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Abstract

This study analyzes the effect of reduction in input and output tariffs on the intra-plant wage inequality in India, which is one of the most unskilled labor abundant countries, for the period 2000 to 2007. We find that a reduction in output tariff increases the wage inequality, whereas a reduction in input tariff does not have any statistically significant effect on wage inequality. These results suggest that the Stolper-Samuelson effect works in the Indian manufacturing sector where unskilled labor-intensive industries were protected the most prior to trade liberalization. We also examine the effect of the increased demand for skilled workers by the modern service sector, which has been the driving force of recent economic growth in India. The increased demand raises the wage inequality in manufacturing implying that skill-biased technological change in modern service sector has an indirect effect on wage inequality in this sector.

Keywords: trade liberalization, wage inequality, India, the Stolper- Samuelson effect, skill biased technical change, tariff

1. Introduction

How does trade liberalization affect wage inequality in developing countries? The existing literature on developing economies mainly focuses on middle-income countries such as Brazil, Columbia, and Mexico[1]. There is evidence that middle-income countries

[1] See Goldberg and Pavcinik (2007) and Anderson (2005).

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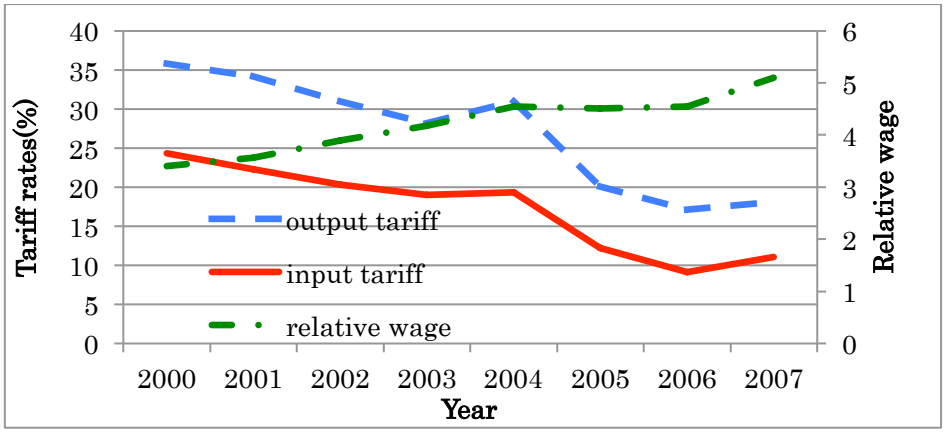
experience skill-biased technical change (hereafter SBTC) (Berman and Machin, 2000) and that trade induced technical change leads to a rise in wage inequality (Caselli, 2014; Gallego, 2012 and Berman, Bound and Machin, 1998). This study, by contrast, focuses on India, which is one of the most unskilled-labor abundant countries, and provides evidence that is consistent with a different mechanism that explains the increase in wage inequality in manufacturing after trade liberalization: the Stolper-Samuelson effect (hereafter S-S effect). As the Indian government protected unskilled labor-intensive industries prior to trade liberalization, the benefit to the unskilled labor force from the concentration of production in unskilled labor-intensive sectors after trade liberalization decreases and the wage inequality widens.

Until recently, India's trade regime was among the most restrictive in Asia in terms of nominal tariffs and nontariff barriers. India launched a radical economic reform in 1991 in the aftermath of a balance-of-payments crisis wherein tariffs were cut dramatically and most quantitative restrictions on import of capital goods and intermediate inputs were removed. In the 2000s, trade liberalization took rapid steps forward and the tariff fell steadily. In the early 2000s, the Indian government eased quantitative restrictions on the import of manufactured consumer goods and agricultural products. The trade liberalization period witnessed an increase in the wage inequality between nonproduction and production workers in the Indian manufacturing sector. Figure 1 illustrates this inverse relationship between tariffs and relative wage for the period between 2000 and 2007.

Figure 1. Average relative wage in plants, output tariffs, and input tariffs between 2000 and 2007.



Note: Based on author's calculation using ASI and WITS data.

