Exchange Rate Dynamics in Monetary Union: an Empirical Assessment*

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Abstract

The aim of this paper is to investigate to what extent belonging to a monetary union affects the determination of the long run equilibrium level of the real exchange rate. In order to do so, we examine the dynamics of the real effective exchange rates in two groups of countries and try to identify whether different patterns can be observed depending on their monetary regimes (monetary union vs. flexible exchange rates). Our econometric estimations show that the role played by the standard determinants of the long run equilibrium level of the real effective exchange rate (sectoral productivity differentials and net foreign assets) differ substantially from one sub-group to another. We find a positive relationship between both sectoral productivity differentials and the net foreign assets position and the RER, in the long run, for the countries operating with a flexible exchange rate. The results concerning the countries belonging to the European Monetary Union (EMU) are different: our estimations confirm that the sectoral productivity differentials is an important determinant of the long run value of the real exchange rate in these countries; however, the effect of the net foreign assets over the

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real exchange rate appears to be negative and limited. This result seems to indicate that this fundamental variable does not operate in the usual way in the determination of the long run equilibrium exchange rate for the countries belonging to the EMU.

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1 Introduction

The earlier literature on exchange rate regimes and macro-economic performance suggests that fixed exchange-rate regimes are associated with better performances in achieving low inflation, whereas there is some evidence that countries with flexible exchange-rate regimes can exhibit better performances in terms of growth - even though the evidence on this latter result is mixed (see Ghosh, Gulde, Ostry & Wolf (1997), Levy-Yeyati & Sturzenegger (2001), or Coudert & Dubert (2005)). An obvious source for explaining these differences lies in the different constraints on relative price adjustments that are associated to the different exchange-rate regimes, and that drive the adjustment of the real exchange rate to its long-run equilibrium value.

In floating countries, real exchange rate misalignment is corrected through nominal exchange-rate changes, and/or adjustments in the fundamental determinants of the relative price level. The situation for countries in monetary unions is different, because their international trade is not affected anymore by fluctuations in the nominal exchange rate (a significant proportion of their trade is usually not affected by nominal exchange rate changes), leaving the burden of real-exchange-rate adjustment to be borne mainly by changes in the fundamentals and the prices.

The purpose of this paper is to investigate to what extent belonging to the European Monetary Union affects the determination of the long run equilibrium level of the real exchange rate. In particular, we examine the dynamics of the real effective exchange rates (RER) in two groups of countries and try to identify whether different patterns can be observed depending on their monetary regimes - namely, on whether they belong to the European Monetary Union or operate with a floating exchange rate.

From a methodological point of view, we based our analysis on equilibrium exchange rate models (more precisely on the BEER (Behavioral Equilibrium Exchange Rate) approach developed by Clark & MacDonald (1998)): we estimate the long-run relationship between the RER and the fundamental variables on a panel of countries which includes both European Monetary Union (EMU) countries and a sample of medium-size OECD countries. While models of underlying determinants of the real exchange rate vary in the literature, relative (internal) prices and the external position (current account balance or net foreign asset position) are widely-accepted standard fundamentals. Therefore, the real effective exchange rate is determined by a measure of relative productivity, consistent with the Balassa-Samuleson hypothesis, and by a measure of the external position. Similar exercises on panels of countries include Maeso-Fernandez, Osbat & Schnatz (2006), Kim & Korhonen (2005), Egert, Lommatzsch & Lahreche-Revil (2006) and López Villavicencio (2006).

We rely on panel data techniques to estimate the long run relationship between the real exchange rate and the fundamentals. We proceed first by estimating the long run relationship for the complete panel, using quarterly data. In a second step, we also performed the panel estimations for the two sub-groups (EMU on the one hand and medium-size OECD countries with flexible exchange rate on the other) in order to see the potential specific features of the adjustment in countries belonging to the European Monetary Union.

By relying on such a methodology, we could highlight the role played by the usual fundamental variables in the determination of the long run level of the RER whether a country operate with a flexible exchange rate or belong to the European Monetary Union. Furthermore, our methodology allows us to see if the speed of adjustement to this long run value is different among the two sub-groups.

From our econometric estimations, it appears that the determinants of the long run equilibrium level of the real effective exchange rate differ substantially from one sub-group to another. Concerning the sub-group of countries operating with a flexible exchange rate, there is a positive relationship between both sectoral productivity differentials and the net foreign assets position and the RER, as it is usually found in this strand of the litterature. For the group of countries belonging to the European Monetary Union, our estimations confirm that the sectoral productivity differentials (in relation with the Balassa-Samuelson effect) represent an important determinant of the long run value of the real exchange rate; however, the effect of the net foreign assets over the real exchange rate is negative and the value of the coefficient that we get from the different methodologies appears to be low. This last result differ from what other studies get in this litterature[1] and seems to indicate that the determination of the long run value of real effective exchange rates does not rely on the net foreign asset dynamics in the case of the European monetary union.

The paper is organised as follows. In section 2, we present in detail the database that we have built for the purpose of our study. The panel methodologies that we used are presented in section 3. The results of the estimations are presented in section 4. We provide some concluding remarks in section 5.

