
Determination of manufacturing exports in the euro area countries using a supply-demand model

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1. INTRODUCTION

In recent decades the weight of exports in economic activity has been increasing. Hence great importance is given to analysing the determinants of their behaviour. When such analysis is carried out, it often considers the determining variables to be only those that affect export demand, particularly competitiveness and external demand. Thus it does not take into account the factors that can influence the supply of exports, which is usually assumed to have infinite elasticity, i.e. export firms stand ready to supply any product quantity demanded of them at the prevailing market price, over which they have no control. However, this approach has certain limitations, since information on supplier behaviour is disregarded prematurely without checking its possible role in the behaviour of foreign sales. This article aims to advance in export analysis, allowing foreign sales to influence export prices. For this purpose, a two-equation supply-demand model is estimated in which prices and quantities are determined jointly, so as to enable determination of the extent to which supply is important in explaining the quantity exported by a country. In particular, a two-equation multivariate model with an error correction mechanism is estimated for eight euro area countries with quarterly manufacturing export data since the beginning of the 1980s.

The article has the following structure: Section 2 develops the theoretical model; Section 3 describes the variables used and analyses their behaviour during the sample period; Section 4 sets forth the econometric results; Section 5 shows simulation exercises; and, finally, Section 6 summarises the main conclusions.

2. THEORETICAL FRAMEWORK AND VARIABLES USED

Following Goldstein and Khan (1976), initially a two-area model (a country and the rest of the world) is used in which the former produces a good that can be exported or consumed within the country and the latter can purchase the country's exports or its domestic goods.

The export demand function is obtained from the solution to the problem of maximising con-

(1) This article is a summary of a working paper to be published shortly.

sumer utility subject to the budget constraint, such that the quantity of country i exports demanded by the rest of the world (X^d) will depend on the export prices in domestic currency (P_x), on the prices of goods produced in the rest of the world ($P_x^* \cdot e$) and on the income of the rest of the world ($Y^* \cdot e$). Also, it is assumed that consumers are not prone to monetary illusion, so the demand function can be expressed in terms of real income and of the ratio of the price of country i exports to the price of goods produced in the rest of the world.

As regards the supply function, naturally a greater quantity of product will be supplied abroad as the return on this activity rises. In the simplest interpretation, the quantity supplied by a firm depends on export prices, on the cost of factors of production and on the opportunity cost of selling in the external market. For a given export price level, the return on foreign sales falls as the factor costs of the exporting industry rise. From the empirical standpoint, factor costs have been approximated by including a domestic price (P) – which is used to represent the opportunity cost of selling on the foreign market and, in addition, usually moves together with the factor cost – and the export prices of competitors in local currency ($P_x^* \cdot e$) – which is used to capture the effect on marginal cost of fluctuations in the exchange rate and in the prices of imported inputs – (2). Straub (2002) includes in the export supply function the export prices of competitors in local currency, arguing that, in addition to serving as indicators of costs, the role of strategic interaction and of pricing to market is important under the influence of imperfect competition (3).

Some studies that estimate export supply functions, apart from containing export price and cost variables, include a measure of trend income (\bar{y}) and/or measures of demand pressure (P_d). The idea underlying the inclusion of the first variable is that export capacity depends on the economy's ability to produce, i.e. secular changes in the aggregate production level due to improving factor supply, infrastructure and total factor productivity will lead to rises in export supply at any price level. The inclusion of a domestic demand pressure variable in the export supply function is based on the assumption that

(2) Empirically, unit labour costs of manufactures and the price of imported raw materials were tested as proxies for factor costs, but for no country was an acceptable supply specification obtained with either joint or separate inclusion of these variables.

(3) *Pricing to market* consists of the following. Firms, instead of transferring foreign exchange rate movements to export prices, seek to maintain their market shares by maintaining their prices in the importing country, evidencing oligopolistic behaviour by them [Dornbusch (1987)].

sales in the domestic market could be more profitable than sales abroad, which would be related to a perception by producers of a higher risk associated with exports and to this difference in profitability not being fully captured by relative price movements.

Hence the quantity demanded and supplied of manufacturing exports (X^d and X^s) and their price (P_x) will be determined by the solution to the following system of equations (4):

$$\begin{cases} X^d = d \left(y^*, \frac{P_x}{P_x^* \cdot e} \right) \\ X^s = s \left(\frac{P_x}{P}, \bar{y}, P_d, P_x^* \cdot e \right) \\ X^d = X^s \end{cases}$$

To estimate the model, use is made of an error correction mechanism specification in which the long-term relationships are the log-linear transformations of the above system of equations.

For each country, the endogenous variables – exports (X) and prices (P_x) – are the volume of manufacturing exports and export prices, considering both intra- and extra-euro area trade. The variable used to measure external income (y^*) is an export market index, calculated as the sum of the volumes of manufacturing imports in each market expressed in constant dollars, weighted by the relative importance of the market in question within the country's total exports. The export price of competitors ($P_x^* \cdot e$) is taken directly from the OECD, which calculates it as a weighting of the export prices of the main export markets. The domestic price (P) is proxied by the producer price index of the manufacturing sub-group. The potential GDP (\bar{y}) is taken directly from the OECD and demand pressure (P_d) is calculated as the difference between the observed and trend industrial production price indices.