Goldberg and Pavcinik (2007) compiled studies on the relationship between trade liberalization and wage inequality in developing countries, most of which suggest that trade liberalization increases wage inequality. Traditional trade theory, like the S-S effect predicts that trade liberalization decreases wage inequality in an unskilled labor abundant country in a Heckscher-Ohlin (hereafter H-O) world. Moreover, the model provides explanations for the increase in equality. The first explanation applies the S-S effect to an unskilled labor abundant country where the unskilled labor-intensive sectors are protected the most prior to a trade reform. The benefit to the unskilled labor force from the concentration of production in unskilled labor-intensive sectors decreases if these sectors are protected most prior to trade liberalization because these sectors are the worst affected by tariff cuts. Attanasio et al. (2004) indicates that the S-S effect worked in Colombia where unskilled labor-intensive industries were heavily protected prior to trade liberalization. The second explanation is skill-biased technical change (SBTC). SBTC arises from the incorporation of new technologies embodied in cheaper imported capital goods, such as machines and office equipment, or intermediate goods that are complementary to skilled workers in unskilled labor-intensive economies. It is relatively easy for firms to import or access imported capital goods after trade liberalization. Therefore, SBTC benefits skilled workers, thus increasing the wage inequality.

We analyze how reduction in output and input tariffs affect the intra-plant wage inequality between nonproduction and production workers using plant level data in the Indian manufacturing sector for the period 2000 to 2007. We also discuss if the effects of trade liberalization on wage inequality are consistent with the theoretical predictions of the S-S effect and SBTC.

Our estimation results indicate that tariff reduction in final goods increases wage inequality; whereas, tariff reduction in intermediate inputs has statistically insignificant effect on wage inequality even when the plant directly imports the intermediate inputs. These results are consistent with the explanation based on the S-S effect.

However, it is possible that SBTCs in other sectors affect increased inequality in manufacturing. In the 2000s, the Indian modern service sector including IT sector grew at a rapid pace. Due to the requirement of computer and English language skills, most workers in this sector are skilled. The increased demand for skilled worker in the modern service sector may put upward pressure on the wage of skilled labor in

manufacturing. We examine this hypothesis and find that this increased demand for skilled worker by the modern service sector does increase the wage inequality in manufacturing. This suggests that SBTC in the modern service sector has an indirect effect on inequality in manufacturing.

The existing studies on the relationship between trade policy and wage inequality in India yield mixed conclusions. Sen (2008) uses industry level data from Annual Survey of Industries (ASI) for the period 1973 to 1997 to find that trade liberalization triggers the increase in wage inequality. He suggests that the decline in protection mostly for the unskilled labor-intensive industries leads to a relative fall in the economy-wide return to unskilled labor as compared to skilled labor. Furthermore, he finds that a negative relationship between the degree of protection, which is measured as the effective rate of protection and import penetration ratio, and wage inequality at the industry level suggesting that trade-induced technological progress leads to an increase in wage inequality within industries. Moreover, Hashim and Banga (2009) use the dynamic industry panel data estimations (GMM) for 58 manufacturing industries for the period from 1998 to 2004 to find that trade liberalization leads to an increase in wage inequality between skilled and unskilled labor. In contrast to these studies, Kumar and Mishra (2005) use individual level data collected by the Indian National Sample Survey Organization (NSSO) to find that trade liberalization leads to a decrease in wage inequalities. They evaluate the impact of the 1991 trade liberalization on the industry wage structure and find that the reduction in trade protection widens differences in wages across industries for similar workers in terms of observable characteristics over time. As different industries employ different proportion of skilled workers, changes in wages across industries translate into changes in relative incomes of skilled and unskilled workers. According to them, tariff reductions are relatively large in sectors with higher proportion of unskilled workers and these sectors experience an increase in wages, which implies that the unskilled workers experience an increasing wage relative to skilled workers. The results of this study are consistent with former studies that use plant level data from ASI.

An important difference of this study from other existing studies is that we distinguish output tariffs from input tariffs. This approach allows us to identify how trade liberalization affects wage inequality through increased input or output competition. Sen (2008) suggests that SBTC works in manufacturing based on the

finding of a negative and significant relationship between the degree of protection, which is measured as the effective rate of protection and import penetration ratio, and the wage inequality at the sectoral level. However, he does not distinguish the effects of tariff reduction in imported output from imported input on wage inequality because the effective rate of protection, which is a measure of the total effect of output and input tariffs and import penetration ratio, is affected not only by input tariff reduction but also by other factors.

