Exports and Success in German Manufacturing

By

Andrew B. Bernard and **Joachim Wagner**

Contents: I. Introduction. – II. Exporters and Exporting. – III. Exporting and Firm Success. – IV. Performance before Exporting. – V. Performance after Exporting. – VI. Entry, Exit and Survival. – VII. Conclusions. – Appendix.

I. Introduction

A growing literature on the characteristics and performance of exporters has documented their exceptional performance characteristics at a point in time and has raised the question of whether exporters outperform non-exporters. All the previous work to date has been on countries moving from low shares of exports to high shares. [1] In fact, increasing export shares have been held up as a potential source of growth booms for less developed economies, see World Bank (1993). Almost nothing is known about the relationship between exporting and success in advanced economies with stable export shares. It can easily be argued that the German case represents perhaps the best example of an economy with a mature export market. Throughout the post-WWII period, and especially in recent years, Germany has relied on export markets to sustain its manufacturing sector. At least in the business press, it is fairly routine to observe comments about how exporting has allowed Germany to maintain its relatively high share of manufacturing in total output. Since it is well established that manufacturing jobs are relatively well paid, the relative strength of German manufacturing has supported higher than average wages for German workers.

Remark: This research was supported by a grant from the German Ministry of Research to the World Economy Laboratory at MIT. Special thanks go to Uwe Rode and the Statistical Office of Lower Saxony for providing access to the data and running the STATA programs. We thank an anonymous referee for helpful comments. All opinions and errors remain ours alone.

[1] This includes work on the U.S. where the export share of manufacturing production has been rising rapidly since 1987 (Bernard and Jensen 1996 b). An exception is Wagner (1995) who examines the relationship between firm size and exporting using the Lower Saxony data.

In this paper, we pursue two goals: first, we examine the characteristics and performance of exporters and non-exporters in German manufacturing. In particular, we document the importance of exporting in both industries and manufacturing establishments. We ask whether exporters pay higher wages and have higher productivity. Second, and perhaps more importantly, we provide evidence on the sources of the relatively good performance traits of exporting firms and plants. We outline and test alternative explanations for the superior performance including those running from exporting to success and those which argue that successful plants become exporters.

Discussions of the role of exports in promoting growth have been ongoing for many years; see for example Keesing (1967) for an early example or Greenaway and Sapsford (1994) for a more detailed list. At a microeconomic level, increasing export intensity is hypothesized to promote faster output and productivity growth through a variety of mechanisms including greater capacity utilization, economies of scale, incentives for technological improvements and increased management efficiency due to competition abroad. Feder (1982) argues that exports increase growth rates of semi-industrialized countries by shifting resources into sectors with higher marginal factor productivities.[2] Greenaway and Sapsford (1994) conclude that there is little evidence that increasing exports leads to higher growth rates. Our research is related to this important policy debate on the role of exports in promoting faster growth. We provide, admittedly through the use of data from a developed economy, direct microeconomic evidence on the role of exporting on firm performance. To the extent that aggregate analyses are likely to confound correlation and causality, this study is an important improvement over traditional methodologies.

The literature on the relationship between exporting and firm performance is relatively recent. Wagner (1995), using the same data set employed here, documents the positive relation between export participation and firm size. In addition, he reports that total sales growth is positively correlated with increases in export intensity. In a series of papers, Bernard and Jensen (1995a, 1995b, 1996, 1997) document the differences between exporters and non-exporters in U.S. manufacturing. They find that exporters have substantial size and productivity advantages over non-exporters and pay significantly

[2] See Sheehey (1990) for a compelling criticism of the methodology used by Feder (1982) and others.

higher wages. In addition, exporters are more capital- and technology-intensive. These export premia hold over time and within size category. In explaining the nature of the performance advantage, Bernard and Jensen (1995 b) find that good attributes lead the way for entering into the export business and that there is less evidence for performance gains once firms have entered the export market. An exception is that export-intensive firms have faster productivity growth rates than non-exporters. Bernard (1995) considers the performance of exporting firms during trade liberalization in Mexico, finding that exporters start with performance advantages and outperform non-exporters as liberalization proceeds.

As in these other studies on exporters, we find that exporting plants in Lower Saxony have decidedly better performance attributes than non-exporters, even within the same industry. While wage differentials are modest, productivity is substantially higher at exporters. Turning to an explanation of these findings, our results are quite clear on several points. Several years before they begin to sell their product abroad, exporters already have many of the superior characteristics. They are larger and more productive and these differences are accentuated in the run-up to exporting. The years prior to entry show significantly faster growth in employment, shipments and productivity for these future exporters.

On the other hand, performance after the start of exporting is no better, and often even worse, than that of non-exporters. Especially over short horizons, exporters have lower growth rates for most performance measures. Part of the reason for the poor performance after entry is due to entry and exit in the export market. Entry is associated with dramatic improvements in outcomes including shipments and productivity, while ceasing exporting is a disastrous outcome for the plant, showing negative growth for all measures.

Our results caution that exporting cannot be held up as the panacea for domestic ills. Successful plants and firms can and do take advantage of export markets to grow. However, exporting itself does not provide a performance edge to firms, rather it appears that the ability to position oneself to compete and sell abroad is the source of superior characteristics at exporting plants.

The remainder of the paper is organized as follows: first, in Section II, we review the evidence on how much better exporters are at any point in time. We then discuss how exporting might interact with firm structure and performance in Section III. In Section IV, we take up the issue of ex ante performance and ask whether good firms

become exporters. We evaluate ex post outcomes over various time horizons in Section V and assess any performance improvements from exporting. To understand the post-entry results, we look at how plants change when they enter and exit the export market in Section VI and we examine whether exporters have a higher probability of surviving. Section VII concludes.

II. Exporters and Exporting

To understand the role of exporting in the success of establishments, we use an unbalanced panel data set on 7,624 German plants from 1978 to 1992. The strict nature of data confidentiality requirements in Germany means that permission is needed from both the Federal and appropriate State statistical agencies to use information collected at the level of the establishment. As a result, we are limited to studying the export performance of firms in one state, Lower Saxony, the second largest of the "old" federal states. The data for this paper come from the annual survey of establishments with 20 or more employees conducted by the Lower Saxony statistical office.[3] Data coverage includes employment, the value of shipments, the value of exports, annual wages by two categories of workers, production worker hours, and investment and capital stocks. We start by considering the composition of industry in the panel and export characteristics by sector.

