Diverse Twins: Analysing China's Impact on Italian and German Exports using a Multilevel Quantile Regressions Approach

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Abstract

Germany and Italy are the largest manufacturing producers in Europe and export over 70% of their products to OECD countries. While they share many characteristics, they are also diverse in term of specialization and destination markets. Italy has a productive structure largely based on labour intensive sectors, while Germany is mainly specialized in high tech goods. We study whether these characteristics make the two countries vulnerable in different ways to the competitive pressure by emerging economies, especially China, which experienced the strongest increase in export market share during the last decades. We discuss the impact of China on the export performance of Italy and Germany on OECD markets. Using data for the period 1995-2009, we implement a novel model to account for two important data characteristics: their hierarchical hidden structure (captured by a multilevel model) and the heterogeneity of the export shares (captured by a quantile approach). Results show that Chinese competition on Italy's and Germany's market shares differ by sectors, but, on average, Italy is not more vulnerable than Germany. These results are relevant for policy implications and for an ex-post analysis of the 'best response' to the Chinese competition.

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Keywords: China; Longitudinal Multilevel Models; Quantile Regressions; Export Competition; Heterogeneity.

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1. Introduction

China has recently become the first world exporter of manufacturing goods, increasing its export shares in all sectors and markets, including the more technologically advanced ones. The rapid growth and increasing international integration of China has modified the balance of world trade, shifting it to the "East". Having gone through a rapid process of structural transformation as well as international integration, while increasing its export shares, China has also been upgrading the quality of its production and exports, becoming a very strong competitor worldwide (Ferrarini and Scaramozzino, 2015). These changes in the structure of Chinese exports, as well as and their consequences, have been object of recent research, aiming at understanding, on the one hand, whether they can be considered exceptional for a country still at an "early stage" of economic development and, on the other, which factors have triggered them and whether and to what extent this has affected other main manufacturing exporters.

When China started opening to international markets in 1978, it supplied large quantities of low cost manufactures. Over time, the range of products exported has substantially increased, covering as well a larger share of more sophisticated ones (Ferrarini and Scaramozzino, 2015). Analyses based on highly disaggregated statistics on trade (at the 6-digit of the Harmonized System) show that in early 2000 China was exporting as many products as Germany, the country exporting the greatest number of products worldwide (Schott, 2004). Beside the range of exported products, also destination markets of Chinese exports have changed in the last decade. In 2009, China was already serving roughly 70% of markets also served by individual EU members (Benkovskis, et al, 2013), triggering fears of a potential displacement also for EU countries.

Whether the competitive threat from China is affecting also developed countries and capitalintensive goods, as suggested by looking at the developments of world market shares and the reshaping of the international production networks, it remains a still relatively understudied issue. Against this background, this paper analyses the impact of China on the market performance of Italy and Germany. Within Europe, Germany and Italy are the two largest manufacturing producers and export a substantial part of their products – over 70 per cent – to other OECD markets. Those two countries are a useful benchmark to understand how recent changes in the global trade landscape have affected the productive structure of advanced economies. While they share many characteristic (e.g. they are among the first exporters of machinery at world level) in term of specialization and destination markets, they are also inherently diverse and their export performance has been diverging since the nineties. Beside its strength on "specialized suppliers"[2] (e.g. machinery), Italy has a productive structure largely based on so-called "traditional" sectors, i.e. those including labour intensive activities such as textiles, footwear, furniture that are at lower technological content, which are likely to make the country more vulnerable to the competitive pressure from emerging economies, especially China after its access to WTO in 2001. Germany, on the other hand, beside "specialized suppliers" is more focused on higher technology sectors and intermediate exports, and has often been considered less at risk of low cost competition (Tiffin, 2014). However, it has lost its leadership as world's main manufacturing exporter in 2009. There is some evidence showing that the so-called China's shock has hit Italy more than Germany due to its initial specialization[3], and that Germany fared better also due to faster reallocation in response to low-cost import competition (Bugamelli et al., 2017; Marin, 2017). In aggregate terms, Italy seems to have experienced a stronger decline in terms of its shares in OECD

[2] Tiffin, 2014 says that specialized suppliers are industries which are often dominated by smaller firms that design, develop and produce equipment tailored specifically to a particular production process or need.

[3] Early specialization in sectors most exposed to Chinese competition is, according to a recent analysis by Bugamelli et al. (2017), a major determinant of the decline of Italian exports before the financial crisis. Interestingly enough, applying a simple counterfactual scenario, they show that this factor can explain up to one tenth of Italy's underperformance relative to Germany.

markets, in the period in which Chinese exports rose at impressive rates (Figure 1). Germany, on the other hand, after a small decrease seems to have recovered its share.

FIGURE 1 HERE

Yet, this evidence can hinder heterogeneous patterns for both countries, depending on the combination of sectors and markets, which we try to identify in more details by means of an innovative econometric technique (longitudinal multilevel quantile regression). This methodology fits well the structure of our data, since it allows to account, on the one hand, for their hierarchical hidden structure (the multilevel part) and, on the other hand, for the heterogeneity of the export shares in different categories (captured by the quantile approach), while also keeping endogeneity under control. We use Chinese export shares as explanatory variable to account for the potential competition and we directly estimate the impact of China on Italy and Germany's market shares. Results show that China has affected Italy's and Germany's market shares in different ways, in different sectors, characterized by different market shares, product composition and quality levels. However, contrary to our expectations, the results show a mixed picture, where in both countries some sectors are potentially displaced by Chinese exports, but others have resisted much better. Furthermore, we do not find evidence of a stronger competitive pressure on Italy compared to Germany, which, to a certain extent, contrasts the common belief that countries more likely to be displaced are those specialized in traditional manufacturing sectors. These results are relevant for their policy implications and for an ex post analysis of the "response" of advanced economies.

The paper proceeds as follows. Section 2 sets the scene reviewing the recent export performance of Italy, Germany and China and the impact of China on other countries' export performance. Section 3 specifies the econometric model, highlighting its novelty and potentials to better explain the competition between countries on destination markets. Section 4 describes data, methodology and results. Section 5 concludes.

