EXPORTING AND GENDER EARNINGS DIFFERENTIALS IN THE U.S. MANUFACTURING SECTOR

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Abstract

We analyze weekly earnings data for approximately 17,000 women and men who worked in the U.S. manufacturing sector in 2016. We estimate the earnings premium in export-intensive industries, based on an econometric analysis that combines worker-level data on earnings, education, occupation, location, and other demographic characteristics from the Current Population Survey with industry-level data on the exports and the total shipments of U.S. manufacturing industries. The estimates indicate that export-intensive industries pay more on average, and that the export earnings premium is larger for female workers, who earned a 21.3% premium in export-intensive industries, than for male workers, who earned an 12.1% premium in export-intensive industries.

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1 Introduction

In its 2015 report highlighting the economic benefits of U.S. trade, the President's Council of Economic Advisers (CEA) identified export wage premia as the second of ten important facts about international trade. The CEA report found that, within the U.S. manufacturing sector, "export-intensive industries pay up to 18 percent more than other industries" on average.[1] CEA's analysis updates earlier econometric research for workers in the U.S. manufacturing sector in Riker (2010) and for workers the U.S. services sector in Riker and Thurner (2011), both using Current Population Survey (CPS) data for 2006-2008. These earlier studies are also updated in Riker (2015) using CPS data for 2014.[2] They complement earlier studies using firm-level wages in Bernard and Jensen (1995) and Bernard and Jensen (1999).

In this paper, we update the analysis of CPS earnings using 2016 data. We re-estimate the earnings premia in export-intensive industries after controlling for the worker's education, work experience, demographics, and location within the United States. We find that export-intensive industries still pay more on average in 2016 and that the export premia in U.S. manufacturing industries are much larger for female workers than for male workers—a 21.3% premium for female workers compared to a 12.1% premium for male workers. This update is the first in the series of CPS analyses to link exporting to the gender wage gap.

The rest of the paper is organized into five parts. Section 2 reviews literature that links the gender wage gap to international trade. Section 3 lists the data sources for the updated econometric analysis and provides descriptive statistics on export intensity and average weekly earnings. Section 4 describes our econometric methodology. Section 5 reports our econometric estimates of the export earnings premia by the industry and gender of the

[1] Council of Economic Advisers (2015), pages 3 and 14-19.

[2] A closely related analysis of CPS data in Ferris and Riker (2016) finds that workers in relative export-intensive metropolitan areas earn more in 2014, even after controlling for observable human capital and demographic characteristics of the individual workers. Ebenstein, Harrison, McMillan and Phillips (2014) includes a more extensive econometric analysis of CPS data for earlier years. They estimate the effects of imports and offshoring as well as exports.

worker. Section 6 concludes.

2 Literature on the Gender Wage Gap and Trade

Our analysis is related to the extensive literature on the gender wage gap, recently surveyed in Blau and Kahn (2017). They document the slow decline in the gender wage gap in the United States over the last four decades, and then they discuss the evidence for alternative explanations of the gap, including the influential view in Goldin (2014) that the gender wage gap mostly reflects the greater frequency of workforce interruptions for female workers and the greater value that they place on work schedule flexibility.[3]

The small branch of literature that links the gender wage gap in the United States to international trade has focused on the impact of import competition rather than export participation. In the United States, the gender wage gap is most often analyzed in the context of NAFTA, using worker-level datasets like the CPS and the American Community Survey. Saure and Zoabi (2014) show that NAFTA tariff reductions affect the labor force participation and wages of women, relative to men, in manufacturing industries. Their data indicate that U.S. industries that are more exposed to trade experienced declining employment that affected men more than women. As wages drop, less able women select out of the labor force, and this raises wages of the more able women who decide to continue working. Hakobyan and McLaren (2017) use U.S. Census data for 1990 and 2000 to estimate the effects of NAFTA on U.S. wages, with an emphasis on gender differences. They find that wage growth slowed following implementation of NAFTA and that the most NAFTA-affected segment of population was married blue-collar women. They attribute some of this

[3]Goldin (2014) argues that the gender wage gap could be reduced or even eliminated if the structure of the labor market changed so that firms no longer have an incentive to disproportionately reward workers who work longer hours or are available during some particular hours. This is demonstrated in Goldin and Katz (2016): industries that have already undergone the change (e.g., pharmacy) have a lower gender wage gap than industries that have not (e.g., financial and legal). Over time, the gap has declined, and this is due to the relative increase in women's human capital accumulation.

decline in growth to higher-paid married women deciding to stop participating in the labor market. Brussevich (2018) examines the impact of import competition and costly dynamic intersectoral labor on the gender wage gap and welfare in the United States, using CPS data. Trade shocks affecting manufacturing fall disproportionately on men, in part because women work primarily in services sectors that are less affected by import competition. Thus wage and welfare gains from trade are higher for women than men and the gender wage gap declines as a result of import competition.

