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MEASURING THE PRICE ELASTICITY OF IMPORT DEMAND IN THE DESTINATION MARKETS OF ITALIAN EXPORTS

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Abstract

The aim of this paper is to compare the price elasticity of import demand in the destination markets of Italian exports to the price elasticity in the destination markets of the other main euro-area countries' exports. To this end, we use the elasticities of substitution across varieties estimated for each destination market (defined as a country-product combination) by Broda, Greenfield and Weinstein (2006). We find that Italy exports to markets which have, on average, a lower price elasticity than the markets where France, Germany and Spain sell their exports. The result is mainly driven by the motor vehicle and other transport equipment sectors. Net of these two industries, the export elasticities of the four countries are basically identical. The sectoral and geographical composition of Italian exports therefore does not seem to expose them to a relatively more elastic demand, contrary to the indications of part of the literature.

JEL Classification: F12, F14.
Keywords: exports, elasticity of substitution, Armington varieties, international specialization, price elasticity of exports.

Contents

* Bank of Italy, Economics, Research and International Relations.

1. Introduction and main findings[1]

Italy's export performance over the past decades has been the subject of extensive research. The literature has repeatedly pointed out a puzzling feature of Italian exports: on the one side, Italy's specialisation in traditional products implies a deeper exposure to the increasing competition from emerging countries (see for example Lissovolik, 2008); on the other side, Italian exporters seem to enjoy extensive pricing power (see for example de Nardis and Pensa, 2004). This paper adds a new piece of evidence on this issue, implementing a novel methodology to investigate whether the sectoral and geographical composition of Italian exports exposes them to markets with a more price-elastic demand, compared with the other main euro-area countries.[2]

The starting point of our work is to measure the price elasticity of import demand for Italian exports in each of the destination markets, which are defined as country-product combinations. The elasticities are estimated by Broda and Weinstein (2006, BW henceforth) and Broda, Greenfield and Weinstein (2006, BGW henceforth), using an approach similar to the one proposed by Feenstra (1994). The basic assumption is that, for each importing country and each product, imports supplied by different countries are different *varieties* of the product, as in Armington (1969). To give just one example, for the product "white wine" imported by Germany, all French white wines are one variety of this product, all Italian white wines are another variety of the same product, and so on for each of the other countries. Assuming that the utility function of the importing country can be represented by a Dixit-Stiglitz constant-elasticity-of-substitution (DS-CES) function, Feenstra shows how to use trade data in order to estimate the **elasticity of substitution** among the different varieties of a given product for a given importing country.[3]

[1] The authors wish to thank the following for their useful comments: Matteo Bugamelli, Paola Caselli, Rodolfo Helg, Marco Magnani, Roberto Tedeschi, two anonymous referees and participants at seminars held at the Bank of Italy and at various conferences run by the Ministry of the Economy and Finance, the Italian Trade Study Group and Economia e Politica Industriale. The views expressed are those of the authors and do not necessarily reflect those of the Bank of Italy. Emails: alberto.felettigh@bancaditalia.it; stefano.federico@bancaditalia.it.

[2] For recent surveys on a comparative evaluation of the export performance of the main euro-area countries, see for example Lissovolik (2008), Felettigh et al. (2006), European Central Bank (2005).

[3] By construction, the estimates capture the substitutability between two varieties of a given good, but neglect the substitutability between imported goods and domestic goods. In other words, "domestic production is not a competing variety". Carrying on with the previous example, the domestic pricing of German white wine is assumed to be irrelevant for the elasticity of substitution between French white wine and Italian white wine on the German market.

A remarkable feature of this parameter is that it can also be interpreted, under the maintained assumptions, as the **price elasticity of demand** for a given product exported by any origin country to a given destination country: if the elasticity of substitution between Italian white wine and French white wine for German consumers is σ, then σ can also be interpreted as the price elasticity met by Italian and French white wine producers exporting to Germany (we shall indicate as σ_{jk} the import "demand elasticity" for product *j* in importing country *k*).

We compute an import demand elasticity for each destination market where Italy exports. Weighting these demand elasticities with each market's share in Italian exports, it is then possible to obtain an average price elasticity of import demand to which Italian exports are exposed (η, "export elasticity" for future reference). This exercise is replicated for the exports of the other main euro-area countries (France, Germany and Spain) over the sample period 1994-2008. For each of these four countries, the sectoral and geographical composition of exports is combined into a single composite good ("exports of goods", in the macroeconomic sense of the term); we obtain an average export elasticity for each year. Notice that *export* elasticities are defined as weighted averages of the *import* demand elasticities.

Our main finding is that the export elasticity of Italian goods is on average lower than the export elasticity of French, German and Spanish goods. The result is mainly driven by two sectors: motor vehicles and other transport equipment. Excluding these two industries, the export elasticities of the four countries are basically identical. The evidence is quite robust to using alternative estimation methods. The sectoral and geographical composition therefore does not seem to expose Italian exports to markets with a more elastic demand compared to the other main competitors, contrary to the indications of part of the literature.

Moreover, some of Italy's main specialisation sectors regarded as being "traditional" and exposed to competition from emerging countries (furniture, non-metallic mineral products, wearing apparel, articles of leather, footwear and toys) in fact show relatively low demand elasticities. This stands in contrast to higher elasticities in other traditional sectors (textiles, jewellery and leather) and in the two crucial sectors (motor vehicles and other transport equipment), which are more heavily represented in the other main competitors' exports. Our findings would therefore indicate that the pricing power of Italian exporters, relatively to the other main euro area countries, has more than offset the upward pressures on export price elasticities exerted by the increasing competition from emerging countries. Trade among the four highly integrated countries under examination is one of the main drivers for the elasticity of their overall exports. Only for Spain do bilateral trade flows contribute to significantly increasing the price elasticity of exports.

In order to qualify our findings better, a few comments are needed. First, we are not claiming that Italian exports face a less elastic demand due to their own intrinsic characteristics, i.e. their quality or other product attributes (branding, after-sales service and other non-price competitiveness determinants). Similarly, we do not estimate a measure of market power specific to Italian exporters, as for example in de Nardis and Pensa (2004), nor do we distinguish products by their quality, as in Monti (2005) and de Nardis and Traù (1999). Our estimates only capture a composition effect, which comes from the sectoral and geographical specialisation.

Second, the price elasticity of import demand in the destination markets we estimate can only be interpreted as a "price elasticity of exports" under a specific set of assumptions. In particular, we need to assume preferences à la Dixit-Stiglitz. In this case, the estimated parameter measures by how much overall "exports of goods" would decrease in volume terms if the export prices of each product simultaneously increased by 1 per cent, *ceteris paribus* (the "all things being equal" clause requires, in particular, that competitors' prices[4] remain unchanged, and that the share of the exporting country in the import volumes of the various destination countries is small enough that the simultaneous price increase does not affect their overall import price index[5]). However, a crucial assumption in the Dixit-Stiglitz framework is that, for a given importing country and a given product, the elasticity of substitution is constant across all origin countries. This assumption is admittedly quite restrictive, in the light of the evidence pointing to large differences in unit values across origin countries, even within finely disaggregated product categories (see Schott 2004 and, with a focus on Italy, Monti 2005). These large differences in unit values could derive from differences in origin-countries' degree of market power, quality or other non-price competitiveness factors, which are not captured by the simplified Dixit-Stiglitz framework.

Finally, although we join an extensive literature in defining varieties à la Armington (1969), the limitations of this definition are apparent. The estimated elasticities may change

[4] Competitors should include firms in the destination country that produce for the domestic market. Recall however from Footnote 3 that "domestic production is not a competing variety" in Feenstra's framework.
[5] Theoretically, one needs an infinite number of varieties on each market.

significantly under different definitions of variety. Interestingly, however, we shall see that the elasticities estimated by Blonigen and Soderbery (2009) are really close to those proposed by BW, despite the fact that the former paper, by focusing on the US auto market, is able to adopt a more convincing definition of variety.

More generally, the aim of this paper is to put to work the elasticities estimated by BGW, which "are becoming something of an industry standard for studies that require an estimate of the price elasticity of import demand" (Hummels et al., 2009, p. 95). In doing so, we are bound to accept all the assumptions they draw on, even if they may be deemed restrictive. Many of them are fairly common in the literature on monopolistic-competition models of trade.

This paper is related to the existing literature looking at Italy's exports and, in particular, at whether their peculiar sectoral composition implies a higher exposure to competition from emerging countries. This literature usually takes an indirect approach, i.e. rather than directly measuring the price elasticity of demand, it looks at proxies for the level of competition. For instance, Moreno-Badia (2008) uses the number of countries exporting into a given destination market and the evenness of the corresponding market shares as measures of the toughness of competition. Monti (2005) and de Nardis and Traù (1999) use instead export unit values as a proxy for "quality". They find that while Italy and emerging countries are indeed specialized in the same traditional products, only the former is specialized in high-quality traditional products. Thus, Italy and emerging countries are not effectively competing, although the authors do not quantify how this affects Italian firms' pricing power. Other studies, like Hooper et al. (2000), directly estimate the price elasticities of Italian exports, but do so with a standard time-series macro approach which completely neglects the composition effects that are at the centre of our analysis.

Our study is also related to the recent literature on quality upgrading by Italian exporters. The basic idea is that an increase in competition from low-wage countries leads firms in high-wage countries to change their mix of inputs (using more capital, more skilled labour or other comparative-advantage factors) in order to produce higher-quality goods. Overall, there is some evidence pointing to a quality upgrading of Italian exports in response to the increasing competition from China and other low-wage countries, although it mainly rests on studies of specific sectors or even specific firms (Lanza and Quintieri 2007). The results also seem to depend on how quality is measured. Using export unit values as a proxy for quality, Marvasi (2010) finds that the share of high-quality exports has increased in the last decade; using a measure based on firms' own perceptions of the quality of their goods; Bugamelli (2007) finds instead that reallocation from low-quality to high-quality firms has little impact.

Our work can only indirectly address the issues related to quality and quality upgrading, since we are primarily interested in the price elasticities of import demand estimated by BGW, who do not distinguish between them on any quality-related basis. One could of course re-estimate these elasticities by further splitting varieties of any given good between a high-quality type and a low-quality type, but that would be an entirely different paper. Our approach nevertheless enables us to assess whether there has been an overall reallocation of Italian exports in favour of more differentiated products, with the additional benefit of using a direct measure of product differentiation such as the price elasticity of demand, rather than relying on more loosely related measures based on export prices and unit values.

The rest of the paper is structured as follows. Section 2 presents the methodology, while Section 3 describes the dataset, including the estimation of the elasticities of substitution. The main findings are discussed in Section 4, while Section 5 analyses the sectoral and geographical contributions. Section 6 concludes.

