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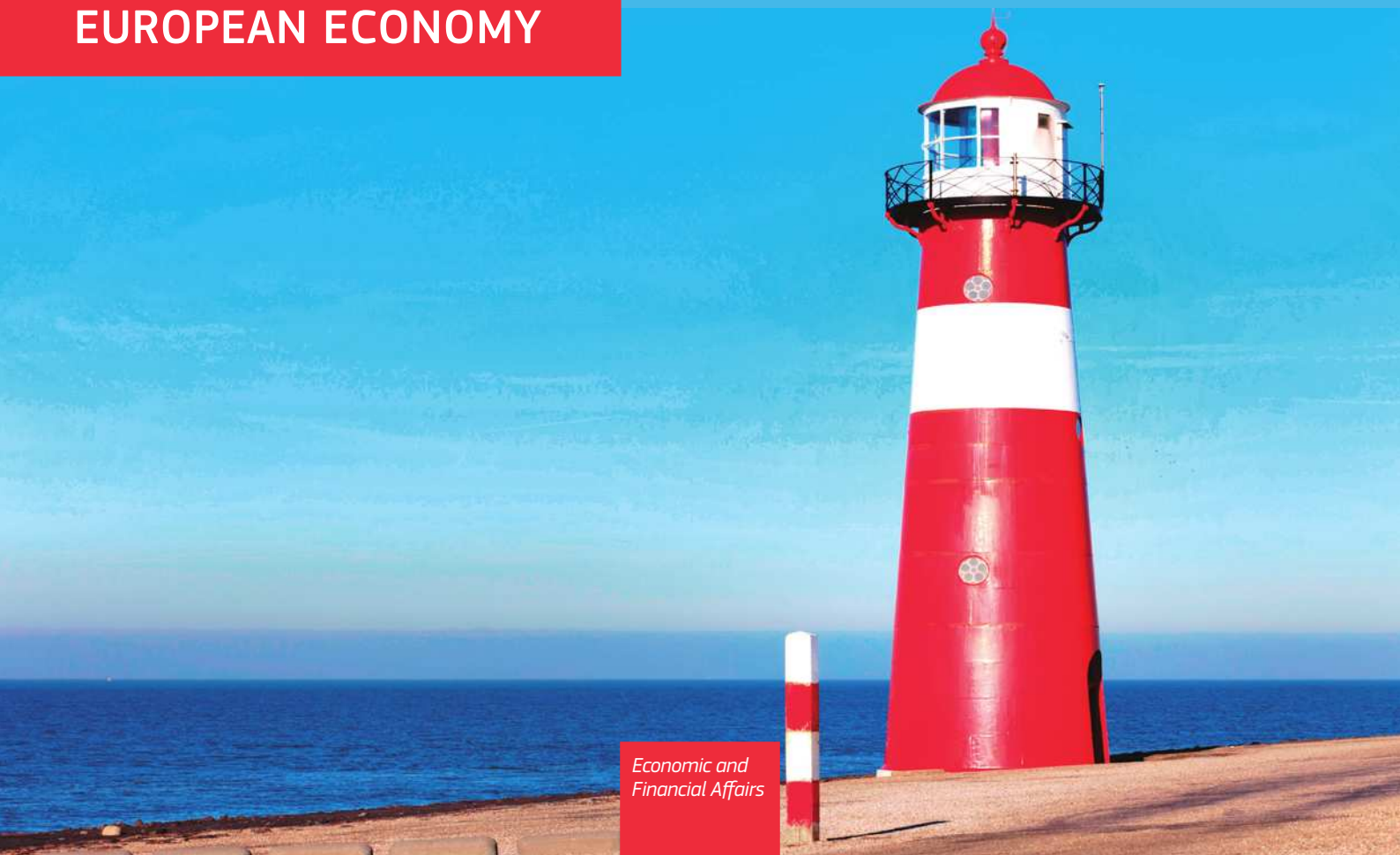

Economic and Financial Affairs

European Commission
Directorate-General for Economic and Financial Affairs

Can we evaluate the Non-Price Competitiveness of French Products Based on Export Data?

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Abstract

France's export market shares declined in the 2000s as in other advanced economies following the rise of major competitors among emerging economies. However, the fall has been more marked for France than for similar EU economies. Cost competitiveness was at first considered the main reason for the deterioration in export performance and the policy response was to introduce actions to lower labour cost. Although measures like the competitiveness and employment tax credit (Crédit d'impôt pour la compétitivité et l'emploi, CICE) lowered the unit labour cost, France's export market shares stabilised but did not recover fully, especially for goods. The attention could then be shifted to other aspects of competitiveness. Non-price competitiveness (a proxy for "quality") is intrinsically difficult to measure but can be approximated as the export sales that cannot be explained by the price and other controlled parameters (distance, economic size …). Our contribution is to apply a gravity model to an updated worldwide dataset of bilateral trade flows in goods and to assess the non-price component of exports at a detailed sectoral level, focussing on the case of France.

Overall, France's exports' non-price competitiveness (a proxy for "quality") is medium-high, ranking 11th among a set of 37 countries (OECD and EU countries) but it has deteriorated in the recent years. The fall in the aggregate indicator was among the most pronounced over the period 2003-2016, notably in the aftermath of the 2008 crisis. This evolution seems to have been driven by average and lower "quality" goods, while only the top of the distribution tended to improve their advantage over time. .Moreover, the performance in terms of non-price competitiveness is quite heterogeneous across the manufacturing sectors. France achieves very good results in sectors in which it specialises such as aeronautics, cosmetics and beverages, while it performs average in sectors like machinery, electrical equipment, vehicles (particularly the car industry) or pharmaceuticals, which are the most important sectors in volume in global trade.

France has demonstrated its ability to produce goods of high quality or high perceived quality through innovation (aeronautics), know-how (agriculture, wines) and branding (luxury products). However this applies to a relatively small share of its exports. To regain competitiveness, several proposals, leveraging on non-price competitiveness aspects, can be suggested: e.g. develop the dissemination of innovation from public to private sector, invest in human capital through education and training, reduce barriers to investment and improve the business environment to boost firm growth.