Finally, there is also a sizable literature that links the gender wage gap in other countries to international trade. The study most closely related to our analysis is Bøler, Javorcik and Ulltveit-Moe (2018), which focuses on exporting. The study uses linked employer-employee data from Norway for the period 1996-2010. Using variation in export participation within each industry and firm, they find that exporting had a significant positive effect on wages, after controlling for observable worker characteristics; on the other hand, using variation within employer-employee job spells, they find that exporting had a significant negative effect on wages. They interpret the latter as evidence that exporting firms are likely to place higher demands on worker availability and flexibility, often requiring work at odd hours to meet demands of customers in other time zones. The Appendix discusses additional studies that link the gender wage gap in other countries to international trade.

3 Data Sources and Descriptive Statistics

Our data on the workers' average weekly earnings are from the Merged Outgoing Rotation Group of the Current Population Survey (CPS-MORG). They include the weekly earnings of approximately 17,000 female and male workers employed in U.S. manufacturing industries in 2016. The CPS-MORG also provides data on several worker characteristics that affect earnings, including education, age (as a proxy for work experience), occupation, race, sex,

union status, whether the worker lives in a metropolitan area, and the state where the worker lived.

We combine the CPS-MORG data with official statistics on U.S. exports and data on the value of shipments for each of the manufacturing industries from the 2016 Annual Survey of Manufactures. Following the methodology in the earlier CPS studies, we designate the worker's manufacturing industry as export-intensive if industry exports exceeded ten percent of the total value of the U.S. industry's shipments in 2016.

Table 1 ranks the export intensity of the sixteen manufacturing industries in the CPS-MORG.[4] The export shares in 2016 ranged from 4.80% for beverages and tobacco products to 39.32% for computer and electronic products.

Table 1: Export Intensity of U.S. Manufacturing Industries

Industry Name (NAICS Code)	Export Share in 2016 (%)
Computer and Electronic Products (334)	39.32
Electrical Equipment and Appliance Manufacturing (335)	34.27
Machinery Manufacturing (333)	31.17
Miscellaneous Manufacturing (339)	28.27
Transport Equipment Manufacturing (336)	26.57
Textiles, Apparel, and Leather (313-316)	24.54
Chemical Manufacturing (325)	23.97
Primary Metal and Non-Metallic Products (327, 331)	17.15
Petroleum and Coal Products (324)	15.32
Plastics and Rubber Products (326)	12.24
Fabricated Metal Products (332)	11.63
Paper and Printing (322-323)	10.23
Food Manufacturing (311)	7.87
Wood Products (321)	6.68
Furniture and Fixtures Manufacturing (337)	6.17
Beverage and Tobacco Products (312)	4.80

Table 2 summarizes the percentage differences in the workers' average weekly earnings by the export intensity of the industry and the gender of the worker. The first column

[4]Several of the CPS industry classifications combine more than one three-digit NAICS code.

includes all workers in the manufacturing industries. The workers' average weekly earnings were 38.8% ($306 per week) higher on average in the export-intensive industries. The second column of the table focuses on female workers, and the third focuses on male workers. For both groups, the dollar values of the gaps are similar, but the export earnings premium as a percent is much larger for female workers. Their average weekly earnings were 44.3% higher in the export-intensive industries, while the percentage gap for male workers was only 33.4%.

Table 2: Differences in Weekly Earnings by Export Intensity of Manufacturing Industry and Gender

	All Workers	Female Workers	Male Workers
Export Share Greater Than 10%	$1,095	$905	$1,169
Export Share Less Than or Equal to 10%	$789	$627	$876
Gap in Dollars per Week	$306	$278	$293
Percentage Gap within Group	38.8%	44.3%	33.4%

Table 3 organizes this information in a way that more directly addresses the gender wage gap literature. The table reports the ratio of the average weekly earnings of women to that of men, sometimes described as "cents on the dollar" statistics, for export-intensive manufacturing industries and all other manufacturing industries. Female workers are paid 77.4 cents on the dollar in export-intensive industries, compared to 71.6 cents on the dollar in other manufacturing industries.

