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Effects of Trade Liberalization on the Gender Wage Gap: Evidences from Panel Data of the Indian Manufacturing Sector[*]

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Abstract

This paper examines the effects of trade liberalization on the gender wage gap in the Indian manufacturing sector during the period 2000 to 2007. We find that trade liberalization has had the effect of widening the gender wage gap in the labour-intensive, but not in the capital-intensive, industries. The explanations offered for the widening gender wage gap are in terms of the Stolper-Samuelson effect and trade-induced skill biased technical change. Policy implications of the findings are noted.

Key words: gender wage gap, trade liberalization, manufacturing sector, India

JEL Classification Code: F16, J16, J31

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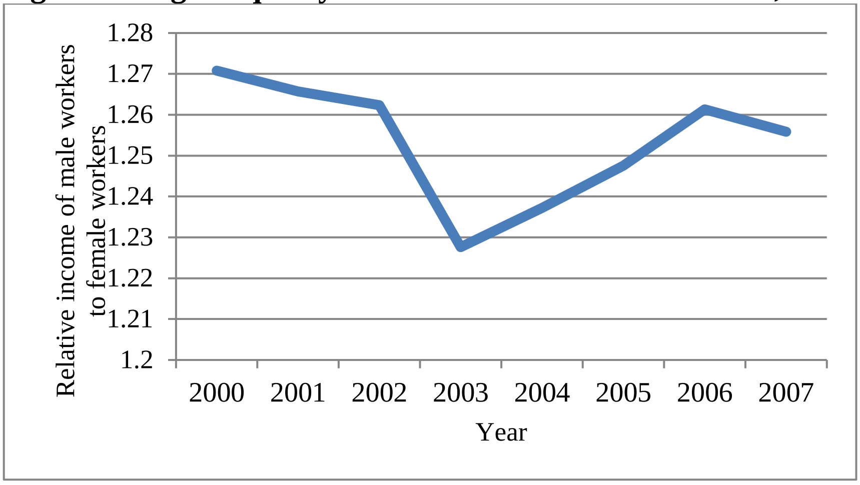
INTRODUCTION

The purpose of the present paper is to examine the effects of trade liberalization on the gender wage gap in the Indian manufacturing sector during the period 2000 to 2007. The gender wage gap in India has been estimated to be at 24.8% in 2013.[1] In our sample of Indian manufacturing, the gender wage gap ranges from 23 to 27% (Figure 1).

There is a strong strand in the literature which sees trade liberalization (and, by extension, globalization) as leading to a narrowing of the gender wage gap and an improvement in gender equality.[2] However, a few studies have found to the contrary. In these studies, increased trade openness is seen to be associated with a higher gender wage gap and this has generally been interpreted as reflecting increased wage discrimination following trade liberalization.[3]

In this paper we use plant level rather than industry level data to address these questions. Most of the existing studies on the topic have used the industry level tariff reduction as the proxy for trade liberalization. A plant or a factory within an industry, however, generally produces many different items, and tariffs on each of these items differ not only from those on the other items that the factory produces, but more importantly also from that on the main product that specifies the industry to which the particular plant belongs. We construct a plant level dataset – the construction of this dataset is discussed in due course – and consider the effects of tariff reductions on the within-plant gender wage gap. This we believe to be an important feature of the present paper.

Figure 1: Wage inequality between male and female workers, 2000 - 2007.



Note: Based on the authors' calculations using the ASI data. Relative income of male workers to female workers within a plant is calculated by taking the average of the ratio of the average annual salary of male workers to that of female workers in a plant in each year.

Plant level data are particularly suitable for analyzing the differential impact of globalization on the wages of male and female workers and of workers of different skill levels within a plant.[4] Spatially segmented labour markets such as India's[5] leave ample room for setting the wages of male and female workers as well as those of skilled and unskilled workers by region and plant. A plant level dataset allows one to control not only for the time variant, but also for the time invariant and unobservable plant characteristics which may affect the estimation results.

