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Trade Liberalization and Gender Inequality[†]

By Chinhui Juhn, Gergely Ujhelyi, and Carolina Villegas-Sanchez*

How does trade liberalization affect wage inequality? A large literature examines this question, focusing mainly on changes in the skill premium.[1] In this paper we consider an underexplored aspect of wage inequality in the trade literature—gender inequality. Aside from equity concerns, the effect of liberalization policies on gender outcomes may be of interest from a long-run growth perspective since there is now growing evidence that empowering women promotes education and better children's outcomes (see Duflo 2012). Thus, in our view, the impact of trade openness on gender inequality is an important question which deserves equal attention to that given to skill premia.

Using household surveys from Mexico, Aguayo-Tellez et al. (forthcoming) conclude that during the establishment of the North American Free Trade Agreement (NAFTA), women's relative wage increased even as their relative employment rates increased, suggesting that demand for female labor increased in the economy as a whole. They also find that the majority of this increase is due to an increase in female wage bill share *within* industries. Why would trade liberalization have differential impact on men and women *within industries and firms*? This is the question we pursue in this paper.

Our model builds on recent work emphasizing the role of firm heterogeneity in trade (Melitz 2003; Bustos 2011). Lower tariffs encourage the most productive firms to incur a fixed cost to enter the export market, as well as to upgrade their technology. Reminiscent of Autor, Levy, and Murnane (2003) in which computers replace the need for routine physical tasks, the new technology in our model replaces the need for physically demanding skills.[2] Thus, the new technology raises women's relative productivity in blue-collar jobs, leading to improved labor market outcomes. We test our model using establishment-level data from Mexico, exploiting tariff reductions associated with NAFTA. As predicted by our model, we find that tariff reductions raise female wage bill shares in blue-collar jobs. In contrast, we find little evidence of increasing female shares in white-collar occupations, where the relative importance of physically demanding skills is unlikely to have changed.

I. Employment Outcomes under NAFTA

The backdrop for our study is trade liberalization under NAFTA, which reduced US tariffs on Mexican goods as well as Mexican tariffs on imports from the United States. The upper panel in Table 1 shows US tariff levels in 1991 before NAFTA and the change from 1991–2000. Similarly, the lower panel shows Mexican import tariffs in 1991 as well as the change in tariffs from 1991–2000. As shown in Table 1, on average, tariffs applied by the United States (export tariffs) fell approximately 5 percentage points, and there is considerable variation in the

* Juhn: Department of Economics, University of Houston, Houston, TX 77204 (e-mail cjuhn@uh.edu); Ujhelyi: Department of Economics, University of Houston, Houston, TX 77204 (e-mail: gujhelyi@uh.edu); Villegas-Sanchez: Department to Economics, ESADE-Universitat Ramon Llul, Barcelona, E-08034 Spain (e-mail: carolina.villegas@esade.edu). We would like to thank Yona Rubinstein, Nathan Nunn, and Peter Morrow for their thoughtful discussions of an earlier version of the paper. We also want to thank Eric Verhoogen and seminar participants at LSE, Dalhousie, and the LACEA–Conference of the Trade and Integration Growth Network, 18th Annual Empirical Investigations in International Trade. We would like to thank INEGI officials for granting on-site access to the firm-level data used in this study under the commitment of complying with the confidentiality requirements set by the Mexican laws and, in particular, to Gerardo Leyva, Adriana Ramirez Nava, and Gabriel Romero Velasco. Villegas-Sanchez acknowledges financial support from Banco Sabadell.

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[1] See Goldberg and Pavcnik (2007) for a review.

[2] Weinberg (2000); Galor and Weil (1996); and Rendall (2010) make a similar argument that technology raised the relative productivity of female labor by reducing the need for physical versus cognitive skills.

Table 1—Tariffs

	Average	SD	Min.	Max.	N
Export tariff					
1991	6.1	3.6	0.1	17.0	206
2000	0.7	1.4	0.0	6.1	201
Change (2000–1991)	−5.2	2.9	−14.4	−0.1	201
Import tariff					
1991	16.1	7.7	0.0	70.5	168
2000	2.6	4.7	0.0	37.5	166
Change (2000–1991)	−13.2	4.3	−35.0	0.0	157

Notes: Export tariff refers to the NAFTA tariffs applied by United States. Tariff data were available originally at the eight-digit Harmonized System (HS) classification and were matched with the Mexican CMAP classification. Note that the US tariff data include information on both ad valorem and specific tariffs. Specific tariffs were converted into ad valorem equivalents by John Romalis and were added to the ad valorem rates. We use as export tariff for 1991 the initial export tariff data available corresponding to 1992. *Import tariff* refers to NAFTA tariffs applied by Mexico. We use as import tariff data for 1991 the initial import tariff data available which is from 1993. "N": Number of industries according to the CMAP classification.

size of the declines across industries. Meanwhile, Mexican tariffs imposed on imports from NAFTA countries decreased on average by 13 percentage points. Since more than 80 percent of the trade occurs with the United States, these tariff changes led to large increases in both exports and imports over the 1990s.