Table 3: Gender Differences in Weekly Earnings by Industry Group

	Female Workers	Male Workers	Ratio of Female to Male Workers
Export-Intensive Manufacturing	$905	$1,169	0.774
All Other Manufacturing	$627	$876	0.716

4 Econometric Approach

The earnings differences in Table 2 are not adjusted for observable differences in the characteristics of the workers in each of the industry and gender groups. Ideally, the earnings differences would be calculated by comparing workers who are employed in the two groups of industries but are otherwise similar in terms of their education, experience, location, and other observable characteristics. This comparison is the aim of the multivariate regression analysis in this section. The regression model effectively removes the contributions of the individual characteristics, including occupation, from the workers' earnings before calculating the inter-industry differences in weekly earnings. The state fixed effects control for geographic differences in earnings within the same industry and gender groups.

The dependent variable of the econometric model is the log of the worker's average weekly earnings. The explanatory variables are (i) an indicator of the export share of the worker's industry is 10% or higher; (ii) the worker's experience, proxied by an indicator of whether the worker is at least 35 years old; (iii) indicators for whether the worker completed a bachelor's degree, completed a graduate degree, is white, lives in a metropolitan area, is a member of a union, is female, and is in a management or professional occupation; (iv) a constant and a set of state fixed effects; and (v) an error term.

We estimate the econometric model of average weekly earnings for the cross-section of workers in U.S. manufacturing industries in the 2016 CPS-MORG data set, and then separately for the female and male workers in these industries. We weight the observations for individual workers using the sampling weights provided in the CPS-MORG data set.

5 Econometric Estimates

Table 4 reports the econometric estimates for all workers and for the two gender groups. All of the estimated coefficients have the expected signs, and most are statistically significant: export intensity, experience (proxied by age), education, being race (white), living in a metropolitan area, working in a managerial or professional occupation, and being a member of a union are all associated with higher weekly earnings on average, while female gender is associated with lower earnings on average.

Table 4: Econometric Model of Log Weekly Earnings

Explanatory Variables	All Workers	Female Workers	Male Workers
Industry's Export Share $> 10\%$	0.142^{***}	0.193^{***}	0.115^{***}
	(0.038)	(0.046)	(0.035)
Experience (Proxied by Age)	0.273^{***}	0.269^{***}	0.276^{***}
	(0.011)	(0.025)	(0.014)
College Degree	0.370^{***}	0.365^{***}	0.373^{***}
	(0.020)	(0.042)	(0.020)
Graduate School	0.098^{***}	0.139^{***}	0.083^{***}
	(0.021)	(0.039)	(0.017)
White	0.090^{***}	0.038^{**}	0.115^{***}
	(0.013)	(0.018)	(0.016)
Metropolitan Area	0.041^{**}	0.018	0.052^{***}
	(0.019)	(0.051)	(0.014)
Professional Occupation	0.452^{***}	0.531^{***}	0.418^{***}
	(0.022)	(0.036)	(0.019)
Union Membership	0.164^{***}	0.172^{***}	0.155^{***}
	(0.021)	(0.032)	(0.021)
Female	-0.293^{***}		
	(0.025)		
Number of Observations	16,841	5,006	11,835
R^2	0.3486	0.3225	0.3260
F Statistic for the State Fixed Effects	3.52	10.34	3.18

Notes: All of the models include a constant and state fixed effects. The standard errors, reported in parentheses, are corrected for potential clustering by industry. * significant at 10%; ** significant at 5%; *** significant at 1%.

The coefficient on export intensity measures the earnings premium in export-intensive manufacturing industries. We calculate the percentage difference in the conditional means of the two groups of industries by exponentiating this estimated coefficient. According to these calculations, earnings in the export-intensive industries are 21.3% higher for female workers and 12.1% higher for male workers within the U.S. manufacturing sector. The estimated values of the individual state fixed effects and the constant are not reported in Table 4 because there are so many, but the F tests at the bottom of the table indicate that the state effects are jointly significant in all three models. The estimated export earnings premia in Table 4 are smaller than the simple percent changes calculated for the different gender groups in Table 2, since they control for the education and experience levels of the workers and other observable differences in the composition of workers in the industries.