2. Literature Review

China's structural transformation and resulting sustained pattern of economic growth over the last three decades has influenced other economies in the world through different channels, with trade being the most significant (Arora and Vamvakidis, 2010). According to Lin and Yang (2014) the structural transformation of China consisted of three main steps. The first in 1986 "when exports of textiles and clothing exceeded crude oil (…). The second (…) in 1995, when China's export of machineries and electronics exceeded textiles and clothing. The third after China's accession to the World Trade Organization (WTO) in 2001, when high and new tech exports grew rapidly, and the level of product sophistication increased. (…) Some exporters have become integral parts of the global supply chains of multinationals in automobiles, computers, cell phones, and airplane parts". (Lin and Yang, 2014: 4).

As consequence of these developments, an extensive literature has investigated their possible impact on trade performance of different groups of countries, mainly concentrating on the post –WTO accession period (Shafaeddin, 2002; Yang, 2006). Most studies focused on East Asia, given the crucial role of China in the re-organization of regional production networks that resulted in China specializing at first on assembling intermediate products from the neighbor countries (Gaulier et al., 2007; Eichengreen et al., 2004). Some contributions analyzed the impact of China on Latin America (Jenkins et al., 2008) and Africa (Giovannetti and Sanfilippo, 2009, Lin and Yang, 2014). The possible impact of Chinese export on developed countries, whose productive structures were considered less at risk due to their relatively more sophisticated production, attracted lower attention[4]. Only recently, the

[4] See the recent discussion paper by Benkovskis, et al (2013) for a study on the impact on EU countries.

increasing evidence on a fast catching-up together with the improvement of "sophistication" of Chinese production[5] stimulated attention on the impact on developed countries. In line with the international trade literature of heterogeneous firms *à la* Melitz, most existing studies looked at how EU domestic firms react to an increase of Chinese competition, showing the impact on upgrading (Mion and Zhu, 2013; Martin and Mejean, 2014), employment (Autor et al., 2014), exit from the market (Colantone et al., 2014) and other relevant dimensions.

To the best of our knowledge, there is less evidence on the implication of China's entry on the export performance of advanced economies at the sector level.

However, the macro patterns are very interesting and may tell a convincing story. As mentioned above, when the share of Chinese exports started to increase at very high rates, the share in world exports of manufactured goods of the most industrialized countries started exhibiting a downward trend. The share of manufactured goods in total exports and the pace of de-industrialization vary largely among advanced economies. Countries with lower shares of manufactured goods in total exports (such as the UK) followed a sharper trend of de-industrialization, whereas Germany and Italy, which have higher shares of manufactured goods in total exports, experienced a slower declining tendency (Vu, 2014).

Benkovski et al. (2013) claims that despite well-grounded raising concerns over Chinese competition, there is only limited evidence of crowding-out for advanced economies and

[5] The so-called "China is special" argument proposed by Rodrik (2006) has been confirmed by Schott (2008) and Fontagné et al. (2008), both claiming that Chinese exports are becoming increasingly similar to those of OECD countries. Pula and Santàbarbara (2011) add also that, despite their lower unit values, the quality of Chinese exports is higher compared to other developing countries.

especially a high heterogeneity in individual country's responses. Abraham and van Hove's (2011) work on intra-OECD trade find that Chinese competition is reducing market shares of many OECD countries and they suggest that competitive pressure is felt in labor-intensive sectors but also in a growing number of industries with high capital-intensity and/or higher value added. A study looking at the impact on the export performance of the G7 countries also finds similar results (Vu, 2014). However, all these studies highlight the heterogeneity among the different exporters. Cheptea et al (2014) show the heterogeneity of developments within industrial countries (EU, US and Japan) and among sectors against the rise of Chinese market shares and maintain that, on average, EU countries have performed better than US and Japan. Husted and Nishioka (2013), evaluating the extent of Chinese competition by means of a constant market shares analysis, reach a similar conclusion. Cheptea et al. (2014) also show that, within EU, market shares have been characterized by different behaviors: while German market shares have been more or less constant, Italian ones have dropped more, but with relevant differences across sectors and products[6]. Most of these analyses use a gravity model of trade.

3. The Method

To better fit the structure of our data with respect to models used so far (usually a modified gravity model), we propose a longitudinal multilevel quantile regression model. This model allows us to take into account two very important characteristics of our data: on the one hand, the data hierarchical hidden structure (units nested in sectors, time and geographical areas, captured by the multilevel model) and, on the other, the heterogeneity of the dependent variable, export shares (captured by the quantile approach). The hidden hierarchical structure

[6]Vu (2014) also supports such findings , but – differently from our paper – he looks at exports to the world market and shows that Germany is the only G7 country not significantly affected by Chinese competition.

of data depends from the fact that export behavior is not only affected by firms' or countries' goals and characteristics, but it is also shaped by the social and economic environment (competitiveness) and clustered on economic sectors as well. Standard regression models (such as the Generalized Linear Models) are inadequate when a complex structure of data exists. On the other hand, quantile regressions on export shares allows us to account for their heterogeneity. Omitting some countries characteristics may generate endogeneity bias, since this information would be absorbed by the error term and will be correlated with the included individual characteristics. From a statistical viewpoint, standard regression models make unsuitable assumptions on the variance–covariance structure. They assume independence of the observations, while export shares are likely to be positively correlated within sectors, geographical areas and time. For instance, a standard panel approach with clustered error assumes a homogeneous correlation structure within each cluster. This is likely to give biased and inconsistent estimates in case of hidden hierarchical data for which the correlation structure is likely to vary across groups (Rabe-Heskethand and Skrondal, 2010). The proposed longitudinal multilevel quantile model has the advantage of being robust both to endogeneity[7] and heterogeneity, allowing us to overcome the omitted variable bias that normally affect this type of analysis (see Autor et al., 2013).

We assume a non-homogeneous and not constant correlation structure at higher level. This means that in

$$y_{ijt} = \alpha + \beta x_{ijt} + u_i + e_j + v_t \tag{1}$$

where i:1, . . . , n units are clustered in j:1, . . . , k groups on t:1,…T years, the correlation between any two units i and i' conditional on time t is

[7] This approach is based on the Mundlak (1978) technique developed for panel data.

$$\mathrm{corr}(y_{ij}, y_{i'j}|t) = \frac{\sigma_u^2}{\sigma_u^2+\sigma_e^2} \tag{2}$$

thus allowing to better capture and estimate the variance of the system. This approach also allows us to account for time effects without explicitly introducing them in the model, leading to a more parsimonious specification. To control for endogeneity, we use a standard Hausman Test.

