Exchange rate fluctuations and extra-eurozone exports: A comparison of Germany and France

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Abstract

To study the extra-eurozone exports of goods by France and Germany, this study applies cointegration methods to estimate long-run equations for the period 1971–2010 (quarterly data), as well as for a shorter period known as the "euro period." Various measures of the real exchange rate of the euro indicate that the price elasticities of exports are higher for France (-0.6 to -0.9) than for Germany (-0.2 to -0.3). Conversely, the income elasticities of German exports are double those of France, reaching nearly 2 for 1 in the French case. These results support French fears about the value of the euro–dollar exchange rate, but they also reveal a delay by France in its adaptation to the new global environment, following the opening of the central and eastern European economies and the arrival of large emerging countries in the worldwide economy.

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1. Introduction

Generally the value of currencies, as well as considerations about the potential misalignments of exchange rates, is the concern of central bankers, finance professionals, business managers engaged in international competition, and academics who study economies. But in a shift of focus, the political class also has expressed increasing interest, as exemplified during the 2007 presidential campaign in France, when candidates debated the value of the euro widely.[1] As Nicolas Sarkozy declared on December 18, 2006: “The overvaluation of the euro is a serious economic mistake.” By June 30, 2008, Sarkozy had become President and complained, in an interview with the French television channel France 3, “Airbus manufactures in the eurozone and sells mainly in the dollar zone.... Every time the euro appreciates by ten cents, Airbus loses a billion euros! How do you want that we compete with Boeing which sells in dollars if we have 30% overvaluation of the euro against the dollar?”[2]

Industry leaders agree. In May 2010,[3] when the euro–dollar exchange rate was around $1.20, the chief financial officer of EADS Hans Peter Ring confirmed the importance of the euro for European aviation companies:

> We should not forget one thing on the euro/dollar: it is not that the dollar is particularly strong, we are just approaching the long-term average. If you remember, when the euro was introduced it was at $1.18. So far it is not that the euro is particularly weak, we are just converging towards the long-term average. If the current trend continues, this would brighten the medium-term outlook for the group given the dollar exposure we have in the future.

French exports certainly are not confined to aerospace, yet this example is representative of the poor export performance by French companies, which has coincided with the rise of the euro against the U.S. dollar since 2001. Revived fears of an overvalued euro in turn have hurt trade balances.

Paradoxically, even as France struggles, Germany has attained outstanding foreign trade performance. Figure 1 summarizes the trade balance (goods) for both countries during the past 40 years: The German trade balance remained permanently in surplus, whereas the French balance was positive only during the 1990s (a decade in which both countries' trade balances improved). In contrast, the 2000s initiated clear divergence, as the German trade surplus increased while almost symmetrically the French situation deteriorated.

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[1] As of January 1, 2011, the euro is the currency for 17 countries of the European Union: Germany, Austria, Belgium, Greece, Spain, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia, Cyprus, Malta, Slovakia, and Estonia.

[2] See http://www.elysee.fr/president/root/bank/print/5637.htm.

[3] See http://www.reuters.com.

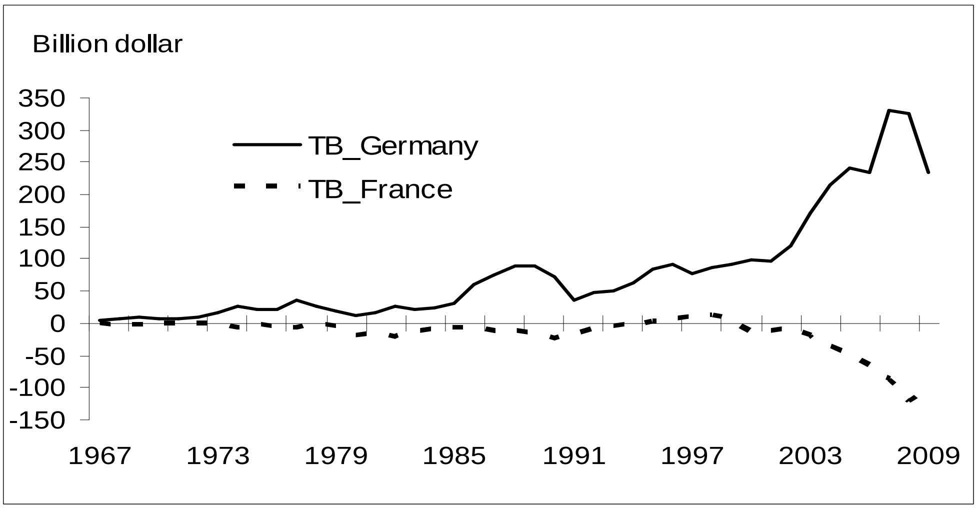

Figure 1: Trade Balance (TB) for Germany and France
Source: Base Chelem (own calculations)

Germany's trade surplus with France may provide a partial explanation, but as Figure 2 reveals, the fall in French trade also occurred in relation to countries outside the euro area.

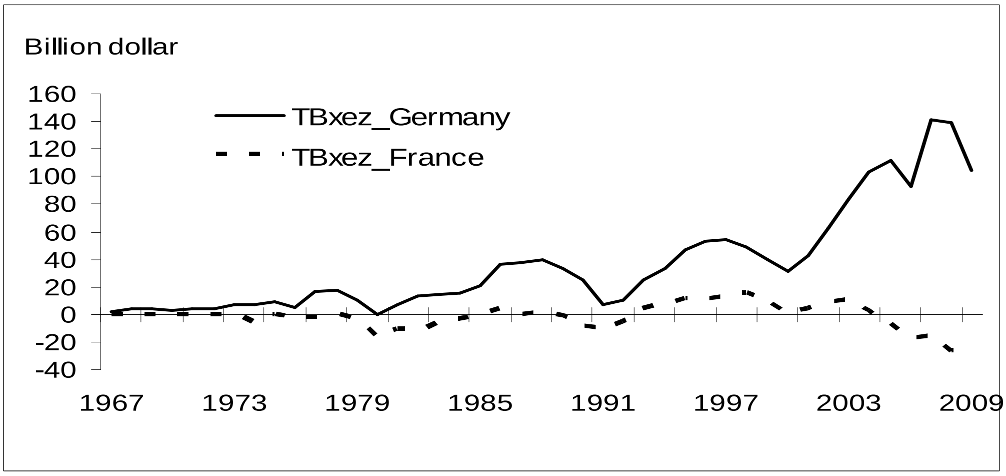

Figure 2: Extra-Eurozone Trade Balance (TBxez) for Germany and France
Source: Base Chelem (own calculations)