The results of our analysis show that the reductions in output tariffs (tariffs on final goods) and input tariffs (tariffs on imported intermediate goods) both widened the gender wage gap in the labour-intensive industries in our sample, but had no statistically significant effects on the gender wage gap in the capital-intensive industries. We provide some explanations for these results. While we cannot definitely rule out the possibility of gender based wage discrimination being behind the widening gender wage gap, it appears that more obviously economic mechanisms (though operating in a gender unequal society) are able to explain our results. We emphasize the role of the Stolper-Samuelson (1948) effect and trade induced skill-biased technological change in the explanation of our results.

The plan of the rest of the paper is as follows. To put our analysis in its institutional context, Section I briefly notes the relevant features of India's foreign trade policy. Section II provides a discussion of the dataset and the variables used. Section III presents the estimating equation, while Section IV presents the results. Section V concludes.

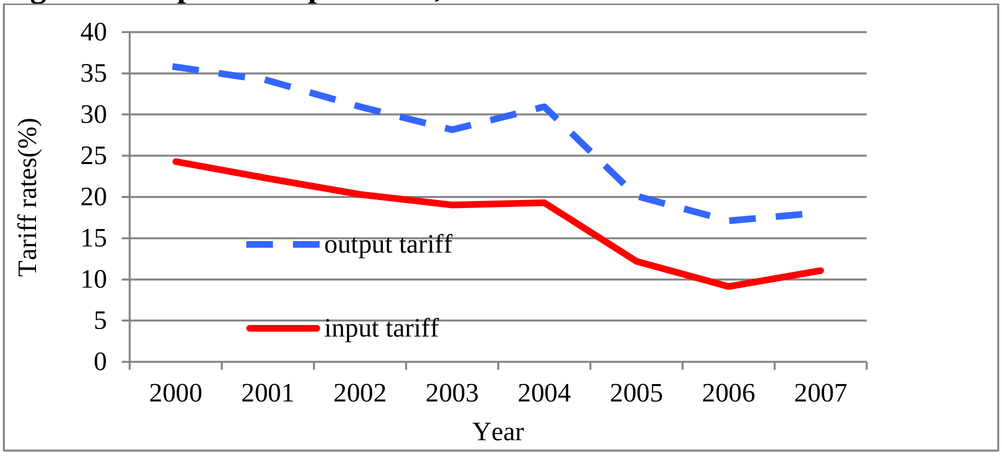
I. A SYNOPTIC BACKGROUND OF TRADE LIBERALIZATION IN INDIA

Following independence in 1947, India adopted import-substituting industrialization policy. Initially, the government strictly regulated imports through quotas rather than tariffs. The regulations were imposed mostly on the import of consumer goods (goods which generally used unskilled labour and were female labour intensive when domestically produced) and not on capital and intermediate goods (which, by contrast, used more skilled labour and generally were more male labour intensive when domestically produced).

From the late 1970s, the government began a slow but steady relaxation of import regulations on capital and intermediate goods. In the mid-1980s, the country shifted from quantitative import controls to a protective system based on tariffs. The government also took some cautious steps towards encouraging the import of capital goods. Consumer goods, however, continued to be heavily protected, now by high tariffs in place of rigid quotas.

Trade policy reform was an important component of the economic reforms of 1991. The average tariffs fell from more than 87% in 1990 to 39% by 1996.[6] The 1991 reforms removed most of the quantitative restrictions on the import of capital goods and intermediate inputs. The dramatic reductions in tariffs primarily affected the unskilled and female labour intensive sectors.[7] For example, in textiles and clothing – the largest manufacturing industry in India in terms of employment – the average output tariffs (i.e., tariffs on final goods) fell from 100% in 1990 to 12.5% in 2007. During the period of our study, 2000 to 2007, the average output tariffs in the Indian manufacturing sector taken as a whole fell from 31% in 2000 to 19% in 2007, while the average input tariffs (tariffs on intermediate goods) fell from 5% to 3% during the same period (Figure 2).

Figure 2: Output and input tariffs, 2000 - 2007



Note: Based on the authors' calculations using the ASI and WITS data. Output tariff is a weighted average of tariffs using the share of the 10 main products produced in a plant as a weight. Input tariff is a weighted average of tariffs using the share of the 5 main imported intermediate goods used as inputs in a plant as a weight. The figure show the average of those tariffs in each year. See the discussion in the text.

