

For a better understanding of the sensitivity of French exports to exchange rate fluctuations using detailed customs data

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For the last three years, the euro has appreciated overall against most currencies, which has increased the price of France's exports and led to a deterioration in its price competitiveness. Nevertheless, the effects of this increase on trade volumes between France and its main trading partners depend on the sensitivity of exports to price fluctuations, and this sensitivity may vary according to the product being exported and the destination country.

To quantify the price sensitivity of French exports, Customs statistical data can be used to track all goods traded between France and the rest of the world between 2002 and 2017 at a highly detailed level. Using an accounting method, the degree of export price sensitivity can be identified by product and by destination country. It appears that, on the one hand, the most price-sensitive products are agricultural products and products associated with energy, while the least sensitive are products in which the French specialise: transport equipment, agrifood products, clothing etc. On the other hand, exports are more sensitive to price fluctuations when they are sent to the most advanced countries.

Another method, complementary to this typological approach, results in a more detailed study of changes in exports using the traditional tools of short-term analysis, i.e. export equations. Overall, the estimated price-elasticities of products are in line with previous results. In addition, the models reveal that since 2009 the increase in the exchange rate has contributed positively to changes in exports of the most price-sensitive manufactured products. ■

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Since 2015, the euro has appreciated against most of the currencies of France's partner countries

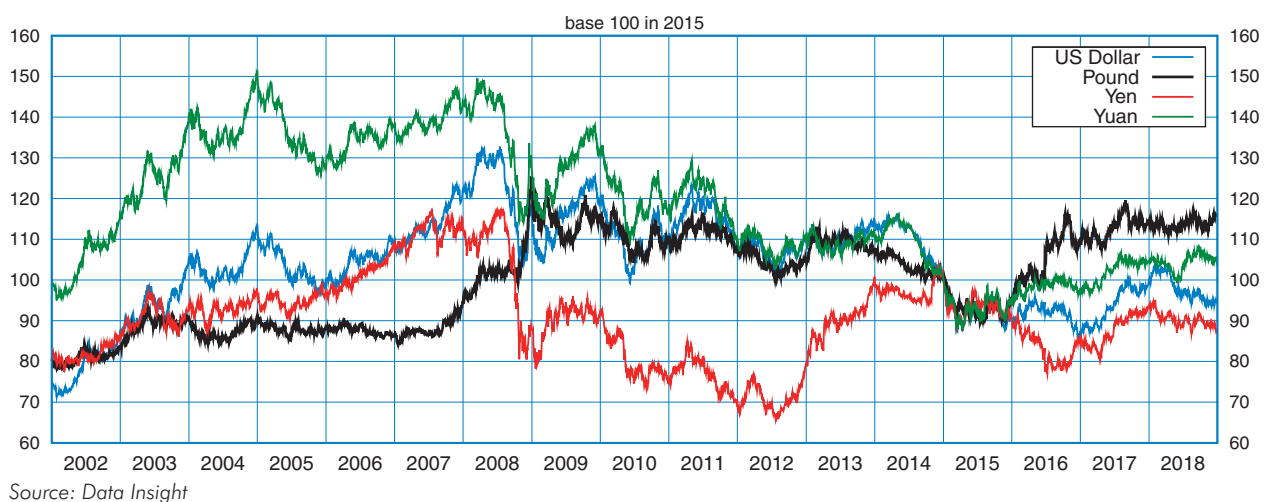
Since 2015, the euro exchange rate has increased overall against the US dollar, the British pound and the Chinese yuan, while depreciating against the Japanese yen (*Graph 1*). In general, an increase (or decrease) of the euro against the currencies of France's competitor countries causes the price of exported products to rise (or fall), provided the margin behaviour of French producers remains unchanged (Cachia, 2008). As a result, the volume of exports and imports traded with France's trading partners may be affected by this change in relative prices. Thus if exports by volume vary strongly (or slightly) as a result of an increase in their price, they will be said to be price-sensitive (or not very price-sensitive). Nevertheless, the effect of a fluctuation in the exchange rate on external trade by volume is complex and depends on several factors that must all be assessed.

The recent appreciation of the euro has brought down the price competitiveness of French exports

In a given market, for example bilateral trade between France and the United States, French exporters have three types of competitor to contend with in the event of, for example, an appreciation in the euro against the other currencies: (1) American producers who would benefit from an increase in the price of European products, (2) Eurozone producers who would suffer in the same way as French producers, and (3) other foreign producers who would benefit from the depreciation of their currency against the euro. The ability of French exporters to compete and gain market share by reducing their selling prices – in this case this would be an improvement in price competitiveness – is therefore affected by fluctuations in the euro exchange rate against these economies. Nevertheless, the notion of exchange rate used until now has a bilateral dimension (the value of the euro against the dollar, for example) and therefore does not include the relationship between French exporters and the other countries in the world. From now on, in order to assess the effects of the exchange rate on a country's price competitiveness, changes must be analysed not bilaterally but against all currencies. As a result, it is customary to use the concept of the effective exchange rate to measure the balance of power between prices and exchange rate that is played out between French exporters and the rest of the world.

Using the nominal effective exchange rate (NEER), changes in the French exchange rate can be assessed against those of its main trading partners (or competitors) by considering the weighting of each country in France's total

1 - Changes in euro exchange rate against the main currencies



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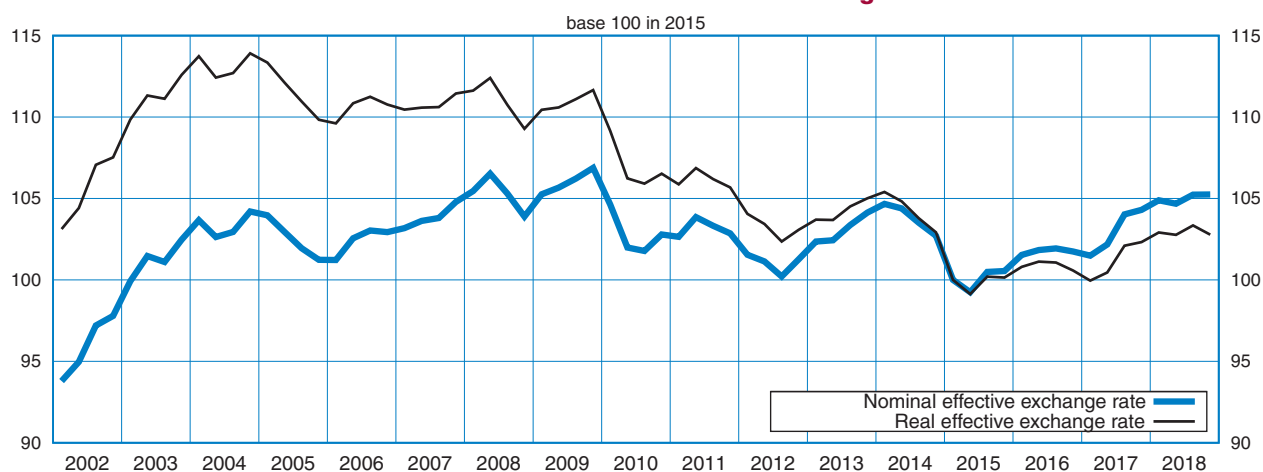
exports. In other words, it is an average of the bilateral exchange rates of the euro with France's main partners weighted according to the proportion of these countries in French exports.

Therefore, a rise in the NEER can be seen as an overall rise in the euro against all of France's trading partners and competitors. In addition to the exchange rate, it is also possible to take into account the ratio of France's domestic prices against those of its partner countries, i.e. the ratio of French consumer prices to foreign consumer prices. This real effective exchange rate (REER) therefore measures price competitiveness. Hence, a rise in REER corresponds to a real (or inflation-adjusted) increase in the euro in relation to all of its main partners and thus implies a drop in its price competitiveness. This loss of competitiveness may be the result of both an increase in the nominal value of the domestic currency and a rise in the price ratio, thus implying that French domestic prices rose more quickly than those of its competitors. Since 2015, the French NEER has increased, but less than the REER (Graph 2). This gap suggests that the nominal increase in the euro since 2015 against France's trading partners has been slowed by the rise in the ratio of national prices to foreign prices, preventing too strong a deterioration in price competitiveness.