1. Exporting Industries in Lower Saxony

In Table 1, we report the distribution of plants in the Lower Saxony panel by industry for 1978 and 1992.[4] Among reporting industries, electrical equipment, engineering, and plastics make up the largest share of shipments, while those industries and nonferrous metals are the largest exporters. In both 1978 and 1992, 44 percent of all establishments in the panel exported and the average exports to shipments ratio was about 40 percent in both years. As might be expected in an export-oriented economy such as Germany, the breadth and depth of exporting is substantial. In particular, it is

[3] See the Appendix for more information on the construction of the data. Details regarding the data are given in Methner (1992).

[4] For reasons of data confidentiality, we cannot report statistics for some industries in each year. Industries omitted from Table 1 cover 28 percent of plants and 42 percent of employment in the sample in 1978 and 57 percent of plants and employment in 1992. All subsequent calculations in the paper include all plants in the sample.

Table 1 – *Industry Characteristics, 1978 and 1992*

Industry	Number of plants	Share of exporter (%)	Size of exporter[a]	Share of exports in shipments (%)	Size of non-exporter[a]
			1978		
Coal mining	100	43.0	123	39.9	140
Stone, sand, clay, asbestos	476	17.4	93	23.2	23
Nonferrous metal	14	87.7	663	40.1	16
Steel drawing, rolling	92	44.6	174	15.9	48
Steel	168	28.6	199	22.7	71
Engineering	465	69.2	163	47.6	65
Shipbuilding	28	71.4	329	58.9	225
Electrical equipment	270	48.1	354	37.0	165
Optics, watches, clocks	151	30.5	187	52.6	34
Metal products	133	58.6	184	25.0	53
Musical instruments	27	74.1	159	26.7	49
Glass	31	74.2	292	33.9	50
Sawmills	115	35.7	85	22.3	24
Wood processing	213	50.7	119	17.8	42
Cellulose, paper and board	19	89.5	332	46.4	76
Paper and board products	85	67.1	141	13.8	90
Printing	175	45.1	74	8.1	77
Plastics	200	70.0	179	28.3	67
Rubber	46	71.7	213	36.6	841
Leather	13	84.6	145	18.7	42
Textiles	78	73.1	252	30.5	59
Clothing	191	33.5	122	22.9	68
Total	4323	44.2	259	40.7	67
			1992		
Coal mining	104	45.2	132	34.7	147
Stone, sand, clay, asbestos	471	15.7	99	22.3	22
Foundries	34	50.0	229	15.6	44
Engineering	461	68.5	161	46.8	65
Electrical equipment	277	48.0	329	34.0	152
Musical instruments	24	83.3	154	24.9	51
Glass	33	72.7	275	32.4	44
Sawmills	112	35.7	90	21.5	22
Wood processing	207	49.3	118	17.9	40
Cellulose, paper and board	19	89.5	322	47.6	75
Paper and board products	85	62.4	155	14.3	73
Printing	177	39.0	77	13.8	70
Plastics	193	71.5	173	27.5	67
Leather	15	86.7	130	15.7	42
Textiles	84	75.0	241	30.7	56
Clothing	190	33.2	118	22.6	68
Total	4329	44.0	257	39.3	66

[a] Measured by persons employed per firm.

significantly higher than in a more closed economy such as the U.S., where 13 percent of manufacturing plants exported an average of 7.3 percent of their output in 1987 (Bernard and Jensen 1995a).[5] As is typically found in comparisons of exporters to non-exporters, within every industry except coal mining, the average size of exporting plants is substantially larger than that of non-exporters.

2. Exporters and Non-Exporters

To begin our examination of the differences between exporters and non-exporters in Lower Saxony and the sources of those differences, we show the distribution of export intensity in Figure 1. In our sample, 44 percent of plants export in 1978 and 1992. However, even in an export-oriented manufacturing sector, only a small fraction of plants produce the majority of their output for foreign destinations. Half of the plants reported export to shipments ratios of 0.15 or smaller in 1978 and only 12.6 percent of plants export more than half their output. Exporting intensities are almost identical in 1992, suggesting that while the volume of exports rose, the degree of outward orientation was relatively stable during this period.[6]

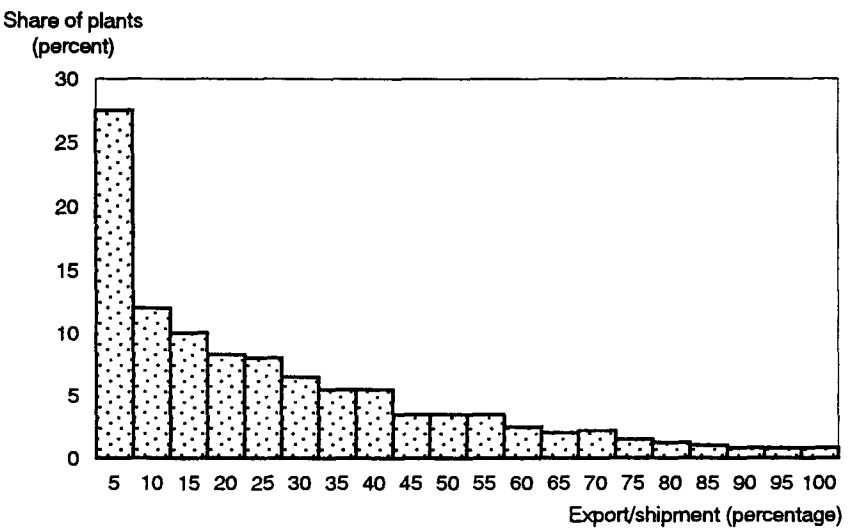
We report plant means for a variety of plant characteristics in Table 2. We consider four groupings of plants by size in both 1978 and 1992: all plants, plants with fewer than 250 employees, plants with more than 250 employees, and large plants with more than 500 employees. As reported above, size differentials between exporters and non-exporters are substantial, even within broad size categories exporters are larger than non-exporters by 30–50 percent. Shipments are accordingly much larger in the case of exporters as well. In fact, labor productivity, measured in either output per worker or value added per worker on average is almost identical across exporters and non-exporters. However, this similarity hides substantial variation across plant size. Smaller non-exporters are 3–4 percent more productive than their exporting counterparts, but large exporters have substantial productivity advantages, in the order of 30–50 percent.