II. DATA AND VARIABLES

We use plant or 'factory' level data for the period 2000 to 2007 from the Annual Survey of Industries (ASI) conducted by India's Central Statistical Office (CSO). The ASI provides a fairly comprehensive picture of manufacturing activities in India. The ASI factory frame is classified into two sectors: the census sector and the sample sector. The sample sector consists of small plants employing 20 to 99 workers if not using electricity and 10 to 99 workers if using electricity. The census sector consists of relatively large plants. It covers all units employing 100 or more workers and also some 'significant' units which, though employing fewer than 100 workers, contribute significantly to the value of output. We focus only on the census sector in this study because the data on the census sector are more detailed and free from the sampling error. Table 1 presents data on the number of plants and the percentage of these hiring women in our dataset. As can be seen, on average only 35% of plants hired women during the period of our study. The sample selection bias that this poses we shall address in due course.

Table 1: ASI Census Sector manufacturing factories, 2000 - 2007

Year	Total no. of plants	No. of plants not hiring women	No. of plants hiring women	% of plants hiring women
2000	10877	6572	4305	40%
2001	11454	7282	4172	36%
2002	9551	5690	3861	40%
2003	8865	5498	3367	38%
2004	9760	5968	3792	39%
2005	13606	9139	4467	33%
2006	16447	11085	5362	33%
2007	19024	13124	5900	31%
Total	99584	64358	35226	35%

Note: Based on the authors' calculations using the ASI data.

Our dependent variable, the gender wage gap, is measured as the log of the ratio of the average annual salary of male workers to that of female workers in a plant.

For our explanatory variables, we construct a database of annual output tariff data from 2000 to 2007 based on the World Bank's World Integrated Trade Solution (WITS) data. Tariff data for India are drawn at the four-digit of the Harmonized System (HS) classification, which are converted to the International Standard Industrial Classification of All Economic Activities, Revision 3 (ISIC Rev.3) by using the appropriate concordance table available from the WITS. [Four-digit level National Industrial Classification (NIC) 98 set by the Indian government in 1998 has a one to one correspondence with the ISIC Rev.3. The product codes are also convertible to the four-digit level NIC code]. We construct the output tariff (tariff on final goods) for plant f as follows:

$$output\ tariff_{f,t} = \sum_{p} \gamma_{f,p,t} \cdot output\ tariff_{pt}$$

$$where\ \gamma_{f,p,t} = \frac{product_{f,p,t}}{\sum_p product_{f,p,t}}. \qquad (1)$$

$\gamma_{f,p,t}$ is the share of product p in the value of total output in plant f. $output\ tariff_{pt}$ is the output tariff for product p. Output data includes the value of the 10 main products in each year (i.e., the output tariff is a weighted average of tariffs using the share of the 10 main products produced in a plant as a weight).

The input tariff (tariff on intermediate goods) for plant f is constructed as:

$$input\ tariff_{f,t} = \sum_{p} \delta_{f,i,t} \cdot output\ tariff_{i,t}$$

$$where\ \delta_{f,i,t} = \frac{input_{f,i,t}}{\sum_i input_{f,i,t}}. \qquad (2)$$

$\delta_{f,i,t}$ is the share of input i in the value of total input in plant f. $output\ tariff_{i,t}$ is the output tariff for intermediate good i. Input data includes the value of 5 main imported inputs in each year (i.e., the input tariff is a weighted average of tariffs using the share of the 5 main imported inputs used in a plant as a weight).

The relationship between wage inequality and tariffs would, of course, be affected by the time varying plant-level characteristics. In order to control for these effects, we include the following control variables: **the ratio of women** (measured as the ratio of the number of female workers to the number of male workers), **the plant size** (measured by the log of the plant's total labor force counted as man days and referred to as **labor** in the regression tables below), **the import ratio** (the ratio of the value of imported inputs to the value of all inputs), and **the ratio of contract** (the ratio of contract labor to the total number of production workers). These variables are mostly self-explanatory. The last variable, the ratio of contract labor, has particular relevance in the context of the minimum wage legislations in various Indian states, all of which set their minimum wage rates independently, but invariably exclude the contract labor from their ambit.[8]

All our specifications below will include plant fixed effect, α_f, and state-year fixed effect, $\alpha_{l,t}$, to control for the time-invariant characteristics of the plant and the time-variant shocks affecting different Indian states differently, respectively.[9]

Finally, we shall employ the SDP share of modern services as one of the two exclusion restrictions for the Heckman-Selection approach that we shall employ below to deal with the sample selection bias mentioned earlier. The modern service sector has been expanding rapidly in India and the demand for skilled labour, especially for female skilled labour, has been growing in this sector.[10] The modern service sector includes communication, banking and insurance, real estate, ownership of dwellings and business services.

