Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987
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PERHAPS AT NO POINT in recent years has the debate over the direction of trade policy so demanded public attention. Whether it has been Al Gore and Ross Perot clashing on national television about the merits and pitfalls of the North American Free Trade Agreement (NAFTA), or individual members of Congress attempting to provide additional protection for domestic industries in the General Agreement on Tariffs and Trade (GATT), the debate over the pace and scope of changes in trade regulations and tariffs has been omnipresent. Both proponents and opponents of NAFTA and GATT have argued that the implementation of these treaties will have large and important effects on the domestic economy.

Close to the surface in this debate is the issue of U.S. manufacturing "competitiveness." The experience of increasing import competition, particularly from export-led economies such as Japan, Korea, Singapore, and Taiwan, concurrent with stagnant living standards during the 1970s and 1980s and decreasing employment in manufacturing, has left some people wondering aloud about the competitiveness of U.S. manufacturing. The concerns include the long-term viability of important

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Opinions expressed in this paper are those of the authors and do not necessarily reflect official positions of the Bureau of the Census. All errors are ours.

industries and the number of jobs and level of wages associated with them.

Opponents of free trade suggest that more openness will result in lost American jobs and lower living standards. Proponents of free trade suggest that lower trade barriers will reduce the costs of goods to consumers and will provide more markets for American exporters. In the new era of global competition, politicians and the media tout exporters as winners, who thus should be supported. Exporters are perceived as being more "competitive" than nonexporters and as "good" for the economy. Exporters are believed to be more productive and profitable and to provide more and better employment opportunities. Based on the belief that exporters are good for the economy, government programs are advocated to support and advance exporting and exporters.

While the arguments rage, the scope of solid information about the role of exporters in the U.S. economy is scant. The debates, both academic and public, have centered on the ability of industries to adapt to the provisions of the treaties; however, little accompanying evidence has been presented about the effects of trade, exchange rate, or foreign demand shocks on domestic firms. Discussions usually focus on industries and regions and rarely provide information about the nature of exporting plants or firms. In this paper, we step back from the controversies regarding the merits of free trade and explore the role of exporting plants in the manufacturing sector. Are exporters different from nonexporters within the same industry? If they are, are these differences meaningful in terms of performance? We provide a picture of the structure of U.S. manufacturing exporters and how they perform over time.

This paper attempts to fill a gap in what is known about the role of exporters in the manufacturing sector. To our knowledge there have been no comprehensive studies of exporting at the plant or firm level. Making use of panel data on a large cross-section of manufacturing plants, we explore the role of exporting establishments in the United States and provide a multitude of facts about exporting industries and exporting establishments.[1] Traditionally, the study of international trade, and thus exports, has used countries or industries as the relevant

1. Recent studies examining exporters using foreign plant-level data include Bernard (1995), Revenga and Montenegro (1995), and Aw and Batra (1994).

unit of observation.[2] Countries trade, and particular industries export, because of differences in technology, endowments, and the structure of production. This focus on differences at the industry level potentially masks important heterogeneity across plants within industries. We make use of exactly this heterogeneity to develop our understanding of the role of exporting in plant performance and structure.

To guide us through the vast quantity of information available from our panel of manufacturing plants, we focus on a narrowly specified set of questions. Are exporters important in the manufacturing sector in terms of shipments and employment? If so, does their structure of production differ from that of nonexporters? In particular, what is their role in the labor market—do they provide so-called "good jobs" at "good wages"? Finally we look at the role of exporting plants in job and wage growth. Along the way we focus on the response of domestic industries to foreign demand and exchange rate shocks.

It is not immediately obvious that exporters should be distinguished from other manufacturers. Although direct exports as a share of manufacturing rose from about 4 percent in 1963 to 9 percent in 1988, exports still account for a relatively small share of total output and thus economists potentially overestimate the overall importance of exporters, and exports. We start by considering the importance of exporting establishments in total U.S. manufacturing. Although exporting establishments made up only 10.4 percent of manufacturing plants in 1976 and 14.6 percent in 1987, these plants accounted for more than 50 percent of total shipments and 40 percent of total employment in both years. Exports per se are a small fraction of shipments at each plant, but the plants that manufacture them play a larger role in overall production.

Exporters are a substantial presence in the manufacturing sector, but are they different from nonexporters? Throughout the paper we focus on two main competing hypotheses. First, we assume that export markets do not differ substantially from domestic markets except for their locations and associated transport costs. Under this assumption, exporters should not differ from their nonexporting counterparts either at any given point or in their subsequent performance.

2. For example, Katz and Summers (1989) use industry-level data on exports to investigate the effect of trade policy on wages.

Alternatively, we consider the idea that selling in international markets is a special and difficult status for a plant to achieve. This assumption corresponds to the notion that exporters are "winners" in the global race to be competitive. If true, this hypothesis suggests that exporters should differ significantly in size and productivity from nonexporters in the same industry in any year.[3] To distinguish between the hypotheses, we consider whether exporters and nonexporters differ in their structure of production within industries.

In addition to static comparisons of the two types of plants, we consider their employment and wage growth over time. If participating in international markets provides a benefit to plants, perhaps through increased awareness of productive and market possibilities, we might expect to see faster growth at exporting plants. Conversely, if exporting plants are merely contemporaneously successful and receive no additional long-term gains from selling abroad, we would expect no significant differences between exporters and nonexporters.

The policy debate over trade and jobs has often focused on whether exporting industries are creating so-called "good" jobs. We concentrate instead on the concept of "good" plants. We consider several potential interpretations of "good" plants, including those that have higher labor productivity levels, higher growth rates, above-average job creation, and higher pay. To determine if exporters offer "better" jobs than nonexporters, we test whether exporters pay higher-than-expected wages given plant and industry characteristics. Additionally, we look at their record of wage growth.

The results are revealing. Compared at a point in time, exporters exhibit "better" performance characteristics than nonexporters in every dimension. Exporters are larger, more productive, and more capital intensive. In addition, exporting establishments pay wages that are more than 14 percent higher than those paid by nonexporting plants; benefits at exporters are a third higher than at nonexporters. On average during 1976–87, a production worker in an exporting plant with 250–499 employees earned $3,429 more a year than a production worker in a nonexporting plant of the same size. Nonproduction workers earned $2,479 more in those same exporting plants.[4] After controlling for other

3. This approach sidesteps the more difficult question of why exporters are different.
4. These numbers are calculated in 1987 dollars.

inputs and variables known to be correlated with higher wages at the plant, the export wage premium is still significant and between 7 percent and 11 percent, although industry variation accounts for much of the premium. These plant characteristics support the hypothesis that exporting is an activity undertaken by successful establishments.

The evidence on the benefits of export experience to the plant is mixed. Exporters do perform significantly better in the short run than nonexporters in terms of employment growth. Short-run wage growth and long-run performance in all areas are negatively correlated with export status in the initial year, however. The source of these negative correlations is not hard to find. The transition rate into and out of exporting is high; 18 percent of exporting plants leave the export market and 9 percent of nonexporters begin foreign shipments in an average year. These transition plants dominate the correlations of long-run growth with initial export status. In particular, plants that start exporting increase employment and wages at dramatically higher rates, while plants that cease exporting fare poorly over short and long horizons.

The results show that exporters are important in terms of size and employment in the domestic economy and that they have all the characteristics of currently successful plants. At any point in time, exporters are larger and more productive and pay higher wages. Current export status, however, is a poor predictor of future wage and employment growth. Short- and long-term performance is conditional on the exporting status of the plant during the period under consideration; plants that become exporters grow the most, plants that cease exporting exhibit poor relative performance. Movement into exporting is associated with success.

Data

We use newly available, detailed plant-level data from the Census Bureau's Annual Survey of Manufactures (ASM) to investigate the relationship between exporting and plant performance. The ASM surveys U.S. manufacturing establishments and collects information on production and nonproduction employment, production hours, salaries and wages, shipments, value-added, capital measures, ownership structure, and direct exports.

For exports, the ASM asks establishments to "report the value of products shipped for export. Include direct exports and products shipped to exporters or other wholesalers for export. Also include the value of products sold to the United States Government to be shipped to foreign governments. Do not include products shipped for further manufacture, assembly, or fabrication in the United States." To the extent that plants do not know the ultimate destination of products they ship, these directly reported exports understate the true value of exports from establishments. The ASM was conducted in every year between 1976 and 1987; however, in 1978, 1979, and 1982 the direct export question was not asked. In 1987 every plant in the Census of Manufactures (a census of manufacturing establishments conducted every five years) was asked to report direct exports.[5] We use this census to construct detailed cross-section comparisons and the ASMs to examine the performance of exporters and nonexporters over time.

Although we are able to link plants' information across time, the ASM is not designed as a long-term panel, it is, instead, a series of five-year panels of U.S. manufacturing establishments. Each five years the sample is partially redrawn. Questionnaires are sent to about 56,000 of the 220,000 establishments that are surveyed in the Census of Manufactures. Some of the 56,000 establishments are included in the sample with certainty. These "certainty" cases include establishments with large total employment (greater than 250 employees), establishments with large value of shipments, and establishments owned by large enterprises.[6] Other establishments are sampled with probabilities ranging from 0.99 to 0.005, based on the size and industry of the establishment. The sample is designed to be representative of the population of manufacturing establishments in terms of industry and plant size. Establishments are assigned weights that are inversely proportional to their sampling probabilities. The weights are used to produce aggregate industry totals.

The plant level data, although limited by the nature of the panel and sampling issues, gives us the ability to identify and control for differ-

5. We do not consider "administrative records" in the Census of Manufactures.

6. Although the criteria for inclusion in the panels have changed over time, particularly between the 1974–78 ASM panel and subsequent panels, the general principle of sampling based on size and importance has held throughout the period we study.

ences between plants in the same industry.[7] This capability is important because of the considerable heterogeneity that exists within industries, even at the four-digit SIC (standard industrial classification) level. Size, production techniques, output, and propensity to export all vary considerably across plants within the same four-digit SIC category.

Choice of Export Variable

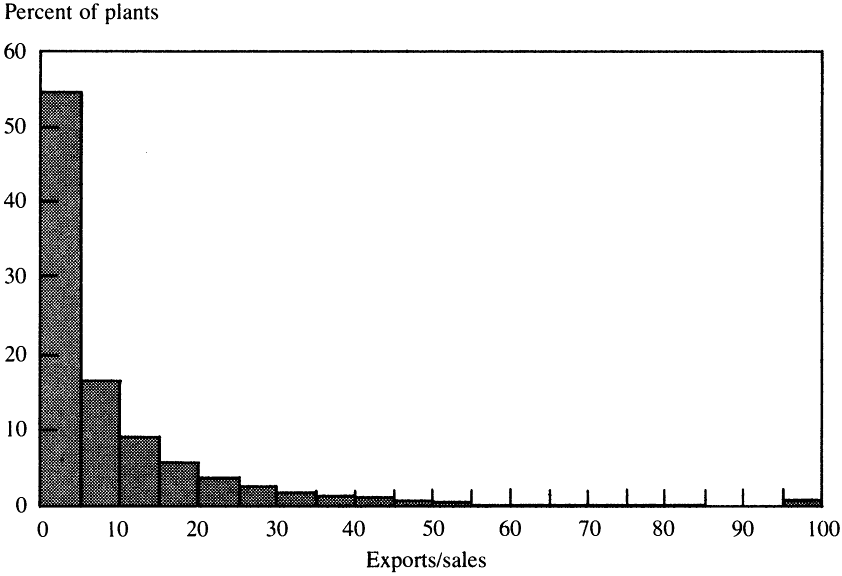
Our definition of an exporting plant is one that reports any magnitude of direct exports in the ASM or Census. We treat export status as the relevant plant characteristic and use a dummy variable for exporting in most of our analyses. An alternative approach might treat the share of exports from the plant as the appropriate plant-level variable. At the plant level, however, export share is small and relatively stable across plants and over time. The majority of exporting establishments export a small fraction of total output; in 1987, 71.1 percent of exporters reported direct exports of less than 10 percent of total shipments, as shown in figure 1. These percentages are stable over time as well. Considering a sample of continuously operating establishments from 1976 through 1987, we find that 60 percent of exporting plants report annual changes in exports of less than 2.2 percent of total shipments. Among plants that start exporting, the median share of exported shipments is 2.4 percent, and similarly for plants that stop exporting, exports comprise 2.5 percent of shipments at the median plant. This stability of the share of sales exported leads us to focus on exporting as a characteristic of the plant.