The model we propose allows us to analyze measurements repeated on the units (recipients) over time and economic sectors (a basic three hierarchical structure regression model can be arranged with export shares at the destination market as first level, economic sectors as second level and time as third level). This, in turn, allows us to analyze the recipients export shares over time as well as the variation of this pattern across economic sectors, taking into account the hierarchical structure hidden in the data (Rabe-Hesketh and Skrondal, 2012; Snijders, 2014).

Given the skewness of the dependent variable (export shares) – and that we do not know the distribution of the underlying population – the quantile multilevel approach seems the right approach to disentangle the evidence of heterogeneity in the data.

Generalizing Koenker and Bassett's (1978) seminal paper, we write the longitudinal quantile regression model as:

$$y_{it} = x'_{it}\beta_\theta + u_{\theta it} \tag{3}$$

With

$$Quant_\theta(y_{it} \mid x_{it}) = x'_{it}\beta_\theta \tag{4}$$

where y is the dependent variable, x is a vector of regressors, β is the vector of parameters to be estimated, and u is a vector of residuals. $Quant_\theta(y_{it} \mid x_{it})$ denotes the θ-th conditional quantile of y given x . The θ-th regression quantile, 0 <θ< 1, solves the following problem:

$$\min_\beta \frac{1}{n}\left\{ \sum_{i,t:y_{it}\geq x_{it}^{'}\beta} \theta\left|y_{it}-x_{it}^{'}\beta\right| + \sum_{i,t:y_{it}<x_{it}^{'}\beta} (1-\theta)\left|y_{it}-x_{it}^{'}\beta\right| \right\} = \min_\beta \frac{1}{n}\sum_{i:1}^{n}\rho_\theta u_{\theta it} \tag{5}$$

Where $\rho\theta(\cdot)$, which is known as the 'check function', is defined as

$$\rho_\theta(u_{\theta it}) = \begin{cases} \theta u_{\theta it} & if\ u_{\theta it} \geq 0 \\ (\theta-1)u_{\theta it} & if\ u_{\theta it} < 0 \end{cases} \tag{6}$$

which is then solved by linear programming methods. As θ increases from 0 to 1, we can trace the entire conditional distribution of y, conditional on x (Buchinsky, 1998)[8]. In this paper the classic quantile longitudinal model is modified due to the hierarchical hidden structure of the data, specifying the vector of residuals according to a longitudinal multilevel approach; thus, it becomes a longitudinal three-level models with random intercept and random slope (Yang, Goldstein, 1996; Skrondal, Rabe-Hesketh, 2004). The model includes all variables described below in the fixed part, a random slope and three level variances to be estimated.

Let the i-th occasion (it corresponds to the Italian or German export shares to the m-th country of destination) in the j-th economic sector (2 digits SITC revision 3, see Table A1 for

[8]More on quantile regression techniques can be found in the surveys by Buchinsky (1998) and Koenker and Hallock (2001) while a set of sufficient conditions that identify a panel quantile regression model with fixed effects can be found in Canay (2011).

a description) of the t-the be expressed by a three level model as follows:

$$y_{tij} = \underbrace{\beta_0 + \beta_1 a_{ti} + \beta_2 a_{ti}^2 + \sum_{j=1}^{N} (\beta_l x_{tij} + \gamma_l x_{(t-1)ij} + \alpha_l d_l) + \sum_{i=1}^{K} \zeta_p s_{ij} +}_{\text{fixed part}}$$

$$\underbrace{+ u_{tj} + v_t + \varepsilon_{tij}}_{\text{random part}} \tag{7}$$

where

$$u_{tj} \approx iid - N(0, \tau_u^{\;2}),\ v_t \approx iid - N(0, \tau_v^{\;2}),\ \varepsilon_{tij} \approx iid - N(0, \tau_\varepsilon^{\;2}) \tag{8}$$

and

y_{ijt} = response variable (export shares to the m-th country of destination); (9)

$i=1,2,\ldots,K$ is the unit (German or Italian export share per country of destination);

$j=1,2,\ldots,N$ is the sector (economic sector at 2 digit SITC);

$t=1,2,\ldots,T$ is the year (time).

This approach allows the simultaneous examination of how individual level and group level variables (contextual variables) are related to individual level outcomes. Contextual variables summarize one or more specific characteristics of individuals in the group and they are constant within the group. The regressors are classified as individual level variables *X* (lagged German or Italian export shares, respectively, and Chinese export shares), contextual variables *S* and *A* (distance and per capita GDP) and the dummies *D* (industry specific fixed effects, being landlocked, contiguity between exporters and importers and whether the recipients are in EU).

The independent variables at each level are assumed to be uncorrelated with the random effects (error terms) on the other level, cov(x_{tij} , u_{tj})=0 , cov($x_{(t-1)ij}$, u_{tj})=0 and cov(s_{ij} , ε_{tij}) 0. In other terms, any unobservable country characteristics relegated to the error term should not be correlated with the observable sector characteristics. In our case, the main concern arises from the cross-level assumption where the random effect on the intercept is correlated with a level one independent variable X. In this case, the assumptions that cov(x_{tij} , u_{tj})=0 and cov($x_{(t-1)ij}$, u_{tj})=0 are violated, and some unobservable country characteristics relegated to the error term are correlated with the observable sector characteristics. Hence, the coefficient estimates are likely to be biased. This is called *level 2 endogeneity problem* (Grilli and Rampichini, 2006). To deal with this, in what follows, we adapt the endogeneity-robust Mundlak approach (1978) for panel data models to the estimation of multilevel models and then run at quantile level. The approach consists of semi-demeaning the estimated equations. In line with Mundlak approach, we run a Hausman Test to deal with a level 2 endogeneity. The null hypothesis is that the random effects (on the intercept) are not correlated with any of the sector-dependent variables, cov(x_{tij} , u_{tj})=0 . This allows us to test a fixed effects specification against a random effects one. If the null hypothesis holds, then the estimates of the coefficients are both consistent and efficient.

3.1 Data and descriptive statistics

The dataset covers the period 1995-2009; the exports destination markets are high-income OECD countries . All monetary variables are transformed in natural logarithm. Data on market shares are computed on bilateral trade flows classified according to the harmonized system (1992) at 6-digit level and come from the BACI dataset published by CEPII (Gaulier and Zignago, 2010). Keeping the high level of disaggregation to account for product specific characteristics, we run the model adopting the grouping structure of the Standard

International Trade Classification (SITC) revision 3. Bilateral distances, measured as simple distance (in Km) between the two most populated cities, comes from the CEPII (Mayer and Zignago, 2011). Data on real GDPs of the exporter and the importers are from the World Bank's World Development Indicators.