However, the effects of the appreciation of the euro on trade volumes depend on the sensitivity of exports to price fluctuations

The recent increase in the REER would appear to suggest a decline in France's price competitiveness over the most recent period. However, the effect of these fluctuations on volumes exported by French producers depends on export price-sensitivity, which can vary according to the destination country or the good being exported. This price-sensitivity depends notably on a complementary notion to that of price competitiveness, which is non-price competitiveness. This time, exporters' ability to compete and gain market share can be achieved by seeking niche positions through product differentiation and/or innovation (Bellone and Chiappini, 2016). As a result, demand for a good may increase at a fixed price when the subjective (perceived) or objective (intrinsic) quality increases. Ultimately, despite potentially higher export prices, French producers can remain competitive or become more so and hence gain market share, as Kaldor already pointed out in 1978. All in all, although an increase in REER will degrade export price competitiveness, volumes traded may not be affected, depending on the level of non-price competitiveness. In other words, the

2 - French nominal and real effective exchange rates



Source: DG Treasury, Calculations: INSEE

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non-price positioning of a product (strong or deficient non-price competitiveness) can be likened to a lower export price sensitivity.

Therefore, a deterioration in price competitiveness may have no effect on volumes traded if the first effect (non-price positioning) outweighs the second (price positioning).

For example, some products positioned in an upmarket segment may be relatively less sensitive than others to price variations, and hence to fluctuations in exchange rate. Similarly, trade may be more sensitive to prices, or less so, depending on the export destination country.

Using Aiginger's method (1997), a price sensitivity indicator can be calculated for French exports

To identify the non-price positioning of French exports, there are three methods that can be used. The first is to measure it indirectly using innovation indicators that are theoretically correlated with it: research and development, number of publications or researchers, patents filed, etc. The second is to estimate an export demand model and consider that the non-price competitiveness of a product is the residual of this demand not accounted for by factors linked with prices (exchange rate, price ratio, etc.; see for example Bas et al. (2015)). This is also the method most commonly used. Finally, the third method, which is used here, is based on the empirical evaluation of the quality of goods using Aiginger's model (1997).

More specifically, this method involves comparing volumes exported and imported in a given geographic area with the purchase price or selling price of the products. Thus, four scenarios can be defined for a given product (Box 1).

-The selling price is higher than the purchase price and the quantities exported are lower than those imported. This trade deficit represents an unfavourable price ratio and therefore a poor price competitiveness.

-The selling price is lower than the purchase price and the quantities exported are greater than those imported. This trade surplus represents a favourable price ratio and hence a strong price competitiveness.

-The selling price is higher than the purchase price and the quantities exported are greater than those imported. This trade surplus cannot be due to the price ratio, which is unfavourable here, but to a recognised quality and hence a strong non-price competitiveness.

-The selling price is lower than the purchase price and the quantities exported are less than those imported. This trade deficit cannot be due to the price ratio, despite it being favourable here, but to a less attractive product and hence a poor non-price competitiveness. One possible interpretation of this example may be the presence of exit barriers (large fixed exit costs, too much specialisation) preventing producers from leaving a market that yields little or no profit.

All in all, the amounts traded depend on both prices and quality. When the price component predominates, i.e. strong or weak price competitiveness, then exports will be said to be more price-sensitive. Conversely, if the quality component predominates, i.e. successful or deficient non-price competitiveness, then exports will be said to be less price-sensitive (Table 1).

Table 1

Typology of price sensitivity according to Aiginger's method

	Export price > Import price	Export price < Import price
Quantity exported > Quantity imported	(1) Not very price-sensitive	(2) Not very price-sensitive
Quantity exported < Quantity imported	(3) Price-sensitive	(4) Not very price-sensitive

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Export price sensitivity varies according to product and destination country

Exported high-tech products are the least price-sensitive

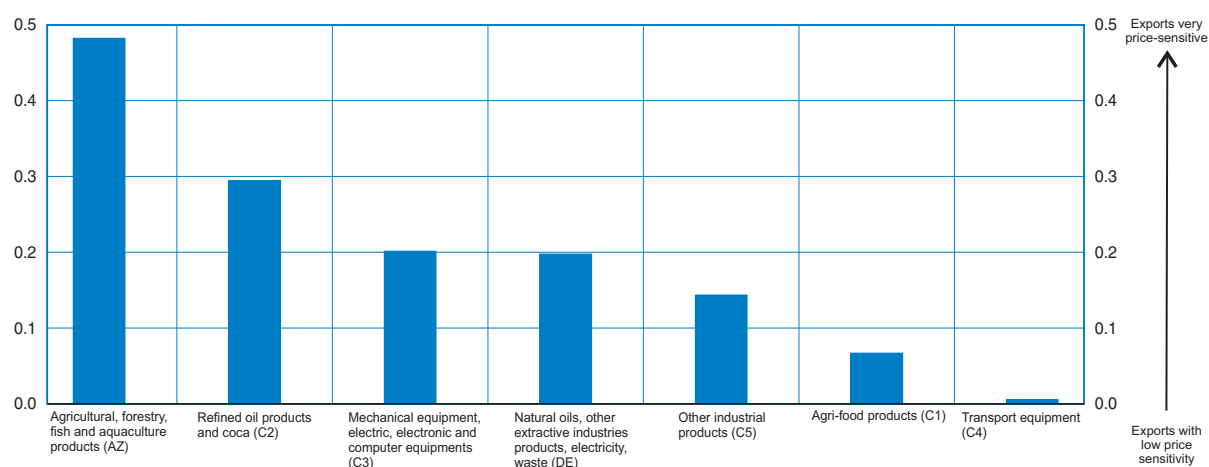
For reasons of clarity, the results presented here are aggregated at a higher level in the product classification, weighting degrees of sensitivity obtained at a basic level according to the product weighting in trade in France.

The results suggest that the least price-sensitive exports are transport equipment (C4) and agrifood products (C1; [Graph 3](#)). Conversely, the most price-sensitive products are agricultural products (AZ) and coke and refined petroleum products (C2). At a more detailed level (level A129 in the classification), the analysis suggests that within transport equipment, the manufacture of air and spacecraft products (C30C) contributes most to this low price sensitivity, followed by railway locomotives and rolling stock (C30B). Conversely, within agricultural products, it is forestry products (A02Z) and mixed farming (A01Z) that account for the high price sensitivity.

The results obtained are broadly in line with the price sensitivities of French exports estimated using a similar method or by panel data econometrics in the literature. Firstly, by adapting Aiginger's method within the developed countries, Sautard et al. (2014) also positioned, air and space navigation products among the least price-sensitive, along with the chemical industry. Conversely, they identified "plastic materials and articles made from them" and "wood, coal products and articles made from them" as being among the most price-sensitive.

In terms of econometrics, Héricourt et al. (2014) show, among other things, that exports of products from the automotive sector are more sensitive overall to exchange rate fluctuations than products from the agrifood or chemical industries, which we also see here at the level of price sensitivities. Bas et al. (2015) used data from French companies to show that the major sectors (in terms of their weighting in French exports) that were most competitive at the non-price level, and which were therefore least price-sensitive, were aeronautics, wine, leather goods and dairy products. When compared with Aiginger's method, at level A129 of the classification, air and space construction products (C30C), dairy products and ice cream (C10E), leather goods, luggage and footwear (C15Z) and beverages (C11Z) were among the ten least price-sensitive products ([Table 2](#)).

3 - Ranking price sensitivity by product exported by France at level A17



How to read it: the score indicates the product's degree of price sensitivity. The closer it is to 1, the more price-sensitive the product, and the closer it is to -1, the less price-sensitive ([Box 2](#)).

Source: French Customs. Calculations: INSEE.

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Table2

Ranking of the 10 most price-sensitive products and the 10 least price-sensitive products

Rank	10 most price-sensitive products		10 least price-sensitive products	
1	C20B	Perfumes, cosmetics and cleaning products	D35Z	gaz manufactured
2	C10E	Dairy products and ice cream	C18Z	printing and reproduction equipment
3	C30C	Aeronautical and space construction products	C12Z	manufactured tobaccos
4	C25C	Weapons and ammunition	A02Z	silvicultural products
5	C15Z	Leather, luggage and shoes	B05Z	coal
6	C11Z	Beverages	B07Z	metallic mineral
7	C26F	electromedical diagnostic and treatment equipment	A01Z	crop and livestock products
8	C14Z	clothing items	C10D	vegetable and animal oils and fats, crabs
9	E37Z	sewage sludge and household waste	C28B	agricultural and forestry machinery
10	C28D	various machines for specific use	C22B	plastic products

