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Modeling the dynamics of Spain's Relative Export Strength

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Abstract

In this paper we assess the current relevance of Ricardian theory. Relative prices, labor costs, and productivity are evaluated as determinants of a country's international competitiveness at the industry level. Working with detailed data on unit values and with industry data on productivity, we empirically implement a MacDougall-type model for Spanish and French trade to Brazil, China, Japan, and the U.S.. The period under study is 1980 to 2001 and we distinguish in our analysis between homogenous, reference-priced, and differentiated goods. Our results indicate that Ricardian theory is currently only valid for explaining trade with developing countries while other factors are of importance for developed economies. Overall price competitiveness is of importance, but for differentiated goods, factors distinct from prices seem to determine export success.

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Modeling the dynamics of Spain's Relative Export Strength

1. Introduction

As a consequence of the globalization process (progressive deregulation of trade achieved in multilateral trade rounds, regional and bilateral trade agreements, and integrated production systems), trade flows have grown in size 22 times since 1970, much more than the GDP during the same period.

International trade flows have changed as dramatically in content and direction over the past three decades as they have in size. What is the response of national economies to globalization in terms of trade? International trade theories (classical or new) predict that increasing globalization is associated with a higher production concentration of certain economic activities, and therefore increasing specialization, according to comparative advantage (Ricardo-type models) and economies of scale criteria (Krugman, 1991). Whereas Ricardian models are generally concerned with non-differentiated goods with a high degree of substitutability, trade theories based on monopolistic competition explain trade with differentiated products where the substitutability of goods is usually low (Gros, 1987). The features, product differentiation, increasing returns to scale, and monopolistic competition make those models useful in analyzing trade between industrial countries. Recent empirical evidence shows that trade in the extensive margin (a wider set of goods) is the dominant trend for large economies (e.g., Hummels and Klenow, 2005).

We will mainly focus on the first class of trade models to analyse the role of productivity differences in influencing international competitiveness. With respect to the second class of models that refers to differentiated products, we are only able to include export unit values as indicators of product characteristics (product quality), since product quality and product design are barely quantifiable.

The relationship between productivity and competitiveness has scarcely been investigated within the framework of the classical Ricardian model. Since the early studies by MacDougall (MacDougall, 1951, 1952 and MacDougall et al., 1962), as well as those by Stern (1962), Balassa (1963), and McGilvray, J. and Simpson D. (1973), only a few authors have recently evaluated the empirical validity of the Ricardian model.

Golub and Hsieh (2000) assessed the contemporary relevance of the classical model for US trade over the period 1970-1992. They found some evidence supporting the theory, but much of the sectoral variation in trade remained unexplained. Choudhri and Schembri (2002) used a modern adaptation of the Ricardian model, which incorporates monopolistic competition and derived a MacDougall-type relationship. They tested this relationship for Canada and the U.S. using panel data for 1966 through 1990 for forty industries. Their results also support the validity of the Ricardian model, although other factors, such as trade liberalization, also play an important role in explaining market shares. This paper extends and updates the existent literature using a different set of countries and years. Since most of the empirical evidence in this field is related to U.S. international trade, we aim to extend the evidence to other countries, and specifically to North-South trade.

In the remainder of the paper, Section 2 briefly presents the Ricardian model. Section 3 describes the data and sources and the empirical implementation of the model. Section 4 presents some results and Section 5 concludes.

2. The Ricardian Model

According to the Ricardian model of free trade, countries tend to export those goods which have the lowest relative costs in autarky. In its simplest form, *comparative advantage* is defined in terms of unit labor requirements in a world of two goods and two countries. Assuming that labor is the only factor of production, the supply of labor is fixed in each country and perfect competition prevails in all markets; Country 1 has a comparative advantage in producing Good i, compared to Country 2 and Good j, if it can produce Good i with less labor relative to Good j, compared to Country 2. Thus,

$$\frac{a_i^1}{a_j^1} < \frac{a_i^2}{a_j^2} \tag{1}$$

It can be shown that world output increases if one or both countries specialize in producing the good in which they have comparative advantage.

The Ricardian model can easily be generalized to multiple goods, i=1,…,N. A ranking can be constructed over the N goods' relative labor requirements in the two countries. The new formulation in terms of Country 1's labor requirements is given by,

$$\frac{a_1^1}{a_1^2} < \frac{a_2^1}{a_2^2} < \ldots < \frac{a_N^1}{a_N^2} \tag{2}$$

According to the theory, Country 1 specializes in goods that lie to the left in this chain, whereas Country 2 specializes in goods that lie to the right. Assuming free trade, a unique break point exists that determines the patterns of specialization in both countries. Although this result does not fully specify the pattern of trade, as in the two-goods case (since a number of goods may not be exported by one or both countries), it nonetheless shows some role for comparative advantage. If Countries 1 and 2 are any two countries in the world, in a world of many countries, it can still be stated that with free trade all of the goods exported by Country 1 and not exported by Country 2 will lie on the left of goods exported by Country 2 in this chain. Therefore, Equation 2 could be used to make partial statements about patterns of trade. In a world of many goods and countries, specialization is associated somehow with low unit labor requirements (Dornbusch, Fischer, and Samuelson, 1977).

Although the Ricardian model is static in nature, recent theoretical developments that integrate trade models and economic growth models (e.g., Lucas, 1988—Ricardian model with learning-by-doing-driven technical progress) indicate that specialization enhances technical progress in exporting industries, reinforcing comparative advantage. Cuñat and Maffezzoli (2007) also present a dynamic comparative advantage model to analyze the effects of falling trade barriers on trade volumes over time.

3. Data sources and empirical implementation

3.1 Data sources and variables

The main problem faced by researchers when they attempt to test the Ricardian theory is that autarky prices are not observable; hence the theory of comparative advantage cannot be directly tested. However, there are other factors that may be observable and that help to explain which goods countries trade; autarky prices then could be explained with country-specific characteristics.