Another important difference from the existing works is the focus on the intra-plant wage inequality. An advantage of the plant level data is that it is possible to control the plant characteristics, such as plant size, skill share, and the proportion of contract labor, that can affect wages. Another benefit of conducting the analysis at the plant level is that we can allow for differential effects between domestically oriented firms and globalized firms. Bernard and Jensen (1997) and Verhoogen (2008) suggest that the wage inequality in globalized firms is much higher than that in domestic firms. However, we do not observe the differences in the intra-plant wage inequality between domestic and globalized plants in our estimation.

Few studies have examined the impact of tariff reduction on intra-plant (or firm) wage inequality using plant (or firm) level unit data in developing countries. Whether tariff reduction widens or shrinks the wage inequality depends on the characteristics of the target countries. Amiti and Cameron (2012) and Albada (2013) find that reducing tariffs decreases wage inequality within firms in Indonesia and the Philippines respectively. Amiti and Cameron (2012) find that reducing input tariffs decreases the wage inequality within firms importing intermediate goods. Albada (2013) suggests that a firm responds to import competition by shifting to manufacturing of products with lower value, which requires unskilled workers, and substituting self-produced intermediate goods with imported intermediate goods. By contrast, Cacelli (2014) finds that wage inequality increases along with tariff reduction in Mexico, and tariff reduction in machinery and equipment that embody skilled-worker favoring technology increases the wage inequality within plant. The present study is the first to investigate and analyze the channels through which trade liberalization could affect intra-plant wage differentials using plant level data in India.

The remainder of the paper is organized as follows. Section 2 provides an overview of wage inequality and trade liberalization in India. Section 3 provides the

theoretical background that could explain the increase in wage inequality after trade liberalization in India. Section 4 describes the estimation strategy. Section 5 describes the data and measurement of key variables. Section 6 presents the estimation results and Section 7 concludes the study.

2. Wage Inequality and Trade Liberalization in India

This section reviews the wage inequality in the Indian manufacturing sector and the historical background of trade policy since its independence.

2.1 Wage Inequality in India

The wage inequality has widened in India since the mid-1980s. Pandey and Shetty (2014) indicate that the share of earnings accounting to production workers in total earnings fell from 65% in 1981 to 47% in 2011, but the proportion of production workers in the total number of workers employed remained unchanged at about 78%. The divergence between white and blue-collar wages began during the mid-1980s and increased over time, especially after 1991 (Chamarbagwala and Sharma, 2007). The present study focuses on the period from 2000 to 2007. Figure 1 indicates that nonproduction workers earn 3.4 times higher wage than production workers in 2000, but 5 times higher in 2007 in our sample.

2.2 Trade Liberalization in India

India's experience with trade liberalization through tariff reduction began in the mid-1980s, which was also the period when the wage inequality between nonproduction and production workers started increasing. Prior to the trade liberalization, unskilled labor-intensive industries were heavily protected.

After independence, India adopted import-substituting industrialization. Initially, the government strictly regulated import through quotas rather than tariffs. The regulation was imposed mostly on the import of consumer goods (unskilled labor-intensive goods) and not on capital and intermediate goods (skilled labor-intensive goods). Since the late 1970s, the government began a slow but sustained relaxation of import regulations on capital goods and intermediate goods. In the mid-1980s, under Prime Minister Rajiv Gandhi, India shifted from quantitative import controls to a protective system based on tariffs and took some cautious steps to

encourage the import of capital goods, while consumer goods continued to be heavily protected, now by high tariff in place of rigid quotas.

Trade policy was an important component of the economic reforms of 1991. During the foreign trade policy from 1992 to 1997[2], the average tariffs fell from more than 87% in 1990 to 39% by 1996 (Topalova and Khandelwal, 2011). The 1991 reform removed most of the quantitative restrictions on the import of capital goods and intermediate inputs. As indicated by Kumar and Mishra (2005) and Sen (2008), these dramatic economic reforms affected the unskilled labor-intensive sectors the most. This phenomenon can also be observed in other developing countries, such as Mexico and Colombia, where the unskilled labor-intensive industries experienced the largest tariff reductions (Hanson and Harrison, 1999 and Attanasio et al., 2004).

The foreign trade policy from 1997 to 2002 did not carry forward the tariff reduction further. Quantitative restrictions on imports of manufactured consumer goods and agricultural products were finally removed on April 1, 2001. The subsequent foreign trade policy from 2002 to 2007 was in line with the agenda of trade liberalization. In 2002, the government signaled a return to tariff reduction policy. In our sample period, the average output tariffs in the Indian manufacturing fell from 35% in 2000 to 18% in 2007 and over this same period, the average input tariffs fell from 24% to 11% (See Figure 1).