2 The database

Our analysis considers quarterly data for the period 1996Q1-2006Q4 and includes the following 20 countries that are divided into two sub-groups:

- A fist group including 10 EMU countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain. We refer to this sub-group as *EMU* hereafter[2].
- A second group of 10 medium-size OECD countries whose nominal exchange rate has been flexibe during the time period of our analysis: Australia, Canada, Denmark, Korea, Mexico, Norway, New Zealand, Sweden, Switzerland and the United Kingdom. We refer to this sub-group as *Flexible* hereafter.

The choice of the countries entering the panel is motivated by the fact that the main purpose of our study is to compared the exchange rate dynamics and the role played by the standard fundamental variables in the determination of long run equilibrium exchange rate between countries belonging to the EMU and countries that operates with flexible exchange rate. Along with the 10 countries belonging to the EMU, we have selected medium-size OECD countries who operates with flexible exchange rates. Despite the fact that the methodology that we used is similar to several studies related to equilibrium exchange rates, one must note that our purpose is not to focus on misalignements.

[1] Nevertheless, one must note that numerous papers on equilibrium exchange rate focus mainly on countries operating with flexible exchange rates.

[2] Due to the lack of data, Greece and Luxembourg are not included in our sample.

The choice of the time period is related to the monetary union sub-group. The European Monetary Union (EMU) has been put in place in 1999 with the creation of the euro currency; neverthless, we could consider that the countries of the euro area behave as in a monetary union several years before the launch of the euro currency, i.e., during the convergence process period. During this period, nominal interest rate and inflation rates have globally converge towards lower rates in all the countries and fluctuations of nominal exchange rates between the currencies of the European Monetary System (EMS) were limited. Nevertheless, some devaluations occurs during the 1990s (mainly during the Exchange Rate Mechanism (ERM) crisis of 1992-1993 and in 1995). Therefore, given that the last devaluations occured in the EMS in 1995, we select the first quarter of 1996 as the starting year for our sample. After this date, no substantial nominal exchange rate fluctuations occurs inside the EMS.

All the data comes from the IMF's *International Financial Statistics*. Based on this information, we constructed the following variables.

- **Real effective exchange rate:**

  The real effective exchange rate (RER), based on consumer prices, measures movements in the nominal exchange rate adjusted for the differential between the domestic price index and trade-weighted foreign price index. The CPI-based RER indicator, of a country i is:

$$RER_{it} = \frac{P_{it}S_{it}}{\prod_{j \neq i}^{N}(P_{jt}S_{jt})^{\omega_{ij}}} \quad , \tag{2.1}$$

  where j is an index of country i's trade partners; N is the number of countries[3], ω_{ij} is the competitiveness weight put by country i on country j, P_i and P_j are consumer price indices in countries i and j, and S_i and S_j represent the nominal exchange rates of countries i and j's currencies in US dollars[4]. An increase (decrease) in a country's index

[3]For the computation of the trade weighted, we used an extended panel of countries: in addition to the 20 countries of our panel, we compute trade weighted by adding the United States, Japan and China to the panel. Indeed, these countries are not included in our panel estimation as they do not share precisely the features of the panel; however, they must be taken into account in order to get the competitiveness dimension of the RER variables.

[4]For the weights we used data from the International Financial Statistics related to the bilateral trade between all the countries. The trade weighted between country i *vis-à-vis* country j is define as the sum of exports and imports of country i with country j divided by the sum of exports and imports of all the countries belonging to the *extended* panel group (including the United States, Japan and China).

indicates an appreciation (depreciation) of the RER. This measure of real effective exchange rate incorporates the fixed exchange rate between the countries belonging to the monetary union: indeed, in the computation of the real effective exchange rate of one country of the monetary union, the nominal exhange rate is fixed with the nine other countries belonging to the monetary union and flexible with the other ones. We work with the logarithm of the real effective exchange rate, denoting this variable as q_t.

- **Sectoral productivity differentials**. The impact of productivity differentials is expected to follow the Balassa-Samuelson doctrine: the differences in productivity bewteen the tradable and the nontradable sector should play a key role in the dynamics of the real exchange rate. It would be desirable to count with a direct measure of productivity differential based, for instance, on output and hours worked or employment in the manufacturing sector. However, we are restricted by the availability of sectoral productivity data (noticeably at a quaterly frequency). As a consequence, we rely on Consumer Price Index and Producer Price Index in order to get an approximation of the sectoral productivity differentials. Given the fact that more of the components of the Producer Price Index (*PPI*) are tradable than those in the Consumer Price Index (*CPI*), to capture the diverging productivity trends we use the ratio of *CPI* to the *PPI*. With such a method, we obtained the ratio of this index for each country to its equivalent weighted foreign average:

$$CPI - PPI_{it} = \frac{CPI_{it}/PPI_{it}}{\prod_{j \neq i}^{N} (CPI_{jt}/PPI_{jt})^{\omega_{i,j}}} \quad , \tag{2.2}$$

  We work with its logarithm and label the variable $cpi - ppi$.