Export Coverage by Industry and Sample

As described above, we use two sources of plant-level data to examine the role of exporters in the manufacturing sector: the 1987 Census of Manufactures primarily for cross-section analyses, and the ASM to study changes over time. Both surveys have potential drawbacks as data sources on exporting. Because these surveys capture only direct exports from establishments, they systematically undercount aggregate and industry exports. To identify the magnitude of this undercount, we compare the ASM direct export totals to data on all exports collected by the

7. Details on the variables used in the paper are presented in the appendix.

Figure 1. Distribution of Exports as a Percentage of Sales, 1987



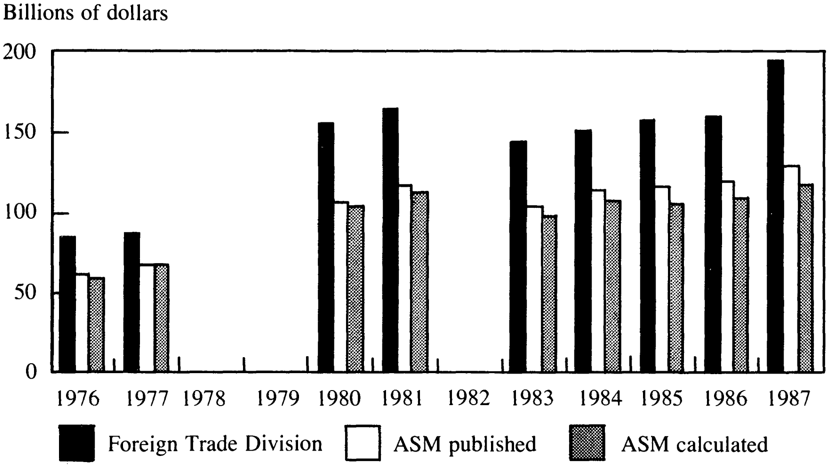
Source: Authors' calculations based on 1987 Census of Manufactures.

Foreign Trade Division (FTD) at the Census Bureau. The FTD data is collected at the port of export and, as a result, includes all exports. Figure 2 shows total exports from the FTD series and direct exports from the ASM. The undercounting of exports by the ASM is evident throughout the time period, averaging about 70 percent of the totals reported by the FTD, and is particularly poor for 1987, when our calculated numbers capture only 60 percent of total exports.

Coverage by two-digit industry exhibits substantial variation. When comparing industry totals from the FTD for 1976 and 1987, we find that ASM coverage is poorest in industries making up a small percentage of total exports.[8] These industries include textiles, apparel, wood, furniture, printing, leather, and miscellaneous manufacturing. The major exception is electronic equipment, which accounts for 11 percent of total exports in 1987. ASM direct exports for electronic equipment

8. Because small plants are undersampled in the ASM, industries dominated by smaller establishments are poorly covered. The poor coverage could also occur because small plants are less likely to export directly.

Figure 2. Comparison of Sample Coverage for Aggregate Exports, Selected Years



Source: See text.

capture only 58 percent and 45 percent of the FTD total in 1976 and 1987 respectively.[9]

An additional shortcoming of the data is that the ASM sampling weights are not explicitly designed to aggregate exports, but to provide accurate estimates of total employment and total shipments. The Census Bureau therefore adjusts the weighted ASM totals before reporting them.[10] For most of our analyses, we avoid these problems by performing calculations at the plant level. Whenever we report industry-level or aggregate numbers from the ASM, however, these potential problems arise, so we briefly discuss their importance.

To examine the coverage of our calculated ASM export totals, we use two reference points. Our weighted export totals are compared with the published, adjusted ASM totals, and with the 1987 Census totals. Figure 2 shows that our weighted totals are close to the published, adjusted totals. In addition, industry tabulations from our data are

9. This finding is troubling because computer-related equipment falls in this category and represents an increasing share of total exports during the period.

10. Unfortunately, we do not have access to the adjustments that are made to the data, and thus our weighted ASM totals do not match the published ASM totals. Weighted export totals are not the only aggregates that are adjusted for ASM publication; employment, and shipments are among the other adjusted aggregates. For a more detailed discussion of ASM sampling issues, see Davis, Haltiwanger, and Schuh (1991).

within 5 percent of reported ASM direct exports for almost all industries.

Because we use Census numbers to conduct the cross-section analyses of the characteristics of exporting establishments, we also are interested in the relationship between Census totals and their ASM counterparts. Across the twenty two-digit industries, only four show differences in total exports of more than 5 percent—apparel, wood, printing, and leather, which total less than 3 percent of direct exports. In fact, the correspondence between the export totals in the Census and the ASM is better on average than the correspondence between reported employment and shipments figures.[11]

Export Concentration: Sectoral and Geographic

Table 1 reports industry characteristics on the percentage of shipments and exports, average plant size at exporters and nonexporters, and average shipments exported at exporting plants. Large industries, those accounting for more than 5 percent of total shipments, include (in descending order) transportation equipment, food, chemicals, machinery, electronic equipment, and petroleum. With the exceptions of food and petroleum and the addition of instruments, these industries also dominate total direct exports. In fact, exports are much more heavily concentrated in these sectors; transportation equipment accounts for 27 percent of exports and 14 percent of total shipments, while electronic equipment makes up almost 13 percent of exports and 9 percent of shipments. Exporting establishments are also concentrated in these sectors, although less so than shipments; seven different industries show more than 20 percent of plants exporting.

Plant size is substantially larger for exporters (253 employees on average) than for nonexporters (58 employees). This is true within every industry, although the size differences are not systematically related to the prevalence of exports in total shipments. Although the percentage of exporting establishments varies considerably across industries, from 43 percent in instruments to 4 percent in apparel, the percentage of output shipped abroad by an average exporter does not vary much. In

11. Coverage is less precise for more disaggregated industries, although most four-digit industries in the ASM are within 10 percent of the corresponding census totals.

Table 1. Industry Characterisics, 1987

	All		Exporters[a]				Nonexporters
Industry	*Number of plants*	*Industry/total shipments*[b] *(percent)*	*Percent of plants*	*Average plant size*[c]	*Percent of total exports*[b]	*Plant exports/ shipments*[d] *(percent)*	*Average plant size*[c]
All	193,463	—	14.6	253	—	10.0	58
Food	11,796	13.40	12.9	245	4.70	5.1	97
Tobacco	91	0.88	40.7	979	1.45	10.8	153
Textiles	3,794	2.55	14.7	320	0.64	4.2	146
Apparel	13,662	2.47	3.9	145	0.35	5.7	73
Wood	16,452	2.75	6.5	106	1.47	13.1	34
Furniture	6,066	1.53	7.4	253	0.18	2.4	66
Paper	4,512	4.54	18.0	302	3.73	8.7	94
Printing	27,842	4.66	2.9	161	0.41	3.2	43
Chemicals	7,312	9.12	30.3	216	13.94	12.0	58
Petroleum	1,815	5.67	12.8	204	1.55	3.2	46
Rubber	8,758	3.42	22.2	154	1.86	6.5	68
Leather	1,052	0.37	17.0	182	0.30	11.6	102
Stone, clay	10,292	2.57	9.0	182	1.16	7.0	37
Primary metals	4,626	4.93	22.1	369	2.17	4.0	83
Fabricated metals	21,940	6.00	15.2	160	3.66	7.5	45
Machinery	27,003	8.95	19.6	186	15.87	13.9	34
Electronic equip.	9,525	8.60	34.6	370	12.74	11.5	105
Transportation	5,439	13.59	23.5	974	27.03	12.9	122
Instruments	4,232	2.74	43.1	218	6.09	15.5	67
Misc. manu.	7,254	1.26	13.0	114	0.69	7.3	37

Source: Authors' calculations based on 1987 Census of Manufactures.
a. Exporters include all plants that report direct exports.
b. Industry/total shipments (exports) are the industry's share in manufacturing shipments (exports).
c. Plant size is the mean number of workers at establishments in the industry.
d. Plant exports/shipments is calculated as total industry exports divided by industry shipments from exporting plants.

Table 2. Direct Exports by State, 1987

State	*Percent of plants exporting*	*Exports (millions of $)*	*Share of total exports*	*Export share/ mfg. share*
Maine	17.87	528	0.42	0.97
New Hampshire	17.14	686	0.55	1.10
Vermont	16.15	331	0.27	1.36
Massachusetts	17.28	3,755	3.02	1.20
Rhode Island	14.26	415	0.33	0.65
Connecticut	18.05	3,253	2.61	1.71
New York	10.49	7,106	5.71	1.03
New Jersey	15.06	2,287	1.84	0.55
Pennsylvania	16.68	3,926	3.16	0.66
Ohio	19.46	9,486	7.62	1.18
Indiana	17.49	3,261	2.62	0.77
Illinois	16.69	5,327	4.28	0.80
Michigan	17.07	8,961	7.20	1.23
Wisconsin	19.03	2,640	2.12	0.74
Minnesota	16.72	2,637	2.12	1.09
Iowa	18.77	1,587	1.28	0.90
Missouri	13.70	3,919	3.15	1.29
North Dakota	14.18	148	0.12	1.12
South Dakota	17.00	133	0.11	0.67
Nebraska	16.36	457	0.37	0.58
Kansas	17.26	1,150	0.93	0.75
Kentucky	15.34	1,786	1.44	0.85
Tennessee	13.41	1,996	1.61	0.68
Alabama	11.30	1,181	0.95	0.57
Mississippi	12.17	1,020	0.82	0.82

thirteen of the twenty industries, exporters ship between 7 percent and 15 percent of their total product abroad.

Table 2 reports export characteristics of individual states from the 1987 Census, including the percentage of plants reporting direct exports and the value of exported shipments. Nationwide, 14.6 percent of all manufacturing plants report direct exports in 1987, varying from a low of 7.4 percent in Montana to highs of 19–20 percent in Wisconsin, Ohio, and Alaska. Somewhat surprisingly, the percentage of exporting establishments varies little across states.