Figure 2 illustrates the relationship between the reduction in output tariff during the period from 1990 to 2007 and the ratio of unskilled workers in an industry in 2000. This indicates that the unskilled labor-intensive industries experienced larger tariff cuts. Table 1 indicates the positive and significant relationship between the reduction in output tariff and the ratio of unskilled workers in an industry.

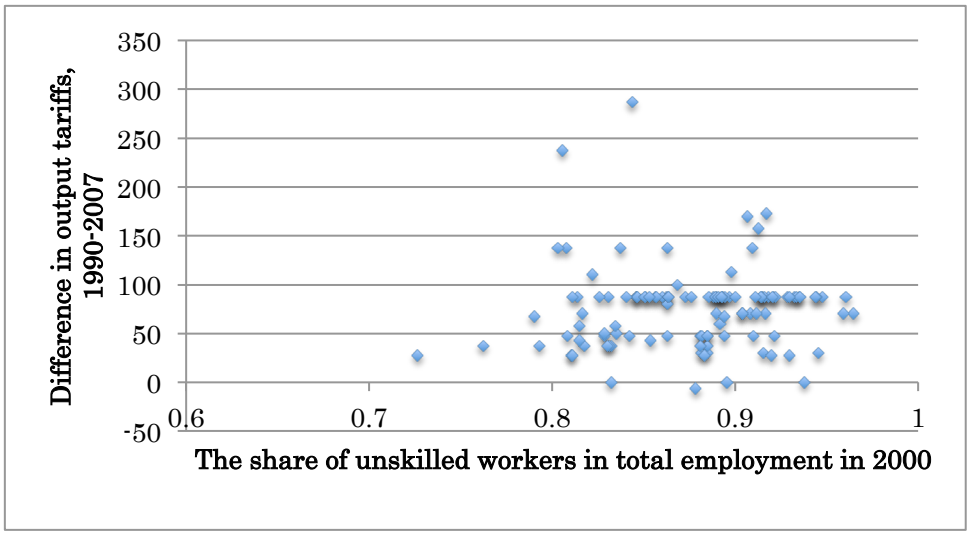
One of the unskilled labor-intensive industries is textiles and clothing. This industry employs around 35 million people and is the largest manufacturing industry in India in terms of employment. It accounted for 4% of the GDP, 14% of the total industrial production in 2004, and 8.62% of total employment. Labor productivity in the textiles and clothing industry is lower than that in other manufacturing industries[3]

[2] Import-export policy 1997-2002.

[3] According to figures by the Department of Heavy Industry, labor productivity measured in terms of gross value added per employee is 1.48 for weaving and spinning, and 1.61 for other textile manufacturing, which is lower than that for machinery (3.31), iron and steel (7.45), and automobiles (10.6).

(WTO, Trade Policy Review, 2006). The average output tariff in this sector decreased from 100% in 1990 to 12.5% in 2007. The tariff reduction in this sector is 87.5% and this reduction is 10% larger than the average tariff reduction in the other manufacturing industries.

Figure 2. Reduction in output tariffs between 2000 and 2007 and the share of unskilled workers in 2000



Note: Based on author's calculation using WITS data.

Table 1. Regression result for reduction in output tariffs between 2000 and 2007 and the share of unskilled workers in 2000

	Tariff reduction, 1990-2007
Share of unskilled workers in 2000	1.638*
	(0.977)
Constant	2.818***
	(0.856)
Observations	110
R-squared	0.025

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

3. Theoretical Background

In the previous section, we can observe that the relative wage of nonproduction to production workers increases during the period from 2000 to 2007 period when tariff reduction steps forward. This section reviews the two theoretical perspectives on the positive effects of trade liberalization on wage inequality, the S-S theorem and skill-biased technical change.

Goldberg and Pavcinik (2007) compiled studies on the relationship between trade liberalization and wage inequality in developing countries such as Mexico, Colombia, Argentina, Brazil, Chile, and India and found that trade liberalization increases wage inequality in most studies. However, in an H-O world with a single cone of diversification, the standard S-S effect predicts that the wage inequality in unskilled labor abundant country decreases under trade liberalization. They provide two possible explanations for the puzzle. First explanation focuses on the inconsistency in the assumptions of the H-O theory. Previous research indicates that the unskilled labor-intensive sectors are protected the most prior to trade reform, and are affected the most by tariff cuts. As trade liberalization affects most in these sectors, the economy wide return to unskilled labor should decrease. Therefore, the widening of the wage gap between skilled and unskilled workers is exactly what the S-S effect predicts. Hanson and Harrison (1999) provide the result that the S-S effect worked in Mexico where the unskilled labor-intensive industries were heavily protected prior to trade liberalization.

