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Productivity premia for German manufacturing firms exporting to the Euro-area and beyond: First evidence from robust fixed effects estimations

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Abstract:

This paper makes three contributions. (1) It summarizes in tabular form a recent literature made of 36 micro-econometric studies for 16 different countries on the relationship between export destination and firm performance. (2) It reports estimates of the productivity premium of German firms exporting to the Euro-zone and beyond, controlling for unobserved time invariant firm specific effects, and tests for self-selection of more productive firms into exporting beyond the Euro-zone. (3) It corrects a serious flaw in hitherto published studies that ignore the potentially disastrous consequences of extreme observations, or outliers. The paper shows that estimates of the exporter productivity premium by destination are driven by a small share of outliers. Using a "clean" sample without outliers the estimated productivity premium of firms that export to the Euro-zone only is no longer much smaller that the premium of firms that export beyond the Euro-zone, too, and the premium itself over firms that serve the German market only is tiny. Furthermore, an ex-ante differential that is statistically significant and large only shows up for enterprises that exported to the Euro-zone already and start to export to countries outside the Euro-zone. These conclusions differ considerably from those based on non-robust standard regression analyses.

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Keywords: Robust estimation, panel data, exporter productivity premium, export destinations
JEL Classification: F14, C23, C81, C87

[*] All computations were done in the research data centre of the Statistical Office in Berlin. The data used are confidential but not exclusive; information how to access the data is provided in Zühlke et al. (2004). To facilitate replication and extensions Stata code for the robust estimation of fixed effects linear panel data models is available from the fist author, and the Stata do-files used to compute the empirical results in the application are available from the second author on request.

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1. Motivation

Differences between exporting and non-exporting firms have been a core topic in the literature on the micro-econometrics of international firm activities that started with the pioneering paper by Bernard and Jensen (1995) and that is surveyed in Greenaway and Kneller (2007) and in Wagner (2007a). This literature shows, among others, that exporters are more productive than non-exporters. Germany is a case in point; productivity differentials in favour of exporting firms compared to firms that sell their products on the national market only are found to be statistically significant and economically important even when observed and unobserved firm characteristics are controlled for.[1]

According to findings from this literature, this productivity differential tends to be due to self-selection of more productive plants on export markets, and to a market driven selection process in which exporters that have low productivity fail as a successful exporter, while only those that are more productive continue to export. The reason for this is that there exist additional costs of selling goods in foreign countries. The range of extra costs include transportation costs, distribution or marketing costs, personnel with skill to manage foreign networks, or production costs in modifying current domestic products for foreign consumption. These costs provide an entry barrier that less productive firms cannot overcome. The findings from this empirical literature triggered a new generation of theoretical models for international activities of heterogeneous firms (see Melitz (2003) for the canonical model and Helpman (2006) for a survey).

[1] Wagner (2007c) is a comprehensive study using panel data for manufacturing plants from the official census for the years 1995 to 2004. Results from earlier studies are summarized in tabular form in Wagner (2007a).

This implies that plants that export to a larger number of foreign markets have to be more productive than plants that serve a smaller number of foreign markets only, because at least some of the extra costs mentioned recur for each market (e.g., preparing a user's manual in another language, or checking the relevant national laws). Lawless (2009) presents a simple theoretical model that builds on the seminal contributions by Melitz (2003) and Chaney (2008) and that has this testable prediction. Furthermore, it seems plausible to assume that the larger the number of markets the higher will be (at least, on average) the distance related costs of exporting an exporter has to bear.

In empirical studies only recently exports by a firm are broken down by destination regions or countries. As the first contribution to the literature the appendix to this paper summarizes 36 micro-econometric studies on export destination and firm performance for 16 different countries, most of which are highly industrialized western countries. These studies are mostly of a recent vintage – the first one was published in 2003, and many papers are still in a working paper state.

Looking at export destinations reveals new insights and sheds light on hitherto not known facts. This is especially true for studies that are based on panel data, because longitudinal data allows controlling for unobserved heterogeneity via fixed effects. Furthermore, panel data offer the opportunity to look at the direction of the relationship between firm performance (usually, productivity) and destination of exports by testing for the presence of ex-ante differences (that existed before exporting to a destination started) and positive effects of exporting to a destination on firm performance (learning-by-exporting to a destination).

Although results are not strictly comparable between the studies due to differences in, among others, the number and type of destinations looked at (e.g., EU vs. non-EU; areas defined according to per-capita income; or a large number of

destination countries), the definition of the sample used (establishments or enterprises; cut-off point of number of employees), the period under investigation, and the statistical methods applied,[2] a big picture emerges that can be sketched as follows:

The bulk of exporting firms trades with only a few countries; the lion's share of exports is done by few large firms that export to a large number of countries; the number of export destinations is positively related to productivity and firm size; we have evidence for self-selection of more productive firms into more demanding markets - while the jury is still out regarding the issue of different learning-by-exporting effects by different export destinations. These findings are in line with the expectations based on theoretical considerations stated above.

For Germany, one of the leading actors on the world market for goods, however, there is next to no empirical evidence on the relationship between firm performance and the destinations of exports. The reason for this lack of evidence is the lack of firm level data for the destination of exports. The only distinction with regard to the destination of exports that is made in the surveys of firms performed by the German Statistical Offices is between exports to countries within the Euro-zone[3] and exports to countries outside the Euro-zone, and these data are only available for the years since 2003.

Wagner (2007b) uses cross-section data for 2004 to document that German firms that export to countries inside the Euro-zone only are more productive than

[2] See International Study Group on Exports and Productivity (ISGEP) (2008) for an empirical investigation that uses an identical approach to investigate the nexus between exports and productivity (without considering the destination of exports) with firm level data from 14 different countries to document stylized facts that hold for all countries and to investigate cross-country differences.

[3] In 2003 the member states of the Euro-zone were Austria, Belgium, Germany, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain; Slovenia joined the Euro-zone on January 1, 2007, Malta and Cyprus on January 1, 2008, and Slovakia on January 1, 2009.

firms that sell their products in solely in Germany, but less productive than firms that export to countries outside the Euro-zone, too. This empirical results is in line with theoretical expectations: A plant that exports to, say, the US has to deal with all extra costs due to changes in the exchange rate between the euro and the dollar, while an exporter that serves markets where the euro is the local currency does not need to take care of this. Furthermore, transportation costs and other export related costs can be expected to be higher on average for serving markets outside the euro-zone. Therefore, only the more productive firms can overcome these higher export costs.

While the findings in Wagner (2007b) fit into the big picture sketched above that emerges from the international literature it should be noted that this study uses cross section data only, and, therefore, neither the control for unobserved firm specific effects nor the investigation of the direction of causality between productivity and size of the export market was possible in this study.