---

[5] By 1992 U.S. export participation and intensity had risen significantly; 19 percent of U.S. plants exported on average over 13 percent of their output. See Bernard and Jensen (1996).

[6] For Germany as a whole, GDP rose by 52.1 percent from DM 1,917 billion in 1978 to DM 2,916 billion in 1992 (measured in constant 1991 prices). Exports from Germany rose by 66.0 percent during the same period from 22.7 percent of GDP in 1978 to 24.8 percent in 1992.

Figure 1 – *Distribution of Exporting Plants by Export Intensity, 1992*



Looking at labor inputs, we again see differences that vary across size categories. Average wages are 7 percent higher in exporting plants but within size categories we see wage premia only at the smaller plants. The average wage differential is driven mostly by the higher numbers of exporters in the large-plant categories. As found in other studies, larger plants pay substantially higher wages. Breaking employment into blue-collar and white-collar workers, we find that any export wage premia exist exclusively for white-collar workers. Again small plants appear to pay an export premium to white-collar workers but again the high share of exporters in the group of larger plants which pay substantially more for their white-collar workers is the dominant source of the export wage disparities.[7] In addition, the composition of employment differs both across export status and plant size. Exporters employ more white-collar workers, especially in the largest plant categories, although the differential has dropped over time.

Surprisingly, exporters are less likely to be part of a multi-plant firm. In the U.S., 60 percent of exporting plants are associated with

[7] The wage-size differential is substantial. Blue-collar and white-collar workers in exporting plants with 500+ employees are paid about 15 percent more than their counterpart in exporting plants with fewer than 250 employees.

Table 2 – *Mean Characteristics for Exporters and Non-exporters in 1978 and 1992*

	All plants		Less than 250 employees		More than 250 employees		More than 500 employees	
	Exporters	Non-exporters	Exporters	Non-exporters	Exporters	Non-exporters	Exporters	Non-exporters
				1978				
Employment	259.20	68.45	80.24	46.73	1,000.68	629.25	1,768.56	1,168.94
Shipments	76,025.6	13,065.1	19,287.2	10,228.7	311,106	86,297.2	576,449	113,843
Wage per worker	41.20	38.17	40.18	37.89	45.46	45.57	46.64	47.01
Production wage	35.96	35.09	35.15	34.91	39.31	39.66	40.35	39.32
Nonproduction wage	55.87	50.73	54.63	50.3	60.98	61.48	65.58	62.33
Shipments per worker	237.08	237.41	232.1	239.8	257.71	175.74	267.74	115.68
Value added per worker	201.26	200.76	196.12	203.19	222.56	138.24	225.1	105.3
Machinery investment per worker	8.20	9.47	7.71	9.31	10.23	13.45	12.09	6.71
Total investment per worker	10.37	11.29	9.94	11.13	12.18	15.38	13.96	8.08
Nonproduction workers/ total workers (%)	28.96	28.37	28.88	28.36	29.25	28.45	38.93	30.16
Multi-plant share (%)	21.72	34.29	15.65	32.7	46.9	76.14	62.35	93.55
Number of plants	1,903	2,360	1,533	2,272	370	88	169	31
				1992				
Employment	257.92	67.22	78.64	45.75	976.46	625.69	1,792.01	1,165.71
Shipments	70,008.6	11,930.1	17,951.5	9,317.68	278,650	79,883.3	533,857	90,878.1
Wage per worker	40.07	37.26	39.00	36.97	44.32	44.93	46.08	46.99
Production wage	34.97	34.16	34.12	33.97	38.38	39.02	39.72	39.82
Nonproduction wage	53.63	49.33	52.32	48.93	58.88	59.3	61.08	62.75
Shipments per worker	227.78	225.43	224.11	227.43	242.49	173.63	248.7	87.13
Value added per worker	194.6	197.00	190.84	199.81	209.66	123.79	205.18	81.76
Machinery investment per worker	7.63	8.19	7.29	7.94	8.99	14.55	9.57	7.13
Total investment per worker	9.57	9.94	9.24	9.65	10.87	17.54	10.98	8.39
Nonproduction workers/ total workers (%)	29.24	28.28	29.19	28.23	28.41	29.39	30.17	28.03
Multi-plant share (%)	22.37	34.76	16.33	33.12	46.7	78.41	64.85	96.77
Number of plants	1,893	2.377	1,515	2,289	378	88	164	31

Note: Employment given by number of persons; values such as shipments in thousands of D-mark.

a larger corporate enterprise. In the Lower Saxony region, only 22 percent of exporters are part of bigger firms, while more than a third of non-exporters had larger corporate structures.

3. Export Premia

The results presented above are broadly consistent with prior work on the differences between exporters and non-exporters in other countries. However, standard trade theory suggets that industry composition may account for the preponderance of these differences. On the other hand, prior research on U.S. and Mexican exports suggests that the differences between exporters and non-exporters within industries are larger than the across-industry variations. Accordingly, we calculate export premia for the plant characteristics controlling for industry and plant size. The export premia are estimated from a regression of the form

$$\ln X_{it} = \alpha + \beta\, Export_{it} + \lambda \ln Size_{it} + \gamma_1\, Industry_{it} + \gamma_2\, Year_t + \varepsilon_{it}\,, \tag{1}$$

where X_{it} is the plant characteristic, $Export_i$ is a dummy for current export status, *Size* is given by total employment, $Industry_i$ is a vector of 185 industry dummies, and $Year_t$ is a vector of year dummies. The export premium, β, shows the average percentage difference between exporters and non-exporters in the same industry.

We also consider a second specification

$$\ln X_{it} = \alpha + \beta\, Export_{it} + \theta\, EXPTVS_{it} + \lambda \ln Size_{it} + \gamma_1\, Industry_{it} + \gamma_2\, Year_t + \varepsilon_{it}\,, \tag{2}$$

where $EXPTVS_i$ is the share of exports in total shipments. This specification allows for an export premium that varies with export intensity.

Results from the two specifications are given in Table 3. As seen above, average wages are slightly higher in exporting plants, but the difference comes entirely from wages for white-collar workers which are 2.3 percent higher in exporting plants, while interestingly, blue-collar workers receive lower wages. The small wage differentials are even more surprising in light of the large productivity differences between exporters and non-exporters. Shipments per worker are 19.4 percent higher at exporting plants and value added per worker is 21.6 percent higher.