In addition, if we distinguish imports from exports, we find that the weakening of the French trade balance mainly reflects weak growth in French exports, in stark contrast to the rapid growth of German exports. With Figures 3 and 4, we display the trends in real exports[4] by France and Germany compared with the rest of the world and with countries outside the eurozone during 1971–2010. These observations confirm that the slowdown of French exports appears to have been the result of a volume effect, not a price effect. During the 2000s, French exports stagnated and then remained sluggish (Gaulier et al. 2006), especially in relation to partners outside the eurozone, even as German exports continued to grow strongly.

[4] See Appendix 3 for the calculations of real exports.

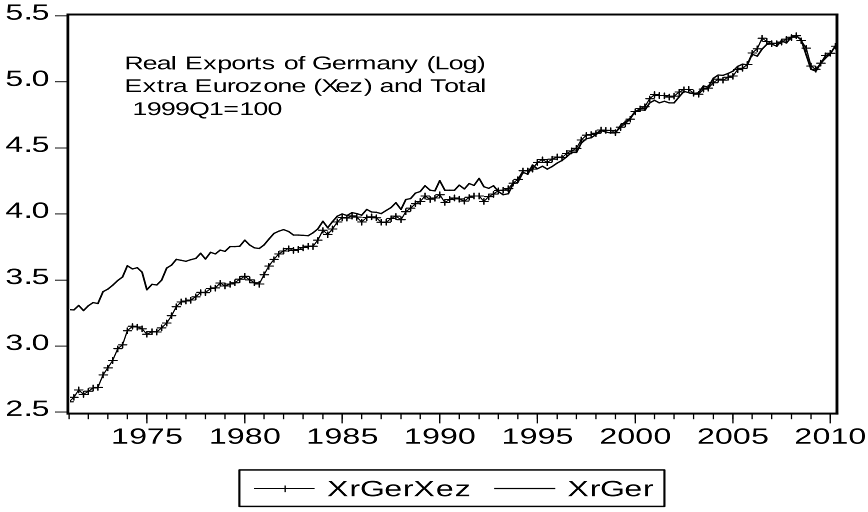

Figure 3: Real Exports of Germany

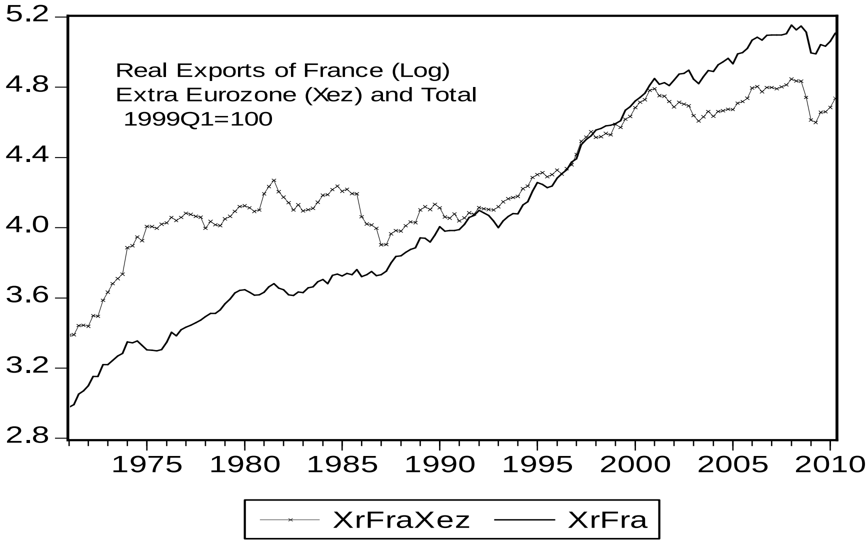

Figure 4: Real Exports of France

These observations fuel questions about the impact of the euro exchange rate, especially considering that the deterioration of the French trade balance coincides with the sharp appreciation of the euro against U.S. currency, whose value increased from $0.87 in the second quarter of 2001 to $1.56 in the second quarter of 2008. Estimating the impact of the exchange rate of the euro on exports is ultimately an empirical analysis; therefore, we assess the relationship between the exchange rate and extra-eurozone real exports of goods by France and Germany, using quarterly data from the first quarter of 1971 to the second quarter of 2010. To determine fluctuations in the exchange rate of the euro, we use both changes in the real exchange rate and exchange rate volatility. In Section 2, we detail these different measures, then in Section 3, we clarify our export model and the statistical properties of our study variables. Section 4 contains the estimation results of the cointegration relationships, followed by a conclusion in Section 5.

2. Exchange rates

We present, in succession, our calculations of the real exchange rates and the measure of exchange rate volatility.

2.1. The real exchange rate

Let $E_{i/j}$ be the nominal bilateral exchange rate between the currency of a partner country *j* and a European country *i* (i.e., number of units of foreign currency per euro), P_i be a price index for France and Germany, and P_j be the price index of the *j* partners. The bilateral real exchange rate $R_{i/j}$ is then $R_{i/j} = E_{i/j}.P_i / P_j$, such that an increase of *R* is synonymous with a real appreciation of the euro.