Table 1 reports descriptive statistics for the variables considered in the model.

TABLE 1 HERE

Table 2 reports the average export shares (in Italy and Germany) and the corresponding size (i.e. number of positive observations) for different quantiles and for the whole sample. As expected, German shares and the number of units within each quantile are always above the Italian ones, Germany being the second world exporter of manufacturing goods. For both countries, export shares to other advanced markets are important, with median values of 3.3% for Italy and 4.4% for Germany. In addition, the number of sectors where the two countries have higher shares (the top 5 and 10 per cent) is relevant (about 5-10% of the total). This suggests a high specialization in specific productions, where the two countries still lead the markets.

TABLE 2 HERE

This pattern becomes even clearer when we analyze the average shares for all sectors (2 digits) considered. The disaggregated analysis is used to highlight the sectors in which each country reports the higher shares (in bold in the table). It also shows that even though Italy on average exports less (Table 3), in some sectors it exports more than Germany (on average, in italics); these, not surprisingly, include all the traditional specializations (clothing, apparel, footwear) of the so-called "made in Italy" products (from 81 to 85).

TABLE 3 HERE

TABLE 4 HERE

Considering different quantiles and sectors (Table 4), this pattern seems to be confirmed and the Italian specialization in traditional sectors (from 81 to 85, Made in Italy sectors) is clear in higher quantiles (from the 50th quantile), supporting the view that Italy has higher shares than Germany in those traditional sectors (in italics). These results can have some interesting implications if coupled with mirror information on the behavior of Chinese corresponding market shares across the different sectors and quantiles. Table 5 reports information on those sectors where the share of China is larger (defined arbitrarily as above 15% of the market) and suggests two main observations.

TABLE 5 HERE

First, when compared with Table 4, it shows that almost all the sectors included are the same in which Italy is most specialized, and a larger exporter with respect to Germany. Second, the weight of the Chinese presence in these sectors tends to reduce as we move from lower to higher quantiles[9]. Looking back at the descriptive statistics by sector and quantile, the latter is a more general finding. The number of sectors in which the Chinese share is prevalent reduces proportionally as we move from the 25th percentile (where Chinese export shares are larger in 15 out of 17 sectors) to the 95th (where the number drops to 10). This can be roughly interpreted as the tendency of Chinese competitiveness to diminish as it moves towards more sophisticated specializations still dominated by traditional exporters, such as Italy and Germany.

4. A Quantile Multilevel Analysis

[9] This is coherent with the empirical findings of Ferrarini and Scaramuzzino (2015), who find that the higher the sophistication of the products, the lower the share of China.

We estimate the impact of Chinese competition, proxied by the share of Chinese exports, on the export shares of Italy and Germany. The main results of the multilevel quantile regression estimation are reported in Tables 6 and 7 (full results, including all the variables, are reported in the Appendix tables A2-A3). First, to check whether the multilevel approach is appropriate in our case, we run a Likelihood Ratio Test on the existence of a hierarchical structure in the data. The results strongly reject the null (absence of a second/third level in the data, LR chi2 = 173.53 with a p-value<0.001), suggesting that the multilevel model is appropriate, while standard regression models would give biased estimates. Notice that, the so-called contextual variables in the multilevel component, such as distance and per capita GDP, are all significant at each quantile, with the expected sign and magnitude (i.e. distance negatively affects export shares, GDP of destination markets positively etc).

Focusing on the general results, all signs are as expected (significant coefficients in bold, robust standard errors in parenthesis) and the Hausman test fails (i.e., no endogeneity). When considering the statistical significance and the numerical values of the coefficient of "Chinese share", we observe two main things. The first is that Italy has been affected by Chinese competition along basically the entire distribution of its shares, with the exception of the very bottom quantiles (i.e. the 5th). This suggests that China could have eroded the presence of Italian exporters when their scale was not substantial. The second result is that the coefficients for Germany are always higher than those for Italy. As clearly shown in Figure 2, which plots the coefficients of China's competition, as quantiles grow (i.e. export shares grow), this effect is even more evident and magnified.

FIGURE 2 HERE

A similar result holds in the whole sample (last row, Table 6): the numerical value of the Chinese competition coefficient is 0.13 for Germany and 0.10 for Italy, i.e. a 1 percentage point (pp) increase in Chinese market shares results in a reduction of German and Italian shares by 0.13 pp and 0.1 pp, respectively.

There are a few possible explanations to explain this slightly stronger impact on German exports compared to Italian ones. The first can be found by looking at the distribution of the competitive effect across the different sectors. Descriptive statistics (Tables 2-4) show that Germany has higher market shares in both the different sectors and quantiles. Hence, it can be argued that the probability that the entry of Chinese competitors affects German (relatively higher) market shares more than the Italian (relatively lower) ones is high. Related to this, higher coefficients may hinder sector heterogeneity, with some sectors in which both countries experience declining specialization being those more severely hit by Chinese competition. The latter seems to be the case of Germany. As shown in Table 5, the pressure from Chinese competition is especially strong in those sectors that are less relevant for Germany, but in which Italy has a consolidate specialization.

The coefficient of distance, as expected from a standard "gravity" interpretation, is always negative and significant, confirming that the farer the destination, the lower the export shares on average, since larger distance implies that exporting is riskier and more complex, resulting in higher trade costs. The numerical values of the coefficients are, however, quite low, and this could be due to the low transaction and transportation costs within the group of OECD countries. Surprisingly enough, when it comes to the coefficients for the top 5 and 10 classes, the coefficient of the distance turns positive (and significant) for both Italy and Germany.

This can be attributed to a kind of “scale effect”. With high market shares, and in presence of large volumes, the negative effect of the physical distance is more likely to be offset[10].

TABLE 6 HERE

Table 7 reports the role of destination countries’ per capita GDP on the Italian and German shares. We introduced a quadratic effect (GPD and GDP squared) to enquire the possible existence of a composite effect of the wealth of destination country . More specifically, the quadratic form allows us to capture decreasing or increasing marginal effects of destination countries GDP on German/Italian export shares.

