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Evidence from Unconditional Quantile Regression with Firm Fixed Effects

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The Exporter Productivity Premium along the Productivity Distribution: Evidence from Unconditional Quantile Regression with Firm Fixed Effects*

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Abstract

One of the stylized facts from the literature on international activities of heterogeneous firms is the existence of a positive exporter productivity premium - on average, exporting firms are more productive than firms that sell on the national market only. In this paper, we look at the productivity distribution of both exporting and non-exporting firms in German manufacturing industries. We recognize that it is potentially important to condition on firm fixed effects for estimation of this exporter premium. We apply a new unconditional quantile estimation technique for panel data to condition on firm fixed effects while estimating the exporter premium throughout the entire productivity distribution. We find that the premium is positive for all productivity levels, but highest at the lowest quantiles. These results support theoretical models which suggest that there is a division in productivity between exporters and non-exporters. Mean regression is incapable of detecting this dimension of firm heterogeneity.

Keywords: Exporter productivity premium, quantile regression, fixed effects, unconditional quantile treatment effects
JEL classification: F14, C21, C23

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1 Introduction

Heterogeneous firms are at the heart of both the *New New International Trade Theory*[1] and the *Micro-econometrics of International Firm Activities*.[2] An emerging literature on international activities of heterogeneous firms argues that productivity is a crucial determinant of export activities. Following Melitz [2003], a large number of theoretical models show that, under certain conditions, firms below a certain cut-off point in the productivity distribution serve the national market only, while firms above it serve both national and foreign markets. This role of productivity as a driver of exports is due to fixed export costs (i.e., costs for learning about a foreign market, setting up a distribution network, adopting products to tastes of consumers and to technical standards demanded in a foreign country, etc.), because only firms with a productivity above a certain threshold can make a profit from serving a foreign market after paying these extra costs of exporting (see Helpman [2006], p. 592ff.).

In support of these theoretical models, empirical studies for countries from all over the world document that exporting firms are, on average, more productive than firms that sell on the national market only (see Wagner [2007] for a survey). This positive exporter productivity premium is robust to controlling for observed firm characteristics and firm fixed effects in regression models.[3] A vast majority of this empirical support is based on a positive exporter premium at the conditional mean of the productivity distribution. However, it is unclear how relevant the conditional mean is in a Melitz-style model. The Melitz model has implications for the *distribution* of productivity of firms that export versus those that do

[1]The canonical paper in this literature is Melitz [2003] who explicitly motivates his theoretical model by referring to findings in the micro-econometric literature; see Helpman [2006] for a survey.

[2]Pioneering papers in this field include Bernard and Jensen [1995] and Wagner [1995]. For partial surveys of this empirical literature see Greenaway and Kneller [2007], López [2005], and Wagner [2007].

[3]For a recent study covering 14 countries see International Study Group on Exports and Productivity [2008].

not. A positive mean premium is one consequence of the Melitz model, but insufficient for determining its accuracy. The implications would be very different if, for example, a few very productive exporting firms are responsible for the positive mean exporter premium. Consequently, the mean estimates in the literature provide little information about the relevance of the Melitz model.

A closer look at firm level micro-data reveals that both exporters and non-exporters tend to be highly heterogeneous. There are low productivity exporters and high productivity non-exporters. This points to the existence of other factors that foster exporting besides productivity and that are absent from the Melitz model.

This paper contributes to the literature by using comprehensive firm level data for manufacturing enterprises in Germany, one of the leading actors on the world markets for goods, to investigate productivity differences between exporting and non-exporting firms over the whole productivity distribution. We use a quantile framework to characterize the entire productivity distribution for both exporting and non-exporting firms. The literature has previously recognized that quantile estimates are interesting in this context. Furthermore, the literature has understood the potential importance of condition on enterprise fixed effects to account for unobserved firm-level characteristics. We also believe that accounting for firm-level fixed effects is potentially important and employ a newly developed unconditional quantile regression estimator for fixed effects models. This QRFE estimator, introduced in Powell [2010a], conditions on firm-level fixed effects for identification purposes - identification originates solely from firm-level changes in exporter status - but the estimates can still be interpreted in the same manner as traditional cross-sectional quantile estimates. We control for firm fixed effects because there may be unobserved factors outside of the Melitz model that impact productivity but correlate with exporter status. Furthermore, the cross-sectional productivity differences at any point in time are uninformative of the potential ramifications of trade liberalization which would result in firms changing export status. Instead, we are interested in the productivity increases due to changes in firm exporting status, implying that it is essential to condition on firm fixed effects. This is the first paper in the literature to simultaneously emphasize the importance of quantile estimation and firm-level fixed effects and, consequently, we believe it offers crucial evidence concerning the impact of trade liberalization and the utility of existing trade models.