2. Methodology

The overall export elasticity for a given country *i* is computed as a weighted average of the demand elasticities in each destination market (defined as a country-sector combination). The weights are given by the share of each market on total exports of country *i*. Formally, the export elasticity for country *i* in year *t* is defined as:

(1) $$\eta_{i,t} = \sum_{jk} \sigma_{jk} \frac{EXP_{i,t,jk}}{\sum_{jk} EXP_{i,t,jk}},$$

where *j* indexes export products, *k* indexes destination countries for country *i*'s exports, σ_{jk} is the estimated demand elasticity for product *j* in importing country *k* and $EXP_{i,t,jk}$ is the value of exports of product *j* from country *i* to country *k* in year *t*. We estimate $\eta_{i,t}$ for four countries

i (Italy, France, Germany and Spain), with t running from 1994 to 2008.[6] A similar methodology is applied by Kang (2008) to the exports of three Asian countries (China, Japan and South Korea), and by Imbs and Méjean (2010) to the exports of 28 countries. In the following description, we shall try to avoid confusion by referring to σ_{jk} and $\eta_{i,t}$ as demand elasticity and export elasticity, respectively.

The demand elasticities σ_{jk} for any given product are assumed to be constant across both time and origin countries. The first assumption implies that $\eta_{i,t}$ changes over time, for a given i, only because of variations in the composition of i's exports across destination countries and sectors. In a similar fashion, the second assumption implies that, in any given year, comparisons across exporting countries only depend on differences in the composition of exports. Note that differences in the geographical composition include the asymmetric effects which are related to the fact that, by definition, a country does not export to itself. For example, Italy's $\eta_{i,t}$ is affected by the elasticities of substitution among varieties in the German market, while Germany's $\eta_{i,t}$ is not affected by them, as Germany does not export to itself.

3. Data

As is clear from equation (1), in order to apply the methodology described in the previous section, two sets of data are needed: 1) a measure of the demand elasticity for each country-product combination; 2) the composition of exports, by country and product, for the four main euro-area countries.

3.1 Elasticities of substitution among varieties (demand elasticities)

The primary source for the elasticities of substitution among varieties is the estimates provided by BGW, whose approach is largely based on Feenstra. The idea is to estimate these elasticities by exploiting the cross-section and panel information available in trade data, rather

[6] The elasticities σ_{jk} are estimated by BGW over a shorter sample period (1994-2003). We re-estimate a subset of these over the sample period 1994-2005 see the Appendix for details.

than using instruments.[7] This method, which only requires quantities and values of imported goods, has been applied with some modifications in two related works: BW, on more than 10,000 products imported by the United States, and BGW, who consider 73 importing countries and 171 products (see the Appendix for a detailed presentation). The only differences between the BGW approach and the celebrated contribution of Feenstra are in the remedies envisaged for dealing with heteroskedasticity of the residuals and measurement error in import prices.

The set of countries for which BGW estimates are available includes all the main countries in the world; the most notable exceptions are Belgium, Bulgaria, Czech Republic, Iran, Israel, Russia, Singapore and Taiwan. The industry classification chosen by BGW corresponds to the first three digits of the Harmonized System (HS) codes and includes 171 sectors. While this level of disaggregation is quite detailed, there are two critical issues. Firstly, it does not always correspond to fully consistent product aggregations: the logical structure of HS is based on chapters (first two digits) and positions (first four digits). Secondly, the level of disaggregation is not homogeneous with respect to trade volumes, with a few sectors covering a significant share of international trade. For instance, just one single product (the 3-digit HS code 870, which includes transport vehicles and equipment) represented 22 per cent of Spanish exports and 18 per cent of German exports in 2006. Symmetrically, some of the 171 products are quite negligible in the export flows of the four countries under examination. Finally, it should be noted that for the majority of the international classifications the HS 3-digit disaggregation is sufficiently fine to uniquely identify each product as being intermediate or final. Therefore, the BGW methodology does allow for varieties of intermediate products to have different elasticities of substitution from those of varieties of final products.[8]

The elasticities estimated by BGW span from 1 to 16,808. While the estimates are bounded below by 1, consistently with the standard theoretical assumptions about the DS-CES utility function, very large elasticities signal that varieties tend to be undifferentiated and perfectly substitutable. While with perfect substitutability the theoretical price elasticity is infinite, we tend to be skeptical about values larger than one hundred: it is hard to accept that, for practical purposes, only nonlinearities and differential calculus can justify the fact that a one percent

[7] In fact, Feenstra also shows that the "between" regression he suggests is equivalent to an instrumental variable regression. See the Appendix for details.
[8] A paragraph at the end of the Appendix further deals with intermediate products.

price increase leads to sales dropping to zero. We choose to correct the BGW elasticities using a winsorisation which reduces to 30 all estimates larger than that. The reason is that, as pointed out by Mohler (2009), an elasticity close to 20 or 30 has approximately the same impact on the level of utility derived from a CES utility function as an elasticity of 100 or even 1,000. This stems from the way the elasticity enters the utility function (see the exponential terms in equation (A1) in the Appendix). Beyond a certain threshold, therefore, differences in the values of the elasticities are not meaningful in economic terms. Furthermore, when we initially used the original BGW elasticities, an extremely small number of very high values turned out to have a very large impact on the weighted export elasticity $\eta_{i,t}$: for instance, just one demand elasticity (the 3-digit HS code 870 in the Italian market) contributed between one half and almost three quarters to the estimated average price elasticity for French, German and Spanish exports, leading to average export elasticities which were unrealistically much higher than those we estimated for Italy (with Spain having an average export elasticity five times as large as Italy's). Our results are robust to alternative thresholds (we have verified with 20 and 50). Table 1 reports the distribution of the elasticities estimated by BGW: only 4.7 per cent of them are above our threshold of 30 (3.0 per cent are above 50).

Special attention is given to the demand elasticities σ_{jk} in the four countries under study, due to the "asymmetric effects" discussed above (letting j and k index two of the four countries, our weighted elasticity $\eta_{j,t}$ is affected by the elasticities of substitution among varieties in country k ($k \neq j$), while $\eta_{k,t}$ is not, as country k does not export to itself). These are especially relevant for our weighted export elasticities since the four economies are closely integrated, leading to substantial trade flows among them: for example, Italy's two main export markets are indeed Germany and France. As a robustness check, we estimate the elasticities of substitution among varieties in the four countries according to three alternative methods, in addition to the original BGW elasticities:[9] 1) the BGW method applied to Eurostat data and a longer time span (1994-2005); 2) the Feenstra method, defining the varieties at the 6-digit level of the Harmonised System, as in BGW; 3) the Feenstra method, defining the varieties at the 3-digit level. See the appendix for details on the estimation methods.[10] For each of the

[9] We would like to thank David Weinstein and Christian Broda for sharing their codes with us.

[10] The Feenstra method may produce values of the elasticities which are not admissible (i.e. lower than unity). When this happens (in 5 to 10 per cent of the cases in our sample), we replace the estimated values with the BGW elasticities.

three methods, we re-estimate 680 out of the 11,300 elasticities estimated by BGW: a threefold re-estimation of the complete set is beyond the scope of this paper.

Our estimations confirm the analysis by Mohler (2009), who finds that the individual elasticities of substitution can be quite sensitive to the estimation method. We shall see, however, that individual differences are very much muted by the weighting process leading to the computation of the export elasticities. Similarly, for estimation errors, we follow BW in acknowledging that some of the individual elasticities are estimated with poor accuracy. We do not suspect systematic errors to arise, however, so that we remain confident that the error component of the overall export elasticity is of a smaller order, since it is a (weighted) average of up to 11,300 individual elasticities.

In re-estimating the elasticities of substitution among varieties in the four countries under examination we maintain the hypothesis that the σ_{jk}'s are time-invariant. Preliminary evidence suggests that this is a reasonable assumption. Specifically, we split our sample into two sub-periods (1994-1999 and 2000-2005) and separately estimate all the demand elasticities. We then compute the mean and the median estimated values in each sub-period and compare them to conclude that only small differences arise, with no common trend among the four countries. This is reassuring for our overall export elasticity, since it signals that destination countries where demand elasticities have increased over time are likely to be averaged with other destination countries where elasticities have decreased. Our results do not contradict the findings of BW, who find that in the US the median elasticity of substitution tends to slightly fall over time, although over a considerably longer time span (1972-2001).

3.2 Export composition

Export shares as defined in equation (1) are computed using Eurostat data on exports in value terms for Italy, France, Germany and Spain over the years 1994-2008. For each of the four countries, Eurostat publishes annual export flows disaggregated by product (defined at the 8-digit level of the Combined Nomenclature)[11] and destination country (around 250 destinations in total). Exports in our dataset represent on average between 80 and 90 per cent of total exports from each country in the period under study (Table 2). The incomplete coverage

[11] The Harmonized System stops at the 6-digit detail; the 8-digit detail is only available in the Combined Nomenclature.

depends on: a) exports to countries not included among the 73 countries in the BGW elasticities dataset; b) exports to countries included among the 73 countries but referring to products for which BGW do not estimate an elasticity; and c) exports with non-numeric codes in Eurostat data, which reflect confidential data or other special categories.

Before presenting our main findings, it is useful to evaluate how different the sectoral and geographical composition is among the four countries under consideration. We compute the share on total exports from a given country for each destination-product pair (where products are defined at the 3-digit HS level, consistently with the level of detail available for the elasticities of substitution among varieties). Table 3 reports simple correlation coefficients among the export shares in the last year of our sample (2008). Overall, the export shares show a positive correlation, although not a very strong one, ranging from 0.47 to 0.75. These correlation coefficients tend to increase over time: a similar computation for the previous years would therefore yield even smaller values.

4. Main findings

Figure 1 reports the average export elasticity for the main four euro-area countries over the years 1994-2008, computed according to equation (1). In each panel of Figure 1 the underlying demand elasticities over country-product combinations (the σ_{jk}'s) for all countries other than Italy, France, Germany and Spain are the BGW elasticities. When the destination market is one of the four euro-area countries, the demand elasticities are estimated with different methods. More precisely, let the product-index j run from 1 to the total number of products considered by BGW (171), and let the country-index k take on values in the union set $K := K_1 \cup K_2$, where K_1 consists of Italy, France, Germany and Spain, while K_2 consists of all remaining 69 countries. Define the following sets:

$$\Sigma_1 := \{\sigma_{jk} \mid j = 1,...,171,\ k \in K_1\};$$

$$\Sigma_2 := \{\sigma_{jk} \mid j = 1,...,171,\ k \in K_2\}.$$

With this notation, Figure 1 is organized as follows:

- in all four panels, all the σ_{jk}'s in Σ_1 are taken from Broda, Greenfield and Weinstein (2006), who use UN Comtrade data over the period 1994-2003 and define products at the HS6 level.