Looking at the value of goods exported (column 2), we find that large industrial states dominate the aggregates; California, Ohio, Michigan, and Texas each account for more than 7 percent of the national total. However, considering the ratio of the state export share to the state

Table 2. (continued)

State	Percent of plants exporting	Exports (millions of $)	Share of total exports	Export share/ mfg. share
Delaware	17.37	353	0.28	0.65
Maryland	11.79	1,441	1.16	1.02
Virginia	11.87	2,475	1.99	0.93
West Virgina	15.09	766	0.62	1.29
North Carolina	13.48	3,497	2.81	0.72
South Carolina	16.11	1,924	1.55	0.93
Georgia	11.49	2,249	1.81	0.58
Florida	11.26	3,313	2.66	1.15
Arkansas	13.33	685	0.55	0.53
Louisiana	11.33	2,308	1.86	0.94
Oklahoma	14.35	720	0.58	0.59
Texas	11.87	9,036	7.26	1.11
Montana	7.36	57	0.05	0.34
Idaho	11.99	411	0.33	1.15
Wyoming	7.73	10	0.01	0.11
Colorado	13.40	956	0.77	0.81
New Mexico	7.66	79	0.06	0.37
Arizona	9.96	1,275	1.03	1.22
Utah	12.89	296	0.24	0.57
Nevada	11.78	92	0.07	0.73
Washington	17.07	8,462	6.80	3.57
Oregon	13.22	1,242	1.00	0.97
California	13.95	14,259	11.46	1.12
Alaska	20.89	537	0.43	3.99

Source: Authors' calculations based on the 1987 Census of Manufactures. Share of total exports is the state's share of total direct manufacturing exports. States are grouped into census regions. Hawaii is grouped with Rhode Island due to coding errors.

share of total manufacturing (column 4), we see that only nineteen states have export-manufacturing share ratios greater than one, suggesting that the distribution of exports by value is more concentrated geographically than the distribution of exporting establishments. Washington and Alaska are especially intensive exporters, accounting for more than three times their share of manufacturing output in exports.

To determine if regional effects matter even after controlling for industries shown in table 1 to be export intensive,[12] we regress both the percentage of exporting establishments in the state and the export-shipment share ratios on regional dummies and industry composition. The results are presented in table 3, both including and excluding Wash-

12. We thank Bob Hall for emphasizing the role of geography in state exports.

Table 3. OLS Estimates of State Export Characteristics on Region Dummies, 1987

	Dependent variables			
	Percentage of plants exporting		*Export share/manufacturing share*	
Independent variables	*w/Alaska & Washington*	*w/o Alaska & Washington*	*w/Alaska & Washington*	*w/o Alaska & Washington*
Intercept	0.0638***	0.0542***	0.2108	0.1168
	(0.0177)	(0.0167)	(0.2012)	(0.1105)
East Coast dummy	0.0070	0.0075	0.0147	0.0223
	(0.0090)	(0.0083)	(0.1455)	(0.0773)
West Coast dummy	0.0431***	0.0147	1.576***	0.3522*
	(0.0159)	(0.0200)	(0.2498)	(0.1807)
Canadian border dummy	0.0116	0.0063	0.59114***	0.3028***
	(0.0106)	(0.0103)	(0.1605)	(0.0899)
Mexican border dummy	−0.0481***	−0.0429***	−0.3101	−0.0376
	(0.0159)	(0.0151)	(0.2503)	(0.1362)
Gulf Coast dummy	−0.0115	−0.0132	0.2866	0.2057*
	(0.0137)	(0.0128)	(0.2164)	(0.1150)
Great Lakes dummy	0.0021	0.0002	−0.1103	−0.0607
	(0.0129)	(0.0120)	(0.1827)	(0.0972)
% of output in export-intensive industries	0.3052***	0.3479***	1.3770***	1.7175***
	(0.0697)	(0.0663)	(0.5034)	(0.2797)
Number	50	48	50	48
R^2	0.48	0.54	0.62	0.57

Source: Authors' calculations based on 1987 Census of Manufactures. Dependent variables are state percentages of manufacturing establishments and ratio of state share of national exports to state share of national manufacturing output. State may belong to more than one region. States are grouped in regions as follows: East Coast—Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Virginia; West Coast—Alaska, California, Oregon, Washington; Canadian border—Alaska, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, New Hampshire, Vermont, Washington; Mexican border—Arizona, California, New Mexico, Texas; Gulf Coast—Alabama, Florida, Louisiana, Mississippi, Texas; and Great Lakes—Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin. Export-intensive industries are defined as those whose experts total more than 5 percent: chemicals, machinery, electronic equipment, transportation, and instruments (See table 1).

***Significant at 0.01 level.

*Significant at 0.10 level.

ington and Alaska. As shown in table 2, the percentage of exporting establishments does not vary much by region, a fact confirmed by the regression analysis. Only the Mexican border dummy is significant in both specifications; states along the Mexican border have lower percentages of exporting plants. Without Alaska and Washington, the West Coast dummy is much smaller and no longer significant, although still positive. Industry composition does matter; states with higher shares of plants in export-intensive industries, such as chemicals, machinery, electronic equipment, transportation, and instruments, have significantly higher percentages of exporting plants.

Looking at the regional concentration of exporting relative to total manufacturing, we find that the ratio of national export share to national manufacturing share is more highly correlated with the region dummies, even after including the industry mix variable. Although Washington and Alaska again strongly influence both the West Coast and Canadian border dummies, they remain positive and significant even after dropping these two states. Throughout the subsequent analyses, we use detailed regional dummies to help control for the concentration of export activity in these areas.

Characteristics of Exporting Plants

Although it is common knowledge that General Motors and Boeing are perennial top-ranked U.S. exporters,[13] few facts are available about the systematic differences between exporting and nonexporting firms or plants. In this section, we develop a basic set of facts about the production and ownership structure of exporting plants and firms. We consider whether the facts hold over time and across plants of different sizes. In addition, we provide evidence on the robustness of the facts over different industries and regions.

Taking the plant as the unit of analysis, we calculate plant means separately for exporting and nonexporting establishments in five categories: size, labor productivity, labor inputs, capital intensity, and ownership structure. The means for all plants in the 1987 census are reported in table 4. Table 5 calculates the means for two broad size categories

13. Rob Norton, ''Strategies for the New Export Boom,'' *Fortune*, August 22, 1994, p. 132.

Table 4. Plant Characteristics, 1987
Dollars unless otherwise indicated

Characteristic	*Exporters*	*Nonexporters*
Total employment (workers)	254	58
Total value of shipments	44,180,000	6,814,640
Wage per worker	24,370	20,420
Wage per production worker	20,670	18,020
Wage per nonproduction worker	33,270	29,050
Benefits per worker	5,720	4,310
Total value of shipments per worker	146,230	107,000
Value added per worker	71,540	51,530
Capital per worker	40,840	27,630
Investment per worker	3,480	2,310
Nonproduction workers as a share of total workers (percentage)	33	26
Multiplant establishment (percentage)	61	31

Source: Authors' calculations based on the 1987 Census of Manufactures. Values represent plant means.

from the same census: small establishments, that is, those with fewer than 250 employees; and larger establishments with more than 250 employees. In table 6 we consider the variation across time and report means for large plants (500 or more employees) in 1977 and 1987 to examine how exporting plants have changed over time.[14]

Perhaps the most striking difference between exporters and nonexporters is their size disparity; exporters are substantially larger than nonexporters both in terms of shipments and employment. On average, exporters are more than four times larger in terms of employment and more than six times larger in terms of the value of shipments. Even within size categories, exporters are significantly larger. In 1977, of plants with 500 or more employees, exporters were larger in terms of both employment and shipments, 43 percent and 67 percent respectively. In 1987, even though the average size of manufacturing establishments had fallen, the size differential between exporters and nonexporters had increased to 46 percent for employment and 94 percent for output.[15]

Exporting plants are also more productive than their nonexporting

14. Because plants of this size are sampled with certainty in the ASM, we can be sure that our coverage within the size class is complete. In addition, plants with more than 500 employees account for more than 68 percent of total exports in both years.

15. Davis and Haltiwanger (1991).

Table 5. Plant Characteristics, by Size Category, 1987

Dollars unless otherwise indicated

	<250 Employees		250+ Employees	
Characteristic	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*
Total employment (workers)	76	38	886	541
Total value of shipments	10,943,810	4,168,410	162,737,920	72,314,230
Wage per worker	23,700	20,410	26,790	20,870
Wage per production worker	19,860	17,990	23,550	18,630
Wage per nonproduction worker	32,760	28,990	35,040	30,550
Benefits per worker	5,490	4,290	6,570	4,800
Total value of shipments per worker	139,560	106,130	169,990	128,570
Value-added per worker	68,560	51,200	82,160	59,750
Capital per worker	36,400	27,370	56,670	34,190
Investment per worker	3,080	2,280	4,930	3,120
Nonproduction workers as a share of total workers (percentage)	33	26	31	26
Multiplant establishment (percentage)	51	29	94	87

Source: Authors' calculations based on the 1987 Census of Manufactures. Values represent plant means.

Table 6. Plant Characteristics in Plants with 500 or More Employees, 1977 and 1987

Dollars unless otherwise indicated

	1977		*1987*	
Characteristic	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*
Total employment (workers)	1,485	1,039	1,492	1,019
Total value of shipments	211,524,210	126,568,830	284,191,000	146,467,000
Wage per worker	27,620	22,660	28,760	22,930
Wage per production worker	25,070	20,980	25,470	20,660
Wage per nonproduction worker	34,830	31,180	36,290	32,100
Benefits per worker	6,430	4,620	7,100	5,370
Total value of shipments per worker	135,270	112,450	186,470	144,540
Value-added per worker	62,040	48,480	89,630	66,470
Capital per worker	46,620	31,720	65,040	43,370
Investment per worker	4,920	3,330	5,720	3,740
Nonproduction workers as a share of total workers (percentage)	32	28	28	24
Multiplant establishment (percentage)	98	94	97	96

Source: Authors' calculations based on the 1977 and 1987 Annual Surveys of Manufactures. Values represent plant means.

counterparts with higher shipments and value-added per employee. Labor productivity, whether measured by shipments or value-added, was approximately a third greater for exporters across both large and small plants in 1987. Over time the gap actually widened by more than 7 percent for the largest plants.

Exporting plants show higher levels of compensation per worker across all measures for all categories of workers. Average annual wages per employee are almost $4,000 higher at exporters; for production workers the premium is more than $2,500 a year, while nonproduction workers earn an additional $4,200 at exporters.[16] Additionally, average benefits per employee are more than $1,400 higher at exporting establishments. The wage differentials between the plant types were substantially bigger for large plants, especially for production workers, 26 percent in plants with 250 or more employees in 1987. Over time, in the largest establishments, the wage gap increased slightly for both categories of employees.[17]

Capital inputs also differ for exporters and nonexporters. Capital-labor ratios are higher at exporting establishments, as are investment rates in machinery and equipment per employee. Exporters are considerably more capital intensive than nonexporters, especially in large plants where the capital-labor ratios and investment rates are more than 45 percent greater. Again, the largest category of plants showed a slight increase in the gap between exporters and nonexporters from 1977 to 1987.

Exporters are more likely to be part of a multiplant firm. Looking at the differences across size categories, however, we find that this is attributable primarily to the size distribution of exporters. More than 85 percent of large plants of both types are members of larger firms.

Controlling for Industry, Size, and Location

As we have shown, the incidence of exporting varies substantially across industries and regions. Although the facts reported above hold

16. Throughout this paper, we refer to salary and wages excluding benefits as wages. A more precise definition might be earnings because the numbers represent annual receipts and not hourly compensation.

17. Osterman (1994) reports from a 1992 establishment survey that selling in international markets is positively correlated with the introduction of modern flexible work practices. The relationships between these practices and higher compensation is less obvious.

over time and across broad size categories, the possibility remains that location or industry group accounts for most of the differences between exporters and nonexporters. To estimate the difference between exporters and nonexporters more precisely, we calculate the percentage differences for the stylized facts after controlling for four-digit SIC industry classifications and state-SMSA (standard metropolitan statistical area) geographic dummies.[18] In addition, to account for the probable differences in production structure across plants of different sizes, we also control for plant size as measured by total employment.