The second contribution of this paper is to extend the study of Wagner (2007b) by using longitudinal firm level data for the years 2003 to 2006 to estimate the productivity premium of German firms exporting to the Euro-zone and beyond, controlling for unobserved time invariant firm specific effects in a linear fixed-effects panel data model, and to test for self-selection of more productive firms into exporting beyond the Euro-zone.[4]

The third contribution made by this paper is to correct a serious flaw in hitherto published studies on productivity and export destinations – and in empirical studies on firm performance and international firm activities in general – namely to ignore the

[4] Note that a test for differences in learning-by-exporting from exporting to the Euro-zone only and from exporting to the larger market including countries outside the Euro-zone is not possible because the data are available for the four years from 2003 to 2006 only – a time span too short to identify firms that start to export to one of the destinations and to follow these starters over time, comparing their performance to the performance of comparable non-starting firms.

potentially disastrous consequences of extreme observations, or outliers. If one investigates a sample of heterogeneous economic units it often happens that some variables for some firms are far away from the other observations in the sample. These extreme observations, or outliers, often have a large impact on the results of statistical analyses – conclusions based on a sample with and without these units may differ drastically.

While applied researchers tend to be aware of this, the detection of outliers and their appropriate treatment is usually not considered as an important issue. Often the distribution of some variables with extreme values is trimmed by dropping the top or bottom one percent of observations or so,[5] or other ad hoc procedures are used. Given the large literature on statistical methods that are robust to outliers[6] and the (at least, potentially) detrimental consequences of ignoring them this habit should change.

One reason for the usually sloppy habit towards outliers seems to lie in the lack of availability of appropriate canned programs in the popular software used by applied economists. At least with regard to Stata this changed recently due to the publication of code for highly robust methods in Verardi and Croux (2009) where, however, methods for the robust analysis of cross section data are dealt with only. Fixed effects models for panel data that are highly popular in the empirical investigation of the relation between firm performance and international firm activities (and in applied economics in general) are not covered. In this paper we will close this gap by applying a highly robust procedure for the estimation of linear fixed effects panel data models.

[5] Examples from the literature dealt with in this paper include Wagner (2007b) and International Study Group on Exports and Productivity (ISGEP) (2008).

[6] For a recent comprehensive textbook treatment see Maronna, Martin and Yohai (2006)

To preview the most important finding, a comparison of results from the non-robust standard approach and from the new highly robust estimator demonstrates that estimates of the exporter productivity premium by destination are driven by a small share of firms which are identified as outliers. Using a "clean" sample without outliers the estimated productivity premium of firms that export to the Euro-zone only is no longer much smaller that the premium of firms that export beyond the Euro-zone, too – the difference in the premium does no longer show up, and the premium itself over firms that serve the German market only is tiny.

The rest of the paper is organized as follows. Section 2 gives information on the data used in the empirical investigation and reports descriptive statistics on export activities of firms by area of destination. Section 3 presents estimated productivity premia of exporters by area of export destination based on a non-robust standard approach that ignores the outlier problem; furthermore, ex-ante productivity premia of export starters by destination are investigated. Section 4 outlines the algorithm for the highly robust estimation method for linear fixed effects panel data models that is used in section 5 to document the influence of outliers on the estimation results from the non-robust standard approach presented in section 3. Section 6 concludes.

2. Data and descriptive statistics

The empirical investigation uses data from an unbalanced panel of enterprises that is built from cross section data collected in regular surveys of establishments by the Statistical Offices of the German federal states. Establishment data were aggregated to the enterprise level. The surveys cover all establishments from mining[7] and

[7] Given that there are only a few establishments from mining industries we will use the term manufacturing industries to describe our sample in this paper.

manufacturing industries that employ at least twenty persons in the local production unit or in the company that owns the unit. Participation of firms in the survey is mandated in official statistics law, and the firms have to report the true figures.[8]

In this data set *export* refers to the amount of sales to a customer in a foreign country plus sales to a German export trading company; indirect exports (for example, tires produced in a plant in Germany that are delivered to a German manufacturer of cars who exports some of his products) are not covered by this definition. From 2003 onwards the firms have to report the value of exports to countries inside the Euro-zone and to countries beyond the Euro-zone separately. In 2003 the member states of the Euro-zone were Austria, Belgium, Germany, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain; Slovenia joined the Euro-zone on January 1, 2007, Malta and Cyprus on January 1, 2008, and Slovakia on January 1, 2009. This study uses data for 2003 to 2006, a time span during which membership of countries in the Euro-zone did not change.

Enterprises are divided into four groups: Non-exporting firms, firms with exports to the Euro-zone only, firms with exports to the non-Euro-zone only, and firms that export both to the Euro-zone and to countries outside the Euro-zone. The shares of enterprises from the four groups in all enterprises in the sample in the four years covered in this study are reported in table 1.[9]

[8] For a description of the data see Malchin and Voshage (2009). Note that the micro level data are strictly confidential and for use inside the Statistical Office only, but not exclusive. Information how to access the data is given in Zühlke et al. (2004).

[9] Given that the East German economy still differs in many respects, and especially with regard to exporting, from the West German economy, this study looks at West German manufacturing enterprises only. For a discussion of the differences in exporting between West German and East German manufacturing firms see Wagner (2008).

[Table 1 near here]

Three in four enterprises in manufacturing industries in West Germany are exporters. Most of the exporters report exports to countries within the Euro-zone and beyond the Euro-zone; the share of exporting enterprises that export to countries from the Euro-zone only is some twenty percent and it is declining slightly over time (from 21.35 percent in 2003 to 18.91 percent in 2006). Note that the number of firms that export to countries outside the Euro-zone only is tiny. Firms from this rather special group are dropped from all computations in this study.[10]

Productivity is measured as total sales per employee, i.e. labour productivity. More appropriate measures of productivity like value added per employee (or per hour worked), or total factor productivity, cannot be computed because of a lack of information on hours worked, value added, and the capital stock[11] in the surveys. Controlling for the industry affiliation, however, can be expected to absorb much of the differences in the degree of vertical integration and capital intensity.[12]

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[10] The data are confidential, and it is not possible to look at the records for these enterprises with exports to non-Euro-zone countries only in detail. Anecdotal evidence, however, points to small firms located next to the German border that trade with customers "around the corner" on the other side of this border only, and these customers might be located in Denmark, Poland, the Czech Republic, or Switzerland – neighbor countries that do not belong to the Euro-zone. In a sense these firms are special case, falling in between the groups of exporters and firms serving the German market only. Therefore, following Wagner (2007b) these firms are dropped from all empirical investigations here.

[11] The survey has information about investment that might be used to approximate the capital stock. A close inspection of the investment data, however, reveals that many firms report no or only a very small amount of investment in many years, while others report huge values in one year. Any attempt to compute a capital stock measure based on these data would result in a proxy that seems to be useless.

[12] Note that Bartelsman and Doms (2000, p. 575) point to the fact that heterogeneity in labor productivity has been found to be accompanied by similar heterogeneity in total factor productivity in

3. Productivity premia of exporters by area of export destination: Results from a non-robust standard approach

The first step in our empirical investigation is a test for differences in the so-called exporter premia - the ceteris paribus percentage difference of labor productivity between exporters and non-exporters - between the two groups of firms that export to different geographical areas. Specifically, we will test whether the results reported in Wagner (2007b) that are based on cross-section data for 2004 and that document that German firms that export to countries inside the Euro-zone only are more productive than firms that sell their products solely in Germany, but less productive than firms that export to countries outside the Euro-zone, too, can be observed when pooled data for 2003 to 2006 are used and when unobserved time-invariant firm specific characteristics are controlled for.