3. BEHAVIOUR OF THE DETERMINING VARIABLES OF EXPORT SUPPLY

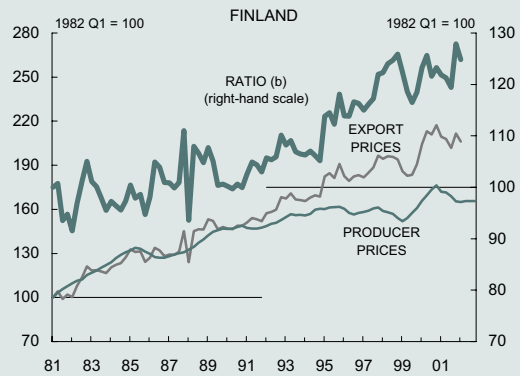
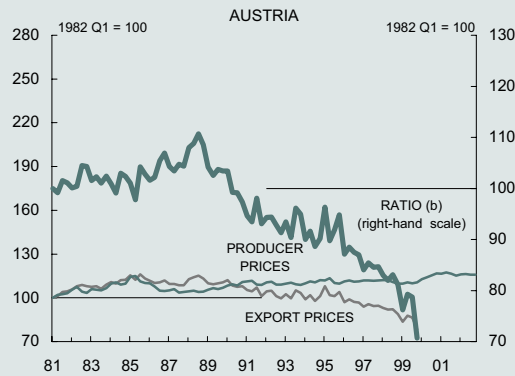
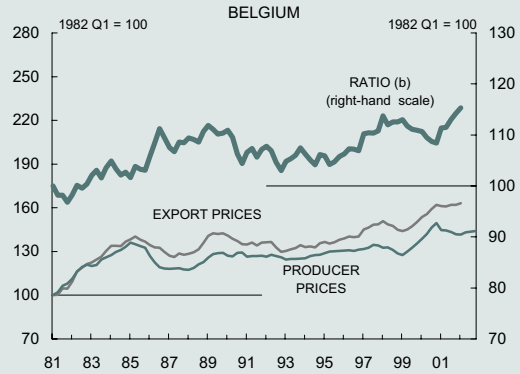
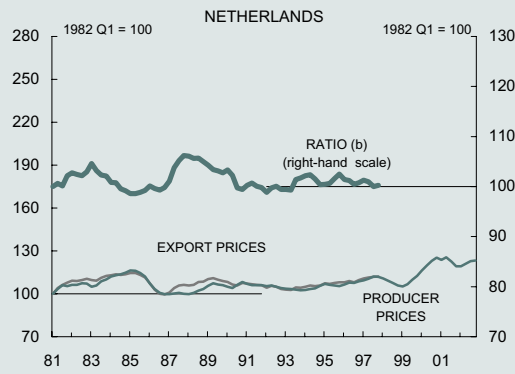
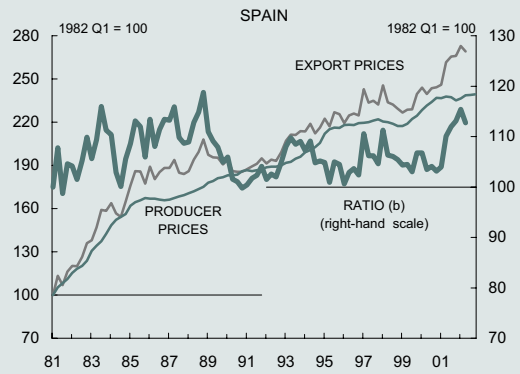
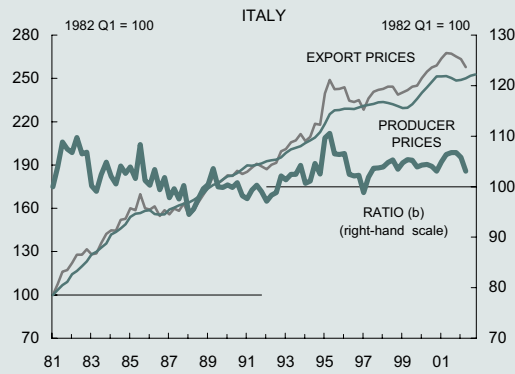
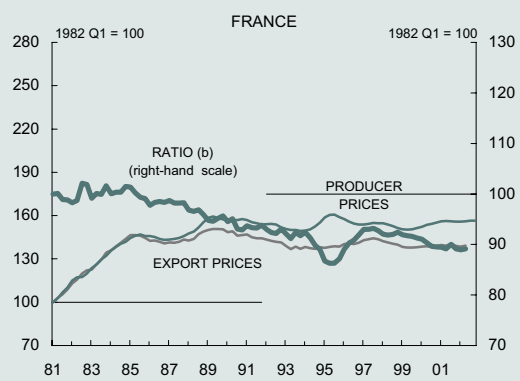
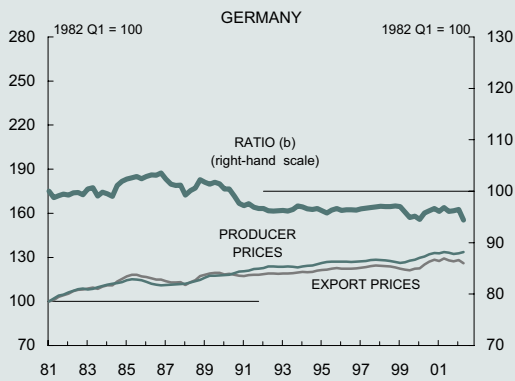
The determining variables of export supply (5) include notably the relative return on exporting compared with the alternative of selling

(4) Observe that the supply equation contains the ratio of export prices to domestic prices, but not these prices separately.