We shall also, however, need to employ an additional exclusion restriction since the variable **the ratio of women** is unsuitable for inclusion in the 1st stage of Heckman estimation, as it is the same as the dependent variable in this case (which is the probability of being a firm that hires women). The additional exclusion restriction we employ is the share of working days spent in manufacturing activities in total working days of male workers employed directly by a firm. We call this variable **the share of production days.** When this share is low, male workers mainly engage in tasks such as the maintenance and repairs of machines, etc. These tasks generally require higher levels of skills than 'production' activities. The skill/educational levels of female workers in our sample are lower than those of male workers and firms which have a greater requirement for these skilled tasks to be performed, therefore, do not in general employ female workers. Indeed, in our sample, such firms rarely hire female workers.

Definitions, means and standard deviations of all the variables used, and all the data sources are detailed in Table 2.

Table 2: ASI manufacturing factories employing both male and female workers: Descriptive statistics

Variable	Obs	Mean	SD	Min	Max
male salary	35226	55888	55362	240	1717390
female salary	35226	47950	52617	92	1837001
gender wage gap	35226	1.25	0.38	0.58	3.51
ratio of women	35226	4.05	21.50	0.00022	3185.23
output tariff	35226	0.24	0.22	0	2.10
input tariff	35226	0.07	0.13	0	2.10
import ratio	35226	0.11	0.23	0	1.00
labor	35226	10.99	1.28	5.10	16.54
ratio of contract	35226	0.09	0.21	0	0.98
sdp share of service	34787	0.19	0.06	0.05	0.47
share of production days	35226	0.99	0.07	0	1

SOURCES: CSO, Annual Survey of Industries (2000 to 2007) for male and female average annual salary, share of female workers, firm size, import share, the share of contract labour in production, and the share of production days. Economic and Political Weekly (EPW) Research Foundation for SDP share of modern services. Input and output tariffs are calculated by the authors based on the World Bank's World Integrated Trade Solution data.

III. ESTIMATION

The gender wage gap regression that we estimate is the following:

$$\ln\left(\frac{w_m}{w_f}\right)_{f,t} = \alpha + \alpha_f + \alpha_{s,t} + \beta_1 * output\ tariff_{f,t} + \beta_2 * input\ tariff_{f,t}$$
$$+ Z_{f,t}\Gamma + \varepsilon_{f,t}\ , \qquad (3)$$

where $\ln\left(w_m/w_f\right)_{f,t}$ is the gender wage gap within plant f in year *t*, with w_m being the average annual salary of male workers and w_f that of female workers. $output\ tariff_{f,t}$ and $input\ tariff_{f,t}$ are the tariffs for final goods and the tariffs for imported intermediate goods (inputs) that plant *f* pays in year *t*, respectively. As already mentioned, $output\ tariff_{f,t}$ is the weighted average of tariffs using the share of the output of plant *f* as the weight. Similarly, $input\ tariff_{f,t}$ is the weighted average of tariffs using the share of the imported inputs of plant f as the weight. $Z_{f,t}$ are the other control variables that we have discussed in the preceding section.

We shall present the results of both the OLS fixed-effect estimation and the Heckman-Selection (1976) model. The OLS fixed-effect estimations are likely to be biased in our case as only 35% of the firms in the sample hire female workers. Since the plant hiring women are selected non-randomly from the population, estimating the determinants of gender wage gap from the subpopulation who hire women is likely to induce bias. To deal with the sample selection bias problem, we apply the Heckman correction approach (Heckman, 1976), and, as indicated in the preceding section, we use the SDP share of the modern service sector for exclusion restrictions.

