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ORIGINAL PAPER

European export performance

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Abstract Using an econometric shift-share decomposition, we explain the redistribution of world market shares at the level of the product variety and by technological content. We decompose changes in market shares into structural effects (geographical and sectoral) and a pure performance effect. We regard the EU-27 as an integrated economy, excluding intra-EU trade. Revisiting the competitiveness issue in such a perspective sheds new light on the impact of emerging countries on the reshaping of world trade. Since 1995 the EU-27 withstood the competition from emerging countries better than the United States and Japan. The EU market shares

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for high-technology products, as well as in the upper price range of the market, proved comparatively resilient, though less so since the crisis.

Keywords International trade · Export performance · Competitiveness · Market shares · Shift-share · European Union

JEL Classification F10 · F14 · F15

1 Introduction

Emerging countries have been winning large market shares over the last two decades. Among these, China stands out with the most remarkable performance: it has almost trebled its world market share since 1995, reaching 17.8 % in 2010. This competitive pressure is striking for the most technological products, where many of the new competitors have combined an increase in market share with a higher unit value of the exported products. How did EU member states adjust to the competitive pressure of emerging countries? What was the contribution of sectoral and geographical composition of EU exports to the observed difference of performance compared to the United States and Japan?

Assessing competitiveness accurately is a challenging issue as most of the action is taking place on the front of non-price competitiveness and is potentially affected by the products or destination markets exporters specialize in. More fundamentally, the effective demand introduced into macroeconomic equations is by construction missing the sectoral or product dimension. Quality positioning, sectoral specialization and geographical orientation of exports all contribute to the observed changes in market shares.

Our aim in this article is firstly to properly measure the contributions of product or geographical specialization of exporters to the observed changes in market shares. Product-level international trade data does not include services, we thus focus only on trade in goods. Secondly, we aim to examine how top-end and high-tech products from developed countries resisted to the increasing pressure of low wage exporting countries. Precisely, we develop firstly an econometric *shift-share decomposition of export growth* that identifies for each exporter the contribution to the intensive margin of (i) the composition of its exports by product and destination and (ii) its competitiveness. Accordingly, export growth for each country is broken down into three components: a geographical composition effect, a sectoral composition effect and an exporter effect capturing other sources of country's export performance, including competitiveness. Our second attempt, in line with a now abundant literature, is to measure export performance at the level of the (vertically differentiated) variety of traded products (Schott 2004; Hallak 2006; Baldwin and Ito 2008; Fontagné et al. 2008; Manova and Zhang 2012; Khandelwal 2010; Hallak and Schott 2011). We also evaluate the performance of exported high-tech products. We adopt the viewpoint of an integrated European market and reconstruct world trade excluding intra-EU trade flows. The latter are considered as "intranational" trade.[1]

[1] 67 % of EU-27 exports are within the Single European Market, where most European countries record larger market shares thanks to better market access.

The method we use yields several improvements with respect to the standard Constant Market Share (CMS) decomposition found in the literature (Tyszynski 1951; Richardson 1971a, b; Bowen and Pelzman 1984; Fagerberg 1988).[2] First, the econometric approach makes it possible to eliminate the non-orthogonality of product and market structure effects in standard CMS analyzes, responsible for the fact that the order of the decomposition changes the results. Second, the competitiveness effect is estimated rather than computed as a residual of the analysis. In addition, we are able to identify confidence intervals for each product, market and exporter effect. Unlike the standard approach, our methodology enables us to obtain results (effects) that are additive over the time dimension and thus take stock of changes in countries' initial export structure.

To proceed, it is necessary to utilize very detailed and longitudinal trade data, covering all countries, including information on bilateral trade unit values. To this end, we make use of a database of international trade at the product level—BACI—developed by Gaulier and Zignago (2010). BACI provides (FOB) reconciled values, as well as unit values (values/quantities), of all international trade flows for about 5,000 product headings from the 6-digit Harmonized System classification (hereafter HS6)—since 1994. We consider all traded products, i.e. the primary and manufacturing sectors, with the exception of mineral products, notably oil, as well as some specific and non-classified sectors. The availability of unit values enables us to classify flows by price range and thus to analyze the positioning of exporters by price segment. We employ these data to examine changes in market shares of leading world exporters over the period 1995–2010. The *world distribution of unit values for each HS6 heading* allows us to classify each product-bilateral flow into three price segments, in line with Fontagné et al. (2008), and examine competition within top-range products. Our dataset enables also to describe changes in market shares for high-tech products.

In the context of a major reshaping of world trade flows since the mid-1990s, we conclude that the redistribution of market shares observed between emerging and developed countries and among developing countries themselves has affected the EU, Japan and the United States differently. European market share losses mostly concern long-standing Member States. The EU's overall good performance over the 1995–2010 period—compared to the United States or Japan—is associated with an original price-quality positioning of its products. However, this original market positioning of EU exporters only partially cushioned the impact of the crisis. All market share losses recorded by the EU since 2000 were recorded over the last three years.

The rest of the paper is organized as follows. We review the redistribution of world market shares in Sect. 2, with a focus on high-tech and top-range products. Our econometric shift share analysis of export growth is implemented in Sect. 3. Section 4 summarizes our conclusions.

[2] Alternative measures of country competitiveness have been used in the literature: comparative advantage, specialization or productivity indicators, cost of leaving indices (Fagerberg 1988; Neary 2006; Delgado et al. 2012).

2 The redistribution of world market shares between 1995 and 2010

The objective of this section is to take stock of the recent shifts in world market shares, taking into account the price segment and technological content of exported products at the most detailed available level of classification of traded products. We firstly characterize the extensive and intensive margins of world trade, then we examine what have been the big changes in market shares, and we conclude with a focus on top-range and high-tech products.

2.1 Changes in trade margins

Trade can increase either by exchanging a larger value of already traded products between the same partners (the intensive margin of trade), or by increasing the number of involved countries and/or exchanged products (the extensive margin of trade). The former refers to the change in the value of existing trade flows, while the latter refers to the change in the composition of trade flows. The entry of new competitors is reflected in the margins of world exports at the most disaggregated level of the product classification.[3] Hummels and Klenow (2005) use a cross-section of detailed trade data to identify the patterns of exports of 126 countries in 1995, and find that 60 % of large economies' export growth is attributable to shipments of a wider set of goods and the remaining 40 % to larger quantities and higher prices of each good already shipped.

We adopt a similar approach but use the most detailed trade data compatible with an exhaustive set of exporters to compute the two margins for the whole matrix of trade flows.[4] Drawing on information by product, market, exporter, and year, we compute the *extensive margin* of trade, as the change in the *number* of trade flows at the most detailed level, or as the *net value* of appearing and disappearing trade flows. Symmetrically, the *intensive margin* of trade is defined as the change in the value of trade flows that are present continuously throughout a given period. While a rapid turnover of trade flows can be observed—in a world matrix mostly full of zeros—the largest contribution to the growth in the world trade value has been on the intensive margin.

To compute these margins (Table 1), we use BACI data from 1995 to 2010 and exclude mineral products, specific and non-classified products.[5] The observed USD 5,983 bn 1995–2010 increase in world trade (column 3) can be decomposed into three components. Firstly, the 1.5 million elementary bilateral trade flows recorded

[3] The extensive margin of exports so defined should not be confused with the heterogeneous firms settings where trade introduces a selection between firms, as well as, in case of multi-product firms, a selection within the portfolio of products of each exporter.

[4] Hummels and Klenow (2005) draw on HS6 data on exports in 1995 by 110 countries to 59 importers. Alternatively, they use United States imports from 119 countries in over 13,000 10-digit United States tariff lines for the same year. Our approach also differs from Besedes and Prusa (2011) who integrate the time dimension into the analysis of export growth and breakdown the intensive margin into a survival and a deepening component.

[5] We exclude HS chapters 25, 26, 27, 97, 98, and 99, as well as intra-EU flows, all throughout this paper, as detailed in Sect. 6.1 in the "Appendix".

Table 1 Extensive and intensive margins in world trade, 1995–2010

	Unit	1995	2010	Δ	Intensive	Extensive		
						Entries	Exits	Net
		(1)	(2)	(3) = (2)–(1)	(4)	(5)	(6)	(7) = (5)–(6)
Value	USD bn	3,179	9,163	5,983	4,773	1,533	324	1,209
Number of flows	Thousands	2,345	3,683		1,453	2,229	892	1,338

Source: Authors' calculations using BACI values (current USD) of traded goods. Data is at the HS 6-digit level. Our panel combines all trade flows, excluding intra-EU trade and mineral, specific, and non-classified products, as well as trade with non-independent territories, micro-states and small value flows (<10,000 USD). Figures are in billion dollars and in thousands of HS6 bilateral flows. Column (3) shows the 1995–2010 increase in aggregate trade, which decomposes in an intensive margin—column (4)—and a (net) extensive margin—column (7)—of trade

in 1995 and still in place in 2010 (second line of Table 1) have increased their value by USD 4,773 bn. Accordingly, the intensive margin accounted for 79.8 % of the change in the value of world trade (ratio of column 4 to column 3). Secondly, over one third of 1995 trade flows (0.89 million flows) have disappeared by 2010. This is the result of firms and countries ceasing trade with certain markets or certain products. In 1995 these trade flows amounted to USD 324 bn. Lastly, 2.23 million new country-partner-product trade flows appeared during the period, corresponding to the positive extensive margin of trade. This is a very large number, comparable to the number of initial trade flows. Overall, only 39.5 % of the number of trade flows recorded in 2010 were already present in 1995. The remaining 60.5 % are new flows (column 5) either in terms of destination, exported products, or both. Meanwhile, the contribution of new entries to the 1995–2010 growth of trade in value terms amounted to only 25.6 %. Exits (column 6) account for 38.0 % of the number of 1995 flows but only for 10.2 % of their value.

The contribution of the different margins of trade can be computed for individual large exporters. Table 10 in the "Appendix" compares the EU to other large exporters from the developed and the developing world. Computations are performed at the country level. For ease of presentation, in Table 10 and in the rest of the paper, results for countries that account for <1 % of world exports from 1995 to 2010 are aggregated within three groups—Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for these three regions and all individual countries are available in our online appendix.[6] We observe that the contribution of the positive extensive margin (entries) to the growth of the value of exports is very similar for the developed economies (at most 4 %). This points to the pronounced inertia in the exports of the advanced economies, particularly the Japanese, German and United States exports. Their trade growth is mainly accounted for by expansion in existing markets (at least 99 % for these countries). The contribution of the positive extensive margin is conversely larger for developing and emerging economies. On average, the

[6] Zipped file at the working paper version webpage of this work.