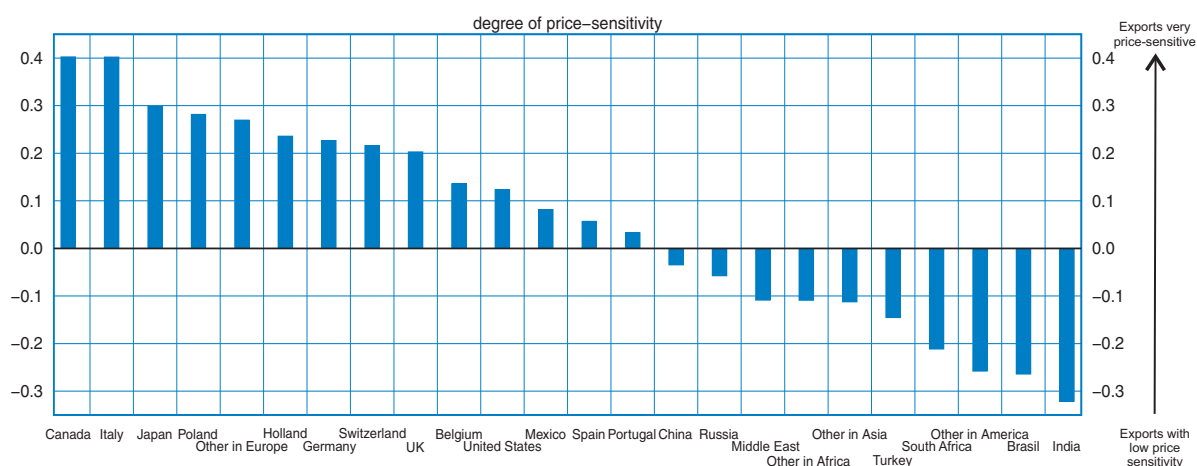
Source: French Customs. Calculations: INSEE.

At product level, it would seem that the least price-sensitive products are high-tech products and/or those in which France specialises¹, whereas the products that are most price-sensitive are those that are most subject to foreign competition or are highly dependent on commodity and energy prices.

Exports to developed countries are the most price-sensitive

In the same way, aggregated results can be obtained for the main export destination countries². The main message that emerges from these calculations is that the least price-sensitive French exports are those destined for emerging countries, and the most price-sensitive are destined for advanced countries (Graph 4). China in particular, a country whose weighting in French exports was around 4% in 2017, is in a pivotal position. Thus, exports could be more price-sensitive when destined for countries where the technology gap with France is smaller, and less price-sensitive when destined for countries where the technology gap with France is great, which is in line with the theory introduced by Posner (1961)³.

4 - Ranking of price-sensitivity of products exported from France by country of destination



How to read it: the score indicates the product's degree of price sensitivity. The closer it is to 1, the more price-sensitive the product, and the closer it is to -1, the less price-sensitive.

Source: French Customs. Calculations: INSEE.

1. For C4 products, see for example: Dortet-Bernadet V., Lenseigne F., Parent C., Quartier-la-Tente A., Stolaroff-Pépin A.-M. and Corentin Plouhinec (2016). After two years of turbulence, the French aeronautical sector is ready to take off again. Conjoncture in France, December 2016, INSEE.

2. For reasons of clarity and precision in the results, only the price-sensitivities of France's main partner countries are analysed.

3. At a given moment, some countries have a technological edge over their competitors which puts them in a temporary monopoly situation. The demand for this product is then much less dependent on the price charged than for other products, in the absence of wide competition. The technology or quality gap between developed countries is, by definition, less than between developed and emerging countries, which could explain the different price-sensitivities obtained.

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In the former case, France would face increased competition with the other developed countries over products of similar quality. In the latter case, French exports would be less price-sensitive when destined for countries where the technology gap is greater, thus making import substitution /domestic production more difficult.

Key: CL (Transport equipment), CE (Chemical, perfumes and cosmetics), CA (Agrifood products), CD (Coke and refined petroleum products), CK (Industrial and agricultural machinery, various machinery), CG (Rubber and plastic products and various mineral products), BZ (Natural hydrocarbons and other products from extractive industries), EZ (Industrial and household waste), CC (Wood, paper and cardboard), DZ (Electricity and manufactured gas), AZ (Products of agriculture, forestry, fishing and aquaculture), CB (Textiles, clothing, leather and footwear), CH (Metallurgical and metal products), CJ (Electrical and household appliances), CM (Various manufactured products), CF (Pharmaceutical products), CI (Computer, electronic and optical equipment).

Price sensitivities of exports according to country of destination and product are varied

By crossing product and destination country, the degrees of price sensitivity of exports to a certain country of destination for a given product can be calculated (*Table 3*). The results suggest that there are major differences according to the product and the country for which the exports are destined. First, transport equipment (CL), agrifood products (CA) and pharmaceutical products (CF) are more price-sensitive in the developed countries than in the emerging countries. These results are in line with what is observed at country level, but not at product level, where they are not very price-sensitive overall. Conversely, for agricultural products (AZ) or industrial and household waste (EZ), which are very price-sensitive overall, degrees of price sensitivity were relatively similar between countries. It is difficult to interpret these observations by product for all countries as a whole, and it seems more appropriate to analyse them by country of destination.

For example, exports of textile products, clothes, leather and footwear (CB), which are not very price-sensitive overall, are very price-sensitive when destined for countries like China, Spain, Portugal and countries of Eastern Europe where the imports/domestic production arbitration is stronger. In general, exports to the developed countries, where the price sensitivity of exports is strong, are somewhat more price-sensitive, irrespective of the product, than exports to the emerging countries.

- A structural effect, i.e. at a given price sensitivity for exports of products (or for destination countries), the share of variation in the degree of price sensitivity that results from a deformation in the structure of French exports of certain products (or to certain countries);
- An intrinsic effect, i.e. at a given product (or country) weighting in French exports, an increase (or decrease) in the price sensitivity of exports caused by certain products (or by certain destination countries) as they are more (or less) price-sensitive than in the previous period;
- A residual term, which represents the combined variation in the weight of products (or destination countries) in exports and the price sensitivities of exports of a given product (or to a given country).

While the contribution of a structural effect to a fluctuation in the degree of export price sensitivity can be explained by, among other things, supply-related factors (specialisation of production in certain products) or demand-related factors (loss of market share at a given degree of price sensitivity), interpreting an intrinsic

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effect is more difficult. Hence (Box 2), a positive or negative contribution by the intrinsic effect can be interpreted as follows:

- A positive contribution corresponds to a rise in the degree of price sensitivity of exports of a certain product (or to a certain country). According to the score achieved, this increase means that, on average, more products are price-sensitive. Thus exports by volume will suffer all the more from a depreciation in the exchange rate affecting their prices;
- A negative contribution corresponds to a fall in the degree of export price sensitivity of a certain product (or to a certain country). According to the score achieved, this decrease means that, on average, fewer products are price-sensitive. Thus exports by volume will suffer less from a depreciation in the exchange rate affecting their prices;

Table 3

Price sensitivity of exports by country of destination and by product (at level A38)

