

Breuer, Sebastian; Klose, Jens

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## Who gains from nominal devaluation? An empirical assessment of Euro-area exports and imports

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# Who gains from nominal devaluation?

## An empirical assessment of Euro-area exports and imports

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Sebastian Breuer

Jens Klose

(both Staff of German Council of Economic Experts)

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# **Who gains from nominal devaluation? An empirical assessment of Euro-area exports and imports<sup>1</sup>**

By

Sebastian Breuer (German Council of Economic Experts)

and

Jens Klose (German Council of Economic Experts)

## **Abstract:**

In early 2013 rumors about the Euro-appreciation gained momentum, which may lead to decreases in exports and increases in imports of the member states. Therefore, we investigate the impact of changes in the nominal Euro exchange rate vis-à-vis major currencies on export and import performance of nine different Euro-area-countries. To disentangle the “true” equilibrium elasticities SURE system error correction models (SSECM) are estimated for nominal exchange rate changes versus the rest of the world or other major currencies. To differentiate between price level changes and changes of the nominal exchange rate, a country’s export and import equation is estimated using separately the nominal rate and the relative price/ unit labor cost as regressors. Results of Wald-tests indicate that assuming both variables to have the same influence on exports and imports is misleading. Whether the relative price/ unit labor costs elasticities are high or low depends crucially on which indicator is chosen, while the effect of nominal exchange rate changes can be estimated robustly for all countries in the sample. Especially France and Spain are hit by a Euro appreciation since their exports are highly exchange rate elastic. However, for France, this effect is at least partly offset by an also negative exchange rate elasticity of imports.

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<sup>1</sup> The authors would like to thank Gerald Fugger for his excellent research assistance.

## I. Introduction

In the end of 2012 and the beginning of 2013 the Euro appreciated considerably towards other currencies. With the appreciation worries gained momentum that this may jeopardize the hard-earned gains in price-competitiveness of peripheral countries in the Euro-area. Among others, the French president François Hollande voiced these worries thereby sparking a discussion about potential exchange rate interventions of the European Central Bank (ECB). In particular, he proposed that the exchange rate should be managed by the ECB in the sense that interventions should be triggered if the exchange rate leaves a predefined band. This becomes even more important as other central banks of industrialized countries like the US Federal Reserve or the Bank of Japan at the end of 2012 and the beginning of 2013 announced an even more expansive monetary policy on their part, thereby making a depreciation of these currencies more likely. Indeed, the Euro has appreciated since mid-2012 against other leading currencies. However, this evolution may also be seen as a correction from the strong depreciation observed in the wake of the European debt crisis.

Nevertheless, a persistent appreciation (depreciation) of the nominal exchange rate may well result in lower (higher) exports and higher (lower) imports, at least in the medium to long term. In the short-run, J-curve effects may cause adjustments in exports and imports to exchange rate changes in the other direction. Therefore, an isolated monetary policy shock of the ECB, which depresses the Euro exchange rate, may be an appropriate tool to directly influence Euro-area countries trade balances. However, if all central banks apply this policy, it becomes a classical prisoner's dilemma game resulting in a "race to the bottom" by increasing inflation rates in all countries while exchange rates remain roughly unchanged.

Yet, prices or labor costs affect exports and imports as well. Politicians are more reluctant to head for a strategy increasing competitiveness internally because this would mean to lower prices or labor costs in many cases via initiating structural reforms, which may jeopardize their goal of re-election. Therefore, calling for a nominal exchange rate adjustment is a preferable option for politicians.

Indeed, there are several studies investigating the export and import performance by estimating their response to an adjustment of the real effective exchange rate, which is the nominal effective exchange rate times relative price or labor costs (Marquez and McNeilly, 1988; Strauß, 2000 and 2002; Allard et al, 2005; Stahn, 2006; Danninger and Joutz, 2007; Bayoumi et al, 2011; Thorbecke and Kato, 2012). So it is implicitly assumed that adjustments of both variables have the same effect on exports and imports.

To the best of our knowledge, we are the first to decompose the change in the real effective exchange rate into a nominal exchange rate component and a relative price component, which allows us to disentangle the various channels that alter exports and imports, and estimate the trade equations separately for individual Euro-Area countries. Moreover, we investigate whether exchange rate adjustments to major currencies like the US-Dollar, the Japanese Yen or the UK Pound show the same or different reactions towards exports reflecting other market structures or different degrees of competition on third markets. Therefore, we use a novel es-

timization technique which is able to generate robust long-run trade elasticities accounting for possible shocks each Euro-area country is hit by simultaneously.

Nevertheless, export and import elasticities have been investigated extensively in the empirical literature. Therefore, this strand of literature cannot be covered fully but has to be limited to those with a closer relation to our approach.

Allard et al. (2005) estimate export and import equations for goods and services separately with respect to the four largest Euro-area countries Germany, France, Italy and Spain in an error correction model. However, they did not rely on a constant set of variables for each specification but used besides the real effective exchange rate, and foreign or domestic demand also relative prices, capacity utilization and time trends, dropping each of them when no significant influence can be identified. We follow this approach but restrict our estimation equation to have the same long-run specification for all countries, so only the optimal number of short-run dynamics is determined by significance. This is done because we want to compare a homogeneous set of long-run elasticities over all countries to determine which countries gain most from nominal exchange rate or relative price/ labor cost changes.

Using a panel approach for bilateral trade in eleven Euro-area countries towards their fifty top trading partners Chen et al. (2013) estimate export and import equations that besides the real exchange rate also incorporate a splitting up of this term in the nominal rate and relative prices. Even though this innovation is not the main focus of their article, they find for Euro-area exports and imports the expected signs of the elasticities and due to low standard errors the elasticities of the nominal rate and relative prices seem to be significantly different. However, with the panel approach, they are unable to distinguish between the Euro-area countries elasticities but assume them to be homogeneous. We will show that this is an assumption hard to justify empirically. Moreover, using only bilateral trade equations necessarily neglects the effects of exchange rate and relative price changes on third markets. That is why we do not solely focus on bilateral exports and imports.

Focusing on the export and import equations for Germany, Strauß (2000) estimates an error correction model using a specification quite similar to our approach. He estimates exports and imports by the real effective exchange rate but does not split up this variable into the nominal rate and relative prices. However, he finds the expected signs of the elasticities even though the exchange rate elasticity of imports is quite low.

This paper proceeds as follows: Section 2 describes the data and the empirical framework, while section 3 presents the results, section 4 concludes.

## II. Export and Import Regressions

The response of trade variables towards the exchange rate has been investigated frequently with export and import equations. This section derives the export and import equations used in this article with the adjustments made, introduces the data used and the estimation strategy employed.

## 1. Exports

Export equations can be written as a function of relative prices and demand::

$$(1) EX_{i,t} = \alpha + \beta rer_{i,t} + \gamma y_{I-i,t} + \varepsilon_{i,t}$$

where  $EX$  are exports,  $rer$  is the real exchange rate,  $y$  is domestic demand where  $I = \sum_{i=1}^X i$ , so the exports of country  $i$  are determined by the demand in the rest of the world. All variables are defined in log terms. A priori, we assume  $\beta$  to be negative because a real appreciation should lead to lower exports, and vice versa. In contrast,  $\gamma$  should be positive as a growing export market should result in increased exports. The real exchange rate is the product of the nominal rate and a relative price indicator or in log terms.

$$(2) rer = ner + (P - P^*)$$

where  $ner$  is the nominal exchange rate and  $(P - P^*)$  is an index of prices or labor costs of country  $i$  relative to the same variable of a reference group, e.g. with respect to the rest of the world. Splitting up the real exchange rate in these two components seems advisable when estimating export equations since both variables vary considerably over time. Ganguly and Breuer (2010) found substantial differences in the volatility of the nominal exchange rate and relative prices in industrialized countries. While nominal exchange rate volatility is of almost the same magnitude as real exchange rate volatility, relative prices are much more persistent. Since both variables exhibit different volatilities this should also be reflected in responses towards exports. From the exporter perspective frequent changes in prices in the foreign market are to be avoided due to high menu costs etc. Therefore, nominal exchange rate volatilities are possibly less represented in the prices as changes in relative prices which are more persistent and represent altered production costs. That is why an equal response of exports towards the nominal exchange rate and relative prices, as assumed in (1) seems to be unlikely. Therefore, we decompose the real exchange rate into an exchange rate component and a relative price component and use both separately in the export equation:

$$(3) EX_{i,t} = \alpha + \beta_1 ner_{i,t} + \beta_2 (P_{i,t} - P_t^*) + \gamma y_{I-i,t} + \varepsilon_{i,t}$$

Both  $\beta$  variables are assumed to have a negative effect on exports: A nominal appreciation and an increase in prices or labor costs should result in lower competitiveness of the domestic firms in the world markets and thus lower exports. Using equation (3), it can be tested whether the assumption of an equal response holds by using a Wald-test specified as  $\beta_1 = \beta_2$ . If both variables are found to be equal, equation (1) can be used, if not effects of a nominal appreciation differ to those of lower relative prices or labor costs.