Table 2 Changes in world market share for the world's largest exporters, 1995–2010

Exporter	Market shares (%)			Δ,p.p.	
	1995 (1)	2007 (2)	2010 (3)	1995–2010 (4)	2007–2010 (5)
EU-27	20.6	19.4	18.0	−2.61	−1.40
France	2.8	2.3	2.2	−0.63	−0.11
Germany	5.6	5.5	5.3	−0.34	−0.23
Italy	2.7	2.3	2.0	−0.70	−0.29
United Kingdom	2.8	2.0	1.8	−1.03	−0.24
Euro Area	15.7	14.9	13.8	−1.85	−1.04
United States	18.3	13.1	11.9	−6.44	−1.18
Japan	14.2	8.9	8.5	−5.75	−0.43
Canada	5.3	3.9	3.0	−2.23	−0.81
Switzerland	2.8	2.3	2.4	−0.42	0.13
China	6.3	15.6	17.8	11.50	2.23
Brazil	1.4	1.7	1.7	0.23	−0.05
India	1.1	1.7	2.1	0.98	0.35
Indonesia	1.2	1.2	1.3	0.10	0.04
Korea	3.8	4.4	4.7	0.90	0.37
Malaysia	2.4	2.1	2.1	−0.29	−0.01
Mexico	2.2	2.8	2.8	0.60	0.01
Taiwan	3.7	3.6	3.5	−0.24	−0.12
Singapore	2.8	2.0	2.1	−0.66	0.09
Thailand	1.8	1.9	2.2	0.38	0.24

Source: Authors' calculations using BACI values (see footnote of Table 1 and the data "Appendix" 6.1). The change in market shares is given in percentage points (p.p.). Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

contribution of new flows in export growth for countries not reported in Table 10 is 34.4 %, clearly in excess of the individual exporters reported in the Table. The lowest shares among emerging countries are observed for China and Mexico, which show a structure of export growth similar to the developed exporters. China confirms the magnitude of the increased intensive margin, but the diversification of its exports was already accomplished in 1995 (China ships roughly as many different products as Germany).[7]

In Sect. 3 we decompose the intensive margin of exports using an econometric shift-share methodology.

[7] Wang and Wei (2010) use export at product level for different Chinese cities and point to the role of human capital and government intervention in shaping a specialization that increasingly overlaps with that in high-income countries.

2.2 EU market shares compared with main world exporters

In Table 2, we summarize the recent shifts in world market shares as follows. The first three columns give the market share in 1995, before the trade collapse (2007), and for the end period of our analysis (2010). In the two subsequent columns, we report the percentage point changes in market shares for the whole period and for the crisis sub-period (2007–2010).

The most remarkable development in Table 2 is that China has more than doubled its world market share (in 2010 its market share was 2.8 larger than in 1995), becoming a larger world trader than the United States, with 17.8 % of the world market. In 1995, EU-27 had a 20.6 % market share of the world trade in goods (excluding intra-EU flows). This market share has been only slightly affected by competitive pressures from emerging economies until the crisis, falling to 19.4 % in 2007. EU countries benefitted less than other developed countries from the recovery of world trade, losing 1.4 percentage points (p.p.) of the world market from 2007 to 2010. Over the entire period, Japan and the United States lose around 6 p.p. of market share each, being more seriously affected by the eleven-point rise in China's share. This result is in line with Husted and Nishioka (2013) CMS decomposition, which shows that China's share growth has come largely at the expense of exporters based in Japan and the United States over the 1995–2010 period.

This redistribution of market shares must be gauged against the evolution of the euro-US dollar exchange rate. In Fig. 1 we plot the evolution of world market shares for selected exporters over the period 2000–2010, and the exchange rate against the dollar. Despite the appreciation of the euro, the early 2000s were a period of partial recovery for the EU's exports, with most of its previous losses recuperated. Among other industrialized countries, Japan continued to lose market shares in a period of exchange rate appreciation. The decline of the UK market share went in line with an appreciation of the pound until 2007, with no correction when the exchange rate evolution reversed. The dramatic increase in the market share of China was accompanied by a moderate appreciation of its currency. The appreciation of the Brazilian real since the mid-2000s led to the stagnation of country's market share around its 2004–2005 level. Lastly, market shares increased for India with no connection to the exchange rate. Finally, until the crisis, we observe a uncorrelated evolution of market shares and exchange rates, magnified for the EMU.

We already noticed that EU market shares were severely affected by the crisis, with half of the 1995–2010 losses concentrating on the year 2010. With this noteworthy exception, the economic crisis has not profoundly changed the redistribution of world market shares among global exporters. The last column of Table 2 gives the percentage point change in the three-year-period 2008–2010, covering the great trade collapse. The long-run trends above mentioned seems to be confirmed: China's performance (+2.2 p.p. gain in world market share between 2007 and 2010) contrasting with the downward trend of United States market shares (−1.2 p.p. respectively). The next sub-section details the technological dimension of larger exporters specialization and addresses another dimension of international competition: performances differ within categories of products according to the

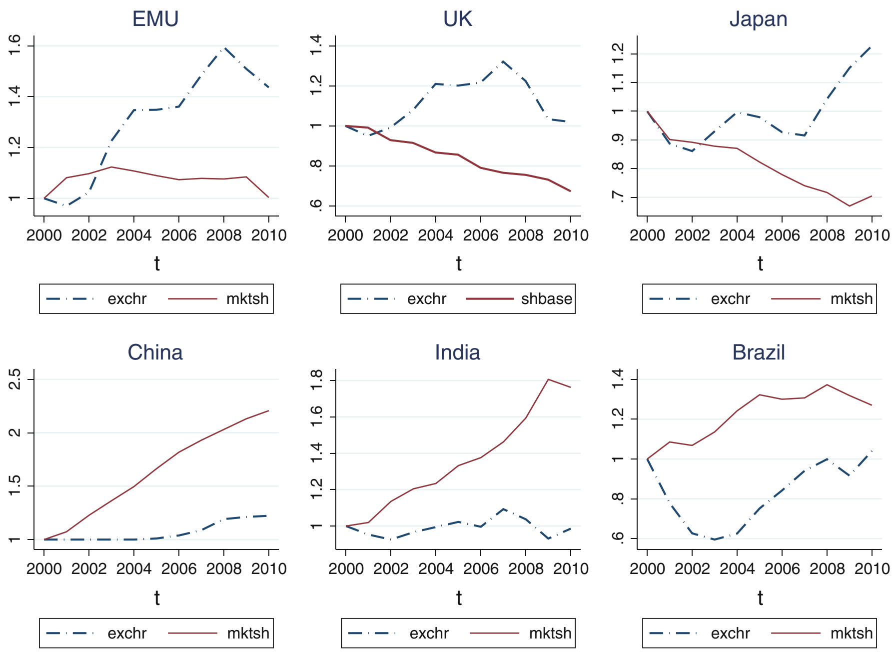

Fig. 1 Evolutions in world market shares and exchange rates, 2000–2010. *Source*: Authors' calculations using BACI values (current USD) of traded goods. Oil and intra-EU trade is excluded. BEA exchange rates against USD

market positioning of varieties. This turns to be fundamentally important for European exporters.

2.3 Performances in high-tech and top-range products

High-tech and top-range products play an important role in international competition, since they are basically the output of innovation and the source of rents. Leamer (1987) pioneered the idea that what one exports matters. Hausmann et al. (2007) went one step further by characterizing the proximity of specialization between advanced and emerging countries at the HS6 product level. They show that the "income level of a country's exports" is a determinant of subsequent growth.

We first focus here on high-tech products and use the classification proposed by Lall (2000). Sectors are classified into primary products, resource-based manufactures, low, medium and high-technology manufactures, and other transactions. The high-tech category comprises electronics and electrical products, as well as pharmaceutical products, aerospace, optical and measuring instruments, cameras, etc. (see Table 9 in the "Appendix" for the sectors classified in the other categories).

Countries' positioning in high-tech products are reported in the first two columns of Table 3. The first one gives the world market shares for high-tech products in 2010, the second one their change in percentage points over the period 1995–2010.

Table 3 Change in world market shares for high-tech and top-range products, 1995–2010

Exporter	High-tech products		Top-range	
	2010 % (1)	95–10 p.p. Δ (2)	2010 % (3)	95–10 p.p. Δ (4)
EU-27	16.2	−0.27	26.7	−2.80
France	2.9	−0.34	3.2	−0.84
Germany	4.3	0.27	8.0	−1.84
Italy	1.1	−0.14	2.8	−0.33
United Kingdom	1.8	−1.24	2.8	−0.95
Euro Area	12.0	0.25	20.9	−2.22
United States	12.0	−11.36	12.6	−5.44
Japan	7.6	−12.06	11.5	−7.75
Canada	1.6	−1.06	1.9	−0.96
Switzerland	2.6	0.18	4.8	−0.33
China	23.8	18.93	9.7	6.92
Brazil	0.5	0.23	1.1	0.27
India	0.9	0.70	1.4	0.95
Indonesia	0.5	0.20	0.9	0.03
Korea	6.7	1.43	3.3	0.25
Malaysia	4.1	−0.54	1.9	0.59
Mexico	3.2	1.07	1.6	0.71
Taiwan	7.5	2.06	3.2	1.34
Singapore	4.0	−2.95	2.9	0.02
Thailand	2.3	0.19	1.9	0.40

Source: Authors' calculations using BACI data (see footnote of Table 1 and the data "Appendix" 6.1). The change in market shares is given in percentage points (p.p.). Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

The EU has lost −0.27 p.p. of market share in high-tech products, i.e. less than the loss of −1.40 p.p. for all products (column 4 of Table 2). The United States and Japan, on the other hand, recorded much larger losses for high-tech products than on average (respectively −11.4 p.p. vs. −6.4 p.p. for the United States, and −12.1 p.p. vs. −5.8 for Japan). In the meantime, Chinese gains are very large on the high-tech market (18.9 p.p.), due to a massive relocation of the assembly of these products to mainland China.

Besides some similarity in terms of exported product categories between developed and developing countries (e.g. Germany and China), trade flows with persistently dissimilar prices can be observed within the most narrowly defined products. Though high-income and emerging economies export quite similar bundles of goods, they actually compete within industries, on different price-quality ranges (Schott 2004, 2008; Fontagné et al. 2008). Hence, specialization occurs within these categories, on vertically differentiated varieties of products. However, quality is not directly observable. Hallak (2006) refers to product quality as a demand shifter that captures all the attributes of a product valued by consumers. Conditional on price, a higher quality increases income share spent on a given variety. Using this definition, he finds that cross-country variation in unit values can be attributed to differences in quality. Competitiveness ultimately depends upon the quality-adjusted price (Baldwin and Harrigan 2011). Baldwin and Ito (2008) classify products according to the related market structures (price competition vs. quality competition) for nine big exporters in the period 1997–2006. Estimating the price-distance relationship separately for each product, they observe more "quality-competition goods" in EU exports than in United States and Japanese exports, and a very low share of "quality-competition goods" in Chinese exports. Unit values can reflect not only quality but also costs (Khandelwal 2010). Idiosyncratic preferences for products' horizontal attributes may also lead to exports of goods of the same quality at different prices. Finally, export prices may vary for reasons other than quality or costs (Hallak and Schott 2011). Accordingly, our approach consists in examining changes in market shares by price range and uses the method developed in Fontagné et al. (2008). If a country's exports are in the high price range but exhibit quality that does not justify such pricing, market shares will shrink. Finally, we decompose each bilateral value (X_{ijkt}) across an additional dimension s, corresponding to the market segment ($s = bottom, mid, top$).