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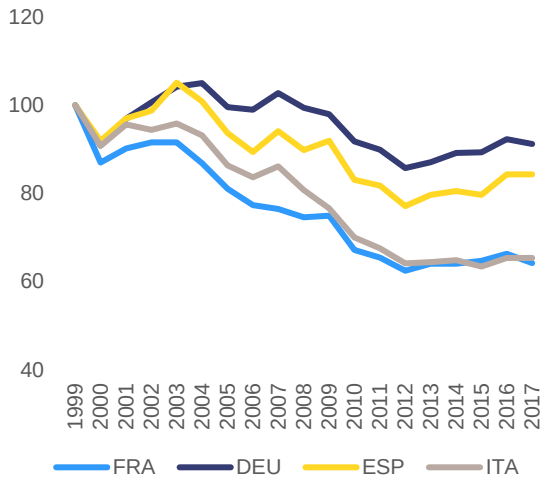
Introduction

Like other advanced economies, France's export market shares dropped in the early 2000's due to the trade integration of emerging economies. However, the reduction in export market shares has been more pronounced in France than in similar economies, especially in the good sectors (see Graph 1). While France lost 40% of its world export market shares in goods between 1999 and 2017, Germany's export market shares dropped by 9% and Spain's by 11% [1].

Graph 1: **Export market share evolution in goods (index 1999=100)**



Source: Eurostat.

The geographical composition and sector positioning of French exports do not seem to be the major cause of the loss in export market shares. Econometric decompositions of export market share growth allow for disentangling the respective importance of sectoral specialisation and geographical composition [2]. According to Bas et al. (2014), the geographical composition of French exports contributes negatively to France's export market share growth, but this effect is around the EU average: all European countries tend to export to less dynamic markets (due to a high share of intra-EU trade). In the case of France, the effect of geographical composition is however more favourable than in Spain and the UK, but less favourable than in Germany and Italy. Moreover, the sectoral specialisation seems to play in favour of France with respect to main competitors, notably Germany.

While the deterioration in export market shares may have been initially driven by weak cost competitiveness, this does not seem to explain the recent evolution. After an important drop in the early 2000s, French cost-competitiveness improved in recent years vis-à-vis main European countries, notably Germany. Until 2008, French unit labour costs of the economy as a whole rose faster than in the rest of the Eurozone, especially due to the evolution of unit labour costs in services[3,4]. Since the 2008 crisis, unit labour costs growth accelerated significantly more in Germany than in France due to higher wage increases in Germany and to several policy measures in France to reduce labour costs (e.g., the tax credit for competitiveness , CICE or the responsibility pact, '*Pacte de responsabilité*') (Graph 2). Particularly, in the manufacturing sector, unit labour costs increased by 8% in Germany from 2010 to 2018 but by only 1% in France. Consequently, French unit labour costs (per hour worked) of the whole economy approached those observed in Germany (see Table 1).

Table 1: **Unit labour cost in 2017 (EUR)**

	Whole economy	Industry*	Services
DEU	34.6	40.2	31.5
ESP	20.8	23.3	20
FRA	36.6	38.8	36.4
ITA	27.3	27.8	27.4

* Except construction

Source: Eurostat.

However, French trade performance could be also impacted by non-price factors of competitiveness, which would imply different policy action.

[1] The drop in both goods and services over this period is 36% for France against 9% in Germany and 16% in Spain.

[2] For details of the methodology see: Gaulier, G.; Santoni G.; Taglioni D.; Zignago S.. 2013. In the wake of the global crisis: evidence from a new quarterly database of export competitiveness. Policy Research working paper, World Bank Group.

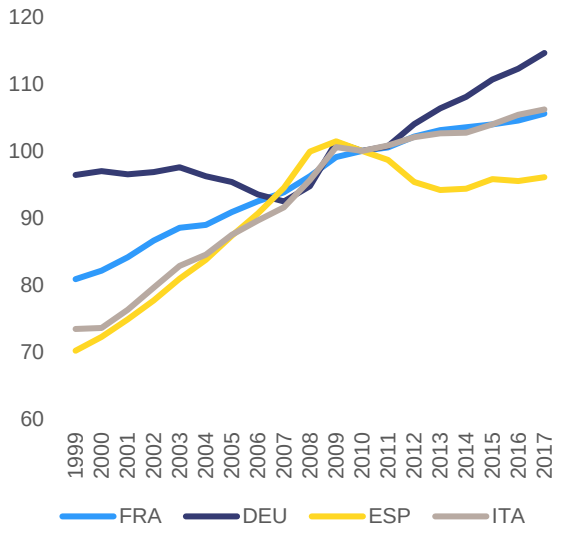
[3] Market services refer to sectors G-N of the NACE rev.2 classification.

[4] Unit labour cost in industry remained relatively stable in France over the period 1999-2017 while it decreased in Germany before the 2008 crisis and increased after.

Measuring non-price competitiveness

Non-price competitiveness refers to all the factors, other than price, that explain export performance. They can be considered as a proxy for "quality" (intrinsic or perceived). These factors include the quality and reliability of materials and workmanship but also product differentiation, consumer taste, marketing, branding, after sales service, etc. These non-price competitiveness factors are partially unobservable and hard to quantify. As a consequence we will rely on an indirect measure as explained below.

Graph 2: **Unit labour cost evolution (index 2010=100, whole economy)**



Source: Eurostat.

The first attempts to measure quality of exports used unit value premium at a highly disaggregated level to reflect within-product specialisation. The main assumption behind the approach was that a higher price for an exported product would reflect a higher quality[5]. However, higher prices may also reflect higher marginal costs, specific market structure or macroeconomic shocks.