Table 7 reports the percentage differences in the characteristics after controlling for these factors. The coefficient on the export status dummy is strongly positive and significant for all the characteristics. Considering measures of plant size, we find confirmation for the anecdotal evidence that exporters are substantially larger than nonexporters even within industries and regions. Employment at exporting plants is about 94 percent greater than at nonexporters within the same four-digit industry. The total value of shipments is 110 percent higher at exporters than nonexporters.[19]

Examining the labor market, we find that plant wages are 9 percent higher on average in exporting establishments than in nonexporters of a similar size in the same industry and location. Looking at wages by worker category, the exporter wage premium is slightly smaller, 7.4 percent for production workers and 5.4 percent for nonproduction workers. The higher average wage differential in part reflects the composition of the work force. Nonproduction workers account for 12.4 percent more of total employment at exporting establishments.[20] As other studies have found, higher wages are not offset by lower nonwage benefits. Total nonwage benefits, including both mandated and supplemental, were also substantially higher (12.7 percent) at exporting plants. These

18. There are 448 regional dummies that are state dummies interacted with SMSA dummies where appropriate; that is, a plant within an SMSA in a state is different from a plant in the same state outside the SMSA. Two plants in the same SMSA but in different states also receive different regional dummies.

19. The log approximation actually underestimates the size differences.

20. The higher employment share of nonproduction workers at exporting plants coupled with gains in their share of total manufacturing employment contributed substantially to the rise in wage inequality across these types of workers in the manufacturing sector during the 1980s. See Bernard and Jensen (1994a).

Table 7. OLS Regression of Plant Characteristics on Export Status (Pooled 1976–1987)

Dependent variable	*Independent variable export dummy*	R^2	*Number*
Wage per worker	0.093***	0.31	193,462
	(0.003)	[0.03]	
Wage per production worker	0.074***	0.30	193,176
	(0.003)	[0.02]	
Wage per nonproduction worker	0.054***	0.14	177,681
	(0.004)	[0.02]	
Benefits per worker	0.127***	0.35	193,363
	(0.003)	[0.04]	
Total shipments per worker	0.149***	0.42	193,358
	(0.004)	[0.03]	
Value-added per worker	0.158***	0.24	191,408
	(0.005)	[0.02]	
Capital per worker	0.093***	0.46	191,408
	(0.006)	[0.01]	
Investment per worker	0.036***	0.26	155,208
	(0.009)	[0.01]	
Nonproduction/total employment	0.124***	0.35	178,062
	(0.004)	[0.04]	
Total shipments	1.10***	0.39	193,358
	(0.009)	[0.13]	
Total employment	0.936***	0.33	193,462
	(0.008)	[0.11]	
Multiplant establishment	0.080***	0.31	193,462
	(0.003)	[0.17]	

Source: Authors' calculations. Reported numbers are coefficients on an export status dummy in a plant level regression for the years 1976–77, 1980–81, 1983–87 controlling for four-digit SIC, 448 state-SMSA regions, and the log of total plant employment (except in the total shipments and total employment regressions). Dependent variables are in logs except for nonproduction/total employment and the multiplant indicator. Standard errors are in parentheses.

R^2 without region and industry dummies is given in brackets, [. . .].

***Significant at 0.01 level.

facts taken together confirm that there are substantial differences in labor force characteristics at exporters and nonexporters.

Measures of factor intensity and labor productivity are also significantly higher for exporters. The capital-labor ratio is 9.3 percent greater for exporters than for nonexporters, and correspondingly the rate of investment per employee is almost 4 percent greater.[21] Perhaps not surprisingly given the labor market and capital characteristics, measures

21. Other studies using these data sources have found that a substantial fraction of

of labor productivity such as shipments per worker are almost 15 percent greater for exporters. Finally, exporters are 8 percent more likely to belong to a multiplant firm.

This section has detailed plant-level differences between establishments that export some of their product and those that export none. The typical exporting plant is much larger, pays higher wages, and is more capital intensive and more productive than its nonexporting counterpart. These plant characteristics hold over time and across size classes and are even true within fairly narrowly defined industries and regions.

Exporters and the Labor Market

The existence of interindustry wage differentials has been documented and analyzed by several authors. Using data from the Current Population Survey, Krueger and Summers have shown that, after controlling for observable worker characteristics, substantial industry wage premiums remain.[22] Partly in response to these findings, authors have suggested a variety of sources for the persistent industry-level wage gaps. We focus on the strand of the theoretical literature that maintains that labor markets are perfectly competitive and that observed industry differentials can be understood in the context of either unobserved worker characteristics, such as innate ability, motivation, and on-the-job training, or through unobserved job characteristics that affect workers' utility and must therefore be compensated through wages.

Wage Premiums for Exporters

If production for export requires more highly skilled workers than production for domestic sale, then exporting plants should pay higher wages, even within fairly detailed industry classifications. This is true particularly if standard industrial classifications hide a large degree of product heterogeneity, as is the case for four-digit SIC codes. Unobserved job characteristics play a similar role in raising wages in ex-

plant-level investment is bunched in relatively short time periods; see Doms and Dunne (1994). This finding should not affect the estimate of average investment rates per worker across exporters and nonexporters, but it limits our ability to discuss in detail the investment characteristics of these plants.

22. Krueger and Summers (1988).

porting plants. We calculate the average wage differentials for workers at exporters and nonexporters. In addition, we attempt to isolate the wage premium associated solely with the export status of the plant by controlling for industry, region, and plant characteristics.

One advantage of examining wages at the plant level is the ability to control for industry and location effects and to determine wage premiums across plants within an industry. In addition, the panel nature of the data allows us to remove fixed plant effects and estimate the change in wages when a plant moves from producing entirely for domestic consumption to exporting some of its production.

Plant Level Evidence on Wages

In this section we lay out the basic results on the relationship between exports and wages. We consider first the existence of wage premiums for exporters across plant characteristics. Previous work on plant-level heterogeneity in wages has emphasized plant size and technology.[23] To determine if exporting plants with varying characteristics pay higher wages, we report average annual wage and benefit differentials per worker between 1976 and 1987 in constant dollars by plant characteristic, export status, and job type in table 8. The numbers represent the difference between mean plant wage or benefits in that category and the mean wage for the overall sample of plants.

For every plant characteristic, the exporter wage is larger (or less negative) than the nonexporter wages.[24] This result holds across size, plant age, ownership, and capital-intensity categories. In addition, the premium exists for both production and nonproduction workers and is slightly larger for production workers in large, capital-intensive, and older plants and in plants that are part of a larger firm. The magnitude of the premium is substantial: for plants with between 1,000 and 2,499 employees, production workers in exporting establishments earn $2,674 more a year than their counterparts in nonexporting plants. For nonproduction workers in the same size category, the export premium is even larger, at $3,356. Benefits show similar patterns, compounding the earnings gap between exporting and nonexporting plants. Average ben-

23. Davis and Haltiwanger (1991) and Dunne and Schmitz (1992).

24. The only exception is for production workers in plants with 2,500–4,999 employees, a category whose mean is dominated by a few outliers.

Table 8. Wage Differentials by Plant Characteristics

Dollars

	Benefits per worker		Production worker wage		Nonproduction worker wage	
Characteristic	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*
Size						
1–20 Empl.	−1,737	−2,906	−2,692	−3,778	−1,285	−6,029
20–50	−1,237	−2,259	−2,906	−4,524	2,166	−1,061
50–100	−883	−2,007	−2,695	−4,700	1,034	−1,182
100–250	−360	−1,589	−1,555	−4,190	−431	−2,518
250–500	32	−1,380	−566	−3,995	−1,355	−3,834
500–1,000	622	−822	1,303	−2,241	−448	−2,939
1,000–2,500	1,653	437	4,007	1,333	2,015	−1,341
2,500–5,000	3,547	2,919	8,428	8,759	6,388	4,076
5,000 +	3,934	2,605	9,481	6,966	7,304	6,076
Age						
0–4 yrs	−316	−2,395	−887	−5,209	345	−3,591
5–9 yrs	−439	−2,080	−1,223	−4,830	−297	−2,674
10+ years	1,641	−917	3,677	−2,022	2,366	−1,626
Ownership type						
Single plant	−1,444	−2,599	−3,827	−5,232	2,550	−1,084
Multiplant	1,556	−727	3,502	−1,869	1,949	−2,541
Capital intensity						
1st quintile	−1,540	−2,998	−5,117	−8,428	−3,017	−5,707
2nd quintile	−937	−2,335	−2,807	−6,135	−1,903	−3,711
3rd quintile	140	−1,577	316	−3,219	−196	−2,628
4th quintile	1,059	−845	1,888	−992	1,281	−1,095
5th quintile	3,160	696	7,737	2,787	5,446	1,734

Source: Authors' calculations based on the Annual Survey of Manufactures, various years. The wage differential is given as the difference between the mean plant wage for the given category and the overall mean plant wage. Numbers represent the average differential for the years 1976–77, 1980–81, 1983–87. All differentials are denominated in constant 1987 dollars per worker. Plants are weighted by sampling weights and total employment.

efits per employee are $1,216 higher for exporters in the 1,000–2,500 employee range.

The size-wage premium found by others holds for both exporters and nonexporters across the two types of workers, although it is generally larger for production workers than for nonproduction workers. An average production employee in the largest category of exporting plant earns $12,387 a year more than an average production worker in an exporting plant with 20–49 workers, for nonexporters the gap is $11,490. The export premium does not vary systematically with plant characteristics for either type of labor.

To see how these differentials have moved over time, table 9 shows the 1976–87 changes in the differentials in 1987 constant dollars. Most categories of plant characteristics show larger increases (or smaller decreases) in the wage premium for exporters during the period. In particular, the change in the wage differential is positive for most exporter categories and negative for most nonexporter categories, suggesting that the differences between the two types of plants increased during the period.[25] Bigger plants saw an increase in the wage differential for exporters but not for nonexporters, suggesting the increases in the size-wage premiums found by other researchers are caused primarily by changes at plants that export.[26] Benefits again mirror the wage premiums movements, rising more or falling less for exporters.

To test for the existence of wage differentials for exporters and nonexporters while controlling for multiple plant characteristics, we estimate a simple wage regression. The basic relationship is given in equation 1.

$$W_{ijt} = f(P_{it}, I_j, L_i\, A_t, X_{ijt}) + \epsilon_{ijt} \quad (1)$$

where W_{ijt} is log real wage or benefits per worker in plant i, industry j, at time t, P_{it} represents a vector of plant variables changing over time, I_j are time-invariant, industry-specific variables, L_i are location-specific variables, A_t are aggregate shocks over time, and X_{ijt} is the indicator of export status at the plant.

25. This result is surprising in light of the large negative exchange rate movements during the period.

26. This is not true for the largest category of exporting establishments, where nonproduction workers saw a substantial decline in their wage premium during the period.