Equation (3) can be estimated with respect to different countries or groups. As commonly done in studies on export equations the rest of the world is used as a reference group. In this case the effective exchange rate and consequently relative prices or labor costs with respect to the rest of the world have to be used:

$$(4) EX_{i,t} = \alpha + \beta_1 neer_{i,t} + \beta_2 (P_{i,t} - P_{World,t}) + \gamma y_{I-i,t} + \varepsilon_{i,t}$$

This is the first empirical approach used in our analysis. When splitting up the real effective exchange rate into a nominal part and relative price or labor cost competitiveness, the latter are thus calculated with respect to the rest of the world.

Moreover, other major countries like the United States may be of special importance for exports of Euro-area countries. To account for their role, we also use bilateral nominal exchange rates and relative prices or labor costs with respect to e.g. the US.

$$(5) EX_{i,t} = \alpha + \beta_1 ner_{ix,t} + \beta_2 (P_{i,t} - P_{x,t}) + \gamma y_{I-i,t} + \varepsilon_{i,t}$$

However, a change in the bilateral exchange rate does not only influence the bilateral trade between the two countries but also the competitiveness of firms from both countries in third markets. To address this, we use aggregated exports of country  $i$  with the rest of the world (as in (4)) instead of using the bilateral trade values. Relative price or labor cost competitiveness components are adjusted in the same way as the bilateral exchange rate. Thus, it is computed against the respective country for which the bilateral exchange rate is added to the equation. Due to the aforementioned third market effects in (5) we also use domestic demand of the rest of the world instead of the domestic demand of the respective bilateral trade partner.<sup>2</sup> All in all this bilateral specification is estimated for Euro-area countries with respect to the United States of America, Japan and the United Kingdom.

In order to deliver a concise picture of the export and also import dynamics, we follow a top-down approach that directly relates to the existing literature. First, we estimate the export and import equation using the conventional representation for the real effective exchange rate (1) before decomposing this variable as in (4). After that the analysis is expanded to cover also bilateral exchange rates (5).

## 2. Imports

In line with export equations also imports are modeled as a function of the real exchange rate and domestic demand:

$$(6) IM_{i,t} = \delta + \theta rer_{i,t} + \mu y_{i,t} + \varepsilon_{i,t}$$

where  $IM$  signals imports. In contrast to the export equation, now the imports are not influenced by the economic performance in the rest of the world but by domestic demand in country  $i$  only. Thus, we still expect the response of imports to  $y$  measured by  $\mu$  to remain positive. For the response to  $rer$  we would instead assume a positive coefficient  $\theta$  since a real appreciation lowers the import prices and thus should increase demand for imports.

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<sup>2</sup> We also tried to separate the effects of the other countries domestic demand from those in the remaining rest of the world, but due to multicollinearity among these two variables the results remained inconclusive.

$$(7) IM_{i,t} = \delta + \theta_1 ner_{i,t} + \theta_2 (P_{i,t} - P_t^*) + \mu y_{i,t} + \varepsilon_{i,t}$$

As before the real exchange rate can be split up into the nominal exchange rate and a relative price or labor cost component. Again we assume both variables to have a positive influence on imports although the response may be different.

We follow Strauß (2000) and expand the domestic demand variable to not only account for domestic consumption and investment but to take also the exports of country  $i$  into account since in different countries a large proportion of imports are devoted to future exports. However, this assumes implicitly that either the domestic demand as well as the exports exhibit the same influence on imports, which is possible but not granted since the motives for domestic consumption or investment are different than those for exporting. That is why we let this question be answered empirically. Therefore, equation (4) is expanded to:

$$(8) IM_{i,t} = \delta + \theta_1 ner_{i,t} + \theta_2 (P_{i,t} - P_t^*) + \mu_1 y_{i,t} + \mu_2 EX_{i,t} + \varepsilon_{i,t}$$

### 3. Econometric Framework

The true equilibrium export and import elasticities, we are interested in, may be covered by short-run disturbances. So in order to disentangle the long-run equilibrium elasticities from the short-run dynamics an error correction model is estimated. We estimate the model in one step thus determining short- and long-run coefficients simultaneously (Stock, 1987):<sup>3</sup>

$$(9) \Delta Y_t = \sum_{j=1}^k a_j \Delta Y_{t-j} + \sum_{j=0}^l b_j \Delta X_{t-j} + c(Y_{t-1} - dX_{t-1}) + u_t$$

where  $Y$  are endogenous,  $X$  are exogenous variables and  $\Delta$  is the first difference operator. In this setting the coefficients  $a_j$  and  $b_j$  deliver the short-run dynamics, while  $c$  is the error correction term and  $d$  signals the long-run coefficients. Thus, our export and import equations (3) and (8) can be rewritten as:

$$(10) \Delta EX_{i,t} = \sum_{j=1}^k a_j \Delta EX_{i,t-j} + \sum_{j=0}^l b_{1,j} \Delta ner_{i,t-j} + \sum_{j=0}^l b_{2,j} \Delta (P_{i,t} - P_t^*) + \sum_{j=0}^l b_{3,j} \Delta y_{i,t-j} + c(EX_{i,t-1} - \alpha - \beta_1 ner_{i,t-1} - \beta_2 (P_{i,t} - P_t^*) - \gamma y_{i,t-1}) + u_{i,t}$$

$$(11) \Delta IM_{i,t} = \sum_{j=1}^k a_j \Delta IM_{i,t-j} + \sum_{j=0}^l b_{1,j} \Delta ner_{i,t-j} + \sum_{j=0}^l b_{2,j} \Delta (P_{i,t} - P_t^*) + \sum_{j=0}^l b_{3,j} \Delta y_{i,t-j} + \sum_{j=0}^l b_{4,j} \Delta EX_{i,t-j} + c(IM_{i,t-1} - \delta - \theta_1 ner_{i,t-1} - \theta_2 (P_{i,t} - P_t^*) - \mu_1 y_{i,t-1} - \mu_2 EX_{i,t-1}) + u_{i,t}$$

Note that the error correction term does not follow a standard normal distribution, thus the critical values have been corrected as Banerjee et al. (1998) suggest it.

<sup>3</sup>Alternatively, an error correction model can be estimated in two steps (Engle and Granger, 1987) by estimating the long-run coefficients in levels and using the residuals of this equation in a second step to determine the error correction term and short-run dynamics.



Since finding country differences in the elasticities is one target of this analysis single equation techniques are inappropriate. On the other hand also conducting a panel data analysis is no suitable way to go since it assumes homogeneous lag structures and elasticities over all countries, which we will show is an assumption hard to justify. Explicitly accounting for these differences in a panel framework would mean to use country dummy interaction terms with each variable, thereby reducing the degrees of freedom by so much that reliable estimates can no longer be guaranteed.

Therefore, we decided to use the positive aspects of both methods but abandon the disadvantages by using a system of country equations which are intertwined by a SURE estimator. With this approach country specific elasticities can be estimated and significant differences between countries or between exchange rate and relative prices/ unit labor costs can be detected, while the efficiency of the estimation is enhanced compared to a single equation estimation, due to the explicitly modeled correlation in the error terms, accounting for shocks the countries are hit by simultaneously. Thus, we introduce a SURE System Error Correction Model (SSECM).

Generally setting the lag length for the short-run dynamics ( $k$  and  $l$ ) is a possible source of manipulating the results. We can think of three ways to determine the lag length: First, the lag length is set based on economic theory. However, we were unable to find such a theory that predicts the optimal lag length in our setting. Second, the lag length can be based on information criteria such as the Akaike or Schwarz criteria. While there is less room for manipulation when using this procedure, there is still some discretion because optimal lag lengths can vary depending on which information criterion is chosen. Therefore, we follow a third procedure brought forward by Hendry et al. (1984). The procedure begins with a maximum lag length of  $k$  and  $l$  equal to 4 each.<sup>4</sup> Thus, each country's initial export equation contains 19 short-run coefficients adding up to 171 for the whole system.<sup>5</sup> Since the import equations additionally consider the impact of domestic exports the corresponding figures are 24 and 216. Starting from this point, a general to specific approach is initiated by implementing an iterative procedure that drops always the least significant coefficient.<sup>6</sup> So in the first round the short-run is reduced to only 170 coefficients, in the second to 169, and so on, until all remaining variables are significantly different from zero at least at a 90 percent level. Note that this procedure is only applied to the short-run dynamics and not to the long-run coefficients. Thus, the level coefficients are always part of the error correction model independent of their significance.

