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WORKING PAPER

Exports and Firm Characteristics –

First Evidence from Fractional Probit Panel Estimates

by

Joachim Wagner

Exports and Firm Characteristics –
First Evidence from Fractional Probit Panel Estimates

Joachim Wagner[#]

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Abstract:

Using recently released nationally representative data and a new estimator for fractional probit panel models, this paper reconsiders the relationship between the fraction of exports in total sales and firm characteristics in West and East German manufacturing. Controlling for unobserved firm characteristics no impact of human capital and R&D intensity on export performance is found, while firm size is positively related to exporting in West Germany only.

Keywords: Exports, firm characteristics, fractional probit panel model, Germany

JEL classification: F14

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1.   Motivation

Germany is one of the leading actors on the world market for manufactured goods, and exports play a key role in shaping the development of the economy. It is important, therefore, to understand what makes a successful exporter. One interesting question in this context is whether there are easily observable characteristics of a firm that are closely related to success on international markets. If this is the case, policy measures might be designed that either target firms with these characteristics to foster export activities, or that help firms that do not yet have these characteristics to build them up and to become the successful exporters of the future. If there are no such characteristics, this casts doubts on the adequacy of specially targeted export promotion programs with a focus on selected groups of firms.

The proof that certain observable characteristics of a firm are closely related to its export activity is all but easily delivered. Obviously, one can compare exporters and importers (or firms that export a small share of their total product with firms that export a large share) with respect to firm size, human capital intensity, or R&D activities. Such comparisons, however, can neither take care of any relationship between these characteristics, nor can they deal with the role of unobserved (and sometimes unobservable) characteristics – like a unique product, or superior quality of the management of a firm - that might be correlated with the observed characteristics. The workhorse in empirical studies faced with these problems is an empirical model estimated with panel data that includes fixed effects to control for time invariant unobserved firm characteristics that might be correlated with the variables in that empirical model.

However, any attempt to apply this strategy is confronted with a problem that is due to the nature of the variable to be explained: The share of exports in total sales is a percentage variable that is by definition limited between zero and 100 percent

with a lot of observations at the lower bound because many firms do not export at all. Papke and Wooldridge (1996) showed that for a fractional response variable of this type, and using cross section data, a fractional logit estimator is appropriate. Wagner (2001) introduced this estimation strategy into the literature on the determinants of exporting activities of firms, and discussed the flaws related to alternative approaches like Tobit or two-step estimators .

If the number of panels (i.e., firms) in a population (an industry, or a country) is finite and each panel is represented in the data set, an unconditional fixed-effects fractional logit model can be used which simply includes an indicator variable for each firm (see Hardin and Hilbe 2001: 195). Wagner (2003) applied this modelling strategy using information on all firms in three manufacturing industries from one German federal state. He finds that the positive relationship between firm size and exports, and between the average wage per employee (a proxy for human capital) and exports, that is usually found in cross-section data vanishes when unobserved firm characteristics are controlled for.

This unconditional fixed-effects approach can only be used when information for the population of firms is available for a number of periods, and that is rarely the case. In a recent paper Papke and Wooldridge (2007) introduce a method that can be applied to estimate fractional response models for panel data with a large cross-sectional dimension and relatively few time periods while explicitly allowing for time-constant unobserved effects that can be correlated with explanatory variables. The data need not cover the whole population, but they must form a balanced panel data set with complete information on all variables in each year for each firm.

In this paper we apply the newly developed panel data method for fractional response variables to reconsider the relationship between the share of exports in total sales and firm size, human capital intensity, and R&D intensity in manufacturing

enterprises in West and East Germany, using unique recently released nationally representative high-quality data. Section 2 introduces the data and the empirical modelling strategy. Section 3 presents the results of the econometric investigation and concludes.

2.   Data and Empirical Modelling Strategy

The data used in this study are merged from two surveys conducted by the German Statistical Offices. One source is the monthly report for establishments in manufacturing industries described in Konold (2007). For this project the information collected at the establishment level has been aggregated at the enterprise level to match the unit of observation from the second source of data used here, the cost structure survey for enterprises in the manufacturing sector. This survey is carried out annually as a representative random sample survey (stratified according to the number of employees and the industries) of around 18.000 enterprises (see Fritsch et al. 2004). Data from the two sources are matched using the enterprise identifier available in both surveys. The resulting panel covers the years 1999 to 2002. These data are confidential but not exclusive (see Zühlke et al. 2004 for details).

The balanced panels used cover 11,117 enterprises in West Germany and 1,995 enterprises in East Germany. While there are differences between West and East Germany with regard to the share of exporting enterprises (three in four in West Germany compared to one in two in East Germany), exporters are significantly larger, more human capital intensive (measured by the average wage per employee) and more R&D intensive (measured by either the share of employees in R&D, or by the ratio of R&D expenditures to total sales) than non-exporters in both parts of Germany.[1]

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[1] A table with descriptive statistics is available on request.