The exporter productivity premia are estimated from a regression model in which log labour productivity is regressed on the current exporter status dummy and a set of control variables:

$$\ln LP_{it} = a + ß\ Export_{it} + c\ Control_{it} + e_{it} \qquad (1)$$

where i is the index of the firm; t is the index of the year; LP is labor productivity; Export is a vector of two dummy variables indicating whether or not an enterprise belongs to the group of firms that export to countries inside the Euro-zone only or to both countries inside the Euro-zone and beyond; Control is a vector of control

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the reviewed research where both concepts are measured. Furthermore, Foster, Haltiwanger and Syverson (2005) show that productivity measures that use sales (i.e. quantities multiplied by prices) and measures that use quantities only are highly positively correlated.

variables including dummy-variables for two-digit industries and years; and e is an error term. The exporter premium, computed from the estimated coefficient ß as 100(exp(ß)-1), shows the average percentage difference between exporters from one of the two different groups and non-exporters, controlling for the characteristics included in the vector Control.[13] To control for unobserved plant heterogeneity due to time-invariant firm characteristics which might be correlated with the variables included in the empirical model and which might lead to a biased estimate of the exporter premia, (1) is augmented by adding fixed enterprise effects .

Results are reported in table 2. The exporter productivity premia computed from the estimates for the coefficients of the exporter status dummy variables are positive and statistically significant at an error level of less than one percent for both empirical models with and without fixed enterprise effects – exporters are more productive that non-exporting firms.

[Table 2 near here]

Results from the empirical model without fixed enterprise effects point to a distinct hierarchy as regards the productivity premium: Enterprises that export to both countries inside and outside the Euro-zone have the highest productivity premium compared to firms that sell their products in Germany only, followed by firms that

[13] Note that the regression equation specified in (1) is not meant to be an empirical model to explain labor productivity at the plant level; the data set at hand here is not rich enough for such an exercise. Equation (1) is just a vehicle to test for, and estimate the size of, exporter premia controlling for industry affiliation. Furthermore, note that productivity differences at the firm level are notoriously difficult to explain empirically. “At the micro level, productivity remains very much a measure of our ignorance.” (Bartelsman and Doms 2000, p. 586)

export inside the Euro-zone only. According to the 95% confidence intervals reported the differences between both groups of exporting firms is statistically significant at a usual error level. Both the estimated premia and the difference in these premia are large from an economic point of view.

Controlling for unobserved time-invariant firm characteristics by adding fixed enterprise effects changes the results considerably. While the estimated productivity premia are still statistically significant for both groups of firms and large from an economic point of view, the point estimates decline by a factor of 3.5.[14] The hierarchy of premia, however, is the same as in the model without fixed effects, and the difference between the estimated premia for firms that export to the Euro-zone only and firms that export beyond the Euro-zone, too, is statistically significant at an error level of five percent, and large from an economic point of view.

The big picture is well in line with our priors: An enterprise that exports to a country outside the Euro-zone where the Euro is not the local currency has to take care of the exchange rate risk and hedging is costly. Furthermore, transportation costs and other export related costs can be expected to be higher on average for serving markets outside the euro-zone. Therefore, only the more productive firms can overcome these export costs that are higher than the export costs facing firms that export to countries inside the Euro-area only. This result still holds when unobserved firm heterogeneity is controlled for by including fixed firm effects in the empirical model.

As stated in the introductory section of this paper, one of two hypotheses discussed in the literature on the linkages between productivity and exporting points

[14] This result – considerably lower estimated exporter premia in empirical models including fixed effects – is standard in micro-econometric studies of firm performance and international activities; see Wagner (2007b) for Germany and International Study Group on Exports and Productivity (2008) for evidence from several countries.

to self-selection of the more productive firms into export markets. To shed light on the empirical validity of the hypothesis that the more productive firms go abroad, and to test for differences among groups of export starters that begin to export to different areas of destination, the pre-entry differences in productivity between export starters and non-exporters are investigated next.

If good firms become exporters we should expect to find significant differences in productivity between future export starters and future non-starters in the years before some of them begin to export. If entry costs are higher in foreign markets outside the Euro-zone than inside we should expect to find significant differences in these ex-ante productivity premia by the area of destination a firm starts exporting to. A way to test whether today's export starters were more productive than today's non-exporters several years back when all of them did not export and whether firms that start to export beyond the Euro-zone were more productive than firms that start to export inside the Euro-zone is to select all firms that did not export at all (or that did export to the Euro-area only) between year t-3 and t-1, and to estimate labor productivity premia of different types of future exporters compared to future non-exporters controlling for industry affiliation by estimating the empirical model

$$\ln LP_{it-n} = a + ß\ Export_{it} + c\ Control_{it-n} + e_{it} \qquad (2)$$

where i is the index of the firm; t is the index of the year (2006 in our case); LP is labor productivity in year t-n (where n is either 3, or 2, or 1 and t-2, therefore, is either 2003, or 2004, or 2005); Export is a vector of (mutually exclusive) dummy variables indicating whether an enterprise did not export between 2003 and 2005 but starts to export to the Euro-zone in 2006, whether it did not export between 2003 and 2005 but starts to export to the Euro-zone and beyond in 2006, and whether a firm

exported to the Euro-zone only in 2003 to 2005 and starts to export outside the Euro-zone in 2006; Control is a vector of 2digit industry dummies; and e is an error term. The pre-entry premium, computed from the estimated coefficient ß as 100(exp(ß)-1), shows the average percentage difference between today's exporters of one of the three types defined above and today's non-exporters n years before starting to export, controlling for industry affiliation.

Results are reported in table 3. While the point estimates of all premia are positive across the three types of export starters and the three years, the coefficients are not statistically significantly different from zero at an error level of five percent in the case of firms starting to export to the Euro-zone only. The estimated premia for the two other types of export starters – firms that did not export between 2003 and 2005 but start to export to the Euro-zone and beyond in 2006, and firms that exported to the Euro-zone only in 2003 to 2005 and start to export outside the Euro-zone in 2006 – are statistically highly significant and rather large from an economic point of view in all years. The overlapping confidence intervals point to no statistically significant differences between the premia for these two types of starters, and the same holds when the estimates are compared over the three years before the export start.[15]

[Table 3 near here]

The findings with regard to ex-ante productivity premia of future export starters and differences in these premia between groups of export starters that begin to export to different areas of destination, therefore, can be summarized as follows:

[15] This is in contrast to findings by Bellone et al. (2008) who report that prior to entry into exports firm productivity temporarily decreases.

There is empirical evidence that more productive German manufacturing enterprises self-select into export activities beyond the Euro-zone, while no such evidence is found for enterprises that start to export inside the Euro-zone only.

4. Robust estimation of linear fixed effects panel data models

The empirical investigations performed in section 3 above followed an approach that is standard in the literature on the micro-econometrics of international firm activities, and that tends to ignore the potential problems that are caused by enterprises that are characterized by having values for one or more variables that are extremely different compared to the bulk of all other enterprises – firms that can be termed outliers.