Country/Products	Agricultural products from livestock and aquaculture	Rubber and plastic products, various mineral products	Water supply; sewerage, waste management and remediation	Electrical equipment	Refined petroleum products and coke	Basic metals and fabricated metal products, except machinery and equipment	Wood and paper products; printing and reproduction of recorded media	Mining and quarrying	Computer, electronic and optical products	Other manufacturing; repair and installation of machinery and equipment	Machinery and equipment n.e.c.	Chemicals and chemical products	Food products and beverages	Basic pharmaceutical products and pharmaceutical preparations	Transport equipment	Wearing apparel, leather and related products	Country ranking
	AZ	CG	EZ	CJ	CD	CH	CC	BZ	CI	CM	CK	CE	CA	CF	CL	CB	
Canada	0,0	-0,3	0,1	-0,3	2,0	3,5	-0,3	0,0	1,7	1,6	-0,1	2,6	9,6	10,5	8,4	-2,3	1
Italy	4,7	2,7	1,5	1,8	0,1	2,7	1,5	0,2	2,3	1,5	3,4	5,0	0,6	3,7	9,2	-0,7	2
Japan	0,3	1,2	0,0	0,2	0,3	0,8	0,3	0,0	2,9	1,7	2,9	9,4	9,4	12,0	-0,9	-11,1	3
Poland	-0,7	-0,8	-0,1	3,1	-0,2	5,3	1,8	0,0	1,0	-0,1	1,2	-5,3	1,3	4,8	16,3	0,3	4
Other Europe	1,0	1,4	0,7	3,4	0,6	0,8	0,7	0,1	3,8	1,1	5,4	2,2	-0,8	-4,3	9,7	0,9	5
Netherlands	5,5	2,1	-0,4	1,3	7,5	1,7	1,2	0,1	-5,5	0,5	2,5	0,2	5,0	-2,6	4,1	0,4	6
Germany	-0,4	3,5	0,7	0,7	0,3	4,0	0,8	0,1	-0,3	0,6	1,9	1,7	1,6	-1,8	8,8	0,1	7
Swiss	0,2	2,0	-0,6	1,0	3,3	4,2	0,5	-0,3	0,5	-4,7	1,9	6,0	4,4	6,4	0,7	-2,1	8
United-Kingdom	-0,3	2,7	0,2	1,3	-0,1	0,5	1,1	0,2	3,1	1,0	1,7	0,4	3,6	3,3	3,3	-2,2	9
Belgium	2,8	1,8	-2,7	0,5	1,2	2,0	0,4	0,1	0,6	-0,1	0,8	1,3	0,4	-4,0	9,7	-1,4	10
United-States	0,2	0,6	0,2	1,6	3,5	2,4	-0,7	0,0	3,9	0,1	3,7	-1,5	-4,6	8,1	-1,0	-3,3	11
Mexico	0,4	2,7	0,0	5,1	2,0	0,5	0,3	0,0	-3,0	1,0	-4,8	0,8	-0,2	2,5	1,1	-0,4	12
Spain	3,1	1,7	1,8	1,2	0,4	3,3	0,1	0,0	0,0	0,7	0,2	1,1	0,4	2,3	-12,0	1,2	13
Portugal	-0,4	1,9	0,5	0,6	0,7	2,6	1,1	-0,1	-1,1	-0,2	0,6	1,7	-0,6	-4,9	-0,1	0,9	14
China	1,2	1,9	2,0	2,0	0,2	1,2	0,3	0,0	5,2	1,2	3,8	0,8	-3,1	-2,5	-21,3	3,3	15
Russia	0,0	-1,4	0,0	2,2	0,3	-1,4	0,2	0,0	3,4	0,8	-0,1	8,8	0,3	-5,7	-9,2	-3,9	16
Middle East	1,8	-0,6	0,0	2,4	-2,8	-1,2	0,2	0,0	2,0	0,8	1,9	-4,2	1,9	5,1	-15,5	-2,1	17
Other Africa	7,0	0,5	0,1	1,9	-1,3	0,2	0,6	0,1	-0,7	-0,3	-5,1	-1,2	1,1	-9,8	-0,6	-2,8	18
Other Asia	0,4	0,6	0,3	1,8	-0,2	-0,8	0,4	0,0	6,4	1,7	-4,1	-2,5	-3,6	5,3	-24,2	7,2	19
Turkey	0,3	-1,0	1,0	0,2	-0,5	4,9	0,3	0,0	0,2	-0,8	-5,4	2,4	0,5	-5,0	-12,2	0,5	20
South Africa	0,2	-1,2	0,0	-1,0	1,7	-0,5	-1,7	0,0	0,1	1,1	-2,8	3,5	0,5	-7,1	-13,5	-0,3	21
Other America	1,4	-0,2	0,0	-0,1	-1,7	-0,2	-0,4	0,0	2,1	0,7	-5,2	-8,9	-0,7	-7,3	-4,7	-0,4	22
Brazil	0,0	-0,7	0,0	1,1	0,5	-1,2	-0,1	0,0	-3,0	0,5	-0,5	-6,2	-0,1	-2,8	-13,9	-0,1	23
India	1,0	1,0	-0,9	-2,7	0,5	2,8	0,4	0,0	-7,1	0,8	0,0	-1,2	0,3	-1,0	-26,4	0,4	24

the least price-sensitive exports

the most price-sensitive exports

Note : the least price-sensitive exports are shown in pink; the most price-sensitive in blue. Degrees of sensitivity are standardised between 100 (exports very sensitive) and -100 (exports with very low sensitivity).

Source : French customs. Calculations: INSEE.

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After stagnating between 2002 and 2012, exports became less price-sensitive from 2012, with a constant structure

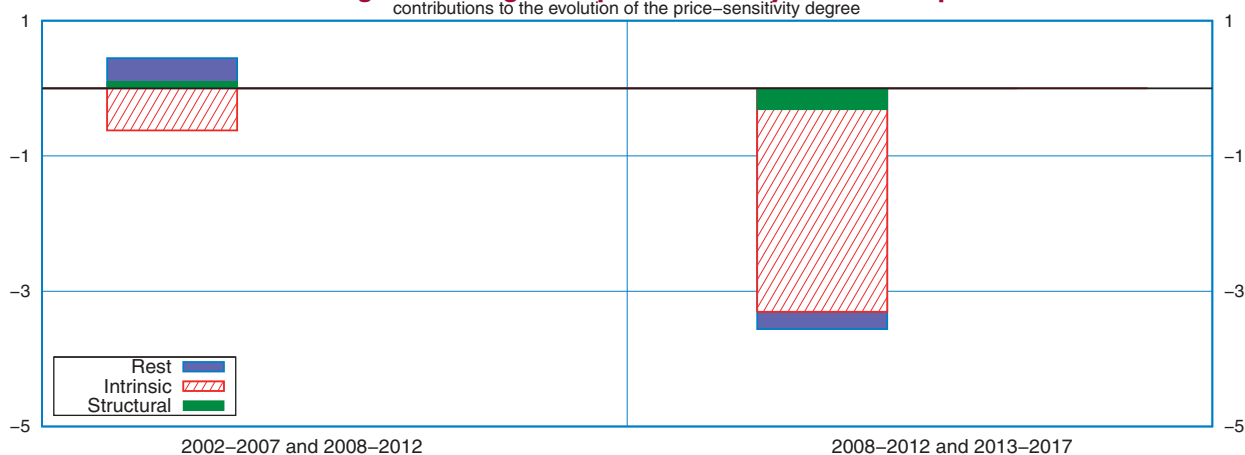
Transport equipment accounted for most of the recent decline in the price sensitivity of French exports

The breakdown above suggests that the degree of price sensitivity stagnated between the periods 2002-2007 and 2008-2012 (*Graph 5*). Conversely, it declined between the periods 2008-2012 and 2013-2017. This was mainly due to an intrinsic effect contribution. In other words, when the structure of the products remains unchanged, their price sensitivity declines. This result is not surprising, given that the fluctuation in product weighting or in French export partner countries is relatively stable over such a short period. Nevertheless, it is interesting to identify the elements within products or countries of destination that contributed most to this decline.

Two sets of products contribute most to the change in price sensitivity of exports between the periods 2002-2012 and 2013-2017, but in opposite directions: transport equipment (C4) and capital goods (C3). On the one hand, C4 products contributed most to the decrease in the overall degree of price sensitivity of French exports, and mainly via a strong intrinsic effect contribution (*Graph 6*). On the other hand, C3 products increased the degree of price sensitivity overall. When breaking down the product classification to a more detailed level, the analysis suggests a strong similarity in contributions within the C3 products: only industrial, agricultural and various machinery (CK) contributed to decreasing the overall degree of price sensitivity, but only marginally. In C4 products, the situation is different. On the one hand, aeronautics and spacecraft construction products (C30C; *Box 3*) and automobile construction products (C29A)

5 - Change in the degree of price sensitivity of French exports

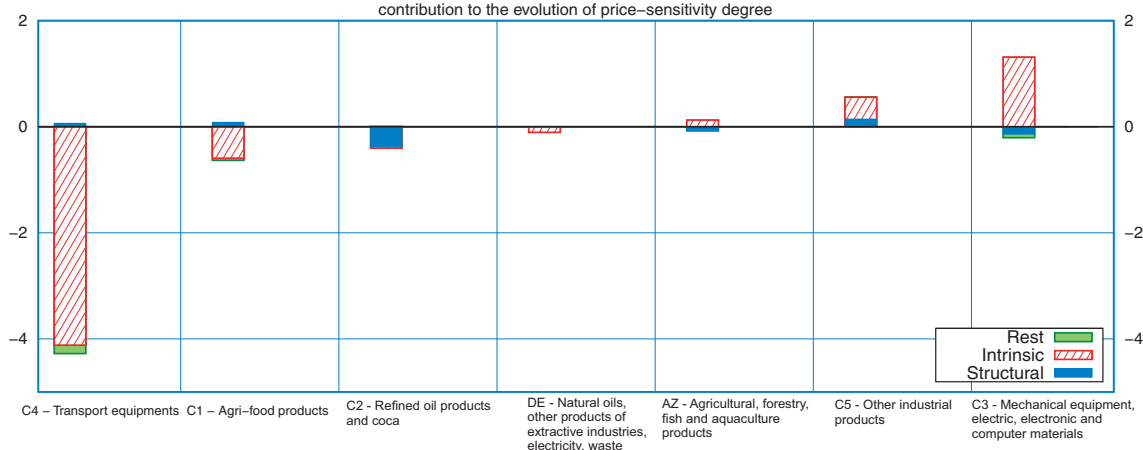
contributions to the evolution of the price-sensitivity degree



Note: degrees of price sensitivity are standardised between +100 (exports very price-sensitive) and -100 (exports with very low price sensitivity)
Source: French customs. Calculations: INSEE.