Another approach to evaluate the quality of exports is based on demand equations derived from theoretical models in which non-price competitiveness can be considered as a residual. This approach is based on demand equations derived from theoretical models, where "quality" acts as a demand shifter. Demand equations of different functional forms can be used, notably the constant elasticity of substitution (CES) function (Feenstra (1994), Broda and Weinstein (2006)), discrete choice framework (e.g. Khandelwal (2010)) or asymmetric preferences in a quadratic utility function (e.g. di Comité, Thisse and Vandenbussche (2014)).

Empirical setting

Following Bas, Martin, Mayer (2014), we estimate a set of gravity equations of bilateral exports. The model adapted the initial setting of Khandelwal, Schott and Wei (2013) to estimate it on bilateral exports at product level[6].

The equation is formalised as:

$$\ln q_{pijt} + \sigma \ln p_{pijt} = \beta_0 + \beta_1 \ln Size_{it} + \beta_2 \ln Dist_{ij} + \sum_{k=3}^{K} \beta_k \boldsymbol{X}_k + \alpha_{pjt} + \epsilon_{pijt},$$

where q_{pijt} stands for the quantity and p_{pijt} the price measured by trade unit value of a product p sold by country i to country j in year t. The product-destination country-time fixed effects α_{pjt} control for differences across products and also for differences in price index and income at destination. We use population as a proxy for the size of the country and include standard binary variables ($\boldsymbol{X}_k$): contiguity of border and past colonial links. *Dist* is the distance between the two trade partners *i* and *j*.

Non-price competitiveness can be approximated as export sales that cannot be explained by the price and other controlled parameters. The logarithm of the quality index λ is thus derived as residual of the regression scaled by the elasticity of substitution σ_p (*i.e.* how easy it is to substitute one good for the other, following a change in price). As assumption, we rely on the Broda and Weinstein (2006) estimates of the elasticity of substitution for the United States at the 5-digit SITC[7], converted using United Nations Trade Statistics correspondence tables.

$$\hat{\lambda}_{pijt} = \widehat{\epsilon_{pijt}}/(\sigma_p - 1)$$

[5] Studies assessed quality of exports using unit values as a proxy for within-product specialisation are numerous (among others Schott, 2004, 2008; Fontagné et al. 2008, Berthou and Emlinger 2010, Bastos and Silva 2010, Martin and Mayneris 2013).

[6] See Annex I for details of derivation.

[7] This choice allows us to capture quality differences at the most detailed disaggregation level, crucial to the study, at the expense of the cross country heterogeneity.

We use a pooled ordinary least squares regression (OLS)[8] to estimate the equation (see Annex III for results) at the product level, making use of the data granularity.

Data sources and selection

Estimation of the equation at a detailed product level requires a large amount of data. For prices and quantities, we used the Trade Unit Values database published by CEPII. These data benefit from a very rigorous treatment of missing quantities, preserving cross-country heterogeneity in trade unit values [9]. As for the elasticity of substitution, we used Broda and Weinstein (2006) elasticity of substitution (SITC Rev.3 5-digit converted to Harmonised System 2002 classification using United Nations Trade Statistics Correspondence tables)[10]. World Bank database is used for population and GeoDist dataset (CEPII) is used for bilateral country characteristics. Overall, this dataset includes 78 million trade flows from 188 exporting countries to 253 destinations, of 5213 products at the 6-digit level of the Harmonised System, from 2000 to 2016.

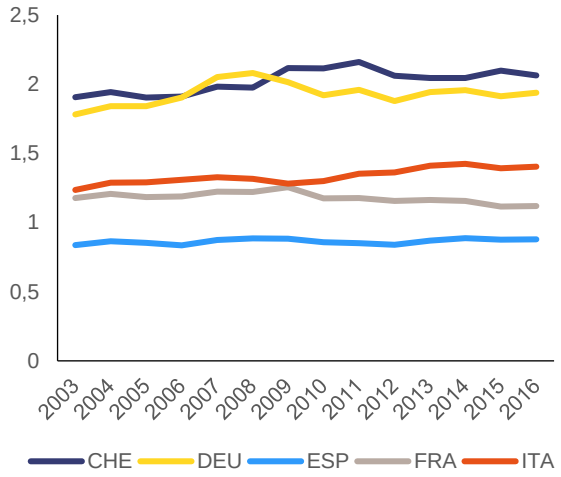
For the analysis, we focused on a restricted subset of trade flows between the selected exporters and the main destinations and excluding extreme unit values. In order to compare quality evolution within similar groups of countries, we focus on a selection of exporters composed of OECD and the other EU countries. We also select the 50 biggest destinations (in terms of value of imported goods over the period). This allows us to cover most of the world trade (around 60% in 2016) and include the most exporters allowing to explain 63% of world export dynamics over 2003-2016[11]. Moreover, given extreme unit values within product categories, we exclude values from the 1st and 99th percentile of the world trade flows distribution, for a given HS 2-digit sector in a specific year.

For any type of aggregation (by sector or by country), we used the median of the subset, less sensitive to outliers (see Annex V for the results of other aggregation methods). Our final results include more than 2 million quality measures at HS6-digit level for 32 million selected trade flows (over the 2000-2016 period).

Quality by country

Taking into account all exports to all the destinations, over the 2003-2016 period, the countries' ranking based on the aggregate quality indicator[12] is broadly stable. Over the period, Switzerland, Germany and Japan are part of the top 3 performers, while France loses three positions in the global ranking: from the 8th position overall in 2003-2005[13] down to the 11th position in 2014-2016, overtaken by the Netherlands, the US and the UK (see Table 2). The study by Bas et al. (2014)[14] already showed a similar pattern for France: ranked 5th in 2000 in terms of the quality indicator but experiencing a significant decrease over the period 2000-2009.

Graph 3: **Aggregated quality index evolution for selected countries**



Source: authors' calculations.

The aggregated quality index of France is gradually decreasing contrary to other large

[8] Following the Bas et al. (2014), the specification allows for including time-invariant gravity variables for importer-exporter pairs, but may induce a bias stemming from the unobserved heterogeneity. This is attenuated by destination country-product-time fixed effects.

[9] Many thanks to Charlotte Emlinger (CEPII) for sharing with us the details of the database.