In cross-sectional regression analysis, three types of outliers can cause least squares to breakdown. Rousseeuw and Leroy (1987) define them as vertical outliers, bad leverage points and good leverage points. Vertical outliers are observations that are outlying in the y-dimension but not in the space of the explanatory variables (x-variables). Their existence affects both the estimation of the intercept and of the regression coefficients, but the effect on the latter is milder. Bad leverage points are observations that are both outlying in the space of the explanatory variables and located far from the regression line. They severely affect the estimation of both the intercept and the slope coefficients. Finally, good leverage points are observations that are outlying in the space of the explanatory variables but are located close to the regression line. Their existence only marginally influences the estimation of both the intercept and the regression coefficients but does affect inference.

The classical way of estimating parameters in regression analysis is to minimize the sum of square residuals (i.e. vertical distances between points and the

regression line or hyperplane). However, by minimizing squared residuals, an excessive importance is awarded to outliers.

Technically speaking, consider the regression model

$$y_i = \alpha + x_i'\theta + \varepsilon_i$$

where y_i is the scalar dependent variable and x_i is the (*px1*) vector of covariates observed for *i=1,...N*. When estimating parameter vector θ by ordinary least squares (LS), the sum of squared residuals is minimized, i.e. $\theta_{LS} = \underset{\theta}{argmin} \sum_{i=1}^{N} r_i^2(\theta)$

with $r_i = y_i - \hat{\alpha} - x_i'\hat{\theta}$ for $1 \leq i \leq N$. By squaring the residuals, LS awards excessive importance to observations with very large residuals (i.e. outliers) and, consequently, estimated parameters are distorted if outliers are present. To cope with this, Huber (1964) introduced the class of M-estimators where the sum of a ρ function of the

residuals is minimized instead of the square. Function $\rho(\cdot)$ is even, non decreasing

for positive values and less increasing than the square. The resulting vector of parameters estimated by M is then $\theta_M = \underset{\theta}{argmin} \sum_{i=1}^{N} \rho\left(\frac{r_i^2(\theta)}{\sigma}\right)$. The residuals are

standardized by a measure of dispersion σ to guarantee scale equivariance (i.e. independence with respect to the measurement units of the dependent variable). M-

estimators are called monotone if $\rho(\cdot)$ is convex over the entire domain and

redescending if $\rho(\cdot)$ is bounded. The practical implementation of M-estimators uses

an iteratively reweighted least squares algorithm. Indeed, let us assume that σ is known. Defining weights $\omega_i = \rho\left(\frac{r_i}{\sigma}\right)/r_i^2$, the equation relative to the M-estimator can be rewritten as $\theta_M = \underset{\theta}{argmin} \sum_{i=1}^{N} \omega_i r_i^2(\theta)$ which is a weighted least-squares estimator. However, since weights ω_i are a function of θ and are thus unknown, parameters should be estimated relying on iteratively reweighted least squares algorithm. An obvious drawback of the method is that σ is not known in advance and must be estimated at each step using residuals fitted in the previous step of the iterative the algorithm. This implies (for reasons that we do not comment given that we believe they are above of the scope of this paper) that the procedure is guaranteed to converge to the global minimum only for monotonic M-estimators, which are known to not be robust with respect to bad leverage points. Robustness can be however achieved by tackling the problem from a different perspective. Remember that LS is based on the minimization of the variance of the residuals. However, since the variance is highly sensitive to outliers, LS will be sensitive to them as well. An interesting idea would thus be to minimize a measure of dispersion of the residuals that is less sensitive to extreme values. Relying on this idea, Rousseeuw and Yohai (1987), introduce S-estimators. The intuition behind this class of estimators is the following. Recall that in LS, the objective is to minimize the variance of the residuals defined as $\sigma^2 = \frac{1}{n}\sum_{i=1}^{n} r_i^2(\theta)$; this expression can be

rewritten as $1 = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{r_i(\theta)}{\sigma}\right)^2$ and LS consists in looking for the minimal σ that satisfies the equality. As stated previously, the square value can be damaging as it gives a huge importance to large residuals. Thus, to increase robustness, the square function could be replaced by another $\tilde{\rho}$ function which awards less importance to large residuals[16]. The estimation problem would now consist in finding the smallest σ that satisfies equality $1 = \frac{1}{n}\sum_{i=1}^{n}\tilde{\rho}\left(\frac{r_i(\theta)}{\sigma}\right)$. Naturally, if data are Gaussian, the estimated parameter $\hat{\sigma}$ would not coincide with the standard deviation and a correction factor is needed to ensure Gaussian consistency. The problem therefore consists in finding the minimal σ^S that satisfies: $\frac{1}{n}\sum_{i=1}^{n}\tilde{\rho}\left(\frac{r_i(\theta)}{\sigma^S}\right)$=b where $b=E[\rho(Z)]$ with

$Z \sim N(0,1)$[17]. Function $\tilde{\rho}$ generally used is the Tukey Biweight defined as

$$\rho(u) \equiv \begin{cases} \frac{u^2}{2} - \frac{u^4}{2k^2} + \frac{u^6}{6k^4} & \text{for} \quad |u| \le k, \\ \frac{k^2}{6} & \text{for} \quad |u| > k, \end{cases}$$

To guarantee a 50% breakdown point (i.e. a resistance to up to 50% of outliers), tuning parameter k is set to 1.546. The pitfall of this estimator is that it has a Gaussian efficiency of only about 28%.

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[16] Remember, ρ(·) is a function which is even, non decreasing for positive values, less increasing than the square with a unique minimum at zero.

[17] That is to say the population counterpart for gaussian data.

To overcome this problem, Yohai (1987) suggests to use an S-estimator to robustly estimate scale parameter σ and then fit an M-estimator as described above fixing the scale parameter to σ^S. By fixing the scale parameter to σ^S, a 50% breakdown point is guaranteed. Furthermore, by choosing an adequate function *ρ* the Gaussian efficiency can be increased without affecting the maximal contamination the estimator can withstand. For example, the final M-estimator with fixed scale σ^S and Tukey Biweight *ρ* function with tuning parameter *k*=6.25 would lead to a 50% breakdown point and 99% efficiency. He defined this class of estimators MM-estimators.

The maximisation problem therefore becomes

$$\theta_{MM} = \underset{\theta}{argmin} \sum_{i=1}^{n} \rho\left(\frac{r_i^2(\theta)}{\sigma^S}\right)$$

It is very important to note that efficiency cannot be increased too much without increasing the bias and it is thus not desirable to set an excessively high efficiency and a level of 70% is generally suggested.. Verardi and Croux (2009) programmed this estimator in Stata (command *mmregress*). For cross-sectional data it can be routinely used. By default the efficiency is set to 70%.

When working with Panel data, a fourth category of outliers should be considered, namely block concentrated outliers that correspond to a situation in which most of outlying observations are concentrated in a limited number of time series (see Bramati and Croux, 2007).

To deal with the presence of outliers in panel data estimations, Bramati and Croux (2007) propose two equally well performing estimators, the Within Groups Generalized M-estimator (WGM) and the Within Groups MS-estimator (WMS). The idea underlying both, is to center the series in a similar way to what is generally done when applying the within transformation. The difference here is that series are

centered by removing the median instead of demeaning because the mean is largely distorted by outliers. Having centered the series, a robust estimator can be applied to deal with atypical individuals. The outcoming results will be comparable to those of a fixed effects estimator but will not be distorted by the presence of atypical individuals.