- **Stock of foreign assets**. The other fundamental variable that we considered in the analysis is the stock of foreign assets. Indeed, there are several channels through which the stock of foreign assets can influence the real exchange rate[5]. The general idea is that an increase in the capital flows will finance greater absorption and a larger current account deficit. This is obtained through a real exchange rate appreciation, either by raising prices or an appreciation of the nominal

[5]Lane & Milessi-Ferreti (1999) explore the theoretical link between the real exchange rate and the net foreign assets, and provide evidence that the net foreign asset position is an important determinant of the real exchange rate.

exchange rate. That is, the real exchange rate is expected to increase (to appreciate) when the stock of foreign assets rises.

One of the most reliable measure for the net foreign asset position for a very large set of countries is given by Lane & Milessi-Ferreti (1999). The database built by these authors provides annual estimates of foreign assets and liabilities using balance of payment data. The estimates are based on existing stock measures and, when available, supplemented by the cumulation of capital flows, with appropriate valuation adjustments.

However, it is not straightforward to compile a reliable measure for the *stock* of foreign assets and liabilities held by the countries on a quaterly basis. It is usually proxied by an accumulation of current accounts over just the sample period and therefore ignore the initial levels. This, in principle, can create a potential significant bias in the estimated long-run relation.

In this paper, we computed the net foreign assets (*NFA*) as the accumulated current account (*CA*) position, taking into account the measure of the net foreign assets provided by Lane & Milessi-Ferreti (2007)[6]. We used their variable to give an aproximation for the initial level of NFA. Thus, to update the data, we started the accumulation of the current account in 1980Q1, for which we took the previous level of the net foreign asset position:

$$NFA_{i,1980Q1} = NFA_{1979} + CA_{i,1980Q1} \quad , \tag{2.3}$$

For all the subsequent quarters, we computed the variable by adding the previous NFA to the contemporaneous quaterly current account:

$$NFA_{it} = NFA_{i,t-1} + CA_{i,t} \quad , \tag{2.4}$$

and considered the variable as percentage of GDP. This variable gives a reasonable estimate of the underlying net foreign asset position and provide the best measure available for the frequency used in this paper.

[6]We could not use directly this information since the data are annual.

3 The Panel Data Methodology

In order to investigate empirically the dynamics of the real effective exchange rates, we rely on the panel of countries presented in the previous section. We believe that these countries not only share common characteristics that justify the use of a panel data approach but also that by estimating a single long-run exchange rate equation, we smooth the impact of individual countries' transitional dynamics.

Indeed, most of the time, countries share common similarities that are usually lost in time series analysis. For instance, non-stationarity appears more as a general feature for macroeconomic series, characterizing an important number of countries. In addition, a panel data framework not only allows to take into account the international dimension and the similarities of a group of countries, but also some specifications consider possible cross-sectional dependence among them. Another major advantage of panel cointegration techniques is that they allow one to selectively pool the long run information contained in the panel while permitting the short-run dynamics to vary and, therefore, some heterogeneity among different members.

In addition, despite the fact that the countries that we have selected share common economic features, they differ concerning the exchange rate regime. The *EMU* sub-group is a monetary union since 1999 whether the countries belonging to the *Flexible* group have floating exchange rate regime. Therefore, in order to highlight the specific features in terms of exchange rate determination and dynamics within each subgroup, we split the sample between EMU country's members and the rest of the medium-size OECD countries and perform the panel estimation for each group.

Therefore, from an empirical point of view, we are particularly interested on these techniques because, by exploiting the cross-section as well as time series variability, we increase the power over univariate methods. Also, given that financial markets and macroeconomic imbalances are increasingly linked between countries, from an economic point of view it is important to consider a more "global" perspective when estimating the long-run relationships between international financial series such as exchange rates and the fundamentals.

As mentioned before, the empirical part of this paper relies on panel data techniques. Firstly, we tested for unit root in the RER and the economic fundamentals (the ratio CPI to PPI and the net foreign asset position as a percentage of the GDP). Secondly, we test for cointegration between the real effective exchange rate and the underlying macroeconomic fundamentals.

Finally, and after having established that a cointegration relation indeed exists, the long-run parameters can be estimated efficiently using techniques similar to the ones proposed for individual time series models.

Most approaches employ a homogeneous framework, that is, the cointegration vectors are assumed to be identical for all panel units, whereas the short-run parameters are panel specific. However, such an assumption seems overly restrictive for some economic relationships. On the other hand, allowing all the parameters to be individual specific would substantially reduce the attraction of a panel data study: it is therefore important to identify parameters that are likely to be similar across panel units while at the same time allowing for sufficient heterogeneity of other parameters.

In this paper, we consider the error correction pooled mean-group (PMG) estimators by Pesaran, Smith & Shin (1999), PSS hereafter, to estimate the long-run relationship among the (integrated) variables. The PMG estimator combines two procedures that are commonly used in panels. The first one, known as the Mean Group (MG) estimate, consists of estimating separate regressions for each group (country) and calculating averages of the group specific coefficients. They show that the MG estimator will produce consistent estimates of the average of the parameters. This estimator, however, does not take into account the fact that certain parameters may be the same across groups. The second one involves the traditional pooled estimators (such as the fixed or random effects estimators) that allow only the intercepts to differ freely across groups while all the other coefficients and error variances are constrained to be the same.