TABLE 7 HERE

For Germany a minimum exists in all quantiles (except for the top 5% highest shares), with an estimated threshold that grows as the export shares grow[11]. This means that as destination market’s per capita GDP grows, German export shares grow constantly, since the non-linear effect exists but its magnitude is quite low. German export shares decrease only in those countries with a very low per capita GDP (923$ to 7000$, on average, all else equal).

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10 Another explanation derives from a “quality effect”. If top performing sectors are, as we expect, those where the two countries have high specialization and a reputation of high quality/value of their manufactures, the demand would be sustained independently on the distance to the final destination.

11 When represented in a graph with destination market’s per capita GDP on x-axis and German export shares on y-axis, this would be a set of U-shape parabolas that shift to the right as GDP grows. This means that there’s a negative effect of destination market’s per capita GDP on German shares as its shares grow (as quantiles grow).

Also for Italy, a threshold exists but, contrary to Germany, it turns out to be a maximum only in higher quantiles (from 50% to 95%) and it tends to decrease as quantiles increase[12]. This suggests that Italy loses competitiveness (in terms of export shares) in higher GDP countries, where it is likely to have higher shares thanks to its specialization in “made in Italy”. Or, as the destination country’s per capita GDP grows, its effect on Italian export shares tends to decrease, leaving Italy weaker in the international markets that count more for its high quality products (on average, all else equal).

The multilevel component of the model disentangles the effects of the economic sectors and allows us also to estimate the percentage of variance explained by each level (sector and time) at each quantile. It shows how the role of sectors is very heterogeneous across quantiles and between Italy and Germany: sectors 81-84 including some of the traditional specialization of Italy (furniture, apparel), for instance, push Italian export share (the opposite effect can be noticed in Germany), confirming what emerged from the preliminary, descriptive analysis. The results on the quantiles and the percentage of variance explained by levels (especially by sectors) are very heterogeneous. On average, along the quantiles and on the whole sample, the variance (heterogeneity) explained by time is higher than that explained by sectors in both countries, suggesting that the sectors heterogeneity is more difficult to be fully captured in a single model.

Finally, we checked the robustness of our results. First, we compared our result with a base model. Second, we augmented our model with some additional controls, common in a gravity

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[12] If we plot this result on a graph with destination market per capita GDP on x-axis and export shares on y-axis, the net effect can be represented as inverted U-shaped parabolas shifting to the left as export shares grow. In other words, this means that the positive effect from GDP is more evident for lower export shares quantiles while this effect becomes negative as the shares grow.

setting: a dummy identifying contiguity between exporting and importing country; a dummy if the importing country is a EU member. The latter serves to disentangle the effect of the custom union. Third, we run a general model on the sub-period 1995- 2007 to rule out the potential effects of the crisis The results – reported in Tables A4.a and A4.b in the Appendix –are robust under all specifications. [13]

5. Conclusions

Over the last decades, the success of Chinese exports has increased the competitive pressure on exports of a large number of countries.

Recent research has emphasized, on the one hand, important and rapid changes in Chinese export specialization and, on the other hand, their competitive impact on developing and emerging countries. European countries were at first considered sheltered from this competitive pressure, because of their different segments of specialization (usually high quality) and because the destination markets for their exports were often different from those for Chinese exports. However, more recent studies show a displacement also of developed countries' exports and highlight important heterogeneity between EU countries and within EU countries at sectoral and product level.

This paper contribution to the literature on the effect of China on exports of developed countries is twofold First, we use an innovative econometric model: a. quantile longitudinal multilevel model that allows us to deal with the hidden hierarchical structure of our data and their heterogeneity, keeping under control potential endogeneity. The model proposed is very flexible and we can disentangle the covariates' effect on export shares to show how heterogeneous they are. Our results, on the whole and at a quantile and multilevel level,

[13] We would like to thank the comments of two anonimous referees that strongly improved the robustness check of the model. For space reasons, some additional results are available upon requests

confirm the flexibility and characteristics of the model proposed. Second, we show that Chinese competition has affected Italy's and Germany's market shares in different ways, in different sectors and market segments: some sectors and segments are potentially displaced while others have resisted much better to the Chinese competition. More specifically, the sectoral composition of the competitive pressure is higher in not specialized segments of the markets, or those with a marginal role in the exporters basket.

The overall assessment of the China effect, properly taking into account the heterogeneity by sectors and markets, seems to point to an important role for quality upgrading and specialization as means to be sheltered from developing countries (low cost) competition.

These results are potentially relevant for their policy implications. If China is a competitor mainly for certain market segments, or in specific destination markets, it is crucial to identify those segments and markets and to understand the underlying dynamics. Tiffin (2014) in a study on Italian competitiveness, for instance, suggests that Italy, penalized by its product composition- biased towards less dynamic low tech- traditional products- and markets composition - towards low growth markets - has been recently able to re-orient its exports to markets with a rapidly expanding demand for imports, and therefore its market shares' losses, at a disaggregated level, have not be as critical as feared. Our results, obtained in a different context and using a totally different methodology, suggest similar conclusions.

These results are also potentially useful for an ex post analysis of the country "response" to the Chinese competition, since they may suggest the usefulness of a quality upgrading of some low tech traditional products. This point calls for further research and is outside the scope of this paper, but helps reconciling counterintuitive evidence.