These facts are in line with evidence form former empirical studies. Furthermore, given that Germany is one of the most highly developed countries we expect that firms using human capital and new technology intensively to produce new products have a comparative advantage and, therefore, are the more successful exporters. To investigate the links between the share of exports in total sales and firm size, human capital und R&D empirically, we use for the first time the pooled fractional probit estimator introduced by Papke and Wooldridge (2007). Papke and Wooldridge proof that time-constant unobserved effects that can be correlated with explanatory variables are controlled for by adding the time averages of the explanatory variables to an empirical model. The model is estimated with a generalized linear models command using Stata.

3.   Results of the Econometric Investigation

Estimation results for West and East Germany are reported in Table 1. To demonstrate the importance of controlling for unobserved time-invariant firm characteristics all models are estimated with and without fixed effects; furthermore, two variables measuring R&D intensity either by the share of employees in R&D or by expenditures for R&D over total sales are used alternatively.

[Table 1 near here]

In the models without fixed effects the estimated coefficients of all the exogenous variables are statistically significant at a usual level and have the expected signs – the share of exports in total sales is higher in larger, more human capital intensive and more R&D intensive enterprises (after controlling for detailed industry affiliation and year). This picture is completely different when we look at the

results from empirical models that control for time-invariant unobserved firm effects by using the new pooled fractional probit estimator introduced by Papke and Wooldridge (2007). None of the reported coefficients is statistically different from zero in the fixed effects models for East Germany. For West Germany, the statistically significant relations between exports and human capital or R&D intensity found in the models without fixed effects vanish when time-invariant unobserved firm characteristics are controlled for, while size and share of exports in total sales are positively related in that model, too.[2]

According to these results controlling for unobserved time-invariant enterprise characteristics is crucial for any empirical study that relates firm characteristics and export activities. The evidence presented demonstrates that in German manufacturing industries it is neither human capital intensity, nor R&D intensity *per se* that make a successful exporter, but that unobserved time-invariant characteristics that are correlated with these observed characteristics matter. Reading beyond professional journals and looking at evidence reported in the business press or trade journals reveals that such characteristics - like a unique product, or superior quality of the management of a firm – are often found in very small firms with no or negligible R&D activities. All this cast doubts that any specially targeted export promotion programs with a focus on selected groups of human capital intensive and R&D intensive firms are adequate.

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[2] Note that only a few enterprises in the samples are larger than the maximum of the quadratic equation in firm size in all models. Therefore, the results indicate that the share of exports in total sales increases with size.

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Table 1:   Results of the econometric study

Endogenous variable: Share of exports in total sales

Exogenous variable		West Germany				East Germany			
		Pooled data		Fixed effects		Pooled Data		Fixed Effects	
Average number of employees	ß	0.000043	0.000049	0.0000341	0.0000346	0.00038	0.00040	0.00011	0.00012
	p	0.000	0.000	0.009	0.008	0.000	0.000	0.368	0.364
Average number of employees (squared)	ß	$-2.80e-10$	$-3.13e-10$	$-1.58e-10$	$-1.59e-10$	$-2.98e-8$	$-3.50e-8$	$-1.31e-8$	$-1.37e-8$
	p	0.000	0.000	0.004	0.003	0.052	0.020	0.134	0.132
Average wage per employee (in €)	ß	0.000019	0.000019	$-5.13e-7$	$-5.24e-7$	0.000028	0.000027	$-1.31e-7$	$-1.17e-7$
	p	0.000	0.000	0.332	0.314	0.000	0.000	0.953	0.958
Share of employees in R&D (%)	ß	4.453		-0.156		1.690		-0.014	
	p	0.000		0.270		0.010		0.940	
Expenditures for R&D over total sales (%)	ß		1.875		0.015		1.734		-0.00014
	p		0.000		0.859		0.000		0.999
Number of enterprises		11,117	11,117	11,117	11,117	1,995	1,995	1,995	1,995
Number of observations		44,468	44,468	44,468	44,468	7,980	7,980	7,980	7,980

Note: All models include a constant, dummy variables for the years 1999, 2000 and 2002, and dummy variables for 4-digit industries. The fixed effects models include the time averages of all exogenous variables, too. For details regarding the estimation strategies see text.

Appendix: Descriptive statistics for exporting and non-exporting enterprises

	West Germany	East Germany
Share of exporting enterprises (percent) in year 1999	75.36	53.93
In year 2002	76.15	56.64
Share of enterprises (percent) that …		
exported in each year between 1999 and 2002	72.78	49.62
never exported in a year between 1999 and 2002	20.91	38.35
Average share of exports in total sales 2002 (percent)		
- all enterprises	23.50	13.24
- exporting enterprises only	30.87	23.37
Average number of employees in year 2002		
- in exporting enterprises	403.82	184.23
- in non-exporting enterprises	122.46	126.28
Average wage per employee in year 2002 (€)		
- in exporting enterprises	33,627	24,660
- in non-exporting enterprises	28,569	21,677
Average share of employees in R&D (percent) in year 2002		
- in exporting enterprises	1.04	1.30
- in non-exporting enterprises	0.13	0.40
Expenditures for R&D / total sales (percent) in year 2002		
- in exporting enterprises	2.20	2.99
- in non-exporting enterprises	0.27	0.89
Number of enterprises in the balanced panel	11,117	1,995

Note: The difference between exporting and non-exporting enterprises is always statistically significant at an error level of one percent according to a two-sample t-test .with unequal variances.

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