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The causal effects of exports on firm size and labor productivity: First evidence from a matching approach[1]

Joachim Wagner

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Abstract:

This paper uses a large plant level panel data set from Germany and a matching approach to look for causal effects of starting to export on plant performance. We find positive effects on growth of employment, labor productivity, and wages.

Zusammenfassung:

Dieses Diskussionspapier untersucht, welche Effekte der Exportstart auf die Performance von Betrieben hat. Es legt einen Matching-Ansatz zugrunde. Datenbasis ist ein großes deutsches Betriebspanel. Es werden positive Auswirkungen des Exportstarts auf Beschäftigung, Arbeitsproduktivität und Löhne nachgewiesen.

JEL classification: F10, D21, L60
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1 MOTIVATION

Debates on the relationships between exports and growth have a long lasting tradition in economics. Summarizing the evidence accumulated at the end of the last century *Baldwin* (2000) argues that despite a number of multi-country case studies utilising comparable analytical frameworks, numerous econometric studies using large cross-country data sets, and important theoretical advances, there is still considerable disagreement how trade and economic growth interact.

Past empirical studies related to this discussion have been performed almost exclusively with aggregate cross-country data. Recently a new literature emerged dealing with the microeconom(etr)ics of trade and exporting, and we now have a growing body of empirical work documenting the superior performance characteristics of exporting plants and firms compared to non-exporters at any given moment. Exporting plants tend to be larger, to have higher levels of productivity and shipments, and to be more capital intensive and technologically sophisticated than non-exporters in the same industry (e.g., for the US, see *Bernard* and *Jensen* (1999); for Germany, *Bernard* and *Wagner* (1997); for a Colombia, Mexico, and Morocco, *Clerides*, *Lach* and *Tybout* (1998); for Taiwan and South Korea, *Aw*, *Chung*, and *Roberts* (1998)).

Differences at a given moment, however, do not tell us anything about the direction of causality. There are at least two important theoretical reasons why exporting might improve firm performance: Serving a larger market might allow a firm to take advantage of any economies of scale in production or to provide some reduction in domestic variations in demand; and firms active on foreign markets are exposed to more intense competition and must improve faster than firms who sell their products domestically only. Looking at the reverse direction, we expect that success leads to exports because there exist additional costs of selling goods in foreign markets, and, therefore, larger, more productive and more innovative firms will be more likely to export because they can recover these extra costs more easily (see, e.g., *Bernard* and *Wagner* 1997). Evidently, for a given population of firms causality may run in both directions simultaneously.

Using large panel data sets the microeconometric studies mentioned above document that, on the one hand, good firms go abroad - levels of success measures and growth

rates are higher for export starters during years prior to starting sales on foreign markets compared to firms in the same industry that do not start to export.

As for the performance of exporters compared to non-exporters, the results are somewhat more mixed. However, if we focus on the post-entry performance of export starters compared to firms that do not export (i.e., if we do not consider the relative performance of continuous exporters or export stoppers vs. non-exporters), and if we concentrate on the highly developed economies of the U.S. and Germany[1], a clear picture emerges: For almost every measure, plants entering the export market have a substantially faster growth (*Bernard* and *Jensen* 1999; *Bernard* and *Wagner* 1997).

Does this point to a causal effect of starting to export on firm size and productivity, or any other measure of firm performance? The answer is, obviously, no: We have evidence from the microeconometric studies mentioned above that better firms self-select into export-starting. If today's export starters are 'better' than today's non-exporters (and have been so in the recent past), we would expect that they should, on average, perform better in the future even if they do not start to export today. However, we cannot observe whether they would really do so because they do start to export today; we simply have no data for the counterfactual situation. So how can we be sure that the better performance of starters compared to non-exporters is caused by exporting (or not)?

This closely resembles a situation familiar from the evaluation of active labor market programs (or any other form of treatment of units): If participants, or treated units, are not selected randomly from a population but are selected or self-select according to certain criteria, the effect of a treatment cannot be evaluated by comparing the average performance of the treated and the non-treated. However, given that each unit (plant, or person, etc.) either participated or not, we have no information about its performance in the counterfactual situation. A way out is to construct a control group in such a way that every treated unit is matched to an untreated unit that has been as similar as possible (ideally, identical) at the time *before* the treatment. Differences between the two groups

1 Summarizing several recent studies using data from Colombia, Mexico, and Morocco, *Roberts* and *Tybout* (1997) argue that although export-oriented development is often touted as a means to achieve rapid productivity growth, there is little evidence in firm-level productivity trajectories that exporting has led to such gains. *Aw*, *Chung*, and *Roberts* (1998) report that in several industries in Taiwan, entry into the export market is followed by relative productivity improvements, a result consistent with learning-by-exporting forces; in South Korea, however, they find no significant productivity changes following entry.