The main data sources are the Groningen Center[4] for productivity and labor compensation at the industry level and the United Nations Commodity Trade Statistics Database (COMTRADE) for disaggregated exports in value and volume. The Groningen Growth and Development Centre carries out research on comparative analysis of levels of economic performance and differences in growth rates in the world economy. The International Comparisons of Output and Productivity by Industry Database (ICOP) consists of relative levels of productivity and unit labor costs for 20 manufacturing industries in 14 countries in the European Union and the United States. The series are based primarily on 1997 benchmark comparisons. The current contents of this database are equal to the Manufacturing Productivity and Unit Labour Cost Database (MPULCD), which is part of a joint study by the GGDC and the National Institute of Economic and Social Research described in O'Mahony and van Ark (2003). Variables covered include current value added, value-added deflators, persons engaged, number of employees, hours worked and labor compensation for the period from 1979 to 2001. For most variables and countries, the OECD Structural Analysis (STAN)

[4] http://www.ggdc.net/

database is taken as the point of departure, which is largely based on national accounts of individual OECD member states. The STAN data are complemented and updated by the use of information from industry surveys and from national accounts of individual countries. The variables used in this research are defined below.

Value added per hour worked is current gross value added, measured at producer prices or at basic prices (depending on the valuation used in the national accounts), in U.S. dollars (at current exchange rates) divided by average annual hours worked per employee.

Labor compensation per hour worked is current price labor costs borne by the employer, in U.S. dollars (at current exchange rates) divided by average annual hours worked per employee. It includes wages, as well as the costs of supplements such as employers' compulsory pension or medical payments. Labor costs can exceed the value added in cases where an industry incurs losses or receives significant net subsidies.

Unit labor costs is labor compensation divided by the value added.

Exports values and quantities were extracted from the UN COMTRADE. The level of disaggregation is four digits according to the Standard International Trade Classification (SITC), Revision 2. *Unit values* are calculated as export values divided by export quantities.

Since exports are classified according to the SITC classification (Revision 2), whereas production data are derived from the ISIC (Revision 2) at three-digit industry level, a conversion table taken from the Jon Haveman Web page[5] has been used.

Table 1 summarizes some descriptive statistics on labor productivity and labor costs for France relative to Spain at the industry level. Whereas a figure greater than one indicates an advantage in productivity for France relative to Spain, figures greater than one indicate a disadvantage for France relative to Spain in labor costs and unit labor costs. For all sectors we observe relative advantages in productivity (value added per hour) and relative disadvantages in labor costs for France. The unit labor costs summarize both indicators in one figure. Here

[5] http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html

we find a mixed picture, relative advantages for France in most of the more differentiated sectors and relative advantages for Spain in the other sectors. On average, Spain has a slight advantage over France in total manufacturing measured in unit labor costs.

The Appendix shows the evolution over time of French unit labor costs relative to Spanish labor costs for each industry.

3.2 Empirical implementation

To test the Ricardian model, we perform a panel analysis of French exports relative to Spanish exports over the period from 1980 to 2001. Following MacDougall (1951, 1952), Stern (1962), and Balassa (1963), export ratios are used as a measure of trade. As in Balassa, we use exports to third markets. The independent variables considered are: relative productivity, relative labor costs, and relative unit values. We set up the following specifications to capture the model described above:

$$\ln\left(\frac{X_{ijkt}}{X_{ljkt}}\right) = \alpha_j + \beta_j \ln\left(\frac{UV_{ijkt}}{UV_{ljkt}}\right) + \lambda_j \ln\left(\frac{ulc_{ikt}}{ulc_{lkt}}\right) + \mu_{jkt}, \quad (3)$$

$$\ln\left(\frac{X_{ijkt}}{X_{ljkt}}\right) = \alpha_j + \beta_j \ln\left(\frac{UV_{ijkt}}{UV_{ljkt}}\right) + \chi_j \ln\left(\frac{a_{ikt}}{a_{lkt}}\right) + \delta_j \ln\left(\frac{w_{ikt}}{w_{lkt}}\right) + \varepsilon_{jkt}, \quad (4)$$

where X_{ijkt} (X_{ljkt}) denotes exports from Country *i (l*) to Country *j*, for Sector *k* in Period *t.* UV_{ijkt} and UV_{ljkt} denote French (*i*) and Spanish (*l*) export unit values to Destination *j*, for Sector *k* in Period *t.* a_{ikt} and a_{ljkt} denote French (*i*) and Spanish (*l*) labor productivity for Sector *k* in Period *t.* w_{ikt} and w_{lkt} denote French (*i*) and Spanish (*l*) labor compensation per employee for Sector *k* in Period *t. ulc* denotes unit labor costs and is calculated as *(w/a).* As destination markets *j*, we chose Japan, the U.S., Brazil, and China, two large developed economies, as well as two important emerging markets. One should note that the unit values differ across sectors and destination markets, whereas the productivity and labor-cost data are constant across destination markets and only differ across sectors. Equation 3 is a restricted form of Equation 4; the main restriction is that the coefficients for relative productivities and relative wages have the same magnitude but opposite signs ($\chi_j = -\delta_j = \lambda_j$) . The restriction will be tested empirically. We expect a positive impact of relative labor productivity on relative exports, a negative impact of relative wages and relative unit labor costs on relative export strength, and a negative impact of relative unit values on relative exports when trade with standard products is considered.

Following Rauch (1999), we classify sectors into three different groups, namely homogeneous (Rauch 1), reference-priced (Rauch 2), and differentiated goods (Rauch 3). Rauch 1 and Rauch 2 belong to the category of standard products that are expected to have a negative price impact. In our estimations we include dummies for the different groups into Equations 3 and 4 or restrict our sample to one of the three groups to acknowledge the differences between these types of goods. We would expect that price competitiveness is less important for differentiated goods than it is for homogeneous or reference-priced goods. Other factors like quality, variety, or uniqueness should be more important for these types of goods.