(5) See Buisán and Caballero (2003) for a detailed description of the behaviour of the variables affecting export demand.

CHART 1

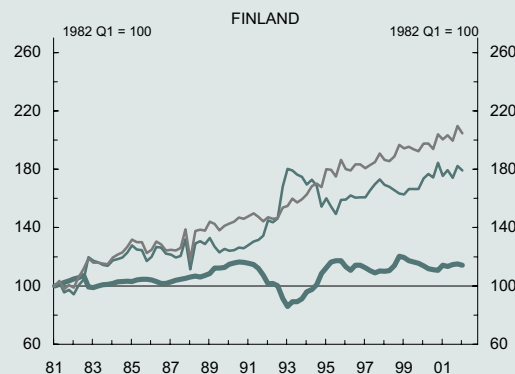
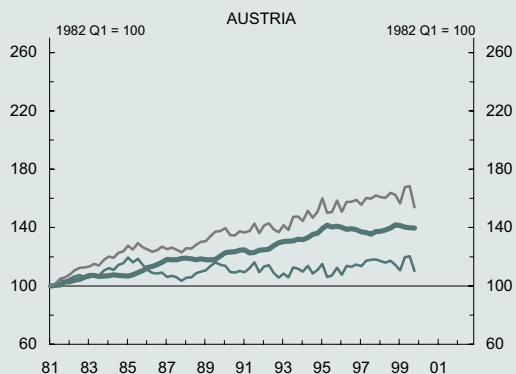
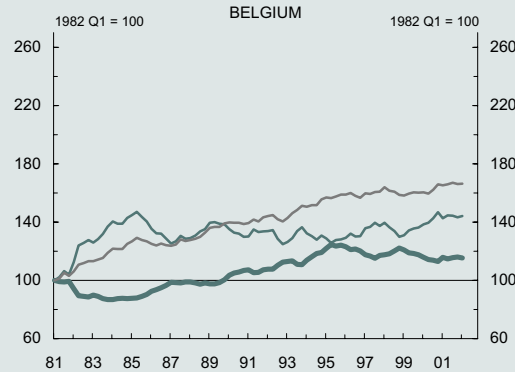
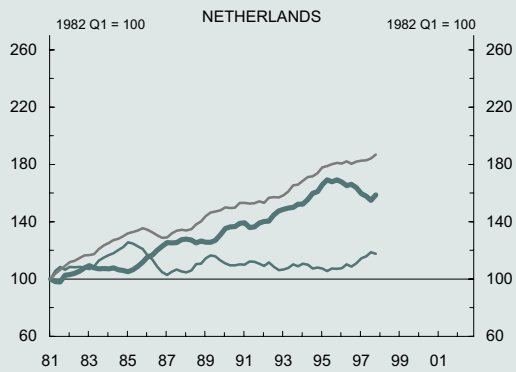
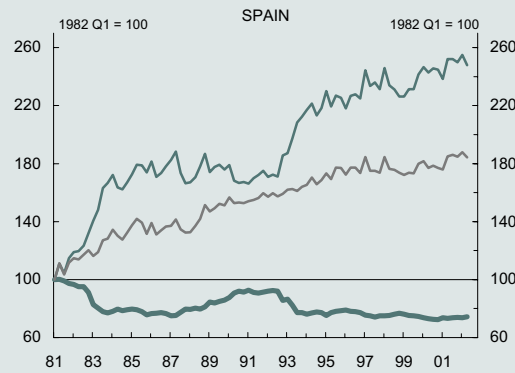
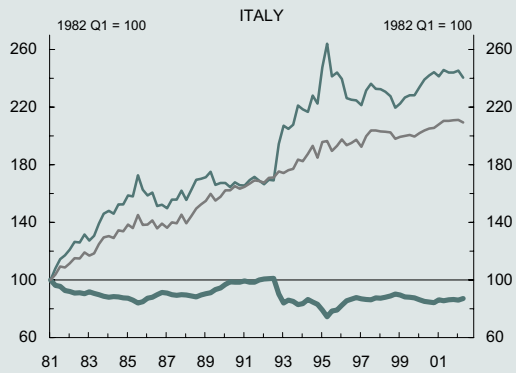
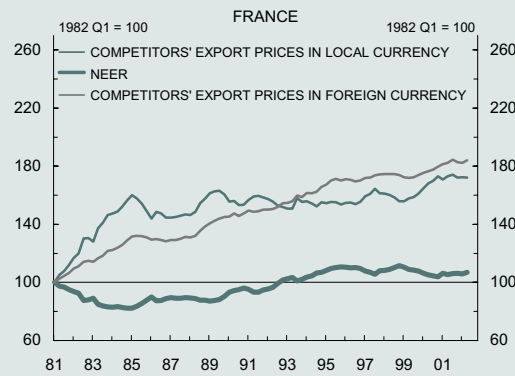
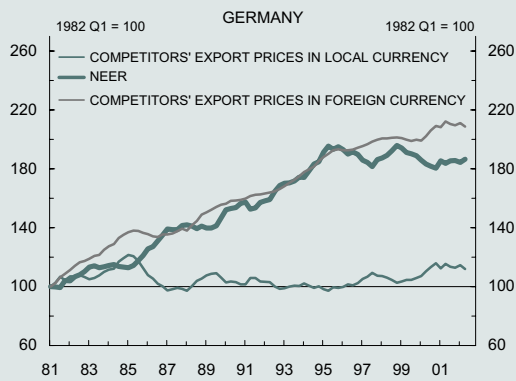
Changes in export prices and in producer prices (a)