Table 9. Change in Mean Wage Differentials, 1976–87

Dollars

	Benefits per worker		*Production worker wage*		*Nonproduction worker wage*	
Characteristic	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*	*Exporters*	*Nonexporters*
Size						
1–20 Empl.	996	740	2,640	1,701	92	1,000
20–50	194	71	−771	−249	−2,955	−1,370
50–100	19	2	−1,117	−694	−2,523	−1,076
100–250	67	21	−868	−618	344	−1,281
250–500	316	109	−35	−967	1,222	−311
500–1,000	113	−150	53	−941	1,600	−40
1,000–2,500	251	−349	1,371	−985	1,899	−783
2,500–5,000	613	−1,013	3,914	−451	2,246	−1,990
5,000 +	−1,618	−2,273	378	−3,528	−1,656	146
Age						
0–4 yrs	1,889	631	4,451	−219	2,751	−1,601
5–9 yrs	−913	−614	−2,827	−2,073	−460	−1,477
10+ years	−497	−246	−377	−1,232	185	−1,027
Ownership type						
Single plant	132	174	−408	50	−445	140
Multiplant	−208	−146	274	−1,068	456	−1,069
Capital intensity						
1st quintile	−268	−69	−1,300	−321	1,536	−571
2nd quintile	443	45	829	−193	760	−2,084
3rd quintile	−135	5	721	−806	−242	−123
4th quintile	82	154	746	−581	1,546	−328
5th quintile	−47	442	1,004	579	1,063	511

Source: Authors' calculations based on the Annual Survey of Manufactures, 1977, 1987. Numbers represent the change in the wage differential by category from 1977 to 1987. The wage differential is given as the difference between the mean plant wage for the given category and the overall mean plant wage. All amounts are denominated in constant 1987 dollars per year per worker. Plants are weighted by sampling weights and total employment.

As we showed earlier, exporting plants within four-digit industries are larger and more capital intensive, and have higher labor productivity than their nonexporting counterparts. All of these plant characteristics are associated with higher wages, thus biasing upward the substantial export premium we observed at the four-digit level.[27] Our set of plant level controls includes the log of the capital-labor ratio, the age of the plant, the log of plant size measured by total employment, the log of production hours per production worker, and a dummy indicating whether the plant is part of a multiplant firm. As our export variable, we report results including a dummy for whether a plant is exporting in the current period.[28]

Table 10 reports the results for a variety of specifications for total wages and total benefits per employee.[29] Running the regression for the pooled sample from 1976 through 1987 and including only plant characteristics and year dummies but no regional or industry controls (column 1) yields an estimate of the export wage premium of 11.6 percent, statistically significant at the 1 percent level. The results suggest a very large wage premium in exporting plants even after controlling for plant characteristics known to increase wages. The export coefficient in the benefits regression (column 4) is even larger, at 18.5 percent. This simple specification accounts for 31.0 percent of the variation in average wages across plants and over time, even without accounting for regional or industry effects.

Other plant characteristics enter significantly and with the expected signs. Total employment and capital intensity are positively related to average worker wages and benefits, as are production hours per production employee. Somewhat surprisingly, given the results on wage premiums by plant characteristics in table 8, the coefficient on the multiplant firm dummy is negative and significant, indicating 3.5 percent lower wages at multiplant firms, although benefits are 14 percent higher at these plants.[30]

27. Davis and Haltiwanger (1991); Brown and Medoff (1989); Barron, Black, and Loewenstein (1987); and Mellow (1982).

28. Results, including the dummy for export status and the share of shipments exported by the plant, were virtually identical to those reported here and are available from the authors by request.

29. Ideally, we would want to estimate an hourly wage, but hours for nonproduction employees are not collected in the ASM.

30. This effect is no longer significant when industry dummies are included.

Table 10. OLS Regressions of Log Wages on Plant Characteristics (Pooled 1976–1987)

	Dependent variable					
	Wage per worker			*Benefits per worker*		
Independent variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Exporter	0.1162	0.0827	0.0446	0.1845	0.1307	0.0756
	(0.0012)	(0.0011)	(0.0011)	(0.0021)	(0.0020)	(0.0021)
Capital per worker	0.1343	0.1294	0.0976	0.2008	0.1908	0.1410
	(0.0004)	(0.0004)	(0.0005)	(0.0008)	(0.0008)	(0.0041)
Hours per worker	0.3880	0.3865	0.3529	0.3883	0.3963	0.3462
	(0.0025)	(0.0023)	(0.0021)	(0.0045)	(0.0042)	(0.0041)
Size of plant	0.0167	0.0259	0.0366	0.0590	0.0737	0.0909
	(0.0004)	(0.0004)	(0.0004)	(0.0008)	(0.0008)	(0.0008)
Multiplant	−0.0353	−0.0024	−0.0008	0.1387	0.1820	0.1717
	(0.0014)	(0.0013)	(0.0012)	(0.0025)	(0.0023)	(0.0023)
4-Digit SIC dummies	No	No	Yes	No	No	Yes
Region dummies	No	Yes	Yes	No	Yes	Yes
Number	411,574	411,327	411,327	408,689	408,442	408,442
R^2	0.311	0.426	0.525	0.331	0.410	0.467

Source: Authors' calculations. Dependent variables are log real salary and wages per employee (without benefits) and log benefits per employee. All specifications include dummies for year effects and plant age. Standard errors are in parentheses.

In columns 2 and 5 in table 10, we add controls for regional effects. Geographic concentration of exporters and exports does explain some of the exporter premium. The export dummy remains significant, although the magnitude of the premium is somewhat reduced. For total wages and benefits, the export premiums are now 8.3 percent and 13.0 percent, respectively.

To see whether exports vary dramatically across industries, as the Census data suggest, we reestimate the wage and benefits regressions, controlling for four-digit industries in columns 3 and 6. Export status of the establishment still enters with a positive and significant coefficient; however, the magnitude of the premium for wages drops almost in half, to 4.5 percent. Similarly, the benefits premium at exporters is now 7.6 percent after controlling for region, industry, and plant characteristics.[31] Note that we are explaining more than 52 percent of wage differentials across plants over time with this specification.

The premium in average wages at exporting plants could result from either higher wages for each type of worker or different compositions of workers at exporting and nonexporting plants. Using the two worker categories in the ASM data, we estimate the wage premiums separately for production workers and nonproduction workers for the three specifications reported above (table 11). Because of a lack of data on nonproduction worker hours, we perform all estimations on annual wages and salary per worker. Looking at the two types of workers separately, we continue to find positive and significant wage premiums, although the magnitudes are smaller. When we control only for plant characteristics, we find that exporters pay production workers 8.0 percent more than nonexporters do, while nonproduction workers receive 7.3 percent higher wages at exporting plants. After controlling for regional and industry differences, the wage premium for both worker types falls to between 2 and 3 percent. The substantial drop in the export premiums for individual worker categories suggests that composition of the work force plays a significant role in the cross-sectional dispersion of plant wages for exporters and nonexporters.[32] Even controlling for four-digit

31. Using two-digit industry dummies, we find virtually identical export premiums, suggesting that most of the industry-export effects are across, rather than within, two-digit industries.

32. In a regression of the nonproduction share in total employment on the same set of controls, the export dummy is significant with a coefficient of 0.028.

Table 11. OLS Regressions of Production and Nonproduction Wages on Plant Characteristics (Pooled 1976–1987)

	Dependent variable					
Independent variables	*Production wage*			*Nonproduction wage*		
Exporter	0.0803	0.0486	0.0280	0.0732	0.0519	0.0202
	(0.0013)	(0.0012)	(0.0012)	(0.0017)	(0.0017)	(0.0019)
Capital per worker	0.1400	0.1322	0.0911	0.0853	0.0851	0.0771
	(0.0005)	(0.0005)	(0.0005)	(0.0007)	(0.0007)	(0.0009)
Hours per worker	0.5749	0.5793	0.5432	0.0722	0.0682	0.0395
	(0.0027)	(0.0025)	(0.0024)	(0.0039)	(0.0038)	(0.0038)
Size of plant	0.0152	0.0246	0.0367	0.0386	0.0448	0.0488
	(0.0005)	(0.0005)	(0.0005)	(0.0007)	(0.0007)	(0.0008)
Multiplant	−0.0172	0.0107	0.0212	−0.1129	−0.0854	−0.0762
	(0.0025)	(0.0014)	(0.0013)	(0.0021)	(0.0021)	(0.0021)
4-Digit SIC dummies	No	No	Yes	No	No	Yes
Region dummies	No	Yes	Yes	No	Yes	Yes
Number	410,806	410,561	410,561	388,627	388,404	388,404
R^2	0.326	0.412	0.509	0.067	0.104	0.138

Source: Authors' calculations. Dependent variables are log real salary and wages per production worker and log real nonproduction salary and wages per nonproduction worker. Standard errors are in parentheses.

Table 12. OLS Fixed Effect Regressions of Wages by Worker Type on Plant Characteristics (Pooled 1976–87)

	Dependent variable			
Independent variables	*Wage per worker*	*Benefits per worker*	*Production wage*	*Nonproduction wage*
Exporter	0.0168	0.0297	0.0123	0.0179
	(0.0010)	(0.0023)	(0.0012)	(0.0021)
Capital per worker	0.0423	0.0613	0.0315	0.0371
	(0.0006)	(0.0015)	(0.0008)	(0.0014)
Hours per worker	0.2685	0.2472	0.4638	−0.0461
	(0.0018)	(0.0043)	(0.0022)	(0.0040)
Size of plant	−0.0704	−0.0916	−0.0426	−0.0566
	(0.0010)	(0.0023)	(0.0012)	(0.0022)
Number	411,574	408,689	410,806	388,627
R^2	0.889	0.809	0.864	0.688

Source: Authors' calculations. Dependent variables are log real salary and wages (excluding benefits) per worker, log real benefits per worker, log real production wage per production worker, and log real nonproduction wage per nonproduction worker. All specifications include dummies for year effects. Standard errors are in parentheses.

industry, however, the export premium is still positive and significant for both types of worker.

These results confirm that exporting establishments pay systematically higher wages than their nonexporting counterparts even after controlling for plant, region, and industry factors that might raise wages. The premium is found for both high and low skilled workers. Because more precise evidence on the composition of workers at exporting and nonexporting plants is unavailable, the possibility remains that our results are driven by heterogeneity in worker composition across plants or by other omitted variables such as plant-specific technological intensity.[33] Because this could represent additional unobserved heterogeneity in the composition of the work force, we take advantage of the large cross-section dimension of our panel and estimate our wage equations using plant fixed effects.

The fixed effects formulation provides additional evidence for an export wage premium (see table 12). The coefficients must be interpreted somewhat differently from the earlier results, as the export dummy now represents the effect on wages and benefits of the within-plant change from nonexporter to exporter, controlling for changes in

33. Doms, Dunne, and Troske (1994).

other plant characteristics and removing aggregate year effects.[34] Column 1 reports the results from the fixed effect model for average plant wages. The coefficient on the export dummy remains positive and strongly significant; plants that start exporting show an increase in wages of 1.7 percent, even after controlling for changes in capital intensity, hours, and plant size. The results for production and nonproduction workers show wage changes of similar magnitudes. Production worker wages increase 1.2 percent in response to a switch from nonexporting to exporting by the plant, while the increase in nonproduction worker wages is slightly larger, at 1.8 percent.[35] Benefits continue to show larger premiums; plants that start exporting increase their benefits per employee by almost 3.0 percent. These results suggest that plants changing their export status are undergoing substantial changes in production structure.

Instruments and Robustness Checks

In the preceding results the export status of the plant could be proxying for another plant characteristic that is truly driving the wage and benefits differentials. To address this problem, we employ a set of instruments correlated with exports yet arguably uncorrelated with other changes in plant characteristics. We must sacrifice some of the detail in our data set because no other variables are available to use as plant-level instruments for export status.

We use as instruments export-weighted exchange rates and foreign income variables. The foreign income variable is weighted aggregate income in the export destinations for a given industry. Using data on destinations of U.S. exports by four-digit SIC classification, we first construct annual export share weights for each country for each industry.[36] An average share of exports for each country for each industry

34. The coefficients on other plant characteristics are significant and have the expected signs. Increases in capital per worker and production hours per production worker increase wages. Increases in plant size have a small, negative effect, most likely because plants hire workers with lower-than-average wages for the establishment.