Implementing this procedure, we observe the market positioning of exported products depicted in the last two columns of Table 3. Columns 3 and 4 give the world market shares in 2010, and their change in percentage points over the period 1995–2010 for the upper three market segment. EU's leadership for top-range exports is ascertained, with almost 27 % of the world market. The EU market share in top-range products is 50 percent higher than per total. The United States and Japan exhibit a quite different pattern, with losses of respectively 30 and 40 % of their 1995 market share for top-range products. The resilience of the EU market share for top-range products is also remarkable, with only 9 % of its initial market share being lost over the whole period.

The evidence provided so far is purely descriptive. We cannot identify the pure performance of exporting countries on this basis, as changes in market shares can be also driven by composition effects. The next section aims to disentangle composition effects from pure competitiveness. This is done for different ranges of vertically differentiated varieties of traded products.

3 Contribution of competitiveness to changes in market shares

This section aims to identify the contributions to export growth: what are the product and market composition effects and what stems from pure competitiveness? One of the simplest ways to investigate growth rates is the *shift-share* approach, also known as the constant market share (CMS) analysis or structural decomposition. Fabricant (1942) and Maddison (1952) were among the first to formalize the shift-share decomposition, which was extensively used afterwards. Although employed mainly in regional studies on employment and productivity growth, this technique has been successfully extended to international trade issues over the last six decades (Tyszynski 1951; Richardson 1971a, b; Fagerberg 1988). The method has been extensively used in country-level competitiveness studies (Laursen 1999; Wörz 2005; Brenton and Newfarmer 2007).

Instead of following this traditional decomposition, we adopt an econometric approach, taking advantage of the data disaggregation. In addition, in order to capture variations across time, we focus on the sum of annual growth in each trade flow rather than on the increase in its value between the first and last year of the considered period. Our method is therefore constrained by the observation of the same flow in two consecutive years (necessary for computing annual growth rates). The 32.8 million HS6 flows that satisfy these condition account for a trade growth of bn USD 5,653. This figure does not include trade flows created (bn USD 2,468) or that disappeared (bn USD 2,137) during the period, and is larger than the intensive margin in Table 1. As previously, market positioning in terms of technology or quality is computed from HS6 level data. However, in order to capture even more trade flows in the intensive margin, the decomposition of export growths is performed on data aggregated to the 2-digits level of the HS classification (this leads to an increase in the intensive margin from bn USD 5,653 to bn USD 5,857).

3.1 The traditional shift share decomposition

In the field of international trade, the CMS or shift-share analysis aims to measure the contribution of countries' geographical and sectoral specialization to the growth of their exports. Since the analysis is performed on export growth, only the intensive margin of trade is explained. The traditional method is simply to compute the contribution of the initial geographical and sectoral composition of exports to changes in market shares. The remaining proportion of the change is attributed to pure performance (i.e. price and non-price competitiveness).

The traditional CMS is based on an algebraic decomposition of the total exports growth of a country (or a region) during a given time period. Four contributions are identified, namely world trade growth, growth in exports of individual products (sectoral effect), growth in imports of specific markets (geographical effect), and a residual performance of the exporter. The following equation gives this identity:

$$X_i^t - X_i^{t-1} = r^t X_i^{t-1} + \sum_k \left(r_k^t - r^t\right) X_{ik}^{t-1} + \sum_{jk} \left(r_{jk}^t - r_k^t\right) X_{ijk}^{t-1} + \sum_{jk} \left(X_{ijk}^t - X_{ijk}^{t-1}\left(1 + r_{jk}^t\right)\right) \quad (1)$$

where i denotes the exporter, j the importer, k the product or sector, t the time period, r the global annual growth rate of exports for all countries in the sample except i, r_k^t the global growth rate of product k exports, and r_{jk}^t the global growth rate of exports of product k to country j. Let S_{ik} and S_{ijk} denote the shares of corresponding export flows in world trade, and market share growth rates g^t, g_k^t, g_{jk}^t be defined analogously to export growth rates r, r_k, r_{jk}. When market shares are considered instead of export growths, as is the case in this study, the CMS decomposition has three RHS components rather than four.[8]

$$S_i^t - S_i^{t-1} = \sum_k \left(g_k^t\right) S_{ik}^{t-1} + \sum_{jk} \left(g_{jk}^t - g_k^t\right) S_{ijk}^{t-1} + \sum_{jk} \left(S_{ijk}^t - S_{ijk}^{t-1}(1 + g_{jk}^t)\right) \quad (2)$$

The decomposition of market share growth rates is obtained by dividing the left- and right-hand side of Eq. (2) by the exporter's initial share, S_i^{t-1}:

$$\begin{aligned} g_i^t &= \frac{S_i^t - S_i^{t-1}}{S_i^{t-1}} \\ &= \sum_k \left(g_k{}^t\right) \frac{S_{ik}^{t-1}}{S_i^{t-1}} + \sum_{jk} \left(g_{jk}^t - g_k^t\right) \frac{S_{ijk}^{t-1}}{S_i^{t-1}} + \sum_{jk} \left(\frac{S_{ijk}^t}{S_i^{t-1}} - \frac{S_{ijk}^{t-1}}{S_i^{t-1}}(1 + g_{jk}^t)\right) \end{aligned} \quad (3)$$

The three terms of Eq. (3) correspond respectively to the the sectoral structure, geographic structure and export competitiveness (performance) effects and are computed for each exporting country i. The decomposition for the entire period is obtained as the product of annual structural and performance effects:[9]

$$g_i = \prod_t \left[1 + g_i^t\right] - 1 = SECT_i + GEO_i + PERF_i \quad (4)$$

A correction term e_i is needed to ensure the equality of left- and right-hand side expressions on Eq. (4).[10] We assimilate this term to the performance effect $PERF_i$. This is in accordance with the convention of the traditional CMS approach of computing export performance as the residual growth rate after deducing the contribution of structural effects. Alternatively, the market share evolution over the entire period can be decomposed into a product of three terms:

$$g_i = (1 + SECT_i) \times (1 + GEO_i) \times (1 + PERF_i^\star) - 1 \quad (5)$$

In this case country's export performance is computed slightly differently,[11] and includes again a correction term v_i.

Such structural decomposition has a major drawback: results are sensitive to the order in which the composition effects are considered. Computing sectoral effects first and geographical effects afterwards and *vice versa* yields different results. Reversing the order of sectoral and geographic structure terms in Eq. (2) yields different amounts for the two effects, but leaves almost unaltered the export competitiveness residual:

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[8] The term $g^t\ S_i^{t-1}$ vanishes because $g^t = 0$.

[9] $SECT_i = \prod_t \left[1 + \sum_k \left(g_k{}^t\right)\left(S_{ik}^{t-1}/S_i^{t-1}\right)\right]$, $GEO_i = \prod_t \left[1 + \sum_{jk} \left(g_{jk}^t - g_k^t\right)\left(S_{ijk}^{t-1}/S_i^{t-1}\right)\right]$,
$PERF_i = \prod_t \left[1 + \sum_{jk} \left(\left(S_{ijk}^t/S_i^{t-1}\right) - \left(S_{ijk}^{t-1}/S_i^{t-1}\right)(1 + g_{jk}^t)\right)\right] + e_i - 1.$

[10] See footnote 9.

[11] $PERF_i^\star = \prod_t \left[1 + \sum_{jk} \left(\left(S_{ijk}^t/S_i^{t-1}\right) - \left(S_{ijk}^{t-1}/S_i^{t-1}\right)(1 + g_{jk}^t)\right)\right] * v_i.$

Table 4 CMS decomposition of world market share evolutions, 1995–2010, all products: sectoral effects computed first

	Change in market share % Δ (g_i)	Contribution of			
		Structure effects		Performance	
		Sectoral ($SECT_i$)	Geographic (GEO_i)	Additive ($PERF_i$)	Multipl. ($PERF_i^{\star}$)
	(1)	(2)	(3)	(4)	(5)
EU-27	−11.3	3.4	6.2	−20.9	−19.2
France	−21.5	2.7	1.4	−25.5	−24.6
Germany	−4.0	1.7	5.9	−11.6	−10.9
Italy	−24.9	−1.4	7.0	−30.5	−28.8
United Kingdom	−35.8	7.5	4.5	−47.8	−42.8
Euro Area	−10.1	2.8	5.6	−18.5	−17.2
United States	−33.7	1.0	−4.6	−30.1	−31.2
Japan	−39.0	1.1	1.9	−42.0	−40.8
Canada	−41.1	−7.0	−16.4	−17.6	−24.2
Switzerland	−13.3	14.5	−2.4	−25.4	−22.4
China	188.5	−5.9	−5.7	200.1	225.0
Brazil	13.4	−9.4	−5.7	28.5	32.7
India	90.3	−0.5	7.4	83.4	78.1
Indonesia	9.9	−8.1	−2.5	20.4	22.5
Korea	25.6	0.7	0.9	24.0	23.6
Malaysia	−11.0	0.6	−5.4	−6.2	−6.5
Mexico	30.0	0.1	−19.7	49.5	61.7
Taiwan	−7.5	0.0	10.2	−17.7	−16.1
Singapore	−21.5	2.5	7.2	−31.2	−28.6
Thailand	24.0	−4.2	4.4	23.8	24.0

Source: Authors' calculations using all trade flows existing in any two consecutive years in the considered period (see the data "Appendix" 6.1). The computation is performed at the 2-digit level of the HS. All figures are expressed in terms of percentage change in market share. Results for all individual countries not shown here are available in the online appendix. The four columns correspond to g_i, $SECT_i$, GEO_i, $PERF_i$, and respectively $PERF_i^{\star}$, in Eqs. (4) and (5). All figures are expressed as percentages of the initial market share. The following identities hold: $g_i = SECT_i + GEO_i + PERF_i$; $g_i = (1 + SECT_i) \times (1 + GEO_i) \times (1 + PERF_i^{\star}) - 1$

$$S_i^t - S_i^{t-1} = \sum_j \left(g_j{}^t\right) S_{ij}^{t-1} + \sum_{jk} \left(g_{jk}^t - g_j^t\right) S_{ijk}^{t-1} + \sum_{jk} \left(S_{ijk}^t - S_{ijk}^{t-1}\left(1 + g_{jk}^t\right)\right) \quad (6)$$

Table 4 displays results of the traditional CMS decomposition, with sectoral structure effects computed first. Calculations were performed at the 2-digit level of the HS, on the intensive margin only: we use all trade flows existing in any two consecutive years in the considered period. Flows associated with HS sections 25, 26, 27, 97, 98, 99, tiny values (below USD 10,000), non-independent territories and micro-states were excluded. In the first column we show the percent change in the market share computed on the intensive margin over the 1995–2010 period for our selected sample of countries (e.g. −11.3 % for the EU). The subsequent columns show the performance effect computed alternatively using an additive decomposition for the entire period as in Eq. (4) and for the multiplicative approach in Eq. (5). The last two columns show the geographic and sectoral effects when the role of the sectoral composition is computed first. The sectoral effect is positive (+3.4 %) for the EU, but much weaker than the geographic effect (resp. +6.2 %).