In this paper, we use exactly the same logic to robustly estimate a fixed effect model. We first center the entire series to remove individual fixed effects and then run a robust estimator to identify the outliers. Outlying individuals are then awarded a weight zero and a standard fixed effect model is fitted to the remaining observations. The robust estimator we use for the outlier identification step is an S-estimator as described above.

Technically speaking, consider the general formulation of the fixed effects linear panel data model.

$$y_{it} = \alpha_i + x_{it}'\theta + \varepsilon_i \text{ for } i = 1, \dots, N \quad t = 1, \dots, T$$

where subscript *i* denotes the cross-section dimension, whereas *t* denotes the time series dimension. The y_{it} term denotes the dependent variable, x_{it} is the *Kx1* column vector of explanatory variables, θ is a *K x1* vector of the regression parameters and the α_is are the unobservable time-invariant individual fixed effects. Finally, the ε_{it}s denote the disturbance terms which are assumed to be uncorrelated through time and cross-sections.

The first step is therefore to center the variables. This leads to a set of new variables defined as $\tilde{y}_{it} = y_{it} - \text{med}_t\, y_{it}$ and $\tilde{x}_{it}^{(j)} = x_{it}^{(j)} - \text{med}_t\, x_{it}^{(j)}$ where $x_{it}^{(j)}$ (for *j=1,..K*) is the j[th] explanatory variable measured for individual *i* at time *t*.

The second step consists in regressing $\tilde{y}_{it}$ on the $\tilde{x}_{it}^{(j)}$s using an S-estimator and thereby obtaining the estimated parameters.

Having obtained the residuals and the estimated measure of dispersion, by relying on the assumed normality of the residuals, we can easily identify the outlying observations by flagging those individuals that have robust standardized residuals (i.e. residuals obtained by the S-estimator divided by $\hat{\sigma}$) that are larger than 2. The final step is then to run a standard fixed-effect estimation awarding a weight zero to the outliers.

5. Productivity premia of exporters by area of export destination: Results from a robust approach

The algorithm for the highly robust estimation method for linear fixed effects panel data models outlined in section 4 is used in this section to document the influence of outliers on the estimation results from the non-robust standard approach presented in section 3. Results are reported in table 4.

[Table 4 near here]

The robust estimator classifies 11.8 percent of the 26,482 enterprises as outliers. Dropping these firms reduces the sample by 16.1 percent to 79,209 observations (the number of firms times the number of years a firm in the sample).

Results based on this “cleaned” sample differ considerably from the results for the original sample reported in table 3. The estimated productivity premium of firms that export to the Euro-zone only is no longer much smaller that the premium of firms that export beyond the Euro-zone, too – the difference in the premium between both groups of exporters is no longer statistically significantly at an error level of five percent, and the premium itself over firms that serve the German market only is less than one percent. To put it differently, results are driven by a subsample of 12

percent of all enterprises, and this clearly demonstrates the importance of using a robust estimator.

How much are the results of the empirical investigation of self-selection of more productive firms into exporting that uses non-robust OLS regression models for cross-section data driven by observations from firms that can be considered as outliers? To investigate this point, the empirical model from equation (2) is estimated using a highly robust method for cross section data. This is done in using the mmregress command of Verardi and Croux (2009) described above with efficiency set to 70 %.

Results from the robust estimation of the empirical model from equation (2) are reported in table 5. A comparison with the OLS-results reported in table 3 reveals that all point estimates of the productivity premia a lower, and that there is no longer a statistically significant ex-ante productivity premium for enterprises that start to export both to the Euro-zone and to the non-Euro zone. An ex.ante differential that is statistically significant and large from an economic point of view only shows up for enterprises that exported to the Euro-zone already and start to export to countries outside the Euro-zone. This conclusion differs considerably from the one based on non-robust OLS regression – again, results are driven by outliers.

[Table 5 near here]

6. Concluding remarks

This paper shows that estimates of the exporter productivity premium by destination are driven by a small share of outliers. Using a “clean” sample without outliers the estimated productivity premium of firms that export to the Euro-zone only is no longer much smaller that the premium of firms that export beyond the Euro-zone, too, and

the premium itself over firms that serve the German market only is tiny. Furthermore, an ex-ante productivity differential that is statistically significant and large only shows up for enterprises that exported to the Euro-zone already and start to export to countries outside the Euro-zone.

These conclusions differ considerably from those based on non-robust standard regression analyses. Given that we have no reason to suspect that outliers do only shape empirical results of studies using enterprise data for Germany, and that software for robust estimation of regression models that are an alternative to OLS estimators for cross-section data and standard linear fixed effects estimators for panel data are readily available now, we strongly recommend to check empirical results by replicating a study using robust methods before considering the findings as stylized facts that can guide theoretical reasoning and that can be used for evidence based policy advice.

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Table 1: Enterprises from manufacturing industries by export destination: West Germany, 2003 – 2006

Year	2003 Number of enterprises (percentage share)	2004 Number of enterprises (percentage share)	2005 Number of enterprises (percentage share)	2006 Number of enterprises (percentage share)
Enterprises with no exports	6,827 (26.95)	6,509 (26.49)	6,022 (25.63)	5,511 (24.55)
Enterprises that export to the Euro-zone only	3,951 (15.60)	3,660 (14.89)	3,583 (15.25)	3,213 (14.31)
Enterprises that export to the non-Euro-zone only	292 (1.15)	247 (1.01)	270 (1.15)	270 (1.20)
Enterprises that export to the Euro-zone and to the non-Euro-zone	14,262 (56.30)	14,160 (57.62)	13,622 (57.97)	13,454 (59.93)
Total number of enterprises	25,332	24,576	23,497	22,448

Table 2: Exporter productivity premia (percentage) by destination of exports in West German manufacturing enterprises, 2003 – 2006: Results from a non-robust standard approach

		Pooled data	Pooled data with fixed enterprise effects
Enterprises that export to the	ß	39.10	10.85
Euro-zone only	p	0.000	0.000
[95% confidence interval for ß]		[0.314, 0.345]	[0.075, 0.130]
Enterprises that export to the	ß	65.37	18.89
Euro-zone and to the non-Euro-zone	p	0.000	0.000
[95% confidence interval for ß]		[0.491, 0.514]	[0.140, 0.205]
Number of observations	94,392		
Number of enterprises	26,482		

Note: ß is the estimated regression coefficient from an OLS-regression of log (labor productivity) on a dummy variable for firms from one of the two groups of exporting firms (taking firms that serve the German market only as the reference group). The pooled model includes a full set of 2digit industry-dummies and year dummies; the fixed effects model includes year dummies and enterprise fixed effects. The estimated coefficients for the exporter dummy variables have been transformed by 100(exp(ß)-1) to report the percentage productivity premium. Standard errors were calculated using the vce(r) option in Stata; p is the p-value, indicating that all reported coefficients are statistically highly significant.