There is evidence that these changes in tariffs led to increases in female wage bill share *within* industries. We explore alternative channels through which trade liberalization can impact women's relative outcomes within industries and firms. One possible channel is through the reduction of discrimination brought about by foreign competition. In his seminal work, Becker (1957) hypothesized that employers who are prejudiced against a particular group will be disadvantaged and driven out of business in the long run by forces of competition. Testing this theory, Black and Brainerd (2004) finds that in the United States, industries which were subject to more competition through trade liberalization experienced greater reductions in the gender wage gap.[3]

[3] See also Ederington, Minier, and Troske (2009) on trade liberalization in Colombia.

The discrimination story begins with the assumption that men and women are equally productive in the production process. To explore the validity of this assumption in our context, we examined questions on hiring preferences which were asked to employers in our balanced panel of firms. In the survey, employers were asked whether they had a preference for hiring males or females or whether they were indifferent between the two. Panel A of Table 2 shows that there are large differences for male preference across occupation categories, with the most pronounced male preference being in blue-collar occupations such as "specialized workers" and "general workers." For white-collar workers such as "managers" employers exhibit no particular preference for hiring male workers. While it is possible that employers discriminate differentially across occupation categories, we find the substantial variation in male preference across occupational categories as evidence that taste discrimination is not the major driving force. In a follow-up question employers are asked the reasons for their preferences, and these answers are reported in panel B of Table 2. For blue-collar occupations, "heavy work" is overwhelmingly the most common reason given for male preference. Table 2 gives credence to the notion that employers view men and women as distinct inputs with different amounts of skills, particularly when it comes to physical skills in blue-collar occupations.

II. Data and Results

The data used in this study come from the Encuesta Nacional de Empleo, Salarios, Tecnologia y Capacitacion (ENESTyC) [National Survey of Employment, Wages, Technology and Training], which is a survey carried out by the Mexican National Statistical Office (INEGI). The analysis focuses on two waves of the survey, implemented in 1992 and 2001. The questions in the survey refer mainly to the year prior to the implementation of the survey, 1991 and 2000. Although the surveys were designed as independent cross-sections it is possible to link a subsample of firms over time. In order to study the within-firm effects of trade liberalization, we create a balanced panel of 938 firms which appear in both 1991

TABLE 2—EMPLOYER PREFERENCES IN HIRING BY OCCUPATIONAL CATEGORY

	Directors		Managers		Specialized workers		General workers	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Panel A. Female-male preference (percentage of observations)								
Male preferred	211	25.79	37	4.01	481	54.85	417	45.77
Female preferred	5	0.61	39	4.23	28	3.19	45	4.94
Indifferent	602	73.59	846	91.76	368	41.96	449	49.29
Total	818	100	922	100	877	100	911	100
	Directors		Managers		Specialized workers		General workers	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Panel B. Reasons for male preference								
Heavy work	10	4.63	8	10.53	336	66.01	376	81.39
Lower absenteeism	18	8.33	13	17.11	10	1.96	8	1.73
Special abilities	88	40.74	20	26.32	114	22.4	40	8.66
Higher productivity	14	6.48	13	17.11	15	2.95	17	3.68
Higher adaptability	35	16.2	13	17.11	18	3.54	10	2.16
Higher control	30	13.89	4	5.26	7	1.38	3	0.65
Lower external turnover	11	5.09	3	3.95	3	0.59	2	0.43
Other	10	4.63	2	2.63	6	1.18	6	1.3
Total	216	100	76	100	509	100	462	100

Notes: Panel A reports the percentage of firms that expressed a gender preference when hiring according to occupational category in 2000. Total Freq. refers to the total number of firms, and it varies across occupational categories because it is based on those firms that hired in that year and occupational category (only firms that hired were asked about their gender preferences). Panel B reports the distribution of firms according to the main reasons expressed in 2000 for preferring men over women according to occupational category.

and 2000.[4] A clear advantage of the ENESTyC survey for our purposes is that it was designed to be representative at the detailed sectoral level and therefore can be linked to our tariff data.[5] The data also contain firm-level information on sales, export revenue, technology upgrading, female and male workers in blue- and white-collar occupations—variables which are all critical for our analysis.