Table 5 displays results of the traditional CMS decomposition, but with geographic structure effects computed first. The three first columns are indeed identical to the first columns of Table 4. However, we obtain very different magnitudes for geographic and sectoral effects. In the EU case, the sectoral effect is

Table 5 CMS decomposition of world market share evolutions, 1995–2010, all products: geographic effects computed first

	Change in market share	Contribution of			
		Structure effects		Performance	
	% Δ (g_i) (1)	Geographic (GEO_i) (2)	Sectoral ($SECT_i$) (3)	Additive ($PERF_i$) (4)	Multipl. ($PERF_i^{\star}$) (5)
EU-27	−11.3	4.6	5.0	−20.8	−19.2
France	−21.5	5.2	−1.1	−25.7	−24.6
Germany	−4.0	4.5	3.2	−11.6	−10.9
Italy	−24.9	6.1	−0.5	−30.4	−28.8
United Kingdom	−35.8	1.5	10.6	−47.9	−42.8
Euro Area	−10.1	4.5	3.9	−18.5	−17.2
United States	−33.7	−3.0	−0.6	−30.1	−31.2
Japan	−39.0	1.9	1.1	−42.1	−40.9
Canada	−41.1	−16.3	−7.1	−17.7	−24.3
Switzerland	−13.3	2.0	9.7	−25.0	−22.5
China	188.5	−10.1	−1.3	199.9	225.2
Brazil	13.4	1.9	−16.1	27.6	32.6
India	90.3	7.3	−0.4	83.4	78.0
Indonesia	9.9	−0.9	−9.7	20.4	22.7
Korea	25.6	7.7	−5.7	23.6	23.7
Malaysia	−11.0	−5.1	0.3	−6.2	−6.5
Mexico	30.0	−17.0	−3.3	50.3	62.0
Taiwan	−7.5	13.1	−2.7	−17.9	−15.9
Singapore	−21.5	8.0	1.6	−31.1	−28.5
Thailand	24.0	−0.7	0.8	24.0	24.0

Source: Authors' calculations using all trade flows existing in any two consecutive years in the considered period (see the data "Appendix" 6.1). The computation is performed at the 2-digit level of the HS. Results for all individual countries not shown here are available in the online appendix. All figures are expressed in terms of percentage change in market share. The four columns correspond to g_i, GEO_i, $SECT_i$, $PERF_i$, and respectively $PERF_i^{\star}$, in Eqs. (4) and (5). All figures are expressed as percentages of the initial market share. The following identities hold: $g_i = GEO_i + SECT_i + PERF_i$; $g_i = (1 + GEO_i) \times (1 + SECT_i) \times (1 + PERF_i^{\star}) - 1$

now larger than the geographic effect, as opposed to the former decomposition. Even the sign of the effects for a given country can be reversed. For the United States, the sectoral effect is positive when the sectoral effects are computed first, but becomes negative when geographic effects are computer first.

3.2 The econometric shift-share approach

Considering the shortcomings of the traditional method, we rely on an alternative shift-share methodology, based on econometrics, proposed by Cheptea et al. (2005), which is a further development of the weighted variance analysis of growth rates of Jayet (1993).[12] Similarly to the traditional CMS, the aim of this method is to ultimately decompose the growth of each country's world market shares into three terms: a geographical structure effect, a sectoral effect, and an exporter-effect which represents the exporter's performance. But contrary to the traditional approach, it relies on econometrics rather than on simple algebra. To compute country-level structural and performance effects, we first explain the growth rate of each individual trade flow (from each exporter to each importer for a given product and year) and, in a second step we aggregate results at the exporter level.

Let w^t denote the average weight of a flow in world trade in years $t-1$ and t: $w^t_{ijk} = \frac{1}{2}\left(\frac{X^{t-1}_{ijk}}{X^{t-1}} + \frac{X^t_{ijk}}{X^t}\right)$ and $w^t_i = \frac{1}{2}\left(\frac{X^{t-1}_i}{X^{t-1}} + \frac{X^t_i}{X^t}\right)$. The bilateral and sectoral export growth rates are regressed on dummies identifying exporters (i), importers (j) and HS2 groups of products (k) with weighted (by w^t_{ijk}) OLS:

$$\ln\left(\frac{X^t_{ijk}}{X^{t-1}_{ijk}}\right) = \alpha^t_i + \beta^t_j + \gamma^t_k + \varepsilon^t_{ijk}. \qquad (7)$$

where X represents the value of exports, β^t_j and γ^t_k capture the contribution of the average global geographical and product trade structure in year t to the annual growth rate of exports between $t-1$ and t, and α^t_i is the amount of growth in t that can be attributed to the export performance of country i. One of the advantages of the econometric shift-share approach, with respect to the traditional approach, is the estimation of standard errors for each effect, which can be used to predict the statistical significance of country-level export performance and structural effects. We suggest two methods for computing standard deviations for each term of the above decomposition as detailed in Sect. 6.3 We decided to rely on the Delta method providing with more accurate standard errors, though imposing more computational constraints.

The shift-share decomposition is performed for each year between 1995 and 2010. We thus estimate fifteen annual effects for each exporter, importer and product.[13]

Unlike Cheptea et al. (2005), the growth rate of country i's exports is computed here as the logarithm of the Törnqvist index of its exports of each product k to each

[12] The traditional shift-share analysis is actually a constrained and imperfect version of regression and variance analysis techniques.

[13] Equation (7) is estimated for 1995–1996, 1996–1997, …, 2009–2010 growth rates. Data on 1994 flows are used to compute weights w^{1995}_{ijt} and w^{1995}_i and as reference for obtaining results in volume terms (Table 11 of the "Appendix").

partner j.[14] The annual growth of country i's exports in period t is obtained as an approximation of the true logarithmic change in its exports:

$$d \ln X_i^t = \ln\left(\frac{X_i^t}{X_i^{t-1}}\right) \approx \sum_{jk} \frac{w_{ijk}^t}{w_i^t} \ln\left(\frac{X_{ijk}^t}{X_{ijk}^{t-1}}\right). \tag{8}$$

Thus, we express the growth of country i's exports as a weighted average of the logarithmic change in its exports of each product k to each partner j.[15]

Combining Eqs. (7) and (8), we can express the overall growth of country i exports in terms of the three types of effects mentioned above:

$$d \ln X_i^t = \alpha_i^t + \sum_j \frac{w_{ij}^t}{w_i^t} \beta_j^t + \sum_k \frac{w_{ik}^t}{w_i^t} \gamma_k^t. \tag{9}$$

To reach Eq. (9) we use the fact that the weights of all flows involving exporting country i add up to the weight of its exports in world trade, $w_i^t = \sum_{jk} w_{ijk}^t$, and that the sample weighted average of the error term in (7) is equal to zero, $\sum_{jk} w_{ijk}^t \varepsilon_{ijk}^t = 0$.[16] Given the large size of our sample (over 200,000 observations per year), the identity established by (9) is almost unaltered if we replace the constant term, exporter, importer, and product effects by their OLS estimates.

Let hats indicate OLS-estimated coefficients in (7). When estimating (7), one importer and one product fixed effects is removed because of collinearity.[17] Therefore, $\hat{\alpha}_i^t$ is a measure of country i's 'pure' export growth relative to the omitted partner country and traded product. A measure of country i's effect independent of the choice of the omitted country is given by the *least square mean*, obtained by adding the intercept and the weighted mean of partner and product effects to the estimated effect:

$$\tilde{\alpha}_i^t = \hat{\alpha}_i^t + \sum_j w_j^t \hat{\beta}_j^t + \sum_k w_k^t \hat{\gamma}_k^t. \tag{10}$$

Note, that the weighted average of country-specific 'pure' export growth gives the growth rate of world trade: $\sum_i w_i^t \tilde{\alpha}_i^t = \sum_{ijk} w_{ijk}^t \ln\left(\frac{X_{ijk}^t}{X_{ijk}^{t-1}}\right) = d \ln X^t$. We employ the fact that the sum of weights across any dimension is equal to one $\left(\sum_i w_i^t = \sum_j w_j^t = \sum_k w_k^t = 1\right)$ to establish this result.

For similar reasons, we normalise the estimated importer and product effects. The new values are obtained by subtracting the weighted average of estimated effects from the parameters estimated originally: $\tilde{\beta}_j^t = \hat{\beta}_j^t - \sum_j w_j^t \hat{\beta}_j^t$ and

[14] The Törnqvist index is the weighted geometric average of the relative change between the current and base period where weights are the arithmetic average of the market shares in the two periods.

[15] Although at the exporter/importer/product level the difference between growth rates computed according to the two sides of the above equation may vary significantly, the weighted averages at the level of each exporter are very similar. For example for France the difference between the two weighted means represents at most 6 % of the largest of the two values. For Germany the difference is even smaller.

[16] The last constraint is implicitly imposed when estimating (7) with weighted OLS.

[17] Dropping the constant permits to keep all exporter fixed-effects.

$\tilde{\gamma}_k^t = \hat{\gamma}_k^t - \sum_k w_k^t \hat{\gamma}_k^t$. Note that with these notations Eq. (7) becomes $\ln\left(\frac{X_{ijk}^t}{X_{ijk}^{t-1}}\right) = \tilde{\alpha}_i^t + \tilde{\beta}_j^t + \tilde{\gamma}_k^t + \varepsilon_{ijk}^t$. The decomposition (9) can then be re-written as:

$$d \ln X_i^t = \tilde{\alpha}_i^t + \sum_j \frac{w_{ij}^t}{w_i^t} \tilde{\beta}_j^t + \sum_k \frac{w_{ik}^t}{w_i^t} \tilde{\gamma}_k^t. \quad (11)$$

The first right-hand side element of (11) represents the *export performance* of country i. The last two terms reflect the contribution of its exports structure by partner and product to the overall growth of its exports. We refer to them as the *geographical* and *sectoral structure* effects.