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<sup>4</sup>Data restrictions would allow for a maximum lag length of six because higher numbers reduce the degrees of freedom so much that estimates would become imprecise. However, with the exception of one equation explaining Italy's imports no fifth and sixth lag is found to have a significant influence on a 90 percent level. Hence, in all other cases the maximum lag length is restricted to be 4.

<sup>5</sup> These are the first to fourth lag of the endogenous and exogenous first differences plus the contemporaneous first differences of the exogenous variables.

<sup>6</sup> In case the real exchange rate is not split up the number of short-run coefficients is reduced by five for each country. However, using the real exchange rate implicitly assumes the nominal rate as well as relative prices/ unit labor costs to follow the same lag structure. This assumption is relaxed when splitting up the real rate.

#### 4. Data

We collected quarterly export and import data for nine of the eleven founding Euro-area countries for the period 1995Q1 to 2012Q4, excluding Finland and Ireland due to data availability.<sup>7</sup> So we include also four years where the Euro-area was not yet founded but where convergence towards a monetary union took place. For the remaining nine countries we also got the domestic demand and internal competitive measures. We used three different measures to account for the latter. First, unit labor costs, second, the consumer price index, these two being the traditional deflators the real exchange rate is computed on and third, the producer price index. The latter is additionally added because producer prices are assumed to model the export costs better than the quite general unit labor costs and consumer prices. However, producer prices may also have its caveats because they are driven by global developments, e.g. in oil prices. But also unit labor costs and consumer prices may be biased because of the European debt crisis. The increased unemployment may bias unit labor costs as more employees with lower productivity lost their jobs. Moreover, unit labor costs do only partly represent the production costs of a company while other cost components are neglected, e.g. capital costs or energy costs (see Sato and Dechezleprêtre, 2013; Bureau et al., 2013 for exports reactions to differing energy costs). Consumer prices are on the other hand biased by the increase in indirect taxes seen in the crisis. All data are seasonally adjusted and taken in logs so the coefficients can be interpreted as elasticities.

The exchange rate is measured either as the real effective or nominal effective rate for each of the nine Euro-area countries. Differences among the countries in the real rate can stem from two sources: First, differences in prices or unit labor costs across countries or second, a different weighting scheme among the countries depending on their foreign trade structure. In contrast to that, only the second source is responsible for differences in the nominal effective exchange rate because price or unit labor cost differences are excluded from a nominal exchange rate measure. In addition nominal bilateral exchange rates are used to account for the effects of bilateral a- or depreciations of the Euro towards other leading currencies, which are here the US-Dollar, the Japanese Yen and the British Pound. So the nominal bilateral exchange rate is the same among all nine Euro-area countries.

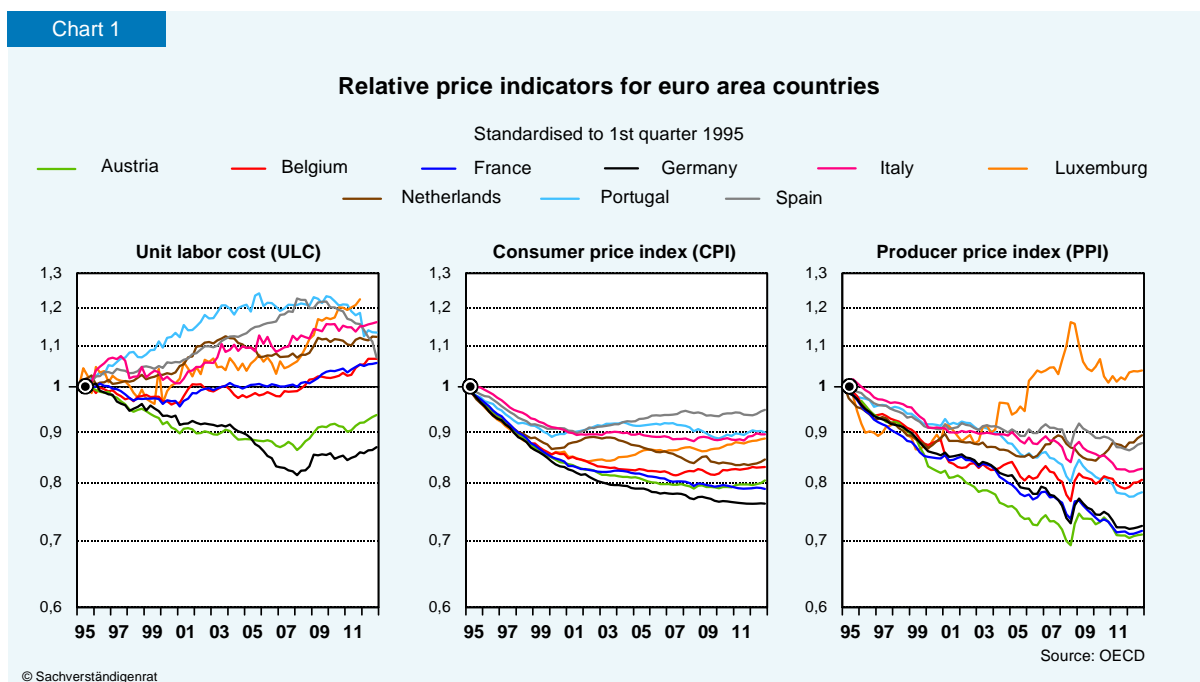
Relative prices and unit labor costs are calculated as the domestic price index or unit labor costs of each of the nine Euro-area countries towards the respective value of the reference group. The reference groups are the rest of the world as well as single countries. While the relative prices or labor costs with respect to other countries can be directly calculated from the data, the measure with respect to the rest of the world needs further explanation. We assume the OECD countries to be a proxy of the world. Moreover, we assume each of the nine Euro-area countries to be small in comparison to the whole OECD. Therefore, they cannot influence the overall price or unit labor cost development significantly. These simplifying assumptions enable us to calculate for each of the nine countries a measure of relative prices or unit labor costs towards the rest of the world (Chart 1). However, we find that the price or wage competitiveness vary widely depending on which indicator variable is used, even though the

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<sup>7</sup> For an overview of the data sources see the data appendix.

country ranking is rather robust with Austria and Germany delivering lower rates, while Portugal and Spain are showing the highest relative prices. So also the estimated export and import price elasticities should vary depending on which indicator is used.

Chart 1



To cover domestic demand in the rest of the world a different strategy is followed: OECD data including China are used as an indicator for this variable. Since domestic demand variables are denominated in their national currency or for the OECD as a whole in US-Dollar, these variables were redenominated into Euro by PPP exchange rates. The domestic demand variable is then constructed as the whole domestic demand of all countries minus the domestic demand of country  $i$ .

### III. Results

In this section we show the empirical results of our analysis using a general to specific approach by showing the results of the standard export and import equations first, before turning to those with a split up of the real exchange rate. Since there are lots of comparisons possible when accounting for all nine Euro-area countries we decided to limit our discussion to the four largest Euro-area economies (Germany, France, Italy and Spain). However, the results for the remaining five countries are still reported in the Charts and Tables.

#### 1. Export equations

This section is divided into two subsections accounting for the counterparty of the export analysis: First, an export equation with respect to the rest of the world is estimated before the analysis is conducted for the three other industrialized countries mentioned above.

### 1.1 The aggregate view: Exports of a single country to the Rest of the World

Starting with the reaction of exports towards the real effective exchange rate, thus the rate assuming that either the nominal exchange rate and the relative prices have the same influence on exports, we find the results as presented in Table 1. Here only the long-run coefficients are presented, while the short-run dynamics are available from the authors upon request. In general the error correction term is found to be significantly negative, as expected. For the four largest economies the point estimates vary from -0.20 in France and Italy to -0.29 in Spain. So for all countries less than one third of equilibrium adjustment is done within one quarter.