IV. RESULTS

Before we present our results, it is worth considering in the Indian context that we have outlined, what should our expectations be about the likely effects of tariff reductions on the gender wage gap? Consider first the effects of a reduction in output tariffs. In general, any reduction in output tariffs will generate competitive pressures from abroad for the domestic producers of final goods as imported final goods become cheaper than before. India, as we have noted earlier, particularly protected the female labour intensive sectors, such as textiles and clothing, through high tariffs prior to trade liberalization. Trade liberalization, in these circumstances, would reduce the output price of female labour intensive goods more than that of male labour intensive goods, resulting in a reduced female wage vis-à-vis the male wage via the Stolper-Samuelson effect (Stolper and Samuelson, 1941).

Consider next the effects of a reduction in input tariffs (i.e., tariffs on intermediate goods). A reduction of these tariffs makes the relatively high quality imported inputs cheaper. Trade liberalization may in these circumstances well be a driving force for changes in technology. If these imported intermediate inputs embody skill-biased technology, then their increased use would raise the demand for skilled labour and lead to an increase in wage inequality via skill premium. On average, the education levels of females in India are lower than those of males and (to the extent that education levels reflect skills) the gender wage gap would consequently increase as a result of the trade induced skill-biased technical change.[11]

Against the background of the above discussion, we can now consider the results of our analysis. Table 3 presents the results of the OLS fixed-effect estimation. In this estimation, we do not find any statistically significant effect of tariff reductions on the gender wage gap. However, as already noted, these results are likely to be marred by the sample selection bias. The results of the more appropriate Heckman-Selection model are presented in Table 4 , and these show the coefficients of both the input and output tariffs to be negative and statistically significant, suggesting that a decrease in both the input tariffs and output tariffs leads to a widening of the gender wage gap.

Table 3: Effect of tariffs on the gender wage gap, fixed effect model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
output tariff	0.00927			0.0116	0.0113	0.0113	0.0114
	-0.0121			-0.0123	-0.0124	-0.0124	-0.0123
input tariff		-0.0146	-0.0178	-0.02	-0.0197	-0.0197	-0.0194
		-0.0147	-0.0167	-0.0173	-0.0173	-0.0173	-0.0175
import ratio			0.00881	0.00862	0.00807	0.00804	0.00812
			-0.0172	-0.0171	-0.017	-0.0169	-0.0169
ratio of women					0.000188*	0.000188*	0.000190*
					-0.000105	-0.000104	-0.000104
labor						0.000185	-0.000746
						-0.00441	-0.00461
ratio of contract							0.0148
							-0.0174
State*Year	YES	YES	YES	YES	YES	YES	YES
Constant	0.200***	0.202***	0.203***	0.199***	0.198***	0.198***	0.205***
	-0.00507	-0.00413	-0.00374	-0.00484	-0.00493	-0.048	-0.0499
Observations	35226	35226	35226	35226	35226	35226	35226
R-squared	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Number of panelid	14849	14849	14849	14849	14849	14849	14849

Note: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable is the gender wage gap, measured as the log of the ratio of the average annual salary of male workers to that of female workers in a plant. The explanatory variables are output or input tariff which is a weighted average of tariffs using the share of main products produced or intermediate goods inputted in a plant as a weight. The control variables are import ratio, ratio of women to men workers, the plant size and the share of contract labor.