Table 3: Ex-ante productivity premia (percentage) of export starters by area of destination in West German manufacturing enterprises: Results from a non-robust standard approach

Type of enterprise / Year		2003	2004	2005
No exports in 2003 – 2005;	ß	8.76	9.42	7.79
exports to Euro-zone only in 2006	p	0.092	0.069	0.146
[95% confidence interval for ß]		[-0.014; 0.183]	[-0.007; 0.188]	[-0.026; 0.176]
Number of enterprises: 148				
No exports in 2003 – 2005;	ß	45.58	39.51	40.35
exports to Euro-zone and to	p	0.001	0.004	0.003
non-Euro-zone in 2006				
[95% confidence interval for ß]		[0.141; 0.580]	[0.108; 0.559]	[0.112; 0.567]
Number of enterprises: 55				
Exports to Euro-zone only in	ß	44.48	50.23	50.53
2003 – 2005; exports to Euro-zone	p	0.000	0.000	0.000
and non-Euro-zone in 2006				
[95% confidence interval for ß]		[0.283; 0.452]	[0.324; 0.490]	[0.324; 0.494]
Number of enterprises: 270				

Note: ß is the estimated regression coefficient from an OLS-regression of log (labor productivity) on a dummy variable for firms from one of the three groups of export starters (taking the 4,505 firms that serve the German market only in all four years from 2003 to 2006 as the reference group). The empirical model includes a full set of 2digit industry-dummies and year dummies. The estimated coefficients for the export starter dummy variables have been transformed by 100(exp(ß)-1) to report the percentage productivity premium. Standard errors were calculated using the vce(r) option in Stata; p is the p-value.

Table 4: Exporter productivity premia (percentage) by destination of exports in West German manufacturing enterprises, 2003 – 2006: Results from robust fixed effects estimations

		Pooled data with fixed enterprise effects Robust estimator
Enterprises that export to the	ß	0.83
Euro-zone only	p	0.007
[95% confidence interval for ß]		[0.0022; 0.0143]
Enterprises that export to the	ß	0.97
Euro-zone and to the non-Euro-zone	p	0.005
[95% confidence interval for ß]		[0.0029; 0.0164]
Number of observations	79,209	
Number of enterprises	23,357	

Note: ß is the estimated regression coefficient from a robust linear fixed effects estimator regressing log (labor productivity) on a dummy variable for firms from one of the two groups of exporting firms (taking firms that serve the German market only as the reference group). The model year dummies and enterprise fixed effects. The estimated coefficients for the exporter dummy variables have been transformed by 100(exp(ß)-1) to report the percentage productivity premium. p is the p-value, indicating that all reported coefficients are statistically highly significant.

Table 5: Ex-ante productivity premia (percentage) of export starters by area of destination in West German manufacturing enterprises: Results from robust estimations

Type of enterprise /	Year	2003	2004	2005
No exports in 2003 – 2005;	ß	5.03	8.44	5.10
exports to Euro-zone only in 2006	p	0.284	0.088	0.302
[95% confidence interval for ß]		[-0.041; 0.139]	[-0.012; 0.174]	[-0.045; 0.144]
Number of enterprises: 148				
No exports in 2003 – 2005;	ß	8.88	6.08	4.81
exports to Euro-zone and to non-Euro-zone in 2006	p	0.291	0.489	0.658
[95% confidence interval for ß]		[-0.073; 0.243]	[-0.108; 0.226]	[-0.161; 0.255]
Number of enterprises: 55				
Exports to Euro-zone only in	ß	29.72	38.54	42.19
2003 – 2005; exports to Euro-zone and non-Euro-zone in 2006	p	0.000	0.000	0.000
[95% confidence interval for ß]		[0.167; 0.354]	[0.234; 0.419]	[0.253; 0.451]
Number of enterprises: 270				

Note: ß is the estimated regression coefficient from a robust regression (discussed in detail in the text of the paper) of log (labor productivity) on a dummy variable for firms from one of the three groups of export starters (taking the 4,505 firms that serve the German market only in all four years from 2003 to 2006 as the reference group). The empirical model includes a full set of 2digit industry-dummies and year dummies. The estimated coefficients for the export starter dummy variables have been transformed by 100(exp(ß)-1) to report the percentage productivity premium. Standard errors were calculated using the vce(r) option in Stata; p is the p-value.

Appendix:

A survey of micro-econometric studies on export destination and firm performance

Differences between exporting and non-exporting firms have been a core topic in the literature on the micro-econometrics of international firm activities that started with the pioneering paper by Bernard and Jensen (1995) and that is surveyed in Greenaway and Kneller (2007) and in Wagner (2007). Only recently in this literature exports by a firm are broken down by destination regions or countries – an approach that is not feasible for all countries of origin of exports due to data limitations. Looking at export destinations reveals new insights and sheds light on hitherto not known facts.

Table A.1 summarizes 36 micro-econometric studies on export destination and firm performance[18] for 16 different countries, most of which are highly industrialized western countries. These studies are mostly of a recent vintage – the first one was published in 2003, and many papers are still in a working paper state.

While eight studies use cross-section data only, 28 are based on panel data that allow to control for unobserved heterogeneity via fixed effects and that offer the opportunity to look at the direction of the relationship between firm performance (usually, productivity) and destination of exports by testing for the presence of ex-ante differences (that existed before exporting to a destination started) and positive

[18] The survey does not include studies that use macro data on export destinations (like Akerman and Forslid (2007), Damijan, de Sousa and Lamotte (2009), Girma, Görg and Hanley (2008) or Trofimenko (2008). Furthermore, studies on export destination without reference to firm performance like Arkolakis and Muendler (2009), Manova and Zhang (2009) and Muraközy and Bekes (2009) are not covered.

effects of exporting to a destination on firm performance (learning-by-exporting to a destination).

Although results are not strictly comparable between the studies due to differences in, among others, the number and type of destinations looked at (e.g., EU vs. non-EU; areas defined according to per-capita income; or a large number of destination countries), the definition of the sample used (establishments or enterprises; cut-off point of number of employees), the period under investigation, and the statistical methods applied,[19] a big picture emerges that can be sketched as follows:

(1) *Exporting firms tend to serve only few foreign market* (Belgium – Muuls and Pisu 2009; Denmark – Eriksson, Smeets and Warzynski 2009; France – Eaton, Korum and Kramarz 2004; Hungary – Békés, Harasztosi and Muraközy 2009; Italy – Castellani, Serti and Tomasi 2010; UK – Breinlich and Criscuolo 2009; USA – Bernard, Jensen, Redding, Schott 2007, 2009)

(2) *The small number of exporters that export to many countries account for a large share of total exports* (Denmark - Eriksson, Smeets and Warzynski 2009; France – Eaton, Korum and Kramarz 2004; Hungary – Békés, Harasztosi and Muraközy 2009; Italy – Castellani, Serti and Tomasi 2010; UK – Breinlich and Criscuolo 2009; USA – Bernard, Jensen, Redding, Schott 2007, 2009)

[19] See International Study Group on Exports and Productivity (ISGEP) (2008) for an empirical investigation that uses an identical approach to investigate the nexus between exports and productivity (without considering the destination of exports) with firm level data from 14 different countries to document stylized facts that hold for all countries and to investigate cross-country differences.