Table 1

Export Model REER<sup>1)</sup>

	AT	BE	DE	FR	IT	LU	NL <sup>3)</sup>	PT	SP
ECM <sup>2)</sup> .....	- 0.14 *** (0.03)	- 0.30 *** (0.06)	- 0.25 *** (0.05)	- 0.20 ** (0.04)	- 0.20 *** (0.04)	- 0.22 *** (0.05)	- 0.23 ** (0.06)	- 0.28 *** (0.06)	- 0.29 *** (0.05)
C .....	-18.19 *** (1.45)	- 9.43 *** (0.90)	-15.62 *** (2.29)	- 2.68 ** (1.30)	- 2.96 (1.86)	-24.05 *** (3.09)	-15.31 *** (1.30)	-17.81 *** (1.74)	-20.27 *** (1.71)
REER .....	- 0.47 (0.59)	- 0.43 ** (0.20)	- 0.82 *** (0.27)	- 1.73 *** (0.31)	- 0.57 (0.42)	0.27 (0.29)	- 0.30 (0.23)	- 1.33 *** (0.41)	- 1.06 *** (0.19)
Y* .....	1.78 *** (0.09)	1.27 *** (0.06)	1.75 *** (0.14)	0.89 *** (0.08)	0.90 *** (0.12)	2.08 *** (0.19)	1.67 *** (0.08)	1.69 *** (0.11)	1.95 *** (0.11)
R2 .....	0.72	0.59	0.28	0.37	0.42	0.38	0.43	0.28	0.30

1) Standard errors are given in parantheses. \*\*\*/\*\*/\* denotes significance at the 1 % / 5 % / 10 % level.– 2) Critical values derived from Banderjee et al. (1996).– 3) Maximum Lags: 3.

Source: Own calculations

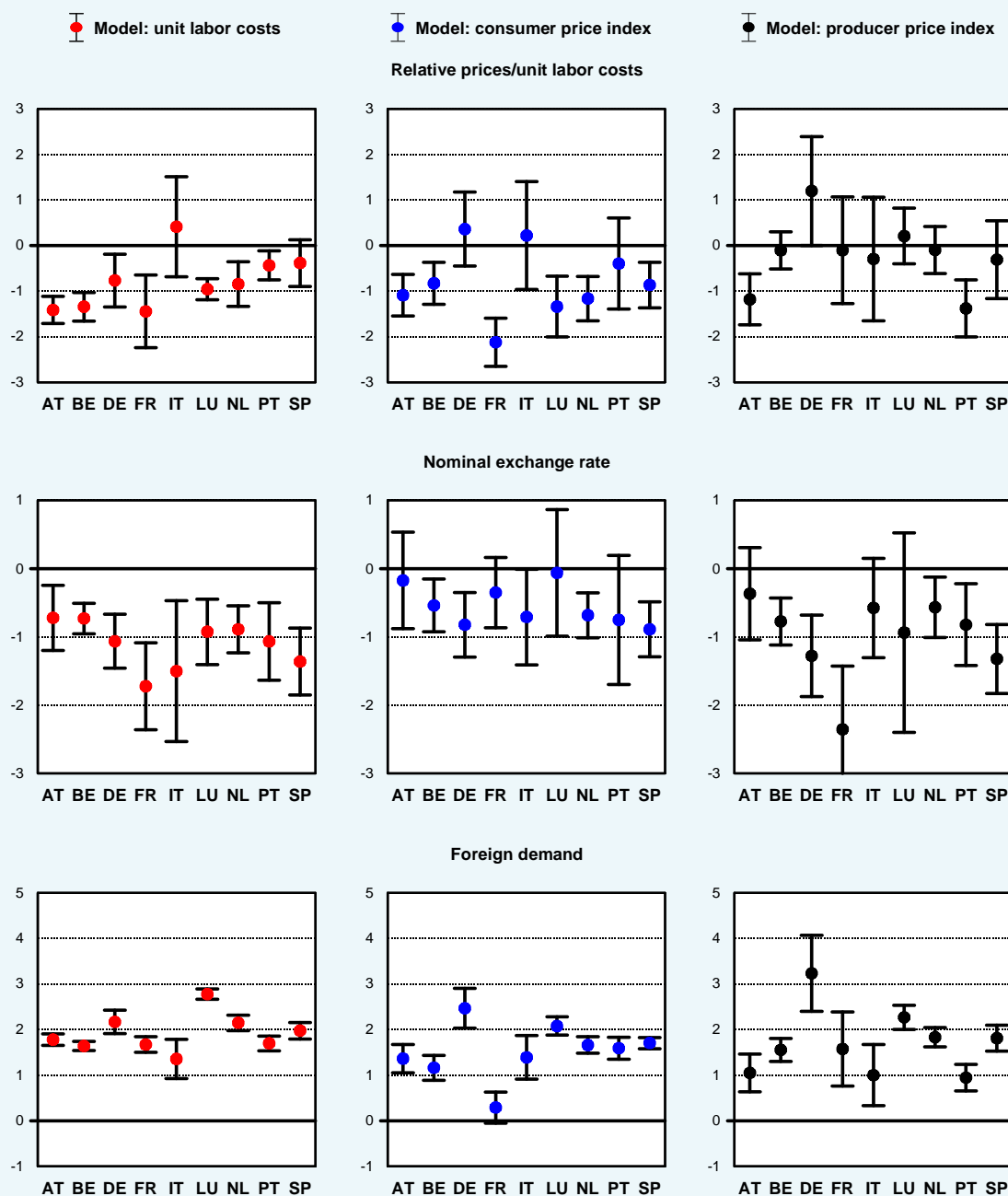
13113\_UK

The response of exports to the real effective rate is proofed to be significantly negative for Germany, France and Spain or insignificant in the case of Italy. But the export elasticities of a real effective exchange rate appreciation vary widely among the countries. While French exports seem to be rather exchange rate elastic with a coefficient of -1.73 which is significantly lower than the elasticities of the three other countries (Table A1, Appendix), the elasticities of Germany, Italy and Spain do not significantly differ.

With respect to the foreign demand elasticity of exports all countries exhibit the expected positive coefficient. France is again found to have the lowest elasticity with 0.89. It is striking that the four largest countries can be separated into two groups when it comes to the foreign demand elasticity: France and Italy are found to have elasticities below unity and thus are also significantly more demand inelastic than Germany and Spain whose elasticity significantly exceeds unity (Table A2, Appendix). Therefore, Germany and Spain seem to gain more from an increase in world demand than France and Italy would do.

As for the real effective exchange rate specification we find also for the estimations splitting up this term into the nominal effective exchange rate and either the relative unit labor costs or relative consumer/ producer prices a stable cointegration relationship given by a highly significant negative error correction term. The results are available from the authors upon request.

Chart 2

Long run export elasticities<sup>1)</sup>

1) Own calculations. Only long term equilibrium elasticities and their significance at a 10% level are presented.

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With respect to the relative prices/ unit labor costs, the results are mixed based on the variable chosen (Chart 2, upper part).<sup>8</sup> This result is not surprising since we have seen that also the underlying time series differ considerably. In general the unit labor cost and CPI based elasticities tend to yield to rather similar results while PPI based elasticities differ more. With

<sup>8</sup> In this and the following charts only the point estimates of the long-run equilibrium elasticities and their 10% confidence intervals are presented. Complete results including the short-run and error correction estimates are available from the authors upon request.

respect to single countries we still find some similarities. For Italy the elasticity is never found to exhibit a significant influence on exports. In contrast to that in all other countries the significance or even the sign of the estimated coefficients depends crucially on which variable is chosen to model relative prices/ unit labor costs. For example, Germany is estimated to have a significantly negative elasticity if unit labor costs are used as an indicator, while the reaction is insignificant for the consumer prices and significantly positive for producer prices. Due to these opposing results we cannot isolate the influence of the competitiveness indicator on the country's exports.

When it comes to the elasticities of the nominal effective exchange rate towards exports some similarities are obvious independent of which relative prices/ unit labor costs are used in the estimation equation (Chart 2, middle part). France and Spain tend to have the highest elasticities followed by Germany and Italy, thus France and Spain can gain more by a Euro-depreciation and are hit harder by a Euro-appreciation than other Euro-area countries.

Testing whether the elasticities of the nominal exchange rate and relative prices/ unit labor costs differ significantly from each other Wald-tests for parameter equality are run (Table A3, Appendix). We find several significant differences depending on the country and price indicator chosen. This is clear evidence that both elasticities need not to be equal and therefore we recommend to split the effects. E. g. for Germany we consistently found that the exchange rate elasticity exceeds the relative price/ unit labor cost elasticity. This is in two of three cases found to be even a significant difference according to the Wald-tests. The same holds for Italy but here only in one case the difference is estimated to be significant.

The foreign demand elasticities of exports can be estimated rather robust (Chart 2, lower part). The results are thus independent from the relative price/ unit labor cost variable used. We find an almost consistent ordering of the elasticities over the three different specifications. For example Germany is found to have a high demand elasticity, which is always significantly higher than the elasticity of French exports. So Germany is gaining more from an increase in world demand than most of the other Euro-area countries do. Moreover, the pattern found when not splitting-up the real rate is also found here as Spanish exports tend to react more to foreign demand than Italian exports.