35. In the fixed effects specification with nonproduction employment share as the dependent variable, the export coefficient is significant but small at 0.002, confirming that plants switching export status also change their employment composition.

36. We consider only U.S. exports to the top twenty-five countries, ranked by value. The countries account for more than 90 percent of U.S. exports in every year. Exports for each country by industry come from the Census Foreign Trade Division Compro

during the period 1976–87 is used as the final weight. The income variables are foreign gross domestic product in 1985 prices, converted to U.S. currency.[37] Our country exchange rate measures are real exchange rate indices, with 1976–77 equal to 100.[38]

Before running the instrumental variables specification, we first use the demand instruments described above to test for the effect of foreign output and exchange rate movements on the exporting sectors of four-digit industries. The basic specification is a fixed effects regression in logs

$$\ln Y_{it} = \alpha_t + \delta_i + \beta \ln X_{it} + \epsilon_{it} \quad (2)$$

where α_t are year dummies, δ_i are four-digit industry dummies, and X_{it} is the vector of foreign demand instruments. Our dependent variables, Y_{it}, include the response of exports and the percentage of plants exporting as well as the changes in total employment and domestic sales.

Table 13 contains the regression results. By setting up a fixed effects specification, we are estimating the within-industry response to foreign demand shocks controlling for aggregate business cycle effects. Both the fraction of plants exporting within an industry and the value of exports themselves increase in response to favorable foreign exchange rate and demand shocks.[39] The estimated income elasticity for the percentage of plants exporting is substantially larger than the corresponding price elasticity. Considering exports directly, the variables again enter with the correct signs, although the exchange rate variable is now insignificant. The point estimate of the export-income elasticity is substantially higher, at 1.51, however, with much larger standard errors. The results suggest that the change in exports due to positive foreign demand shocks is attributable primarily to increases from existing exporters rather than to increasing numbers of exporting plants.

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database for various years. These industrial classifications are matched with the 1972 four-digit industrial classifications used in the ASM and Census of Manufactures.

37. We use purchasing power parity exchange rates given in Summers and Heston (1991).

38. The real exchange rate is calculated as the nominal exchange rate adjusted for foreign and domestic inflation; all variables drawn from various International Financial Statistics Yearbooks. Although this measure might be problematic if used to compare income or consumption levels across countries, it yields an appropriate measure of the foreign price movements for each industry.

39. Because exchange rates are denominated in foreign currency per U.S. dollar, a fall in exchange rates improves relative prices for U.S. exporters.

Table 13. OLS Fixed Effect Regressions of Industry Characteristics on Foreign Demand Workers (Pooled 1976–87)

Dependent variable	*Log foreign exchange*	*Log foreign demand*
Number of exporters	−0.0675*	0.4938***
	(0.0399)	(0.0848)
Value of exports	−0.2000	1.5121***
	(0.2597	(0.5508)
Exports as a share of total shipments	−0.0159**	0.0729***
	(0.0079)	(0.0167)
Share of employment at exporters	−0.0473	0.2890***
	(0.0323)	(0.0687)
Total employment	−0.2213***	−1.0128***
	(0.0827)	(0.1756)
Domestic shipments	−0.2614***	−0.9631***
	(0.0923)	(0.1958)

Source: Authors' calculations. Dependent variables are at four-digit SIC industry level. Additional variables include four-digit industry dummies and year dummies. Foreign exchange rate is four-digit SIC industry export-share weighted foreign currency per U.S. dollar. Foreign demand is four-digit SIC industry export-share weighted gross domestic product in 1985 U.S. dollars adjusted for purchasing power parity. Standard errors are in parentheses.

***significant at 0.01 level.

**significant at 0.05 level.

*significant at 0.10 level.

To understand whether foreign demand shocks shift production from domestic to foreign sales, we estimate the response of exports as a percentage of shipments, total employment, and domestic sales on the foreign demand variables. Both income and exchange rates are positively and significantly correlated with the export share in total shipments. The results are mixed for both the total industry employment and the domestic sales regressions. Favorable exchange rate shocks increase total employment and domestic shipments, while favorable foreign income shocks are surprisingly strongly negatively correlated with both measures.[40]

These industry results are encouraging. Neither of these instruments is likely to be correlated with plant- or industry-omitted variables, yet both have the potential disadvantage of possessing only weak correlation with plant-level export status. However, an F-test in the first stage

40. Total employment and domestic sales regressions using three-digit industry dummies yield negative and insignificant coefficients for the foreign exchange variable and the expected positive and significant coefficients on foreign income.

Table 14. IV Regressions by Worker Type on Plant Characteristics (Pooled 1976–87)

Independent variables	*Dependent variable*			
	Wage per worker	*Benefits per worker*	*Production wage*	*Nonproduction wage*
Exporter	0.2915	0.1033	0.1051	−0.0157
	(0.0775)	(0.1338)	(0.0814)	(0.1120)
Capital per worker	0.0923	0.1452	0.0930	0.0754
	(0.0022)	(0.0037)	(0.0023)	(0.0031)
Hours per worker	0.3459	0.3342	0.5385	0.0412
	(0.0029)	(0.0055)	(0.0031)	(0.0053)
Size of plant	0.0136	0.1058	0.0360	0.0469
	(0.0083)	(0.0145)	(0.0087)	(0.0125)
Multiplant	−0.0308	0.1789	0.0088	−0.1029
	(0.0035)	(0.0060)	(0.0036)	(0.0051)
Exogeneity test	1.692+	0.329	−0.522	−0.113
Estimated wage premium*	0.1001	0.0355	0.0610	−0.0053

Source: Authors' calculations. Instruments for export status of the plant include four-digit industry foreign demand and foreign exchange rates. All specifications include dummies for years and four-digit industries. Standard errors are in parentheses. The test for the exogeneity of export status is of the form given by Spencer and Berk (1981).

+Rejection at the 0.10 level.

*The first stage regression yields a probability of exporting at the plant. To produce an estimate of the wage premium for the average plant, we multiply the average linear probability prediction by the estimated coefficient.

regression strongly rejects the null hypothesis that the instruments are uncorrelated with the export status of the plant.[41]

The results using the industry variables as instruments for plant export status are reported in table 14. For average plant wage, the export status variable is positive and significant. For the two worker categories and benefits, the estimates of the exporter dummy are insignificantly different from zero. To compare the results of the instrumental variables (IV) specification to the OLS estimates, we multiply the estimated coefficient by the average linear probability from the first stage regression. The resulting estimate of the premium for total wages is 10.0 percent. These IV results offer additional evidence that composition effects are playing a large role in the wage increase at exporting plants.

To provide some evidence on the robustness of our results on the wage premium, we explore what happens to the export coefficients when we split our sample of plants by labor productivity and size

41. The first stage is a linear probability model; the F-statistic on the joint significance of the two instruments is 49.31. We perform an exogeneity test for plant export status and weakly reject exogeneity (at the 10 percent level) only for the total wage equation. See Spencer and Berk (1981).

classifications. Because we cannot directly control for labor productivity in our specification, we split the sample into ten labor productivity categories based on initial value-added per worker. To avoid issues of different waves of the ASM discussed earlier, we restrict ourselves to the years 1984 through 1987.[42] The export wage premium does not vary systematically with respect to initial labor productivity levels and remains significant, suggesting that the result is not driven by a correlation with plant labor productivity. The percentage of plants exporting does increase dramatically, however, as labor productivity rises, confirming the fact that high-productivity plants are more likely to be exporters.

Another possible explanation for the export-wage relationship is the size-wage premium for large plants. Although we controlled for plant size in our specification through total employment, plant size may still be playing a role. To check this we estimate the wage regressions separately for ten size categories. Again the export premium remains across plant size categories.[43]

In this section, we have documented the existence of a sizable wage premium in exporting plants for both production and nonproduction workers for both wages and benefits. This premium holds across all types of plants even after controlling for capital, size, labor productivity, and ownership characteristics. After adding regional and industry controls, the premiums are substantially reduced, although still positive and significant. Wages and benefits also increase in plants that shift from nonexporting to exporting status. The results show that workers at exporting plants do receive substantially higher wages and benefits; however, most of that differential can be explained by plant characteristics such as location, industry, capital intensity, and size.

Wage Growth

The results on wage differentials over time suggest that the export premium has been growing for plants in most categories. This finding is distinct, however, from the issue of whether wages have been rising more rapidly at exporting plants. To determine whether export status is a good predictor for wage increases, we regress both annual and long-

42. Firms are still entering and exiting, but this sample minimizes problems of comparing productivity levels across years.

43. These results are available upon request from the authors.

run wage changes at individual plants on initial plant characteristics, including initial export status. We consider both the predictive value of knowing the plant's status in the initial year and knowing its export status in the initial and final years. This specification on initial levels allows us to ask how exporters perform relative to nonexporters with similar characteristics.[44]

The results for the annual changes are reported in table 15. Average annual regressions of growth in wage per worker on export status in the initial year show that changes in wages for both worker types are negative for plants that are exporting in the initial year. The effects on both types of workers are small but significant, a 0.6 percent annual decline for production workers and a 0.5 percent decline for nonproduction workers in exporting plants relative to those in nonexporting establishments. Plant size in the initial year is positively correlated with wage growth, while higher initial capital intensity and higher hours per worker are negatively correlated with wage growth.

We also look at the export status of the plant in more detail by considering both the initial and final export status of the plant.[45] The negative coefficient on initial export status is driven largely by the strong relative wage decline in plants that stopped exporting. Compared with nonexporters throughout, wage growth at stoppers was 1.8 percent lower and the growth in benefits was 3.7 percent lower. Relative wage growth was highest for plants that started exporting. Plants that exported throughout were not significantly different from nonexporters. These results confirm the findings of the fixed effects regressions performed above. Starting (stopping) exporting is significantly positively correlated with wage increases (decreases) for both types of workers. This is particularly true for nonproduction workers, whose wages decrease 4.2 percent in plants that stop exporting relative to those in plants that begin exporting during the year. The magnitude of the starting and stopping effects is roughly symmetric.

Table 16 contains long-run regressions where the dependent varia-

44. In addition, this specification largely avoids the problem of endogenous regressors. An alternative specification with changes in plant characteristics as right-hand-side variables would identify wage increases at exporters after controlling for capital deepening and employment increases. The signs and magnitudes of the coefficients on the export variables remain unchanged. Results are available from the authors upon request.

45. Although the exogeneity assumption for initial export status seems reasonable, this is not true for the final export status of the plant.