[10] Although estimated for the US and thus not reflecting cross-country heterogeneity, it allows for a more detailed analysis between products (digit 5 of SITC rev. 3 classification), crucial for our study.

[11] Using TUV database, taking into account missing observations.

[12] The aggregate index is calculated as median quality across products and destinations in a given year. Additional aggregation methods have been tested (see Annex V).

[13] To rule out annual peaks, we take a simple average over 3 years of the aggregate quality index.

[14] Bas et al. (2014) uses BACI database instead of the Trade Unit Values one. The subset of exporting and importing countries, as well as estimation period also differs.

exporters, notably following the 2008 crisis. The index declined from 1.19 in 2003-2005 to 1.13 in 2014-2016. Given that a very large number of products are accounted for in the median quality index over three years, the drop appears to be marked. Moreover, this unfavourable evolution is only shared with Japan and Sweden. For the other top quality exporters, namely Germany, the US, Italy and the UK, the aggregated quality index increased over time.

Table 2: **Quality of top performers in 2014-2016**

		Share of world's exports in 2016	Quality index 2014-2016	Quality index 2003-2005	Ranking in 2003-2005
1	CHE	1.85	2.07	1.92	1
2	DEU	8.22	1.94	1.82	2
3	JPN	4.51	1.57	1.58	3
4	ITA	2.94	1.41	1.27	5
5	SWE	0.88	1.4	1.43	4
6	AUT	0.97	1.35	1.2	7
7	NLD	2.72	1.28	1.13	12
8	BEL	2.13	1.24	1.24	6
9	USA	8.73	1.20	1.07	14
10	GBR	2.46	1.2	1.17	10
11	**FRA**	**3.26**	**1.13**	**1.19**	**8**

Source: authors' calculations.

Table 3: **Quality rank changes of top performers in 2014-2016**

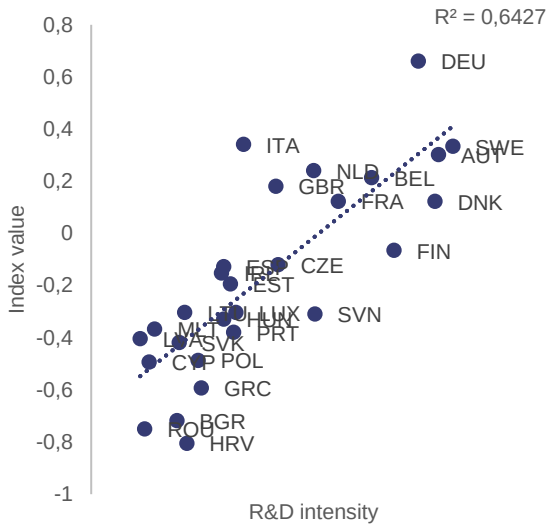
		Change in the quality index	Ranking of the change	Ranking in 2003-2005
1	CHE	+0.15	5	1
2	DEU	+0.11	12	2
3	JPN	+0.00	21	3
4	ITA	+0.14	8	5
5	SWE	-0.04	26	4
6	AUT	+0.15	6	7
7	NLD	+0.15	4	12
8	BEL	+0.00	22	6
9	USA	+0.13	9	14
10	GBR	+0.03	17	10
11	**FRA**	**-0.06**	**29**	**8**

Source: authors' calculations.

In particular, France is the country with the 7th biggest drop in quality index and 6th biggest drop in market shares over 2003-2016. It is followed closely by Denmark (8th and 7th position). During the period, most of the emerging countries as well as Eastern European countries upgraded the quality of their products which could have contributed to the rise of their market shares. In parallel, most of the advanced economies among top exporters have seen a small increase in quality and a slighter drop than France in their export market shares.

The aggregated quality index by country is positively correlated to factors expected to positively affect quality. In order to give a validation of the results, we verified several variables that should intuitively be correlated to quality, notably labour productivity, R&D intensity or number of patents application per capita (see Graph 4 and Annex IV for more graphs). All the correlations confirmed the expected positive correlation of quality with the above-mentioned variables, suggesting that the calculated quality index correctly depicts the non-price component of exports.

Graph 4: **Correlation between total R&D intensity (% GDP) and the quality index by country (2016)**



Source: SPI database (EU countries only), authors' calculations.

Sectoral analysis

Among the eight sectors[15] weighing the most on French trade in value, France is a leader in three of them (aeronautics, beverages, and cosmetics) in terms of world export market shares. These three sectors can be considered as French strengths accounting for around 19% of the French trade value. However, they account for a relatively small share of world trade (1.8% for aeronautics and 0.7% for beverages and cosmetics, see Table 4). The other five sectors (machinery, vehicles, electrical equipment, pharmaceuticals, and plastics) accounting for 39% of the French trade value are among the sectors with the largest shares of world trade, but France ranks only between 5th and 13th position in terms of export market shares in these sectors.

Table 4: **Important sectors of the French trade in 2016 (share in %)**

HS2	Sector	Share in French export revenues	French world market share	Share of the sector in the world trade
84	Machinery	11.5	3.0 (8th)	12.6 (2nd)
88	**Aeronautics**	**11.5**	**21.5 (2nd)**	**1.8 (11th)**
87	Vehicles	10.2	3.7 (10th)	8.9 (4th)
85	Electrical equipment	7.2	1.6 (13th)	14.5 (1st)
30	Pharmaceuticals	6.3	6.1 (5th)	3.4 (8th)
39	Plastics	3.8	3.5 (8th)	3.5 (6th)
22	**Beverages**	**3.6**	**16.6 (1st)**	**0.7 (29th)**
33	**Cosmetics**	**3.5**	**15.6 (1st)**	**0.7 (26th)**

Source: BACI 2016 and authors' calculations.

The three sectors considered as French strengths, (aeronautics, beverages and cosmetics) show a high quality index. France ranks in 3rd, 5th, and 3rd position in these sectors, respectively (see Table 5). However, France lost some leadership in aeronautics (from 2nd to 3rd) and beverages (from 4th to 5th) over 2003-2016. It is worth mentioning that France never ranks first in any sector but is however 2nd in leathercraft and musical instruments.