(3) *The number of export markets served increases with productivity and/or firm size* (Belgium – Muuls and Pisu 2009; Denmark – Eriksson, Smeets and Warzynski 2009; France – Eaton, Korum and Kramarz 2004; Germany – Wagner 2007; Ireland – Ruane and Sutherland 2005, Lawless 2009; Italy – Serti, Tomasi and Zanfei 2009, Castellani, Serti and Tomasi 2010, Conti, Turco and Maggioni 2010; Japan – Wakasugi and Tanaka; Slovenia – Damijan, Polanec and Prasnikar 2004, De Loecker 2007); Spain – Blanes-Cristobal, Dovis, Milgram-Baleix and Moro-Egido 2007, Mánez-Castillejo, Rochina-Barrachina and Sanchis-Llopis 2010; Sweden – Andersson, Lööf and Johansson 2008, Eliasson, Hansson and Lindvert 2009; UK – Breinlich and Criscuolo 2009; USA – Bernard, Jensen, Redding, Schott 2009)

(4) *Exporters to more developed economies have superior ex-ante productivity levels than non-exporters and firms exporting to less developed countries* (Belgium – Pisu 2008; Italy – Serti and Tomasi 2009; Slovenia - Slovenia – Damijan, Polanec and Prasnikar 2004, Damijan and Kostevc 2006, De Loecker 2007, Kostevc 2008; Spain - Blanes-Cristobal, Dovis, Milgram-Baleix and Moro-Egido 2007)

(5) *Evidence for different causal effects of exporting on productivity by destination of exports rare and not conclusive* (see Belgium – Pisu 2008, reporting no causal effect irrespective of development level of destination countries; see Japan – Yashiro and Hirano 2009, finding only exporters serving worldwide enjoyed significant advantage in productivity growth; see Slovenia - Damijan, Polanec and Prasnikar 2004, stating that exporters can benefit from exporting through learning and competition effects only when serving more demanding advanced markets; De Loecker 2007, finding that firms exporting only to low income regions get additional

productivity gains that are lower than in firms exporting to high income countries; and Kostevc 2008, stating that evidence of the learning process is not conclusive)

What can we learn from the micro-econometric studies surveyed here about the relationship between export destinations and firm performance? Even if the evidence we have so far might not qualify as a stylized fact due to restrictions in the comparability of the studies it seems fair to state that we know that the bulk of exporting firms trades with only a few countries, that the lion's share of exports is done by few large firms that export to a large number of countries, that the number of export destinations is positively related to productivity and firm size, and that we have evidence for self-selection of more productive firms into more demanding markets while the jury is still out regarding the issue of different learning-by-exporting effects by different export destinations.

Table A.1: Micro-econometric studies on export destination and firm performance

Country Author(s) (year of publication)	Period covered Areas covered	Topics investigated[1]	Methods used[1]	Important findings[1]
Belgium Pisu (2008)	1998 – 2005 Four groups of countries by per capita income	Exports and productivity by destination	Regression; matching approaches; diff-in-diff	Exporters to more developed economies have superior ex-ante productivity levels than non-exporters and firms exporting to less developed countries. No causal effect of export on productivity irrespective of development level of destination countries
Belgium Muuls and Pisu (2009)	1996 – 2004 Country of destination	Facts about Belgium firms	Descriptive statistics; regressions	Firms tend to serve only few foreign markets. Negative relation between number of exporting firms and number of export destinations served. Number of export markets served increase with productivity.
Canada Sabuhoro, Larue and Gervais (2006)	1993 – 2000 Number of countries of destination; regions of destination	Survival / exit of exporters	Cox proportional hazards regression	Hazard of exit varies negatively with number of destinations. Hazard of exit varies with region of destination.
Colombia Eaton, Eslava, Kugler and Tybout (2007)	1996 – 2005 Countries of destination	Export dynamics	Descriptive statistics; decompositions	Large numbers of firms enter or exit each destination market every year. New exporters begin in a single foreign market and, if they survive, gradually expand into additional destinations. The geographical expansion paths they follow, and their likelihood of survival as exporters, depend on their initial market

Denmark Eriksson, Smeets and Warzynski (2009)	1993 – 2003 Countries of destintion	Facts about Danish firms in International trade	Descriptive statistics	While the median firm exports to two countries, the average number of destination countries is considerably higher (6.3 in 2003). The quarter of firms that export to five or more countries account for 92 percent of aggregate export value. Firms that export to more countries are larger. Firms entering into exporting often export to a small number of countries only (75% to only one country)
France Eaton, Kortum and Kramarz (2004)	1986 Countries of Destination	Firms in different export markets	Descriptive statistics	The modal exporter ships to only one foreign destination, whereas exports by the small fraction of firms that ship widely constitute a substantial share of exports. The frequency with which more markets are served declines smoothly and monotonically
France Eaton, Kortum and Kramarz (2008)	1986 Countries of Destination	Firms in different export markets	Descriptive statistics	The number of French firms selling to a market, relative to French market share, increases systematically with market size. Sales distributions are very similar across markets of very different size and extent of French participation. Average sales in France rise very systematically with selling to less popular markets and to more markets
France Buono, Fadinger and Berger (2008)	1995 – 1999 Countries of destination	Dynamics of firms' exports to different countries	Descriptive statistics; OLS	Export relations – defined as shipment by a firm to a destination in a given year – are very volatile. In a typical year around 27 % of all relations are newly created and 21 % are destroyed.
France Berman, Martin, Mayer (2009)	1995 – 2005 Countries of destination	Reaction of exporters to exchange rate changes	Fixed effects panel	Pricing to market by exporters is more pervasive in destination countries with higher distribution costs

France Bellone, Guillou and Nesta (2010)	2005 Europe vs. rest of the world	TFP differences between non-exporters, exporters to Europe, and global exporters	t-test; Kolmogorov-Smirnov-test; OLS; Quantile regression	Global exporters have higher productivity than intra-Europe exporters while the TFP distribution of intra-Europe exporters is not significantly different from the one of non-exporters. No exporter premium for only intra-Europe exporters, but high and significant for global exporters. Export premia are very stable over the different quintiles, but tend to be higher for highest quintiles.
Germany (West/East) Wagner (2007)	2004 Euro-zone vs. non-Euro zone	Productivity differences	t-test; Kolmogorov-Smirnov-test; with and without top/bottom one percent of the productivity distribution	Exporters inside Euro-zone more productive than firms selling in Germany only, but less productive than firms selling outside the Euro-zone too
Hungary Békés, Harasztosi and Muraközy (2009)	1992 – 2003 Countries of destination	Exports by country of destination	Descriptive statistics	A large number of firms sell to a single country only, but most trade is carried out by firms trading with many countries. Germany is in the lead with over 30 percent of manufacturing export share
Ireland Ruane and Sutherland (2005)	1991 – 1998 Exports to UK vs. global exports	Exports and performance by destination	Regression	Non-UK exporters are larger than UK exporters in terms of turnover ,pay increasingly higher wages, employ a higher proportion of skilled labour and are more productive.
Ireland Lawless (2009)	2000 – 2004 >50 countries of destination	Productivity and destinations	Descriptive statistics; OLS	Firms with greater market coverage tend to be more productive. No rigid ordering of destinations found. Firm-level export growth largely driven by existing markets; most growth due to continuing exporters. Changes in market portfolios of exporters a relatively common occurrence.