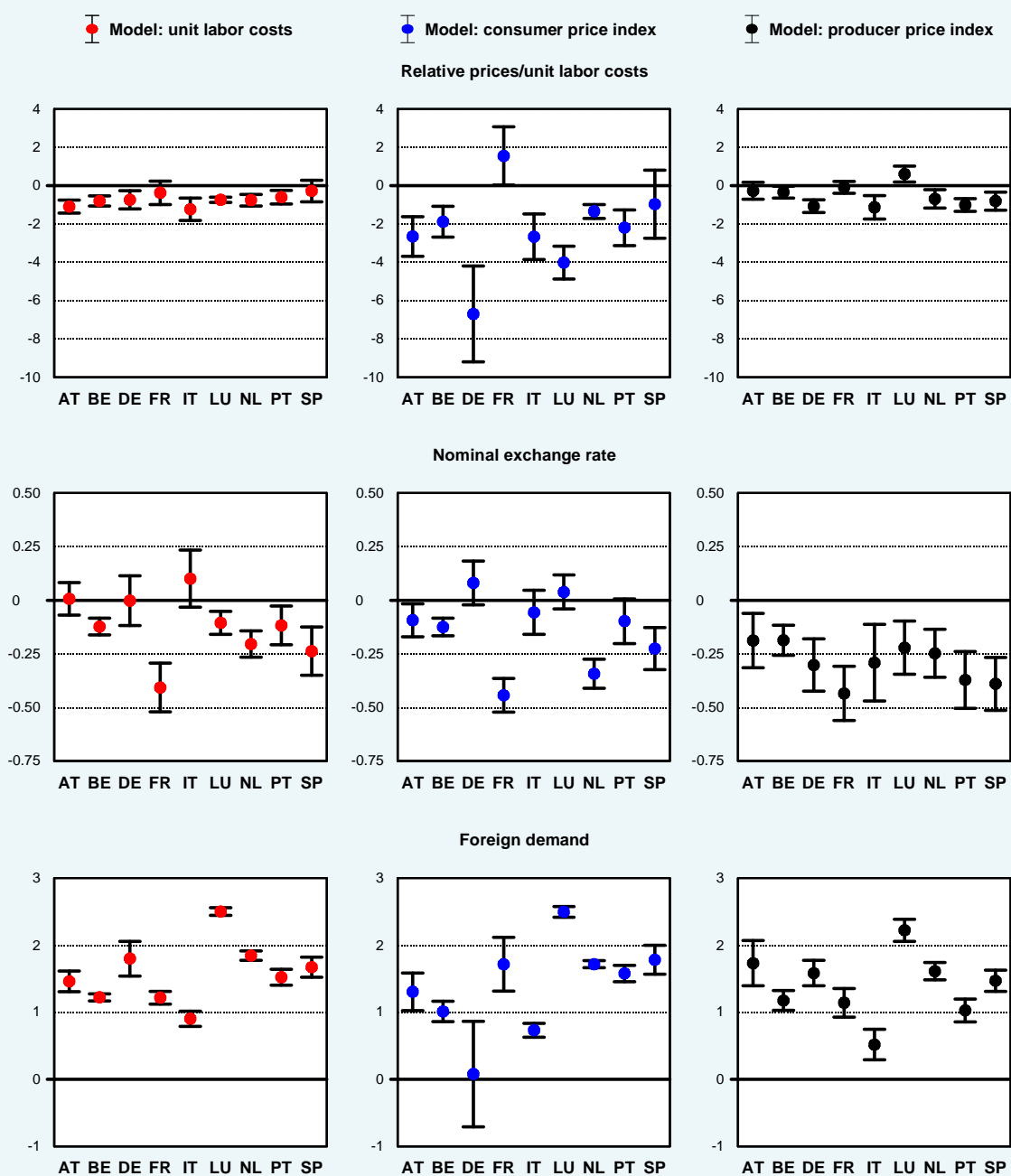
All in all it has to be concluded that the size and sign of the relative price elasticities depends crucially on the chosen indicator variable, while the ordering of the nominal exchange rate and foreign demand can be estimated more precisely over the specifications. It becomes evident that countries like France and Spain gain more from a nominal exchange rate devaluation while especially Germany profits from an increase in world demand.

## 1.2 The bilateral view: Aggregate export performance and bilateral exchange rates

While the export elasticities towards the rest of the world deliver a concise picture of the whole trading structure, some countries are of even greater importance with respect to either direct exports or as competitors on international markets. Therefore, also bilateral exchange rates should play a role for those. To account for this fact we estimated equations of a coun-

try's aggregate exports but use bilateral nominal exchange rates and bilateral relative prices/unit labor costs instead. By using the total global demand and aggregate exports, we cover third market effects need to be added to any direct trade linkage. However, we are well aware that the effects on the nominal exchange rate might be overestimated if the bilateral exchange rate moves in tandem with other rates, e.g. in response to a monetary policy change by the ECB. But as will be shown below we generally find the exchange rate elasticities are well below those estimated in section III.1.1 as we would expect.

Chart 3

Long run export elasticities: United States counterpart<sup>1)</sup>

1) Own calculations. Point estimates of long term equilibrium elasticities and their 10% confidence intervals are presented.

Estimating export equations with bilateral nominal exchange rates and price changes relative to the US shows once more that the ordering of the relative price elasticities of the ULC and CPI based estimates are rather similar while the PPI results differ considerably (Chart 3, upper part). For the first two we see that France and Spain yield the lowest or even positive elasticities a pattern also present in the French PPI based estimate. So these countries gain less by an increase in their price competitiveness. On the other hand Italy and Germany are shown to be among the group with the highest elasticities, thus gaining most by an increase in competitiveness.

This picture is completely reversed when it comes to exchange rate elasticities (Chart 3, middle part). Here Germany and Italy are the two countries which are among the group of the least exchange rate elastic countries, while for France and Spain the reverse is true. This result provides even more support for our argument that relative prices/ unit labor costs and nominal exchange rates should be added separately to the export equation, since they could yield opposing results. This can also be seen by the Wald-tests of parameter equality between these two variables (Table A4, Appendix). In this bilateral specification even more significantly different parameters can be detected. So, for Germany and Italy the relative price/ unit labor cost elasticity is always significantly larger than the nominal exchange rate elasticity. In contrast for France the latter is significantly larger in two of three cases while for Spain this holds only in one case.

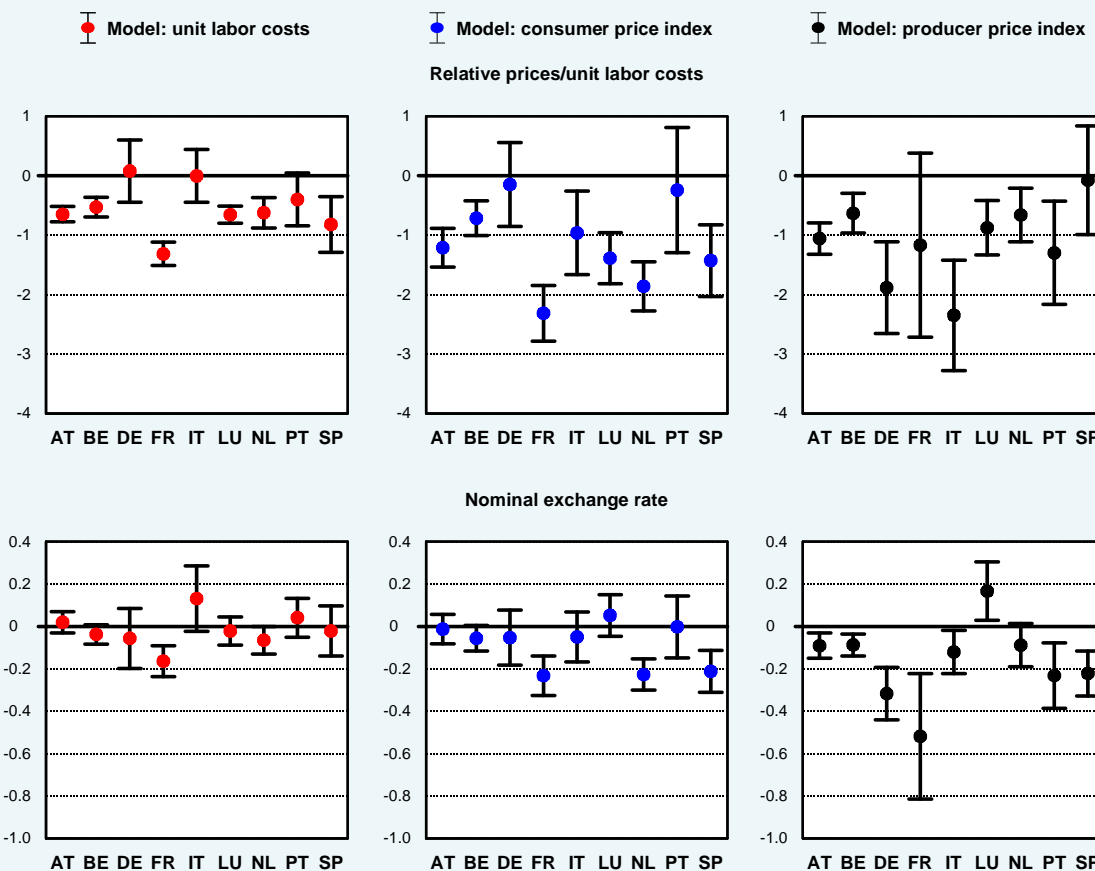
Again the foreign demand elasticities can be estimated robustly and do not differ considerably from those in section III.1.1 which is not surprising since either the exogenous as well as the endogenous variable are the same (Chart 3, lower part). This pattern holds also for the two specifications covering the export equations with the decomposed real exchange rate vis-a-vis Japan and UK. Therefore, these will not be presented here, but the results are available from the authors upon request.