Table 3 – *Exporter Premia for Various Plant Characteristics*

	Exporter (t-stat)	R^2	Exporter (t-stat)	Export share (t-stat)	R^2
Wage per employee	0.0169 (1.79)	0.465	0.0135 (1.29)	0.0813 (3.46)**	0.479
Production wage	−0.0178 (1.73)	0.425	−0.0182 (1.65)	0.0454 (1.78)	0.440
Nonproduction wage	0.0232 (2.28)*	0.282	0.0171 (1.39)	0.0881 (3.12)**	0.282
Shipments per worker	0.194 (5.00)**	0.423	0.1414 (3.61)**	0.3304 (5.78)**	0.426
Value added per worker	0.2163 (6.81)**	0.338	0.1371 (4.69)**	0.4159 (6.05)**	0.353
Capital per worker	0.1223 (4.69)**	0.37	0.047 (1.80)	0.3914 (3.57)**	0.378
Machinery investment per worker	0.076 (2.23)*	0.233	0.0121 (0.40)	0.3355 (3.02)**	0.234
Nonproduction workers/ total employment	0.0402 (4.68)**	0.223	0.0332 (4.02)**	0.049 (2.77)**	0.240
Shipments	0.9573 (13.89)**	0.392	0.6721 (9.73)**	1.6093 (10.52)**	0.412
Employment	0.7175 (14.15)**	0.400	0.5099 (10.10)**	1.2287 (9.05)**	0.437
Multi-plant	−0.1307 (6.72)**	0.246	−0.0867 (5.53)**	0.1209 (2.71)**	0.249

Note: * and ** denote significance at the 5 percent and 1 percent level.

Part of the higher productivity is due to increased capital intensity in exporting plants. Within industries exporters are 12.2 percent more capital-intensive and invest 7.6 percent more per worker. The composition of employment differs substantially as well, exporters employ 4.0 percent more white-collar workers as a fraction of their total work force. Even controlling for industry and plant size, in Lower Saxony, exporters are less likely to be part of a multi-plant establishment.

The relationship between export intensity and plant characteristics is given in Table 3. For all types of wages, there is a positive relationship between export intensity and the wage level. This is particularly true for white-collar wages which rise 0.9 percent for each 10 percent increase in export intensity. Since we have no controls for the human capital of the workers, it is likely that the increasing white-collar wage

premium is due to higher skill and education levels of workers in exporting firms.[8]

The relationship between productivity and export intensity is even stronger. Plants that ship less than 10 percent of their product abroad have a productivity advantage of 14–17 percent over non-exporters, while plants that ship more than half of their output abroad have productivity premia of 31–34 percent. This matches the differences in capital intensity and investment per worker, both of which rise sharply as export intensity increases. Similarly the share of white-collar workers in total employment increases as export intensity rises.[9] While the average exporter is less likely to belong to a multi-plant firm, plants with high export shares are increasingly likely to be part of such a firm.

In unreported results, we recalculate the premia after dropping the industry controls. Wage premia rise substantially especially for white-collar workers. In other words, exporters in general receive higher wages but this is mostly an industry effect, exporting industries pay higher wages. This could reflect German wage setting practices whereby significant fractions of wage movements are determined in industry bargaining and firm-specific components are relatively small. Productivity differentials are unchanged (or slightly higher). Capital intensity differentials are actually lower, and insignificant without the industry controls, while investment per worker is unchanged. Similarly the white-collar fraction of employment is unchanged when the industry dummies are dropped.

In the previous results we found that wages were slightly higher in exporting plants, particularly for white-collar workers. To evaluate the role of exporting in the increased wages more properly, we present results in Table 4 from regressions of the form below:

$$\ln Wage_{it} = \alpha + \beta_1 Export_{it} + \lambda \ln Plant_{it} + \gamma_1 Industry_{it} + \gamma_2 Year_t + \varepsilon_{it}, \quad (3)$$

$$\ln Wage_{it} = \alpha + \beta_2 Export_{it} + \theta EXPTVS_{it} + \lambda \ln Plant_{it} + \gamma_1 Industry_{it} + \gamma_2 Year_t + \varepsilon_{it}, \quad (4)$$

[8] Wagner (1996) reports evidence from a panel of firms that the share of employees with a university or polytechnic degree is positively correlated with export status and export intensity.

[9] This result suggests that the increased share of white-collar workers is not simply due to the overhead requirements of exporting.

Table 4 – *Exporter Wage Premia*

	All	Production	Non-production	All	Production	Non-production
Exporter	0.0259	−0.0070	0.0329	0.0187	−0.0108	0.0214
	(2.91)**	(0.80)	(3.18)**	(2.00)*	(1.17)	(1.74)
Export share	—	—	—	0.0608	0.0350	0.0712
				(2.81)**	(1.54)	(2.50)*
Employment	0.0477	0.0478	0.0485	0.0461	0.0482	0.0475
	(13.31)**	(12.81)**	(7.44)**	(12.65)**	(12.01)**	(6.56)**
Capital per worker	0.0390	0.0351	0.0495	0.0406	0.0361	0.0507
	(9.46)**	(9.97)**	(8.30)**	(9.82)**	(9.73)**	(8.03)**
Production hours/worker	0.3892	0.5531	0.0243	0.3873	0.5420	0.0225
	(14.93)**	(18.68)**	(0.77)	(14.83)**	(18.31)**	(0.69)
Multi-plant share (%)	0.0934	0.0962	0.1023	0.0890	0.0912	0.1013
	(8.72)**	(9.19)**	(7.03)**	(8.14)**	(8.43)**	(6.80)**
R^2	0.588	0.590	0.308	0.592	0.592	0.308
			Fixed effects regression			
Exporter	0.0087	−0.0007	0.0136	0.0081	−0.0007	0.0102
	(3.25)**	(0.27)	(2.39)*	(2.91)**	(0.24)	(1.70)
Export share	—	—	—	0.0070	−0.0058	0.0109
				(0.76)	(0.58)	(0.54)
Employment	−0.0300	−0.0078	−0.0178	−0.0389	−0.0165	−0.0237
	(12.33)**	(2.99)**	(3.33)**	(15.37)**	(6.03)**	(4.22)**
Capital per worker	0.0189	0.0169	0.0174	0.0191	0.0172	0.0189
	(15.34)**	(12.77)**	(6.55)**	(15.46)**	(12.89)**	(6.92)**
Production hours/worker	0.3082	0.4981	−0.0793	0.2948	0.4786	−0.0845
	(69.80)**	(104.82)**	(8.28)**	(65.82)**	(98.90)**	(8.55)**
Multi-plant share (%)	−0.0082	−0.0012	0.0145	−0.0077	−0.0013	0.0185
	(2.13)*	(0.31)	(1.78)	(2.01)*	(0.32)	(2.23)*
R^2	0.335	0.374	0.081	0.342	0.373	0.081