To preview our results, we show that the exporter premium is positive over the whole productivity distribution even when unobserved firm heterogeneity is controlled for. Importantly, we find the largest premium at the bottom of the distribution, suggesting that there is a meaningful productivity division between exporters and non-exporters. This implies that the central policy implication of the Melitz-model is still valid in a world with more than one driver of exports: a reduction in trade barriers leads to exit of low-productive firms and reallocation of output and employment towards higher-productivity firms. Trade liberalization increases productivity and fosters economic growth.

The rest of the paper is organized as follows. Section 2 describes the data used in this study. Section 3 reports descriptive results on productivity differences between and among exporters and non-exporters inside narrowly defined industries and shows that there are many low productivity exporters and high productivity non-exporters. Section 4 introduces our empirical strategy. Section 5 documents the differences in productivity between exporters and non-exporters along the productivity distribution based on results from quantile regressions with cross-sectional data. Section 6 uses panel data and a new quantile regression method with fixed effects to take care of unobserved firm specific characteristics in the analysis of the exporter productivity premium over the productivity distribution. Section 7 concludes.

2 Data

The empirical investigation uses data from an unbalanced panel of enterprises that is built from cross-sectional 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 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.[4]

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. Given that the East German economy still differs in many respects from the West German economy, especially with regard to exporting, this study looks at West German and East German manufacturing enterprises separately.[5]

Productivity is measured as total sales per employee, i.e. labor productivity. More appropriate measures of productivity such as 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[6] in the surveys. Controlling for firm fixed effects, however, can be expected to absorb much of the differences in the degree of vertical

[4]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].

[5]For a discussion of the differences in exporting between West German and East German manufacturing firms see Wagner [2008].

[6]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.

integration and capital intensity.[7]

3 Productivity heterogeneity between and within export status: descriptive results

One of the stylized facts uncovered in the recent large empirical literature on export activities of firms is that the (unconditional and conditional) exporter productivity premium at the mean is positive, statistically significant, and large (see Wagner [2007]). A closer look at the firm level data reveals, however, that both exporters and non-exporters are highly heterogeneous with regard to productivity - inside narrowly-defined industries (defined at the 4-digit-level), there are both exporters with low productivity and non-exporters with high productivity. Table 1 shows the sample of German manufacturing enterprises that is used in this paper where productivity (defined as total sales per employee) of a firm is measured as a percentage of the average value of productivity in the 4-digit-level industry. Results are reported for three years, the first year in our sample (1995), a middle year of the sample period (2000), and the last year (2006).

Productivity differences between exporters and non-exporters at the mean are statistically highly significant according to a t-test, and they are large from an economic point of view in each year and both in West Germany and in East Germany. Furthermore, a Kolmogorov-Smirnov test indicates that the productivity distributions differ between ex-

[7]Note that Bartelsman and Doms [2000] point to the fact that heterogeneity in labor productivity has been found to be accompanied by similar heterogeneity in total factor productivity in the reviewed research where both concepts are measured. Furthermore, Foster et al. [2008] show that productivity measures that use sales (i.e., quantities multiplied by prices) and measures that use quantities only are highly positively correlated. In a recent comprehensive survey Syverson [2010] argues that "(t)he inherent variation in establishment- or firm-level microdata is typically so large as to swamp any small measurement-induced differences in productivity metrics. Simply put, high-productivity producers will tend to look efficient regardless of the specific way that their productivity is measured."

porters and non-exporters and that the productivity distribution of exporters first-order stochastically dominates the productivity distribution of non-exporters. These are the standard results reported in the literature.