Table 15. OLS Regressions of Year to Year Percentage Changes in Wages

	Dependent variable							
Independent variables	*Wage per worker*		*Benefits per worker*		*Production wage*		*Nonproduction wage*	
Exporter in year 0	−0.0066		−0.0175		−0.0061		−0.0045	
	(0.0010)		(0.0021)		(0.0012)		(0.0018)	
Nonexporter in year 0 & nonexporter in year 1		—		—		—		—
Exporter in year 0 & nonexporter in year 1		−0.0176		−0.0369		−0.0151		−0.0226
		(0.0016)		(0.0034)		(0.0019)		(0.0030)
Exporter in year 0 & exporter in year 1		0.0011		−0.0025		0.0006		0.0066
		(0.0011)		(0.0024)		(0.0013)		(0.0021)
Nonexporter in year 0 & exporter in year 1		0.0153		0.0331		0.0141		0.0191
		(0.0016)		(0.0034)		(0.0019)		(0.0030)
Size of plant	0.0145	0.0137	0.0101	0.0086	0.0134	0.0127	0.0116	0.0105
	(0.0004)	(0.0004)	(0.0008)	(0.0008)	(0.0005)	(0.0005)	(0.0008)	(0.0008)
Hours per worker	−0.1691	−0.1693	−0.1532	−0.1536	−0.2747	−0.2749	0.0245	0.0245
	(0.0019)	(0.0019)	(0.0041)	(0.0041)	(0.0023)	(0.0023)	(0.0038)	(0.0038)
Capital per worker	−0.0133	−0.0135	−0.0233	−0.0237	−0.0090	−0.0092	−0.0116	−0.0119
	(0.0004)	(0.0004)	(0.0009)	(0.0009)	(0.0005)	(0.0005)	(0.0008)	(0.0008)
Multiplant firm	−0.0022	−0.0024	−0.0007	−0.0013	−0.0038	−0.0036	−0.0074	−0.0077
	(0.0011)	(0.0011)	(0.0023)	(0.0023)	(0.0013)	(0.0013)	(0.0021)	(0.0021)
Number	350,051	350,051	347,014	347,014	348,201	348,201	328,555	328,555
R^2	0.034	0.035	0.011	0.012	0.046	0.047	0.004	0.004

Source: Authors' calculations. Dependent variables are percentage changes in real wages per worker. All specifications include dummies for plant age, region, and industry. Standard errors are in parentheses.

Table 16. OLS Regressions of Percentage Changes in Wages; Long Differences, 1976–87

	Dependent variable							
Independent variables	*Wage per worker*		*Benefits per worker*		*Production wage*		*Nonproduction wage*	
Exporter in year 0	−0.0046		−0.0380		−0.0068		−0.0103	
	(0.0041)		(0.0097)		(0.0046)		(0.0082)	
Nonexporter in year 0 & nonexporter in year 1		—		—		—		—
Exporter in year 0 & nonexporter in year 1		−0.0083		−0.0255		−0.0033		−0.0294
		(0.0057)		(0.0135)		(0.0064)		(0.0114)
Exporter in year 0 & exporter in year 1		0.0173		−0.0353		0.0102		0.0235
		(0.0051)		(0.0122)		(0.0058)		(0.0103)
Nonexporter in year 0 & exporter in year 1		0.0313		0.0174		0.0309		0.0342
		(0.0053)		(0.0125)		(0.0059)		(0.0106)
Size of plant	0.0169	0.0153	−0.0006	−0.0008	0.0112	0.0100	0.0271	0.0245
	(0.0018)	(0.0018)	(0.0043)	(0.0043)	(0.0020)	(0.0020)	(0.0037)	(0.0037)
Hours per worker	−0.2964	−0.2976	−0.2670	−0.2670	−0.4925	−0.4933	0.0464	0.0442
	(0.0108)	(0.0108)	(0.0260)	(0.0260)	(0.0123)	(0.0123)	(0.0223)	(0.0223)
Capital per worker	−0.0070	−0.0077	−0.0436	−0.0438	0.0002	−0.0004	−0.0050	−0.0059
	(0.0021)	(0.0021)	(0.0050)	(0.0050)	(0.0024)	(0.0024)	(0.0043)	(0.0043)
Multiplant firm	0.0165	0.0159	0.0176	0.0171	0.0220	0.0213	0.0238	0.0235
	(0.0055)	(0.0055)	(0.0130)	(0.0130)	(0.0062)	(0.0062)	(0.0111)	(0.0111)
Number	24,567	24,567	24,448	24,448	24,420	24,420	23,749	23,749
R^2	0.135	0.137	0.090	0.090	0.157	0.158	0.058	0.060

Source: Authors' calculations. Dependent variables are percentage changes in real wages per worker. All specifications include dummies for plant age, region, and industry. Standard errors are in parentheses.

bles are percent wage changes between 1976 and 1987. Plants in this sample are those who were in the 1976 ASM and were still in existence in 1987. As a result the sample consists of "successful" establishments. We consider the relative wage growth of plants within industries that stayed in operation. For all three wage variables, initial export status enters with a small, negative, and insignificant coefficient. Export status does not appear to predict above or below average wage changes over long horizons; however, changes in benefits are significantly negative at initial exporters. Considering the effects of other plant characteristics, we find that initial plant size and the multiplant status of the plant are both positively correlated with long-run wage increases, especially for nonproduction workers. Capital intensity again is negatively correlated with the wage changes. Breaking the export status into the four beginning and ending categories in table 16, we see broadly similar results for long-run wage changes. Plants that start exporting during the period increase wages the most, while stoppers perform relatively poorly. Exporters throughout have significantly higher wage growth than nonexporters throughout.

Employment Growth

To determine whether exporters also increase employment faster than nonexporters, we consider the relationship between export status and job growth. In tables 17 and 18, we estimate differences in short- and long-run relative employment changes for exporters and nonexporters.[46] As in the wage growth specifications, we control for initial levels of plant characteristics including size, capital intensity, hours per worker, and multiplant status.

Unlike the wage results, exporters show substantially higher annual employment growth for both types of workers. The total employment growth rate was 2.4 percent higher at plants that exported initially, as was the growth rate for production workers. Nonproduction employment growth was also faster at exporting plants than at nonexporters, 1.5 percent a year. As in the wage regression, initial plant characteristics enter significantly with the expected signs. Initial employment

46. Both tables include plants that survived the period, thus potentially biasing the results. In an earlier draft, we report that exporters have a higher probability of survival, especially over short time horizons. See Bernard and Jensen (1994b).

Table 17. OLS Regressions of Year to Year Percentage Changes in Employment

	Dependent variable					
Independent variables	*Total employment*		*Production workers*		*Nonproduction workers*	
Exporter in year 0	0.0243		0.0238		0.0153	
	(0.0016)		(0.0018)		(0.0020)	
Nonexporter in year 0 & nonexporter in year 1		—		—		—
Exporter in year 0 & nonexporter in year 1		−0.0222		−0.0243		−0.0148
		(0.0026)		(0.0029)		(0.0033)
Exporter in year 0 & exporter in year 1		0.0540		0.0514		0.0367
		(0.0018)		(0.0020)		(0.0023)
Nonexporter in year 0 & exporter in year 1		0.0544		0.0438		0.0438
		(0.0026)		(0.0029)		(0.0033)
Size of plant	−0.0380	−0.0408	−0.0405	−0.0430	−0.0279	−0.0301
	(0.0006)	(0.0006)	(0.0007)	(0.0007)	(0.0008)	(0.0008)
Hours per worker	0.1718	0.1711	0.2434	0.2427	0.0300	0.0293
	(0.0031)	(0.0031)	(0.0035)	(0.0034)	(0.0041)	(0.0041)
Capital per worker	0.0367	0.0359	0.0352	0.0345	0.0244	0.0238
	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0023)	(0.0009)
Multiplant firm	0.0045	0.0037	0.0047	0.0041	0.0018	0.0011
	(0.0018)	(0.0018)	(0.0019)	(0.0020)	(0.0023)	(0.0022)
Number	350,157	350,157	349,029	349,029	330,301	330,301
R^2	0.042	0.045	0.047	0.046	0.013	0.015

Source: Authors' calculations. Dependent variables are percentage changes in real wages per worker. All specifications include dummies for plant age, region, and industry. Standard errors are in parentheses.

Table 18. OLS Regressions of Percentage Changes in Employment: Long Differences, 1976–87

	Dependent variable					
Independent variables	*Total employment*		*Production workers*		*Nonproduction workers*	
Exporter in year 0	0.0032 (0.0010)		−0.0009 (0.0112)		−0.0103 (0.0133)	
Nonexporter in year 0 & nonexporter in year 1		—		—		—
Exporter in year 0 & nonexporter in year 1		−0.0585 (0.0143)		−0.0586 (0.0155)		−0.0604 (0.0184)
Exporter in year 0 & exporter in year 1		0.1834 (0.0130)		0.1772 (0.0140)		0.1364 (0.0166)
Nonexporter in year 0 & exporter in year 1		0.2246 (0.0133)		0.2256 (0.0144)		0.1826 (0.0171)
Size of plant	−0.2188 (0.0046)	−0.2323 (0.0046)	−0.2231 (0.0049)	−0.2365 (0.0049)	−0.1976 (0.0060)	−0.2089 (0.0060)
Hours per worker	0.1050 (0.0276)	0.0952 (0.0273)	0.2115 (0.0300)	0.2016 (0.0297)	0.0386 (0.0362)	0.0474 (0.0361)
Capital per worker	0.0907 (0.0054)	0.0853 (0.0053)	0.0944 (0.0058)	0.0889 (0.0058)	0.0427 (0.0070)	0.0383 (0.0069)
Multiplant firm	−0.0228 (0.0140)	−0.0264 (0.0138)	−0.5259 (0.0355)	−0.0133 (0.0149)	−0.0598 (0.0180)	−0.0625 (0.0180)
Number	24,567	24,567	24,435	24,435	23,795	23,795
R^2	0.255	0.272	0.239	0.253	0.167	0.175

Source: Authors' calculations. Dependent variables are percentage changes in real wages per worker. All specifications include dummies for plant age, region, and industry. Standard errors are in parentheses.

levels are negatively correlated with subsequent growth, while the correlations for hours and capital intensity are both large and positive.

The source of the differences in the wage and employment growth regressions is the strong employment growth in plants that export throughout the period. Both starters and continuing exporters perform strongly, with total employment growth rates 5.4 percent higher than those of nonexporters throughout. Employment growth rates for production workers are actually larger for continuing exporters than for starters. Plants that stop exporting fare particularly poorly, with employment growth rates 7.7 percent lower than either continuing exporters or starters.

Table 18 reports the relationship between export status and employment growth for continuing plants between 1976 and 1987. Initial export status is positively and significantly correlated with total employment growth during the period, although the coefficients are small, 0.3 percent over eleven years. The estimates for the two categories of workers are negative and not significant. These results are similar to those for the long-run wage changes, and examining the role of export status in the initial and final years, we again see that starters and stoppers dominate the movements. Continuing exporters outperform continuing nonexporters in terms of employment growth: 18.3 percent, 17.7 percent and 13.6 percent for total employment, production, and nonproduction workers respectively. Starters again grow the fastest, with a relative total employment gain of 28.3 percent compared with stoppers.

Conclusions

In this paper, we have used microeconomic data to explore the role of exporting plants in the manufacturing sector. We performed two distinct analyses: first, we documented the characteristics of exporters and nonexporters, testing whether exporters are relatively successful plants. Second, we examined how these plants have behaved over time, considering variables that influence exporting and whether exporters perform better than nonexporters.

Perceptions that exporters are "better" than nonexporters were borne out by the cross-section evidence from the 1987 Census of Manufactures. Although exports make up a small fraction of total manufacturing output, exporting plants had a disproportionate weight in total employment and output. Exporters were substantially larger than nonexporters and systematically differed in their input characteristics. Capital intensity and investment per employee both were higher at exporters. In the labor market, both nonproduction and production workers received 14.5 percent higher pay at exporting plants, not controlling for industry or region, and benefits per employee were 32.7 percent larger at exporters. In addition to their higher wage payments, exporters also showed higher labor productivity, measured by both value-added and shipments per employee.

We explored in detail the sources of these large wage differentials. Exporters had higher ratios of nonproduction to production workers, partially explaining why the total wage premium at exporters was systematically larger than the wage premium for either nonproduction or production workers. Accounting for plant size, capital intensity, and hours per worker, we found that exporting plants still paid higher wages and benefits. Even with the addition of controls for industry and location, the export premiums were positive and significant, although the magnitudes were greatly reduced. Fixed effects and instrumental variables estimates also showed small positive and significant export wage premiums. The bulk of the wage differences between exporters and nonexporters, however, was due to differences in plant characteristics, location and industry.