[15] Sectors are defined as HS 2-digit level classification. The index is calculated as median quality of an exporter across destinations at 2-digit level. For more details and alternative aggregations, see Annex 5.

Table 5: **Quality index for sectors weighing the most in terms of value of French trade**

Sector	France's quality rank		Quality leaders (2014-16)
	2003-05	2014-16	
Machinery	13	12	DEU, CHE, USA
Aeronautics	2	3	USA, GBR, FRA
Vehicles	5	13	DEU, BEL, SWE
Electrical equipment	7	12	DEU, USA, CHE
Pharmaceuticals	9	11	CHE, IRL, BEL
Plastics	12	14	BEL, DEU, CHE
Beverages	4	5	CHE, NLD, USA
Cosmetics	3	3	CHE, IRL, FRA

Source: authors' calculations.

The quality of French products in the other sectors weighing the most in terms of value of French trade is deteriorating. In the five important sectors by size worldwide (electrical equipment, machinery, vehicles, plastics, pharmaceuticals), French quality ranking is average, between the 11th and 14th position. But a deterioration of the ranking is observed over time. While France was well positioned in some key sectors, its ranking deteriorated over 2003-2016: less 6 positions in vehicles, 5 positions in electrical equipment, 2 positions in pharmaceuticals and plastics. In comparison, Germany leads in quality in the three most important manufacturing sectors by size in the world (electrical equipment, machinery, and vehicles). It also leads in 12 other sectors, the best performance worldwide.

The quality performance of the French automotive sector deteriorated strongly between 2003 and 2016. Focussing on the seven car types captured by the Harmonised System at 6-digit level, France was in a strong position over 2003-2005, particularly among the small engine cars (gasoline < 3000 cm^3 and diesel < 2500 cm^3), ranking between the 1st and 4th position. The picture in 2014-2016 is drastically different. The quality index fell significantly for almost all car types (except the gasoline >3000 cm^3) (see Table 6). Overall, aggregating the seven car types, France dropped from the 3rd to the 12th position. The country however sustained a 6th position in the smaller diesel cars. This situation could be partly explained by the relocation process in the French automotive sector where production sites were moved to countries with lower labour costs diminishing partly direct exports from France.

Table 6: **Quality index for the French automotive**

Fuel	Engine in cm³	HS6 code	Quality index		Ranking	
			2003-05	2014-16	2003-05	2014-16
Gasoline	<1000	870321	5.75	2.15	1	10
	1000-1500	870322	4.68	1.97	4	12
	1500-3000	870323	5.29	1.19	4	14
	>3000	870324	0.56	0.88	21	15
Diesel	<1500	870331	3.89	2.51	1	6
	1500-2500	870332	5.03	2.70	3	10
	>2500	870333	1.30	0.39	10	27
All automotive aggregated (870321-33)			3.14	1.59	3	12

Source: authors' calculations.

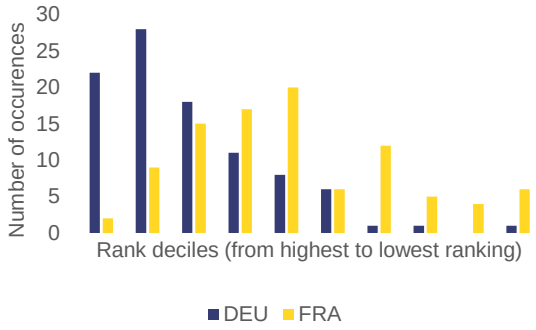
France shows high quality in some niche products. Digging further into product-level results (6-digit classification) shows that France is a quality leader for products related to its strengths such as perfumes and make-up (cosmetics), mineral water, wine, sparkling wine and spirits (beverages), helicopters and aircraft propellers (aeronautics). Outside those sectors, France is also a quality leader in products such as leather luggage, nuclear reactors and fuel cartridges, turbo-jets, track laying bulldozers, textile machinery and locomotives.

Quality index distribution

The comparison between the distributions of the ranks of the quality index in France and Germany shows that the high quality in France seems to be more concentrated in a small number of products. The index distributions in 2016 show that Germany has a larger number of high-quality products than France (see Graph 5). It supports the view that French high quality exports are more specialised in a small number of sectors.

When comparing France to Germany, Italy and Spain, the high quality products seem to weigh relatively less in the French exports. In terms of export shares (in value), French high quality products account for less in the national exports than in the case of Germany and Italy, but more than in Spain [16]. Their export market shares seem to decrease markedly over time, which is not the case for the other countries. This results both from the increasing quality index in the reference countries driving the threshold for high quality upward and a decreasing quality of French products (apart from the very top of the distribution, see Graph 6). Consequently, the share of middle and low quality products in total exports appears to increase for France, exposing the country to more competition, notably from emerging countries.

Graph 5: **Frequency histogram of digit 2 sector-level quality rankings in France and Germany**



Source: authors' calculations.

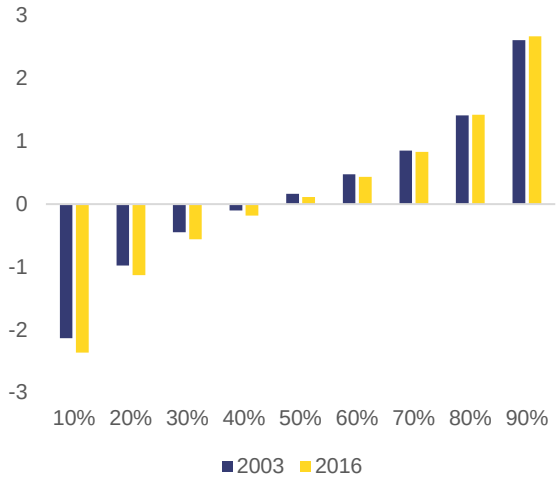
Table 7: **Export shares (% of national exports) by quality level**

		High quality	Medium quality	Low quality
DEU	2003	61.8	37.1	1.2
	2016	60.9	37.9	1.2
ESP	2003	23.3	57.1	19.7
	2016	30.7	53.6	15.7
FRA	2003	40.9	54.4	4.7
	2016	30.4	63.2	6.4
ITA	2003	42.8	51.1	6.1
	2016	43.3	51.8	4.9

Source: authors' calculations.