Sources: Eurostat and OECD.
 (a) Both refer to manufacturing.
 (b) Export prices/Producer prices*100.

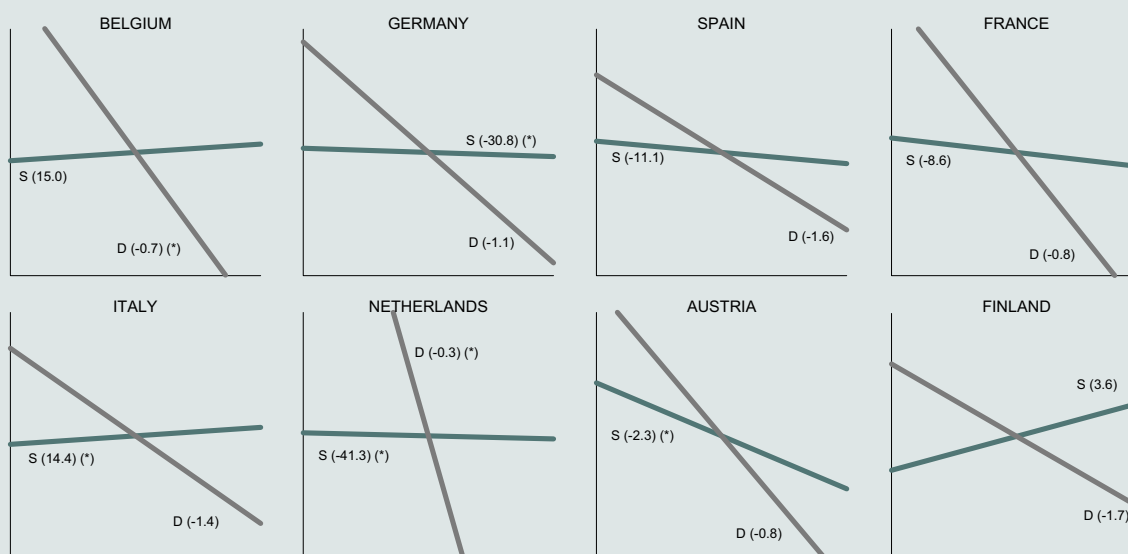
CHART 2

Changes in competitors' export prices and in the NEER



Source: OECD.

Estimated export supply and demand equations
(X-axis, quantities exported; Y-axis, export prices) (a)



Source: Banco de España.

(a) The estimated value of the elasticity is indicated in brackets. An asterisk denotes that the coefficient is not significant at the 5% level.

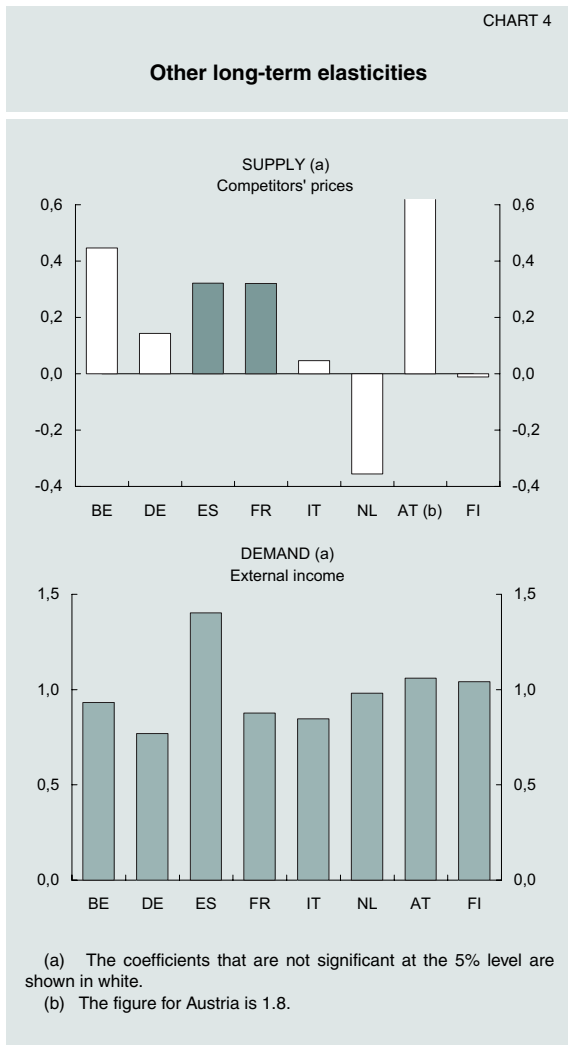
the production on the domestic market, measured by the export prices/producer prices ratio (6). Chart 1 shows the behaviour of this ratio and of its two components for the euro area countries. It can be seen that, in the countries where the ratio shows higher variability, this is mainly caused by the behaviour of export prices, whereas producer prices show more stable behaviour. This could be related to the sharp fluctuations in exchange rates over the period considered, while producer prices, by contrast, move basically in line with the domestic conditions in each country.