- in panel A (labelled "BGW"), all the σ_{jk}'s in Σ_2 are also taken from Broda, Greenfield and Weinstein (2006). Therefore, panel A uses the complete set of the original BGW demand elasticities.
- in panel B (labelled "FF^{BGW}_HS6"), all the σ_{jk}'s in Σ_2 are estimated by us, using the BGW estimator on Eurostat data (over the period 1994-2005); products are defined at the HS6 level.
- in panel C (labelled "$FF^{Feenstra}$_HS6"), all the σ_{jk}'s in Σ_2 are estimated by us, using the Feenstra estimator; products are defined at the HS6 level.
- in panel D (labelled "$FF^{Feenstra}$_HS3"), all the σ_{jk}'s in Σ_2 are estimated by us, using the Feenstra estimator; products are defined at the HS3 level.

As explained in the previous section, all the σ_{jk}'s are winsorised to 30. Finally, pick any of the four panels and consider, for instance, the line labelled "ITA" (for Italy). The line depicts the time series $\eta_{i,t,}$ with index i identifying Italy, computed from equation (1).

Starting with panel 1.A (where all the underlying σ_{jk}'s are those estimated by BGW), the average export elasticity is lowest for Italy and highest for Germany and Spain, while it falls in the intermediate range for France. Looking at the dynamics over time, there is a very slight upward trend for Italy (from 5.3 in 1994 to 5.6 in 2008). France shows a hump-shaped pattern, first rising from 6.4 in 1994 to 7.0 in 1999 and then decreasing to 6.1 in 2008. A similar pattern is also found for Spain (which reaches a peak of 7.8 in 1999 and then falls down to 7.0 in 2008) and for Germany (which rises from 7.0 in 1994 to 7.9 in 2002 and then decreases to 7.4 in 2008). Recall that dynamics only emerge due to the varying composition of exports, since the underlying demand elasticities (the σ_{jk}'s) are time-invariant.

Turning to the other three panels of Figure 1, one may notice some variability across the estimation methods. As regards the levels, the average export elasticity tends to be highest when it is measured with the FF^{BGW}_HS6 method (panel 1.B) and lowest with the $FF^{Feenstra}$_HS3 method (panel 1.D). This result is in line with the BGW finding that the elasticity of substitution among varieties increases when moving toward finer product definitions, the intuition being that as goods become more narrowly defined, we move closer to the ideal "homogeneous good" so that varieties become more substitutable in the agents' preferences. For Italy, the average elasticity in 2008 ranges from 5.7 with the former method to 6.2 with the $FF^{Feenstra}$_HS6 method (panel 1.C) and 6.6 with the FF^{BGW}_HS6 method. There are also differences in terms of dispersion of the estimated elasticities: the average gap between the country with the highest elasticity and the country with the lowest is 2.5 for the FF^{BGW}_HS6 method, while it is about 1 for the $FF^{Feenstra}$_HS3 method, and 1.2 for the $FF^{Feenstra}$_HS6 method.

Despite these differences, the country rankings are generally consistent across the various estimation methods. In particular, Italy turns out to be the country with the lowest export elasticity in every year and in every specification. Only in one case ($FF^{Feenstra}$_HS6) does there appear to be no difference relative to France, but only toward the end of the sample. Among the other countries, France tends to have a lower elasticity, while Germany shows a higher elasticity, with Spain being somewhere in between. The ranking changes only with the $FF^{Feenstra}$_HS3 method, where Spain has a lower elasticity than France over most of the period, and with the FF^{BGW}_HS6 method, where Spain has the highest elasticity. Overall, the evidence pointing to Italy as the country with the lowest export elasticity is very robust. Further, the dynamics of the average elasticities over time appear to be largely independent of the estimation method. Looking at time averages, Italy has the smallest average export elasticity, ranging from 5.5 to 6.5 depending on the estimation method. Relative to this benchmark, the average gap estimated by us ranges between 0.4 and 1.0 for France, between 1.0 and 2.0 for Germany, and between 0.5 and 2.5 for Spain.

An important question is whether such differences in the export elasticities are economically meaningful. In 2008, using the BGW method, we estimate that the price elasticity of Italian exports (for the composite bundle "exports of goods") is 5.6, which would imply a constant mark-up over marginal costs of around 22 per cent.[12] As a comparison, the corresponding mark-up for Spain and Germany (with elasticities equal to 7.0 and 7.5 respectively) would be of about 17 and 15 per cent, respectively. Although these magnitudes look reasonable, the difference in mark-ups implied by different export elasticities is not negligible and could have potentially significant consequences in terms of price levels and efficiency. For instance, a one per cent difference in mark-ups between country *1* and country *2* means that either the two countries share the same cost structure and country *1*'s exports are (roughly) one per cent more expensive, or country *1* needs its marginal costs to be (roughly) one per cent below country *2*'s marginal costs in order to match its export prices.

[12] Using the standard relationship between prices and marginal costs: $p = (\sigma / (\sigma\text{-}1))\ mc$, where σ is the estimated price elasticity of exports.

Similarly, differences in the *dynamics* of the export elasticity can be mapped into (theoretical) differences in the rate of growth of export prices (unit values), with a downward trend for the export elasticity translating into an upward trend for mark-ups,[13] thus adding a source of inflation to the one stemming from marginal costs. We shall not try and pursue international comparisons along these lines any further, since standard mark-up theory may perform very poorly in the present context. Indeed, recall that we are dealing with a composite good, named "exports", so that even if one is willing to take our estimated export elasticities for granted, marginal costs cannot be realistically assumed to be comparable across countries or time, since they depend not only on the state of technology, but also on the composition of aggregate output by product (not to mention the country of origin for imported inputs and local prices for the international immobile factors of production).

5. Findings on the sectoral and geographical decomposition

We shall now investigate the contribution of various sectors and destination countries to the overall export elasticity. In doing so, we focus on the most robust of our findings, by looking at the time-average levels of our estimated export elasticities. We consider exclusively the BGW elasticities, since they are very close to the $FF^{Feenstra}$_HS6 elasticities and represent the intermediate case between the high dispersion arising from the FF^{BGW}_HS6 elasticities and the low dispersion resulting from the $FF^{Feenstra}$_HS3 method (see Figure 1).

We start by considering the time-average between 1994 and 2008, which only requires us to drop the time indices in equation (1) and to consider the 14-year span as a single period (thanks to the maintained assumption that the elasticities of substitution among varieties σ_{jk} are time-invariant). We next aggregate the 171 products into 17 sectors and re-define the terms on the right-hand side of equation (1) – after dropping time indices - so that it can be used with *j* now indexing sectors rather than products. For the share on total exports, it suffices to add the shares of all products falling into a given sector. As for the estimated elasticity of substitution among varieties of *sector j* in the importing country *k*, we re-define σ_{jk} ("sectoral elasticity" hereafter) as a weighted average of the demand elasticities of all

[13] Note from the previous footnote that the mark-up σ / (σ-1) is inversely related to σ, since it can be rewritten as: 1 + (1 / (σ-1)).

products falling into a given sector, with weights given by the relative importance of each product.

At this stage, the contributions to the overall export elasticity η_i are disaggregated by market, defined as a *sector*-destination pair. By collapsing the destination-country dimension of this two-way table, we obtain the sectoral decomposition of the overall export elasticity. Vice-versa, we obtain the geographical decomposition of the overall export elasticity by collapsing the sector dimension.

5.1 Sectoral decomposition

We start with the sectoral decomposition, which is summarized in Table 4. The last four columns report, for each of the four euro area countries, the sectoral contribution – expressed in percentage terms – to the overall export elasticity η_i of the country (the levels of the four elasticities η_i are reported in the last row of the first four columns). The middle block of columns reports, for each country, the percentage share of exports in each sector on total exports. The first block of columns reports, for each country, the sectoral elasticities. The bubble graphs in Figure 2 provide a graphical representation of Table 4, with sectoral elasticities on the horizontal axis and sectoral export shares on the vertical axis. The size of the bubbles is proportional to the sectoral contributions to the overall export elasticity.

Table 4 reveals that the variability is mainly between sectors, rather than within sectors. At this level of aggregation the profiles of sectoral elasticities for the four countries are very similar, with correlation coefficients ranging between 0.92 and 0.99. Relatively high elasticities (the first four columns) are found for motor vehicles and other transport equipment (always above 10 in both cases, for any of the four countries) and for minerals and mineral products (between 5 and 8). The evidence for the latter sector is consistent with BW's conjecture that varieties of goods traded on organized exchanges (such as commodities) should be more substitutable than varieties of other goods. The other sectors tend to show elasticities of between 3.5 and 6. The lowest values are found for wearing apparel, wood and products of wood, non-metallic mineral products and computer, electronic and optical products. As for technological intensity, standard classifications (such as low-technology versus high-technology goods) are not clearly correlated with sectoral elasticities.

The next block of columns, one for each of the four countries, shows each sector's share on total exports. There is now a greater variability within sectors, reflecting differences in specialisation patterns among the four euro-area countries. It is well known that sectors producing "traditional" goods such as textiles, wearing apparel, leather products, footwear, and furniture and other manufacturing account for a much larger share of Italian exports than is the case for other countries' exports. Italy is also specialised in machinery and equipment, whose share of total exports is the largest among the four countries.

The last block of columns shows, for each of the four countries, the sectoral percentage contributions to the time-average (1994-2008) of the overall export elasticity η_{it} of the country under examination. Table 4 reveals that chemical and pharmaceutical products as well as machinery and equipment tend to yield relatively large contributions due to their relatively large share in total trade, while displaying below average sectoral elasticities. Symmetrically, other transport equipment tends to yield relatively large contributions due to above average sectoral elasticities. These common features can probably be distinguished more clearly in Figure 2. The figures also reveal that most of the sectors are characterised by sectoral elasticities of between 3 and 6, with the corresponding shares in total exports being below ten per cent. These sectors, having small elasticities and small shares, clearly contribute the least to overall export elasticity. The remaining 4 to 5 sectors are heavy contributors, representing 48 per cent of the total for Italy, 66 per cent for Germany and Spain, and 73 per cent for France.

Indeed, the differences in the overall export elasticity across the four countries are mostly due to the motor vehicle sector. This sector represents a large share of German and Spanish exports (more than 21 per cent in both countries) and its average sectoral elasticity is relatively high. One potential concern is that the large size of this sector may be due to the fact that it aggregates a lot of products, which may introduce a bias in the estimated elasticity of substitution. However, as pointed out by BW, aggregation is likely to imply a *downward* bias in the estimated elasticity, the reason being that a more aggregated sector includes goods that are likely to be less substitutable with each other, which tends to lower the estimated elasticity of substitution.

Another potential concern is that the estimations for the motor vehicle sector may be biased because product classifications in trade data do not closely map market products, as perceived by the consumers. It is therefore useful to compare our findings with Blonigen and Soderbery (2009), who apply the BW methodology to the U.S. automobile market and consider two very different definitions of varieties: the first is the usual Armington definition based on trade data at the 10-digit HS level; the second is a "market-based" definition of variety, which corresponds to a specific car model (e.g. Honda Civic, Toyota Corolla, etc.). Both definitions of varieties yield similar elasticities of substitution (11.4 for the former, 11.7 for the latter), which suggests that estimation is not biased by the definition of variety and confirms that the sector tends to be characterized by relatively high elasticities.