For Germany, as for France, the exchange rate of the euro against the dollar is critical. On the one hand, European firms are in direct competition with U.S. companies, whether in their respective markets or in third-party markets. On the other hand, some strong competitors such as China have anchored their currencies to the U.S. dollar. Thus, we initially define bilateral real exchange rates for France and Germany and for the euro area in relation to the United States. With the price data available, we can calculate the following rates:[5]

- Two bilateral rates, Germany–United States (gross domestic product [GDP] deflator and export price of Germany) and France–United States (GDP deflator and export unit value index of France[6]).
- Two bilateral rates for the eurozone–United States: consumer price and the wholesale price of the euro area.[7]

In a second step, we construct a real effective exchange rate (REER) for both France and Germany in relation to their main partners, defined as a geometric average of the bilateral real exchange rates:

$$\text{REER} = \prod_{i=1}^{n} \left(\text{E}_{\text{i/j}} \,.\, \frac{\text{P}_\text{i}}{\text{P}_\text{j}} \right)^{\omega \text{i}}, \text{ where } \sum_{i=1}^{n} \omega\text{i} = 1. \qquad (1)$$

The weights ωi reflect the structure of exports of France and Germany outside the euro area to *n* key partners.[8] An increase (decrease) in the REER indicates a real appreciation (depreciation) of the euro.

In Figures 5–7, we note the changes in these rates over the entire period. For Germany (Figure 5), the bilateral real exchange rates generally behave very similarly, whether we retain the German export price (R_ger_us_xp) or the deflator GDP (R_ger_us_def). In the real effective exchange rate (REERger), four distinct evolutionary phases appear:

- Depreciation, though less marked than that for the bilateral rates against the dollar alone, during the 1970s until the mid-1980s;
- Strong appreciation in the mid-1980s to mid-1990s;
- Depreciation in the effective rate during the second half of the 1990s; and

[5] See Table A1 in Appendix 1 for the details of these calculations.
[6] The data regarding export unit value for France are available since 1990Q1 (see Appendix 3).
[7] The data regarding wholesale prices in the eurozone are available since 1982Q4 (see Appendix 3).
[8] See Appendix 2.

- Stability in the real rate during the 2000s, which contrasts with the dynamics of the bilateral real rates that reveal a movement of real appreciation.

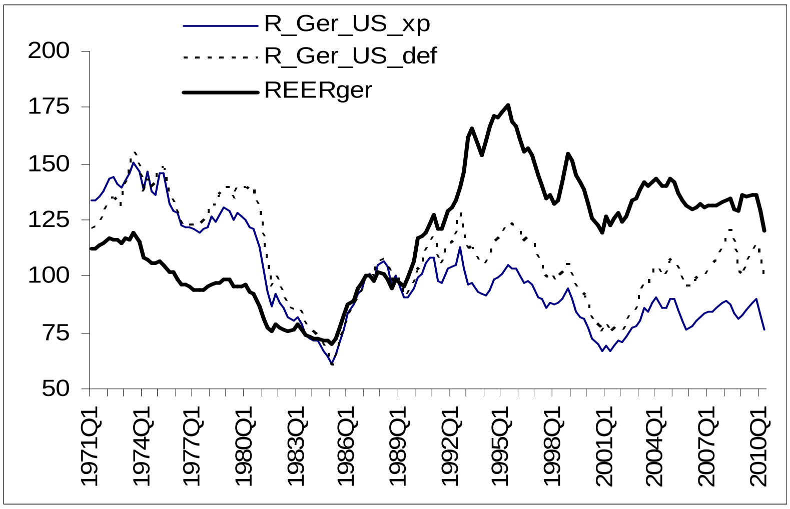

Figure 5: Real Bilateral and Effective Exchange Rates of Germany (1987Q1: 100)

For France (Figure 6), the differences appear more pronounced between the bilateral rates against the dollar (R_fra_us_def and R_fra_us_xp) and the effective rate (REERfra). This outcome might reflect the large size of its trade with the Middle East and North Africa (MENA), which accounted for 25–30% of French exports during the period. Moreover, though the effective rate evolves similarly to Germany's since the mid-1980s, reflecting the change in France's monetary policy (i.e., new European monetary system after 1987; see Giavazzi and Spaventa, 1990), we observe a marked divergence in the 1970s, resulting in higher inflation in France.

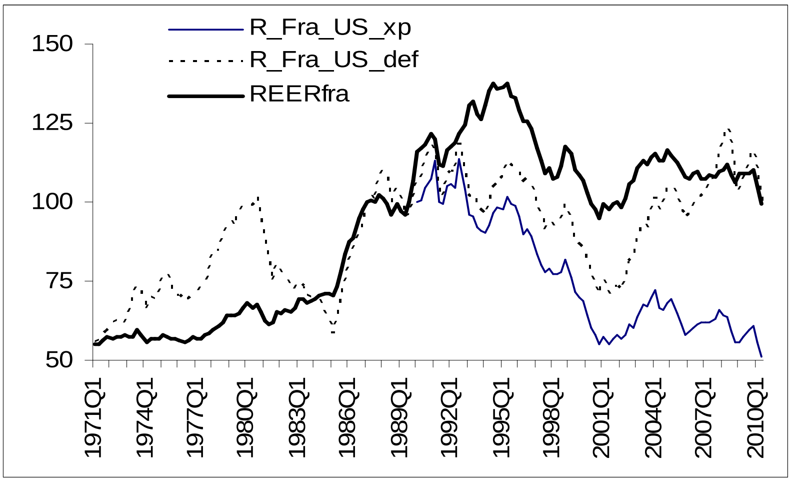

Figure 6: Real Bilateral and Effective Exchange Rates of France
(1987Q1: 100, and 1990Q1:100 for R_Fra_US_xp)

Finally, the calculation of bilateral rates between the euro area and the United States shows that the bilateral rates have been fairly stable over the past 40 years, using consumer prices (R_ez_us_cp) or wholesale prices (R_ez_us_wp). But over shorter periods, the fluctuations of the euro–dollar nominal exchange rate affect the real exchange rate and price competitiveness.