However, Table 1 also reveals that both exporters and non-exporters are highly heterogeneous with regard to productivity. In each group of firms, there are relatively productive and relatively unproductive firms in each year in both parts of Germany, and the difference between the first and the 99th percentiles are rather large. Furthermore, Table 2 demonstrates that neither low-productivity exporters nor high-productivity non-exporters are a rare species. While the share of exporters increases over the productivity distribution, more than half of all firms at the lowest quintile of the productivity distributions are exporters in West Germany, and some 20 percent of all firms at the highest quintile are non-exporters; the picture is similar in East Germany where a large number of exporters can be found at the lowest quintile and a large number of non-exporters at the highest quintile.

The descriptive results indicate that, empirically, there is no such thing as a single cut-off point in the productivity distribution that separates non-exporters and exporters. Hallak and Sivadasan [2010] document a similar fact. Using data for manufacturing establishments from India, the U. S., Chile, and Columbia, they show that the fraction of exporters in each of 40 size quantiles (defined by industry) increases with size, but there are still many exporters among the smallest firms as well as a substantial fraction of firms with no export activity even among firms at the top of the size distribution. Hallak and Sivadasan [2010] use firm size, defined by firms' revenue, as the empirical measure for productivity, pointing out that the endowment of firms with productivity perfectly predicts firms' revenue and export status in theoretical models of the Melitz [2003] type. They therefore refer to productivity and firm size interchangeably.

To explain this lack of a monotonic relationship between productivity and export status, Hallak and Sivadasan [2010] develop a model of international trade with two dimensions of firm heterogeneity. The first dimension is productivity - the ability to produce output with fewer variable inputs. The second dimension is caliber - the ability to produce quality using fewer fixed inputs. With export quality constraints, there are high-productivity low-caliber firms which refrain from exporting because they find the cost of satisfying the export quality constraint to be too high, and low-productivity high-caliber firms that export despite their low productivity.[8]

High product quality is often regarded as a decisive characteristic of goods exported by German manufacturing firms. For example, in the most recent annual report on the economic status published by the ministry of economics and technology, it is argued that 40 percent of German exports are investment goods, and that for many of these goods, quality is the most important factor, while demand is comparably price-inelastic (see Bundesministerium für Wirtschaft und Technologie [2010], p. 16). High-quality investment goods that are highly attractive for customers in foreign countries are sold for a high price. This means that, on the one hand, comparably low productivity firms can make a profit from serving a foreign market after paying the extra costs of exporting if they produce high quality goods. Therefore, we observe exporters with low productivity. On the other hand, there are high productive firms that do not have the ability to produce high-quality goods, and that do not export.

[8] Hallak and Sivadasan [2010] test a set of predictions their model delivers. We do not pursue this issue here because in our data set we do not have information on quality and prices of the goods produced by the firms.

4 Estimation Strategy

A central contribution of this paper is methodological, using a newly-developed estimator introduced in Powell [2010a]. We believe that the distribution of the exporter premium is critical to test the usefulness of existing trade theory models and for our understanding of the impact of trade liberalization. Quantile estimation has been found to be useful in such contexts where the variables of interest may have varying effects throughout the outcome distribution. Quantile regression allows the parameters of interest to vary based on unobserved "proneness," as termed by Doksum [1974]. Some firms have higher underlying labor productivity and we are interested in the exporter premium for these firms and, separately, the premium for less productive firms. Introduced by Koenker and Bassett [1978], quantile regression is useful for equations such as

$$y_i = \mathbf{x}_i' \beta(\alpha_i + \epsilon_i). \tag{1}$$

The impact of the variables of interest varies based on the total disturbance. With cross-sectional data, it is unnecessary to distinguish between α_i and ϵ_i in the above equation, but this will be notationally instructive below. To borrow terminology from Chernozhukov and Hansen [2008], we are interested in the Structural Quantile Function (SQF)

$$S_{y_i} = \mathbf{x}_i' \beta(\tau), \quad \tau \in (0, 1). \tag{2}$$

The SQF provides the τ^{th} quantile of $y_{\mathbf{x}} = \mathbf{x}_i' \beta(u)$ for a fixed $\mathbf{x}$ and a randomly-selected $u \sim U(0, 1)$. In our context, the SQFs provide the distributions of the outcome variable for both exporting and non-exporting firms.