Furthermore, one may argue that Italy, France and Spain on the one side and Germany on the other side do not export the same type of cars. In particular, German BMWs and Mercedes may well exhibit a lower elasticity of price demand than Italian Fiats, French Renaults or Spanish Seats (or German Volkswagens, for that matter). Blonigen and Soderbery (2009) find that US imports of compact and midsize cars are more price-elastic than imports of SUVs and sports cars. We acknowledge that the German motor industry is a unique case among the four countries considered here and that our estimations for the crucial German motor vehicle sector may not fully control for large quality differentials. At the same time, trade data for a complex industry such as motor vehicles need to be interpreted with extreme caution and deep competence is needed on how companies have organized their production worldwide: for example, BMW produces SUVs in the US[14] for the world market so it is actually the US that exports them to Germany rather than vice-versa.

Due to the importance of the motor vehicle sector, it is of interest to compute what the export elasticities of the four countries would be net of this industry (Table 5). The across-time average export elasticity would drop from 6.5 to 5.3 for France, from 7.5 to 5.2 for Germany, from 5.5 to 4.8 for Italy and from 7.4 to 5.2 for Spain. This exercise confirms our previous statement that the differences in the overall export elasticity across the four countries are mostly due to the motor vehicle sector. Yet it remains true that Italy shows the smallest overall elasticity. An even more striking result is obtained by excluding both the motor vehicle and the other transport equipment sectors: the export elasticities of the four countries turn out to be almost identical (4.5, 4.6, 4.7 and 4.9 for France, Germany Italy and Spain respectively). These two sectors have the highest sectoral elasticities and account for around

[14] http://www.bmwusfactory.com/#/home/.

25 per cent of the overall exports of France, Germany and Spain, while the weight is only 11 per cent for Italy.

As a further robustness check, we compare our results to an alternative measure of the price elasticity of demand, based on the Survey on Investments in Manufacturing (SIM) conducted by the Bank of Italy. In two waves of the survey (1996 and 2007), a sample of Italian firms was asked the following question: "Hypothetically, assuming your firm raised its prices by 10% today, what percentage change would there be in turnover in nominal terms if your competitors did not change their prices and all other conditions remained the same?". The answers tell us how price-elastic firms perceive their demand to be. An important difference with our elasticities is that this question refers to total demand, i.e. the sum of foreign demand (exports) and domestic demand. Notice also that the sample includes only firms with 50 employees or more.

Table 6 reports the sales-weighted mean elasticity perceived by firms in 1996, 2007 and the average of the two years. Consistently with our previous analysis, we report the price elasticity of quantities, rather than turnover. Overall, the weighted mean elasticity as an average of both years is 5.0, slightly lower than our estimated export elasticity of 5.5 (see Table 4). The stronger competition usually faced by firms in the export markets compared with the domestic markets could explain this difference. Looking now at sectoral elasticities, we find the highest values to be in the motor vehicles and other transport equipment sectors which is fully consistent with our results.[15] Finally, there is some evidence pointing to a modest increase over time of the price elasticity of demand perceived by firms, which on average rises from 4.8 in 1996 to 5.2 in 2007, again in line with our results.

We conclude with some comments on the Italian sectors producing "traditional" goods. We compare the export elasticities for traditional sectors with the overall export elasticity net of the motor vehicle and other transport equipment sectors. Net of these two industries, the export elasticity for Italy is 4.7, with sectoral elasticities spanning a narrow range (from 3.8 to 6.5). As Table 7 illustrates, while it is true that on average Italian traditional sectors display above average export elasticities (5.1), the elasticities for many of Italy's specialization industries are in fact low, contrary to the indications of the literature, which underlines competition from emerging countries as a major stress factor for Italian exports. Two

[15] Notice that the sectoral aggregation available in the SIM survey is not fully consistent with the aggregation we have chosen for our own analysis.

traditional sectors (wearing apparel and non-metallic mineral products like tiles and glassworks) have elasticities well below the average (4.0 and 3.9, respectively). The other traditional sectors display above average elasticities: furniture and other manufacturing (5.1), textiles (5.6) and leather and footwear (6.5). However, a finer sectoral disaggregation reveals some interesting qualifications. For example, the 5.1 elasticity for furniture and other manufacturing is an average of the below-the-mean elasticities recorded by furniture and toys and the above-the-mean elasticities recorded by jewellery and the remaining products. Similarly, the relatively high 6.5 elasticity for leather and footwear is an average of the well-above-the-mean elasticity recorded by leather (12.8) and below-the-mean elasticities recorded by articles of leather (2.9) and footwear (4.6).

Overall, the export elasticity of Italian traditional sectors has remained flat over our sample period. Sales in countries characterized by relatively lower demand elasticities have grown slightly faster than exports to high elasticity destinations. One may argue that the markets where competition, especially from emerging countries, is fiercer should also be the markets characterized by relatively higher demand elasticities. Pursuing this line of thought, the fact that Italian exports have underperformed in high elasticity destinations may be interpreted as evidence that competition from emerging countries is indeed worrying for Italian exports. However, conclusions along these lines are not warranted for one simple reason: we are not able to control for demand factors. It may well be the case that the underperformance of sales in high elasticity destinations is mainly determined by aggregate demand having been subdued in those countries (or to exporters' pricing practices, for that matter).

Figure 3 depicts the evolution over time of the export elasticity for the main traditional sectors, showing a moderate upward trend for textiles and furniture and other manufacturing, and a slight downward trend for non-metallic mineral products. Wearing apparel as well as leather and footwear tend to display a flat profile. Time trends tend to be quite homogeneous within sectors, with a few exceptions. The downward pressures on the export elasticity of non-metallic mineral products are driven by a recomposition in favour of low-elasticity products, with ceramic products losing ground. Conversely, the upward pressures on the export elasticity of furniture and other manufacturing come from the decrease in the share of furniture, whose export elasticity is below the average of the remaining products in the sector. In the leather and footwear sector, the modest decline of the export elasticity for leather and related products in the 2000s has been balanced by the rise of the export elasticity for footwear.

5.2 Geographical decomposition

To investigate the role played by the geographical composition of exports, we start with the contributions to the overall export elasticity η_i disaggregated by market, defined as a sector-destination pair, and collapse the sector dimension. Table 8 presents the results for the 16 main destination countries included in our data.[16] In parallel with the sectoral analysis, the first four columns of the table report, for each of the four exporting countries, the demand elasticity in each of the destination countries (demand elasticity by destination country). These are computed as weighted averages of the underlying demand elasticities estimated by BGW. For any given destination country, they differ among the four euro area exporters only because of the product composition of exports.

Our results show that there is no strong correlation between demand elasticities by destination country and their per capita income. For example, Romania, Hungary and Sweden show the highest elasticities, while the lowest are found for Mexico, the US, Austria, the United Kingdom and Portugal. These findings are in line with the conclusions of BGW: they compute the median across products of the demand elasticities they estimate for each of the 73 countries in their database and find that these medians are not correlated with per capita income.

All countries except Germany show low elasticities for the US. This reflects the product composition of German exports to the US, with the motor vehicle sector accounting for a very large share (40 per cent) and displaying an above average demand elasticity.

Looking at the shares on total exports in the middle block of columns, it emerges that differences in the geographical composition of exports across the four countries are much less significant than differences in their sectoral composition. There are some exceptions, mainly related to the fact that trade tends to be more intense with neighbouring countries[17] or to specific markets (e.g. the US for exports from Germany). Turning to what we have dubbed

[16] Recall that Belgium is not included in the set of countries for which BGW elasticities are available.
[17] As emphasised by the gravity models of trade.

"asymmetric effects", the first four rows are a warning for their potential impact. Note in particular:

- France is a big market for Spanish exports (22 per cent) but Spain is a much less important market for French exports (10 per cent);
- Germany is a big market for Italian and Spanish exports (17 and 14 per cent, respectively) but Italy is a much less important market for German exports (8 per cent). Similarly for Spain (5 per cent).

The last four columns of Table 8 show the destination country's percentage contributions to the time-average (1994-2008) of the overall export elasticity η_{it} of the exporting country being examined. For each of the four countries the biggest contributions come from the other three. In fact, large contributions tend to be driven by large shares, rather than by large demand elasticities. In other words, the geographical dispersion of demand elasticities is too low for small destination markets to matter significantly for the overall export elasticity[18]. The fact that export shares are a good estimator of the contributions to the overall export elasticity is confirmed by the last row of the table, where the overall export share of the 16 countries being considered is almost identical to the overall contribution (except for Germany).

Exports to Italy from the other three countries tend to be the only case where high export shares are associated with relatively high demand elasticities. Is it the case that the overall export elasticities of France, Germany and Spain are larger than Italy only because a large share of their exports goes to Italy, whereas the same is (obviously) not true for Italy? More generally, turning to the "asymmetric effects", an interesting question is how much they contribute to the differences in the overall export elasticities. The answer is that they matter quite a lot for Spain (11 per cent of its overall export elasticity, 0.8 over 7.4), but not for the other countries. For instance, Spanish exports to Italy contribute almost 16 per cent to η_{Spain} (1.2 in level terms), whereas Italian exports to Spain contribute only 6 per cent to η_{Italy} (0.3 in levels). Since η_{Spain}=7.4 and η_{Italy}=5.5, it turns out that almost half of the difference is due to the "asymmetric effect". The "asymmetric effect" is less relevant for the remaining countries:

- Italian exports to Germany contribute 18 per cent to η_{Italy} (1.0 in level terms), whereas German exports to Italy contribute around 11 per cent to $\eta_{Germany}$ (0.9 in level terms);

[18] The same is also true in our analysis of the sectoral decomposition, but to a lesser extent. In particular, "other transport equipment" tends to be a relatively small sector, though significant in terms of the overall export elasticity due to a large demand elasticity.

- Italian exports to France contribute around 16 per cent to η_{Italy} (0.9 in level terms). French exports to Italy also contribute around 16 per cent to η_{France} (1.0 in level terms);
- German exports to France contribute almost 15 per cent to $\eta_{Germany}$ (1.1 in level terms), whereas French exports to Germany contribute almost 17 per cent to η_{France} (1.1 in level terms).

6. Conclusions

Italy's manufacturing sector shows a peculiar specialisation structure compared with the other main euro-area countries. This has been the subject of a long debate, with several observers arguing that it is an important weakness factor, exposing Italian exporters to increasing competition from emerging countries. On the other hand, it is hard to reconcile this argument with evidence pointing to significant pricing power enjoyed by Italian firms, including those producing traditional goods. This paper contributes to the debate by implementing a novel methodology which enables us to assess whether the sectoral and geographical composition of Italian exports exposes them to markets with a more price-elastic demand, relatively to the other main euro-area countries.