The decomposition of export growth is carried out separately for each year. Note that the sum of annual growth rates yields the change in the value of exports between the first and last year of the period. Therefore, results for the entire 1995–2010 period are obtained by adding together the different effects across years:

$$d \ln X_i^{95-10} \equiv \sum_t d \ln X_i^t = \sum_t \tilde{\alpha}_i^t + \sum_t \left(\sum_j \frac{w_{ij}^t}{w_i^t} \tilde{\beta}_j^t \right) + \sum_t \left(\sum_k \frac{w_{ik}^t}{w_i^t} \tilde{\gamma}_k^t \right). \quad (12)$$

Now, we can transpose this decomposition into a decomposition of changes in market shares. For this, we subtract from both the left and right-hand side expressions of (12) the logarithmic change in world exports over the period, computed as a Törnqvist index, $d \ln X^{95-10}$, and take the exponentials of the resulting expressions.[18] We obtain:

$$\begin{aligned} g_i^{95-10} &\equiv \exp\left(d \ln X_i^{95-10} - d \ln X^{95-10}\right) - 1 \\ &= (1 + Perf_i) \times (1 + Geo_i) \times (1 + Sect_i) - 1 \end{aligned} \quad (13)$$

where $Perf_i = \exp\left(\sum_t \tilde{\alpha}_i^t - d \ln X^{95-10}\right) - 1$, and Geo_i and $Sect_i$ are the exponentials of the last two terms of the right-hand side expression of Eq. (12) minus one. Note that $d \ln X_i^{95-10}$ and $d \ln X^{95-10}$ are approximations of true logarithmic changes in country and world exports obtained with the Törnqvist index.[19] Therefore, g_i^{95-10} in Eq. (13) is an approximation of the actual market share growth rate.[20]

Exporting countries have no influence on structural effects affecting their exports. These effects result from the growth in destination markets, given the geographical and sectoral composition of exports. In contrast, the performance effect is a true competitiveness effect. It indicates the degree to which the exporting country has been able to gain or lose market shares, after controlling for composition effects.

3.3 Econometric decomposition of changes in world market shares: all products

We now report the results of the shift-share analysis. We explain the annual growth of all trade flows existing in any two consecutive years and aggregate results in

18 Accordingly, we have $d \ln X^{95-10} \equiv \sum_t (d \ln X^t) = \sum_t \left(\sum_i w_i^t \, d \ln X_i^t\right)$.

19 $d \ln X_i^{95-10} \approx \ln\left(X_i^{2010}/X_i^{1995}\right)$ and $d \ln X^{95-10} \approx \ln\left(X^{2010}/X^{1995}\right)$.

20 Actual (true) market share growth rates are obtained as $\left(\frac{X_i^{2010}}{X^{2010}} - \frac{X_i^{1995}}{X^{1995}}\right) / \left(\frac{X_i^{1995}}{X^{1995}}\right)$.

terms of market shares over the period 1995–2010.[21] The estimation is performed at the 2-digit level of the HS: the 6-digit level does not give very different results, while the HS2 secures higher statistical significance of parameter estimates. However we continue to define unit values ranges and technological products at the HS6 level. The statistical significance of fixed effects is indicated in the tables of results (see "Appendix" for details on their computation).

Table 6 shows the differences between market shares considered in this section and those in Sect. 2. The first column in Table 6 reports the changes in market shares between 1995 and 2010 for both the intensive and extensive margin, as presented in Table 2 (e.g. the EU25 loses 2.6 p.p. of the world market shares). These amounts are computed as:

$$\frac{X_i^{2010}}{X^{2010}} * 100 - \frac{X_i^{1995}}{X^{1995}} * 100 \qquad (14)$$

The following three columns consider the change in world market shares by focusing on the intensive margins of trade only. Column (2) gives changes in original market shares attributed to the intensive margin computed on an annual basis (i.e. for flows existing in any two consecutive years). It is obtained by excluding the extensive margin from the first numerator:

$$\frac{\tilde{X}_i^{2010}}{X^{2010}} * 100 - \frac{X_i^{1995}}{X^{1995}} * 100 \qquad (15)$$

where $\tilde{X}_i^{2010} = X_i^{1995} + \sum_{t=1995}^{2010} \sum_{jk} \left(X_{ijk}^{t+1} - X_{ijk}^{t}\right) * \mathrm{I}\left[X_{ijk}^{t} \neq 0 \cap X_{ijk}^{t+1} \neq 0\right]$ and I[.] is an indicator variable (dummy) taking the value one when the condition under the brackets is verified and zero otherwise. Note that the difference between columns (1) and (2) is negligible for all countries. This indicates that the change in market shares for the intensive margin is a good proxy of the change in market shares computed from all trade flows.

Column (3) provides market share evolutions computed on the intensive margin only, i.e. using the exact sample on which we perform the shift-share analysis. Unlike in column (2), the global market in each year is defined as the sum of positive trade flows that do not vanish by the next year. Accordingly, evolutions in column (3) are obtained as follows:

$$\frac{\bar{X}_i^{2010}}{\bar{X}^{2010}} * 100 - \frac{\bar{X}_i^{1995}}{\bar{X}^{1995}} * 100 \qquad (16)$$

where $\bar{X}_i^{1995} = \sum_{jk} \left(X_{ijk}^{1995} * \mathrm{I}\left[X_{ijk}^{1995} \neq 0 \cap X_{ijk}^{1996} \neq 0\right]\right)$ and $\bar{X}_i^{2010} = \tilde{X}_i^{2010} - \sum_{jk} X_{ijk}^{1995} * \mathrm{I}\left[X_{ijk}^{1996} = 0\right]$.[22]

[21] As mentioned above and in the data "Appendix", we eliminate from our sample the noise associated with very small values (below USD 10,000), non-independent territories and micro-states, and drop HS sections 25, 26, 27, 97, 98, 99 (mineral, specific and non-classified products).

[22] $\bar{X}_i^{2010} = \bar{X}_i^{1995} + \sum_{t=1995}^{2010} \sum_{jk} \left(X_{ijk}^{t+1} - X_{ijk}^{t}\right) * \mathrm{I}\left[X_{ijk}^{t} \neq 0 \cap X_{ijk}^{t+1} \neq 0\right]$.

Table 6 Changes in world market shares for large exporters, 1995–2010: overall growth, intensive margin and *shift-share decomposition*

Exporter	Overall as in Table 2	Intensive margin			Shift-share		
		The global market defined as			Export performance	Structural effects	
		Σ all flows	Σ surviving flows[a]			Geographical	Sectoral
	p.p. (1)	p.p. (2)	p.p. (3)	% Δ (4)	% Δ (5)	% Δ (6)	% Δ (7)
EU-27	−2.61	−2.97	−2.19	−12.5	−25.7***	7.8***	9.2***
France	−0.63	−0.66	−0.56	−23.3	−37.8***	9.4**	12.7**
Germany	−0.34	−0.36	−0.13	−4.4	−19.8***	7.7***	10.7***
Italy	−0.70	−0.74	−0.65	−26.6	−28.7***	10.8**	−7.1***
UK	−1.03	−1.04	−0.96	−39.6	−49.7***	1.7***	18.0***
Euro Area	−1.85	−2.02	−1.42	−11.3	−24.2***	7.9***	8.4***
United States	−6.44	−6.48	−5.96	−34.9	−42.8***	4.4***	9.0***
Japan	−5.75	−5.76	−5.38	−41.2	−47.5***	3.2***	8.6***
Canada	−2.23	−2.26	−2.12	−41.6	−24.8***	−23.7*	1.6***
Switzerland	−0.42	−0.44	−0.33	−11.0	−27.0***	−2.9**	25.6
China	11.50	11.35	12.14	192.3	349.8***	−16.2***	−22.5**
Brazil	0.23	0.11	0.17	20.2	35.5***	−1.4	−10.1
India	0.98	0.89	0.98	94.2	122.4***	3.3**	−15.5*
Indonesia	0.10	0.06	0.12	12.4	52.0***	−6.2***	−21.1*
Korea	0.90	0.83	1.04	27.8	14.5***	11.2***	0.4***
Malaysia	−0.29	−0.32	−0.23	−12.3	−4.0***	−7.1***	−1.7**
Mexico	0.60	0.58	0.71	29.1	68.8***	−23.7*	0.3***
Taiwan	−0.24	−0.39	−0.24	−8.9	−19.7***	19.0***	−4.7***
Singapore	−0.66	−0.68	−0.59	−17.1	−28.4***	7.4**	7.7***
Thailand	0.38	0.35	0.45	23.9	44.1***	−4.4***	−10.1***

Source: Authors' calculations using BACI database (see the data "Appendix" 6.1). Figures in column (1) are obtained using the sample of the panel (1) of Table 1. Column (2) is obtained by excluding the extensive margin from the numerator. Column (3) provides the same information as column (2), but computed on the intensive margin only. This value is approximated by the Törnqvist index in column (4)

***, **, * denote significance at the 1, 5 and 10 % level. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

[a] Surviving flows for each year t are flows that exist not only in t, but also in $t-1$ and/or $t+1$. The shift-share estimation is performed at the 2-digit level of the HS. The last four columns correspond to terms $g_i, Perf_i, Geo_i$ and respectively $Sect_i (g_i = (1 + Perf_i) \times (1 + Geo_i) \times (1 + Sect_i) - 1$, Eq. 13), in percentage form. Recall that the order of decomposition does not matter with this method

Global trade corresponding to the intensive margin is simply the sum of trade values computed for each exporting country.[23] Column (4) displays the Törnqvist

[23] $\bar{X}^t = \sum_i \bar{X}_i^t$.

approximation of changes in column (3), expressed in percentage terms of exporters' initial shares, i.e. g_i^{95-10} from Eq. (13) where $X_{\cdot}^{t}$ are replaced with $\bar{X}_{\cdot}^{t}$. The decomposition of the change in column (4) according to our econometric shift-share analysis is reported in the last three columns of Table 6.

To clarify the difference between the different columns of Table 6, let us consider the case of Chinese exports. In 1995 Chinese exports represented only 6.3 % of the value of world trade; by the year 2010 they increased by 11.50 p.p. When we exclude the extensive margin (flows that appeared and disappeared over the period), the market share growth is almost unchanged: 11.35 p.p. or 12.14 p.p., depending on how one defines the global market (the sum of all flows or only of flows that exist as well in the previous and/or following year). The 12.14 p.p. gain represents a 192.3 % increase in the initial Chinese world market share (column 4).[24] The 192.3 % 1995–2010 growth in exports from China is the sum of the sectoral, geographical and performance effects, computed for each year of the period, here in a multiplicative form $[(1-0.162)\times(1-0.225)\times(1+3.498)-1]$.

In the EU-27 case, the 12.5 % market share loss according to the Törnqvist approximation (column 4, Table 6) is decomposed in columns (5) to (7). This loss, driven by the negative performance effect, was smoothed by the geographical and sectoral effects. The sectoral effect contributed for more than half of this smoothing.

However, the magnitude of the EU's losses is much more limited than those recorded by Japan and the United States (resp. −41.2 and −34.9 %). All in all, the EU's performance compares favorably with the United States or Japan given the pressure of new competitors. China, but also India and Indonesia show impressive export performances, although experience negative sectoral contributions in general.[25] Mexico is penalized by the geographical structure of its exports. The resilience of EU's market shares is largely due to Germany's resilience and, to a lesser extent, to new Member States performances.[26] Moreover, the EU's losses are smaller in volume terms (Table 11 in the "Appendix"), indicating a negative price effect, in particular for Germany and France.

