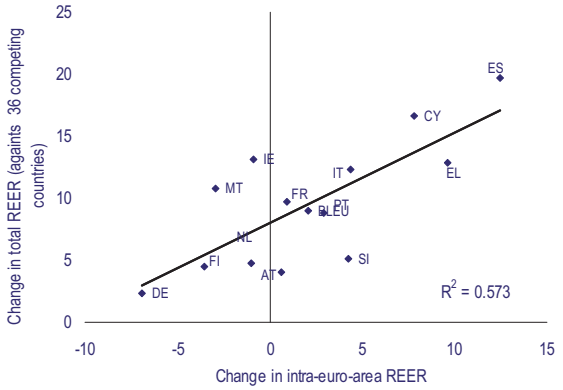
(1) Intra-area REER.
Source: Commission services (2008 data based on autumn 2008 forecast).

Graph 6: **Broad and narrow measures of the REER, euro-area Member States** (1)
(change 1999Q1-2008Q4 in %)



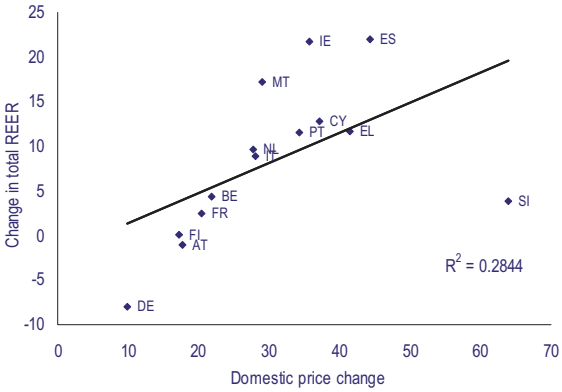
(1) Intra-area REER.
Source: Commission services(2008 data based on autumn 2008 forecast).

Graph 7: **Intra-area and total REER, euro-area Member States** (1)
(changes 2002Q1-2008Q4 in %)



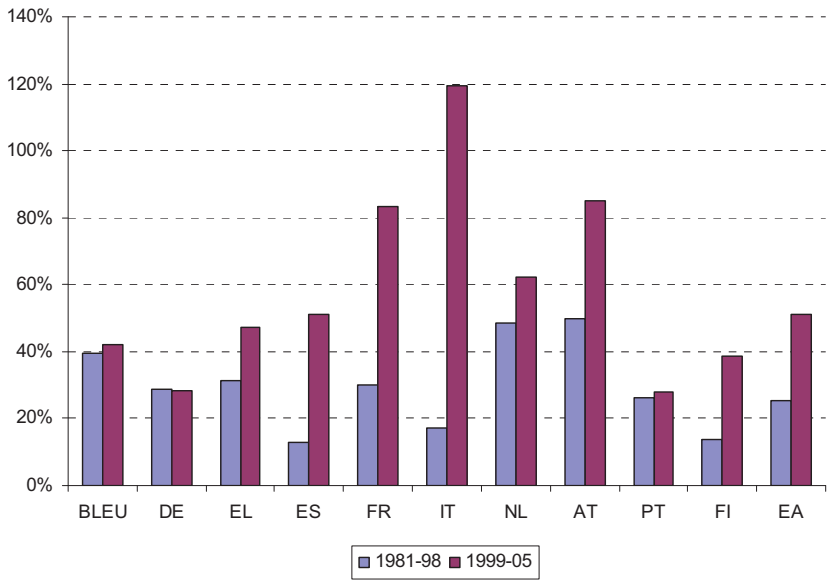
(1) Based on the GDP deflator. Results are similar for ULC-based REER.
Source: Commission services (2008 data based on autumn 2008 forecast).

Graph 8: **Total REER and domestic inflation, euro-area Member States** (1)
(changes 1998-2008 in %)



(1) REER and inflation are calculated on the basis of GDP deflators.
Source: Commission services (2008 data based on autumn 2008 forecast).