We start with the Armington (1969) idea that different countries export different varieties of a given product. We then draw on the contribution by Feenstra, who shows how to use trade data in order to estimate the elasticity of substitution among different varieties of the same product. Under certain assumptions, the estimated elasticity of substitution corresponds to the price elasticity of demand facing all the exporters of a given product. We borrow the elasticities of substitution among varieties estimated by Broda, Weinstein and Greenfield (2006) for each market, defined as a combination of 73 countries and 171 products. A convenient weighted average of these demand elasticities yields a measure of export elasticity for the composite bundle "exports of goods" of the four euro-area economies under consideration (Italy, France, Germany, Spain).

We find that Italy's export elasticity tends on average to be lower than the export elasticity of the other three countries. This result mainly reflects differences in the sectoral composition of exports and is mainly driven by two sectors (motor vehicles and other transport equipment), which are characterized by relatively large demand elasticities and represent a much smaller share of Italian exports than in the other three countries. Net of these two industries, the export elasticities of the four countries decrease substantially and basically become identical; in fact, France and Germany display export elasticities marginally lower than Italy. The evidence is quite robust to using alternative estimation methods. The sectoral and geographical composition therefore does not seem to expose Italian exports to markets with a more elastic demand compared with the other main competitors, contrary to the indications of part of the literature. Our results indicate that the underperformance of Italian export volumes relative to France and Germany, and the loss of market shares in world trade do not rest upon adverse export elasticities.

Italy's main specialisation sector (machinery and equipment) has a relatively low elasticity of substitution. Among traditional goods, the elasticities are higher for textiles, jewellery and leather, but very low for articles of leather, furniture, non-metallic mineral products and wearing apparel.

We are aware that elasticities of substitution can be quite sensitive to the estimation method, as pointed out by Mohler (2009). As a robustness check, we re-estimate 680 out of the 11,300 elasticities estimated by BGW, using a different data source and alternative estimation methods. We select the demand elasticities most relevant to our analysis, that is the *import* elasticities in the four highly integrated euro-area countries in question. While confirming Mohler's findings, the weighting procedure we implement in the computation of the export elasticities clearly mutes individual differences. We conclude that our main results are quite robust to alternative estimation methods.

Our findings are subject to the caveats mentioned in the introduction. In particular, the Armington (1969) definition of variety could be quite restrictive, especially in some sectors. Future work could follow the direction taken by Blonigen and Soderbery (2009), who estimate the elasticities of substitution among varieties using a more appropriate and "market-based" definition of variety for the motor vehicle sector. This sector definitely deserves a more thorough investigation, given its large share in manufacturing output and exports. Other avenues for future research point at retaining the Armington (1969) definition while challenging the assumption that in any given market all varieties share the same elasticity of substitution. In particular, it would be interesting to investigate whether varieties of final products tend to be less substitutable than varieties of intermediate products, or if varieties of high-quality products tend to be less substitutable than varieties of low-quality products.

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Appendix

This appendix provides a short description of the estimation methodology proposed by Feenstra and applied, with modifications, by BW and BGW. We depart slightly from the notation used in the text so as to stick to the one used in the original contributions: we now select an importing country so as to drop the index *k* and let *g* index products (instead of *j*).

Feenstra's methodology - It is assumed that the importing country's utility function can be described by the following non-symmetric CES function:

(A1) $$M_{gt} = \left(\sum_c d_{gct}^{1/\sigma_g} \left(m_{gct} \right)^{(\sigma_g - 1)/\sigma_g} \right)^{\sigma_g/(\sigma_g - 1)}$$

where M_{gt} is the utility from consuming good (product) g at time t, d_{gct} is a taste or quality parameter for product g imported from country c (c indexes origin countries, i.e. varieties), m_{gct} is the quantity of product g imported from country c and σ_g is the elasticity of substitution among varieties of good g (assumed to be larger than one). The demand for imports of variety c of good g can be expressed as a function of its price in the following way:

(A2) $$\Delta \ln s_{gct} = \varphi_{gt} - (\sigma_g - 1)\Delta \ln p_{gct} + \varepsilon_{gct}$$

where s_{gct} is the value share of imports of good g from country c on total imports of good g by the importing country and p_{gct} is the price of good g imported from country c. Supply is determined by the following equation:

(A3) $$\Delta \ln p_{gct} = \psi_{gt} + \frac{\omega_g}{1+\omega_g} \Delta \ln s_{gct} + \delta_{gct}$$

in which the supply elasticity is assumed to be constant across all supplying countries.[19] It is also maintained that the error terms in the demand and supply equations are independent. For any fixed good g, take a given supplying country k as the reference country and differentiate (A2) and (A3) relative to country k, then combine the two equations to obtain the following regression equation:

(A4) $$\left(\Delta^k \ln p_{gct}\right)^2 = \theta_1 \left(\Delta^k \ln s_{gct}\right)^2 + \theta_2 \left(\Delta^k \ln p_{gct} \Delta^k \ln s_{gct}\right) + u_{gct},$$

where the notation $\Delta^k p_{gct}$ indicates the difference between Δp_{gct} in country k and Δp_{gct} in country $j \neq k$. Note that (A4) defines a panel regression for each good g and each importing country $j \neq k$ (for the sake of notation we have omitted to index the two parameters θ_1 and θ_2). Using the estimated values for $\hat{\theta}_1$ and $\hat{\theta}_2$ one may then obtain $\hat{\sigma}_g$, i.e. the estimated elasticity of substitution among varieties of good g (in the given importing country), according to the following equation:

[19] Notice that prices are measured in the importing country's currency, so that their responsiveness to exchange rate movements depends on the degree of pass-through. Since the elasticities of substitution will be separately estimated for each good and each importing country, the methodology allows for the degree of exchange rate pass-through to vary across goods and importing countries.

(A5) $$\hat{\sigma}_g = 1 + \left(\frac{2\hat{\rho} - 1}{1 - \hat{\rho}} \right) \frac{1}{\hat{\theta}_2}$$

where $\hat{\rho}$ is given by:

(A6) $$\hat{\rho} = \frac{1}{2} + \left(\frac{1}{4} - \frac{1}{4 + (\hat{\theta}_2^2 / \hat{\theta}_1)} \right)^{1/2} \qquad \text{if } \hat{\theta}_2 > 0$$

(A7) $$\hat{\rho} = \frac{1}{2} - \left(\frac{1}{4} - \frac{1}{4 + (\hat{\theta}_2^2 / \hat{\theta}_1)} \right)^{1/2} \qquad \text{if } \hat{\theta}_2 < 0$$

Notice that $\hat{\sigma}_g$ is ultimately a function of $\hat{\theta}_1$ and $\hat{\theta}_2$ alone. Feenstra shows that the estimates $\hat{\theta}_1$ and $\hat{\theta}_2$ are robust to the simple form of measurement error in the prices, with equal variance across supplying countries, provided that a constant term is added to equation (A4). He further shows that consistent estimation of θ_1 and θ_2 can be obtained by taking time-averages in (A4), that is by running the "between" regression[20] associated with (A4). In fact, one needs to run Weighted Least Squares on the "between" regression, with weights equal to the total number of years in which each variety is imported. Feenstra also shows that this is equivalent to a standard IV approach where the instruments are chosen to be the origin-country dummy variables. This estimator corresponds to the Generalized Methods of Moments (GMM) estimator. Feenstra also shows that a consistent *and* efficient estimator can be obtained by taking the residuals from the consistent estimation and using their standard deviation to weigh the data in the IV estimation.
The references we have made in the text to Feenstra's methodology for estimating elasticities point to the consistent *and* efficient estimation, augmented for the constant term as detailed above.

The methodology of BW and *BGW* – BW and BGW also take equation (A4) as a starting point, but depart from Feenstra in various ways. Firstly, they allow for a more general treatment of measurement error in the prices, concluding that the constant term Feenstra suggests adding to equation (A4) should be replaced by the following term:

(A8) $$\theta_0 \frac{1}{T_{gc}} \sum_t \left(\frac{1}{q_{gct}} + \frac{1}{q_{gct-1}} \right),$$

where q_{gct} is the quantity of good g imported from country c in year t, T_{gc} is the total number of years in which variety c is imported (in positive amounts) and θ_0 is the extra parameter to be estimated. Notice that the regressor is indeed a constant term if q_{gct} is constant through time. As for why the regressor is helpful in dealing with measurement error in unit values, the intuition is that prices are measured more precisely when larger quantities are traded. Secondly, the authors address the issue of heteroskedasticity in the data and propose to weigh them by

[20] The intuition is straightforward: the error term u_{gct} is proportional to the product of the two structural errors ε_{gct} and δ_{gct}, which are assumed to be independent. Switching to time averages, the error term vanishes asymptotically.

(A9) $$T^{3/2}\left(\frac{1}{q_{gct}}+\frac{1}{q_{gct-1}}\right)^{-1/2}$$

In conclusion, the authors estimate (for each importing country and each good *g*) the "between" regression associated with the following equation

(A10) $$\left(\Delta^k \ln p_{gct}\right)^2 = \theta_0 \frac{1}{T_{gc}} \sum_t \left(\frac{1}{q_{gct}}+\frac{1}{q_{gct-1}}\right) + \theta_1 \left(\Delta^k \ln s_{gct}\right)^2 + \theta_2 \left(\Delta^k \ln p_{gct} \Delta^k \ln s_{gct}\right) + u_{gct},$$

after weighting all endogenous and exogenous variables by the term in equation (A9).
One issue Feenstra was not concerned with is that equation (A10), via equation (A5), may yield inadmissible estimates for the elasticity of substitution, i.e. values lower than unity.[21] When this happens, the authors resort to the GMM interpretation suggested by Feenstra: by implementing a grid search procedure on the GMM objective function they are able to ensure that the estimated elasticity of substitution is larger than unity (for details see Broda and Weinstein, 2006).

Product and prices definition – A few clarifications are in order on how products (goods) and their prices are defined. Starting with the Eurostat trade data where a product is defined by an 8-digit Combined Nomenclature code, the method we have dubbed as $FF^{Feenstra}$_HS3 collapses all products sharing the first three digits into a single "product": we have referred to this practice as defining products at the 3-digit level. In BGW a product is identified by a 6-digit HS code, but it is assumed that all products falling into the same 3-digit HS code share the same elasticity of substitution among varieties. This reduces the number of regressions to be run while preserving the variability across goods. The same product definition is used in what we have dubbed the FF^{BGW}_HS6 estimates and the $FF^{Feenstra}$_HS6 estimates.
As for product prices appearing in equation (A4), they are simply defined as unit values, the ratio of export values (quoted in euros in the Eurostat dataset) and quantities (quoted in tons). After 2005, European Union members have started collecting data on quantities allowing for "supplementary units" in place of weight (for example: length for cables). This made it impossible to define prices on a homogeneous basis and that is the reason why in estimating price elasticities of import demand our sample period ends in 2005.