Conditioning on additional variables creates problems with quantile estimation.

Quantile regression allows the coefficients to vary based on unobserved proneness for the outcome variable. By including additional covariates, some of this unobserved proneness becomes observed. Powell [2010b] discusses the importance of unconditional quantile treatment effects in the presence of covariates. Fixed effects pose a special problem in this circumstance. With panel data, we want to condition on fixed effects for the purposes of identification but, typically, we do not want to change the interpretation of the coefficients. Many quantile panel data estimators, however, do not estimate parameters that can be interpreted in the same manner as cross-sectional estimates. For example, Koenker [2004] introduces a location-shift model where the underlying equation is

$$y_{it} = \alpha_i + \mathbf{x}_{it}'\beta(\epsilon_{it}).$$

The coefficient of interest now only varies based on ϵ_{it}, which is different from the cross-sectional case, as seen in equation (4). Similarly, Harding and Lamarche [2009] introduce an IV version for the estimation of equations such as

$$y_{it} = \alpha_i(\epsilon_{it}) + \mathbf{x}_{it}'\beta(\epsilon_{it}).$$

Again, these coefficients vary based only on the observation-specific disturbance, not the total disturbance. These estimators are useful in situations where we want to define the quantiles by the firm's productivity relative to its fixed level of productivity. However, we are primarily interested in the effect of the covariates on high productivity firms and, separately, low productivity firms. For illustrative purposes, assume that α_i is known and supplied to the econometrician. The Koenker [2004] estimator is equivalent to a traditional quantile regression of $(y_{it} - \alpha_i)$ on $\mathbf{x}_{it}$. In other words, the fixed effect has been differenced out. Location-shift models are similar to differencing one's data and subsequently using quantile regression. The "high quantiles" refer to firms experiencing large increases in productivity. Some of these firms may, cross-sectionally, be in the lower part of the productivity distribution.

This paper uses an unconditional quantile regression technique derived specifically for panel data, introduced in Powell [2010a]. The estimator conditions on fixed effects for identification purposes, but the resulting estimates can be interpreted in the same manner as traditional cross-sectional quantile estimates. The fixed effects are allowed to be arbitrary correlated with the levels of the variables of interest, accounting for fixed unobserved firm-level differences. The implicit underlying equation is

$$y_{it} = \mathbf{x}'_{it}\beta(\alpha_i + \epsilon_{it}). \tag{3}$$

This is equivalent to equation (4). Thus, the Powell [2010a] estimator is ideal for this topic. We want to condition on firm fixed effects, but we are still interested in the exporter premium for high productivity firms and low productivity firms. The SQF remains the same. With year fixed effects, it can be written as

$$S_{y_{it}} = \gamma_t(\tau) + \mathbf{x}'_{it}\beta(\tau), \quad \tau \in (0,1). \tag{4}$$

These are the first quantile estimates of the exporter premium which condition on firm fixed effects. Estimation details are straightforward and discussed in Powell [2010a]. Standard errors are derived from bootstrapping (clustering at firm-level).

5 Main Results

5.1 Mean Fixed Effect Results

The mean exporter premium can be estimated using OLS for the following specification:

$$P_{it} = \gamma_t + \alpha_i + \beta E_{it} + \epsilon_{it}, \tag{5}$$

where P_{it} is the log of labor productivity for firm i at time t and E is a dummy variable for "exporter." Firm and year fixed effects are included.

We present estimates of the mean productivity premium to compare with the quantile results below and because this is what is typically estimated in the literature. Table 3 shows these results for both East and West Germany. The estimates are very similar to one another and significant from 0 at the 1% level. These premia suggest that exporters are more productive than non-exporters, matching the central finding of the literature.

5.2 Cross-Sectional Quantile Regression

The descriptive results reported in Section 3 indicate that looking at the (unconditional or conditional) productivity difference at the mean between exporters and non-exporters is only a first step in the investigation of productivity differentials between both groups of firms. As Buchinsky [1994] states, "'On the average' has never been a satisfactory statement with which to conclude a study on heterogeneous populations." If we acknowledge that firms are heterogeneous, we have reasons to suspect that the conditional difference in productivity between exporting and non-exporting firms does not need to be the same for all firms. For example, it might be the case that the productivity difference between exporters and non-exporters is higher for firms at the lower end of the productivity distribution.