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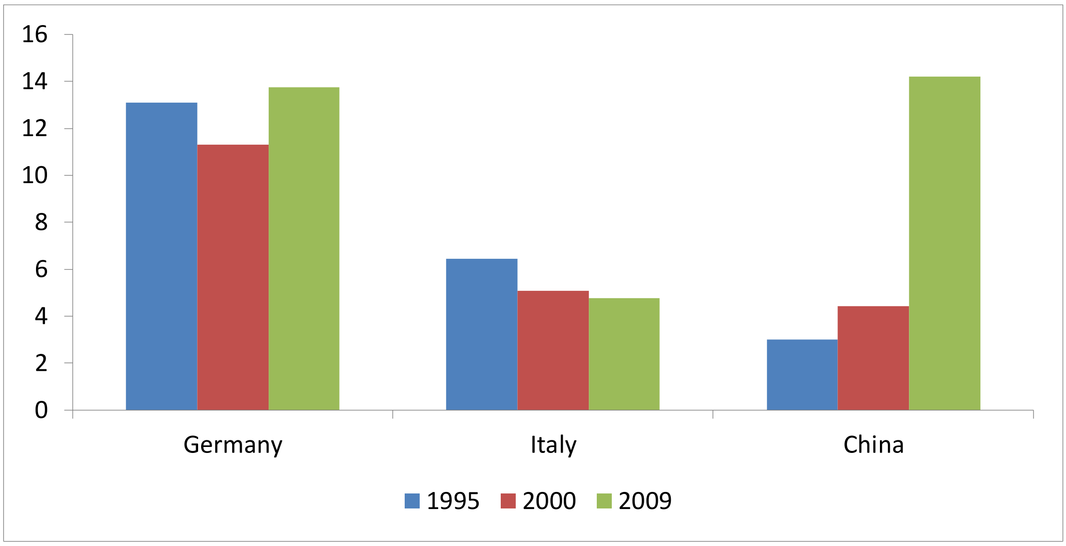
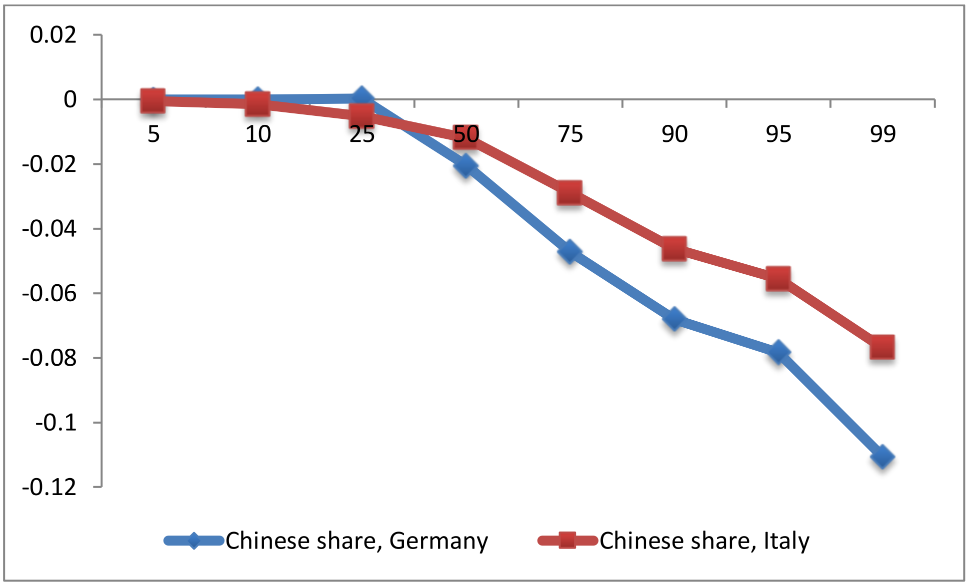
Figures

Figure 1. Manufacturing Export shares (%) of selected countries in OECD markets



Source: Authors' elaboration on UN Comtrade data accessed via WITS

Figure 2. Estimated Coefficients of China's competition (y-axis) by quantiles (x-axis)



Tables

Table 1. Summary Statistics

Italy

	Obs	**Mean**	**Std. Dev.**	**Min**	**Max**
Export Shares	43611	0.119	0.138	0	1
GDP (recipient country, per capita) real US$	41240	8448.09	12973.01	693.14	94908.01
Distance (Km)	43611	5798.50	3898.92	492.34	18572.15
Chinese Export Shares	43611	0.15	0.15	0	0.99

Germany

	Obs	**Mean**	**Std. Dev.**	**Min**	**Max**
Export Shares	45477	0.139	0.145	0	1
GDP (recipient country, per capita)	42806	8259.30	12829.5	693.14	94908.01
distance (km)	45477	6140.30	3817.70	173.52	18824.75
Chinese Export Shares	45477	0.14	0.14	0	0.99

Table 2. Italian and German export shares by quantile

Quantiles	Italian Shares	**Obs** (Italy)	German Shares	**Obs** (Germany)
5	0.0019022	2181	0.0029089	2273
10	0.0048151	4362	0.0062621	4548
25	0.0145556	10902	0.0191204	11370
50	0.0336912	21806	0.0445776	22739
75	0.0595038	32709	0.0761936	34107
90	0.0831829	39250	0.1024219	40929
95	0.0951938	41430	0.1147213	43204
99	0.1108353	43174	0.1307142	45022
top 10	0.4392739	4361	0.4667202	4548
top 5	0.5670441	2181	0.5975578	2273

Table 3. Average of Italian and German shares and number of observations of selected sectors in Machinery and transport equipment (7) and miscellaneous manufactured articles (8)

Sectors	Italian Shares	**Obs** (Italy)	German Shares	**Obs** (Germany)
71	0.124729	2645	0.164967	2779
72	**0.198553**	2722	**0.2162051**	2773
73	**0.185263**	2510	**0.2014911**	2622
74	0.135063	2753	0.1745163	2818
75	0.04424	2489	0.0996754	2697
76	0.046008	2559	0.0905934	2708
77	0.103942	2727	0.1538245	2806
78	0.0773	2675	0.1330409	2765
79	0.160658	2154	**0.2065598**	2348
81	*0.106442*	2559	0.1044963	2623
82	*0.150856*	2652	0.0688497	2607
83	*0.111728*	2294	0.0704372	2495
84	*0.137027*	2624	0.0912279	2687
85	*0.158162*	2543	0.0549303	2506
87	0.086135	2623	**0.2087672**	2801
88	0.107727	2346	**0.1937508**	2626
89	0.087751	2736	0.1180012	2816

Note: See Table A1in the Appendix for the precise description of the sectors at two digits

Table 4. Average of Italian and German shares and number of observations for different sectors and quantiles