Intermediate products – Intermediate products *appear* to be ruled out by assumption in the methodology presented here (since only final products enter the *utility function*), despite their large weight in world trade. In fact, BGW show that estimation equations (A4) and (A10) also arise in an alternative setting where all products are intermediate goods, whose demand is driven by a CES production function. The estimation methodology, therefore, applies equally to imports of intermediate goods and final goods. In conclusion, the BGW methodology does allow for varieties of intermediate products to have different elasticities of substitution from those of varieties of final products: the only requirement is that each product be unambiguously identified as being either intermediate or final, which is warranted for the vast majority of products (defined at the HS 3-digit level) – given the standard classifications of intermediate goods.

[21] Feenstra only considered a limited number of goods imported by the US and, apparently, never ran into this anomaly.

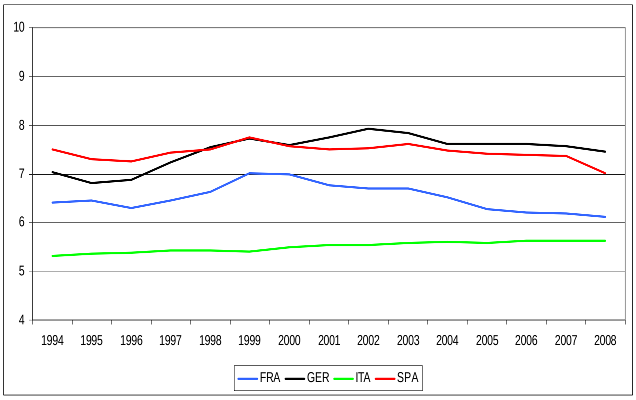
Choosing the reference country – Equation (A4) requires that a reference country k be chosen among all origin countries. BGW choose, for a fixed importing country c and a fixed good g, the supplier with the highest market share, on average, over the given time horizon. It is further required that imports from country k take place in each year of the sample period. Mohler (2009) documents that the set of rules chosen to identify the reference country do not have a big impact on the estimated elasticities. In particular, they are very robust to picking the country with the second highest market share.

Figures and Tables

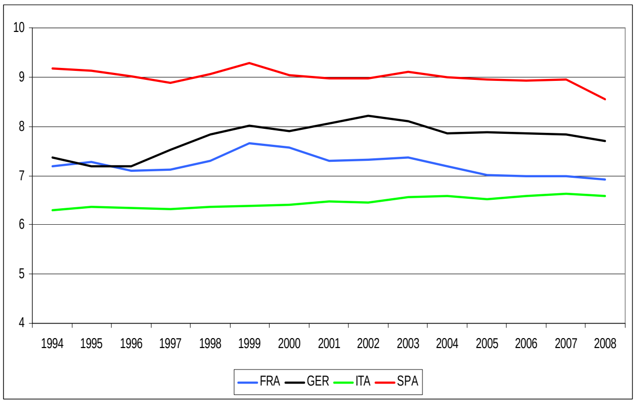
Figure 1

Average export elasticity for the main four euro-area countries

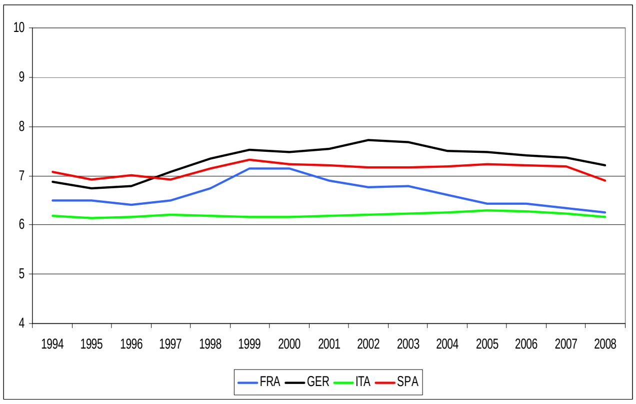
1.A : BGW elasticities



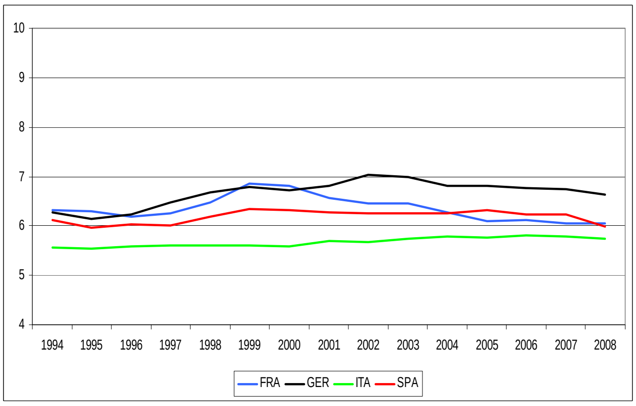
1.B : FF^{BGW}_HS6 elasticities



1.C : FF^{Feenstra}_HS6 elasticities



1.D : FF^{Feenstra}_HS3 elasticities

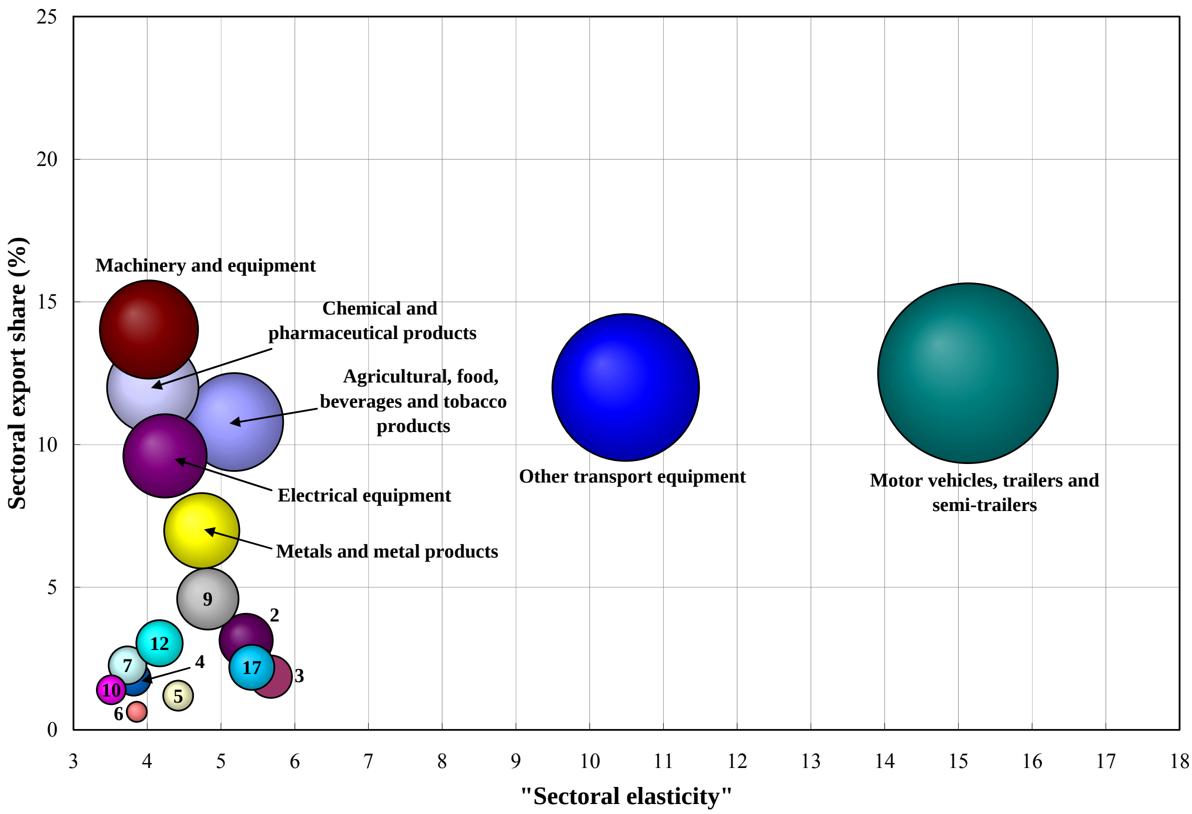


Note: the export elasticities are weighted averages of demand elasticities in the destination markets, with weights equal to each market's share on exports (as indicated in equation (1)). When the *destination* market is one of the four euro-area countries, each panel uses the demand elasticities estimated according to a different method: see the beginning of Section 4 for a detailed explanation. All elasticities are winsorised to 30. For further details on the estimation methods, see the Appendix.

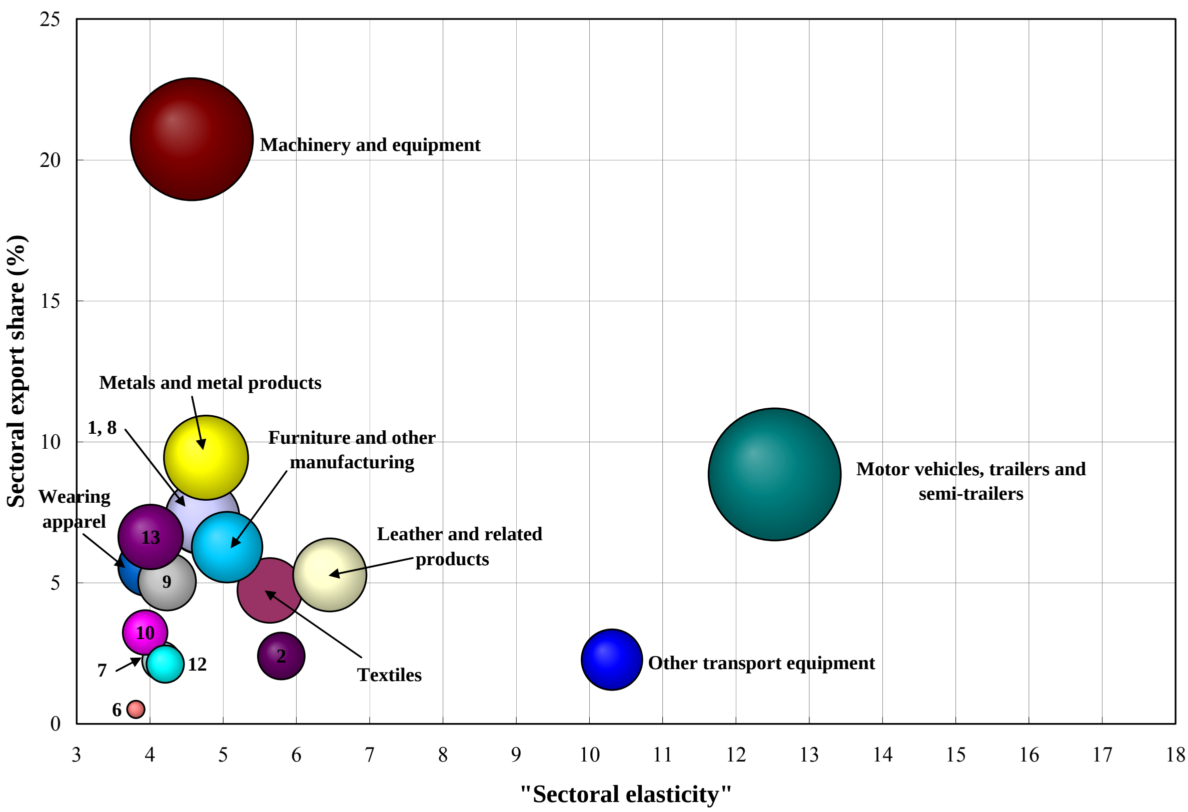
Figure 2

Contribution of the sectoral elasticities and the export share to the overall export elasticity