Note: * and ** denote significance at the 5 percent and 1 percent level. Figures in parentheses under the coefficients are t-statistics.

where $Plant_{it}$ is a vector of plant characteristics including total employment, capital per worker, production worker hours, and a multi-plant dummy. The wage premia found before remain almost unchanged, even though all the plant characteristics enter the regressions significantly. The average wage premium in exporting plants is 2.6 percent, while blue-collar workers receive no premium and white-collar workers are paid 3.3 percent more. Results including export intensity are similar, increasing intensity raises the wages of all workers, especially that of white-collar workers. When excluding the industry dummies, we receive wage premia in the order of 5–10 percent, again lowest for blue-collar workers and highest for white-collar employees.

Finally, to determine the robustness of the wage premia to unobserved heterogeneity across plants, we estimate a fixed effect specification. The magnitude of the export premium for average wages drops to 0.8 percent and that for white-collar workers drops to 1.3 percent, but both remain significant. [10]

III. Exporting and Firm Success

The previous section documented emphatically that exporters have relatively desirable performance characteristics. In particular, productivity in exporting plants is substantially higher than in non-exporting plants. However, the exact relationship between exporting and good firm outcomes is not revealed by the cross-section analysis. In this section, we present several different, but not necessarily mutually exclusive, discussions of how exporting and success might be related at the firm level.

1. Exporting Improves Firms

When discussing the relationship between exporting and firm success in Germany, two familiar phrases are given: "all German firms are exporters" and "German firms have to export in order to succeed". The descriptive statistics in the previous section clearly refute the argument that all German firms are exporters but the question remains of whether exporting firms outperform non-exporters. In a

[10] Considering the coefficients on the other observable plant characteristics, we find that capital deepening is positively related to wages for all types of workers, as is the multi-plant dummy. Increasing size has a negative effect in the fixed effects specification, suggesting that new workers may be paid less than the average wage.

survey, Richardson and Rindal (1995) outline numerous arguments why exporters might be better firms than non-exporters and make the case for increasing policy attention to the concerns of exporting plants.

There are several theoretical reasons why exporting might improve firm performance. First, in an economy such as Germany's, exporting provides a natural expansion of the market. 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. In either case, we would expect to see higher output levels in exporting firms as well as a lower probability of failure. These mechanisms for the link from exporting to better performance are often cited in the literature on export-led growth (see Feder 1982).

Another link running from exporting to success stems from the more nebulous notion of international competition. The reasoning, often associated with the McKinsey (1993) study of manufacturing, argues that firms participating in international markets are exposed to more intense competition and must improve faster than firms who sell their products domestically and face no international markets. The exact source of this increased competition is not clear. It could stem in part from the non-tradable aspect of many domestically produced goods or it could result from barriers to entry in domestic markets. In its purest form, this argument does not require exporting because a domestic-oriented firm can face "imported" competition. However, we would expect that, on average, exporting firms should outperform non-exporters in terms of sales and productivity growth. An additional implication is that an exit from export markets will signal failure and be associated with negative outcomes.

Yet another route for exporting to lead to success focuses on product variety. If firms are not differentiated by cost of production, but rather by product attributes, then those products that are desirable to foreign consumers will be exported. Exporting firms will sell more goods and hire more inputs but might have no relative gain in productivity. Empirical implications of this model include relative employment and output increases when firms begin exporting but no growth advantages in the long run for any characteristic.[11]

[11] Shipments and input growth might be faster or slower in exporting plants after entry depending on the relative growth of domestic and foreign markets.

2. Good Firms Export

While there are many reasons why exporting might improve firm performance, the argument for reverse causation is simple and compelling. There is little doubt that there exist additional costs of selling goods in foreign markets. The range of extra costs include transportation costs if the market is distant, distribution or marketing costs, personnel with skill to manage foreign networks or production costs in modifying current domestic products for foreign consumption. Any additional cost of selling abroad has a similar effect, more productive firms will be more likely to export. Similarly, firms with greater monopoly power should export earlier. In either case, the cross-sectional differences between exporters and non-exporters may be easily explained by ex ante differences between firms. Good firms become exporters.

A related dimension of the story that runs from success to exporting may result from a forward-looking behavior of firms. If firms must lower costs or introduce new products to successfully export, then improved performance might occur just before the entry into the export market. Instead of exporting to lead to ex post success, the desire to export leads the firm to improve its performance ex ante.

IV. Performance before Exporting

The competing explanations presented in the previous section for the positive correlation between exporting and good plant characteristics provide some simple testable implications. If exporting leads to success, we would expect that today's exporters should outperform today's non-exporters, ceteris paribus. If, on the other hand, firms succeed before they begin exporting, we would expect higher levels and faster growth rates for future entrants into the export market. Nothing about the explanations is mutually exclusive so we might find evidence for both explanations. We start by considering the characteristics of exporters several years prior to their entry into the foreign market.

If good firms become exporters then we should expect to find significant differences in performance measures several years before they begin to export. To verify this possibility, we select a sub-sample of our plants, including only those that did not export for at least three years in a row, i.e. plants that did not export in years T-3, T-2, and T-1, but may or may not have exported in year T. We then regress the

levels of our performance measures in year T-3 on the export status of the plant in year T.

$$\ln X_{iT-3} = \alpha + \beta\, Export_{iT} + \gamma\, Industry_i + \kappa\, Year_{T-3} + \varepsilon_{iT-3}\,. \quad (5)$$

The results are reported in Table 5. We find that few of the coefficients on the export dummy in year T are significant, even at the 10 percent level.[12] However, the magnitude of the point estimates suggests that exporting establishments do indeed have many of their desirable performance characteristics 3 years prior to entering the export market. Employment is 9 percent higher at future exporters, higher for white-collar workers, and shipments are 11 percent greater. Even productivity is 2–5 percent greater at these establishments.