Table 4: Effect of tariffs on the gender wage gap, Heckman selection model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Without an exclusion restriction				With an exclusion restriction			
	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage
output tariff	-0.00709	-0.362***	-0.00995	-0.378***	-0.0201***	-0.112***	-0.0213***	-0.104***
	(0.00640)	(0.0584)	(0.00642)	(0.0620)	(0.00704)	(0.0184)	(0.00689)	(0.0193)
input tariff	-0.0727***	0.818***	-0.0263**	0.102	-0.0440***	0.515***	-0.0228*	0.0486
	(0.0109)	(0.0789)	(0.0127)	(0.107)	(0.0133)	(0.0339)	(0.0129)	(0.0403)
import ratio			-0.0157**	-0.0246			-0.0144**	0.0126
			(0.00695)	(0.0651)			(0.00707)	(0.0232)
ratio of women	0.000785***	176.4***	0.000854***	158.3***	0.000787***		0.000837***	
	(6.25e-05)	(0.903)	(6.26e-05)	(0.900)	(6.25e-05)		(6.31e-05)	
labor			-0.0155***	0.502***			-0.00599***	0.188***
			(0.00116)	(0.0132)			(0.00222)	(0.00336)
ratio of contract			0.00661	-0.906***			-0.0584***	-1.309***
			(0.00669)	(0.0595)			(0.0159)	(0.0176)
spd share of service						2.258***		2.085***
						(0.0618)		(0.0635)
share of production days						1.448***		1.797***
						(0.0539)		(0.0561)
Mills	0.00392		0.0317***		0.0782***		0.0687***	
	(0.00444)		(0.00532)		(0.0192)		(0.0155)	
State*Year	YES	YES	YES	YES	YES		YES	
Constant	0.0656	-2.079***	0.233***	-7.513***	0.0665	0.511***	0.0671	-4.264***
	(0.0640)	(0.549)	(0.0651)	(0.617)	(0.0640)	(0.163)	(0.0740)	(0.0700)
Observations	94,534	94,534	94,534	94,534	92,479	92,479	92,479	92,479

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. In the Heckman selection model, the first stage is a choice model – does the plant hire women or not? We use predictors to determine this. The second stage then examines the effects of tariffs on the gender wage gap. In columns (1) to (4), we do not include the exclusion restriction, while we include those in column (5) to (8). We employ the SDP share of modern services and the share of production days as the exclusion restrictions. We also control for the plant time-varying characteristics in columns (3), (4), (7) and (8).

As a robustness check, we next estimate the effects of tariff reductions on the gender wage gap in the labour-intensive and capital-intensive industries separately. A labour-intensive industry is defined as one where capital-labour ratio is below the average of that in the sample at 3-digit industry level. The results of the OLS fixed-effect estimation are presented in Table 5. We note that in the case of labour-intensive industries, the coefficient of the input tariffs is negative and statistically significant, suggesting the presence of skill-biased technical change following tariff reductions. The results of the more relevant Heckman-Selection model are presented in Table 6. The coefficients of both the output tariffs and import tariffs are negative and statistically significant in the case of labour-intensive industries (suggesting that a reduction in output and input tariffs both leads to a widening of the gender wage gap in the labour-intensive industries), but changes in the output and input tariffs have no statistically significant effect on the gender wage gap in the capital-intensive industries. These results would seem to support our reasoning via the Stolper-Samuelson effect.

Table 5: Effect of tariffs on the gender wage gap in labor-intensive and capital-intensive industries, fixed effect model

	(1) Labor Intensive Industries	(2) Captial Intensive Industries
output tariff	0.0153	-0.00499
	(0.0161)	(0.0200)
input tariff	-0.0497**	0.0138
	(0.0216)	(0.0214)
import ratio	0.0315**	-0.0196
	(0.0152)	(0.0317)
ratio of women	0.000194*	4.69e-05
	(0.000112)	(0.000238)
labor	-0.00130	-0.00224
	(0.00530)	(0.00937)
ratio of contract	-0.000619	0.0354
	(0.0234)	(0.0243)
State*Year	YES	YES
Constant	0.217***	0.202*
	(0.0555)	(0.104)
Observations	21,735	13,491
R-squared	0.023	0.023
Number of panelid	9,406	5,638

Note: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%. A labour-intensive industry is defined as one where capital-labour ratio is below the average of that in the sample at 3-digit industry level.