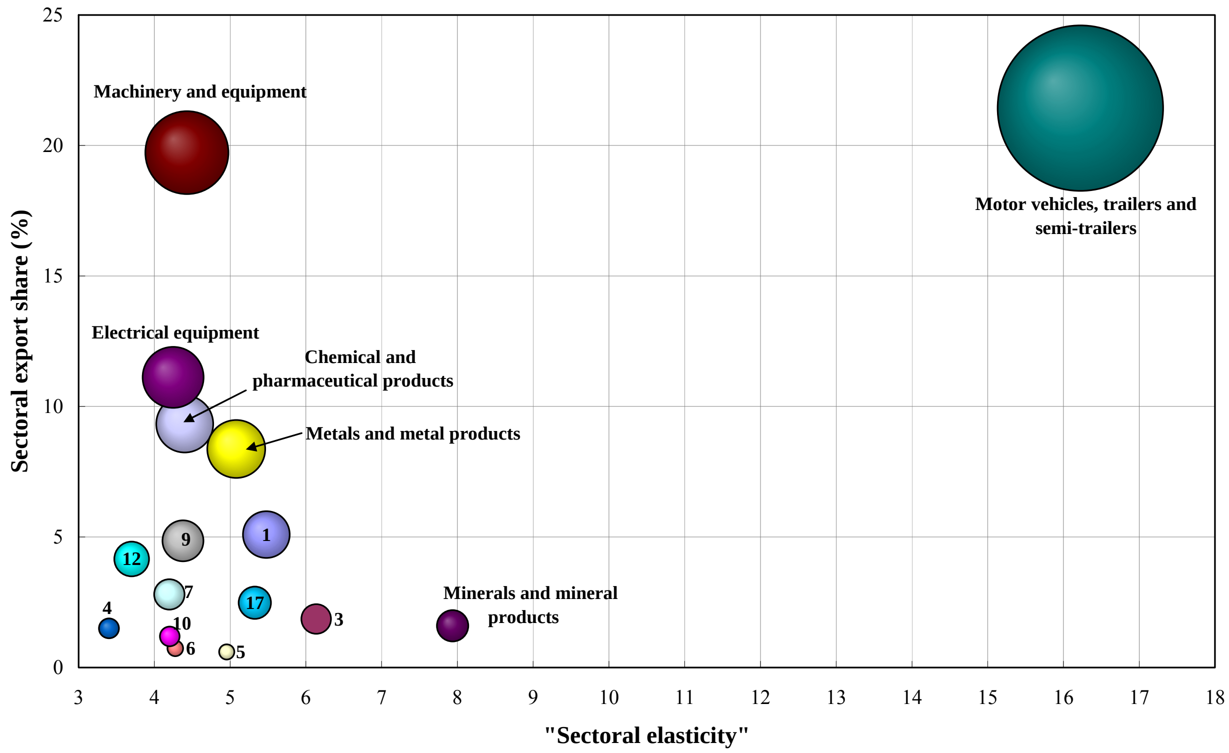
2.A: FRANCE



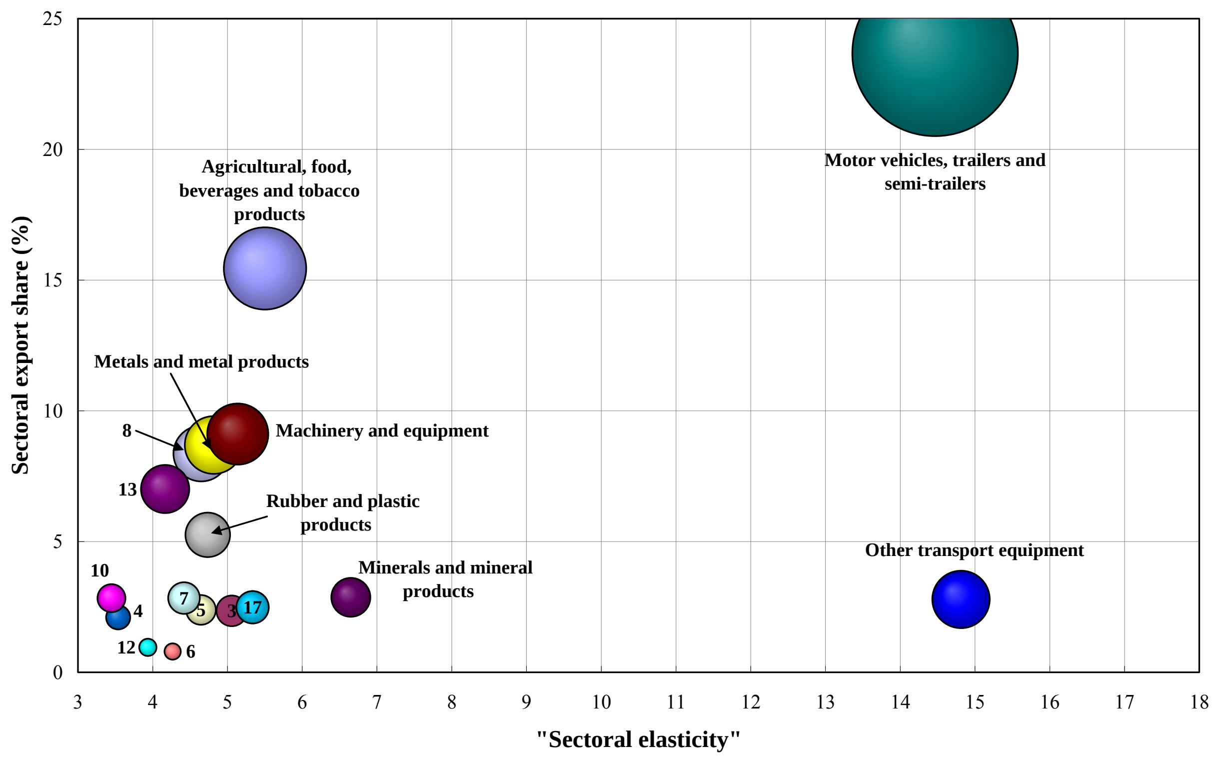
2.B: ITALY



2.C: GERMANY



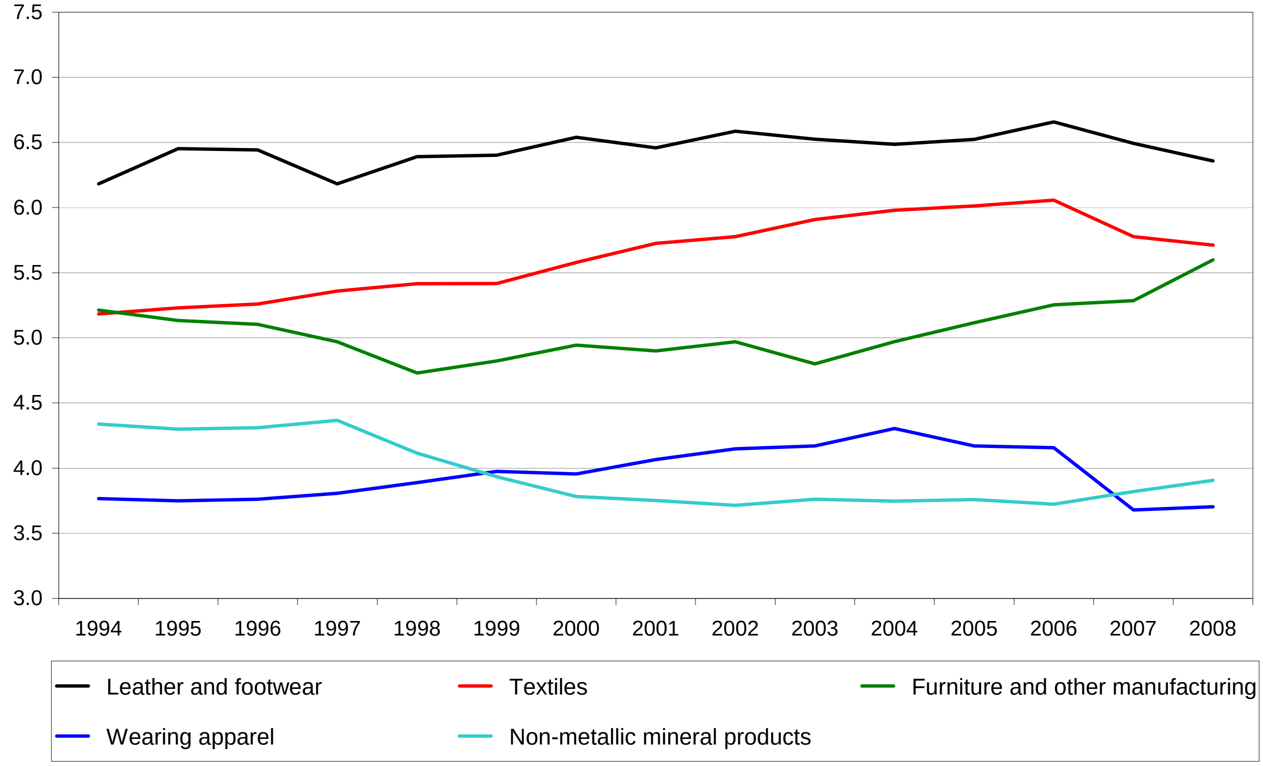
2.D: SPAIN



Note: the graphs report the sectoral elasticities and the export shares for the 17 sectors in each of the four countries, as listed in Table 4. The size of each bubble is proportional to the sector's contribution to the overall export elasticity in a given country. **List of sectors:** 1. Agricultural, food, beverages and tobacco products – 2. Minerals and mineral products – 3. Textiles – 4. Wearing apparel – 5. Leather and footwear – 6. Wood and products of wood (except furniture) – 7. Paper and paper products, printing – 8. Chemical and pharmaceutical products – 9. Rubber and plastic products – 10. Non-metallic mineral products – 11. Metals and metal products – 12. Computer, electronic and optical products – 13. Electrical equipment – 14. Machinery and equipment – 15. Motor vehicles, trailers and semi-trailers – 16. Other transport equipment – 17. Furniture and other manufacturing.

Figure 3

Export elasticities for Italian traditional sectors: evolution over time



Note: results based on the underlying BGW demand elasticities.