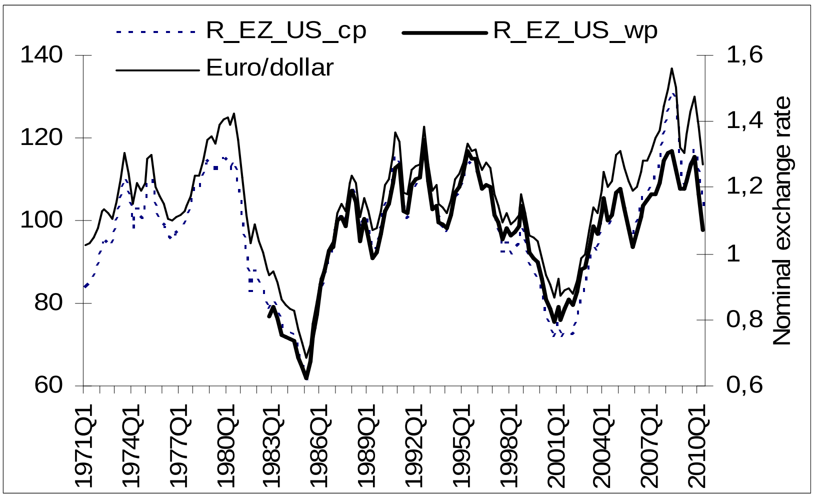

Figure 7: Real and Nominal Exchange Rates between the Eurozone and United States (1987 Q1:100)

2.2. Volatility of exchange rates

The exchange rate volatility is calculated from a conditional standard deviation (GARCH model) of the log difference in the nominal euro–dollar exchange rate. Volatility (*V*) is defined as $V = \sqrt{h}$, where *h* is the conditional variance derived from a GARCH (p, q) form:

$$h_t = \delta + \sum_{i=1}^{q} \alpha_i \cdot \varepsilon_{t-1}^2 + \sum_{j=1}^{p} \beta_j \cdot h_{t-1} , \quad (2)$$

and where $\delta > 0$; $\alpha \geq 0$; $\beta \geq 0$; and ε_t is the residual obtained from an underlying process[9] for a Ψ set of information, such as $\varepsilon_t / \Psi_{t-1} \sim N(0, h_t)$. Figure 8[10] shows the evolution of this volatility: high in the mid-1970s, corresponding to the end of the Bretton Woods system, and during the 1980s, relatively weak during the 1990s, while the rise at the end of the period coincides with the financial crisis.

[9] If e_t is equal to $\log(E_t / E_{t-1})$, then $e_t = \mu + \varepsilon_t$, with μ the mean e_t conditional on past information (Ψ_{t-1}).
[10] See Appendix 4 for the results of this estimation.

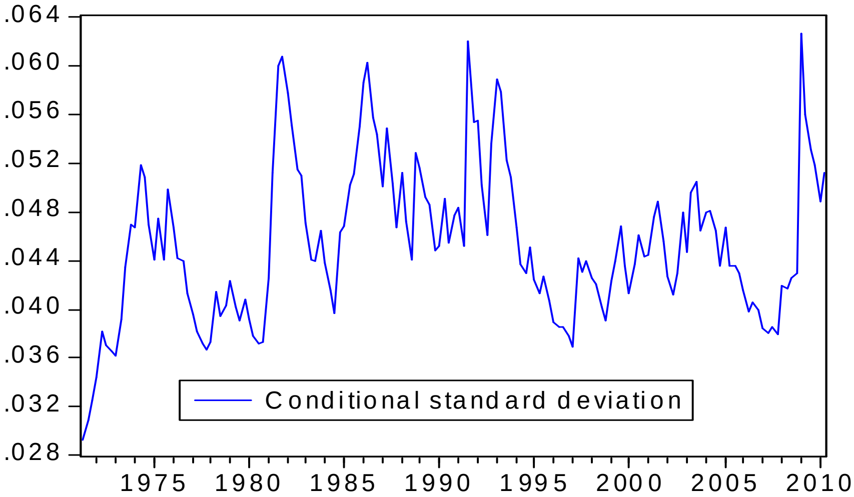

Figure 8: Volatility of the Nominal Euro–Dollar Exchange Rate

3. The export equations

3.1. The model

If X_i represents the total exports of goods from an *i* country (*i* = France, Germany), Y^* is the real GDP of partners (foreign economic activity), *R* is the real exchange rate of the euro, and *V* provides an indicator of the volatility of euro–dollar exchange rate, the export demand model takes the form:

$$X_i = X_i(Y^*, R, V), \tag{3}$$

where $\partial X_i / \partial Y^* > 0$, $\partial X_i / \partial R < 0$, and $\partial X_i / \partial V < 0 \; or > 0$

Real exports by France and Germany are limited to exports to partner countries that do not belong to the eurozone. To obtain the real exports of Germany, we divide the export value by the export price index; for France, because this index is not available throughout the study period, we divide the export value by the GDP deflator.[11]

The real GDP of the partner countries is defined as multilateral real GDP, which reflects the geometric mean of the real GDP of partners, weighted by the share of each partner among the extra-eurozone exports of France and Germany. The weights are identical to those used to calculate the real effective exchange rates. Considering the opening of central and eastern European countries (CEEC) in the early 1990s, we adopt two weighting schemes: (1) without CEECs for the period 1971Q1–1992Q2 and (2) with CEECs for the period 1992Q3–2010Q2. We expect a positive effect of a rise of GDP partners on exports.

For each country, we retain either the real effective exchange rate or the various bilateral real exchange rates with the volatility variable. A real appreciation of the euro (an increase in R) reduces exports. Higher volatility generally will have a negative impact on trade (risk aversion), though it might be positive if firms anticipate that higher volatility will increase their prospects for profits beyond the cost of entry or exit. According to some

[11] See Appendix 3.

scholars, "the capacity to export is tantamount to holding an option and when exchange rate volatility increases, the value of that option also increases, just as it would for any normal option" (McKenzie and Brooks, 1997 p.75). Finally, after a logarithmic transformation of all variables, we estimate the model in Equation (3) using cointegration.

3.2. Variables' statistical properties

To examine the statistical properties of the series, we use unit root tests, specifically, the augmented Dickey-Fuller (ADF) test and the Saikkonen and Lütkepohl (2002) test (hereafter, SL), which take into account the effects of unknown structural changes in the data. In addition, Saikkonen and Lütkepohl posit that a shift may spread over several periods rather than being restricted to a single period. The tests we use enable us to examine the null hypothesis of a unit root, based on the following general specification:

$$X_t = \mu_0 + \mu_1.t + f_t(\theta)'\gamma + z_t, \qquad (4)$$

where θ and γ are unknown parameters, t is the time trend, the error term z is generated by an *AR(p)* process, and $f_t(\theta)'\gamma$ is the shift function, which depends on θ and the regime shift date T_B. We consider three shift functions.