We estimate the following equation:

$$\Delta FemaleRatio_{i,s} = \beta_\tau \Delta ExportTariff_s + \beta_x X_{i,s1991} + \delta_{s'} + \Delta\varepsilon_{i,s},$$

where i denotes firm, and s refers to sector. $\Delta FemaleRatio_{i,s}$ refers to log change in the ratio of female to male outcomes for employment and wage bill for the firm, $\Delta ExportTariff_s$ is the sectoral change in US tariffs from 1991 to 2000, and $X_{i,s,1991}$ includes a set of initial firm characteristics such as firm size, capital intensity, R&D intensity, and foreign ownership. $\delta_{s'}$ are two-digit sector fixed effects.

Columns 1 and 2 of Table 3 refer to white-collar occupations, while columns 3 and 4 refer to blue-collar occupations. As shown in the first two columns, we find no evidence that tariff reductions improved relative outcomes of women in white-collar occupations. By contrast, we find that reductions in tariffs are associated with larger increases in the growth of female employment and wage bill shares for blue-collar workers. These results strongly support our model: we find improving female outcomes exactly in the employment category where we expect the relative importance of "brawn" to decline as a result of improved technology. While we do not report the results here, we have also investigated the

[4] Detailed description of the data cleaning procedure and summary statistics of the variables are available in Juhn, Ujhelyi, and Villegas-Sanchez (2012).

[5] The industrial classification is based on the Clasificacion Mexicana de Actividades y Productos (CMAP) [Mexican Classification of Activities and Products]. Industries are grouped in six-digit industries called clases (classes), four-digit industries called ramas (branches), and two-digit industries called divisiones (divisions).

Table 3—Tariff Changes and Female-Male Labor Outcomes

Dependent variable: growth in female-male labor ratios	White collar		Blue collar		White collar		Blue collar	
	Employment (1)	Wage bill (2)	Employment (3)	Wage bill (4)	Employment (5)	Wage bill (6)	Employment (7)	Wage bill (8)
Δ*Export tariff*	0.020	0.012	−0.040*	−0.046**	0.023	0.017	−0.044*	−0.050**
	(0.020)	(0.024)	(0.022)	(0.021)	(0.024)	(0.023)	(0.026)	(0.025)
Δ*Import tariff*					−0.002	0.001	0.016	0.015
					(0.012)	(0.011)	(0.019)	(0.020)
Observations	899	898	895	895	820	819	816	816
R^2	0.026	0.02	0.0095	0.012	0.033	0.027	0.012	0.014
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at CMAP level in parentheses. Δ*Export tariff* indicates the change in sectoral tariffs (six-digit sector classification) applied by the United States between 2000 and 1991. Δ*Import tariff* indicates the change in sectoral tariffs (six-digit sector classification) applied by Mexico between 2000 and 1991. *Female-male employment growth* refers to the growth in female-to-male employment ratios between 1991 and 2000. *Female-male wage bill growth* is the growth in female-to-male wage bill ratios between 1991 and 2000. The growth rate is computed as $\ln((\text{female-maleratio}) + 0.001)_t - \ln((\text{female-maleratio}) + 0.001)_{t-1}$. All columns include the following firm-level controls: the log of total assets to value added in 1991, the log value added in 1991, the share of R&D spending in total income in 1991, and a dummy that takes the value of one if the firm was more than 10 percent owned by foreign-owned investors in 1991 and zero otherwise. Sector fixed effects are at the two digit level.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

channel that generates this relationship between tariff changes and female outcomes. Consistent with our model we find that export tariff reductions lead to entry of newly exporting firms, and these firms upgrade their technology toward new computerized production machinery.[6]

One possible alternative channel is import tariffs. Reductions in import tariffs may subject domestic firms to competition and reduce discriminatory hiring practices. To the extent that the reductions in import and export tariffs are positively correlated across industries, we may be capturing the impact of import tariffs. We examine this possibility by including $\Delta\, ImportTariff_s$ in the regression in addition to export tariffs and report the results in columns 5–8 in Table 3. The results show that the effect is driven exclusively by export tariffs, with the coefficient estimates changing very little when import tariffs are added in the regression.

[6] We note that any alternative story would have to explain both the differential change in female outcomes by export status and by occupation category (blue versus white collar). For example, a supply-side model based on the increase in women's education level over this period could explain an overall increase in relative wages but would have a hard time explaining the differential changes we find.

III. Conclusion

This paper studies the effect of trade liberalization on an underexplored aspect of wage inequality in the trade literature—gender inequality. We consider a model where firms differ in their productivity and workers are differentiated by skill as well as gender. A reduction in tariffs induces more productive firms to modernize their technology and enter the export market. New technologies involve computerized production processes and lower the need for physically demanding skills. As a result, the relative wage and employment of women improves in blue-collar tasks, but not in white-collar tasks. We test our model using a panel of establishment-level data from Mexico exploiting tariff reductions associated with the North American Free Trade Agreement (NAFTA). Consistent with our theory we find that tariff reductions increased employment and wage bill shares of female workers.

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