Although all signs pointed toward current exporters having better performance attributes than nonexporters, the evidence on exporting as an indicator of future success was less clear-cut. Controlling for observed plant characteristics, we estimated a negative correlation between wage growth and initial export status over both one year and longer horizons. Employment growth, on the other hand, was positively correlated with initial export status for annual changes but was uncorrelated over longer intervals.

The driving force behind this mixed performance can be identified quite easily. Breaking plants into categories based on their export status in both the initial and the final year, we found plants that become exporters perform substantially better than plants that do not change their export status, especially in terms of wage growth and long-run employment growth. In addition, plants that stop exporting showed the worst performance characteristics. These findings confirmed the perception that ''good'' plants are exporters, but they do not support the notion that on average today's exporters will be tomorrow's success stories.

This combination of results about cross-section characteristics and performance over short and long horizons reinforces the perception that exporters are important plants in the manufacturing sector but that current export status is a poor indicator of short- and long-run increases in wages. In other words, current exporters have been successful in the past—it is likely that success has helped them become exporters—but there is no guarantee that current exporters will continue to outperform other establishments in the future.

Given the sustained policy interest in promoting exports as a way to increase the performance of the U.S. manufacturing sector, these results call for substantial caution. Consider a policy that aids plants designated as ''winners.'' Our results suggest that using current export status as the selection criterion *may* pick plants that will do well over short horizons but not necessarily over longer periods. It is likely that such a policy would merely reward previous accomplishments rather than identify future success.

Based on our findings, we conclude that exporting plants have an important role to play in the economy and that future research should focus on how plants move from domestic production to a combination of domestic and foreign sales. Knowing that exporters are successful can help us learn what distinguishes successful plants from failures in the same markets.

Appendix: Data Description

Descriptions of variables are from Census of Manufactures General Summary MC87-S-1 (Bureau of Census 1987). Total employment represents the total number of employees at the plant, which is broken into two components, production workers and nonproduction workers. Production workers are employees (up through the working foreman level) engaged in fabricating, processing, assembling, inspecting, receiving, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and watchman services, product development, auxiliary production for plant's own use (for example, powerplant), record-keeping, and other services closely related to these production activities at the establishment. Nonproduction workers include those employees of the manufacturing establishment engaged in factory supervision above the level of line supervisor, including sales, sales delivery, advertising, credit, collection, installation, service, clerical, executive, purchasing, financial, legal, personnel (including cafeteria, medical, etc.), professional, and technical employees. These two categories of employment are clearly inadequate for describing the changing composition of employment within plants; however, they do capture some of the within-industry heterogeneity across exporters and nonexporters.

Salaries and wages represent the total gross earnings paid in the calendar year to employees at the establishment. Benefits are supplemental labor costs, both those required by state and federal laws and those incurred voluntarily or as part of collective bargaining agreements. Salaries and wages and benefits are deflated by the Bureau of Labor Statistics regional consumer price index (1987 = 100).

Total value of shipments represents the output of the plant. We use the machinery assets at the end of the year as our capital measure. It represents the original cost of all production machinery, transportation equipment, and office equipment and any costs incurred in making the assets usable.[47]

Value-added is derived by subtracting the cost of materials, containers, fuel, purchased electricity, and contract work from the value of shipments. The result of this calculation is adjusted by the net change in finished goods and work in process between the beginning and end-of-year inventories. Shipments, capital, and value-added are deflated by four-digit sectoral deflators.[48] In addition to plant characteristics, we make use of information on the ownership structure of the firm. We construct a dummy for plants that are owned by a larger firm composed of other establishments, either manufacturing or other (such as retail and wholesale).

47. Other research suggests that this measure of capital performs comparably to more detailed measures such as perpetual inventory methods. See Baily, Hulten, and Campbell (1992).

48. Bartlesman and Gray (1994).

Comments and Discussion

Comment by Robert Z. Lawrence: In this useful paper, Bernard and Jensen explore the behavior of exporting plants in the United States. From one vantage point, their results can be judged disappointing, because they suggest that exporting is neither a powerful independent source of growth nor a good predictor of future success. But I think these findings are useful and have an important bearing on three critical questions in current trade policy discussions.

First, premium wages. In the debates about the North American Free Trade Agreement and the Uruguay Round trade agreements, official supporters of the legislation frequently cited the statistic that U.S. jobs associated with exports pay 18 percent more than those in the rest of the economy. The implication was that more exports would mean more jobs with high wages. But, of course, that does not necessarily follow. Workers engaged in exports, for example, might be better educated than those who are not. Such workers might earn higher wages even if they are not engaged in exporting. The key issue, therefore, is whether the association between exports and high wages reflects links that are causal or simply coincidental. Do exports provide benefits that would not be obtained otherwise?

Bernard and Jensen show that the data associating exporting with other measures of success do tend to exaggerate the pure benefits of exporting. The raw data indicate that wages are 14.5 percent higher at exporting plants and benefits per employee 32.7 percent higher. But the authors find that the impact of exports, while positive and statistically significant, is considerably reduced once the effects of capital intensity, industry, plant scale, and location are controlled for. One suspects, moreover, that the premiums would be even further reduced if the authors were able to control for worker characteristics. Thus the wage benefits that are attributable solely to exporting appear to be rather small.

At the same time, the partial equilibrium approach adopted here ignores the possibility that an increase in exports could raise the return to plants (or workers) with particular characteristics throughout the economy. It could therefore understate the economywide impact of exporting. Indeed, the central theory of the distributional impact of trade, the Stolper-Samuelson theory, predicts a positive association between exports and the economywide rewards to factors used relatively intensively in export industries. One would not want to conclude, in that model, that because wages of skilled workers were the same in export and import-competing industries, exports (or trade) had not affected wages.

Second, exports and growth. In the debate about the sources of the rapid growth in the emerging Asian economies, considerable attention has been paid to the role of export-led growth. Although they differ in the degree to which they protected their domestic markets, all successful Asian nations emphasized exports. Some economists, most notably those who participated in the study by the World Bank on the East Asian miracle, have stressed the benefits from exporting and indeed left the impression that the benefits from a dollar's growth in exports exceeds those from other types of activity. According to the World Bank, "broad government support for exports was a highly effective way of enhancing absorption of international best practice technology and thus boosting productivity and output growth."[1] Similar arguments have been applied to industrialized countries. In particular, it is argued that access for U.S. electronics firms to Japan's markets is crucial, not only because of the potential for increased sales, but also because of the benefits firms obtain from learning and competition.

There are many plausible reasons why exporting activity might afford advantages, such as scale economies and exposure to foreign competition, ideas, and customers. But, again, correlation does not necessarily imply causation. Indeed, the chain of causation could actually be re-

1. World Bank (1993, p. 293).

versed. Successful production could lead to more exports rather than the reverse. The findings here that exporting per se adds only small additional benefits casts some doubt on the view that, for a large, industrialized country such as the United States, exporting brings unusually large benefits. Of course, it might still be the case that, for developing countries, export market exposure is more important.

These findings would have been even more powerful if the authors had used estimates of total factor productivity, rather than just output per employee and wages as their measures of successful performance.

Third, exports and industrial policy. In its report on the East Asian miracle, the World Bank extols the virtues of using export performance as an objective indicator of successful performance. The report describes how the governments of Japan, Korea, and Taiwan organized economic "contests" among their firms in which preferential access to credit, licenses, and foreign exchange were granted to successful exporters. "Exports, and especially manufactured, nontraditional exports, were the yardstick against which the success of other allocation decisions—for example, credit allocation, domestic content requirements and industrial licensing—were judged. . . . From a social standpoint, exporting may be a better indicator of whether a firm merits additional funds than success in selling domestically," the authors said.[2] In industrialized countries, similarly, efforts have been made to promote champion firms in export markets, in the belief that export performance brings unusually large social rewards. But the paper demonstrated that exports are the result of successful performance but not a predictor of future success in long-term employment and growth in labor productivity. This provides a very useful caution for the type of industrial policy in which exporters are rewarded with various kinds of preferential treatment.

General Discussion: Because the authors' analysis focused on plants rather than firms, the relationship between firm structure and the propensity of plants to export was a topic of concern for some of the participants. F. M. Scherer noted that multiplant firms can be of several types: vertically integrated, horizontally integrated, and conglomerate. He said that in vertically integrated firms, most plants would not be

2. World Bank (1993, p. 97).

exporting at all because they would be sending their output to other plants for additional assembly; thus, export propensities would be asymmetrical within a vertical chain. For those firms that are horizontally integrated because of the need to decentralize operations in order to reduce transportation costs, low export propensities would be expected. Conversely, those firms that are horizontal because of product differentiation should have plants with a very high propensity to export, as long as the logic of intraindustry trade is correct. Scherer said that the export picture for conglomerates was somewhat unclear. In response, Henry Aaron argued that a high propensity to export would also be found in vertically integrated transnational companies, because such firms must send their intermediate products across international borders.

Several participants discussed data, modeling, and measurement issues and suggested avenues for additional research. Eric Bartelsman argued that the four-digit price deflators used in the paper were not sensitive enough to the product mix in some of the industries, such as chemicals and precision instruments, where exports are concentrated. As a result, he said, the productivity effects from exporting may have been underestimated.

Frank Lichtenberg argued that a firm that wishes to enter a foreign market must choose between exporting and building a new plant in that country. Thus, he said, the authors' exclusive reliance on Census of Manufactures data, which cover only domestic plants, leads to a sample selection bias. He suggested that the authors look at Compustat geographic segment data, which includes information on both overseas and domestic employment at the firm level.

Sam Peltzman noted that the paper's data covered a period of significant exchange rate movements. He argued that the authors' results were picking up the lag effects of, first, the low dollar of the early 1980s and, later, the high dollar of the mid-1980s. He suggested that the authors examine whether the characteristics of firms drawn into exporting when exchange rates are favorable differ systematically from those of firms entering the export business when they are not.

Susan Collins said that it is not surprising that, over the long-run and once industry and other characteristics are controlled for, exporting plants do not significantly outperform nonexporters. She argued that several trade models imply that it is exactly those characteristics that determine the propensity of a plant to export. Thus, she suggested, rather than looking for differences between exporting and nonexporting plants, the authors should focus on the effects of impediments to exporting and what happens to plant performance when such impediments are removed. According to Collins, possible export impediments would include export disincentives of U.S. economic policy, labor disputes, and foreign trade barriers.

Aaron agreed with discussant Robert Lawrence, arguing that the controls for plant characteristics utilized by the authors may have hidden some of the wage effects of exporting. He said that if industries in which exports are concentrated have, by chance, a high ratio of nonproduction to production workers or of high- to low-wage workers, a rising demand for exports caused by, for example, falling exchange rates, would have the effect of raising the demand for nonproduction or high-wage workers, which would increase their employment and income relative to that of production or low-wage workers.

Ralph Landau argued that one of the most important benefits individual firms receive from exporting (and from dealing with the impact of imports) is the opportunity to compete against the world's most efficient companies. He said that this search for competitiveness-enhancing innovations forces firms to invest in research and development. An example, he said, is Germany's I.G. Farben chemical cartel, which was formed as a monopoly in the 1920s and thus in theory should have been uncompetitive. The country's need to earn hard currency to pay its World War I reparations obligations, however, compelled Farben to export and, in turn, to compete with such leading international firms as DuPont and Monsanto. This competition forced Farben to develop several important innovations, some of which were still contributing to the international success of the German chemical industry after World War II.

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