Relative volatility (1) **of the domestic and the external components of the intra-area REER** (2)**, euro-area Member States** (in %)
Alternative estimates based on EU KLEMS data



(1) Ratio of volatility of the non-tradable component to volatility of the tradable component. Volatility is measured by the standard deviations of the annual changes in the corresponding components.
(2) The various intra-euro-area REER are calculated using sectoral output prices from the EU KLEMS database. Non-tradable sectors are those with a trade intensity (i.e. [(imports + exports)/2]/value added) of less than 20%.
Source: Commission services, EU KLEMS.

Box 1: Panel unit roots and co-integration

We want to assess the relationship between real exchange rates and particularly the prices of non-tradables relative to tradables and the balance of goods and services. To do so, we begin by examining the time series properties of the data. Table (1) present the results of the Hadri (2000) stationarity (panel) test. For all series we reject the null hypothesis that the series is stationary. Performing the Im-Pesaran-Shin panel unit root test with the null hypothesis of a unit root confirms the result as we do not reject the null for any of the series except for oil exposure (Table 1, columns C+D). We therefore test whether the series are co-integrated with the Pedroni (1999) group t-test. The test results presented in Table (1) show that indeed the series are co-integrated. Therefore a long-run relation among the variables can be assumed.

Table 1: Stationarity and co-integration tests

	A	B	C	D
Stationarity/ Unit root test by	**Hadri**		**IPS**	
	Z-statistic	p-value	tbar	p-value
Real oil price (oil)	28.77	0.00	-1.60	0.27
Oil exposure (oil_exposure)	42.95	0.00	-1.90	0.02
Gov. consumption in percent of GDP (govc)	6.34	0.00	-2.58	0.01
REER based on export prices (reer_ex)	17.57	0.00	-0.88	0.99
REER based on GDP deflator (reer_gdp)	14.84	0.00	-1.52	0.43
REER based on consumption deflator (reer_cp)	13.91	0.00	-1.57	0.35
GDP per capita relative to EA average (GDPrelpc)	22.82	0.00	-0.95	0.98
Relative productivity (Prod)	12.63	0.00	0.38	1.00
Balance of goods and services (bal_gs)	22.78	0.00	-1.35	0.70
Current account (CA)	15.796	0.00	-1.23	0.84

Co-integration test	Pedroni Panel PP statistic	p-value
(reer_gdp, bal_gs, GDPrelpc, prod, oil exposure)	-7.56	0.00
(reer_ex, bal_gs, GDPrelpc, prod, oil exposure)	-5.85	0.00

Note: Hadri (2000) test for the null of (level) stationarity, controlling for serial dependence in errors. Controlling for heteroscedastic disturbances across units gives same results. Test results of Im Pesaran Shin (IPS) unit root test with two lags. The inclusion of four lags and trend yields comparable results. Pedroni (1999) panel pp test for null of no co-integration among multivariate vector (Group rho statistic). EU15 sample, excluding Luxembourg. Tests on OECD sample yield similar results.

Table A 1: **Panel estimates of determinants of the real effective exchange rate and the relative deflator**
in OECD countries (1973-2007)

Log of:	REER based on GDP deflator		REER based on export price deflator		Industry sector deflator relative to entire economy deflator	
	A	B	C	D	E	F
Trade balance (1)	**-0.010**	**-0.009**	**0.000**	**0.001**	**0.012**	**0.012**
	-4.47	-3.55	-0.19	0.29	5.72	5.63
EMU* trade balance		**-0.003**		**-0.007**		**0.001**
		-1.63		-3.57		0.22
Relative GDP pc (2)	**1.061**	**0.998**	**0.532**	**0.404**	**-0.141**	**-0.018**
	9.04	9.04	4.62	3.3	-1.29	-0.18
Relative productivity (3)	**0.000**	**0.001**	**-0.003**	**-0.003**	**-0.890**	**-0.817**
	-0.28	0.54	-3.85	-3.44	-26.91	-16.96
Log of real oil price	**-0.070**	**-0.055**	**-0.055**	**-0.044**	**0.063**	**0.057**
	-6.47	-4.5	-5.38	-3.79	7.88	5.87
sample92*relative GDP pc		**-0.333**		**-0.173**		**0.147**
		-6.02		-3.47		2.54
sample92		**0.018**		**0.016**		**-0.031**
		1.34		1.4		-2.55
EMU		**0.000**		**0.029**		**-0.040**
		0.03		1.45		-2.74
N	543	543	543	543	523	523
R squared	0.64	0.67	0.50	0.54	0.87	0.89

Note: Robustness with respect to oil price.