The Japanese export equations do mostly lead to opposing results than those for the US when it comes to the relative price/ unit labor cost elasticity but only for the ULC and CPI based estimates (Chart 4, upper part). Germany is now found to have the lowest estimates and France and Spain the highest. However, some similarities to the US estimates do hold for the nominal exchange rate elasticity (Chart 4, lower part). Here the French elasticity is always the largest followed by the Spanish. But the elasticities are generally found to be very low and mostly insignificantly different from zero, so the Japanese exchange rate seems to be unimportant for most Euro-area countries. The only exception is France whose elasticity is in all three cases highly significant.

Due to the rather low exchange rate elasticities the Wald-tests indicate for several countries the relative prices/ unit labor costs are more important for exports (Table A5, Appendix). This is especially true for France and Spain and contrasts the results found with respect to the US.



Chart 4

Long run export elasticities: Japan counterpart<sup>1)</sup>

1) Own calculations. Point estimates of long term equilibrium elasticities and their 10% confidence intervals are presented.

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Export equations with the decomposed real exchange rate vis-a-vis the United Kingdom yield robust country ordering results for all three internal competitiveness indicators (Chart 5, upper part). Those yield to the conclusion that Italy has none or an even positive reaction towards a reduction in their competitiveness. On the other hand Spain tends to have a highly negative elasticity.

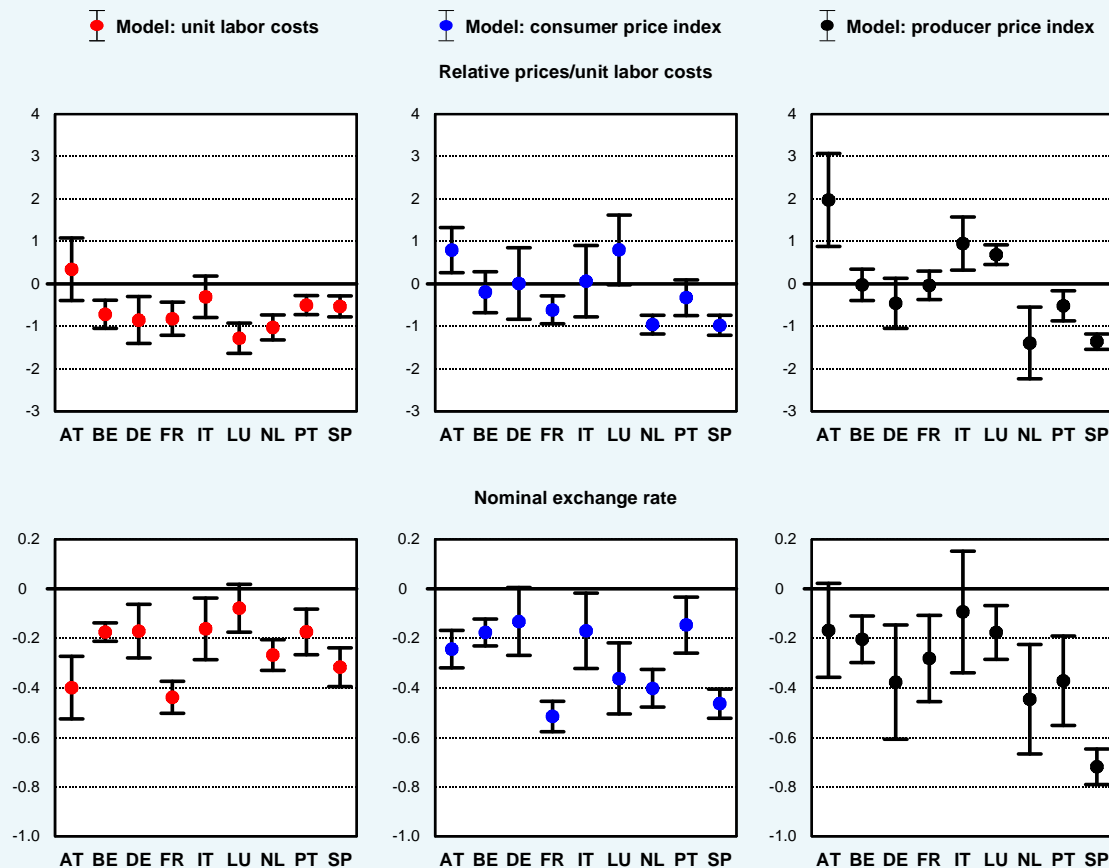
However, the ordering of the nominal exchange rate elasticities is again found to be robust with France and Spain leading with the highest estimates (Chart 5, lower part). In contrast to the Japanese elasticities the one for the UK are mostly found to be significantly negative for all countries. These more significantly estimates result in less significant deviations of the nominal exchange rate and relative prices/ unit labor costs (Table A6, Appendix). But also in this case we find for many countries significant differences so splitting up the real exchange rate is the better way to model export equations.

In general we have verified that there are substantial regional differences in the export elasticities of the Euro-area countries. While the ordering of the foreign demand and nominal exchange rate elasticities is rather robust over countries, even though the importance of the Yen exchange rate is low, the relative price/ unit labor cost elasticity depends very much on the

region of comparison. While for Germany and Italy the US competitors are of more importance for France and Spain this are the Japanese or even the British competitors. This is possibly due to the more homogeneous product portfolio among those countries.

Chart 5

### Long run export elasticities: United Kingdom counterpart<sup>1)</sup>



1) Own calculations. Point estimates of long term equilibrium elasticities and their 10% confidence intervals are presented.

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## 2. Imports

Since a change in the exchange rate is well known to have not only effects on the country's exports but also on their imports both of them determining the trade balance, we estimate in this section the import effects with the help of equation (7) in the SSECM framework. So, internal demand is split up into the two components domestic demand and demand determined by exports. All results are only presented with respect to the rest of the world since the imports from specific countries are of only minor importance for each of the Euro-area countries.

Table 2 provides evidence when the real effective exchange rate is used as indicator, so relative prices/ unit labor costs and the nominal exchange rate are not split up at this stage. As in the case of exports the error correction term is found to be highly significant with the correct

negative sign.<sup>9</sup> The adjustment process to the new equilibrium is estimated to be in the same magnitude as for the export equations with respect to the four largest Euro-area economies ranging from -0.22 in Italy to -0.33 in Germany.

Moreover, for all countries domestic demand and exports are found to have the expected positive influence on imports, although to a different degree. Domestic demand elasticities in the four largest economies vary from 0.45 (Germany) to 1.71 (France). The export elasticities range from 0.32 (France) to 0.74 (Germany). One striking feature of these results is that for Germany the export elasticity is larger than the domestic demand elasticity, while the reverse is true for the remaining countries France, Italy and Spain, thus Germany is mainly importing pre-products necessary for future exports while the latter group is mainly consuming its imports.