More detailed examination distinguishes various types of behaviour. Most noteworthy is the high stability of the ratio in the Netherlands and in Belgium – in this case interrupted by the brief divergence between the two prices in the mid-1980s – which is consistent with their high degree of openness to foreign trade. In Germany and France the ratio shows a slightly declining trend, possibly associated with the growing level of competition from foreign competitors, particularly from those euro area countries that were initially less open to trade. The high volatility of the exchange rate in Spain and Italy and the appreciation of the Austrian schilling explain the movement of their respective domestic prices/external prices ratios. Finally, the acceleration of Finnish export prices in the first half

of the 1990s is related not only to exchange rate fluctuations – the sharp depreciation of the Finnish mark following the collapse of the Soviet Union –, but also to the substantial change in its export structure: specifically, the foreign sales of the paper and wood industries have fallen and those of telecommunications equipment have risen, which has boosted the average price of exports.

Chart 2 plots export prices in domestic currency of competitors and their components: aggregate export prices of competitors expressed in a common currency (the US dollar) and the nominal effective exchange rate (NEER) of each country. As regards the first variable, the behaviour of export prices is very similar in all countries. The small differences are basically due to divergences in the inflation rates of the countries with which trade is conducted: in the German case, for example, the average export price of competitors grew faster than the prices of domestic production, while in Spain average inflation during the period considered was higher than that of its competitors, including Germany. Nevertheless, the NEER is the variable that most fully explains the dynamics of competitors' export prices in domestic currency. Regarding the behaviour of this variable, three groups of countries can be distinguished. In the first, consisting of Spain and Italy, the NEER tends to depreciate, so there is a higher rise in competitor prices when they are expressed in domestic currency. In the second

(6) Both prices refer to manufactures.



group, formed by Germany, the Netherlands and Austria, the NEER appreciated over most of the period, so competitor prices expressed in domestic currency showed high stability. Finally, in France, Belgium and Finland, the NEER does not follow such a well defined trend as in the above cases and, as a result, the export prices of competitors show similar behaviour regardless of the currency in which they are expressed.

4. SUPPLY-DEMAND MODEL ESTIMATES

As regards demand, in the short term, whereas the export market variable is significantly positive, the volume of past exports and the relative price index do not seem to be significant in explaining the changes in real exports in any country. By contrast, in the long term, price elasticity is significantly different from zero in all cases except Belgium and the Netherlands, and has the expected negative sign (see Chart 3). The magnitude of the elasticity varies from country to country, with Spain,

Italy, Finland and, to a lesser extent, Germany being most sensitive to changes in relative prices. Finally, the long-term income elasticity of demand is relatively homogeneous among countries and has a value of around one in most cases, Spain being most sensitive to this variable with an elasticity of 1.4 (see bottom panel of Chart 4).