In Table 5, we provide another check of the relationship between ex ante success and exporting. We consider the growth performance of future exporters in the years prior to entry, i.e. from year T-3 to T-2 and T-2 to T-1, in a regression of the following form

$$\Delta \ln X_{it} = \alpha + \beta\, Export_{iT} + \gamma\, Industry_i + \kappa\, Year_t + \varepsilon_{it}\,. \quad (6)$$

Here, we find emphatic evidence that plants which enter the export market outperform their non-exporting counterparts in the years prior to entry. Employment growth is 1.4 percent faster per year and is 2.4 percent higher for white-collar workers. Shipments grow 2.7 percent faster in the years leading up to exporting. Even productivity growth is 1.0–1.6 percent higher although the coefficient is not significant. Wage performance is not different at the two types of plants, confirming our earlier results that exporters do not have substantially different wage levels than non-exporters.

On balance, we find evidence that exporters have better performance than non-exporters several years before beginning to export. In addition, these differences are increasing at rapid rates during the run-up to exporting. In the next section, we ask whether this superior performance continues once the plant begins to export.

V. Performance after Exporting

To evaluate the possible effects of exporting on plant performance in Germany, we run a simple regression of changes in plant characteristics. As mentioned above, we focus on the results for shipments and

[12] The high p-values are mostly being driven by the small number of future exporters relative to future non-exporters.

Table 5 – *Plant Characteristics and Growth Rates Prior to Exporting*

	Exporter (t-stat)	R^2	Exporter (t-stat)	R^2
	Plant		*Growth*	
Employment	0.0971 (1.57)	0.409	0.0135 (2.74)**	0.049
Production workers	0.0931 (1.49)	0.412	0.0126 (2.40)*	0.051
Nonproduction workers	0.1117 (1.78)	0.331	0.0242 (3.30)**	0.031
Shipments	0.1124 (1.62)	0.358	0.0273 (2.55)*	0.060
Shipments per worker	0.0206 (0.57)	0.537	0.0158 (1.52)	0.038
Value added per worker	0.0502 (1.07)	0.401	0.0096 (0.78)	0.022
Nonproduction workers/ total employment	0.0008 (0.12)	0.289	0.0007 (0.56)	0.015
Wage per employee	0.0018 (0.14)	0.529	−0.0003 (0.09)	0.027
Production wage	−0.0149 (1.14)	0.470	−0.0032 (0.89)	0.020
Nonproduction wage	0.0253 (0.95)	0.302	0.0024 (0.31)	0.017

Note: * and ** denote significance at the 5 percent and 1 percent level.

Table 6 – *Exporter Performance for Various Horizons*

	One year		Five years		Nine years	
	Exporter (t-stat)	R^2	Exporter (t-stat)	R^2	Exporter (t-stat)	R^2
Wage per employee	−0.0047 (3.70)**	0.023	−0.0098 (2.45)*	0.060	−0.0086 (1.00)	0.116
Production wage	−0.0035 (2.26)*	0.029	−0.0109 (2.20)*	0.082	−0.0079 (0.86)	0.135
Nonproduction wage	−0.0044 (2.08)*	0.007	−0.0070 (0.98)	0.027	−0.0206 (1.21)	0.063
Employment	0.0020 (0.06)	0.036	0.0170 (1.20)	0.121	0.0031 (0.14)	0.182
Production workers	0.0048 (1.59)	0.042	0.0280 (1.93)	0.127	0.0067 (0.29)	0.185
Nonproduction workers	−0.0002 (0.07)	0.018	−0.0026 (0.17)	0.086	0.0088 (0.30)	0.136
Shipments	−0.0127 (2.92)**	0.027	0.0226 (1.25)	0.106	−0.0348 (0.99)	0.162
Shipments per worker	−0.0174 (5.28)**	0.020	−0.0510 (3.53)**	0.102	−0.0488 (1.88)	0.154
Value added per worker	−0.0159 (2.91)**	0.012	−0.0373 (2.50)*	0.060	−0.0379 (1.68)	0.113
Nonproduction workers/ total employment	0.0005 (0.88)	0.014	−0.0028 (1.34)	0.043	0.0046 (1.09)	0.073

Note: * and ** denote significance at the 5 percent and 1 percent level.

productivity to evaluate plant performance (Table 6). Productivity, employment and wage growth provide indicators of the benefits to the overall economy.

$$\%\,\Delta X_{iT} = \frac{1}{T}(\ln X_{iT} - \ln X_{i0}) = \alpha + \beta\, Export_{i0} + \delta\, Plant_{i0} + \varepsilon_{iT}\,. \tag{7}$$

The results for one-year horizons are particularly poor for all characteristics. Wages of all types grow more slowly in exporting than in non-exporting plants, 0.4 percent per year slower. The coefficient for employment growth is slightly positive although not significant. Shipments growth is substantially lower for exporters, 1.2 percent per year less than for non-exporters. This lower growth in output results in a dramatically lower productivity growth, exporters having a productivity growth 1.5–1.7 percent lower than similar non-exporting firms.

Since it is likely that the year of entry into export markets is one of substantial changes for the plant, we also consider exporters' performance over a five-year horizon. Wages continue to show significantly negative results, especially for blue-collar workers. Employment gains for production workers are positive over the long horizon. Perhaps most importantly, productivity growth is still sharply lower for exporters even over the longer interval, averaging 0.7–1.0 percent per year less. Results over the longest available horizon in our panel, nine years, show no significant growth differences between exporters today and non-exporters today.

These results are bad news for the theories that exporting by itself improves plant performance. At best there are no significant differences, and for most intervals exporters substantially underperform non-exporters. The most damaging evidence comes from the productivity numbers. We find significantly worse labor productivity growth for exporters. To help understand the sharp differences in relative performance, in the next section we describe the changes that occur at plants as they enter and exit the export market.