6 - Breakdown by product (at level A17) of the increase in degree of price sensitivity between the periods 2008-2012 and 2013-2017

contribution to the evolution of price-sensitivity degree



Source: French Customs. Calculations: INSEE.

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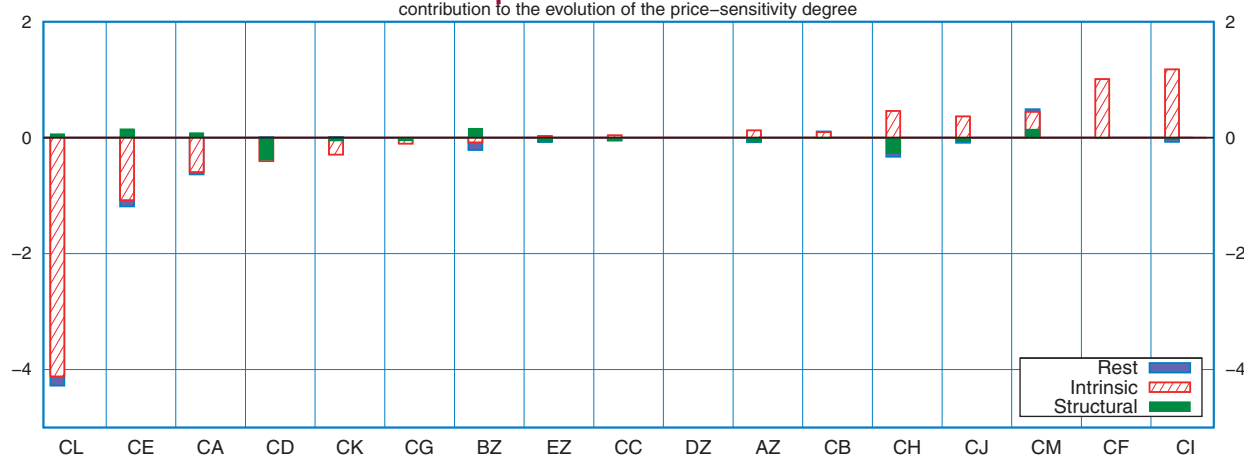
contributed to a decline in price sensitivity overall. On the other hand, automobile equipment (C29B) contributed to an increase in the degree of price sensitivity overall, mainly due to an intrinsic effect. In other words, their price sensitivity increased independently of their weighting in French exports (Graph 7). All in all, the contribution made by transport equipment reduced price sensitivity overall, but nevertheless outweighed that of capital goods which increased price sensitivity.

In the export destination countries, all products combined, the reduction in the degree of price sensitivity is due mainly to an intrinsic effect of exports to Germany. Conversely, three countries are boosting this trend to a similar degree: Italy, the United States and China (Graph 8).

The price sensitivity of exports to Germany has declined due to a strong contribution from transport equipment, specifically aeronautics and spacecraft construction. This result can be compared to the analysis at product level: the strong contribution by transport equipment to the increase in overall price sensitivity is mainly the result of exports to Germany.

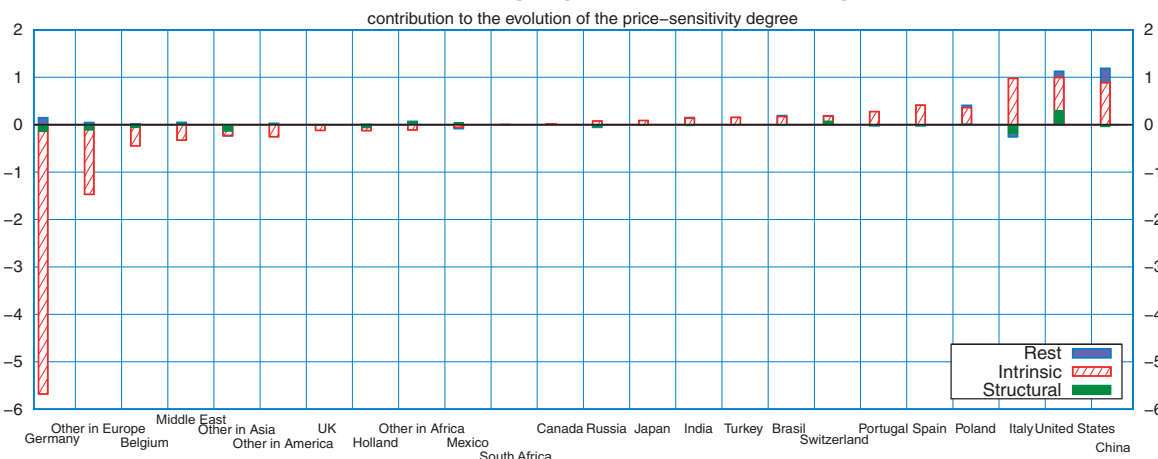
In contrast to Germany, the degree of price sensitivity of exports to Italy increases because of other industrial products (C5) and capital goods (C3). Similarly, exports of transport equipment and agrifood products (C1) to China are partly

7 - Breakdown by product (at level A38) of the increase in degree of price sensitivity between the periods 2008-2012 and 2013-2017
contribution to the evolution of the price-sensitivity degree



Source: French Customs. Calculations: INSEE.

8 - Breakdown by export destination country
contribution to the evolution of the price-sensitivity degree



Source: French Customs. Calculations: INSEE.

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the reason for the increase in the degree of price sensitivity of exports to this country. Nevertheless, although the intrinsic effect predominates for C1 products, the contribution by transport equipment is held back by an increase in the structural component, illustrating the greater share of exports of transport equipment to this country, products that are not very price-sensitive. For the United States, the increase in the degree of price sensitivity is the result of transport equipment, both through a contribution of the structural effect reflecting the loss of market share for this product in this country and the intrinsic effect. In addition there is an increase in the degree of price sensitivity of other industrial products (C5).

Export equations by product help to understand the different effects of the exchange rate since 2002

The Aiginger method in particular has made it possible to rank the price sensitivities of French exports by product. In order to quantify the effect of a variation in REER on traded volumes, it seems appropriate to complement this with traditional export equations based on error correction models by distinguishing the type of product sold abroad (Box 4).

Models by product can refine the diagnosis

Usually, the equations used to forecast exports in Conjoncture in France concern exports in their entirety (all sectors combined) and manufacturing exports, because they represent a significant proportion of total exports (around 67% by volume in 2017). The main determinants used to analyse and forecast exports in the short term are world demand for French goods and price-related variables.

However, in view of the results previously arrived at, price sensitivity differs according to the products under consideration. At level A17 of the classification, manufactured goods are less price-sensitive than other goods. The degree of price sensitivity also differs among the manufactured products considered, since transport equipment products are the least sensitive, whereas refined petroleum products are the most sensitive. In order to help us refine our export forecasts and our diagnoses, there are several econometric models that differentiate exports by product at level A17.

The real effective exchange rate as a price competitiveness variable

While France's price competitiveness is often measured using indicators that compare export prices to the prices used by competing countries in foreign markets, a change in prices relating to exports can be broken down into relative costs (unit wage costs), the behaviour of corporate margins and the exchange rate (Marc and Patier, 2016). Here, the price competitiveness variable used is the real effective exchange rate (REER). This variable has the advantage of taking into account both France's market share abroad, and the ratio of France's export prices to those of competing countries. Thus, an increase in the REER (i.e. a real appreciation of the exchange rate) corresponds to a deterioration in export price competitiveness.

Estimating the "exchange" effect, differentiated by product, reveals a greater sensitivity in energy products

To ensure consistency, all the models proposed here include changes in the REER among their short-term explanatory variables. The coefficient associated with this variable corresponds to the elasticity of exports by volume in relation to the REER and thus provides information on the price sensitivity of these products. In the models selected here, this elasticity appears to be stronger for energy sector products (electricity, waste, natural hydrocarbons), but weaker for "other industrial products", which cover textiles, chemical products and pharmaceutical products (Table 4).