The other line of explanation for the increased demand for skilled labor is SBTC. Wood (1994, 1995, 1997) and Acemoglu (2003) indicate that trade liberalization may well be a driving force of changes in technology. SBTC arises from the incorporation of new technologies embodied in cheaper imported capital goods, such as machines and office equipment, or intermediate goods that are complementary to skilled workers in unskilled labor-intensive countries. It is relatively easy for firms to import or access such imported capital after trade liberalization. Therefore, SBTC benefits skilled workers, thus increasing the wage inequality.

4. Estimation Strategy

This section explains how to estimate the impact of tariff reduction on wage inequality. The results of the estimation are consistent with the theoretical predictions that we discussed in the previous section.

Our estimation strategy involves using the industry variation in tariffs over time to identify how reductions in the four-digit industry level output tariffs and in the three-digit industry level input tariffs affect the intra-plant wage inequality. The dependent variable is the wage inequality measured by the log of the ratio of the average wage of nonproduction workers to the average wage of production workers.

Following Amiti and Cameron (2012), we estimate the reduced form equation[4] as under

$$\ln\left(\frac{w_s}{w_u}\right)_{f,i,t} = \alpha_f + \alpha_{l,t} + \beta_1 * input\ tariff_{i,t} + \beta_2 * input\ tariff_{i,t} * impshare_{f,i,t} + \beta_3 * output\ tariff_{i,t} + Z_{f,i,t}\Gamma + \varepsilon_{f,i,t}.$$

In the above equation, $\ln(w_s/w_u)_{f,i,t}$ and $impshare_{f,i,t}$ are the variables representing wage inequality and the plant's share of imported intermediate goods within plant f in industry i in year t respectively. $input\ tariff_{i,t}$ and $output\ tariff_{i,t}$ are input tariff at three-digit industry level and output tariff at four-digit industry level in year t. All specifications also include plant fixed effect, α_f, and state-year fixed effect, $\alpha_{l,t}$, to control time-invariant characteristics of the plant and the time-variant shocks affecting states differently respectively[5]. The vector $Z_{f,i,t}$ in the equation controls for the time varying plant-level characteristics such as the plant's size, import share, the skill share (measured as the ratio of the number of nonproduction workers to the total employed), and the share of contract workers in production workers. The plant's import share is included to control the difference in the wage inequality between importers and non-importers because Bernard and Jensen (1997) and Verhoogen (2008) found that the wage inequality in globalized firms is much higher than that in domestic firms. We include the size of the plant because the wage structure may be different between small plants and large plants. The skill share represents the relative supply of skilled workers and a higher share of contract labor in production workers widens the inequality because the wages of contract workers are less than the wages of regular workers and are mostly equal to or less than the minimum wage decided by the state. In recent years,

[4] Although Amiti and Cameron (2012) include the interaction term between the export share of a firm and its output tariff, we could not include it because we were not able to identify from our data if a plant exported or not.

[5] The economy wide effects on the wage structures would be absorbed by the year–state dummy. For example, the minimum wage is important for the wage structure. The minimum wage is different among states and changes over time. As we can observe, the number of contract labor increased in the Indian manufacturing sector. Therefore, wage inequality might be affected by the level of minimum wages. Moreover, the labor regulations of each state may affect wage inequality. Besley and Burgess (2004) measure the strength of labor regulation in different states using the amendment in Industrial Dispute Act (IDA) for which the state government has the authority. They indicate that pro-worker amendments of the IDA are associated with lowered investment, employment, productivity, and output in registered manufacturing, and increased urban poverty.

the replacement of regular workers with contract workers has become a common phenomenon in Indian manufacturing (Goldar and Aggarwal, 2012).

First, consider the effect of reducing output tariff. The reduction in output tariffs makes the domestic market for the final goods competitive because the imported final goods become relatively cheap. The S-S effect in a standard H-O world, in which the government decreases output tariffs uniformly across industries, predicts the decrease in wage inequality because India, which is one of the most unskilled labor abundant countries, specializes more in producing unskilled labor-intensive goods, thus increasing the relative demand for unskilled labor. This implies that the coefficient of the output tariff, β_3, is positive.