(the treated, and the matched non-treated) after the treatment can then be attributed to the treatment (for a comprehensive discussion, see *Heckman*, *LaLonde* and *Smith* 1999).

This paper contributes to the literature by using (to the best of my knowledge, for the first time) this matching approach to test for causal effects of starting to export on firm size and productivity.[2] The rest of the paper is organized as follows: Section 2 introduces the data, discusses the identification of export-starters, and compares starters with non-exporters in the way this is usually done in microeconometric studies of exporter performance. Section 3 gives a non-technical outline of the matching approach used here and reports empirical results for the causal effects of starting to export on firm size and productivity. Section 4 concludes.

2 EXPORT STARTERS AND NON-EXPORTERS

The empirical study is based on an unbalanced panel of establishments (local production units, plants) build from cross section data collected in regular surveys by the Statistical Office of Lower Saxony, one of the 'old' federal states of Germany. The surveys cover all local production units from manufacturing industries that employ at least 20 persons in the local production unit or in the company that owns the unit. The panel starts in 1978, and in this paper we use data for 1978 to 1989, the year prior to the German reunification. Note that the data are confidential but not exclusive; information on the content of the data set and how to access it is given in *Wagner* (2000).

Export starters and non-exporters are defined as follows: Plants that did not export for three years prior to year t, export in year t, and export in at least two years between t+1 and t+3 belong to the cohort of export starters in year t. Non-exporters from this cohort did neither export for three years prior to year t nor in any year between t and t+3.

Pooling cohorts for 1981 to 1986 results in data for 186 starters and 9239 non-exporters. Table 1 reports results from a comparison of both groups. Starters were on average larger than non-exporters in the year t-1. Average sales per person employed is used to proxy labor productivity, because we have no information about value added or the

2 Note that this notion of causality is different from the concept of Granger causality used in time series studies where given a universe including the two series (Xt) and (Yt), X is said to cause Y if the forecast for Yt from the history of the universe excluding X can be improved by taking the history of X into account; see *Kunst* and *Marin* (1989) for a study on exports and productivity.

Table 1 Comparison of export starters and non-exporters: All plants

Means	**Export starters (N = 186)**	**Non-exporters (N = 9239)**
Firm size in year t - 1 (Number of persons)	91.87	55.56
Average sales per person in year t – 1 (1000 DM)	220.05	226.14
Average wage per person in year t - 1 (1000 DM)	33.99	32.84
Growth of size between years t - 1 and t + 3 (percent)	11.62	-0.42
Growth of average sales per person between years t – 1 and t + 3 (percent)	18.71	14.06
Growth of average wage per person between years t – 1 and t + 3	4.83	3.19
Exporter premia	**Percent**	**Probvalue**
Firm size	34.84	0.000
Average sales per person	3.89	0.382
Average wage per person	3.58	0.015
Growth of size	9.56	0.000
Growth of average sales per person	5.98	0.258
Growth of average wage per person	2.65	0.015

Note: Year t is the year in which export starters exported for the first time during the time span under consideration; see text. Average sales and wages are in constant are in constant prices (1985 = 100). Export premia for levels are computed from regressions controlling for 4-digit industries, branch plant status, and year; the premia regressions for growth rates include the levels for size, labor productivity, and average wages in t - 1, too.

capital stock of the plant in the data. Both labor productivity and wages per person in t-1 were slightly lower in starters than in non-exporters. Controlling for 4-digit industries, years, and branch plant status in OLS regressions of (log) plant size and (log) labor pro-

ductivity on a dummy variable indicating whether a plant is a starter or not, we find a starter premia of 34.5 percent for size, and a starter premia of 3.9 percent (that is, however, not statistically significant at any conventional level) for labor productivity. Note that the starter premia for the average wage per employee is 3.6 percent, pointing to a higher intensity of human capital in export starters compared to non-exporters. By and large, therefore, we have a picture that is familiar from other microeconometric studies of exporting: export starters are 'better' than non-exporters from the same industry before starting; the good go abroad.