PSS suggest an intermediate estimator, called the Pooled Mean Group estimator because it involves both pooling and averaging. This estimator allows the intercepts, short-run coefficients and error variances to differ freely across groups, but the long-term coefficients are constrained to be the same. An interesting feature of this methodology is that some of the long-run parameters can also be unconstrained, so that they may be different for each group. Also, the PSS methodology has the benefit over other methodologies (such as the fully-modified OLS (FMOLS) by Pedroni (1997) and Phillips & Moon (1999) and the dynamic OLS (DOLS) by Pedroni (2000), Mark & Sul (2001) and Kao & Chiang (2000)) that it is based on dynamic equations so it not only provides the cointegrating relationship but also short-run effects.

The starting point of the procedure is an autoregressive distributed lag (ARDL) model of order $(p, q, q, ..., q)$ where p and q are the autoregressive orders of the dependent and independent variable(s), respectively. Reparameterized as a vector error correction mechanism (VECM) the system can be expressed as:

$$\Delta y_{it} = \theta_i y_{i,t-1} - \beta_i' x_{i,t-1} + \sum_{j=1}^{p-1} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \delta_{ij} \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \ , \quad (3.1)$$

where y is the dependent variable, $x_{i,t-j}$ is the $(k \times 1)$ vector of explanatory variables for group (country) i, β_i are the long-run parameters, the θ_i are the equilibrium (or error) correction parameters, λ_{ij} and δ_{ij} include the country-specific coefficients of the short-term dynamics, μ_i represents the fixed effects and ε_{it} is a white noise process. In principle, the panel can be unbalanced and p and q may vary across countries. The pooled mean group restriction is that the parameters of β_i are common across countries; that is $\beta_i = \beta$ in equation (3.1).

Hence, if θ_i is significantly negative, there exists a long-run relationship between y_{it} and x_{it}. Estimation of (3.1) could proceed by OLS, imposing and testing the cross country restrictions on β. However, this will be inefficient since it ignores the contemporaneous residual covariance. Therefore, PSS suggest a maximum likelihood estimator.

Instead of assuming common long-run parameters, the estimation can also be done with individual specific β_i, which are then averaged over N to obtain the MG estimator. As can be expected, this is a natural background to test for the presence of slope homogeneity using a Hausman test. This test is based on the results that an estimate of the long-run parameters in the model can be derived from an average (MG estimation) of the country regressions and this is consistent even under heterogeneity. However, if the parameters are in fact homogenous, the PMG estimates are more efficient. That is, if the poolability assumption is invalid then the PMG estimates are no longer consistent.

In order to confirm the robustness of the previous results, we compare the PMG estimates with two alternative approaches to estimate a long-run relationship among integrated variables in a panel framework: (1) the fully-modified OLS (FMOLS) proposed by Pedroni (1997) and Phillips & Moon (1999), (2) the dynamic OLS (DOLS) estimators associated with Pedroni (2000), Mark & Sul (2001) and Kao & Chiang (2000).

The FMOLS takes into account the presence of a constant term and a possible correlation between the error term and the differences of the regressors. Consider a long-run relationship as in the following equation:

$$y_{it} = \alpha_i + \delta_i t + \theta_t + \beta_1 x_{1it} + ... + \beta_k x_{k,i,t} + \varepsilon_{it} \ , \tag{3.2}$$

where k is the number of regressors, β_k are elasticities and the index i indicates the section of the panel and the time index t the length of the sample. As it can be seen, fixed effects, individual specific deterministic trends and different error variances are all permitted. To adjust for the correlation, under the FMOLS methodology, the dependent variable is non-parametrically adjusted for the part of the error that is correlated with the regressors[7]:

$$y^{\star}_{it} = y_{it} - \sigma^{'}_{i,\varepsilon\upsilon} \Sigma^{-1}_{i,\varepsilon\varepsilon} \Delta x_{it} \tag{3.3}$$

where $\sigma^{'}_{i,\varepsilon\upsilon} \Sigma_{i,\varepsilon\varepsilon}$ is the long-run variance-covariance matrix between the error term and the first difference of the regressors. A second correction is necessary when computing the OLS estimator:

$$\hat{\beta}_i = \left[\sum_{t=1}^{T} x_{it} x^{'}_{it} \right]^{-1} \left[\sum_{t=1}^{T} (x_{it} y^{\star}_{it} - T\lambda_{i,\varepsilon\upsilon}) \right] \tag{3.4}$$

where $T\lambda_{i,\varepsilon\upsilon}$ is the adjustment for the presence of a constant term. The associated statistic for testing the significance of the parameters needs to be similarly adjusted. In the panel setting, the mean-group FMOLS long-run coefficients are obtained by averaging the group estimates over N:

$$\hat{\beta}^{FMOLS}_{MG} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_i \tag{3.5}$$

where the corresponding t-statistic converges asymptotically to a standard normal distribution.