VI. Entry, Exit and Survival

Thus far, we have shown evidence that exporters outperform non-exporters prior to entry but perform substantially worse after starting to export. In this section, we evaluate the changes that occur during

the transition years in and out of exporting. We would expect to find that shipments adjust sharply in the transition years as firms begin supplying a new market, however, other measures such as employment and productivity may or may not adjust during the transition year. We estimate

$$\Delta \ln X_{iT} = \alpha + \beta_1 Start_{iT} + \beta_2 Both_{iT} + \beta_3 Stop_{iT} + \gamma Z_{i0} + \varepsilon_{iT}, \quad (8)$$

where Z_{i0} is a vector of plant characteristics in year 0, including measures of size, capital intensity, hours, and multi-plant status. The dummies for export status are defined as

$$\begin{aligned} Start_{iT} &= 1 \quad \text{if} \quad (Export_{i0} = 0) \quad \text{and} \quad (Export_{iT} = 1) \\ Both_{iT} &= 1 \quad \text{if} \quad (Export_{i0} = 1) \quad \text{and} \quad (Export_{iT} = 1) \\ Stop_{iT} &= 1 \quad \text{if} \quad (Export_{i0} = 1) \quad \text{and} \quad (Export_{iT} = 0), \end{aligned} \quad (9)$$

where non-exporting in both years is the reference category. The coefficients, β_1, β_2, and β_3, give the increase in growth rates for entrants, exporters in both years, and exits relative to non-exporters in both years.

The results are reported in Table 7. For almost every measure, plants entering the export market have a substantially faster growth. Conversely, exiting plants suffer terrible outcomes by every measure. Employment grows strongly at plants entering the export market (4.2 percent), but plants that exit show even larger drops (−11.6 percent) while continuing exporters increase employment 1.6 percent faster than non-exporters. The employment changes are more pronounced for white-collar workers than blue-collar employees. Firms entering the export market increase their white-collar employment by 6.1 percent and drop it by 9.7 percent when they exit. The comparable adjustments for blue-collar workers are 3.1 percent and −5.8 percent, respectively. Wages increase at starters (0.8 percent) and fall sharply at stoppers (−1.6 percent). Surprisingly, continuing exporters see a worse wage performance than non-exporters.

Not surprisingly, we find a large change in total shipments as plants enter and exit. Entrants increase their shipments by 10.2 percent, while exits see their shipments fall by 12.9 percent. Productivity shows similar patterns rising by 4.8–6.7 percent in the year exports begin and falling by 3.6–8.4 percent in the year exports cease.

Comparing plants that do not change status, we find mixed results. Continuing exporters see larger growth in employment, and somewhat faster shipments growth. However, productivity and production

Table 7 – *One-Year Performance by Export Status (Starters, Stoppers, Both)*

	Start (t-stat)	Stop (t-stat)	Both (t-stat)	R^2
Employment	0.0421 (5.13)**	−0.1157 (5.04)**	0.0162 (4.97)**	0.047
Production workers	0.0312 (3.19)**	−0.0579 (4.46)**	0.0128 (4.00)**	0.046
Nonproduction workers	0.0610 (6.13)**	−0.0974 (4.76)**	0.0136 (3.69)**	0.024
Shipments	0.1015 (5.13)**	−0.1286 (6.22)**	0.0068 (1.61)	0.034
Shipments per worker	0.0669 (3.62)**	−0.0839 (5.44)**	−0.0054 (1.72)	0.023
Value added per worker	0.0483 (2.94)**	−0.0359 (1.85)	−0.0100 (1.97)*	0.013
Wage per employee	0.0078 (2.44)*	−0.0160 (2.32)*	−0.0031 (2.37)*	0.024
Production wage	0.0052 (1.28)	−0.0007 (0.12)	−0.0035 (2.08)*	0.029
Nonproduction wage	0.0096 (1.01)	−0.0289 (2.72)**	−0.0014 (0.77)	0.008
Nonproduction workers/ total employment	0.0047 (2.40)*	0.0115 (2.94)**	−0.0001 (0.17)	0.016

Note: * and ** denote significance at the 5 percent and 1 percent level.

Table 8 – *Probability of Plant Failure*

	One year		Nine year	
Exporter	−0.0342 (15.77)**	−0.0002 (0.17)	−0.1477 (10.33)**	−0.0127 (0.75)
Employment		−0.0174 (20.51)**		−0.1199 (14.37)**
Value added per worker		−0.008 (10.97)**		−0.0575 (6.18)**
Capital per worker		−0.0052 (9.61)**		−0.0443 (6.72)**
Hours per production worker		−0.0183 (6.00)**		−0.184 (5.05)**
Multi-plant		−0.0041 (2.57)*		0.0163 (0.99)
White collar/total employment		0.0186 (4.51)**		0.0338 (0.69)

Note: * and ** denote significance at the 5 percent and 1 percent level.

worker wages grow more slowly than in non-exporting plants in both periods.

For our final exploration of the exporting-success nexus, we consider perhaps the most important potential benefit, the impact of exporting on the probability of plant survival. Since one of the most important advantages to the firm from exporting may be the diversification of risk associated with demand shocks, we examine the relationship between exporting and plant survival. Table 8 presents the results from a probit of the form

$$F_{it} = \begin{cases} 1 & \text{if} \quad \beta\, Export_{it-1} + \lambda Z_{it-1} + \gamma\, Year_{t-1} + \varepsilon_{it} > 0 \\ 0 & \text{otherwise} \end{cases}, \quad (10)$$

where F_{it} equals one if the plant fails in year t. As before Z_{it-1} is a vector of plant characteristics in the initial year. We look at failure probabilities over one-, five- and nine-year intervals and consider specifications with and without plant characteristics in the initial year. Excluding plant characteristics, we find a strong increase in the probability of survival associated with exporting. The probability of failure is 3 percent lower over the one-year horizon, 10 percent lower over the five-year interval and almost 15 percent lower nine years out. However, when we control for other observable characteristics of the plant, including size, productivity, and employment, the coefficient on export status, while still negative, is close to zero and insignificant.

VII. Conclusions

This paper has documented important performance advantages of exporting establishments in Germany. As in other countries, comparing plants within an industry, we find that exporters in Germany are substantially larger, more capital-intensive, employ more white-collar workers, and are substantially more productive than non-exporters. The productivity advantage of 15–20 percent for exporters is of particular interest. If participation in foreign markets leads to substantial productivity gains for firms, then there are important consequences for policy and long-run economic performance.

To understand the nature of the correlation between exporting and good performance, we propose several alternative explanations. Exporting may lead to successful outcomes if competition in international markets is more intense than in the German domestic market. On the other hand, there are numerous reasons to believe that good firms self-select into the export market.