3.4 Comparison between the two shift-share methods

We now compare effects obtained with the traditional CMS analysis (both with additive and multiplicative terms) and with the econometric approach. Market share growth rates obtained with the two methods are comparable, although not exactly

[24] China's 1995–2010 intensive margin accounted for 11.35 p.p. of the overall global market (including both flows that survive and vanish from year to year), and for 12.14 p.p. of the global market computed on the intensive margin (as the sum of flows that exist as well in the previous and/or following year). These changes represent, respectively, 180.0 and 188.5 % of the corresponding global markets. When export growth rates are computed with the Törnqvist approximation, the 188.5 % Chinese market share growth becomes 192.3 %.

[25] As confirmed by Beltramello et al. (2012) using our methodology and data, the sectoral effect is negative for most emerging exporters, reflecting their specialization toward more traditional, lower technology industries. The CMS analysis from Crespo and Fontoura (2010), which uses a panel similar to ours, also provides evidence of the growth of market share of many emerging countries in Asia and Central and Eastern Europe, despite their negative sector and /or geographical structure effects.

[26] Detailed results by individual EU-27 countries are available in the online Appendix.

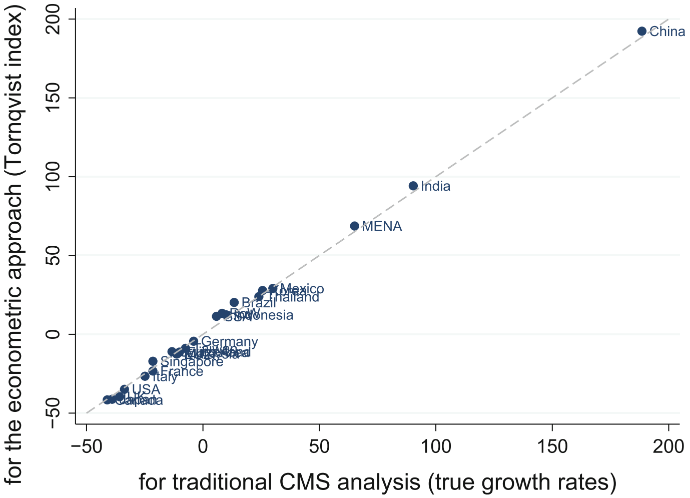

Fig. 2 Export market share growth rates used by the traditional and econometric shift-share decompositions. *Source*: Data displayed in Tables 4, 5, and 6 for countries and groups accounting for more than 1 % of world exports in the period 1995–2010

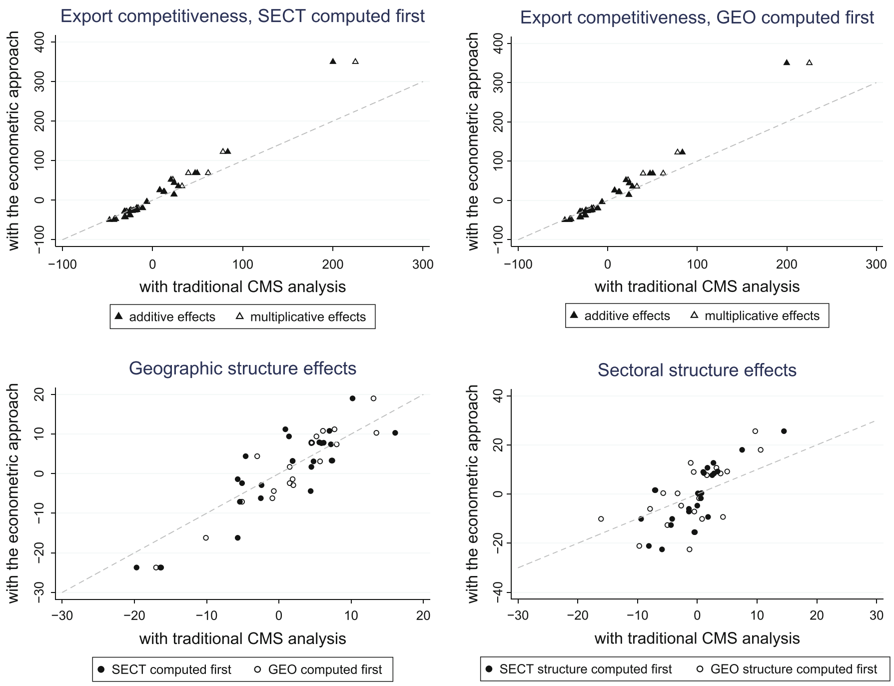

Fig. 3 Composition effects: econometric vs. traditional shift-share analysis. *Source*: Data displayed in Tables 4, 5, and 6 for countries and groups accounting for more than 1 % of world exports in the period 1995–2010. Figures on the "Appendix" 6.2 include all countries in the world

equal. The difference comes from the fact that under the econometric approach country level annual growth rates are computed as weighted averages of annual growth rates of individual flows, i.e. with the approximation given by Eq. (8). More importantly, the comparison of the respective contributions of the three components—sector, destination market, and exporting country performance—points to the advantage of using a method independent from the order of decomposition. We start by comparing in Fig. 2 the true and Törnqvist approximated change in the market shares of individual countries. This comparison confirms the quality of the approximation done and illustrates the performance of China, India but also the MENA countries.

In Fig. 3 we compare the composition effects as obtained by the econometric versus traditional shift-share analysis. Interestingly, the differences depend on the order of decomposition done with the traditional method, illustrating the fact that one of the effects is always biased. The choice between the additive or the multiplicative approach yields different values only for export competitiveness. However, it does not significantly affect the difference in results obtained with the traditional and econometric CMS method. Composition effects obtained with the two methods are more similar when each structure effect of the traditional CMS analysis is computed first. This can be seen particularly well when plotting results for all countries in the sample as in Fig. 5 from the "Appendix" 6.2.

3.5 Focus on high-tech and top-range products

We now consider the changes in world market shares for high-tech products and top range products. As in Sect. 2.3, these two aspects are considered separately. High-tech products are defined at the most detailed level of the product classification, regardless of their market positioning in terms of unit values. In addition, we rank individual countries exports in three price segments of the world market, considering *all* products, whatever their technological level, and taking unit values of trade flows. The decomposition is performed again at the HS2 level.

Regarding high-tech products, results reported in Table 7 show a rather stable EU's world market share, as opposed to the United States or Japan. The United States lose about half of their 1995 market shares over the decade and Japan even more. This is due to a massive relocation of their assembly lines to Asia, particularly China. The share losses of developed countries are mirrored by large gains recorded by many developing countries, in particular China, India and Brazil. Here, geographic and sectoral structure effects are not significantly different from zero in several cases. This is due to the concentration of high-tech products at the HS2 level: all high-tech products fall within only 7 HS2 categories. This result is of no concern as we firstly aim at measuring competitiveness, which is significant for most exporters of high-tech products. It also illustrates the advantage of relying on a statistical measure of composition effects, instead of an algebraical decomposition of changes in market shares. At this level of analysis, one cannot ascertain, for instance, that the sectoral composition of exports is the main determinant of gains in market share for high-tech products observed for Germany.

Table 7 Shift-share decomposition of changes in world market shares, 1995–2010: technological products

	% Δin market share using Eq. (13)	Contribution of		
		Export performance	Structure effects	
			Geographic	Sectoral
	(1)	(2)	(3)	(4)
EU-27	−0.2	−28.8	2.3	37.1
France	−14.6	−46.9**	8.4	48.4
Germany	16.1	−14.8***	3.3	31.9
Italy	−13.1	−40.0	0.2	44.6
United Kingdom	−43.3	−57.7**	−6.9	44.0
Euro Area	3.1	−27.7	3.0	38.4
United States	−49.5	−56.9***	2.9	13.9*
Japan	−62.1	−63.7***	10.8*	−5.8**
Canada	−40.8	−30.6**	−29.3	20.6
Switzerland	7.4	−46.0*	−7.4	114.6
China	402.1	720.4***	−17.5**	−25.9*
Brazil	179.1	167.4	−10.9	17.2
India	338.9	144.7	11.0	61.6
Indonesia	58.9	127.7	−10.8	−21.8**
Korea	29.7	32.9***	13.3*	−13.8*
Malaysia	−11.9	26.1***	−7.5	−24.5*
Mexico	51.5	157.7**	−32.7	−12.7**
Taiwan	34.8	22.7***	27.0	−13.5
Singapore	−43.5	−39.1***	12.7	−17.6*
Thailand	9.2	56.2**	−5.5	−26.0

Source: Authors' calculations using BACI database (see the data "Appendix" 6.1). The shift-share estimation is performed on flows existing in two consecutive years over the period, at the 2-digit level of the HS. All figures are expressed in terms of percentage change in market share. The four columns correspond to terms g_i, $Perf_i$, Geo_i and respectively $Sect_i$ ($g_i = (1 + Geo_i) \times (1 + Sect_i) \times (1 + Perf_i) - 1$, Eq. 13), in percentage form. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

The decomposition of changes by market segment, raises an additional data issue. In order to fully capture year-on-year changes in market share for a given exporter, one must take into account the fact that some flows may be classified in two different market segments depending on the year. If the computation of the growth rates were performed on flows classified at both dates in the same market segment, these shifters would not be present. To overcome this problem, we adopt the following strategy. For each trio (exporter, importer, HS6) and year we classify as middle range products flows present in the top-range in t_1 but not in t_0 and flows present in the top-range in t_0 but not in t_1, and as bottom range products other shifters.[27]

[27] Non-shifters (e.g. top-range in t_0 and t_1) are indeed kept in their initial range.