On the other hand, the starting point of the DOLS set-up is also a long-run relationship as in equation (3.2). In order to obtain an unbiased estimator of the long-run parameters, this procedure involves a parametric adjustment to the errors of the static relation. The correction is achieved by assuming that there is a relationship between the residuals from the static regression and the first differences of the leads, lags and contemporaneous values of the regressors in first differences:

[7] In a country-by-country set up, the Engle and Granger procedure generates consistent estimators of the long-run parameters. However, in a panel framework, it has been shown that the long-run parameters are biased (see Kao, Chiang & Chen (1999)).

$$\varepsilon_{it} = \sum_{j=-q}^{q} c_{ij}\Delta x_{i,t-j} + \varepsilon^{\star}_{it} \tag{3.6}$$

where ε_{it} is orthogonal to all leads and lags of Δx_{it}. Substituting equation (3.6) into (3.2) yield to:

$$y_{it} = \alpha_i + \delta_i t + \theta_t + \beta_1 x_{1it} + ... + \beta_k x_{k,i,t} + \sum_{j=-q}^{q} c_{ij}\Delta x_{i,t-j} + \varepsilon^{\star}_{it} \tag{3.7}$$

A simple OLS regression provides a super-consistent estimate of the long-run parameters. The t-statistic is based on the long-run variance of the residuals instead of the contemporaneous variance, which is commonly used in OLS regressions. The group-mean DOLS are obtained in a similar way as the group-mean FMOLS.

4 Estimation results

Given the fact that the variables are integrated and cointegrated, we turn to the estimation of the long-run relationship between the RER and the economic fundamentals[8]. At the same time, the determinants of the real exchange rate are analysed in terms of their impact on the short-term. Therefore, the empirical strategy involves panel error-correction modelling, by means of the pooled mean group (PMG) estimates. Furthermore, in order to give robustness to our findings, we also present the panel FMOLS and DOLS estimates. Results of these estimations are presented in Table (4.1) below[9].

Considering the whole sample, we can highlight some interesting points from the estimated models. First, the variables are significant and correctly signed: a rise in the *NFA* position (i.e., an improvement in the current account or a reduction in the net foreign liabilities) or in the *CPI* to *PPI* ratio (i.e., a rise in the relative productivity) leads to a real exchange rate appreciation.

Second, we found a negative and statistically significant error correction term (ECT) implying that, if the fundamentals in the last period dictate a lower

[8]To avoid too many tables, results from panel unit root and cointegration tests are available from the authors upon request.

[9]In the Appendix we present the results of the same estimations based on non-seasonally adjusted data for CPI and PPI. The results are close to the one presented in Table 4.1.

Table 4.1: **Fully modified, dynamic OLS and pooled mean group estimates. Seasonally Adjusted variables.**

		FMOLS		**DOLS**		**PMG**	
		Coef.	t-value	Coef.	t-value	Coef.	t-value
ALL							
	CPI-PPI	0.879	13.15	0.778	2.63	0.656	8.33
	NFA	0.049	4.82	0.070	0.85	0.070	2.85
	ECT					-0.115	-5.32
	h-test					1.80	0.41
EMU							
	CPI-PPI	1.280	8.54	1.205	7.48	1.009	8.43
	NFA	-0.116	-4.27	-0.108	-2.70	-0.030	-2.18
	ECT					-0.109	-1.94
	h-test					3.97	0.14
Flexible							
	CPI-PPI	0.877	8.97	0.535	1.88	0.028	0.40
	NFA	0.340	8.67	0.219	2.49	0.078	2.53
	ECT					-0.112	-2.58
	h-test					7.09	0.04*

Notes: (1) ALL: includes all the countries; (2) EMU: includes only EMU countries of the sample; (3) Flexible: includes countries other than EMU in the sample; (4) DOLS: Dynamic OLS, (5) FMOLS: Fully modified OLS; (6) PMG: pooled mean group; (7) CPI-PPI: (log) consumer price index to producer price index; (8) NFA: net foreign asset as percentage of GDP; (9) The $REER$ and $cpi - ppi$ computed considering seasonally adjusted series for the CPI and PPI; (10) ECT: error correction term, (11) DOLS includes 2 leads and lags; (12) FMOLS includes 3 lag truncation for kernel estimator; (13) PMG based on an ARDL selected according to the Akaike selection criterium, allowing for a maximum of 4 lags; (14) In PMG, the static fixed effects OLS estimates were used as initial estimates for the pooled maximum likelihood estimation; (15) In PMG, the Newton-Raphson method was used the compute the log-likelihood function; (16) h-test is the Hausman test and the values presented in the last column is the p-value; (17) * indicates rejection of the null hypothesis at the 5%.

RER than the one observed, then the RER will strictly depreciate in the current period. The (average) error correction coefficients reported shows that adjustment is substantial (about 11% taking place within a quarter of a year). In addition, a significant ECT is a confirmatory evidence for the presence of cointegration. In other words, there is a long-run relationship between the fundamentals and the real exchange rate.