1. A simple shift dummy,

$$f_t^1 = d_{1,t} = \begin{cases} 0, & t < T_B \\ 1, & t \geq T_B \end{cases}. \qquad (5)$$

2. An exponential distribution function, which allows for a nonlinear gradual shift to a new level, starting at time T_B,

$$f_t^2(\theta) = \begin{cases} 0, & t < T_B \\ 1 - \exp[-\theta(t - T_B + 1)], & t \geq T_B \end{cases}. \qquad (6)$$

3. A function similar to a rational function with a lag operator applied to a variable dummy d_{1t}. The term regime change takes the form $\left[\gamma_1.(1-\theta L)^{-1} + \gamma_2(1-\theta L)^{-1}L\right]d_{1t}$, where θ is a scalar parameter between 0 and 1, and $\gamma=(\gamma_1,\gamma_2)'$:

$$f_t^3(\theta)'\gamma = \begin{cases} 0, & t < T_B \\ \gamma_1 & t = T_B \\ \gamma_1 + \sum_{j=1}^{t-T_B} \theta^{j-1}(\theta\gamma_1 + \gamma_2), & t \geq T_B \end{cases}. \qquad (7)$$

If we assume a model with a linear trend and shift term, the relevant parameters $\eta = (\mu_0, \mu_1, \gamma')'$ can be estimated by generalized least squares (GLS).[12] Then we apply an ADF test to the adjusted data, which include the series obtained by subtracting them from the original series.[13] The test results in Table 1 confirm that the variables are nonstationary; the only doubt pertains to the euro–dollar real exchange rate with the wholesale price, for which

[12] T_B corresponds to the date at which the GLS objective function is minimized (cf. Lütkepohl, 2004a).

[13] The adjusted series are $\hat{X}_t = X_t - \hat{\mu}_0 - \hat{\mu}_1.t - f_t(\hat{\theta})'\hat{\gamma}$.

nonstationarity is rejected at the 10% but not at the 5% level. Nevertheless for this variable, the estimation period is limited by the lack of data for wholesale prices in the euro area. Insofar as the variables of the export model are nonstationary, we can estimate the export equations using a cointegration method.

Table 1: Unit root tests

	Trend	ADF Tests	SL Tests (break date unknown a priori)				Conclusion
Variables (Log)		t-stat.(a)	Break date	Shift dummy t-stat(b)	Exp. distrib. t-stat(b)	Rational function t-stat(b)	
Extra-Eurozone exports							
XrGERxez	yes	-3.234*	2009Q1	-2.060	-1.899	-1.574	I(1)
XrFRAxez	yes	-2.640	2009Q1	-1.654	-1.620	-1.656	I(1)
PIB effectif							
GDPeff_ger	yes	-3.023	2009Q1	-1.981	-1.831	-1.644	I(1)
GDPeff_fra	yes	-2.846	2009Q1	-1.930	-1.789	-1.662	I(1)
Real exchange rates							
Germany							
REER_gerl	no	-1.272	2001Q1	-1.337	-1.325	-1.332	I(1)
R_ger_us_def	no	-2.101	1988Q3	-2.126	-2.115	-2.266	I(1)
R_ger_us_xp	no	-1.791	1992Q3	-1.713	-1.696	-2.247	I(1)
France							
REER_fra	no	-1.520	2001Q1	-1.521	-1.517	-1.599	I(1)
R_fra_us_def	no	-2.590*	1991Q2	-2.299	-2.247	-2.283	I(1)
R_fra_us_xp (c)	no	-1.735*	1991Q2	-0.657	-0.639	-1.242	I(1)
Eurozone							
R_ez_us_cp	no	-2.505	1992Q3	-2.464	-2.440	-2.275	I(1)
R_ez_us_wp(d)	no	-2.384	1991Q2	-2.596*	-2.592*	-2.741*	I(0) *
Volatility of the nominal euro–dollar exchange rate							
Euro/dollar	no	-0.7402	1981Q2	-3.498**	-2.500	-2.421	I(1)

*Significant at 10% level. **Significant at 5% level.
(a) For the ADF test, the lags are determined by the Schwartz criterion. Critical values for the 1%, 5%, and 10% levels are, respectively, -3.96, -3.41, and -3.13 for the model with trends and -3.48, -2.88, and -2.58 for the model without trends. (b) Critical values for the 1%, 5%, and 10% levels are, respectively, -3.55, -3.03, and -2.76 for the model with trends and -3.48, -2.88, and -2.58 for the model without trends. (c) Sample period: 1990Q1–2010Q2. (d) Sample period: 1982Q4–2010Q2

4. Cointegration

As the next step in our analysis, we investigated the number of cointegration relations between series, then estimated these relationships. Following the same approach employed for unit root tests, we adopt the estimation methods with the breaks developed by Saikkonen and

Lütkepohl (2000) for the cointegration tests and by Ahn and Reinsel (1990) for the estimation of the vector error correction model.[14]

4.1. Cointegration tests

In Table 2, we list the results of the various cointegration tests, for which we specify where order *p* using model selection criteria. For both countries, we always find at least one cointegration relationship, regardless of the definition of real exchange rate that we use.