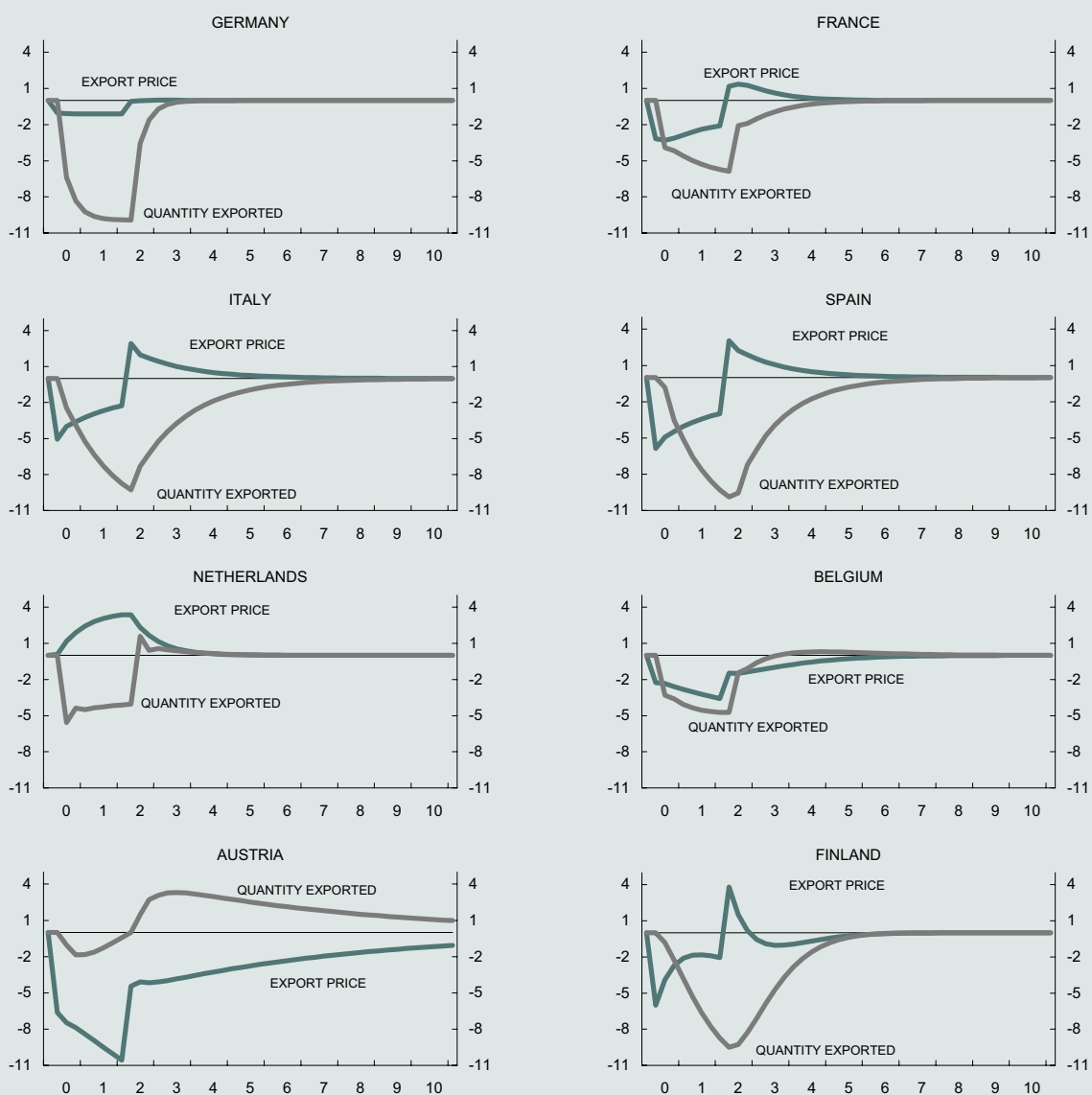
In the supply function it was found that neither pressure of domestic demand nor trend production seemed to have a significant effect. The most characteristic trait, shared by all countries except Finland and Austria, is the high elasticity of the long-term curve, which is reflected in its very low slope, as seen in Chart 3. This finding would support the estimation of a model in which the quantity exported were determined using a single export demand equation, as in Buisán and Caballero (2003), since it would be reasonable to accept the assumption of an infinitely elastic supply curve. In fact, in certain countries – Germany, Italy and the Netherlands – the slope is not significantly different from zero. Moreover, although in some cases the estimated slope is negative, the absolute value of the supply curve's elasticity is also very high on these occasions, so the assumption can be maintained. As seen in Chart 4, competitor prices do not have an effect significantly different from zero in the long term, except in Spain and France, where the impact is approximately 0.3. In the short term, only competitor prices have an impact on export prices that is positive and significantly different from zero (except in the Netherlands).

5. SIMULATIONS

Based on the above-mentioned estimates, a simulation exercise is presented to give a general idea of the responses predicted by the model in the face of changes in variables as important as competitiveness and income. Estimates were made of responses to a permanent 10% rise in the income of demanders and to a 10% loss in competitiveness as a result of a decrease in competitor prices. The effects were also estimated for a non-permanent loss of competitiveness in which after two years, competitor prices again increase to their initial value.

A decrease in competitors' prices in local currency represents a loss of competitiveness for domestic producers which, in principle, should lead to a loss of export volume and a decrease in prices. Charts 5 and 6 show that generally the adjustments to declining competitor prices take place more through quantity than through price, as a result of the low slope of the supply curve

Simulation: effect of a 10% loss of competitiveness for two years (a)



(a) The charts show the difference between the variable under a 10% decrease in competitors' prices for two years and the variable in the absence of that decrease.