Next, comparative advantage can also be understood as a dynamic process. The pattern of specialization today depends on past specialization. Countries' relative exports and the degree to which they specialize in producing a given good are not independent from the "recent history." To capture these dynamics, we estimate a dynamic version of Model 4 that includes a lagged dependent variable as an additional regressor:

$$\ln\left(\frac{X_{ijkt}}{X_{ljkt}}\right) = \alpha_j + \varphi_j \ln\left(\frac{X_{ijkt}}{X_{ljkt}}\right)_{(-1)} \beta_j \ln\left(\frac{UV_{ijkt}}{UV_{ljkt}}\right) + \chi_j \ln\left(\frac{a_{ikt}}{a_{lkt}}\right) + \delta_j \ln\left(\frac{w_{ikt}}{w_{lkt}}\right) + \varepsilon_{jkt} \qquad (5)$$

4. The econometric model and results

In the empirical application, we simplify the terms used in Equations 3 and 4 which have France in the numerator and Spain in the denominator. *lxv* stands for relative (France over Spain) export strength in logs, *luv* is utilized for relative unit values in logs, *lw* is relative labor compensation, and *lva* is relative productivity in logs. *j* characterizes the destination market, k stands for sector, and t stands for time. We obtain the following Equations 6 and 7:

$$lxv_{jkt} = \alpha_j^{'} + \beta_j^{'} luv_{jkt} + \lambda_j lulc_{jkt} + \varepsilon_{jkt}^{'} . \tag{6}$$

$$lxv_{jkt} = \alpha_j + \beta_j luv_{jkt} + \chi_j lva_{jkt} + \delta_j lw_{jkt} + \varepsilon_{jkt} \tag{7}$$

To control for cross-correlation between destination markets *j*, we estimate Specifications 6 and 7 respectively as a system, with one equation for each destination market using seemingly unrelated regression (SUR). In prior estimations, we allow for country-specific constants and country-specific coefficients. However, testing for equality of the coefficients using a Wald test indicates that the differences between the coefficients are not significant in all cases. We therefore estimate Equations 6 and 7 with common coefficients and country-specific constants. Autocorrelation is addressed by the inclusion of AR(1) terms. It appears that heteroskedasticity does not affect the estimated coefficients; all SUR results presented are robust compared to GLS approaches[6].

In order to model dynamics we considered the introduction of the Koyck geometric lag structure that introduces the lagged dependent variable as an additional regressor. The main disadvantages of this specification are related to the statistical difficulties caused by the combination of an endogenous regressor (lagged relative exports) and autocorrelated errors. As a result, the OLS estimates are biased and inconsistent (the coefficient of the lagged dependent variable is biased towards unity, whereas the remaining coefficients are biased towards zero).

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6 Models 5 and 6 were also estimated using weighted least squares. Results are available upon request from the authors.

These difficulties can be easily overcome using more sophisticated estimation techniques that control for endogeneity of the explanatory variables and for autocorrelated errors. The dynamic specification is given by

$$lxv_{jkt} = \alpha_j + \varphi_{jkt} lxv_{jkt-1} + \beta_j luv_{jkt} + \chi_j lva_{jkt} + \delta_j lw_{jkt} + \varepsilon_{jkt} \quad (8)$$

Instrumental-variable techniques are required to remove the econometric problem of joint endogeneity in Equation 8, whereas taking first differences could be a way to eliminate unobserved heterogeneity. According to the Arellano and Bond (1991) estimator, Model 8 in first differences is estimated, taking as valid instruments for the differenced components of endogenous explanatory variables (lxv_{jkt-1}-lxv_{jkt-2}) lagged values of the original regressors[7]. The estimated model is

$$\begin{aligned} lxv_{jkt} - lxv_{jkt-1} &= \alpha_j + \varphi_{jkt}(lxv_{jkt-1} - lxv_{jkt-2}) + \beta_j(luv_{jkt} - luv_{jkt-1}) + \chi_j(lva_{jkt} - lva_{jkt-1}) + \\ &+ \delta_j(lw_{jkt} - lw_{jkt-1}) + (\varepsilon_{jkt} - \varepsilon_{jkt-1}) \end{aligned} \quad (9)$$

We have the following moment conditions:

$$E(lxv_{jkt-s}[\varepsilon_{jk} - \varepsilon_{jkt-1}]) = 0 \quad (10)$$

The exogenous variables can be used directly as instrumental variables in Equation 9.

Nevertheless, the loss of information caused by taking first differences is detrimental to the validity of the data and, when the time dimension is not very short (20 years), as in our case, another option is to estimate the dynamic model in levels using instruments for the lagged dependent variable and adding an AR(1) term to control for autocorrelation. As demonstrated by Baltagi and Griffin (1983) and Baltagi, Bresson, Griffin, and Pirotte (2003), this model performs better in terms of out-of-sample forecast accuracy.

[7] Satisfactory instruments outside the model are difficult to find and we are constrained to use lagged values of endogenous variables as instruments. Although the use of these instruments has limitations, they give us the possibility of dealing with the endogeneity issue.

First we present the results for the static model. Table 2 reports the results for French, relative to Spanish, exports to four destination markets: the U.S., Brazil, Japan, and China[8]. The period under study is 1980 to 2001. At a first glance these results support the Ricardian theory of comparative advantage; the coefficients for unit labor costs, labor costs, and value added are significant and show the expected sign (negative signs for Unit Labor Costs and Labor Costs and a positive sign for Value Added). The restriction that the coefficients for relative productivities and relative wages have the same magnitude but opposite signs (χ_j=-δ_j= λ_j) cannot be rejected. The coefficient of the unit values is significant with the expected sign as well, but it is rather small. The negative and significant coefficients of the Rauch 1 and Rauch 2 dummies indicate that France has an advantage over Spain in exporting differentiated goods compared to homogenous and reference-priced goods. Compared to other studies[9], the explanatory power of our estimates is rather high, which might be due to the fact that this study, in contrast to previous ones, evaluates the time-series properties of the data.

In a next step we estimated the model for reference-priced and differentiated goods separately. The results are shown in the second and third columns of Table 3. Since our productivity data mainly include manufacturing, there is only a relatively small number of observations available for homogeneous goods, excluding most agricultural products.