Table 2: Cointegration Test Results

SL (without trend; $\mu = \mu_0 + \delta.D$) (a) LR Statistics						
$H_0(r_0): r = r_0$ $H_1(r_0): r > r_0$		r_0=0 r>0	r_0=1 r>1	r_0=2 r>2	r_0=3 r>3	
C.V. 5%		40.07	24.16	12.26	4.13	
C.V. 10%		37.04	21.76	10.47	2.98	
Real exchange rates	Lags					Deterministic terms
Germany						
REERger	4	46.77** (0.01)	25.10** (0.03)	3.67 (0.75)	0.85 (0.41)	Constant, d1981q2, d2001q1, d2009q1
R_ger_us_def	1	132.1** (0.00)	25.58** (0.03)	7.23 (0.30)	1.88 (0.20)	Constant, d1981q2, d1988q3, d2009q1
R_ger_us_xp	1	137.6** (0.00)	27.77** (0.01)	13.04** (0.04)	1.69 (0.23)	Constant, d1981q2, d1992q3, d2009q1
R_ez_us_cp	2	40.22** (0.04)	24.31** (0.04)	12.67** (0.04)	4.02* (0.06)	Constant, d1981q2, d1992q3, d2009q1
R_ez_us_wp (b)	2	39.77* (0.06)	21.68 (0.11)	5.36 (0.52)	2.54 (0.13)	Constant, d1991q2, d2009q1
France						
REERfra	2	45.45** (0.01)	21.55 (0.11)	3.00 (0.84)	0.13 (0.77)	Constant, d1981q2, d2001q1, d2009q1
R_fra_us_def	2	50.06** (0.00)	39.37** (0.00)	17.36** (0.01)	3.62* (0.07)	Constant, d1981q2, d1991q2, d2009q1
R_fra_us_xp (c)	2	40.12** (0.04)	14.51 (0.50)	7.57 (0.28)	0.60 (0.50)	Constant, d1991q2, d2009q1
R_ez_us_cp	2	49.70** (0.00)	37.10** 0.00)	12.32** (0.04)	3.46* (0.07)	Constant, d1981q2, d1992q3, d2009q1
R_ez_us_wp (b)	7	40.37**(0.04)	19.97 (0.16)	9.62 (0.14)	1.32 (0.29)	Constant, d1991q2, d2009q1

Notes: H_0 is the null hypothesis; r is the number of cointegration vectors. We compute the SL tests with JMulTi software. P-values in parentheses. L indicates the number of lags. *Rejection of the hypothesis at the 5% level. **Rejection of the hypothesis at the 10% level. (a) If a trend is orthogonal to the cointegration relations, it is captured by the intercept term. (b) Sample period: 1982Q4–2010Q2 (c) Sample period: 1990Q1–2010Q2

[14] For a detailed presentation, see Lütkepohl and Krätzig (2004).

4.2. Cointegration relationships over the global period

The results in Table 3[15] are broadly consistent with those predicted by the model, in the sense that a real appreciation of the euro, as a greater volatility, has a negative effect on exports from Germany and France, whereas an increase of GDP partners has a positive effect. However if we compare the estimates for the two countries, some differences are worth noting:

- Whatever the definition of real exchange rates, the price elasticities of French exports are higher than (on average, twice) those of German exports. The same holds for the coefficients of the volatility variable. This result is consistent with the lower market power of French exporters compared with German exporters, which leads them to adopt pricing-to-market (PTM) strategies. Gaulier et al. (2006, p. 185) note that "French exporters squeeze their margins to keep their export market shares while the German exporters directly transmit much more fluctuations in their export prices, allowing them to preserve their margins. When the euro depreciates, French exporters restore their margins, even losing price competitiveness." Our results confirm that the country with higher price elasticities also conducts more PTM. Our findings also echo those of Danninger and Joutz (2007), who use a real effective exchange rate calculated from unit labor costs and obtain price elasticities for German exports of between -0.2 and -0.4 in their study of total exports of goods between 1993 and 2005.
- Symmetrically, we obtain higher income elasticities for Germany, between 1.8 and 2.4 compared with 1.0 to 1.7 for France.

[15] Insofar as the French the export unit value index is only available from 1990Q1, we present only the estimation of the cointegration relationship over the euro period.

Table 3: Normalized Cointegrating Equations of Exports, 1971Q1–2010Q2

Variables Real exchange rates (Log)	Lags (a)	LogR	LogVol	LogGDPeff	Constant	Dummy Variables
Germany						
REERger	8	-0.107* (0.07)	-0.207 (0.12)	2.468** (0.00)	-6.281** (0.00)	D1981q2, TD2001q1, D2009q1
R_ger_us_def	3	-0.240** (0.01)	-0.334** (0.01)	2.045** (0.00)	-4.380** (0.00)	TD1981q2, D1988q3, D2009q1
R_ger_us_xp	7	-0.341** (0.00)	-0.213** (0.00)	1.819** (0.00)	-2.685** (0.004)	D1981q2, D1992q3, D2009q1
R_ez_us_cp	7	-0.335** (0.00)	-0.149** (0.03)	2.183** (0.00)	-3.891** (0.03)	D1981q2, D1992q3, D2009q1
R_ez_us_wp (b)	3	-0.308** (0.00)	-0.295** (0.00)	2.047** (0.00)	-3.936* (0.00)	D1991q2, D2009q1
France						
REERfra	3	-0.776** (0.001)	-0.560** (0.04)	1.674** (0.00)	-0.802 (0.48)	D1981q2, TD2001q1, D2009q1
R_fra_us_def	6	-0.638** (0.00)	-0.313* (0.06)	1.712** (0.00)	-0.595 (0.44)	TD1981q2, D1991q2, D2009q1
R_ez_us_cp	4	-0.457** (0.00)	-0.426** (0.03)	1.641** (0.00)	-1.424 (0.14)	TD1981q2, D1992q3, D2009q1
R_ez_us_wp (b)	6	-0.842** (0.00)	-0.500** (0.00)	1.042** (0.00)	2.098** (0.00)	D1991q2, D2009q1

Notes: p-values in parentheses. D indicates shift dummy; TD indicates trend shift dummy. ** Significant at the 5% level. * Significant at the 10% level. (a) Lags determined from Akaike (AIC) and Schwarz (SIC) information criteria. (b) Sample period: 1982Q4–2010Q2

Nevertheless, considering the many events that took place during the study period, it is possible that the behaviors and elasticities changed. We therefore test the stability of the model. In Table 4, we provide the results of two Chow tests, one that tests for the presence of a rupture (breakpoint test) at a date endogenously determined, and another that tests the validity of a decomposition into two subsamples (sample-split test).

For all models, the *p*-values obtained from chi-square tests, as well as seven of the nine *p*-values obtained by bootstrap, suggest the rejection of the stability hypothesis.[16] The breakpoint dates are usually around 1980, with the exception of the model that takes into account the wholesale price of the euro area, tested over a shorter period.