[16] The categories for high, medium and low quality are defined as the 30th and 70th percentile of the distribution of the four countries together. Alternative specifications of the benchmark (all the 37 countries of the dataset, national benchmarks) support the same conclusions.

Graph 6: **Distribution of quality indices by decile in France**



Source: authors' calculations.

The deterioration of the French quality index over the period 2003-2016 is observed mostly in the middle and the bottom of the distribution, while the top quality products remain stable or increase. In France, products at the very top (90th percentile) of the quality index distribution, seem to increase their advantage over time. However, the rest of the top distribution remains broadly stable (80th percentile) or only slightly decreases (70th percentile). The overall drop in the country index is thus driven by middle and low quality products decreasing in quality over time. This profile is not observed in other neighbouring countries: in Italy and Spain the entire distribution shifts up to higher quality, while in Germany the top of the distribution (at the quality frontier) raises significantly, and only the very low quality products deteriorated over time.

French quality by destination

French quality is valued worldwide but is not ranked number one. When aggregating the quality of French exports by destination, it appears that the top 10 destinations for French quality is distributed all over the world (within the limits of our dataset). Italian and American imports from France are those containing the highest median quality (Table 8). However, from the importer's perspective French quality does not rank number one. Only within Italian imports, France ranks 3rd in terms of quality. For the rest of the major importers, France never ranks better than 5th.

Table 8: **French exports quality by destination (top10)**

Destination	Median quality of French exports	Rank of France among the country's importers
ITA	1.76	3
USA	1.74	6
JPN	1.52	6
CHN	1.50	6
ESP	1.49	6
UAE	1.42	5
POL	1.34	6
BRA	1.32	8
KOR	1.32	8
DEU	1.31	9

Source: authors' calculations.

Conclusion

For a number of years, French competitiveness has shown a mixed-picture (European Commission, 2020a) as export market shares have stabilised over the recent past after years of losses. In terms of price competitiveness, unit labour costs have grown more moderately than in other euro area countries as wage developments have been contained. As to non-price competitiveness (as a proxy for "quality"), our findings show that France ranks at the 11th position worldwide based on the aggregated index but that this performance is deteriorating over the observation period (2003-2016).

From a sectoral point of view, France has continued to maintain a very high level of non-price competitiveness in the sectors in which the economy is mainly specialised: aeronautics, beverages and cosmetics. However, in the most important trading sectors worldwide (machinery, electrical equipment, vehicles, pharmaceuticals, plastic), France ranks between the 11th and 14th positions in terms of non-price competitiveness, systematically behind the world leaders, namely Germany, the US or Switzerland. The automotive sector is a particularly interesting case as the analysis showed a marked deterioration of the index for several car segments where France was a world leader at beginning of the 2000's (small gasoline and diesel engines).

Analysing the distribution of the non-price competitiveness index across all product/destination

shows that only the top "quality" products in France are evolving positively while the rest of the products tends to stagnate or deteriorate which weakens the overall performance of the country. France is able to produce very high "quality" products and strong brands such as in aeronautics or luxury items. However, overall, the non-price competitiveness components of the French exports are deteriorating, driven by sectors such as the automotive sector that suffered big losses in the recent years.

High-end specialisation is a possible safeguard against cost competition as the willingness to pay by consumers for high quality goods is generally higher. The deteriorating non-price competitiveness in France tends to lead to a greater exposure of its exporting firms to price-competition pressure from countries betting on their cost advantages.

Weaknesses in non-price competitiveness in France may be linked to various possible explanations, notably the relocation strategies of firms, a shift in demand unfavourable to French products, a higher quality offered by main competitors, a change in the perception of French products or in the consumer tastes. The relative deterioration of non-price competitiveness of French exports appears to be in contrast with the fact that investments in France remain high. Recent reports mention a paradox between the high rate of investment in France and the deterioration in non-price competitiveness (e.g. Guillou et al. 2018).

To reclaim its lost market shares, France should explore further measures to improve the non-price competitiveness aspects of its export performance, taking into consideration sectoral specificities. France has exploited its know-how in several segments of trade, demonstrating its ability to produce technology-intensive products. However, France lags behind top EU performers, notably Germany, in terms of total R&D intensity and innovation (European Commission, 2019c). While public support to R&D in France provides a very high level of public support to business R&D, a more efficient cooperation between public and private research should be promoted, allowing for more innovation, producing high-end goods and ultimately escaping pure cost competition. This could also include further investment in human capital (education and training)[17], which is a pre-condition to ensure future generations of innovators, as well as enhancing the business environment and allowing firms to grow to reach the critical size to access international markets (European Commission, 2019b and 2020b).

Finally, on the methodology, our Economic Brief is based on the application of the Bas, Martin, Mayer (2014) used to measure non-price competitiveness as a residual. It gives a try at measuring "quality", intrinsically non-measurable, using a large and up-to-date dataset. It allows for a global analysis but also country and sectoral/product decompositions. Our results are robust to the choice of the database, explanatory variables, country inclusion[18] and confirming previous studies. However, several remarks seem relevant to indicate the limitations of our exercise. First, one needs to be cautious when interpreting the index as a "quality" measure. It is obtained as a residual of the regression and thus encompasses all the elements other than price and classic determinants of bilateral trade. Also, the use of the elasticity of substitution could introduce some bias in the estimation if the parameter differs systematically across countries. The methodology does not allow to distinguish between perceived (brands) and intrinsic quality (see for instance Di Comité, 2011), which in the case of France could impact the interpretation of the results as the country is known for specific niche product categories.