Table 6: Effect of Tariffs on the gender wage gap in labor-intensive and capital-intensive industries, Heckman selection model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor Intensive Industries				Capital Intensive Industries			
	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage
output tariff	-0.0732***	-0.519***	-0.0650***	-0.574***	0.0339*	0.132***	0.0306	0.198***
	(0.0136)	(0.0306)	(0.0128)	(0.0322)	(0.0189)	(0.0237)	(0.0225)	(0.0247)
input tariff	-0.0412**	0.766***	-0.0607***	0.401***	0.0714	0.589***	-0.000713	-0.0740
	(0.0178)	(0.0518)	(0.0185)	(0.0640)	(0.0730)	(0.0457)	(0.0227)	(0.0534)
import ratio			0.0246**	-0.100***			-0.0220	0.197***
			(0.00992)	(0.0369)			(0.0230)	(0.0307)
ratio of women	0.000738***	176.1***	0.000769***		0.000507*		0.000545**	
	(6.33e-05)	(1.202)	(6.40e-05)		(0.000274)		(0.000277)	
labor			-0.00541**	0.207***			0.0251	0.211***
			(0.00229)	(0.00496)			(0.0211)	(0.00477)
ratio of contract			-0.0775***	-1.493***			-0.164	-1.073***
			(0.0169)	(0.0248)			(0.111)	(0.0256)
spd share of service		3.169***		2.355***		1.166***		1.233***
		(0.0857)		(0.0735)		(0.0934)		(0.0967)
share of production days		1.850***		2.705***		0.329***		0.245**
		(0.0698)		(0.0881)		(0.0972)		(0.101)
State*Year	YES		YES		YES		YES	
Mills	0.0679***		0.0536***		0.301*		0.256*	
	(0.0183)		(0.0146)		(0.167)		(0.139)	
State*Year	YES		YES		YES		YES	
Constant	0.00602	-2.377***	0.0893	-4.742***	-0.319	-1.147***	-0.493	-3.190***
	(0.0817)	(0.0733)	(0.0864)	(0.0966)	(0.238)	(0.0978)	(0.404)	(0.114)
Observations	47,806	47,806	47,806	47,806	44,673	44,673	44,673	44,673

Note: * significant at 10%; ** significant at 5%; *** significant at 1%.

Finally, while our explanations via the Stolper-Samuelson effect and trade-induced skill-biased technological change are economic in nature, these economic mechanisms in the Indian case clearly operate in a gender unequal society. Extent of gender based discrimination is thought to vary greatly by regions in India. The south of India, in particular, is generally considered to be more liberal than other regions in the country in such characteristics as marriage customs, kinship and inheritance patterns. Women in the southern states are believed to have enjoyed a greater degree of freedom since the pre-Christian era.[12] It may, therefore, be of some interest to see if the effects of tariff reductions on the gender wage gap also vary by the extent of gender inequality in different regions.

It is, of course, extremely difficult to measure with precision the extent of gender based discrimination in any particular state or region. We have, therefore, to resort to using proxies. The proxy we use is the Gender-related Development Index (GDI) for each of the main states in India in 1997 and this is based on Ram and Mohanty (2005).[13] GDI is designed to capture the inequalities in human development by sex and uses a number of variables such as female life expectancy, school attendance and literacy rates to compute the index. We use an interaction term between GDI and tariffs to capture the differential impacts, if any, of tariff reductions on the gender wage gap by states in terms of their GDI. While the results of the OLS fixed-effect estimation presented in Table 7 show that the interaction terms between GDI and output tariffs or input tariffs are not statistically significant, the results of the Heckman estimation in Table 8 show the interaction term between GDI and input tariff is positive and significant, suggesting that the impact of a reduction in input tariffs on the gender wage gap is larger in states with higher levels of gender inequality.

Table 7: Effect of tariffs on the gender wage gap with interaction terms, fixed effect model

	(1)	(2)	(3)
output tariff	-0.0257	0.0224*	-0.0830
	(0.173)	(0.0129)	(0.179)
input tariff	-0.0230	0.154	0.185
	(0.0190)	(0.155)	(0.170)
GDI*output tariff	0.0778		0.177
	(0.285)		(0.296)
GDI*input tariff		-0.293	-0.347
		(0.246)	(0.275)
import ratio	0.00205	0.00290	0.00265
	(0.0177)	(0.0178)	(0.0177)
ratio of women	0.000205*	0.000205*	0.000206*
	(0.000120)	(0.000120)	(0.000120)
labor	0.00213	0.00233	0.00227
	(0.00448)	(0.00451)	(0.00451)
ratio of contract	0.00867	0.00858	0.00854
	(0.0182)	(0.0182)	(0.0182)
State*Year			
Constant	0.177***	0.174***	0.175***
	(0.0492)	(0.0495)	(0.0496)
Observations	31,601	31,601	31,601
R-squared	0.008	0.008	0.008
Number of panelid	13,169	13,169	13,169

Note: Robust standard errors in parentheses are clustered at 5-digit industry-year level. * significant at 10%; ** significant at 5%; *** significant at 1%. Gender-related Development Index (GDI) is derived from Ram and Mohanty (2005).