Italy Serti and Tomasi (2009)	1993 – 1997 Geographical areas	Firm performance and export destinations	Regression	Productivity levels higher for firms exporting to high medium income countries compared to firms exporting to European and low income countries. Results more mixed in terms of size and workforce composition. Ex-ante trade premia higher for those firms that start investing in more advanced countries
Italy Serti, Tomasi and Zanfei (2009)	1993 – 1997 Geographical areas	Skill intensity, wages and exports by destination area	Regression	Firms trading with more distant countries appear to be the most skill intensive and to pay highest wages
Italy Crinò and Epifani (2009)	2003 EU15; new EU members; other European countr.; North America; Latin America; China; other Asian countries; Africa; Oceania	Export intensity and productivity	Descriptive statistics; regression	TFP strongly negatively correlated with export intensity to low-income destinations and uncorrelated with export intensity to high-income destinations, conditional on exporting
Italy Castellani, Serti and Tomasi (2010)	1993 – 1997 Countries of destination	Differences between firms with different numbers of countries of destination	Descriptive statistics; non-parametric kernel regressions; pooled OLS and fixed effects	Bulk of firms trade only with a few countries, but a handful of diversified traders account for the majority of exports. Firms that export to larger number of countries are larger, more productive, and more capital intensive
Italy Conti, Turco and Maggioni (2010)	2003 EU25; EU15; non-EU; industrial markets outside Europe	Exporters in services and productivity	Descriptive statistics; regression	Only more productive and skilled labour endowed firms have a higher probability to export to industrial countries outside Europe
Japan Wakasugi and Tanaka (2009)	2005 Asia, North America, Europe	Productivity and exports by destination area	Regression	Productivity of firms simultaneously internationalized in multiple regions higher than in firms exporting in a single region

Japan Yashiro and Hirano (2009)	2002 – 2005 Asia, Western, other regions	Productivity effects of export boom	Diff-in-diff	Only exporters serving worldwide enjoyed significant advantage in productivity growth
New Zealand Fabling, Grimes and Sanderson (2009)	2002 – 2006 Countries of destination	What determines which market an exporter chooses to export to next?	Rare events Logit	Firms with import experience in a specific country show between 40 and 90 percent higher chances of entering a new relationship with that country. Richer and more open countries are more common targets for new relationships; same hold for countries closer to New Zealand
Slovenia Damijan, Polanec and Prasnikar (2004)	1994 – 2002 Countries of destination	Productivity and different export markets	Descriptive statistics; OLS, fixed effects, sytem-GMM	Firms that export to more markets are on average more labor productive. Only high productivity firms can afford to export to advanced markets. Exporters can benefit from exporting through learning and competition effects only when serving more demanding advanced markets
Slovenia Damijan and Kostevc (2006)	1994 – 2002 ex-Yugoslav vs. EU	Learning-by-exporting	Correlations; matching, diff-in-diff	Both firms exporting to EU markets as well as those exporting to former Yugoslav countries experience only a one-time increase in their productivity the year after they start exporting
Slovenia De Loecker (2007)	1994 – 2000 8 groups of countries	Productivity and different export markets	Propensity score matching; regression	Positive correlation between number of destinations and productivity. Productivity premia considerably higher for firms shipping products to more developed regions. Firms exporting only to low income regions get additional productivity gains, however, lower than their counterparts exporting to high income countries
Slovenia Kostevc (2008)	1994 – 2002 EU, Eastern and Central Europe, ex-Yugoslav	Productivity differences ex ante and learning-by-exporting	OLS; System GMM	More efficient exporters choose to serve more demanding markets; evidence of the learning process not conclusive

Spain Barrios, Görg, Strobl (2003)	1990 – 1998 EU/OECD vs. non-OECD	R&D activity and exports	Pooled Tobit; random effects Tobit	Domestic R&D activity and spillovers from R&D undertaken by MNEs are only statistically significant determinants for the propensity to export to EU/OECD countries
Spain Blanes-Cristóbal, Dovis, Milgram-Baleix, Moro-Egido (2007)	1990 – 2002 EU, OECD, rest of the world	Sunk exporting cost differences between export destination markets	Descriptive statistics Panel Probit	Share of exports, advertisement, R&D on sales and presence of foreign capital larger for firms that export to the EU non exclusively and to OECD. Exporters to EU more productive than other exporters and than non-exporters. Sunk costs differ among markets, higher in developed Markets than in rest of the world
Spain Esteve-Pérez, Mánez-Castillejo, Rochina-Barrachina and Sanchis-Llopis (2007)	1990 – 2000 EU, OECD, rest of the world	What keeps a firm continuously exporting?	Discrete time survival analysis	Firms exporting primarily to the European Union and to the rest of the OECD countries have a lower risk of ending and exporting spell than firms exporting to the rest of the world
Spain Esteve-Pérez, Pallardo and Requena (2009)	1997 – 2006 Countries of destination	Duration of Spanish firms' trade relationships by destination	Discrete time survival analysis	Firm-country export relationships are shorter-lived and less persistent than firm export status. The period of time a firm is "in" a particular market is often fleeting, with a median duration of two years. Trade relationships with low risk partners endure far better survival conditions
Spain Mánez-Castillejo, Rochina-Barrachina, Sanchis-Llopis (2010)	1990 – 2002 EU; rest OECD; rest of the world	Learning-by-exporting, firm size, and area of export destination	Descriptive statistics	Level of diversification across areas substantially higher for large firms than for small firms, and higher diversification in destination markets is expected to be associated with higher learning opportunities
Sweden Andersson, Lööf and Johansson (2008)	1997 – 2004 Number of countries of destination	Productivity differences	GLS random effects; two-step GMM	Exporter premium for labor productivity is increasing in the number of countries which firms export to

Sweden Eliasson, Hansson and Lindvert (2009)	1997 – 2006 Number of countries of destination	Productivity differences	OLS; propensity-score matching	Larger firms tend to export to more destination countries. Information on destination of exports not used in investigation of learning-by-exporting vs. learning-to-export
United Kingdom Breinlich and Criscuolo (2009)	2000 – 2005 Countries of destination	Trade in services	Descriptive statistics; OLS; fixed effects	Most firms only export to a small number of countries (mostly three or less); trade volume, employment, turnover and value added highly concentrated among small group of firms trading with many countries with higher-than-average productivity and size. Higher employment and labour productivity associated with exporting to more countries
U.S.A. Bernard, Jensen, Redding, Schott (2007)	2000 Countries of destination	Exports by number of countries of destination	Descriptive statistics	Number of destination countries served by the average exporting firm is small; 64 % export to single country only. 13.7% export to five or more destinations, but account for 92.9% of exports, and are much larger than firms that export to a single destination country only.
			OLS regression	Number of exporting firms sharply decreasing in distance to destination country and increasing in importer income. Average export value increasing in distance and decreasing in importer income
U.S.A. Bernard, Jensen, Redding, Schott (2009)	1993, 2000 Countries of destination	Exports by number of countries of destination and by type of country	Descriptive statistics	More than half of exporters transact with just a single foreign country; dominant portion of exports flow through firms transacting with the largest number of countries. Trading partner intensity increases over time. Average employment positively correlated with number of countries with which firms trade. In 1993, 65.5 % of exports destined for upper-income countries, just 1 % for low-income countries

Notes: [1] Only topics / methods/ findings with regard to export destination are included in the table

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