Note that the Melitz model has specific implications for the relative productivity at the bottom of the distribution. Thus, it is imperative that we focus on the distribution of productivity. If we follow the standard approach in the literature (summarized in Wagner [2007]) and regress the log of productivity on an exporter dummy variable and a set of control variables (including fixed firm effects) using ordinary least squares (OLS), there is no room for firm heterogeneity of this kind. OLS estimates the average effect over the entire distribution. This summary statistic, however, may not be representative of the relationship between exports and productivity at any part of the productivity distribution. For example, if the exporter premium is positive *only* at the top of the productivity distribution, this evidence would actually contradict the implications of the Melitz model. Yet, the mean productivity premium would still be positive.

The literature has recognized that quantiles are potentially interesting in this context. Quantile regression has been used in other studies on international firm activities (including Dimelis and Louri [2002], Falzoni and Grasseni [2005], Wagner [2006], Yasar et al. [2006], Yasar and Morrison Paul [2007], Trofimenko [2008], Serti and Tomasi [2009], Bellone et al. [2010], Haller [2010], and Wagner [2010]).

We are interested in the Structural Quantile Function

$$S_{P_i} = \gamma(\tau) + E_i\beta(\tau), \quad \tau \in (0,1). \tag{6}$$

Again, the dependent variable is the log of labor productivity (defined as total sales per employee of a firm and measured as a percentage of the average value of productivity in the 4-digit-level industry) and the independent variable is a dummy variable that takes on the value of one if a firm is an exporter and zero if it is a non-exporter. Estimation results for the exporter productivity premium from quantile regressions are reported in Table 4 for 3 separate years for both East and West Germany.

The most important result from the quantile regressions is that the exporter productivity premium is positive and highly statistically significant in each quantile of the productivity distribution in each of the three years[9] in both parts of Germany. Exporting firms are more productive than non-exporting firms not only at the mean, but at each point of the productivity distribution. Importantly, the results are largest for the lowest quantiles. The implications of this finding will be discussed after the next step in which we control for unobserved firm heterogeneity.

5.3 Quantile Regression with Fixed Enterprise Effects

The cross-sectional differences between exporting and non-exporting firms may be driven by many factors. A standard solution in the literature on the micro-econometrics of international firm activities is conditioning on firm-specific fixed effects. Using pooled cross-section time-series data for firms and including fixed firm effects in the empirical model controls for time invariant unobserved firm heterogeneity. The coefficients for the time variant variables can be estimated without any bias caused by the non-inclusion of the unobserved variables that are correlated with these included variables. In Table 4 of International Study Group on Exports and Productivity [2008], exporter productivity premia are reported based on empirical models with and without fixed effects. If fixed firm effects are added to control for time invariant unobserved heterogeneity, the point estimates of the exporter productivity premia are much smaller compared to the results based on pooled data only. Thus, unobserved firm heterogeneity does matter. The fixed effects are capable of non-parametrically accounting

[9]The same holds for all other years in the sample period; results are available from the second author on request.

for fixed differences between firms.

When fixed enterprise effects are included, identification originates from changes in exporter status. These fixed effects are likely very important. First, we have discussed how omitted fixed firm characteristics may be spuriously correlated with exporter status. In the quantile regressions above, we did not take account of other dimensions of firm heterogeneity besides productivity, such as quality, which are potentially correlated with the exporter status of a firm. This could lead to biased estimates of the exporter productivity premium at the various quantiles of the productivity distribution. Second, we are primarily concerned with productivity changes resulting from firms switching exporter status. There are many reasons that productivity distributions may be different between exporting and non-exporting firms at any fixed point if time. Using panel data and fixed effects reduces concerns that these other factors are driving the results.