Moreover, the dataset is limited to goods only, while France exports more services than other countries and this share is growing over time. Finally, the recent modest export performance of France is very likely to be affected by important and fast-growing investments of French enterprises abroad. If these foreign direct investments can be considered, at least partially, as substitutes for exports, it is an important caveat for the interpretation of the non-price competitiveness index, which cannot capture this process, especially to the extent that enterprises investing abroad appear to be more productive than the average. By the same token, the methodology does not account for the existence of global value chains. Relocation of intermediate and final production abroad has an impact on export market shares, introducing different (both upward and downward) biases to the non-price components. Further research in this direction could be envisaged.

17 The link between quality and human capital was demonstrated by, among others, Costinot (2009); between quality and business environment by Costinot (2009) or Nunn (2007).

18 Results available on request.

ANNEX I – Theoretical setting: Khandelwal, Schott and Wei (2013)

The model assumes a CES utility function of the representative consumer over a continuum of goods belonging to the set Ω indexed $\boldsymbol{\omega}$, with $\boldsymbol{q(\omega)}$ denoting quantity consumed, $\boldsymbol{\lambda(\omega)}$ accounting for "quality" and $\boldsymbol{\sigma}$ measuring the elasticity of substitution between varieties in Ω:

$$\boldsymbol{U} = \left(\int_{\boldsymbol{\omega}\in\Omega}\left(\boldsymbol{\lambda(\omega)q(\omega)}\right)^{\boldsymbol{\sigma-1/\sigma}}\ \boldsymbol{d\omega}\ \right)^{\boldsymbol{\sigma/\sigma-1}},$$

Utility maximisation in the monopolistic competition framework with two countries a la Melitz (2003) yields the following demand function for a given product *p*, firm *f* in a country *j* at time *t*

$$\boldsymbol{q_{pfjt}} = \boldsymbol{\lambda_{fpjt}^{\sigma-1}}\ \frac{\boldsymbol{p_{fpjt}^{-\sigma}}}{\boldsymbol{P_{jt}^{1-\sigma}}}\ \boldsymbol{Y_{jt}}$$

Log-linearising the above equation provides a tractable way of determining the non-price component:

$$\ln \boldsymbol{q_{pfjt}} + \boldsymbol{\sigma} \ln \boldsymbol{p_{pfjt}} = \boldsymbol{\alpha_p} + \boldsymbol{\alpha_{jt}} + \boldsymbol{\epsilon_{pfjt}}$$

As the fixed effects $\boldsymbol{\alpha_p}$ capture product characteristics and $\boldsymbol{\alpha_{jt}}$ both price index and income at a destination country, the logarithm of "quality" measure will therefore be derived as:

$$\hat{\boldsymbol{\lambda}}_{\boldsymbol{pfjt}} = \widehat{\boldsymbol{\epsilon_{pfjt}}}/(\boldsymbol{\sigma}-\mathbf{1}).$$

$\hat{\boldsymbol{\lambda}}_{\boldsymbol{pfjt}}$ is thus a proxy of non-price competitiveness as it reflects the export sales that cannot be explained by the price and other controlled parameters.

ANNEX II – Descriptive statistics

Table: **Descriptive statistics – entire sample** (over 30 million observations)

	Mean	Median	Standard deviation	Min	Max
Quantity	1.60E+03	4.99E+00	2.86E+05	1.00E-06	6.94E+08
Value	2.96E+06	7.51E+04	6.36E+07	5.17E+00	6.00E+10
Unit value	2.70E+05	1.55E+04	2.03E+07	4.61E-01	2.64E+10
Population	5.01E+07	3.80E+07	6.40E+07	4.01E+05	3.23E+08
Distance	4115	1851	4155	161	18885
Contingency	0.13	0.00	0.34	0.00	1.00
Colony	0.07	0.00	0.25	0.00	1.00

Table: **Descriptive statistics – France** (1,798,604 observations)

	Mean	Median	Standard deviation	Min	Max
Quantity	1.08E+03	6.53E+00	2.00E+04	1.00E-06	4.11E+06
Value	3.19E+06	1.21E+05	4.21E+07	2.80E+01	1.57E+10
Unit value	2.98E+05	1.76E+04	1.62E+07	7.08E-01	1.31E+10
Population	6.48E+07	6.50E+07	1.42E+06	6.22E+07	6.69E+07
Distance	3829	1759	3901	474	16513
Contingency	0.16	0.00	0.37	0.00	1.00
Colony	0.05	0.00	0.23	0.00	1.00

ANNEX III – Regression results (baseline)

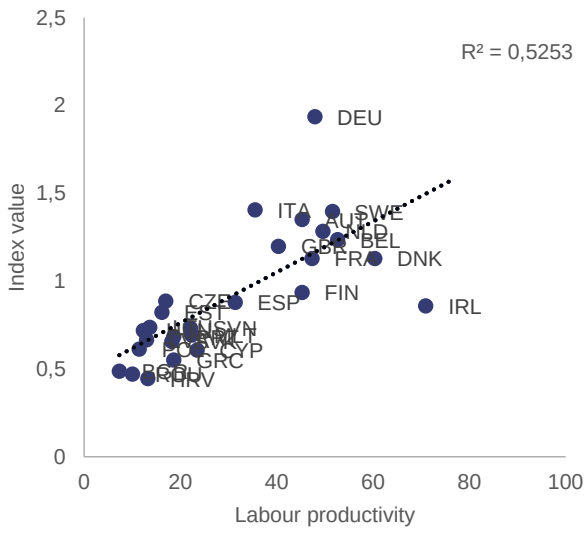
Table: **Baseline regression**

Linear regression, absorbing indicators		Number of obs.	29,860,249
Absorbed variable: id_jp		No. of categories	3,545,209
		F(4,26315036)	109.58
		Prob > F	0
		R-squared	0.996
		Adj R-squared	0.9955
		Root MSE	164.2122