Table 8 Shift-share decomposition of changes in world market shares, 1995–2010: top-range products

	% Δ in market share using Eq. (13)	Contribution of		
		Export performance	Structure effects	
			Geographic	Sectoral
	(1)	(2)	(3)	(4)
EU-27	3.0	−5.1***	−0.7***	9.4***
France	−4.9	−17.8***	2.6**	12.7*
Germany	1.7	−4.2***	4.2***	1.8**
Italy	−13.9	4.5***	1.3**	−18.6
United Kingdom	−22.3	−35.5***	−1.4***	22.2***
Euro Area	5.6	−1.1***	−1.1***	7.9***
United States	−30.3	−31.7***	−7.0***	9.8***
Japan	−17.9	−29.4***	20.9***	−3.7***
Canada	−55.6	−46.3***	−17.0*	−0.5
Switzerland	−12.7	−32.6***	−2.8	33.2*
China	193.8	470.7***	−25.3***	−31.1
Brazil	40.5	64.6**	−16.4	2.1
India	39.9	65.1*	−2.8	−12.8
Indonesia	−8.4	31.8**	−2.1*	−29.0
Korea	−9.9	6.9***	9.6**	−23.1
Malaysia	−11.3	13.8***	−4.2**	−18.7**
Mexico	54.0	78.2***	−12.7	−1.0*
Taiwan	15.0	19.0***	27.1*	−24.0**
Singapore	−39.8	−51.6***	20.8*	3.0
Thailand	−0.9	38.3***	−7.9**	−22.2*

Source: Authors' calculations using BACI database (see the data "Appendix" 6.1). The shift-share estimation is performed on flows existing in two consecutive years over the period, at the 2-digit level of the HS. All figures are expressed in terms of percentage change in market share. The four columns correspond to terms g_i, $Perf_i$, Geo_i and respectively $Sect_i$ ($g_i = (1 + Geo_i) \times (1 + Sect_i) \times (1 + Perf_i) - 1$, Eq. 13), in percentage form. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

Table 8 focus now on the upper segment of the world market. For the EU, the growth in market share for top-range products (+3.0 %) contrasts with the global result (−12.5 % in Table 6) and suggests, at first sight, a better market positioning of European products having higher unit values. A deeper analysis points to the role of the sectoral structure of EU exports in top-range products: the EU has mostly benefited from a favorable sectoral orientation of its exports, whereby world demand has increased faster for its most exported top-range products. This again contrasts with the very negative outcome for Japan and the United States. However, unlike the EU and the United States, Japan has benefited from a favorable geographical orientation of its exports of top-range products, thanks to a larger and natural orientation toward a fast growing Asian market.

4 Conclusion

Our analysis relied on a methodological contribution and shed light on new evidence regarding the European export performance. In the context of a profound reshaping of world trade flows starting in the mid-1990s, we showed that the redistribution of market shares observed between emerging and developed countries—and among developing countries themselves—has affected differently the EU, Japan and the United States. EU managed to maintain its world market share at 18.0 % for goods (excluding energy and intra-EU trade) losing only 2.6 % points over the period 1995–2010. Market share losses are considerably larger in the case of the United States and Japan with a decline of around 6 percentage points. The crisis has however severely impacted European market shares: half of its losses occurred since the early days of the crisis.

Identifying the role of competitiveness, net of product and market composition effects, in the reshaping of world trade patterns, requires a proper decomposition of changes in countries' market shares. We showed that an econometric shift-share analysis can be preferred to the traditional Constant Market Share Analysis. This method attributes the increase in the EU share of the world market for top-range products mainly to the sectoral structure of EU exports, and so despite competitiveness losses.

From a policy perspective, our results indicate that the EU has withstood better the competition from the major emerging traders until the crisis, thanks to buoyant world demand for top-range products its exporters were specialized in.

Acknowledgments We are indebted to an anonymous referee for helpful remarks and suggestions on a previous version. We would also like to thank the participants in the Banque de France Seminar, the PSE-GmonD Conference on Quality and Trade, and the XII Conference on International Economics (Castellón), as well as Charlotte Emlinger, Guillaume Gaulier, Luciana Juvenal and Julia Wörz for their comments. The views are those of the authors. The usual disclaimer applies.

Appendix

Data description

The trade data used in this paper are from the BACI database, a database for the analysis of international trade at the product-level developed by Gaulier and Zignago (2010). BACI draws on the UN COMTRADE information, in which imports are reported CIF (cost, insurance and freight) and the exports FOB (free on board). BACI provides reconciled FOB data on trade flows: for a given product k and a given year t, exports from country i to importer j are equal to j imports from i. This reconciliation of mirror flows is performed for both values and quantities, and relies on estimated indicators of the reliability of import and export country reports. The quantity units are converted into tons, making possible the computation of homogeneous unit values.[28]

[28] Different versions of BACI data are updated and available at the CEPII webpage to COMTRADE users.

Table 9 The classification of sectors according to the technological content, Lall (2000)

Classification	Examples
Primary products (PP)	Fresh fruit, meal, rice, cocoa, tea, coffee, wood
Manufactured products	
Resource based manufactures (RB)	
Agro/forest based products	Prepared meats/fruits, beverages, wood products, vegetable oils
Other resource based products	Ore concentrates, petroleum/rubber products, cement, cut gems, glass
Low technology manufactures (LT)	
Textile/fashion cluster	Textile fabrics, clothing, headgear, footwear, leather manufactures, travel goods
Other low technology	Pottery, simple metal parts/structures, furniture, jewellery, toys, plastic products
Medium technology manufactures (MT)	
Automotive products	Passenger vehicles and parts, commercial vehicles, motorcycles and parts
Medium technology process industries	Synthetic fibres, chemicals and paints, fertilisers, plastics, iron, pipes/tubes
Medium technology engineering industries	Engines, motors, industrial machinery, pumps, switchgear, ships, watches
High technology manufactures (HT)	
Electronics and electrical products	Office/data processing/telecommunications equip, TVs, transistors, turbines, power generating equipment
Other high technology	Pharmaceuticals, aerospace, optical/measuring instruments, cameras
Other transactions (OT)	Electricity, cinema film, printed matter, 'special' transactions, gold, art, coins, pets

Source: Lall (2000)

BACI covers trade between more than 200 countries, in the roughly 5,000 products of the 6-digit Harmonised System (HS6) classification. However, this study excludes intra-EU-27 trade flows. This choice must be borne in mind when it comes to market shares and changes therein. We also exclude mineral, specific and non-classified products.[29] Trade flows below USD 10,000 and involving non-independent territories and micro-states are also excluded in Sect. 2.1 and in Sect. 3 For the shift-share analysis in Sect. 3 we employ HS2 data obtained by aggregation of HS6 data. The motivation behind is to keep a larger share of trade flows in the intensive margin, the only component of the export growth discussed in that section.

Concerning the high-tech products, we use the classification in broad sectors proposed by Lall (2000), detailed in Table 9.

The availability of traded unit values at a very disaggregated level (country-partner-product-year) in the BACI database makes it possible to compute international trade price indices. Similar to Gaulier et al. (2008), we compute price

[29] More precisely, we exclude the six following chapters of the Harmonized System: the mineral products (chapters 25, 26 and 27), the works of art, collectors' pieces and antiques (chapter 97) and the two last chapters, 98 and 99, devoted to special classifications or transactions.

indices as chained Törnqvist indices of unit values, but unlike them we compute an index for each pair of trading countries (exporter-importer) and HS2 heading. Data in 2,000 is taken as reference. We use these indices to deflate trade values (expressed in current USD in BACI) to obtain trade volumes expressed in terms of 2,000 prices. Since this exercise allows us to disentangle price effects, we refer to obtained data as volumes.

The world distribution of unit values for each HS6 heading allows us to classify each product-bilateral flow into three price segments, and to examine competition among the main world exporters within each of these segments. Trade flows are ordered according their unit values and classified as follows: flows with the lowest unit value form the *bottom-range*, the ones with intermediate unit values—the *mid-market*, and the ones with the highest unit value—the *mid-range*. We employ the technique developed by Fontagné et al. (2008) to construct the three market segments. There is also a small "non-classified" range of trade flows for which data on trade quantities is not available and unit values cannot be computed, but they represent <10 % of world trade.

Tables of this paper display results for countries accounting for more than 1 % of world exports from 1995 to 2010. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for all other countries in the world are available in our online appendix.[30]

Additional results

See Tables 10, 11 and Figs. 4, 5.

Table 10 Extensive and intensive margins in 1995–2010 for world exports by country, %

	Intensive margin computed					
	As the 1995–2010 Δ in trade			On annual basis		
	Intensive margin	Extensive margin		Intensive margin	Extensive margin	
	(1)	+ (Entries) (2)	− (Exits) (3)	(4)	+ (Entries) (5)	− (Exits) (6)
EU-27	96.61	4.01	0.62	98.88	5.75	4.63
France	97.89	2.36	0.25	98.57	3.86	2.43
Germany	99.27	0.83	0.09	99.76	1.09	0.85
Italy	96.79	3.39	0.18	99.29	2.98	2.27

[30] Zipped file at the working paper version webpage of this work and authors' personal webpages.

Table 10 continued

	Intensive margin computed					
	As the 1995–2010 Δ in trade			On annual basis		
	Intensive margin	Extensive margin		Intensive margin	Extensive margin	
	(1)	+ (Entries) (2)	− (Exits) (3)	(4)	+ (Entries) (5)	− (Exits) (6)
United Kingdom	98.31	2.35	0.67	98.99	4.35	3.35
Euro Area	97.93	2.44	0.37	99.46	3.59	3.06
United States	99.21	0.86	0.07	99.85	0.78	0.63
Japan	99.84	0.33	0.17	99.97	0.83	0.80
Canada	97.79	2.51	0.30	99.34	2.82	2.17
Switzerland	98.63	1.55	0.18	99.25	2.36	1.61
China	99.04	0.97	0.01	99.93	0.27	0.20
Brazil	89.66	10.82	0.48	95.86	8.82	4.68
India	94.97	5.16	0.13	98.51	3.17	1.68
Indonesia	95.44	4.74	0.19	99.22	4.02	3.23
Korea	97.86	2.21	0.07	99.32	2.45	1.77
Malaysia	97.75	2.40	0.15	98.92	2.76	1.68
Mexico	98.89	1.26	0.14	99.58	2.09	1.67
Taiwan	93.07	7.13	0.20	96.68	7.18	3.86
Singapore	97.90	2.51	0.41	100.20	4.34	4.54
Thailand	97.94	2.31	0.25	99.74	1.53	1.28

Authors' calculations using BACI values (current USD) of traded goods at the HS 2-digit level. The samples used in panels (1) and (2) are those from Table 1. Column (1) refers to the contribution of export flows (product × destination market) present both in 1995 and 2010. Column (4) refers to the contribution of export flows (product × destination market) present in any two consecutive years from 1995 to 2010. The other columns refer to the contribution of export flows appearing (positive contribution) or disappearing (negative contribution) over the period. The columns add up as follows: (1) + (2) − (3) = 100 and (4) + (5) − (6) = 100. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

Table 11 Shift-share decomposition of changes in world market shares, all products, 1995–2010: in volume terms

	% Δ in market share using Eq. (13)	Contribution of		
		Export performance	Structure effects	
			Geographic	Sectoral
	(1)	(2)	(3)	(4)
EU-27	−8.1	−15.8***	0.8***	8.4***
France	23.9	2.6***	3.4**	16.7
Germany	10.3	−3.6***	2.0**	12.2***
Italy	−35.4	−32.3***	2.2**	−6.7***
United Kingdom	−47.2	−51.2***	−5.2***	14.1***
Euro Area	−2.2	−10.7***	1.5***	8.0***
United States	−37.9	−48.6***	8.0**	12.0***
Japan	−37.5	−46.1***	4.5***	11.0***
Canada	−49.7	−36.5***	−24.5	5.0**
Switzerland	−28.0	−39.6***	−1.5*	21.0*
China	183.5	345.2***	−17.8***	−22.6**
Brazil	−0.5	15.6***	1.8	−15.4
India	65.9	127.8***	1.2*	−28.0
Indonesia	0.6	39.3***	−6.2***	−23.0
Korea	39.9	22.2***	13.4***	1.0***
Malaysia	−7.5	−6.1***	−3.5**	2.0**
Mexico	40.0	85.1***	−24.8	0.6**
Taiwan	38.0	−8.3***	45.0*	3.8**
Singapore	−6.6	−23.0***	9.8**	10.4***
Thailand	10.7	26.9***	−3.8***	−9.3***