sector/quantile	Export share (IT)	Obs (IT)	Export Share (DE)	Obs (DE)	Export share (IT)	Obs (IT)	Export Share (DE)	Obs (DE)
	25				**50**			
71	0.017	385	0.024	176	0.041	1105	0.064	913
72	0.016	91	0.026	89	0.047	348	0.067	440
73	0.015	213	0.022	263	0.040	580	0.056	825
74	0.020	188	0.029	91	0.047	861	0.071	763
75	0.011	1567	0.020	903	0.021	2132	0.043	1681
76	0.012	1606	0.020	1079	0.022	2182	0.040	1867
77	0.019	562	0.029	213	0.040	1489	0.064	1186
78	0.015	905	0.023	579	0.033	1772	0.049	1295
79	0.013	538	0.019	366	0.030	964	0.045	744
81	0.014	683	0.021	921	0.033	1320	0.042	1671
82	0.015	401	0.018	1347	*0.038*	1006	0.035	2064
83	0.012	605	0.016	1475	*0.033*	1210	0.031	2067
84	0.015	436	0.017	1324	*0.039*	1101	0.033	1962
85	0.013	426	0.014	1667	*0.034*	829	0.026	2164
87	0.018	840	0.025	49	0.035	1743	0.074	540
88	0.016	744	0.026	299	0.034	1482	0.057	964
89	0.018	712	0.028	529	0.037	1682	0.053	1593
	75				**95**			
71	0.072	1999	0.104	1892	0.106	2541	0.147	2656
72	0.097	1293	0.120	1439	0.162	2455	0.182	2531
73	0.083	1316	0.096	1552	0.144	2264	0.154	2350
74	0.083	1966	0.111	1886	0.118	2651	0.155	2677
75	0.029	2338	0.069	2335	0.039	2465	0.092	2651
76	0.030	2415	0.062	2417	0.039	2526	0.079	2662
77	0.064	2265	0.095	2026	0.086	2625	0.132	2665
78	0.051	2355	0.083	2044	0.068	2624	0.125	2709
79	0.057	1437	0.088	1338	0.102	1914	0.152	2069
81	0.059	1970	0.066	2229	*0.093*	2477	0.088	2540
82	*0.067*	1648	0.049	2414	*0.121*	2441	0.060	2558
83	*0.057*	1751	0.040	2284	*0.091*	2199	0.054	2428
84	*0.068*	1854	0.049	2331	*0.108*	2454	0.071	2587
85	*0.070*	1492	0.035	2352	*0.131*	2365	0.045	2469
87	0.052	2300	0.117	1527	0.069	2536	0.175	2562
88	0.052	1942	0.094	1694	0.075	2219	0.141	2353
89	0.058	2368	0.081	2347	0.077	2674	0.105	2737

Note: See Table A1in the Appendix for the precise description of the sectors at two digits, e.g. 85 footwear etc; DE stands for Germany; IT stands for Italy

Table 5. Sectors where both German and Italian export shares are higher than 0.15 across quantiles

	quantiles and countries							
Economic sectors	25 DE	25 IT	50 DE	50 IT	75 DE	75 IT	95 DE	95 IT
76	0.185	0.183	0.172	0.176	0.163	0.17	0.157	0.167
81	0.201	0.206	0.182	0.186	0.164	0.17	0.154	0.156
83	0.322	0.333	0.311	0.325	0.303	0.315	0.296	0.3
84	0.328	0.391	0.3	0.35	0.283	0.308	0.271	0.272
85	0.282	0.286	0.265	0.29	0.257	0.276	0.253	0.248
88	0.215	0.207	0.19	0.184	0.171	0.183	0.155	0.181
89	0.255	0.255	0.23	0.234	0.21	0.216	0.2	0.208

Note: See Table A1in the Appendix for a full description of the sectors; DE stands for Germany; IT stands for Italy

Table 6. Chinese Shares estimated effect on Germany and Italy and corresponding distances

Quantiles	Chinese share, Germany	Chinese share, Italy	Distance Germany	Distance Italy
5	-0.0000777	-0.0005342	-0.0000106	**-0.0004508**
10	-0.0000453	**-0.0015015**	-0.0002261	**-0.0011009**
25	0.0002474	**-0.0052483**	**-0.0010034**	**-0.0039536**
50	**-0.0205097**	**-0.0119869**	**-0.0151221**	**-0.0094808**
75	**-0.0471835**	**-0.0289698**	**-0.0227761**	**-0.0155938**
90	**-0.0680817**	**-0.0462765**	**-0.0279063**	**-0.0188169**
95	**-0.0784098**	**-0.0555281**	**-0.0278912**	**-0.019211**
99	**-0.1106498**	**-0.0769632**	**-0.0213854**	**-0.0166017**
top 10	**-0.4567923**	**-0.3513537**	**0.0622206**	**0.0337083**
top 5	**-0.5366606**	**-0.43835**	**0.0713893**	**0.0512402**
Tot	**-0.1303854**	**-0.1036476**	**-0.0169577**	**-0.0129088**

Note: Statistically significant coefficients in bold. Detailed results and diagnostic tests in Appendix A

Table 7. The estimated impact of destination countries' GDP on the export shares of Germany and Italy: the linear coefficients and the estimated thresholds (in $) by quantiles.

quantiles	GDP on German Shares	GDP on German Shares (squared)	GDP on Italian shares	GDP on Italian shares (squared)	Threshold GDP On Germany	Threshold GDP on Italy
5	**-0.00034**	**0.0000251**	-1.59E-06	3.63E-06	**923.975**	1.245
10	**-0.00085**	**0.0000747**	-0.00029	0.000033	**289.844**	85.627
25	**-0.00143**	**0.0001254**	0.001404	-5.8E-05	**303.963**	196319.753
50	**-0.00546**	**0.0003685**	**0.004764**	**-0.00024**	**1643.772**	**17221.093**
75	**-0.00875**	**0.0005353**	**0.010334**	**-0.00064**	**3549.878**	**3148.117**
90	**-0.0146**	**0.0008278**	**0.011025**	**-0.00077**	**6751.965**	**1266.467**
95	**-0.02322**	**0.0013074**	**0.006929**	**-0.00058**	**7175.465**	**384.317**
99	**-0.043**	**0.0024463**	**-0.00807**	0.000226	**6559.842**	58509556.93
top 10	**-0.04103**	**0.0028568**	-0.01812	0.000113	**1315.496**	6.2018E+34
top 5	0.013934	-0.000633	0.000435	-0.00092	60568.961	1.265979318
total	**-0.04242**	**0.0023954**	**-0.01705**	**0.000727**	**7006.665**	**124497.341**

*Note: **Maximum**: positive sign on levels, negative sign on squared; **Minimum**: negative sign on levels, positive sign on squared. For a detailed description see Wooldridge (2008). Statistically significant coefficients in bold. Detailed results and diagnostic tests in Appendix A*

Appendix A

Table A.1. Description of 2-digit industries, SITC classification Rev. 3

SITC code	Description
71	Power generating machinery and equipment
72	Machinery specialized for particular industries
73	Metalworking machinery
74	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
75	processing machines
76	Telecommunications and sound recording and reproducing apparatus and equipment
77	Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non- electrical counterparts, n.e.s., of electrical household type equipment)
78	cushion vehicles)
79	Other transport equipment
81	Prefabricated buildings; sanitary, plumbing, heating and lighting fixtures and fittings, n.e.s.
82	Furniture, and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings
83	Travel goods, handbags and similar containers
84	Articles of apparel and clothing accessories
85	Footwear
87	Professional, scientific and controlling instruments and apparatus, n.e.s.
88	Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks
89	Miscellaneous manufactured articles, n.e.s.