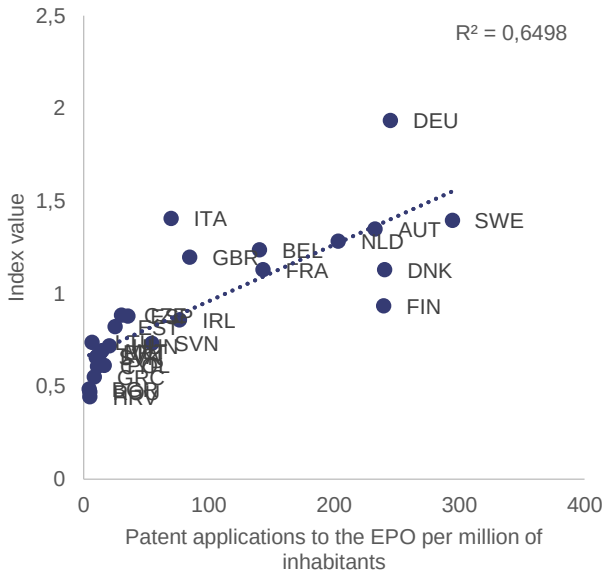
	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Log population	0.491	0.028	17.440	0.000	0.436	0.547
Log distance	-0.581	0.056	-10.290	0.000	-0.691	-0.470
Contingency	0.213	0.117	1.820	0.069	-0.016	0.442
Colony	0.069	0.138	0.500	0.620	-0.203	0.340
Constant	76.850	0.587	131.000	0.000	75.700	78.000

ANNEX IV– Additional correlations

Graph: **Correlation between labour productivity per hour worked and the aggregate index (2016)**

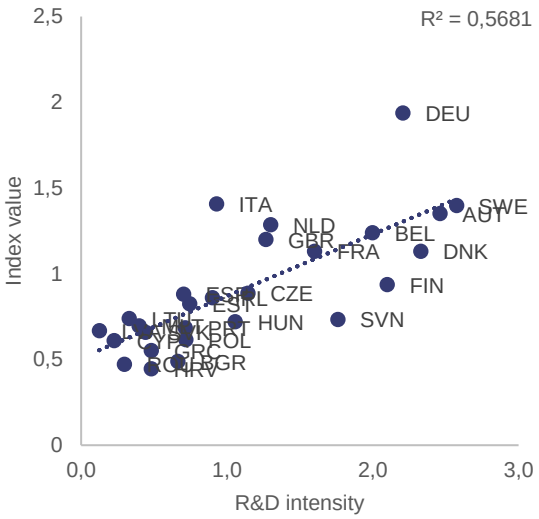


Graph: **Correlation between number of patents applications to the European Patent Office (EPO) per capita and the aggregate index (2016)**

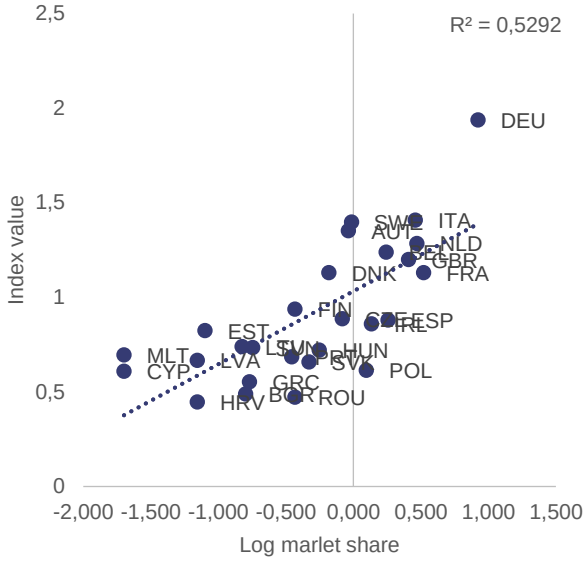


Source: SPI and Eurostat databases, authors 'calculations.

Graph: **Correlation between R&D intensity and the aggregate index (2016)**



Graph: **Correlation between export market shares and the aggregate index (2016)**



Source: SPI and Eurostat databases, authors 'calculations.

ANNEX V – Aggregate index ranking in 2016 (robustness checks)

Table: **Robustness check: time coverage**

	Index in 2005		Index in 2016	
	Baseline	Before 2009 only	Baseline	After 2009 only
CHE	1	1	1	1
DEU	2	2	2	2
JPN	3	3	3	3
ITA	5	5	5	5
SWE	4	4	6	6
AUT	7	7	4	4
NLD	11	12	9	8
BEL	6	8	8	7
USA	13	6	7	9
GBR	10	9	11	12
FRA	8	10	12	11

Table: **Robustness check: country inclusion**

	No DEU	No USA	No ITA	No ESP	No FRA
CHE	1	2	1	1	1
DEU	-	1	2	2	2
JPN	2	3	3	3	3
ITA	3	4	-	4	5
SWE	6	6	5	6	6
AUT	5	5	4	5	4
NLD	10	9	8	9	9
BEL	9	8	7	8	8
USA	4	-	6	7	7
GBR	8	7	10	11	10
FRA	7	10	11	12	-

ANNEX VI – Aggregate index ranking in 2016 – different aggregation methods

Country	Median across all products	Median across median quality index at product level	Simple average of the ranking
CHE	1	1	3
DEU	2	2	1
JPN	3	3	2
ITA	4	5	4
SWE	5	4	7
AUT	6	6	5
NLD	7	7	8
BEL	8	9	10
USA	9	8	6
GBR	10	10	9
FRA	11	11	11
DNK	12	12	12
KOR	13	13	18
FIN	14	14	19
CZE	15	17	14
ESP	16	18	15
IRL	17	16	21
NOR	18	15	22
EST	19	19	16
AUS	20	20	13
LTU	21	22	17
SVN	22	24	20
HUN	23	23	24
MLT	24	21	29
PRT	25	25	26
LVA	26	28	23
CHL	27	26	32
SVK	28	29	25
CAN	29	27	27
POL	30	30	28
CYP	31	31	34
GRC	32	32	30
BGR	33	33	31
ROU	34	34	36
HRV	35	35	33
MEX	36	36	35
TUR	37	37	37

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