We are interested in quantile estimation to understand the exporter premium throughout the productivity distribution, and we want to estimate the same Structural Quantile Function as equation (6) which, when year fixed effects are included, is

$$S_{P_{it}} = \gamma_t(\tau) + E_{it}\beta(\tau), \quad \tau \in (0,1). \tag{7}$$

Our main results use the Powell [2010a] estimation technique. They are reported in Table 5. In West Germany, the productivity premium of exporters over non-exporters is statistically different from zero at each quantile of the productivity distribution. This holds for East Germany as well with the exception of the very high end. The premium tends to be small (but not negligible) over large parts of the distribution from the 30th percentile onwards where it is about 5 percent. However, it is much larger at the lower end. For the 5th percentile the estimate in favor of the exporters is 29.0 percent[10] in West Germany and 33.1

[10]The percentage value is computed from the estimated regression coefficient β as $100(e^{\beta} - 1)$.

percent in East Germany, and the corresponding figure at the 10th percentile is 15.6 percent in both parts of Germany.

The finding that the exporter productivity premium is positive, statistically significant and of an order of magnitude that is relevant from an economic point of view all over the productivity distribution is important because it shows that a central policy implication of the Melitz [2003] model is still valid here with the presence of low productivity exporters and high productivity non-exporters: a reduction in trade barriers leads to an increase in productivity. Note that the estimates of the exporter premia decrease substantially when fixed effects are included, suggesting that existing estimates in the literature are biased due to unobserved firm heterogeneity. However, the pattern of the results survives - the effect is largest at the bottom of the productivity distribution.

The Melitz model predicts a clear division between exporters and non-exporters. Practically, this seems unlikely. We should expect some level of fluidity. Our results suggest that there is a rather large difference in productivity at the bottom of the distribution. The exporters are more productive throughout the entire distribution, which also matches the predictions of the Melitz model. The only possible exception is at the very top of the distribution for East Germany, where the exporter premium is not significantly different from 0. Such "catch-up" is not predicted by the Melitz model, though this is tenuous evidence given the number of parameters estimated.

The results reported in Table 5 indicate that the exporter premium is not constant over the productivity distribution. The hypothesis of equality of coefficients is rejected at any error level,[11] implying that OLS estimation is unlikely to be useful in this context. The main results indicate that unproductive firms must become much more productive to become an exporting firm. This dimension of firm heterogeneity remains undetected if only

[11] We use a Kolmogorov-Smirnov test as described in Chernozhukov and Hansen [2006].

the estimates for the premium at the conditional mean of the productivity distribution are looked at. Notice that the quantile estimates are different from the OLS estimate for almost the entire distribution.

The results suggest that there is a Melitz-type division between exporters and non-exports in productivity. Reductions in barriers to trade increase profits which exporters can earn in foreign markets and reduce the productivity cutoffs above which firms export. The increased labor demand due to increased exports bids up wages and reduces the profits of non-exporters, some of which will exit the domestic markets because they are no longer profitable. Exit of low-productive firms and reallocation of output and employment towards exporting firms that are more productive than non-exporting firms in each quantile of the productivity distribution increases overall productivity and thereby fosters economic growth.

6 Conclusion

One of the stylized facts from the emerging literature on international activities of heterogeneous firms is the existence of a positive exporter productivity premium - exporting firms are more productive than firms that sell on the national market only. A large number of empirical studies document this premium in regression models including fixed firm effects. These studies test for a difference in productivity between exporters and non-exporters at the conditional mean of the productivity distribution. In this paper we start with a closer look at the productivity distribution of both exporting and non-exporting firms in German manufacturing industries, and we show that - contrary to the predictions from the standard theoretical model of trade with heterogeneous firms by Melitz [2003] - that neither low productivity exporters nor high productivity non-exporters are a rare species. However, we estimate the premium to test the magnitude of the division between exporters and non-exporters.

The literature has previously recognized that firm fixed effects are important to account for unobserved differences between exports and non-exporters. Other papers have argued that quantile estimation is necessary to understand the distributional effects of exporter status. However, this is the first paper which has provided quantile estimates while conditioning on firm fixed effects, providing some of the best evidence to date of the Melitz model. We find evidence that the exporter premium is largest at the bottom of the distribution. Furthermore, the premium is positive throughout the entire productivity distribution. These findings imply that trade liberalization will increase productivity and foster economic growth.