Consequently, we prefer to not draw conclusions from a sub-sample, including only Rauch 1 goods. For reference-priced goods, we find that that labor costs and unit values have a greater impact than they have for *all goods*, whereas productivity turns out to be insignificant. In contrast to differentiated goods, unit values have a positive sign, indicating that other factors apart from price competitiveness seem to play a role. While labor costs are only weakly significant, both labor costs and productivity carry the expected signs.

[8] The model was also estimated for exports to the world. The results obtained, available upon request from the authors, also supported the Ricardian theory.
[9] Golub and Hsieh (2000).

We expect differences in the validity of Ricardian theory between developed and developing economies. As Hummels and Klenow (2005) have shown, it is the extensive margin, a larger variety of goods exported, which determines export success among developed economies. Therefore it can be expected that the theory of comparative advantage and specialization in production might still be explaining trade with developing countries but not trade between developed economies. To examine these differences we first estimate the model including only Brazil and China as destination markets (Table 4). In this case the results are perfectly consistent with Ricardian theory; all coefficients are significant and show the expected sign. However, the restriction that the coefficients for relative productivities and relative wages have the same magnitude but opposite signs (χ_j=-δ_j= λ_j) is now rejected by the data. Once more, the Rauch 1 and Rauch 2 dummies are negative and significant.

When we compare the results obtained from the reference-priced and differentiated goods sub-samples (Table 5) we find that competitiveness in labor costs and unit values is of major importance for reference-priced goods, while productivity turns out to be insignificant. For differentiated goods, both labor costs and productivity are significant and show the expected signs and almost the same magnitude. In contrast, the unit-value coefficient has a positive and weakly significant sign, indicating that it is not price competitiveness that explains export success for this type of goods.

The results for the two developing countries differ from what we find when we restrict the sample to Japan and the U.S. (Table 6). Neither the coefficients of unit labor costs nor productivity or labor costs are significant. Only price competitiveness seems to play a role, but the estimated coefficient is rather small. Hence, the estimation results for the developed countries in our sample do not support the theory of comparative advantage and specialization in production.

The dynamic model estimation results are presented in Tables 7 through 9. Table 7 shows the estimates of Equation 8 in Columns 1 and 2 and the estimates of Equation 9 in Column 3. The main result is that dynamics are important, since the coefficient of the lagged dependent variable is always significant and positive, indicating that past relative export strength influences current export strength. The short-run coefficients of wages, productivities, and unit values show slightly lower magnitudes than in the static model (Table 2). Due to the important loss of information (number of observations) when taking first differences, only the results of the dynamic model in levels (using instruments) are shown for sub-groups of countries and for different types of products[10].

Table 8 displays the estimates for the two sub-samples—Brazil and China results in Column 2 and Japan and the U.S. in Column 3. Relative wages and relative productivities are significant for Brazil and China, whereas relative wages and unit values are significant for Japan and the U.S.

Finally, Table 9 shows the estimates for different types of products. Only relative export unit values are significant (and have a negative coefficient) for referenced price goods (Rauch 2) indicating that price competitiveness is the main force determining dynamic comparative advantage. Relative productivities and relative export unit values are significant for differentiated goods (Rauch 3), but the estimated coefficient for relative export unit values is positive. This could be indicating that in the case of exports of differentiated goods, unit values may be a proxy for better quality products.

5. Conclusions

The aim of our study was to examine the validity of the Ricardian model for different types of destination markets. Brazil and China are representatives of emerging/developing markets; Japan and the U.S. represent highly industrialized countries. Theory would lead us to expect

[10] The estimation results for the equations in differences are available upon request from the authors.

more inter-industry (Ricardo type) trade between France and Spain and developing countries and to observe more intra-industry trade between France and Spain and industrialized countries. Furthermore, according to the theory, inter-industry trade is driven by price competitiveness factors, whereas intra-industry trade is driven primarily by factors related to taste differences, product variety, and product quality.

In fact, our empirical analysis indicates that Spanish exports to developing countries (Brazil and China), relative to French exports to those countries, can well be explained by the Ricardian model, i.e., by labor compensation and labor productivity (unit labor costs). In contrast, Spanish exports to developed countries, relative to French exports, are not so much determined by unit labor costs but by product characteristics. This conclusion is supported by the high proportion of intra-industry trade among industrialized countries. Products are imported because consumers of developed countries desire variety and are willing to pay more for a product with certain characteristics.

The empirical evidence shows that the simpler model with common coefficients for destination markets provides more robust results than the model with destination-market-specific coefficients. However, there are some interesting differences in the coefficients when different types of products are investigated. Relative exports of products in the categories homogenous goods (Rauch 1) and reference-priced goods (Rauch 2) depend on price advantages and are therefore governed by price competitiveness factors. In contrast, relative exports of differentiated products (Rauch 3) are positively related to unit values. For this type of good, a higher relative price seems to be an indicator of higher quality or superior product properties, explaining why relative exports rise with increasing prices.

Modeling dynamics is also important and the results obtained when estimating the dynamic specification support the evidence found when estimating the static model.

In summary, the results in this paper add some evidence showing that Ricardian theory is valid to explain North-South trade and that dynamics are important. Although price competitiveness is almost always an issue, other factors aside from price differences are probably more relevant in determining export success for differentiated goods. Consequently, “new” trade theories, related to monopolistic competition and economies of scale, are certainly more appropriate to explain trade among developed countries.