Table A2. Results, selected quantiles of export share and total, Germany

VARIABLES	Quantile 25 Export Shares DE	Quantile 50 Export Shares DE	Quantile 75 Export Shares DE	Total Export Shares DE
Export Shares DE (log, lag 1)	0.0010	0.0694***	0.203***	0.573***
	(0.00163)	(0.0226)	(0.0343)	(0.0370)
GDP (per capita, log)	-0.00143*	-0.00546**	-0.00875**	-0.0424***
	(0.000736)	(0.00264)	(0.00342)	(0.00641)
GDP (per capita, log, squared)	0.000125**	0.000368**	0.000535**	0.00240***
	(4.97e-05)	(0.000168)	(0.000234)	(0.000350)
Distance (log)	-0.00100***	-0.0151***	-0.0228***	-0.0170***
	(0.000305)	(0.000755)	(0.00164)	(0.00213)
Export Shares CH (log)	0.000247	-0.0205***	-0.0472***	-0.130***
	(0.000621)	(0.00412)	(0.00756)	(0.0210)
Constant	0.0196***	0.216***	0.315***	0.395***
	(0.00509)	(0.0121)	(0.0202)	(0.0431)
Observations	3,807	19,932	29,956	39,056
Industry fixed effects	Yes	Yes	Yes	Yes
Log likelihood	15893	47122	57171	43421
σ_j	6.89e-09	9.46e-12	1.64e-11	2.86e-11
σ_t	.0002039	.0017117	.0032484	.0074438
σ_{res}	.0037162	.0227011	.035784	.0793868
Hausman Test: chi2(3) = 0.08 Prob>chi2 = 0.99				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3. Results, selected quantiles of export share and total, Italy

VARIABLES	Quantile 25 Export Shares IT	Quantile 50 Export Shares IT	Quantile 75 Export Shares IT	Total Export Shares IT
Export Shares IT (log, lag 1)	0.00860	0.0822***	0.223***	0.606***
	(0.00568)	(0.0217)	(0.0369)	(0.0310)
GDP (per capita, log)	0.00140	0.00476**	0.0103***	-0.0170***
	(0.00134)	(0.00206)	(0.00296)	(0.00420)
GDP (per capita, log, squared)	-5.76e-05	-0.000244*	-0.000641***	0.000727***
	(9.50e-05)	(0.000145)	(0.000177)	(0.000211)
Distance (log)	-0.00395***	-0.00948***	-0.0156***	-0.0129***
	(0.000359)	(0.000575)	(0.000950)	(0.00108)
Export Shares CH (log)	-0.00525***	-0.0120***	-0.0290***	-0.104***
	(0.00185)	(0.00445)	(0.00721)	(0.0140)
Constant	0.0461***	0.0987***	0.149***	0.246***
	(0.00474)	(0.0105)	(0.0153)	(0.0252)
Observations	9,611	19,500	29,293	38,203
Industry fixed effects	Yes	Yes	Yes	Yes
Log Likelihood	32035	49808	59759	43356
σ_j	2.87e-10	1.06e-11	1.42e-11	2.39e-11
σ_t	.0005867	.0021258	.0034303	.0060017
σ_{res}	.0086161	.0187337	.0313475	.0776216
Hausman Test: chi2(3) = 0.12 Prob>chi2 = 0.76				

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4.a: Robustness Checks Germany

Variables	Total Whole Sample Export Shares DE	Total Whole Sample Export Shares DE (more controls)	Total Whole Sample Export Shares DE (1995-2007)
Export Shares DE (log, lag 1)	0.573***	0.566***	0.565***
	(0.037)	(0.037)	(0.038)
GDP (per capita, log)	-0.0424***	-0.038***	-0.044***
	(0.00641)	(0.006)	(0.007)
GDP (per capita, log, squared)	0.00240***	0.002***	0.002***
	(0.00035)	(0.0004)	(0.00035)
Distance (log)	-0.0170***	-0.014***	-0.013***
	(0.00213)	(0.002)	(0.002)
Export Shares CH (log)	-0.130***	-0.133***	-0.145***
	(0.021)	(0.021)	(0.023)
Constant	0.395***	0.359***	0.374***
	(0.0431)	(0.041)	(0.042)
UE28		-0.001	0.001
		(0.001)	(0.002)
Contiguity		0.027***	0.030***
		(0.004)	(0.004)
Observations	39,056	39,056	33,658
Industry fixed effects	Yes	Yes	Yes
Log Pseudo-Likelihood	43421	43531.32	36433.143
σ_j	2.86E-11	2.87E-11	3.64E-11
σ_t	0.007444	0.0074889	0.0063391
σ_{res}	0.079387	0.0791606	0.0818003

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table A4.b: Robustness Checks Italy

Variables	Total Whole Sample Export Shares IT	Total Whole Sample Export Shares (more controls)	Total Whole Sample Export Shares IT (1995-2007)
Export Shares IT (log, lag 1)	0.606***	0.596***	0.596***
	(0.031)	(0.032)	(0.031)
GDP (per capita, log)	-0.0170***	-0.021***	-0.023***
	(0.0042)	(0.005)	(0.005)
GDP (per capita, log, squared)	0.000727***	0.001***	0.001***
	(0.000211)	(0.00015)	(0.00018)
Distance (log)	-0.0129***	-0.017***	-0.018***
	(0.00108)	(0.001)	(0.002)
Export Shares CH (log)	-0.104***	-0.107***	-0.117***
	(0.014)	(0.015)	(0.017)
Constant	0.246***	0.290***	0.308***
	(0.0252)	(0.032)	(0.035)
EU28		-0.016	-0.017
		(0.0011)	(0.001)
Contiguity		0.005**	0.007***
		(0.002)	(0.003)
Observations	38203	38,203	32,980
Industry fixed effects	Yes	Yes	Yes
Log Pseudo-Likelihood	43356	43468.4	36303.238
σ_j	2.39E-11		3.71E-11
σ_t	0.0060017		0.005997
σ_{res}	0.0776216		0.0803238

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1