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Table 1: Productivity distribution of exporters and non-exporters in manufacturing enterprises in Germany 1995, 2000, and 2006

	Mean	Std Dev	p1	p25	p50	p75	p99
West Germany 1995							
Exporters (N = 17,286)	105.2	62.3	26.7	69.8	92.5	123.9	333.3
Non-exporters (N = 7,344)	87.9	54.4	13.0	56.3	77.3	105.8	288.3
West Germany 2000							
Exporters (N = 18,432)	106	107.8	22.8	66.7	90.5	125	352.1
Non-exporters (N = 7,928)	86.8	63.7	10.2	52.5	73.7	103.6	327.0
West Germany 2006							
Exporters (N = 16,902)	105.6	77.5	18.3	64.2	89.4	125.6	387.1
Non-exporters (N = 5,411)	83.8	78.3	5.8	45.5	68.1	102.0	321.7
East Germany 1995							
Exporters (N = 1,996)	106.4	71.1	17.0	64.9	92.8	128.1	379.0
Non-exporters (N = 2,454)	94.9	62.3	12.2	59.4	82.3	115.8	317.2
East Germany 2000							
Exporters (N = 2,411)	111.7	72.8	17.3	67.3	95.7	136.4	394.2
Non-exporters (N = 2,555)	89.7	57.8	11.0	55.5	77.3	109.5	297.7
East Germany 2006							
Exporters (N = 2,449)	109.7	78.4	17.6	62.6	89.9	132.2	451
Non-exporters (N = 1,643)	86.2	65.7	12.3	49.2	69.8	103.1	337.7

Productivity is total sales / employees, measured as a percentage of the average value of the 4-digit level industry. Columns labeled p1 - p99 refer to percentiles.

Table 2: Share of exporters and non-exporters in the quintiles of the productivity distribution in manufacturing enterprises in Germany 1995, 2000, and 2006

Quintile	1	2	3	4	5
West Germany 1995					
Exporters (%)	55.25	67.87	72.45	76.63	78.64
Non-exporter (%)	44.75	32.13	27.55	23.37	21.36
West Germany 2000					
Exporters (%)	54.83	66.72	72.34	76.24	79.28
Non-exporter (%)	45.17	33.28	27.66	23.76	20.72
West Germany 2006					
Exporters (%)	58.05	74.21	80.19	82.31	83.69
Non-exporter (%)	41.95	25.79	19.81	17.69	16.31
East Germany 1995					
Exporters (%)	38.81	39.66	44.67	49.33	51.8
Non-exporter (%)	61.19	60.34	55.33	50.67	48.2
East Germany 2000					
Exporters (%)	36.2	42.73	46.94	54.06	62.59
Non-exporter (%)	63.8	57.27	53.06	45.94	37.41
East Germany 2006					
Exporters (%)	45.56	51.89	60.61	67.6	73.41
Non-exporter (%)	54.44	48.11	39.39	32.4	26.59

Productivity is total sales / employees, measured as a percentage of the average value of the 4-digit level industry.

Table 3: Mean Estimates of the Exporter Productivity Premium

Dependent Variable: Log(Labor Productivity)		
	West Germany	East Germany
Exporter	0.125	0.120
	(0.007)	(0.011)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
N	303,073	56,550

The dependent variable is the log of labor productivity (defined as total sales per employee of a firm and measured as a percentage of the average value of productivity in the 4-digit-level industry). Standard errors in parentheses, clustered by firm.