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Table 1 *Descriptive Statistics on Relative Productivity and Labor Costs*

	Relative value added per hour			Relative labor costs per hour			Relative unit labor costs		
	Min.	**Average**	**Max.**	**Min.**	**Average**	**Max.**	**Min.**	**Average**	**Max.**
Food, drink & tobacco	1.267	1.434	2.072	1.344	1.591	1.790	0.838	1.122	1.351
Textiles	1.265	1.466	1.665	1.457	1.751	1.922	1.025	1.199	1.383
Clothing	1.091	1.409	1.774	1.659	1.966	2.288	1.147	1.413	1.723
Leather and footwear	1.350	1.770	2.685	1.720	1.984	2.260	0.740	1.162	1.428
Wood & products of wood and cork	1.493	1.671	2.461	1.430	1.715	2.082	0.804	1.033	1.324
Pulp, paper & paper products	0.809	1.129	1.463	1.296	1.574	1.738	0.906	1.422	2.018
Printing & publishing	1.109	1.379	1.981	1.403	1.725	2.333	0.937	1.276	1.554
Chemicals	1.299	1.574	1.968	1.273	1.625	1.797	0.863	1.040	1.335
Rubber & plastics	0.916	1.087	1.328	1.050	1.408	1.644	1.016	1.305	1.656
Non-metallic mineral products	1.075	1.176	1.296	1.391	1.777	1.991	1.123	1.518	1.787
Basic metals	1.050	1.354	1.638	1.202	1.426	1.590	0.734	1.079	1.512
Fabricated metal products	1.759	2.124	2.663	1.415	1.769	2.070	0.718	0.839	0.980
Mechanical engineering	1.285	1.506	1.748	1.313	1.578	1.769	0.903	1.055	1.377
Office machinery	1.931	3.192	9.439	1.516	2.239	3.055	0.292	0.795	1.293
Insulated wire	1.195	1.586	2.066	1.184	1.483	1.820	0.720	0.947	1.270
Other electrical machinery and apparatus nec.	1.408	1.662	1.862	1.321	1.606	1.861	0.834	0.968	1.113
Electronic valves and tubes	1.684	2.348	3.088	1.267	1.671	2.021	0.516	0.741	1.155
Telecommunication equipment	1.130	2.116	3.165	0.931	1.355	1.809	0.464	0.664	0.867
Radio and television receivers	1.455	1.842	2.515	0.824	1.449	2.486	0.427	0.801	1.439
Scientific instruments	1.809	2.198	2.882	1.512	1.859	2.172	0.625	0.864	1.137
Other instruments	1.127	1.474	1.886	0.901	1.323	2.465	0.626	0.893	1.307
Motor vehicles	0.691	1.006	1.457	1.047	1.364	1.655	0.920	1.396	1.970
Building and repairing of ships and boats	0.996	1.795	3.535	0.730	1.882	2.994	0.416	1.122	1.618
Aircraft and spacecraft	1.077	2.423	4.910	1.181	1.895	2.617	0.434	0.923	1.502
Railroad equipment and transport equip. nec.	0.978	1.909	2.783	1.073	1.508	2.331	0.468	0.854	1.747
Furniture, miscellaneous manufacturing; recycling	1.176	1.363	1.474	1.495	1.788	2.080	1.133	1.314	1.473
Total manufacturing	**1.400**	**1.512**	**1.741**	**1.404**	**1.707**	**1.893**	**0.996**	**1.132**	**1.299**

Note: Average values over the period for French exports relative to Spanish exports.

Table 2 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil, China, Japan, and the U.S.*

Estimation method: SUR	Equation 6		Equation 7	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lulc	-0.229	0.022	-	
lw	-		-0.231	0.117
lva	-		0.228	0.060
luv	-0.039	0.000	-0.039	0.000
AR(1)	0.749	0.000	0.749	0.000
Rauch 1	-1.478	0.000	-1.479	0.000
Rauch 2	-0.429	0.000	-0.429	0.000
Constant Brazil	1.066	0.000	1.068	0.000
Constant China	1.482	0.000	1.484	0.000
Constant Japan	2.304	0.000	2.305	0.000
Constant U.S.	1.792	0.000	1.793	0.000
Brazil Observations: 4352				
Adjusted R-squared	0.513		0.513	
Durbin-Watson	2.166		2.166	
China Observations: 2468				
Adjusted R-squared	0.310		0.309	
Durbin-Watson	2.394		2.394	
Japan Observations: 6060				
Adjusted R-squared	0.641		0.641	
Durbin-Watson	2.068		2.068	
U.S. Observations: 8178				
Adjusted R-squared	0.647		0.647	
Durbin-Watson	2.158		2.158	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain). lulc denotes unit labor cost, lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification

Table 3 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil China, Japan, and the U.S. (Rauch 2 and Rauch 3)*

Estimation method: SUR	Rauch 2		Rauch 3	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lw	-1.139	0.006	-0.283	0.080
lva	-0.329	0.285	0.412	0.002
luv	-0.283	0.000	0.022	0.043
AR(1)	0.721	0.000	0.734	0.000
Constant Brazil	1.679	0.000	0.956	0.000
Constant China	1.394	0.000	1.521	0.000
Constant Japan	2.453	0.000	2.270	0.000
Constant U.S.	2.147	0.000	1.692	0.000
Brazil Observations:	1076		3198	
Adjusted R-squared	0.540		0.491	
Durbin-Watson	2.043		2.187	
China Observations:	599		1832	
Adjusted R-squared	0.230		0.325	
Durbin-Watson	2.202		2.392	
Japan Observations:	1263		4637	
Adjusted R-squared	0.617		0.629	
Durbin-Watson	2.100		2.025	
U.S. Observations:	1801		6136	
Adjusted R-squared	0.623		0.655	
Durbin-Watson	2.055		2.121	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain). lulc denotes unit labor cost, lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

Table 4 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil and China*

Estimation method: SUR	Equation 6		Equation 7	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lulc	-0.688	0.002		
lw	-		-0.803	0.017
lva	-		0.642	0.007
luv	-0.054	0.005	-0.054	0.005
AR(1)	0.650	0.000	0.650	0.000
Rauch 1	-2.476	0.000	-2.485	0.000
Rauch 2	-0.377	0.012	-0.382	0.011
Constant Brazil	1.221	0.000	1.298	0.000
Constant China	1.603	0.000	1.681	0.000
Brazil observations: 4352				
Adjusted R-squared	0.515		0.515	
Durbin-Watson	1.954		1.954	
China observations: 2468				
Adjusted R-squared	0.339		0.339	
Durbin-Watson	2.234		2.234	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain). lulc denotes unit labor cost, lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

Table 5 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil and China (Rauch 2 and Rauch 3)*