In providing empirical evidence on these alternatives, we find the results to be quite clear. Good firms most certainly become exporters. Most, if not all, the productive advantages are present three years before entering export markets. In addition, growth rates of employment, shipments and productivity are faster in the years leading up to exporting. There is little or no evidence that exporting by itself enhances performance. While exporters do show higher survival rates unconditionally over various time horizons, these can be easily explained by the superior performance characteristics of plants before exporting.

While shipments, wages, and productivity do not grow faster after entry into the export market, we do find that plants undergo substantial changes during the years they enter or exit. In particular, growth rates for new exporters are significantly higher than for non-entrants in almost every category. Growth rate advantages for employment, shipments and productivity are 4, 10, and 5 percent, respectively. Plants that stop selling abroad see more than comparable decreases in performance.

Our findings demonstrate that firms must succeed in order to begin exporting. The transition from producing solely for the domestic market to selling abroad involves dramatic changes for the firm including rapid growth of employment and output and sharp increases in productivity.

Appendix

The data employed in this study are establishment level data from manufacturing industries in the one of the "old" German Federal States (Länder), Lower Saxony (Niedersachsen). They were collected in the regular surveys by the Statistical Office (Niedersächsisches Landesamt für Statistik – NLS). The surveys cover all establishments from manufacturing industries that employ at least 20 persons in the local production unit or in the company that owns the unit. For details on coverage in specific industries see Methner (1992).

Using the establishment identification code, we matched surveys from 1978 through 1992 to form an unbalanced panel. Annual data is available on: industry, blue-collar hours, blue-collar workers, sum of annual gross wages, sum of annual gross salaries, total employment (average from monthly reports), blue-collar employment (average from monthly reports), sales in Germany, sales outside of Germany, investment (in machinery, in land with/without buildings), payments for rents and leasing, value of production.

All monetary values are reported in current prices. To compute real values, wages and salaries were deflated using the consumer price index (Preisindex für die Lebenshaltung; Früheres Bundesgebiet; Gesamtlebenshaltung). Sales and value of production were deflated using the price index of production at the two-digit SYPRO industry level (Index der Erzeugerpreise gewerblicher Produkte) and investments in machinery were deflated using the price index for machinery goods (Preisentwicklung nach den Volkswirtschaftlichen Gesamtrechnungen; Früheres Bundesgebiet; Anlageinvestitionen/Ausrüstungen).

Capital stocks for establishments were calculated from real investment in machinery using a perpetual inventory method with an 18 percent depreciation rate. After construction of the capital stocks we are left with data for 1983–1992.

References

Bernard, A. B. (1995). Exporters and Trade Liberalization in Mexico: Production Structure and Performance. MIT, mimeo.

Bernard, A. B., and J. B. Jensen (1995a). Exporters, Jobs, and Wages in U.S. Manufacturing, 1976–1987. *Brookings Papers on Economic Activity, Microeconomics*. 1995: 67–119.

— (1995b). Exceptional Exporter Performance: Cause, Effect or Both? MIT, mimeo.

— (1996). Understanding the U.S. Export Boom. MIT, mimeo.

— (1997). Exporters, Skill-Upgrading, and the Wage Gap. *Journal of International Economics*, forthcoming.

Feder, G. (1982). On Exports and Economic Growth. *Journal of Development Economics* 12: 59–73.

Greenaway, D., and D. Sapsford (1994). What Does Liberalisation Do for Exports and Growth? *Weltwirtschaftliches Archiv* 130(1): 152–174.

Keesing, D. B. (1967). Outward-Looking Policies and Economic Development. *Economic Journal* 77 (June): 303–320.

McKinsey Global Institute (1993). *Manufacturing Productivity*. Washington, D.C.: McKinsey and Company, Inc.

Methner, E. (1992). Das Erhebungsprogramm der amtlichen Statistik im Bereich des Produzierenden Gewerbes. In R. Ertel and J. Wagner (eds.), *Produzieren in Niedersachsen. Empirische Untersuchungen mit Betriebsdaten*. NIW-Vortragsreihe 6. Hannover: NIW.

Richardson, J. D., and K. Rindal (1995). *Why Exports Really Matter!* Washington, D.C.: The Institute for International Economics and the Manufacturing Institute.

Sheehey, E. J. (1990). Exports and Growth: A Flawed Framework. *Journal of Development Studies* 15(1): 111–116.

Wagner, J. (1995). Exports, Firm Size and Firm Dynamics. *Small Business Economics* 7(1):29–39.

— (1996). Export Performance, Human Capital, and Product Innovation in Germany: A Micro View. *Jahrbuch für Wirtschaftswissenschaften* 47(1):40–45.

World Bank (1993). *The East Asian Miracle: Economic Growth and Public Policy*. Oxford: Oxford University Press for the World Bank.

* * *

Abstract: Exports and Success in German Manufacturing. – While Germany has a very open, export-oriented manufacturing sector, there has been little research on the role of exporting in German firms' performance. This paper documents the significant differences between exporters and non-exporters and attempts to identify the sources of these disparities. Exporters are much larger, more capital-intensive, and more productive than non-exporters. However, the bulk of the evidence suggests that these performance characteristics predate the entry into export markets. The authors find no positive effects on employment, wage or productivity growth after entry. The authors' results provide evidence that success leads to exporting rather than the reverse. JEL no. F10, D21, L60

*

Zusammenfassung: Exporte und Erfolg der deutschen Industrie. – Obwohl der deutsche gewerbliche Sektor sehr offen und exportorientiert ist, hat es wenige Untersuchungen über die Rolle des Exports bei den Erfolgen der deutschen Firmen gegeben. Die Verfasser belegen die signifikanten Unterschiede zwischen Exporteuren und Nicht-Exporteuren und versuchen, die Ursachen für diese Unterschiede zu ermitteln. Exportierende Firmen sind viel größer, kapitalintensiver und produktiver als nichtexportierende Firmen. Allerdings zeigt sich, daß diese Erfolgsmerkmale schon vor dem Eindringen in die Exportmärkte bestanden. Nach dem Eindringen stellen die Verfasser keine positiven Wirkungen auf die Beschäftigung, die Löhne oder das Produktivitätswachstum fest. Ihre Ergebnisse deuten darauf hin, daß Erfolg zum Export führt und nicht umgekehrt.