Source: Authors' calculations using BACI database deflated using chained Törnqvist infices of unit-values (see the data "Appendix" 6.1). The shift-share estimation is performed on flows existing in two consecutive years over the period, at the 2-digit level of the HS. All figures are expressed in terms of percentage change in market share. The four columns correspond to terms g_i, $Perf_i$, Geo_i and respectively $Sect_i$ ($g_i = (1 + Geo_i) \times (1 + Sect_i) \times (1 + Perf_i) - 1$, Eq. 13), in percentage form. Results for countries accounting for <1 % of world exports from 1995 to 2010 are aggregated within three groups: the Middle East and North Africa (MENA), Sub-Saharan Africa (SSA), and Rest of the World (RoW). Results for the three groups and all individual countries not shown here are available in the online appendix

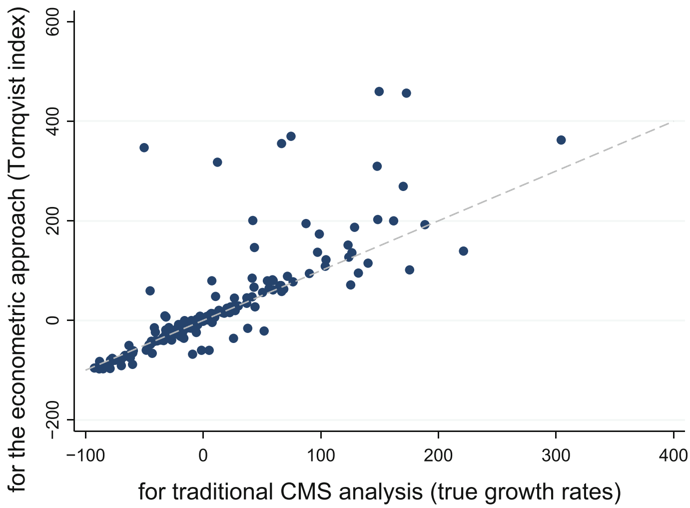

Fig. 4 Export market share growth rates used by the traditional and econometric shift-share decompositions, all countries in the sample

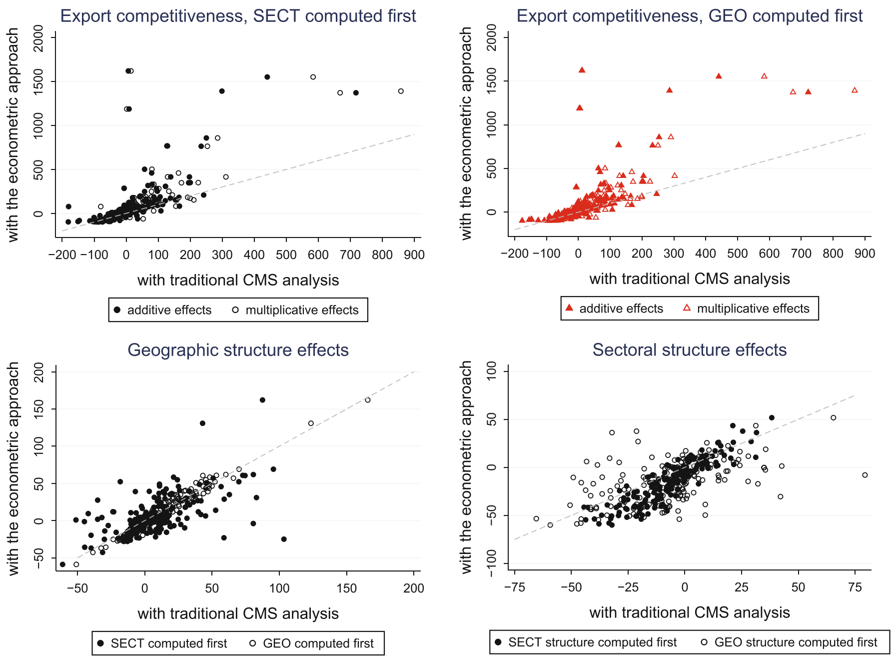

Fig. 5 Composition effects: econometric vs. traditional shift-share analysis, all countries in the sample

Computation of standard errors

One of the advantages of the econometric shift-share approach, with respect to the traditional approach, is the estimation of standard errors for each effect. Effects $Perf_i$, Geo_i, and $Sect_i$ of the decomposition of market share growths, given by Eq. (13), are computed from exporter, importer and sector fixed effects α_i^t, β_j^t, γ_k^t estimated with Eq. (7). Summarizing the computations in Sect. 3.2, we have:

$$Perf_i = \exp\left(\sum_t \hat{\alpha}_i^t + \sum_{j,t} w_j^t \hat{\beta}_j^t + \sum_{k,t} w_k^t \hat{\gamma}_k^t - \sum_{i,t} w_i^t \left(\hat{\alpha}_i^t + \sum_j w_j^t \hat{\beta}_j^t + \sum_k w_k^t \hat{\gamma}_k^t\right)\right) - 1 \quad (17)$$

$$Geo_i = \exp\left(\sum_{j,t} \frac{w_{ij}^t}{w_i^t}\left(\hat{\beta}_j^t - \sum_j w_j^t \hat{\beta}_j^t\right)\right) - 1 \quad (18)$$

$$Sect_i = \exp\left(\sum_{k,t} \frac{w_{ik}^t}{w_i^t}\left(\hat{\gamma}_k^t - \sum_k w_k^t \hat{\gamma}_k^t\right)\right) - 1 \quad (19)$$

One can use the standard errors of these effects to predict the statistical significance of country-level export performance and structural effects. We compute standard deviations for terms $Perf_i$, Geo_i, and $Sect_i$ using the so-called *Delta method*, as the diagonal of square matrices $S = (A\Omega A^T)^{1/2}$, where A is the matrix of partial derivatives of effects $Perf_i$, Geo_i, or $Sect_i$ with respect to the vector of all estimated effects $\mathbf{v} = (\alpha_i^t\ \beta_j^t\ \gamma_k^t)$, and Ω is the variance-covariance matrix of effects α_i^t, β_j^t, γ_k^t estimated with Eq. (7). Note that the covariance of different type of effects is equal to zero: $\Omega = \begin{pmatrix} \sigma(\alpha_i^t)^2 & 0 & 0 \\ 0 & \sigma(\beta_j^t)^2 & 0 \\ 0 & 0 & \sigma(\gamma_k^t)^2 \end{pmatrix}$.

Using the definition of $Perf_i$, Geo_i, or $Sect_i$ (see above), we have:

$$S(Perf) = \left(\begin{pmatrix} \vdots \\ \frac{\partial Perf_i}{\partial \mathbf{v}} \\ \vdots \end{pmatrix} \Omega \left(\ldots \frac{\partial Perf_i}{\partial \mathbf{v}} \ldots\right)\right)^{1/2}$$

$$S(Perf)_{i,l} = \sqrt{Perf_i Perf_l \left(\sum_t \sigma(\alpha_i^t, \alpha_l^t) + \sum_{j,d,t} w_j^t w_d^t \sigma(\beta_j^t, \beta_d^t) + \sum_{k,m,t} w_k^t w_m^t \sigma(\gamma_k^t, \gamma_m^t)\right)_{i,l}}$$

$$S(Geo) = \left(\begin{pmatrix} \vdots \\ \frac{\partial Geo_i}{\partial \mathbf{v}} \\ \vdots \end{pmatrix} \Omega\left(\ldots \frac{\partial Geo_i}{\partial \mathbf{v}} \ldots \right) \right)^{1/2}$$

$$S(Geo)_{i,l} = \left(\sqrt{\sum_{j,d,t} \frac{\partial Geo_i}{\partial \beta_j^t} \ \sigma(\beta_j^t, \beta_d^t) \ \frac{\partial Geo_l}{\partial \beta_d^t}} \right)_{i,l}$$

$$= \left(\sqrt{Geo_i \cdot Geo_l \cdot \sum_{j,d,t} \left(\frac{w_{ij}^t}{w_i^t} - w_j^t \right) \left(\frac{w_{ld}^t}{w_l^t} - w_d^t \right) \sigma(\beta_j^t, \beta_d^t)} \right)_{i,l}$$

$$S(Sect) = \left(\begin{pmatrix} \vdots \\ \frac{\partial Sect_i}{\partial \mathbf{v}} \\ \vdots \end{pmatrix} \Omega\left(\ldots \frac{\partial Sect_i}{\partial \mathbf{v}} \ldots \right) \right)^{1/2}$$

$$S(Sect)_{i,l} = \left(\sqrt{\sum_{k,m,t} \frac{\partial Sect_i}{\partial \gamma_k^t} \ \sigma(\gamma_k^t, \gamma_m^t) \ \frac{\partial Sect_l}{\partial \gamma_m^t}} \right)_{i,l}$$

$$= \left(\sqrt{Sect_i \cdot Sect_l \cdot \sum_{k,m,t} \left(\frac{w_{ik}^t}{w_i^t} - w_k^t \right) \left(\frac{w_{lm}^t}{w_l^t} - w_m^t \right) \sigma(\gamma_k^t, \gamma_m^t)} \right)_{i,l}$$

where $i, l = \overline{1, I}$, $j, d = \overline{1, J}$, $k, m = \overline{1, K}$, and $t = \overline{1, T}$.

The standard errors of shift-share decomposition effects are obtained as follows:

$$\sigma(Perf_i) = \sqrt{Perf_i^2 \cdot \left(\sum_t \sigma(\alpha_i^t)^2 + \sum_{j,d,t} w_j^t w_d^t \sigma(\beta_j^t, \beta_d^t) + \sum_{k,m,t} w_k^t w_m^t \sigma(\gamma_k^t, \gamma_m^t) \right)}$$

$$\sigma(Geo_i) = \sqrt{Geo_i^2 \cdot \sum_{j,d,t} \left(\frac{w_{ij}^t}{w_i^t} - w_j^t \right) \left(\frac{w_{id}^t}{w_i^t} - w_d^t \right) \sigma(\beta_j^t, \beta_d^t)}$$

$$\sigma(Sect_i) = \sqrt{Sect_i^2 \cdot \sum_{k,m,t} \left(\frac{w_{ik}^t}{w_i^t} - w_k^t \right) \left(\frac{w_{im}^t}{w_i^t} - w_m^t \right) \sigma(\gamma_k^t, \gamma_m^t)}.$$

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