Estimation method: SUR	Rauch 2		Rauch 3	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lw	-1.973	0.012	-0.767	0.041
lva	0.447	0.391	0.752	0.005
luv	-0.368	0.000	0.041	0.064
AR(1)	0.636	0.000	0.639	0.000
Constant Brazil	1.858	0.000	1.154	0.000
Constant China	1.556	0.000	1.696	0.000
Brazil observations:	1076		3198	
Adjusted R-squared	0.537		0.492	
Durbin-Watson	1.854		1.976	
China observations:	599		1832	
Adjusted R-squared	0.262		0.349	
Durbin-Watson	2.054		2.229	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain). lulc denotes unit labor cost, lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

Table 6 *Determinants of French Export Strength Relative to Spanish Export Strength for Japan and the U.S.*

Estimation method: SUR	Equation 6		Equation 7	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lulc	-0.132	0.229		
lw	-		-0.117	0.467
lva	-		0.143	0.291
luv	-0.034	0.002	-0.034	0.002
AR(1)	0.784	0.000	0.784	0.000
Rauch 1	-1.324	0.000	-1.322	0.000
Rauch 2	-0.472	0.000	-0.471	0.000
Constant Japan	2.258	0.000	2.245	0.000
Constant U.S.	1.752	0.000	1.740	0.000
Japan observations: 6060				
Adjusted R-squared	0.643		0.643	
Durbin-Watson	2.153		2.154	
U.S. observations: 8178				
Adjusted R-squared	0.648		0.648	
Durbin-Watson	2.249		2.249	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain). lulc denotes unit labor cost, lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

Table 7 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil China, Japan, and the U.S.: Dynamic model*

	Levels (Equation 8) FE		Levels (Equation 8) 3SLS		Differences (Equation 9) A&B	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
lw	-0.220	0.001	-0.169	0.007	0.222	0.349
lva	0.114	0.008	0.084	0.056	0.412	0.041
luv	-0.017	0.022	-0.008	0.284	0.005	0.729
Lxv(-1)	0.847	0.000	0.859	0.000	0.691	0.001
Rauch 1	-0.281	0.000	-0.211	0.000	0.021	0.851
Rauch 2	-0.064	0.002	-0.026	0.209	0.018	0.653
AR(1)	-0.275		-0.278	0.000	-	-
Constant Brazil	-0.109		0.169	0.000	-0.028	0.558
Constant China	-0.042		0.254	0.000	-0.067	0.418
Constant Japan	0.078		0.349	0.000	-0.018	0.540
Constant U.S.	0.008		0.279	0.000	-0.010	0.695
Observations	18410					
Brazil Observations:			3104		2665	
China Observations:			1527		1203	
Japan Observations:			4826		4375	
U.S. Observations:			6890		6358	

Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain. lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification. FE denotes Fixed effects, 3SLS denotes Three Stages least Squares, and A and B denote the Arellano and Bond (1991) estimator.

Table 8 *Determinants of French Export Strength Relative to Spanish Export Strength for Brazil and China / Japan, and the U.S.: Dynamic model*

Levels (Equation 8) 3SLS	*Brazil and China*		*Japan, and the U.S.*	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lw	-0.321	0.068	-0.139	0.031
lva	0.185	0.075	0.054	0.234
luv	0.005	0.779	-0.014	0.100
Lxv(-1)	0.795	0.000	0.884	0.000
Rauch 1	-0.512	0.003	-0.153	0.007
Rauch 2	-0.040	0.375	-0.026	0.230
AR(1)	-0.260	0.000	-0.282	0.000
Constant Brazil	0.278	0.001	0.291	0.000
Constant China	0.387	0.000	0.233	0.000
Constant Japan	-0.321	0.068	-0.139	0.031
Constant U.S.	0.185	0.075	0.054	0.234
Brazil Observations:	3104		3104	
China Observations:	1527		1527	
Japan Observations:	4826		4826	
U.S. Observations:	6890		6890	

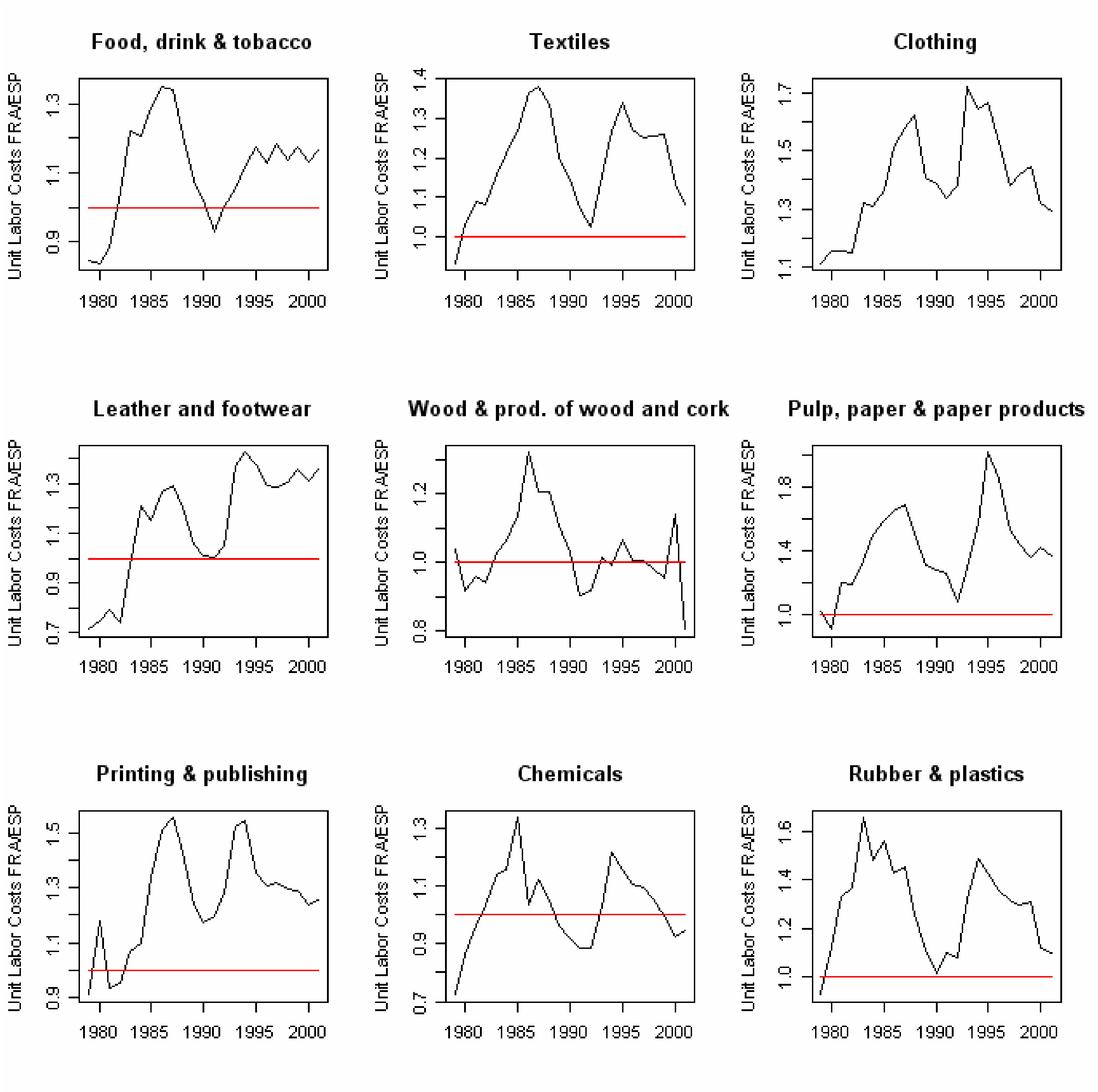
Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain. lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