The results produced by error correction models (Box 4) are therefore consistent with the analysis of degrees of price sensitivity carried out previously. In fact, while the products most sensitive to change were energy-related, the order of degrees of price sensitivity, established previously, is also respected in manufactured products. Thus a 1% rise in REER results in a drop of 1.1% in sales of refined petroleum products, 0.6% in sales of capital goods and 0.2% in exports of other

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Table 4

Ranking of estimated price elasticities by product

Product	Estimating the effect of the REER	
motor vehicles, trailers and semi-trailers (CL1)	not significant	↓
Food products and beverages (C1)	not significant	
Other manufacturing (C5)	-0.2	
Machinery and equipment goods (C3)	-0.6	
Coke and refined petroleum products (C2)	-1.1	
Energy (DE)	-2.3	very sensitive to "exchange"

How to read it: a 1% rise in REER results in a drop in volume of energy exports (DE) of 2.3%.

Note: the lack of an equation for aeronautical and naval (CL2) exports is due to a lack of data concerning major long-term contracts. In fact these contracts are very disruptive for quarterly changes in aeronautic and naval exports.

Source: INSEE.

The model reflects a positive contribution of the effect of the exchange rate on exports of the most price-sensitive manufactured products since 2009

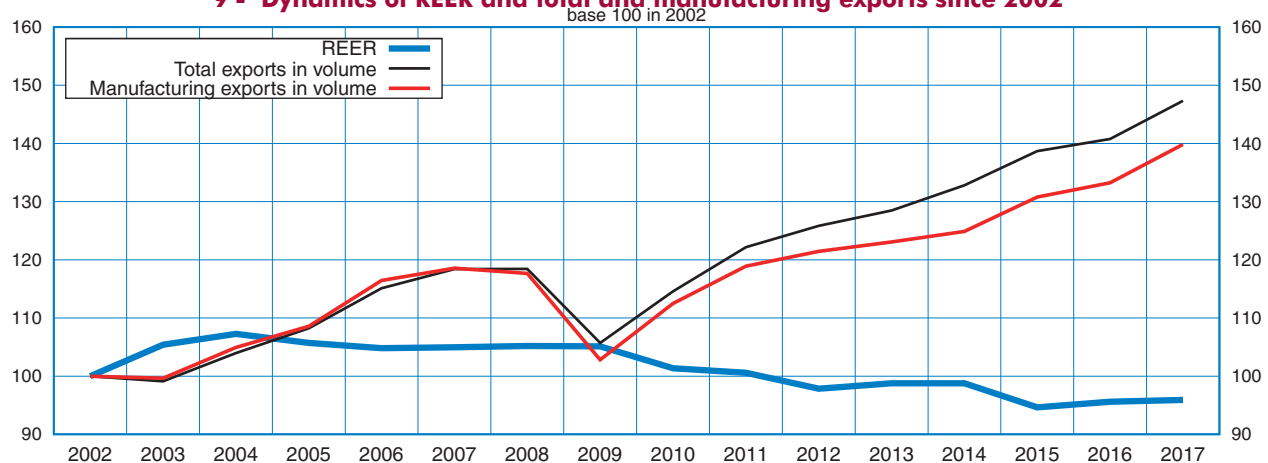
industrial products. Finally, the statistical non-significance of the coefficient associated with the REER for agri-food products and automobile products can be interpreted as zero elasticity to the exchange rate. However, this lack of significance in certain equations also reveals the limitations of the short-term determinants chosen in this model. Since there are many channels for the transmission of price competitiveness, not all of them are considered when constructing the REER.

Since the 2008 economic crisis, the real effective exchange rate has declined sharply (-8.8% between 2009 and 2017) and reached its lowest levels during this period (-2.7% in 2012 and -4.2% in 2015). This significant decline in the exchange rate is due partly to measures put in place by the ECB since the crisis, with these policies being passed on to the foreign exchange rate through the monetary channel and through base interest rates. It was able to contribute to the 39.4% recovery in total exports and 36% in manufacturing exports during the period 2009-2017, exceeding their pre-crisis levels (Graph 9).

This buoyancy in manufacturing exports, driven by the steep decline in the exchange rate (steady from 2009 to 2012), can be seen in this sector excluding aeronautics and more particularly for capital goods and other industrial products, two sectors that between them cover about 70% of exports of manufactured products, excluding aeronautics.

More specifically, before the crisis, the REER contributed negatively (-6.6 points) to the trend in sales of capital goods. Conversely, for the period 2009-2017, there was a 31.5% increase in exports of capital goods, of which 18.7 points are due to the REER (Table 5), and reflect changes in the REER. A similar analysis can

9 - Dynamics of REER and total and manufacturing exports since 2002



Source: INSEE, Tresor

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Table 5
Contributions to changes in exports of French manufactured goods by product and by time period

	2002-2017			2002-2009			2009-2017		
	Equipment goods (C3)	Other manufacturing (C5)	excluding aeronautics	Equipment goods (C3)	Other manufacturing (C5)	excluding aeronautics	Equipment goods (C3)	Other manufacturing (C5)	excluding aeronautics
global demand	61.8	61.4	61.7	24.7	29.9	27.5	37.1	31.5	34.3
REER	8.1	5.2	5.8	-10.6	-6.6	-8.1	18.7	11.8	14
further explanations	-40.4	-34.2	-43	-18.7	-16	-20.1	-21.6	-18.2	-23
Residues	-1.0	2.9	3.2	1.6	-1.2	0.2	-2.7	4.1	2.8
Total	28.5	35.3	27.7	-3.0	6.1	-0.5	31.5	29.2	28.1

How to read it: between 2002 and 2017, French exports of capital goods increased by 28.5%; the economic contribution of the REER is 8.1 points and that of world demand by 61.8 points

Source: INSEE

Over the period to mid-2019, the real effective exchange rate is likely to depreciate

be carried out for other industrial products, apart from the fact that the REER's contribution is slightly weaker over the most recent period (+11.8 points). This reduced contribution by the REER to other industrial products is mainly seen in products described as not very price-sensitive, such as chemical products and luxury goods.

While the method adopted here does have the advantage of ranking degrees of price sensitivity of exported products, it does have some intrinsic limitations, as already outlined (*Box 1*). The results obtained are therefore determined by the period studied and the methodology used. Nevertheless, these are coherent with the model of changes in exports using error correction methods. In the same way, the estimated sensitivity of exports to fluctuations in the REER remains relative due to the inherent limitations of the econometric methods.

Nevertheless, the results presented here have made it possible to refine the forecast diagnosis for French exports by differentiating the effects of an increase in exchange rate according to product. For example, the REER looks set to depreciate at the beginning of 2019, and as a result, exports by volume could benefit from this drop in prices, especially sales of the most price-sensitive products, i.e., all other things being equal, agricultural and energy products. ■

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Box 1: Measuring the price and non-price competitiveness of exports using Aiginger's method (1997)

Description of the method

In order to determine whether France's exports by volume are more sensitive to price competitiveness or to non-price competitiveness, we replicate Aiginger's method (1997), based on unit values. For a determined area, for example bilateral trade between France and a country i , the unit value of export (or import) of a product p at time t , is defined as the ratio of the exported (or imported) flows in value to a measurement of volume (e.g. mass in kg). This unit value corresponds to a measurement of the price of exports (or imports) of this good. The ratio between the unit value of exports and imports of a given product is a measurement of the terms of trade of this good for France. Hence it is the exact opposite of the terms of trade of this product vis-à-vis France for country i . Aiginger (1997) assumes that for a sufficiently homogeneous given product:

- Countries with a lower unit value for exports than for imports must be net exporters of this product. Conversely, countries with a higher unit value for exports than for imports must be net importers.
- If countries are net exporters despite a higher unit value of exports, this must be due to a higher quality of product. Conversely, if countries are net importers despite a lower unit value, this must be due to a lower quality of product.

Using the notation X_{pit} (or M_{pit}) for exports (or imports) by value of product p , to country j (or from country j) on date t ,

we can define VU_{pit}^X (or VU_{pit}^M), the unit value of exports (or imports) as:

$$VU_{pit}^X = \frac{X_{pit}}{Q_{pit}^X}$$

$$VU_{pit}^M = \frac{M_{pit}}{Q_{pit}^M},$$

such that these assumptions can then be summarised into four scenarios where a country's trade flows are located in a given zone and for a given product.

In particular, we can say that exports by volume are price-sensitive if they are in categories 2 or 3, since trade flows are determined according to their price positioning (table 1). Conversely, we can say that exports by volume are not very price-sensitive if they are in categories 1 or 4. This property can be summarised through a dichotomous variable, or score, for a product p exported or imported to or from a country j at time t . This is defined as $S_{pit} = +1$ if we are in scenarios 2 or 3, and as $S_{pit} = -1$ in scenarios 1 or 4. Using this method, export price sensitivity can be identified but it is no longer possible to identify, for example, whether an increase in price sensitivity derives from a deterioration in price competitiveness or an improvement in price sensitivity.