Table 2

**Import Model REER<sup>1)</sup>**

	AT	BE	DE	FR	IT <sup>3)</sup>	LU	NL	PT	SP
ECMP <sup>2)</sup> .....	- 0.35 *** (0.07)	- 0.35 ** (0.09)	- 0.33 *** (0.07)	- 0.31 ** (0.08)	- 0.22 ** (0.05)	- 0.80 *** (0.10)	- 0.47 *** (0.10)	- 0.39 *** (0.07)	- 0.24 *** (0.04)
C .....	- 1.48 (1.24)	- 4.36 *** (1.01)	- 2.89 (5.05)	-14.24 *** (0.88)	-12.92 *** (2.23)	- 2.17 *** (0.25)	- 3.70 *** (0.54)	- 6.48 *** (0.74)	-10.16 *** (0.95)
REER .....	0.31 *** (0.12)	0.12 (0.08)	- 0.12 (0.22)	- 0.46 *** (0.14)	0.36 (0.23)	0.14 *** (0.05)	- 0.19 *** (0.04)	- 0.00 (0.16)	- 0.05 (0.15)
Y .....	0.37 ** (0.15)	0.71 *** (0.15)	0.45 (0.39)	1.71 *** (0.15)	1.41 *** (0.22)	0.49 *** (0.05)	0.46 *** (0.07)	0.92 *** (0.08)	1.28 *** (0.12)
EX .....	0.74 *** (0.04)	0.67 *** (0.07)	0.74 *** (0.04)	0.32 *** (0.10)	0.55 *** (0.09)	0.77 *** (0.03)	0.85 *** (0.02)	0.67 *** (0.04)	0.49 *** (0.06)

1) Standard errors are given in parantheses. \*\*\*/\*\*/\* denotes significance at the 1 % / 5 % / 10 % level.– 2) Critical values derived from Banerjee et al. (1996).– 3) Maximum lags: 5, only goods.

Source: Own calculations

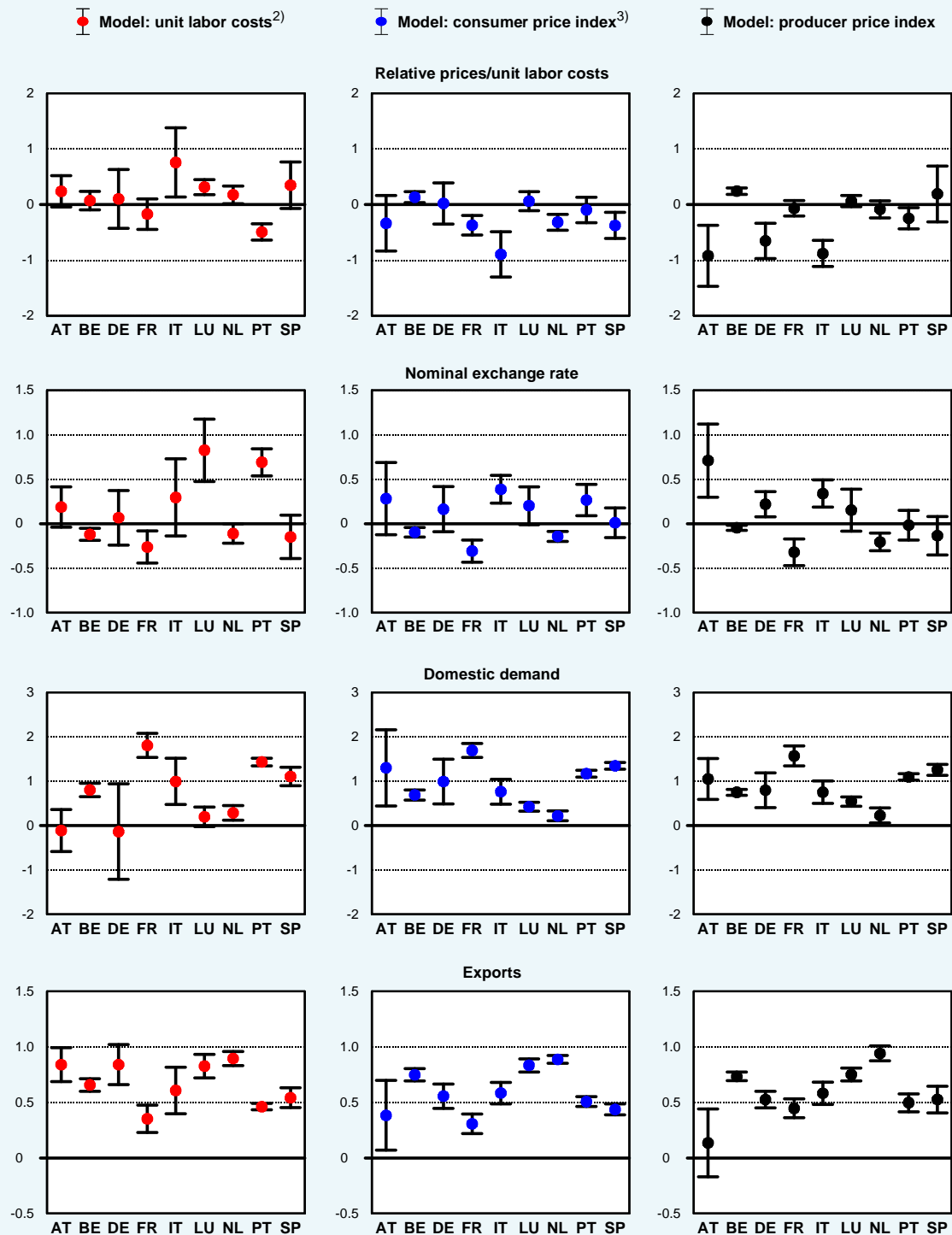
In contrast to the estimations of the export equation, the coefficient size and sign of the real exchange rate differs widely across the import equations. For none of the four largest Euro-area economies the expected positive influence of a real appreciation can be verified. Even worse, in France the elasticity is estimated to be significantly negative thus contradicting the theory. For Germany, Italy and Spain the real effective exchange rate does not seem to have a significant influence on imports. This puzzling result has frequently been found in empirical studies of import equations (see e.g. Stephan, 2006). Whether this can be attributed to either the elasticity of nominal exchange rate or the relative prices/ unit labor costs can be investigated when splitting up the real rate as we will do in the following.

When doing so we find that relative prices/ unit labor costs are hardly ever found to have the expected significantly positive influence on imports (Chart 6, first row). For none of the four countries we were able to estimate a consistently positive coefficient, irrespectively which

<sup>9</sup> For Italy another specification has to be chosen to find a significant error correction term. Here only goods imports with a maximum lag of 5 are used.

indicator variable is used. On the other we are also unable to verify a consistently negative influence of this variable for each of the countries. Therefore, it has to be concluded that relative prices/ unit labor costs do not contribute significantly to the import development of these Euro-area countries.

Chart 6

Long run import elasticities<sup>1)</sup>

1) Own calculations. Point estimates of long term equilibrium elasticities and their 10% confidence intervals are presented. – 2) Germany: maximum lags=2. – 3) Austria not interpretable due to non-significance in error correction term.

Although the nominal exchange rate elasticities provide a more homogeneous country ordering and the estimates are found to be on average positive, also for this variable no country provides consistently significant positive parameter values (Chart 6, second row). But for France the elasticities are in all three specifications found to be significantly negative, thus this empirical result contradicts theory. This is also the reason why Wald-tests for parameter equality of the nominal exchange rate and relative prices/ unit labor costs point to a significantly lower nominal exchange rate response of imports (Table A7, Appendix). Therefore, splitting up the real exchange rate in its two subcomponents is preferable for imports as well, as also several other significant differences in the other countries show, even if for no other country a clear indication which elasticity dominates the other can be found. However, we are unable to show that either the increases in the nominal exchange rate or relative prices/ unit labor costs have a significantly positive effect on imports as it is predicted by theory.

As it was the case in the export equations also for the import equations the elasticity of demand component is estimated rather precisely over all three specifications (Chart 6, third row). Especially France and Spain are found to have high elasticities and thus respond more to changes in domestic demand.

However, the reverse is true for the export elasticity of imports (Chart 6, last row). Here France and Spain come up with the lowest elasticities. Therefore, the result found in the specification using the real exchange rate is reinforced in these estimations.

#### IV. Conclusions

Our analysis of the impact of exchange rate changes on Euro-area countries exports and imports provides several interesting insights. First, the real exchange rate seems to be a rather poor control variable for export or import performance since it implicitly assumes that the nominal rate and the relative prices/ unit labor costs have the same impact on exports and imports. Our analysis has revealed that this need not be the case. In our opinion this result might be driven by the different reasons for alterations in both variables. While nominal exchange rates are exogenous and highly volatile from a firm level perspective and its changes are seldom considered persistent. Any change in exchange rates leads to direct alterations in export and import prices and thus exports and imports. On the other hand changes in relative prices or unit labor costs are more persistent, so because of pricing to market they might not immediately and fully be reflected in export and import prices and thus exports and imports.