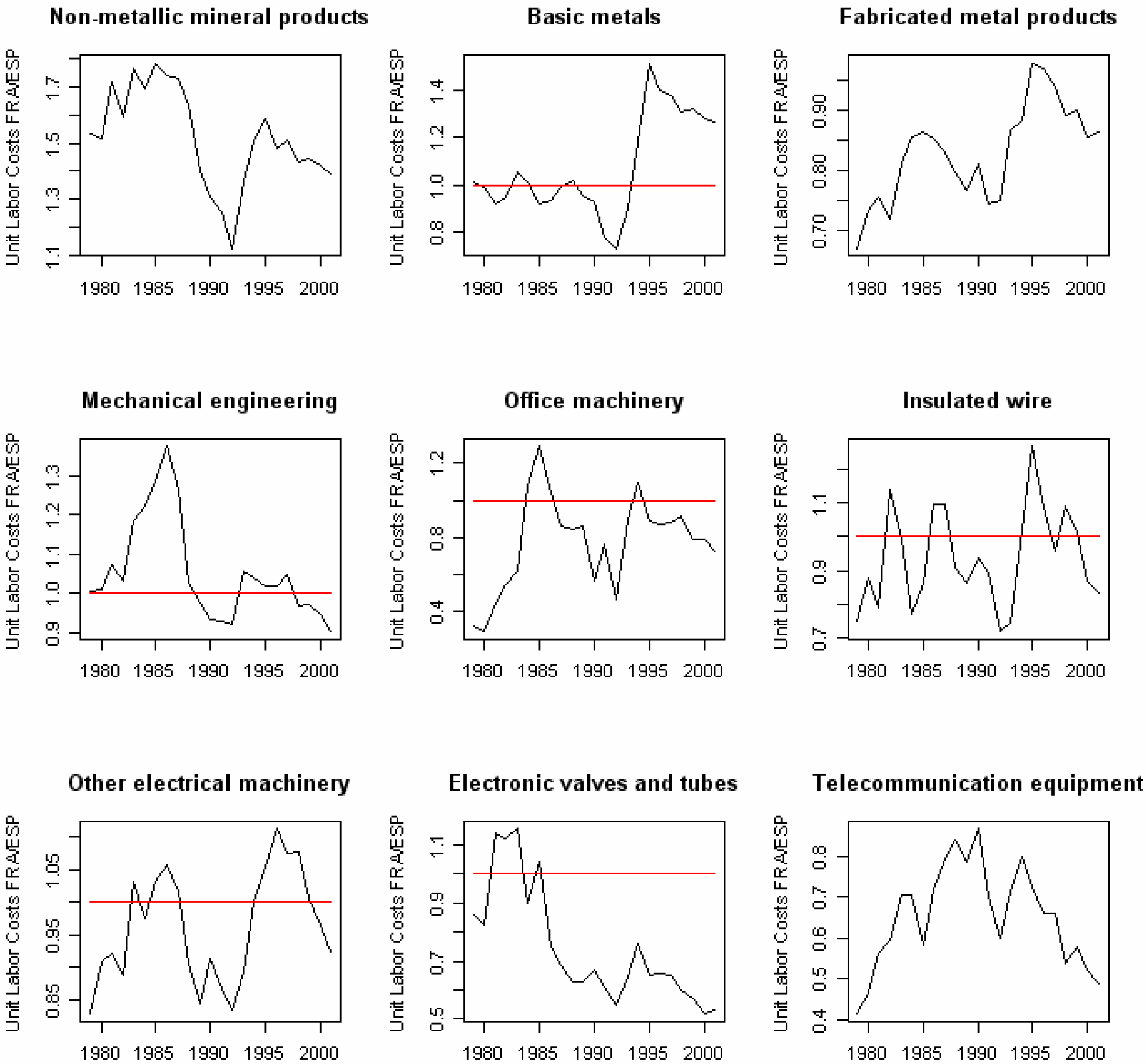
Table 8 *Determinants of French Export Strength Relative to Spanish Export Strength for Rauch 2 and Rauch 3: Dynamic model*

Levels (Equation 8) 3SLS	*Rauch 2*		*Rauch 3*	
Dependent variable: lxv	Coefficient	Prob.	Coefficient	Prob.
lw	-0.632	0.143	-0.103	0.534
lva	-0.258	0.436	0.259	0.066
luv	-0.235	0.000	0.041	0.000
AR(1)	-0.266	0.000	-0.277	0.000
Lxv(-1)	0.847	0.000	0.863	0.000
Constant Brazil	1.672	0.000	0.860	0.001
Constant China	1.742	0.006	1.840	0.000
Constant Japan	2.941	0.000	2.539	0.000
Constant U.S.	2.168	0.000	1.955	0.000
Brazil Observations:	770		2292	
China Observations:	362		1148	
Japan Observations:	975		3727	
U.S. Observations:	1465		5249	