Table 1
Classification of trade flows according to Aiginger (1997)

	$VU_{pit}^X < VU_{pit}^M$	$VU_{pit}^X \geq VU_{pit}^M$
$Q_{pit}^X < Q_{pit}^M$	1. Poor quality competitiveness	2. Poor price competitiveness
$Q_{pit}^X \geq Q_{pit}^M$	3. Good price competitiveness	4. Good quality competitiveness

However, using this method to identify product price competitiveness does have its limitations. First, the unit value of exports is compared with the unit value of imports for a given country. This approach is therefore linked to bilateral trade with France and does not take into account the prices and performances of the other competing countries. Erkel-Rousse and Gallo (2002) have extended this method by comparing the terms of trade of a French product directly with the average terms of trade of its competitors for this same product, however, this approach requires a database listing international trade flows between different countries. Their results relate to the French economy vis-à-vis the main advanced countries over the period 1991-1994, but they are nevertheless close to those obtained in this report concerning the classification of products. Second, the notion of volume used here (mass in kg) is not perfect and could cause the analysis to be biased. However, it does have the merit, on the one hand, of being straightforward and well adapted to Customs data, and on the other hand, of being based on accounting rather than econometric identities. Indeed, the latter can pose many problems of endogeneity or identification, making it difficult to interpret or obtain results.

Calculating scores at an elementary level using Customs data

The French Customs authorities publish annually national foreign trade statistics for French exports and imports of goods to and from the rest of the world. These record monthly exports and imports by value for about 10,000 products (8-figure combined classification, NC8),

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to or from most world States. The database also has a volume index (mass in kg) useful for creating a price index. All in all, we have exports and imports by value and volume according to country, products and countries x products over the period 2002-2017.

In order to ensure there are sufficient data¹ scores are calculated at a basic level according to the method described in Box 2 for about 3,000 products (classification of French products to 6 figures, CPA6) for a given period of time and for 24 countries or country groupings² that were the destination or the source of trade flows. ■

1. Import and export flows for a sufficient number of products and countries over a determined period. 2. Countries: South Africa, Germany, Belgium, Brazil, Canada, China, Spain, India, Italy, Japan, Mexico, Netherlands, Poland, Portugal, United Kingdom, Russia, Switzerland, Turkey. Country groupings: Other African countries, Other American countries, Other Asian countries, Other European countries, Middle East.

Box 2: Score aggregation method

To calculate the score at a sufficiently aggregated level (for France, for a product or a particular destination), we aggregate the scores obtained at a basic level. To obtain usable results, products are aggregated at levels A17, A38 and A129 of the French classification of activities. In addition, scores are calculated over the entire period 2002-2017 and over three sub-periods: 2002-2007, 2008-2012 and 2013-2017.

Calculating a score for an aggregate of products or a basic product

Let P_0 be an aggregate of products (e.g. capital goods (C3) at level A17) or a product at a basic level, and C the set of countries in the database, then the score is written thus:

$$S_{P_0T} = \sum_{p \in P_0} \sum_{c \in C} \frac{X_{pcT}}{X_T} S_{pcT}$$

where X_{pcT} represents exports by value of product p , to country c over the time period P and the time T and X_T represents total exports for France ($X_T = \sum_{p,c} X_{pcT}$). In other words, the score of an aggregate of products is the average of the basic scores of the component products, weighted by their share in France's exports¹.

Calculating a score for exports to a given country

Let c_0 be a given country, and P all products in the database, we can define a score for this country in the same way:

$$S_{c_0T} = \sum_{p \in P} \frac{X_{pc_0T}}{X_T} S_{pc_0T}$$

Calculating the aggregated score for French exports

We can now construct the aggregated score for French exports by aggregating scores for countries or products. Similarly, the two formulae are equal in accounting terms. Thus we define:

$$S_t = \sum_{p \in P} \frac{X_{pt}}{X_t} S_{pt} = \sum_{c \in C} \frac{X_{ct}}{X_t} S_{ct}$$

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Changes in scores over time

This aggregation method has two advantages. Firstly, it is simple and intuitive: the aggregated scores are only the average of the elementary scores weighted by product or country shares in French exports.

Secondly, as scores are calculated over the three sub-periods, the method is able to identify whether their change is due to a strong or weak price sensitivity of the elementary products or to the structure of foreign trade in France. Thus the increase in France's score between periods t and $t-1$, can be broken down as follows:

$$\begin{aligned}
 S_t - S_{t-1} = & \sum_{p \in P} \underbrace{\left(\frac{X_{pt}}{X_t} - \frac{X_{p,t-1}}{X_{t-1}} \right)}_{(A)} S_{p,t-1} \\
 & + \sum_{p \in P} \underbrace{(S_{pt} - S_{p,t-1})}_{(B)} \frac{X_{p,t-1}}{X_{t-1}} \\
 & + \sum_{p \in P} \underbrace{\left(\frac{X_{pt}}{X_t} - \frac{X_{p,t-1}}{X_{t-1}} \right) (S_{pt} - S_{p,t-1})}_{(C)}
 \end{aligned}$$

The increase in the score can therefore be broken down into three distinct effects: (A) structural effect (B) price sensitivity effect (C) unexplained effect. Hence, the score for France can be calculated from the country scores and it is therefore possible to perform this breakdown in this case. In general, it is possible to replicate this breakdown for all levels of aggregation (especially products and countries).

Therefore, the increase in the score can be broken down into three distinct effects:

(A) a structural effect,

(B) an intrinsic effect,

(C) a residual term

This breakdown has been made by product but alternatively it is possible to do it by country ■

1. The basic scores of products could also be weighted by their share in the total mass of exports (i.e. by their weight in volume). Although the results obtained are similar, due to the intrinsic limitations already mentioned in Box 1 of a measurement of volume linked to mass, we tend to favour the first weighting.

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Box 3: The French aeronautical sector has moved upmarket since 2016

The aeronautical and naval sector could not be modelled individually by an export equation due to a lack of long-term data for major aeronautical and naval contracts. In fact, the presence of these large contracts disrupts the series considerably, and changes cannot be explained by simply applying the traditional determinants. However, between 2012 and 2017, the weight of the aeronautical and naval sector in French exports increased by almost 1 point and today stands at about 10% of total exports, with aeronautical deliveries reaching record heights. Since 2016, the European aircraft manufacturer has unfailingly increased its rates of production (deliveries increased by 26% since 2015) and has managed to partly limit supply problems by producing engines in France. The aircraft that have been delivered have also moved into a higher range (the A320neo appeared in 2016 and the A321neo in 2017) and the weighting of the A320neo has risen steadily within French aeronautical deliveries (36% in 2018). This type of aircraft, incorporating better technology (new generation engines, which reduce fuel consumption by 15% compared with earlier models), is more expensive to buy than the A320 range (9.4 million dollars difference between the A320 and the A320neo). Also, since aeronautical deliveries are denominated in dollars, their export price seems not very sensitive to an increase in exchange rate.

Coordinated production is becoming less and less important in the aeronautics and naval sector

Within bilateral aeronautical trade between France and Germany, some trade flows fall within the framework of “coordinated” production. This consists in aircraft or aircraft parts going back and forth for minor processing work, and this is counted by customs. However, when producing the national accounts, these flows must be eliminated in order to balance the accounts because some of the parts that are exported in the context of coordinated production are not counted as output. While the proportion of coordinated production represents on average half of all aeronautical exports to Germany, its importance vis-à-vis the method used in this report must be put into perspective. On the one hand, the proportion of coordinated production is declining, in line with the reorganisation of production processes on both sides of the Rhine. On the other hand, flows of exports and imports produced by coordinated production are comparable in level, which reduces the disruption in calculating degrees of price sensitivity by the Aiginger method. ■

Box 4: Export equations by product

The econometric modelling currently used for French export forecasts mobilises standard determinants like the real effective exchange rate (REER), under the assumption that a single elasticity to the exchange rate is applied to all exported goods. However, the price sensitivity of exports can vary considerably, depending on the products. For this reason, the models presented here are drawn up by type of product in order to highlight a different exchange rate effect depending on the product being considered.

Error correction models are used to identify the contributions of explanatory variables, mainly demand for French goods and a price competitiveness variable like the REER. The equations are estimated in one step and the restoring force is significantly negative in the sense of the test proposed by Ericsson and MacKinnon (2002).

The construction of the explanatory variables is described below.

Demand for French goods

World demand for French goods is an indicator defined as the change there would have been in the volume of French exports if its market shares (for all goods) in each partner country had remained constant. World demand for French goods is calculated as the weighted geometric average of imports of goods and services by volume of its trading partners, where the weight of each corresponds to France's share of this market in exports (by value).