Table 4: Quantile regression estimates of the exporter productivity premium

	West Germany			East Germany		
Quantile	1995	2000	2006	1995	2000	2006
0.05	0.519	0.452	0.621	0.197	0.261	0.336
	(0.021)	(0.037)	(0.032)	(0.061)	(0.060)	(0.058)
0.10	0.305	0.305	0.434	0.120	0.241	0.276
	(0.016)	(0.017)	(0.018)	(0.041)	(0.035)	(0.043)
0.15	0.255	0.260	0.402	0.104	0.196	0.227
	(0.010)	(0.012)	(0.013)	(0.027)	(0.031)	(0.033)
0.20	0.237	0.243	0.360	0.084	0.194	0.251
	(0.009)	(0.010)	(0.011)	(0.020)	(0.027)	(0.031)
0.25	0.214	0.238	0.343	0.088	0.193	0.241
	(0.008)	(0.009)	(0.008)	(0.022)	(0.022)	(0.021)
0.30	0.204	0.227	0.333	0.100	0.172	0.241
	(0.007)	(0.008)	(0.010)	(0.020)	(0.021)	(0.024)
0.35	0.194	0.221	0.318	0.118	0.186	0.244
	(0.007)	(0.008)	(0.011)	(0.019)	(0.020)	(0.022)
0.40	0.186	0.213	0.302	0.120	0.204	0.231
	(0.008)	(0.008)	(0.011)	(0.018)	(0.016)	(0.016)
0.45	0.182	0.207	0.287	0.116	0.210	0.242
	(0.006)	(0.008)	(0.009)	(0.017)	(0.017)	(0.019)
0.50	0.179	0.205	0.272	0.120	0.214	0.253
	(0.007)	(0.007)	(0.009)	(0.020)	(0.015)	(0.021)
0.55	0.177	0.202	0.260	0.123	0.203	0.268
	(0.007)	(0.007)	(0.008)	(0.016)	(0.018)	(0.021)
0.60	0.177	0.202	0.242	0.109	0.209	0.264
	(0.007)	(0.008)	(0.009)	(0.021)	(0.017)	(0.021)
0.65	0.169	0.194	0.233	0.106	0.202	0.268
	(0.007)	(0.007)	(0.009)	(0.015)	(0.022)	(0.025)
0.70	0.163	0.189	0.221	0.104	0.212	0.262
	(0.007)	(0.008)	(0.010)	(0.023)	(0.020)	(0.025)
0.75	0.159	0.188	0.207	0.101	0.220	0.249
	(0.008)	(0.009)	(0.009)	(0.020)	(0.022)	(0.031)
0.80	0.158	0.185	0.204	0.102	0.238	0.250
	(0.008)	(0.009)	(0.011)	(0.027)	(0.019)	(0.028)
0.85	0.155	0.178	0.194	0.110	0.224	0.251
	(0.009)	(0.009)	(0.014)	(0.026)	(0.026)	(0.026)
0.90	0.134	0.168	0.156	0.115	0.223	0.262
	(0.011)	(0.016)	(0.015)	(0.029)	(0.029)	(0.038)
0.95	0.114	0.126	0.131	0.123	0.248	0.229
	(0.020)	(0.019)	(0.019)	(0.037)	(0.042)	(0.062)
Number of firms	24,630	26,360	22,313	4450	4966	4092

The dependent variable is the log of labor productivity (defined as total sales per employee of a firm and measured as a percentage of the average value of productivity in the 4-digit-level industry). Standard errors in parentheses.

Table 5: Fixed effects quantile regression estimates of the exporter productivity premium

Quantile	West Germany (1995 - 2006)	East Germany (1995 - 2006)
0.05	0.255	0.286
	(0.019)	(0.039)
0.10	0.145	0.145
	(0.012)	(0.023)
0.15	0.090	0.105
	(0.008)	(0.019)
0.20	0.075	0.100
	(0.008)	(0.014)
0.25	0.065	0.075
	(0.006)	(0.013)
0.30	0.050	0.055
	(0.006)	(0.011)
0.35	0.050	0.055
	(0.006)	(0.011)
0.40	0.050	0.065
	(0.007)	(0.013)
0.45	0.045	0.050
	(0.006)	(0.011)
0.50	0.045	0.050
	(0.006)	(0.013)
0.55	0.045	0.050
	(0.006)	(0.015)
0.60	0.045	0.065
	(0.007)	(0.014)
0.65	0.040	0.045
	(0.008)	(0.014)
0.70	0.035	0.045
	(0.009)	(0.014)
0.75	0.035	0.065
	(0.010)	(0.019)
0.80	0.050	0.060
	(0.011)	(0.026)
0.85	0.040	0.065
	(0.012)	(0.026)
0.90	0.055	0.050
	(0.015)	(0.034)
0.95	0.055	0.010
	(0.024)	(0.035)
Number of firms	34,560	7,347
Number of observations	303,073	56,550
Test of H0: Equality of Coefficients (p-value)	0.000	0.000

The dependent variable is the log of labor productivity. The empirical model includes a full set of year dummies. Standard errors are based on 100 bootstrap replications and clustered by firms.