Table 4.2: **Mean group estimates for the *Flexible* countries group.**

	MG	
	Coef.	t
CPI-PPI	1.131	1.89
NFA	0.390	2.27
ECT	-0.32	-5.05

Regarding the subgroups of countries, some important features have to be mentioned. Indeed, while the real effective exchange rate in the group of the *Flexible* countries reacts mainly to movements in the NFA position in the long-run according to the PMG estimation, the RER in the *EMU* countries seem to be mainly determined by a Balassa-Samuelson effect. Effectively, as it can be seen, the coefficient associated to this variable is particularly high compared to both the whole sample and the *Flexible* countries group, confirming that productivity differentials represent an important determinant of the real exchange rate in the EMU countries. A permanent increase of 1% in the relative sectoral productivity induces an increase of 1.01% of the RER in the long run according to the PMG estimation and of 1.28% according to the FMOLS estimation. Moreover, the coefficient associated to the NFA in the EMU sub-group is significant and negative according to the three methodologies, even though it appears to be relatively small: an increase of 1% of the NFA (in percentage of GDP) induces a decrease (i.e., a depreciation) between 0.03% and 0.12% of the RER in the long run according to the different estimations.

It is important to notice that, as reflected by the Hausman test, the Mean Group estimators are more efficient than the PMG ones in the *Flexible* countries group. As a consequence, we proceed to a Mean Group estimation for this specific sub-group[10]. Therefore, the relevant coefficients for this group would be the ones presented in Table (4.2). As shown, the coefficient for the $cpi - ppi$ is not significative, whereas the one associated to the NFA is positive and significant. This results contrast with the case under the FMOLS, which indicates positive and significant coefficients for both the Balassa-Samuelson variable and the NFA.

The particular negative long-term effect of the stock of foreign assets on the real exchange rate in the EMU countries is confirmed at the country

[10]Precisely, the equations are estimated for each country within the *Flexible* sub-group separately and then averaging in order to obtain the long-run coefficient.

level, as given by the country FMOLS and DOLS estimates reported in the Table A.2 in the Appendix. As it can be seen, while the only country in the *Flexible* group with this characteristic is Korea, among EMU countries seven of them present either a negative or not significant coefficient[11]. A positive and significant effect of the productivity differential is obtained for 5 countries of the EMU group.

As mention before, the PMG estimation imposes common long-run coefficients for all the countries in the panel, but allows the short-run dynamics to differ among them. This is of particular interest because, although a long run effect may be negligible, we may still have a short run effect for some variables (or the opposite). Tables A.3 and A.4 in the Appendix shows the short-run coefficients obtained by imposing the sub-group long-run PMG coefficients to each of the countries of the sample.

The results of the country estimates show a positive and significant short-run effect of the productivity in several countries of the *EMU* sub-group, with a few exceptions like France, Germany, Italy with not significant or slightly negative coefficients. In the case of the *Flexible* group, this feature is less common (only Korea, Mexico and Sweden display a significant and postive response to the sectoral productivity shock).

Regarding the short-run effects of the stock of foreign assets, the results are less homogenous for the EMU countries[12]. Indeed, positive short run effects are found in Ireland, Portugal and Spain among the EMU countries and in most of the countries belonging to the *flexible* group. This implies that in some EMU countries, as expected, an increase in the foreign liabilities (i.e. a deficit in the current account) depreciates the real exchange rate in the short-run, but this effects disappears in the long-run[13]. For the rest of the EMU countries, both in the short and in the long run, an increase in their net foreign assets position actually leads to a real exchange rate depreciation, whereas an appreciation should be the expected as a long-term reaction.

From a dynamic perspective, we could see that despite the fact that the long run effect of a shock on the Net Foreign Assets is limited in the case of the EMU countries, the short run effects could be more substantial as hilighted by the impulse response function of the RER for France (see Figure 4.1). This Figure displays the response of RER to a 1% permanent increase

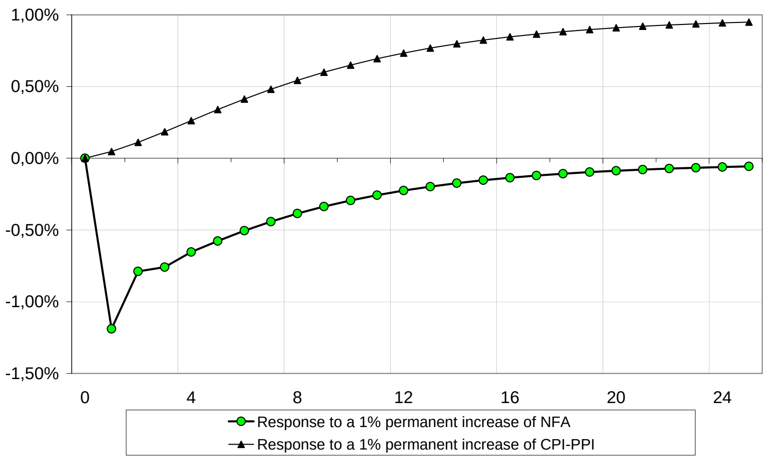
[11] The exceptions are Austria, Germany and Spain.

[12] A negative short term response of NFA was found for some industrialised countries by MacDonald (1997).