The estimates in Table 4 indicate differences across the workers in the two gender groups. Most important is the size of the export earnings premium, which is much larger for female workers. In addition, a post-graduate education and a managerial or professional occupation have greater effects on the earnings of female workers, while race (white) and living in a metropolitan area have greater effects on the earnings of male workers.

Table 5 report estimates from an additional econometric specification that interacts the measure of export intensity with the indicator for gender. We use the estimated coefficients to calculate the difference in ratio of female to male pay in the two groups of industries, in the "cents on the dollar" format common in the gender wage gap literature. The estimated coefficients imply that there is a statistically significant difference in ratio of female to male pay in the two sets of industries, with a ratio of 75.8 cents on the dollar for the export-intensive industries and a ratio of 69.2 cents on the dollar for the other manufacturing industries.[5]

[5]The robust standard errors for these ratios are 2.1 cents on the dollar and 1.3 cents on the dollar, respectively. The ratios for the two groups of workers are statistically different with a p-value of 0.007.

Table 5: Econometric Model of Log Weekly Earnings

Explanatory Variables	All Workers
Industry's Export Share $>$ 10% and Female	-0.277***
	(0.027)
Industry's Export Share $<$ 10% and Female	-0.480***
	(0.025)
Industry's Export Share $<$ 10% and Male	-0.111***
	(0.035)
Experience (Proxied by Age)	0.272***
	(0.011)
College Degree	0.369***
	(0.020)
Graduate School	0.099***
	(0.020)
White	0.090***
	(0.012)
Metropolitan Area	0.042**
	(0.019)
Professional Occupation	0.453***
	(0.022)
Union Membership	0.164***
	(0.021)
Number of Observations	16,841
R^2	0.3491
F Statistic for the State Fixed Effects	3.62

Notes: The model includes a constant and state fixed effects. The standard errors, reported in parentheses, are corrected for potential clustering by industry.
* significant at 10%; ** significant at 5%; *** significant at 1%.

6 Conclusions

Even after controlling for observable human capital, demographic, and location factors in the econometric models in Tables 4 and 5, there remains a significant difference in earnings between industries that are export-intensive and industries that are not. The export earning premia are much larger for female workers than for their male counterparts. As we noted in the literature review, the estimates in Bøler et al. (2018) suggest that further examination with linked employer-employee data – if they are available for U.S. workers – could help to better measure and explain these wage gaps.

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Appendix: Additional Literature on the Gap in Other Countries

The literature linking wage outcomes in other countries to international trade tends to focus on the effects of trade liberalization on gender differences in the wages of workers in import-competing domestic industries. The findings are often mixed. For example, Menon and van der Meulen Rodgers (2009) examine the effects of India's major trade reforms of 1991 on wage outcomes of workers in import-competing manufacturing sectors. The authors find that at a sector level, an increase in trade openness is associated with an increase in the gender wage gap. Benguria and Ederington (2017) examine how increased regional exposure to Chinese imports affects the gender wage gap in various industries in Brazil. The authors find that trade increases female share of workers in higher paying occupations. In other words, an increase in imports reduces average wages of Brazilian men, but has little effect the overall wages of Brazilian women. As a result, the cross-industry gender wage gap decreases. Artecona and Cunningham (2000) examine how trade liberalization in Mexico affects the gender wage gap in the manufacturing sector in urban areas. Using a difference-in-differences approach, the authors look at how different Mexican firms adjusted to trade liberalization of the mid-1980s. Firms' exposure to import competition is measured using the ratio of imports to domestic shipments. The authors find no significant effect of trade liberalization on the gender wage gap in manufacturing industry. However, their qualitative result suggests that trade liberalization may decrease the gender wage gap. These mixed findings suggest that industry and occupational choices interact with patterns of trade, underlining the importance of paying special attention to local labor market structure when examining the economy-wide wage effects of trade.

Finally, Oostendorp (2009) investigates the impact of globalization, more broadly defined, on occupational gender wage gap in a study of 161 industries in over 80 countries. He finds that economic development, increases in trade flows, and higher inflows of FDI are generally

linked with a decrease in the gender wage gap; however, this does not necessarily hold true for all workers in all occupations and countries.