World demand index for the goods of a country i (in this case, France):

$$DM_i = \sum_{i,j} IM_j \times \alpha_{i,j}$$

with:

- $\alpha_{i,j}$: weight of the market j in the exports of country i
- IM_j : imports (by volume) by partner j from country i

Usually (Armington, 1969), the coefficient of demand is limited to 1 in the long-run equation. In the long term, exports adjust to the demand for goods and services from France's trading partners.

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The real effective exchange rate

The real effective exchange rate is calculated as the product of bilateral exchange rates vis—vis partner countries, weighted by the respective trade weights against total foreign trade, or

$$REER = NEER \times IPR$$

With:

$$\bullet TCEN = \prod_{i=1}^N e_i^{x_i}$$

$N=22$, e_i = bilateral exchange rate between country's national currency and foreign currency i , x_i = weight of country i in the weighting system

$$\bullet IPR = \prod_{i=1}^N \left(\frac{IP_R}{IP_i} \right)^{x_i}$$

IP_R = Price index of reference country (R), IP_i = price index of country i

To obtain the *REER*, the *NEER* is deflated by the consumer prices of these countries. An increase in *REER* corresponds here to a deterioration in export price competitiveness.

Trends

In order to take into account a certain “structural effect”, i.e. a change in exports of a given product in total exports or distortion of market shares, in particular with the entry of China into the WTO in 2001, trends were added in the long-run part of each of the estimated product equations (except for the automobile sector).

Dummy variables

Dummy variables are able to capture a shock that is not perceived by other explanatory factors.

For example, to estimate exports of energy products, a dummy was added to the short-term determinants in order to take into account the downturn in Russian imports from Q3 2008 to Q2 2009, which is not fully explained by world demand for French goods. Russia accounts for only 1.2% of France's total exports, but trade between the two partners is made up essentially of food and energy products.

Similarly, two dummies were included in the forecasting equation for exports of refined petroleum products. The first reflects the downturn in imports from the major oil-producing countries (OPEC) from Q2 1998 to Q1 2000. The second reflects the shock of the 2007 financial crisis.

Finally, in the forecasting equation for automobile sector exports, a dummy from Q1 2008 to the present day reflects both market share losses in this sector and the phenomenon of automobile manufacturers relocating their activity and also the median positioning of ranges of cars (Dahmani et al (2014)).

Modelling energy exports

$$\Delta \log(X_{DE,t}) = 1,79 - 0,31 \times \Delta \log(M_{DE,t-1}) - 2,36 \times \Delta \log(TCER_t) - 0,18 \times 1_{t \in [2008T3 ; 2009T2]} \\ (4,6) \quad (-2,3) \quad (-2,2) \quad (-4,9) \\ -0,47 \times [\log(X_{DE,t-1}) - \log(DM_{t-1}) + 2,9 \times 10^{-3} (Tendance_{t-1})] \\ (-4,5) \quad (-3,9)$$

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where:

- X_{DE} : Exports of energy sector products (electricity, waste, hydrocarbons)
- M_{DE} : Imports of energy sector products (electricity, waste, hydrocarbons). They represent the volume of energy purchases (electricity, waste, hydrocarbons) abroad. As the energy sector is highly volatile, due mainly to oil and energy prices, exports are very dependent on amounts imported on date $t-1$.

Student's t-test statistics for coefficients are given in brackets below the coefficients.

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$R^2 = 0.49$ and SD of residuals = 0.064 - Estimation period: Q1 2005 to Q1 2017

Modelling agrifood exports

$$\Delta \log(X_{C1,t}) = \underset{(-3,6)}{-0,33} + \underset{(4,5)}{0,46} \times \Delta \log(DM_t) - \underset{(-1,9)}{0,30} \times \Delta \log(TCER_t) - \underset{(-3,6)}{0,18} \times [\log(X_{C1,t-1}) - \log(Prod_{C1,t-1})] + \underset{(3,3)}{6,6 \times 10^{-4}} (Tendance_{t-1})$$

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where:

- X_{C1} : Production of agrifood products.
- $Prod_{C1}$: In the forecasting equation for agrifood exports the coefficient of production is restricted to 1 over the long term. In fact, production of this type of product gives a better picture of their sales abroad than world demand.

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R^2 = 0.31$ and SD of residuals = 0.018 - Estimation period: Q4 1992 to Q4 2017

Modelling exports of refined petroleum products

$$\Delta \log(X_{C2,t}) = \underset{(4,8)}{1,5} + \underset{(4,6)}{0,46} \times \Delta \log(Prod_{C2,t}) - \underset{(-2,3)}{1,1} \times \Delta \log(TCER_t) - \underset{(-3,0)}{0,07} \times 1_{t \in [1998T2; 2000T1]} - \underset{(-4,1)}{0,20} \times 1_{t \in [2007T4]} - \underset{(-4,8)}{0,35} \times [\log(X_{C2,t-1}) - \log(DM_{t-1})] + \underset{(-4,6)}{3,3 \times 10^{-3}} (Tendance_{t-1})$$

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where:

- X_{C2} : Production of refined petroleum products.
- $Prod_{C2}$: As the production of refined petroleum products may be irregular due to maintenance work being carried out in refineries, as happened in Q2 2018, for example, the inclusion of this variable when estimating sales of refined petroleum products ensures that these short-term shocks are taken into account.

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R^2 = 0.54$ and SD of residuals = 0.04 - Estimation period: Q1 1995 to Q1 2017

Modelling exports of capital goods

$$\Delta \log(X_{C3,t}) = \underset{(4,5)}{2,48} + \underset{(10,9)}{1,10} \times \Delta \log(DM_t) - \underset{(-3,6)}{0,63} \times \Delta \log(TCER_t) - \underset{(-4,4)}{0,15} \times [\log(X_{C3,t-1}) - \log(DM_{t-1})] + \underset{(-5,2)}{1,0 \times 10^{-3}} (Tendance_{t-1})$$

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where:

- X_{C3} : Trend of exports of capital goods

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R^2 = 0.71$ and SD of residuals = 0.016 - Estimation period: Q1 1995 to Q1 2017

Modelling exports of automobile sector products

$$\Delta \log(X_{CL1,t}) = \underset{(3,2)}{0,67} + \underset{(6,4)}{1,54} \times \Delta \log(DM_t) - \underset{(1,2)}{0,37} \times \Delta \log(TCER_t) - \underset{(-3,3)}{0,15} \times [\log(X_{CL1,t-1}) - \log(DM_{t-1})] + \underset{(-3,1)}{0,50 \times 1_{t \in [2008T1; 2018T4]}}$$

Statistiques de Student

where:

- X_{CL1} : Trend of exports of automobile sector products

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R^2 = 0.37$ and SD of residuals = 0.04 - Estimation period: Q1 1991 to Q1 2017

For a better understanding of the sensitivity of French exports to exchange rate fluctuations using detailed customs data

Modelling exports of other industrial products

$$\Delta \log(X_{C5,t}) = 2,28 + 0,67 \times \Delta \log(DM_t) - 0,17 \times \Delta \log(TCER_t) \\ (4,9) \quad (11,6) \quad (-1,7) \\ -0,17 \times [\log(X_{C5,t-1}) - \log(DEM_{t-1}) + 1,3 \times \log(TCER_{t-1}) + 9,8 \times 10^{-4} (Tendance_{t-1})] \\ (-4,0) \quad (-4,9) \quad (-4,7)$$

Statistiques de Student

where:

- X_{C5} : Trend of exports of other industrial products

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R = 0.68$ and SD of residuals = 0.009 - Estimation period: Q1 1995 to Q1 2017

Modelling manufacturing exports excluding the aeronautical sector

$$\Delta \log(X_{hCL2,t}) = 2,13 + 0,88 \times \Delta \log(DM_t) - 0,23 \times \Delta \log(TCER_t) \\ (5,0) \quad (14,4) \quad (-2,1) \\ -0,14 \times [\log(X_{hCL2,t-1}) - \log(DEM_{t-1}) + 1,6 \times \log(TCER_{t-1}) + 9,8 \times 10^{-4} (Tendance_{t-1})] \\ (-4,1) \quad (-4,9) \quad (-5,0)$$

Statistiques de Student

where:

- X_{hCL2} : Trend of manufacturing exports excluding the aeronautical and naval sector

Student's t-test statistics for coefficients are given in brackets below the coefficients.

$R = 0.76$ and SD of residuals = 0.010 - Estimation period: Q1 1995 to Q1 2017 ■