Comparing the performance of starters and non-exporters over the period t-1 (i.e. just before the starters enter the foreign market) to t+3 reveals that on average starters grew much faster than non-exporters (by 11.62 percent compared to -0.42 percent), and labor productivity increased slightly more in starters (18.71 percent) than in non-exporters (14.06 percent). Controlling for 4-digit industries and years, plus number of employees, labor productivity, average wages, and branch plant status in t-1, in OLS regressions gives similar results: starters have a 9.6 percent higher rate of growth of employment, a 2.65 percent higher rate of growth of average wages, and labor productivity growth is 6.0 percent higher (though the regression coefficient is insignificant at a conventional level). Again, this is a picture familiar from earlier studies for Germany and the U.S.

3 CAUSAL EFFECTS OF STARTING TO EXPORT

In section 1 it was argued that a comparison of the average performance of export starters and non-exporters cannot reveal any causal impact of exports on plant performance due to self-selection of better plants into exporting. In the absence of any information about the counterfactual situation we have to select a control group from the non-exporters to be compared with the export-starters in which the distribution of observed variables is as similar as possible to the distribution in the starter group. To do so for every starter a non-exporter has to be selected that was as similar as possible to the starter in t-1 (i.e., with the same or a quite close number of employees, labor productivity, branch plant status, average wage per employee, from the same industry and cohort). Technically this is usually done by matching starters and non-exporters with the same or a very similar so-called propensity score. This score is computed from a probit regression of a dummy variable indicating whether or not a firm is an export starter on all the relevant plant characteristics in t-1. Additionally one can add one or more plant characteristics to this estimated propensity score to form a vector of variables for each

starter and each non-exporter, and then select for each starter the non-exporter whose vector has the minimum Mahalanobis distance from the vector of the starter.

Matching was performed in Stata 7.0 using the psmatch command (*Sianesi* 2001) with the propensity score and the number of employees in t-1 as the matching variables. 182 of the 186 export starters could be matched to a total of 171 non-exporters (note that a non-exporter can be matched with more than one starter due to matching with replacement). Matching was successful; a comparison of mean values in t-1 for starters and matched non-exporters reported in table 2 shows no statistically significant differences at a level of 5 percent for the number of persons employed, average sales per person, and average wage per person.

Table 2 Comparison of export starters and non-exporters: Matched plants

Means	**Export starters (N = 182)**	**Non-starters (N = 171)**	**Prob-value for H_0: difference of means = 0**
Firm size in year t - 1 (Number of persons)	89.66	90.44	0.9518
Average sales per person in year t – 1 (1000 DM)	207.60	207.96	0.9894
Average wage per person in year t - 1 (1000 DM)	33.91	36.20	0.0635
Growth of size between years t – 1 and t + 3 (percent)	11.54	-1.78	0.0001
Growth of average sales per person between years t - 1 and t + 3 (percent)	18.85	14.96	0.3122
Growth of average wage per person between years t – 1 and t + 3	4.84	1.91	0.0231

Note: Year t is the year in which export starters exported for the first time during the time span under consideration; see text. Average sales and wages are in constant are in constant prices (1985 = 100).

A comparison of the performance of export starters and matched non-exporters reveals a causal effect of starting to export on firm growth (see table 2): between t-1 and t+3 the growth rate for starters was 11.54 percent on average compared to -1.78 percent for non-exporters. This difference is statistically significant at any conventional level, and it is large from an economic point of view. On the other hand, we have only week evidence for a positive effect of starting to export on labor productivity proxied by average sales per person: while on average productivity growth differs between starters and matched non-exporters by about one percent per year (18.85 percent vs. 14.96 percent over the four year horizon between t-1 and t+3), this difference in not statistically different from zero at any conventional level. Furthermore, the average real wage per person grew significantly faster in starters than in matched non-exporters (4.84 percent compared to 1.91 percent).

4 CONCLUDING REMARKS

Using a matching approach to look at the causal effects of starting to export on firm performance reveals economically and statistically significant positive effects on two indicators of plant performance, growth of employment and wages, and weeker evidence for a positive effect on labor productivity. All in all, starting to export seems to be a good thing to do.

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