In a further robustness test, we check, whether the inclusion of house price developments as a further control variable changes the estimation results (Table A2). Some countries have experienced strong increases in house prices in the investigated sample. Such increases have often been accompanied by significant current account worsening. The coefficient on the trade balance could have changed since the additional demand should drive up house prices, which are not included in the GDP based real exchange rate. However, our results do not point at instability of the coefficients as regressions A-C show.

B Appendix: Robustness of the euro break

In a further robustness step, we want to assess whether our results on the structural break due to EMU are robust. To do so, we show the results of a difference in difference estimation; The results are presented in Table A3.

The difference in difference approach combines the before-after approach with the cross-section dimension. It consists of a regression, which has an interaction with a time dummy for all countries as of 1999[17], a cross section dummy for all countries that have the euro and finally a third interaction of the two dummies and the variable of interest. The last interaction should capture the "pure" effect of the introduction of

[17] For Greece the value is 1 as of 2001.

the euro (the so-called "treatment effect"). However, we do not want to put too much emphasis on this regression approach since the number of observations is relatively limited for such a sophisticated approach. Indeed, the correlation between the different interacted regressors is quite high (above 0.9 in some cases) suggesting that co-linearity is an issue of concern.

Table A 2: **Robustness checks with respect to housing prices**

	A	B	C
REER based on deflator of	GDP	Export prices	Industry relative to entire economy deflator
Trade balance	**-0.008**	**-0.002**	**0.005**
	-3.26	-0.76	1.76
Log of real per capita GDP	**1.330**	**0.520**	**-0.431**
	7.42	3.57	-2.75
Relative productivity	**0.001**	**-0.001**	**-0.766**
	0.98	-1.52	-14.59
Oil exposure	**-0.005**	**-0.001**	**0.013**
	-1.6	-0.44	4.68
House price index	**-0.001**	**0.000**	**0.000**
	-1.58	0.12	-0.84
N	453	453	434
r2	0.62	0.52	0.88
Robustness checks relative to inclusion of house prices			

Table A 3: **Robustness checks concerning the role of the euro**		
	Dif in dif	
Variable	A	B
	gdp	ex
Trade balance	**-0.010**	**-0.003**
	-1.91	-0.59
EA12* trade balance (1)	**0.006**	**0.008**
	1.14	1.49
sample99 * trade balance (2)	**0.005**	**0.007**
	0.71	1.45
EA12*sample99*trade balance (1), (2)	**-0.014**	**-0.017**
	-2.03	-3.04
Relative productivity	**0.001**	**-0.002**
	0.76	-1.96
Log of real per capita GDP	**1.154**	**0.599**
	8.28	5.11
Oil exposure	**-0.006**	**-0.006**
	-1.74	-1.81
EA12 (1)	**-0.091**	**0.013**
	-1.35	0.32
sample99 (2)	**-0.035**	**-0.012**
	-1.16	-0.63
EA12* sample99 (1), (2)	**0.016**	**0.016**
	0.48	0.61
N	504	504
r2	0.63	0.56
joint effect of bal in EMU (3)	**-0.013**	**-0.004**
p-value	0.00	0.12

Note: (1) EA12 is a dummy variable taking the value 1 for all initial 12 countries that have the euro. (2) sample99 is a dummy variable equal to one as of 1999 for all countries. (3) Row gives the effect of the sum of all coefficients for those observations with the euro. T-values below the coefficients.

The estimation results broadly confirm our results on the structural break due to the euro. In regressions A and B, we show that the overall effect of the trade balance on the export based real exchange rate in EMU is insignificant while the effect on the GDP based real exchange rate is statistically significant.