Table 4: Stability Tests

Real Exchange Rates	Break		Breakpoint Chow Test	Sample Split Chow Test
		Germany		
REERger	1984Q3	(1)	0.010**	0.070*
		(2)	0.000**	0.000*
R_ger_us_def	1978Q3	(1)	0.282	0.362
		(2)	0.000**	0.10*
R_ger_us_xp	1983Q3	(1)	0.174	0.042**
		(2)	0.000**	0.000**
R_ez_us_cp	1983Q2	(1)	0.304	0.182
		(2)	0.000**	0.000**
R_ez_us_wp	1989Q4	(1)	0.032**	0.374
		(2)	0.000**	0.082*
		France		
REERfra	1978Q2	(1)	0.010**	0.114
		(2)	0.009**	0.006*
R_fra_us_def	1982Q1	(1)	0.006**	0.000**
		(2)	0.000**	0.000**
R_ez_us_cp	1979Q3	(1)	0.020**	0.042**
		(2)	0.000**	0.000**
R_ez_us_wp	1998Q3	(1)	0.004**	0.006**
		(2)	0.000**	0.000**

(1) Bootstrap p-value. (2) Asymptotic chi-square p-value. ** Reject the null hypothesis of constant parameters (stability) at the 5% level. *Reject the null hypothesis of constant parameters (stability) at the 10% level.

It also seems useful to reestimate the model for the subperiods. To focus on the effects of the euro on trade, we stick to the second period, as revealed by the tests of stability. We

[16] For a detailed presentation of these tests, see Lütkepohl (2004b).

call it the "euro period," because it covers both the euro period *stricto sensu* (from 1999), and European Monetary System period (from 1979) that set the stage for the transition to the euro.

4.3. Cointegration relationships over the "euro period"

Table 5 provides the results for the cointegration relationships[17] estimated for the euro period. The differences observed in the values of elasticities become even more pronounced. Specifically, the price elasticities remain low in Germany, between -0.2 and -0.3, though the real effective rate indicates that elasticity is very low and not significant. This finding confirms that the euro–dollar exchange rate is the relevant factor for explaining German exports. All price elasticities fall between -0.6 and -0.9 for France, twice and triple in absolute value the results for Germany. Similarly, the coefficients of the volatility variable are negative and consistently higher for France.

The values of income elasticities are also quite different between the two countries. German exports are most sensitive to external demand, and all the models offer similar results, with coefficients of the trading partner GDP between 2 and 2.2. In contrast, elasticities are twice as low for France, between 0.8 and 1.3, depending on the model. The results are clear: German exports outside the euro area are very sensitive to external demand and weakly sensitive to price competitiveness, whereas French exports outside the euro area depend more heavily on price competitiveness and are less sensitive to external demand.

These observations further confirm that Germany has done better than France in terms of taking advantage of global growth. A 1% increase in foreign demand leads to a 2% average increase in German exports, compared with only 1% in French exports. This result reflects the differences in specialization for both countries. Whereas Germany exports more to the CEEC and Scandinavian countries or the United States, France is more heavily oriented toward MENA (see Table A2). Furthermore, the Germans have a significant advantage in the automotive, machinery, and equipment industries (L'Angevin and Serravalle, 2005), whereas France's advantage lies more in the areas of food and aerospace (Artus and Fontagné, 2006), which helps explain French reactions to the appreciation of the euro.

We also note that Germany appears to have taken advantage of the opening of CEEC and preserved its price and cost competitiveness, even as international competition increased. Noting hourly labor costs of 27.6 euros in 2004,[18] compared with 1.4 to 4.5 euros per hour in CEEC (Sinn, 2006), German companies relocated part of their production process, especially upstream activities that rely on unskilled labor, but kept more downstream activities that require more capital and skilled labor in the country. They thus "regionalize" their production processes, such that "Germany is gradually turning into a bazaar economy that is supplying the world with a broad range of products but has a growing share of the value of its goods produced in its Eastern hinterland" (Sinn, 2006, p. 1162; see also Boulhol, 2006). This shift has greatly increased the share of imported inputs, which rose from 28% in the early 1990s to 42% in 2005 (Danninger and Joutz, 2007).

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[17] The cointegration tests, not presented here, reveal at least one cointegration relationship in all cases.
[18] This cost is valued at 20.74 euros for France.

Table 5: Normalized Cointegrating Equations of Exports: “Euro period”

Variables Real exchange rates (Log)	Period	Lags(a)	LogR	logVol	LogGDPeff	Constant	Dummy Variables
				Germany			
REERger	1984Q3-2010Q2	6	-0.029 (0.76)	-0.473* (0.08)	2.273** (0.02)	-6.658** (0.00)	D2001q1, D2009q1
R_ger_us_def	1978Q3-2010Q2	1	-0.282** (0.00)	-0.292** (0.01)	2.063** (0.00)	-4.146** (0.00)	D1981q2, D1988q3, D2009q1
R_ger_us_xp	1983Q3-2010Q2	5	-0.277** (0.00)	-0.322** (0.00)	1.991** (0.01)	-3.903** (0.00)	D1992q3, D2009q1
R_ez_us_cp	1984Q4-2010Q2	5	-0.210** (0.00)	-0.357** (0.00)	2.049** (0.00)	-4.547** (0.00)	D1992q3, D2009q1
R_ez_us_wp	1989Q4-2010Q2	1	-0.317** (0.00)	-0.351** (0.00)	2.047** (0.00)	-4.067** (0.00)	D1991q2, D2009q1
				France			
REERfra	1978Q2-2010Q2	4	-0.623** (0.00)	-0.885** (0.01)	1.356** (0.00)	-1.307 (0.26)	D1981q2, D2001q1, D2009q1
R_fra_us_def	1982Q1-2010Q2	10	-0.706** (0.00)	-0.429** (0.00)	1.103** (0.00)	1.457** (0.00)	D1991q2, D2009q1
R_fra_us_xp	1990Q1-2010Q2	3	-0.920** (0.00)	-0.479** (0.00)	1.127** (0.01)	2.899** (0.03)	D1991q2,TD2009q1
R_ez_us_cp	1979Q3-2010Q2	4	-0.661** (0.00)	-0.768** (0.00)	1.094** (0.00)	0.345** (0.460)	D1981q2, D1992q3, D2009q1
R_ez_us_wp	1998Q3-2010Q2	7	-0.632** (0.00)	-0.392** (0.00)	0.863** (0.00)	2.528** (0.00)	D2009q1

Notes: p-values in parentheses. D indicates shift dummy; TD indicates trend shift dummy. ** Significant at the 5% level. * Significant at the 10% level. (a) Lags determined from Akaike (AIC) and Schwarz (SIC) information criteria.