[13] By looking at the country estimates in table (A.2), one can notice that that there is no long-run effect of the NFA on the real exchange rate in Austria, Ireland and Spain.

of NFA or to a 1% permanent increase of the sectoral productivity. The impulse response are based on the long run equation deriving from the PMG estimation for EMU countries presented in Table 4.1; as explained above, the short run coefficients are country-specific (and are presented in Table A.3 in the Appendix). Despite the fact that the shock on NFA is permanent, the long run response of the RER is close to zero (as it appears previously in the long run elasticities estimated with the PMG in Table 4.1).

Figure 4.1: Impulse Response Function for the French RER:



Our estimations seems to indicate that the long run relationship between net foreign assets and RER is limited for the countries belonging to the monetary union (the long run coefficient is negative and small according to the different estimations procedures that we used). This result appears to be different to what the majority of studies on this issue usually get. However, these studies do not provide estimation of the long run relationship between equilibrium exchange rate and the fundamentals variables for the countries belonging to the EMU; rather, they take the Euro area as a whole. One must note that adjustments in the nominal exchange rate is often emphasised as a way to correct for misalignments in the real exchange rate. In particular, the positive relationship between NFA and RER postulates that the adjustment should proceed through variations of the nominal exchange rate. In the case of the EMU countries, misalignments cannot be corrected through this mechanism (deficits among EMU countries cannot be corrected by depreciation of the nominal exchange rate, leaving this role to other variables, such as prices). A deeper understanding of this result is needed. In particular, it should be of particular interest to look more precisely at the relationship between NFA and RER that we have estimated for the countries belonging to the EMU, noticeably by using the information contained in the *country currency exposure index* as proposed by Lane & Shambaugh (2007) in the database they have built.

5 Conclusion

The aim of this paper is to investigate to what extent belonging to the European Monetary Union affects the determination of the long run equilibrium level of the real exchange rate. By relying on panel data techniques, we estimate the long run relationship between the real exchange rate and the fundamentals for a panel of countries that included EMU countries and medium-size OECD exchange rate countries, operating with flexible exchange rate. By relying on such a methodology, we could highlight the role played by the usual fundamental variables in the determination of the long run level of the RER whether a country operate with a flexible exchange rate or belong to the EMU. Our results confirm the notion that the sectoral productivity differentials (in relation with the Balassa-Samuelson effect) represent an important determinant of the long run value of the real exchange rate both in the *EMU* countries and in the *Flexible* countries. However, there are substantial differences concerning the impact of Net Foreign Assets in the determination of the long run value of the exchange rate. While we get a positive coefficient for this variable in the case of the *Flexible* countries, our estimates show a negative, though low, coefficient in the case of the EMU countries. This result differ from what other studies get in this litterature; however, one must note that numerous papers usually focus on countries operating with flexible exchange rates[14]. Our results seems to indicate that the determination of the long run value of real effective exchange rate in the case of the countries belonging to the European Monetary Union does not rely on the stock of net foreign asset.

[14]Some recent papers have focused on the equilibrium exchange rate in the transition economies of Eastern Europe (see for instance Maeso-Fernandez et al. (2006)).

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Appendix

A Estimations with variables not seasonally adjusted

Table A.1: **Fully modified, dynamic OLS and pooled mean group estimates**

	FMOLS		DOLS		PMG	
	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value
ALL						
CPI-PPI	0.877	12.04	0.709	2.32	0.584	8.16
NFA	0.111	3.16	0.273	2.87	0.097	5.80
ECT					-0.148	-3.83
EMU						
CPI-PPI	0.954	7.64	0.866	8.25	1.014	9.73
NFA	-0.155	-4.52	-0.09	-3.21	-0.031	-2.58
ECT					-0.105	-1.83
REST						
CPI-PPI	0.800	9.38	0.454	1.97	0.186	1.84
NFA	0.377	8.99	0.208	2.67	0.228	6.60
ECT					-0.102	-2.23

Notes: (1) *IDEM* table 4.1, except (9) .