Table 1

Distribution of BGW import elasticities

Estimated values	Percentage	Cumulative percentage
1-5	72.1	72.1
5-10	16.6	88.6
10-20	3.8	92.5
20-30	2.8	95.3
30-50	1.7	97.0
50-100	0.9	97.9
100-200	2.0	99.9
+200	0.1	100.0
Total	**100.0**	**100.0**

Note: the table reports the percentage and cumulative distribution of the 11,293 import elasticities estimated by BGW.

Table 2

Percentage of total exports in our dataset over total exports of goods in official statistics (average 1994-2008)

Italy	France	Germany	Spain
85.3	81.1	83.4	87.5

Source: our computations based on Eurostat data.

Table 3

Correlation matrix of export shares by market (product-destination pair) in 2008

	Italy	France	Germany	Spain
Italy	1			
France	0.748	1		
Germany	0.557	0.520	1	
Spain	0.651	0.715	0.474	1

Note: the table reports the contemporaneous correlation coefficients among the four countries' export shares in 2008. Shares are defined over destination-product pairs, products being identified at the 3-digit HS level.

Table 4

Sectoral decomposition for the time-average (1994-2008) of the overall export elasticities $\eta_{i,t}$, by exporting country

	Sectoral elasticity (A)				Percentage share on total exports (B)				Percentage contribution to the overall export elasticity η_i ($A \cdot B / \eta_i$)			
	FRA	GER	ITA	SPA	FRA	GER	ITA	SPA	FRA	GER	ITA	SPA
Agricultural, food, beverages and tobacco products	5.2	5.5	4.7	5.5	10.8	5.1	7.3	15.4	8.6	3.7	6.2	11.4
Minerals and mineral products	5.3	7.9	5.8	6.6	3.1	1.6	2.4	2.9	2.6	1.7	2.5	2.6
Textiles	5.7	6.1	5.6	5.1	1.9	1.9	4.7	2.4	1.6	1.5	4.8	1.6
Wearing apparel	3.8	3.4	4.0	3.5	1.8	1.5	5.6	2.1	1.1	0.7	4.0	1.0
Leather and footwear	4.4	5.0	6.5	4.6	1.2	0.6	5.3	2.4	0.8	0.4	6.2	1.5
Wood and products of wood (except furniture)	3.9	4.3	3.8	4.3	0.6	0.7	0.5	0.8	0.4	0.4	0.4	0.5
Paper and paper products, printing	3.7	4.2	4.2	4.4	2.3	2.8	2.2	2.8	1.3	1.6	1.7	1.7
Chemical and pharmaceutical products	4.1	4.4	4.7	4.6	12.0	9.3	7.3	8.4	7.5	5.4	6.3	5.2
Rubber and plastic products	4.8	4.4	4.2	4.7	4.6	4.9	5.0	5.3	3.4	2.8	3.9	3.4
Non-metallic mineral products	3.5	4.2	3.9	3.4	1.4	1.2	3.2	2.8	0.8	0.7	2.3	1.3
Metals and metal products	4.7	5.1	4.8	4.8	7.0	8.4	9.4	8.7	5.1	5.6	8.1	5.6
Computer, electronic and optical products	4.2	3.7	4.2	3.9	3.0	4.2	2.1	1.0	1.9	2.0	1.6	0.5
Electrical equipment	4.2	4.2	4.0	4.2	9.6	11.1	6.6	7.0	6.2	6.3	4.8	3.9
Machinery and equipment	4.0	4.4	4.6	5.1	14.0	19.7	20.7	9.1	8.7	11.6	17.2	6.3
Motor vehicles, trailers and semi-trailers	15.1	16.2	12.5	14.5	12.5	21.4	8.8	23.7	29.0	46.1	20.1	46.1
Other transport equipment	10.5	18.3	10.3	14.8	12.0	3.2	2.3	2.8	19.3	7.7	4.2	5.6
Furniture and other manufacturing	5.4	5.3	5.1	5.3	2.2	2.5	6.3	2.5	1.8	1.8	5.7	1.8
TOTAL[1]	**6.5**	**7.5**	**5.5**	**7.4**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: see Section 5 for a precise definition of the variables reported in the table. Results based on the underlying BGW demand elasticities. In each column, shadowed cells highlight the highest values.

(1) Overall weighted export elasticity for the first four columns.

Table 5

Export elasticities (1994-2008) net of motor vehicles and other transport equipment

	FRA	GER	ITA	SPA
Total (overall export elasticity)	6.5	7.5	5.5	7.4
Total w/o motor vehicles	5.3	5.2	4.8	5.2
Total w/o motor vehicles and other transport equipment	4.5	4.6	4.7	4.9

Note: see Section 5 for a precise definition of the variables reported in the table. Results based on the underlying BGW demand elasticities.

Table 6

Price elasticity of demand perceived by Italian manufacturing firms in 1996 and 2007

	1996	2007	Both years
Agricultural, food, beverages and tobacco	3.7	3.9	3.8
Textiles and wearing apparel	3.9	4.9	4.3
Leather and footwear	2.9	2.5	2.6
Wood and products of wood	5.1	2.9	3.5
Paper and paper products, printing	5.3	7.1	6.4
Chemical and pharmaceutical products	2.9	4.9	4.0
Rubber and plastic products	4.9	4.0	4.2
Non-metallic mineral products	4.8	3.9	4.2
Metals and metal products	5.5	6.2	6.0
Machinery and equipment	4.3	5.0	4.7
Electrical products and electronical equipment	4.8	5.0	4.9
Motor vehicles, trailers and semi-trailers and other	6.3	6.8	6.4
Furniture and other manufacturing	3.5	3.6	3.6
TOTAL	**4.8**	**5.2**	**5.0**

Note: the table reports the price elasticity of demand perceived by a sample of Italian manufacturing firms with 50 employees or more in 1996 and 2007, according to the Bank of Italy survey (SIM). Firms were asked the following question: “Hypothetically, assuming your firm raised its prices by 10% today, what percentage change would there be in turnover in nominal terms if your competitors did not change their prices and all other conditions remained the same?” The answers are rescaled in order to obtain a measure of the price elasticity of demand and weighted by firm-level sales. In contrast to the other tables, the price elasticities here refer to total demand (domestic and foreign demand). The sample includes 882 firms in 1996 and 995 firms in 2007. In each column, shadowed cells highlight the highest values.

Table 7

Sectoral decomposition for the time-average (1994-2008) of the overall export elasticity: Italian traditional sectors

Sector	Sectoral elasticity	Percentage share on total exports
LEATHER AND FOOTWEAR	**6.5**	**5.3**
Raw hides and skins (other than furskins) and leather	12.8	1.4
Articles of leather; saddlery and harness; travel goods, handbags	2.9	1.0
Footwear, gaiters and the like; parts of such articles	4.6	2.8
Other products	5.4	0.1
TEXTILES	**5.6**	**4.7**
Wool, fine or coarse animal hair; horsehair yarn and woven fabric	7.3	1.0
Cotton	5.8	1.0
Man-made filaments	4.9	0.7
Man-made staple fibres	5.2	0.6
Knitted or crocheted fabrics	5.3	0.4
Other products	4.9	1.1
WEARING APPAREL	**4.0**	**5.6**
Articles of apparel and clothing accessories, knitted or crocheted	4.3	2.1
Articles of apparel and clothing accessories, not knitted or crocheted	3.6	3.1
Other products	5.3	0.3
NON-METALLIC MINERAL PRODUCTS	**3.9**	**3.2**
Articles of stone, plaster, cement, asbestos, mica or similar materials	3.8	1.0
Ceramic products	4.3	1.6
Glass and glassware	3.4	0.7
FURNITURE AND OTHER MANUFACTURING	**5.1**	**6.3**
Furniture; bedding, mattresses; lamps and lighting fittings; prefabricated buildings	3.3	3.7
Jewellery , pearls, (semi-)precious stones, precious metals; imitation jewellery	8.9	1.7
Toys, games and sports requisites; parts and accessories thereof	4.6	0.5
Other products	4.9	0.4
TRADITIONAL SECTORS (TOTAL)	**5.1**	**25.1**

Note: see Section 5 for a precise definition of the variables reported in the table. Results based on the underlying BGW demand elasticities.

Table 8

Destination-country decomposition for the time-average (1994-2008) of the overall export elasticities $\eta_{i,t}$, by exporting country

	Demand elasticity by destination country (A)				Percentage share on total exports (B)				Percentage contribution to the overall export elasticity η_i ($A \cdot B / \eta_i$)			
	FRA	GER	ITA	SPA	FRA	GER	ITA	SPA	FRA	GER	ITA	SPA
France	---	9.4	6.1	7.5	---	11.8	14.1	21.6	---	14.8	15.7	21.8
Germany	6.0	---	5.8	7.1	18.1	---	17.1	13.6	16.7	---	18.0	12.9
Italy	9.7	10.8	---	12.0	10.4	7.9	---	10.0	15.6	11.3	---	16.1
Spain	6.3	5.4	4.4	---	10.3	5.0	7.4	---	10.0	3.6	5.9	---
Netherlands	6.2	4.9	4.7	6.8	4.8	7.3	3.0	3.8	4.5	4.7	2.5	3.5
United Kingdom	5.1	6.5	4.4	7.3	10.7	8.8	7.6	9.4	8.4	7.6	6.0	9.2
Portugal	6.4	6.5	5.5	6.6	1.8	1.1	1.4	10.4	1.7	0.9	1.4	9.3
Sweden	8.1	7.1	6.9	7.7	1.6	2.5	1.2	1.1	1.9	2.3	1.5	1.1
Austria	6.8	5.1	5.1	5.4	1.1	6.2	2.7	1.0	1.2	4.2	2.5	0.7
Switzerland	9.8	6.1	6.3	7.2	4.3	4.8	4.6	1.4	6.5	3.9	5.3	1.3
Turkey	6.4	6.9	6.4	7.6	1.4	1.6	2.0	1.6	1.4	1.5	2.3	1.6
Poland	6.2	6.4	6.5	6.7	1.3	3.3	2.0	1.1	1.3	2.8	2.4	1.0
Hungary	9.9	9.3	8.6	15.1	0.6	1.8	1.1	0.5	0.9	2.2	1.7	1.1
Romania	14.1	12.9	14.1	12.2	0.5	0.7	1.6	0.3	1.1	1.3	4.0	0.5
USA	4.0	11.6	3.8	3.6	10.5	13.7	10.2	5.4	6.4	21.0	6.9	2.6
Mexico	3.7	3.6	4.9	5.4	0.6	0.9	0.8	1.6	0.3	0.4	0.7	1.2
TOTAL[1]	**6.5**	**7.5**	**5.5**	**7.4**	**78.0**	**77.4**	**76.8**	**82.8**	**77.9**	**82.5**	**76.8**	**83.9**

Note: see Section 5 for a precise definition of the variables reported in the table. Results based on the underlying BGW demand elasticities. In each column, shadowed cells highlight the highest values. Recall that Belgium is not included in the set of countries for which BGW elasticities are available.

(1) Overall weighted export elasticity for the first four columns.

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