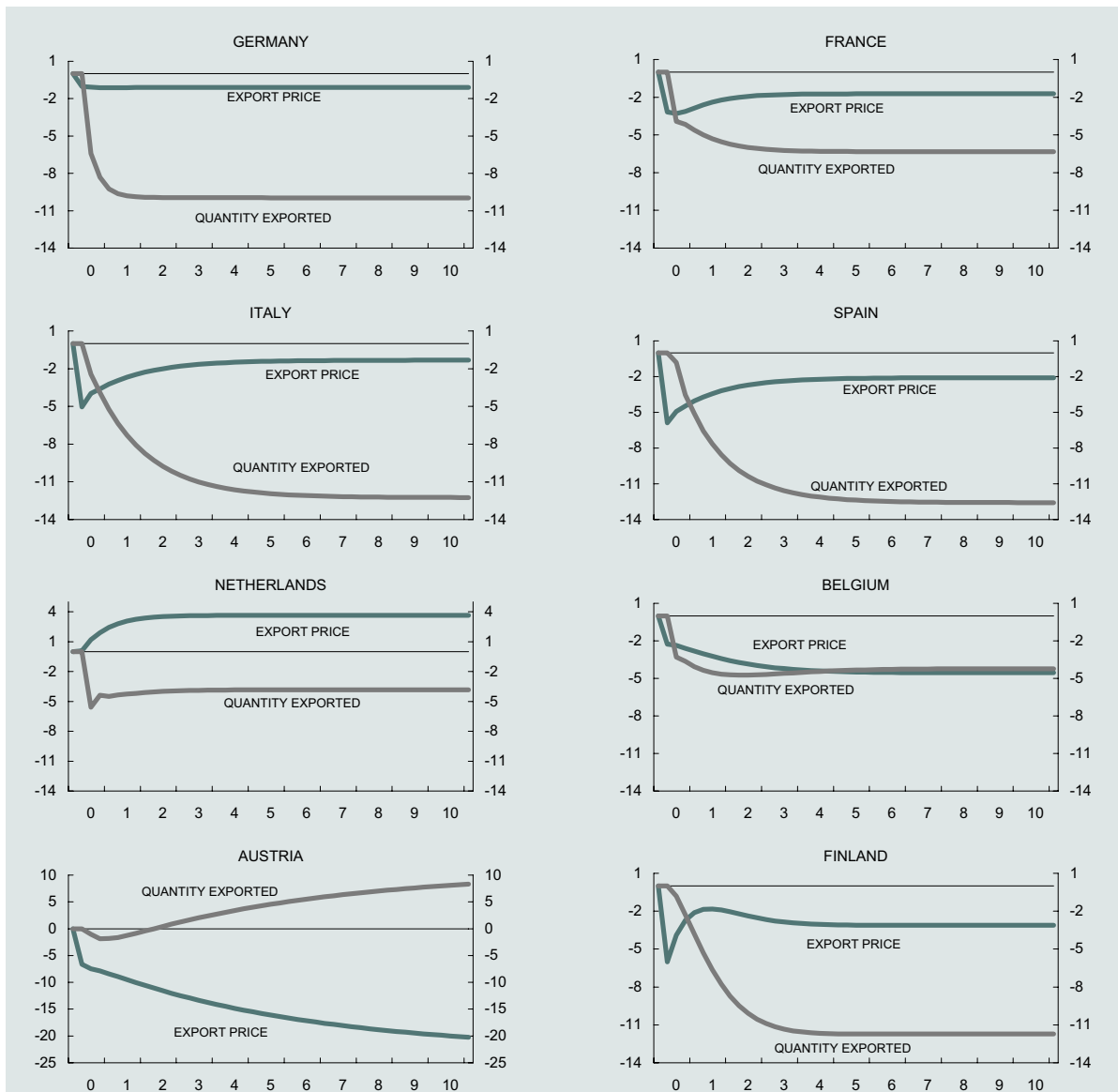
estimated above (7). When the shock is temporary (Chart 5), exports decrease to their lowest level in all countries about two years after the loss in competitiveness and subsequently, between years 2 and 5, recover to approximately their initial level. In particular, France, Italy, Spain and Finland take longer to return to the initial quantities, while Germany, for example, returns very suddenly in the second year. In addition, the size of the decrease in quantities differs

across countries. Thus in Germany, Italy, Spain and Finland the impact of the moderation in competitor prices is stronger than in the other countries. The decline in prices is not, however, as sharp. Generally they fall for approximately two years and then return to their initial path.

When the loss of competitiveness is of a permanent nature (Chart 6), anomalous behaviour is shown by the Netherlands and Austria, with price growth in the former and a rise in exports in the latter. In most countries, the high elasticity of supply gives rise to larger adjustments in quantities than in prices, and these

(7) The charts plot the amount by which price and quantity after a shock differ from their values in the absence of such a shock.

Simulation: effect of a 10% permanent loss of competitiveness (a)



(a) The charts show the difference between the variable under a 10% permanent decrease in competitors' prices and the variable in the absence of that decrease.

adjustments peter out in approximately two years. The loss of markets is particularly marked in Germany, Italy, Spain and Finland, while the impact is milder in France and Belgium. Prices seem to initially over-react to competitor prices in France, Italy, Spain and Finland, while the adjustment is more gradual in the other countries.