Table A.2: **Fully modified and dynamic OLS country-by-country estimates**

	FMOLS		DOLS	
Panel member	*cpi* − *ppi*	NFA	*cpi* − *ppi*	NFA
AUSTRALIA	1.00	1.07	1.24	1.12
	2.11	8.45	1.76	7.42
AUSTRIA	-0.22	0.30	-0.56	0.28
	-1.02	6.28	-1.79	9.62
BELGIUM	0.12	-0.16	-0.53	-0.19
	0.91	-4.05	-1.02	-2.89
CANADA	2.04	-0.02	2.31	-0.13
	10.62	-0.24	10.72	-1.46
DENMARK	-0.15	0.29	-0.29	0.32
	-0.27	2.71	-0.44	2.16
FINLAND	1.50	-0.08	1.50	-0.07
	2.87	-2.92	3.91	-4.44
FRANCE	0.27	-0.63	0.26	-0.59
	0.59	-6.20	0.35	-3.68
GERMANY	1.52	0.67	1.31	0.71
	2.50	2.51	1.02	1.22
IRELAND	0.98	-0.55	1.17	-0.56
	9.44	-2.08	12.29	-2.50
ITALY	2.60	-0.83	4.19	-0.79
	3.46	-4.49	5.63	-5.01
KOREA	2.98	-1.06	2.55	-1.13
	5.06	-3.08	1.96	-1.59
MEXICO	0.94	1.58	1.57	2.16
	1.28	3.88	1.51	3.30
NETHERLANDS	2.00	-0.30	3.39	-0.42
	1.73	-1.68	0.92	-0.72
NORWAY	0.09	0.09	0.08	0.14
	0.86	2.18	0.44	8.98
N. ZEALAND	-0.52	0.81	-0.59	0.87
	-2.13	12.57	-1.84	2.54
PORTUGAL	0.56	-0.13	0.72	-0.17
	2.02	-3.14	1.31	-2.59
SPAIN	3.46	0.56	4.03	0.80
	4.50	2.28	2.87	1.47
SWEDEN	1.74	0.05	1.65	0.00
	9.75	1.00	6.09	0.00
SWITZERLAND	-0.47	-0.03	-0.40	0.01
	-1.18	-0.75	-1.65	0.59
UK	1.13	0.61	0.31	-0.33
	2.27	0.70	0.72	-0.50

Notes: (1) t-values in *italics*; (2) IDEM notes (4) and (5) table (4.1).

Table A.3: **Short-run effects derived from the PMG estimation: EMU countries**

	Austria	Belgium	Find.	France	Germany	Ire.	Italy	Neth.	Portugal	Spain
Δq_{t-1}		0.160	0.199	0.410	0.632			-0.376		
		1.383	*1.463*	*3.250*	*5.502*			*-2.839*		
Δq_{t-2}		0.245		0.173				0.127		
		2.133		*1.861*				*1.716*		
Δq_{t-3}								0.188		
								2.412		
$\Delta cpi - ppi_t$	0.197	0.304	0.447	0.038	-0.019	0.882		0.432	0.111	0.677
	1.702	*3.555*	*1.912*	*0.140*	*-0.071*	*5.324*		*2.720*	*1.933*	*2.302*
$\Delta cpi - ppi_{t-1}$				-0.256	0.274			0.311		
				-0.860	*1.011*			*1.797*		
$\Delta cpi - ppi_{t-2}$				0.371	-1.119					
				1.268	*-4.064*					
$\Delta cpi - ppi_{t-3}$					0.415					
					1.580					
ΔNFA_t	0.318	-0.130	-0.343	-1.241	-1.881	0.920	-0.1279	-0.386	0.231	0.634
	4.940	*-5.232*	*-2.629*	*-6.992*	*-5.719*	*3.508*	*-0.340*	*-10.368*	*6.069*	*6.936*
ΔNFA_{t-1}	0.106	-0.020	-0.325	0.949	2.101			-0.215		-0.183
	1.787	*-0.816*	*-2.469*	*4.248*	*6.499*			*-3.488*		*-2.044*
ΔNFA_{t-2}	-0.043	0.063	-0.313							
	-0.600	*2.297*	*-2.627*							
ΔNFA_{t-3}			-0.445							
			-3.708							

Notes: (1) t statistics in *italic*.

Table A.4: **Short-run effects derived from the PMG estimation: rest of the countries**

	Australia	Canada	Denm.	Korea	Mexico	Norway	N.Z	Sweden	Swit.	U.K
Δq_{t-1}	-0.007	0.078	0.213	0.296		0.227		0.214	0.195	0.290
	-0.054	*0.814*	*1.621*	*1.638*		*1.764*		*1.425*	*1.616*	*2.433*
Δq_{t-2}	-0.389	-0.236	0.082			0.255		0.035		
	-2.951	*-2.412*	*0.607*			*1.960*		*0.300*		
Δq_{t-3}			0.243			0.261		-0.097		
			2.000			*1.906*		*-0.833*		
$\Delta cpi - ppi_t$	-0.028		0.082	2.376	0.930			2.002	0.599	
	-0.173		*0.294*	3.363	3.559			5.066	1.505	
$\Delta cpi - ppi_{t-1}$	0.102		0.419	-0.375				-0.785		
	0.612		*1.405*	*-0.470*				*-1.603*		
$\Delta cpi - ppi_{t-2}$	-0.467		0.238	-0.130						
	-2.475		*0.796*	*-0.172*						
$\Delta cpi - ppi_{t-3}$				-0.531						
				-0.766						
ΔNFA_t	1.137	2.066	0.635	3.262	0.552	-0.334	0.756	-0.374	-0.137	
	10.708	*8.516*	*3.348*	*3.705*	*2.458*	*-3.132*	*10.163*	*-1.640*	*-3.973*	
ΔNFA_{t-1}	-0.134		0.000	-1.918	0.423		-0.079			
	-0.768		*0.000*	*-1.809*	*2.115*		*-1.037*			
ΔNFA_{t-2}	0.423		-0.262	-1.303	-0.176		0.121			
	2.605		*-1.188*	*-1.550*	*-0.879*		*1.585*			
ΔNFA_{t-3}				1.506			-0.078			
				2.089			*-1.058*			

Notes: (1) IDEM A.3