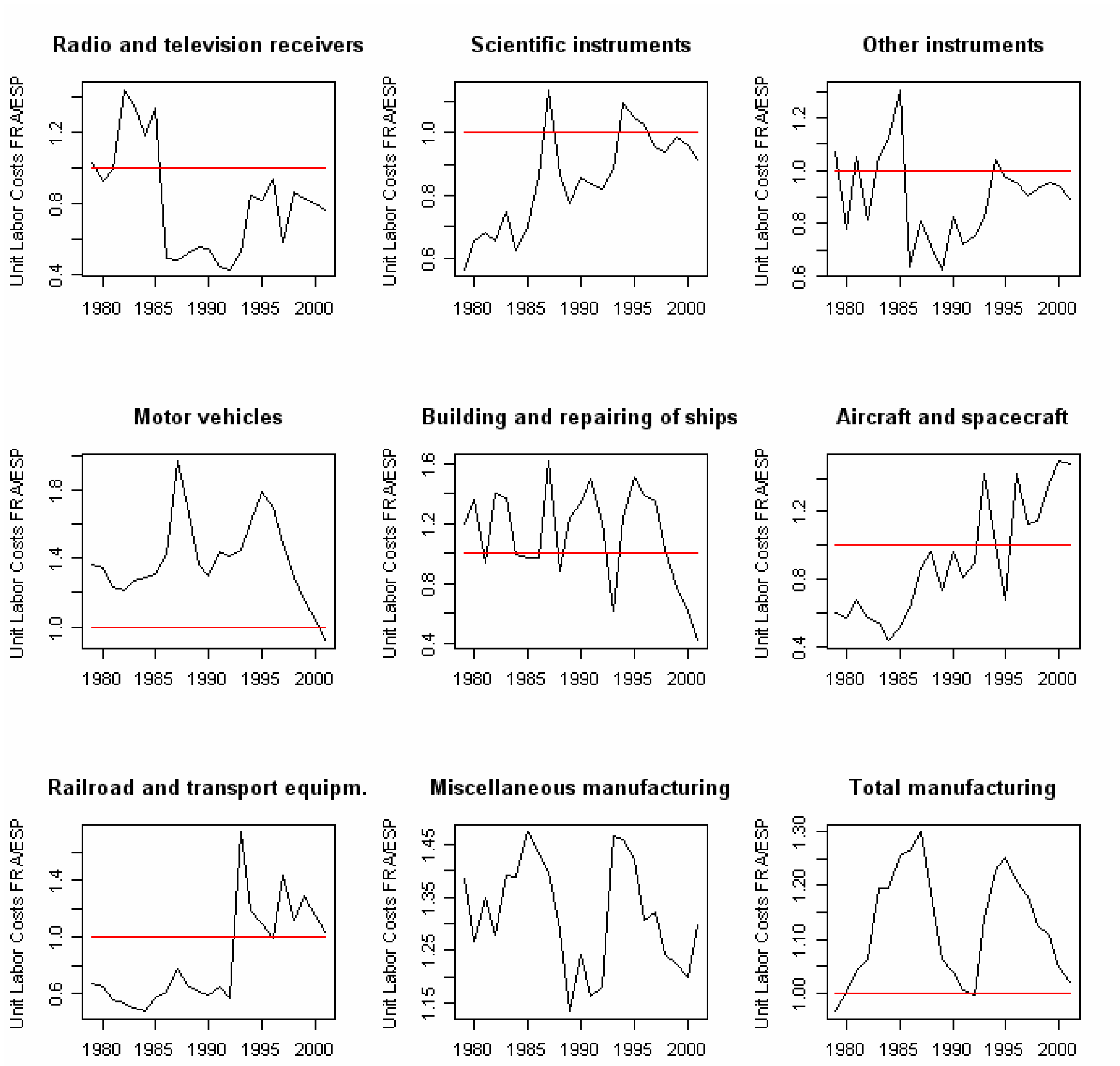
Note: All the variables except dummies are in natural logs and in relative terms (France relative to Spain. lw denotes labor compensation, lva denotes value added per hour, and luv denotes unit values. Autocorrelation was corrected by adding an AR(1) to the model specification.

Appendix: French Unit Labor Costs Relative to Spanish Unit Labor Costs





Non-metallic mineral products
Unit Labor Costs FRA/ESP
1.1 1.3 1.5 1.7
1980 1985 1990 1995 2000
Basic metals
Unit Labor Costs FRA/ESP
0.8 1.0 1.2 1.4
1980 1985 1990 1995 2000
Fabricated metal products
Unit Labor Costs FRA/ESP
0.70 0.80 0.90
1980 1985 1990 1995 2000
Mechanical engineering
Unit Labor Costs FRA/ESP
0.9 1.0 1.1 1.2 1.3
1980 1985 1990 1995 2000
Office machinery
Unit Labor Costs FRA/ESP
0.4 0.8 1.2
1980 1985 1990 1995 2000
Insulated wire
Unit Labor Costs FRA/ESP
0.7 0.9 1.1
1980 1985 1990 1995 2000
Other electrical machinery
Unit Labor Costs FRA/ESP
0.85 0.95 1.05
1980 1985 1990 1995 2000
Electronic valves and tubes
Unit Labor Costs FRA/ESP
0.5 0.7 0.9 1.1
1980 1985 1990 1995 2000
Telecommunication equipment
Unit Labor Costs FRA/ESP
0.4 0.5 0.6 0.7 0.8
1980 1985 1990 1995 2000


Radio and television receivers
Scientific instruments
Other instruments
Motor vehicles
Building and repairing of ships
Aircraft and spacecraft
Railroad and transport equipm.
Miscellaneous manufacturing
Total manufacturing
Unit Labor Costs FRA/ESP