Finally, the varying specializations of the two countries mean that Germany's exports are less sensitive to the appreciation of the euro. For example an appreciation by 10% leads to a reduction in the quantities exported by France from 6% to 9%, following the model, but the drop is only 2% for Germany.

5. Conclusions

Unlike most research on exports by European countries, particularly that relating to Germany and France, we focus on the export of goods from France and Germany to partners outside the eurozone. In so doing, we highlight the effect of the exchange rate, which is artificially reduced when we retain exports vis-à-vis all partners, because countries that trade heavily with each other often adopt the same currency.

For this effort, we estimate the long-term price and income elasticities with cointegration equations. We show that German exports are more responsive to external demand and, conversely, less sensitive to changes in the euro exchange rate. These results are robust against different definitions of the euro real exchange rate. They also hold when we consider the impact of higher volatilities for a single currency. To explain these differences, we concur that “the international fragmentation of production has grown faster in Germany than in France for fifteen years. This policy led by large companies has made substantial gains in competitiveness to Germany, although exports have thus earned relatively low employment content” (Artus and Fontagné, 2006, p. 65).

Extensions of our research might offer a supplementary analysis of the dynamics of short-term exports, which would help measure the impact of misalignments (over- or under-valuations) of the euro on exports. Overall though, with the results we offer herein, we understand why French economic actors, as well as its political leaders, worry more than their German counterparts about the value of the euro.

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Appendix 1: Definitions of the bilateral real exchange rates

We retain six different bilateral real exchange rates; two for Germany, two for France, and two for the eurozone.

Table A1: Definitions of real bilateral exchange rates

	Domestic Country Price Index	Partner Country Price Index	Period	Model
		Germany–United States		
R_ger_us_def	GDP deflator	GDP deflator	1971Q1- 2010Q2	Germany
R_ger_us_xp	Export price	Wholesale price	1971Q1- 2010Q2	Germany
		France–United States		
R_fra_us_def	GDP deflator	GDP deflator	1971Q1- 2010Q2	France
R_fra_us_xp (a)	Export U. V. index	Wholesale price	1990Q1-2010Q2	France
		Eurozone–United States		
R_ez_us_cp	Consumer price	Consumer price	1971Q1- 2010Q2	France and Germany
R_ez_us_wp (b)	Wholesale price	Wholesale price	1982Q4-2010Q2	France et Germany

Notes: U.V. indicates unit value (IFS CD-ROM). (a) The export unit value index for France is available from 1990Q1. (b) The wholesale price index for the eurozone is available from 1982Q4 (IFS CD-ROM).

Appendix 2: Weights of trading partners used to construct real effective exchange rates and effective GDP

We retain the main destinations/partners outside the eurozone for the exports of goods from Germany and France. At the end of the period, selected countries accounted, respectively, for 84% and 83% of exports outside the eurozone. To account for the opening of the former USSR and the countries of Central Europe, we distinguish two periods, 1971Q1–1992Q2 and 1992Q3–2010Q2. The weights are averages over each period.

Table A2: Weights of partners

Exporters	Germany		France	
	1971Q1-1992Q2	1992Q3-2010Q2	1971Q1-1992Q2	1992Q3-2010Q2
Partner countries	Average	Average	Average	Average
United States	0.1930	0.1631	0.1575	0.1440
Canada	0.0230	0.0194	0.0248	0.0227
Japan	0.0443	0.0374	0.0362	0.0331
United Kingdom	0.1967	0.1663	0.2210	0.2022
Scandinavia	0.1712	0.1447	0.0793	0.0725
Asia	0.1314	0.1111	0.1207	0.1104
CEEC	-	0.1549	-	0.0854
MENA	0.1269	0.1072	0.2723	0.2491
South America	0.0679	0.0574	0.0606	0.0554
Australia/N. Zealand	0.0210	0.0178	0.0143	0.0131
South Africa	0.0246	0.0208	0.0134	0.0122

Notes: Scandinavia includes Denmark and Sweden. Asia includes Indonesia, India, Asian NIC, and China. CEEC includes Ex-USRR, Turkey, and Central European countries. MENA includes Middle Eastern and North African countries. South America includes Brazil, Mexico, and Argentina.
Sources: Own calculations, from Chelem base

Appendix 3: Data sources

The euro–dollar exchange rate and consumer price index of the eurozone came from Datastream and Eurostat from 1971 to 1999, and International Financial Statistics (IFS) CD-ROM. Bilateral exports (yearly frequency) came from the Chelem base, total exports (quarterly) from IFS CD-ROM. Other variables came from IFS CD-ROM

Calculation of extra eurozone real exports: For both countries, we referred initially to export data from the Chelem base and IMF, provided for each partner and on a yearly basis for the Chelem base, as well as in total exports (all partners) and on a quarterly and annual basis for the IMF. Also, for each year we calculated the ratio of total exports to extra-eurozone exports. Extra-eurozone export data in quarterly frequency were obtained again, assuming that for the four quarters of a year, this ratio remains the same. Real exports of Germany were obtained by dividing the export value by export prices, and those of France were obtained by dividing by the GDP deflator.

Appendix 4: GARCH model estimation

Table A3: Estimation Results, GARCH(1,1) Euro–Dollar Nominal Exchange Rate, 1971Q12–2010Q2

Variable	δ	α	β	Log-likelihood
$\Delta LogE_{i/j}$	-0.0003 (0.35)	0.139 (0.28)	0.703** (0.00)	264.7

Notes: Entries in parentheses represent the p-values for the null hypothesis
** Significant at the 5% level.