Table 8: Effect of tariffs on the gender wage gap with interaction terms, Heckman selection model

	(1)	(2)
	2nd Stage	1st Stage
output tariff	-0.0990	-3.500***
	(0.0860)	(0.159)
input tariff	-0.319**	-3.366***
	(0.128)	(0.410)
GDI*output tariff	0.122	5.829***
	(0.144)	(0.272)
GDI*input tariff	0.487**	5.572***
	(0.212)	(0.687)
import ratio	-0.0115	-0.0570**
	(0.00741)	(0.0246)
ratio of women	0.000865***	
	(6.51e-05)	
labor	-0.00742***	0.171***
	(0.00211)	(0.00369)
ratio of contract	-0.0611***	-1.344***
	(0.0165)	(0.0188)
spd share of service		2.229***
		(0.0882)
share of production days		1.884***
		(0.0598)
State*Year		
Mills	0.0681***	
	(0.0157)	
State*Year	0.293***	-4.139***
Constant	(0.0337)	(0.0763)
Observations	81,199	81,199

Note: * significant at 10%; ** significant at 5%; *** significant at 1%.

V. CONCLUSION

In this paper we have found that trade liberalization has had the effect of widening the gender wage gap in the Indian manufacturing sector during the period of our study, 2000 to 2007. We have suggested two possible avenues through this has occurred: one via the Stolper-Samuelson effect and the other via trade-induced skill-biased technical change. These are economic mechanisms, but they clearly operated in a gender unequal society. The policy implications of our study would, therefore, still be to eliminate the existing gender based discrimination in the society and to further enhance women's education and (labour market) skills and bring these in line with those of males.

ENDNOTES

[1] See Varkkey and Korde, 2013.
[2] See, among others, Duflo, 2012; Munshi and Rosenzweig, 2006; Juhn et al., 2013; and Oostendorp, 2009.
[3] See Barik, Rodgers, and Zveglich, 2004; and Menon and Rodgers, 2009. See also, Dominguez-Villalobos and Brown-Grossman (2010), Wamboye and Seguino. (2015), and Siddiqui (2009) in this context.
[4] cf. Goldberg and Pavcinik, 2007.
[5] In a perfectly competitive labour market, the law of one price holds and the factor prices for skilled or unskilled workers would be the same across the country. India, however, is a very diverse country. It is home to several languages, with 23 declared as official. The country is divided into states by major languages. Therefore, it makes it difficult for workers to move between regions. There is also the problem of poor transport infrastructure and high transportation costs. It is the segmented local labour markets that decide the wages of workers and it would, therefore, appear reasonable to examine the effects of trade liberalization on the wage inequality within regions and plants. See also Munshi and Rosenzweig (2016) who report how caste-based networks are associated with low mobility and spatial wage inequality.
[6] See Topalova and Khandelwal, 2011.
[7] See Kumar and Mishra, 2005; and Sen, 2008. This phenomenon can also be observed in other developing countries, such as Mexico and Colombia, where the unskilled labour intensive industries experienced the largest tariff reductions. See Hanson and Harrison,1999: Attanasio et al.,2004.
[8] See also endnote 9.
[9] We have already refereed to the minimum wage rates. These are set differently by different states and changes over time. The number of contract labour in the Indian manufacturing sector has increased over time. Therefore, wage inequality very well might be affected by the level of minimum wages. Equally, other labour regulations in place in different states may affect wage inequality differently. Besley and Burgess (2004), for example, found that those states which introduced pro-worker amendments to the Industrial Dispute Act had lower investment, employment, productivity and output in registered manufacturing compared to other states.
[10] In response, many young women are obtaining more schooling or post-school training. See, among others, Jensen (2012) and Oster and Steinberg (2013).
[11] See Acemoglu, 2002; Violante 2008. See also Chamarbagwala, 2006.
[12] On these aspects, see, among others, Dyson and Moore (1983) and Bhattacharya (2006).
[13] The main states included are Andhra Pradesh, Assam, Bihar, Gujarat, Haryana Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

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