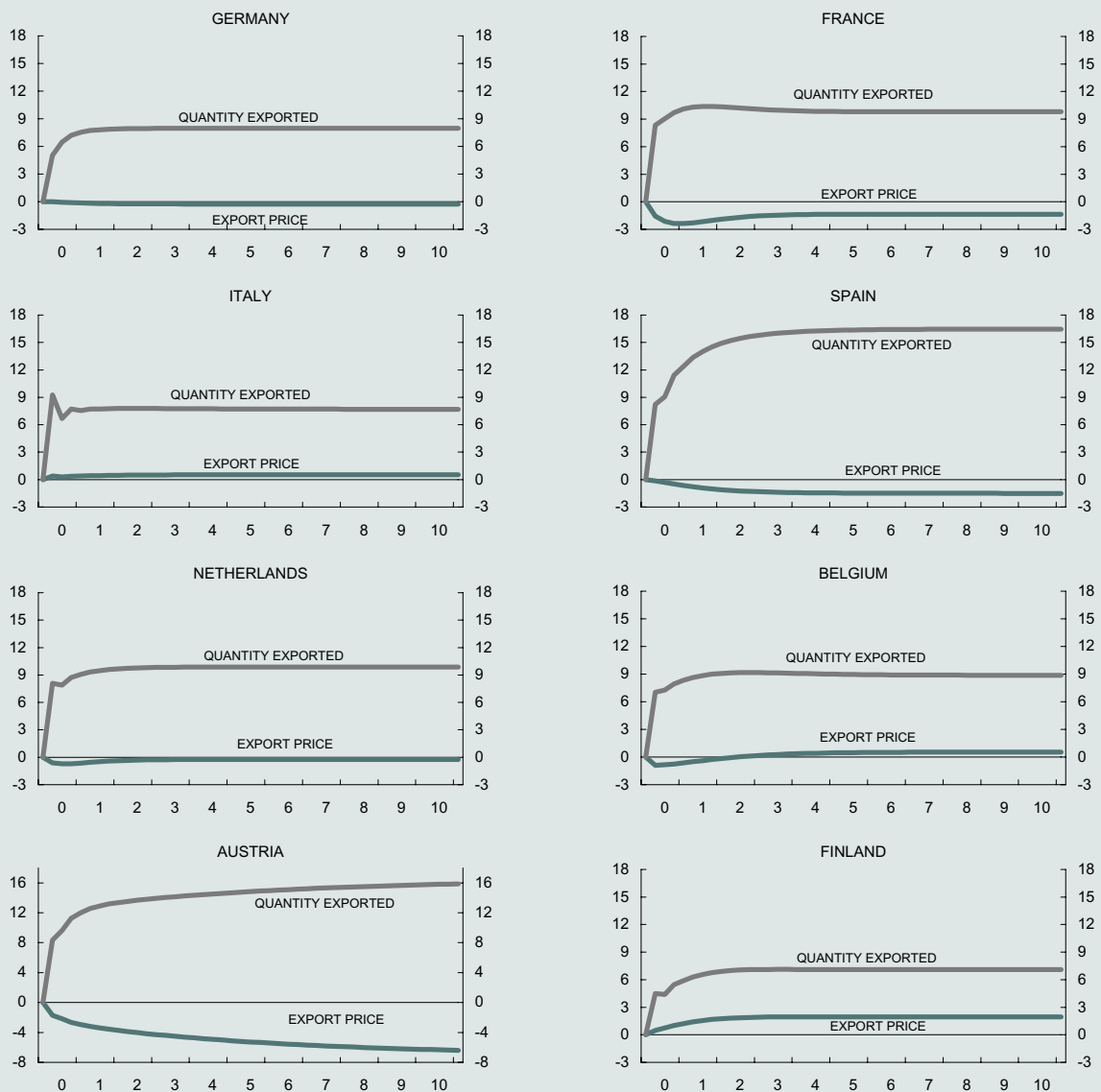
Chart 7 shows how a rise in the income of export demanders affects the prices and quantities of exported goods. Again, the flatness of the supply curve means that this shock has a large positive impact on quantity and a smaller

impact on price. Indeed, export quantities are boosted in all countries in line with the income elasticity estimated by the model. Thus Spain – which has the highest long-term income elasticity – and Austria form a first group in which the impact is larger, followed by France, Germany, Belgium and the Netherlands and, lastly, by Finland and Italy.

6. CONCLUSIONS

This article has analysed the manufactured goods export market for some euro area coun-

Simulation: effect of a 10% permanent increase of export markets (a)



(a) The charts show the difference between the variable under a 10% permanent increase in export markets and the variable in the absence of that increase.

tries by overall estimation of an aggregate export supply and demand model. The estimation was performed by means of an error correction mechanism model using quarterly data since the early 1980s.

The main result is the robustness shown by demand to the various supply specifications which, together with an estimate of supply that in most cases is very elastic, agrees with a large part of the literature on export determination whereby producers generally adjust their foreign sales depending on their ability to compete and on the behaviour of world demand. It

should be noted that neither the possible positive externalities on cost arising from growth of the domestic economy nor the demand pressure by domestic consumers have an appreciable effect on export prices.

The simulations of the impact of a loss of competitiveness and of an increase in demanders' income show that, due to the near-zero slope of the supply function, the adjustments to these shocks take place mainly through changes in quantities, which decrease in the first case and increase in the second. The response of export prices, by contrast, is milder: in the first

case, they decrease slightly to compensate for the loss of competitiveness, while in the case of a rise in external income, they show a wide range of behaviour.

The sensitivity of exports to a loss of competitiveness, whether it be temporary or permanent, is higher in Spain, Germany, Finland and Italy, while it is lower in Belgium and the Netherlands. The foreign sales of the latter two countries also show a lower response to possible shocks in export markets, which affect the other countries very uniformly, except for Spain, where exports are more sensitive.

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