Second, the effect of relative prices/ unit labor costs depends crucially on which indicator variable is used to model those. This result is not surprising given the different evolution of these variables. In contrast, nominal exchange rate elasticities can be estimated rather precisely, especially an ordering of the Euro-area countries investigated in this study can be made. According to our results, the deteriorating effect of a Euro appreciation would be most pronounced for French and Spanish exports. Conversely, these countries would profit the most from a Euro depreciation.

Third, bilateral competition, either direct or on third markets, seems to be of different importance for Euro-area countries. While German and Italian competitors seem to be from the United States of America, French and Spanish firms compete mostly with Japanese or even British companies. This is possibly due to the more homogeneous product portfolio of these countries.

Fourth, exchange rate elasticities of imports (nominal or real) are not found to be significantly positive in most of the cases in contrast to what economic theory would predict. In our opinion this is because for Euro-area countries the choice is not between imports or domestic production because certain sector production is no longer present in those countries. It is more a decision of substituting imports from one country by imports from other countries if there are shifts in the exchange rate with respect to specific countries/ regions.

Fifth and finally, since the exchange rate elasticities indicate that there is no significant effect on imports, the response of the overall trade balance to changing exchange rates seems to be solely determined by its influence on exports. Since exchange rate elasticities on exports are found to be significant with the correct sign in most cases, a Euro depreciation would on average increase the trade balance. This also holds for France which according to our results shows a significantly negative exchange rate elasticity of imports that are nevertheless smaller in absolute terms than the corresponding elasticity of exports thereby overcompensating the induced increase in imports.

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## Data Appendix

### Exports:

Total exports of goods and services for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal and Spain; SOURCE: Datastream.

### Imports:

Total imports of goods and services for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal and Spain; SOURCE: Datastream.

### Exchange rates:

Real effective exchange rate: Based on GDP-deflator vis-a-vis 40 trading partners with constant trade weights for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal and Spain; SOURCE: OECD.

Nominal effective exchange rate: Vis-a-vis 40 trading partners with constant trade weights for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal and Spain; SOURCE: OECD.

Bilateral nominal exchange rates: Euro versus US-Dollar, Japanese Yen, UK-Pound; SOURCE: Datastream.

### Unit labor costs:

Total economy unit labor costs for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal, Spain, United States of America, Japan, United Kingdom and OECD; SOURCE: OECD.

### Consumer prices:

For Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal, Spain and United Kingdom harmonized index of consumer prices, for United States personal consumption expenditures, for Japan and OECD consumer price index; SOURCE: Datastream and OECD.

### Producer prices:

Domestic producer price index excluding construction and energy for Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal, Spain, United States of America, Japan, United Kingdom and OECD, SOURCE: Datastream, Eurostat and OECD.

### Domestic demand:

For Austria, Belgium, Germany, France, Ireland, Italy, the Netherlands, Portugal, Spain, United States of America, Japan, United Kingdom and OECD, SOURCE: Datastream and OECD.

## Appendix

Table A1

### Wald test results for exports: country comparison of the real effective exchange rate elasticities<sup>1)</sup>

	AT	BE	DE	FR	IT	LU	NL	PT	SP
Austria (AT) .....									
Belgium (BE) .....	0,95								
Germany (DE) .....	0,55	0,23							
France (FR) .....	0,04	0,00	0,01						
Italy (IT) .....	0,88	0,76	0,55	0,02					
Luxembourg (LU) ...	0,22	0,03	0,01	0,00	0,10				
Netherlands (NL) ...	0,67	0,52	0,12	0,00	0,45	0,30			
Portugal (PT) .....	0,21	0,04	0,24	0,39	0,14	0,00	0,01		
Spain (ES) .....	0,33	0,02	0,39	0,03	0,23	0,00	0,02	0,50	

1) p-values.

Table A2

### Wald test results for exports: country comparison of the foreign demand elasticities<sup>1)</sup>

	AT	BE	DE	FR	IT	LU	NL	PT	SP
Austria (AT) .....									
Belgium (BE) .....	0,00								
Germany (DE) .....	0,86	0,00							
France (FR) .....	0,00	0,00	0,00						
Italy (IT) .....	0,00	0,00	0,00	0,99					
Luxembourg (LU) ...	0,15	0,00	0,17	0,00	0,00				
Netherlands (NL) ...	0,24	0,01	0,42	0,00	0,00	0,03			
Portugal (PT) .....	0,48	0,00	0,73	0,00	0,00	0,07	0,55		
Spain (ES) .....	0,20	0,00	0,29	0,00	0,00	0,53	0,02	0,04	

1) p-values.

Table A3

### Wald test results for exports: nominal exchange rate versus relative prices/unit labor costs<sup>1)</sup>

	Unit labor costs	Consumer price index	Producer price index
Austria .....	<b>0.02</b>	<b>0.09</b>	0.11
Belgium .....	<b>0.01</b>	0.50	<b>0.06</b>
France .....	0.71	<b>0.00</b>	<b>0.02</b>
Germany .....	0.48	<b>0.05</b>	<b>0.01</b>
Italy .....	<b>0.08</b>	0.21	0.79
Luxembourg .....	0.92	0.12	0.31
Netherlands .....	0.91	0.23	0.31
Portugal .....	0.11	0.73	0.28
Spain .....	<b>0.06</b>	0.97	0.18

1) p-values.

Table A4

**Wald test results for exports United States counterpart:  
nominal exchange rate versus relative prices/unit labor costs<sup>1)</sup>**

	Unit labor costs	Consumer price index	Producer price index
Austria .....	<b>0.00</b>	<b>0.00</b>	0.71
Belgium .....	<b>0.00</b>	<b>0.00</b>	0.35
France .....	0.94	<b>0.03</b>	<b>0.02</b>
Germany .....	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>
Italy .....	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>
Luxembourg .....	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Netherlands .....	<b>0.00</b>	<b>0.00</b>	<b>0.07</b>
Portugal .....	<b>0.02</b>	<b>0.00</b>	<b>0.00</b>
Spain .....	0.90	0.50	<b>0.09</b>

1) p-values.

Table A5

**Wald test results for exports Japan counterpart:  
nominal exchange rate versus relative prices/unit labor costs<sup>1)</sup>**

	Unit labor costs	Consumer price index	Producer price index
Austria .....	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Belgium .....	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>
France .....	<b>0.00</b>	<b>0.00</b>	0.45
Germany .....	0.65	0.82	<b>0.00</b>
Italy .....	0.64	<b>0.02</b>	<b>0.00</b>
Luxembourg .....	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Netherlands .....	<b>0.00</b>	<b>0.00</b>	<b>0.03</b>
Portugal .....	0.12	0.70	<b>0.02</b>
Spain .....	<b>0.01</b>	<b>0.00</b>	0.79

1) p-values.

Table A6

**Wald test results for exports United Kingdom counterpart:  
nominal exchange rate versus relative prices/unit labor costs<sup>1)</sup>**

	Unit labor costs	Consumer price index	Producer price index
Austria .....	0.14	<b>0.00</b>	<b>0.00</b>
Belgium .....	<b>0.01</b>	0.95	0.31
France .....	0.13	0.60	<b>0.03</b>
Germany .....	<b>0.03</b>	0.77	0.74
Italy .....	0.65	0.61	<b>0.00</b>
Luxembourg .....	<b>0.00</b>	<b>0.02</b>	<b>0.00</b>
Netherlands .....	<b>0.00</b>	<b>0.00</b>	<b>0.02</b>
Portugal .....	<b>0.00</b>	0.41	0.27
Spain .....	0.17	<b>0.00</b>	<b>0.00</b>

1) p-values.

Table A7

**Wald test results for imports: nominal exchange rate versus relative prices/unit labor costs<sup>1)</sup>**

	Unit labor costs	Consumer price index	Producer price index
Austria .....	0.82	0.15	<b>0.00</b>
Belgium .....	0.09	<b>0.00</b>	<b>0.00</b>
France .....	0.68	0.63	<b>0.04</b>
Germany .....	0.72	0.59	<b>0.00</b>
Italy .....	0.42	<b>0.00</b>	<b>0.00</b>
Luxembourg .....	<b>0.01</b>	0.47	0.62
Netherlands .....	<b>0.02</b>	<b>0.07</b>	0.31
Portugal .....	<b>0.00</b>	<b>0.08</b>	<b>0.04</b>
Spain .....	0.14	<b>0.07</b>	0.35

1) p-values.