However, as mentioned earlier, India protected the unskilled labor-intensive sectors through high tariffs prior to trade liberalization. This situation is different from one in a standard H-O world. Prior to trade liberalization, the output price of unskilled labor-intensive industries and the wage of unskilled workers are relatively high. Although India is an unskilled labor abundant country, the S-S effect predicts the increase of wage inequality between unskilled and skilled labor. If this is the case, the coefficient of output tariff, β_3, is negative.

Second, consider the effects of reducing input tariffs on the wage inequality. A reduction in input tariffs makes the relatively high quality import inputs cheaper. If these imported intermediate inputs embody skill-biased technology, then their increased use raises the demand for skilled labor and wage inequality. We call this case trade-induced SBTC. The coefficient of the interaction term between input tariff and import share would capture the direct impact of the reduction of input tariff because import plants directly use these imported inputs. The term input tariff describes the indirect or spillover effect on non-importers. If this effect is present, the coefficient of input tariff, β_1, and the coefficient of the interaction term between input tariff and the plant's input share, β_2, are both negative.

5. Data and Measurement

5.1. Data

We use plant level panel data of the Indian manufacturing sector for the period from 2000 to 2007. The unit level information comes from the Annual Survey of Industries (ASI) data, undertaken by the Central Statistical Organization (CSO), which is the

annual census-cum-sample survey of the formal manufacturing plants. The ASI data cover two sets of surveys, census and sample. The census survey captures all enterprises hiring more than 100 workers. To construct the panel data in which it is possible to control the time-invariant plant's fixed effect, we consider only the plants belonging to the census sector.

5.2. Measurement of main variables

The main variables we use for the estimations are as follows. The wage inequality between nonproduction and production workers is the ratio of the wage rate of the supervisory and managerial staff to the wage of floor-level workers. Each wage rate is calculated as the average daily wage per worker, derived from a division of total emolument paid by the plant to the nonproduction (production) workers by the number of nonproduction (production) workers counted as man days. The total emolument includes not only wages but also bonus, contribution to provident and other funds, and workman and staff welfare expenses. As is the standard in the literature, we define skilled workers to be nonproduction workers and unskilled workers to be production workers.

We construct a database of annual output tariff data from 2000 to 2007 based on the 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 ISIC Rev.3. Therefore, output tariff is at the four-digit industry level. The input tariff for industry j is constructed as

$$input\ tariff_{jt} = \sum_s \alpha_{st} \cdot output\ tariff_{st},$$

where α_{st} is the share of input s in the value of output j, which is calculated from the 1998 Input-Output (IO) table. The industrial classification of the IO table is at the three-digit NIC level. Therefore, input tariff for the industry is at the three-digit industry level.

The relationship between wage inequality and tariffs would be affected by the time varying plant-level characteristics. In order to control for those effects, we include the skill share measured as the ratio of the number of nonproduction workers to the total employment, the size of the plant measured by the log of the plant's total labor force counted as man days, and the ratio of the number of contract labor to the total number of production workers as control variables (See Appendix A. for summary of definition of main variables).

5.3 Descriptive Statistics

Table 2 indicates the descriptive statistics of the main variables (the variable named the share of modern service sector in the State Domestic Product (hereafter SDP) is used in section 6.2). The sample size is 100,304 for the period from 2000 to 2007. The dependent variable of the regression, log of wage inequality, has a sample average of 1.185. This implies that the wage of nonproduction is 327% of the wage of production worker on an average.

Output tariff and input tariff imposed on the sample plants are on an average 27% and 15% respectively. Output tariff is higher than input tariff by about 10%. The average import share (the share of imported intermediate goods in total intermediate goods used in production) is only 9%, reflecting that two third of the plants are non-importers.

The average size of the plant measured as the log of the plant's total labor force counted as man-days is 10, which implies that a plant employs, on annual average, about 22,000 man-days. The average skill share is 10% and this ratio ranges from about 0 to 94%. The average ratio of contract labor is 20%. As mentioned earlier, this ratio increased from 15% in 2000 to 22% in 2007 and peaked at 23% in 2004.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln(w_s/w_u)_{f,i,t}$	100,304	1.185	0.686	−4.607	8.291
w_s	100,304	693.244	1195.678	1.654	159973.800
w_u	100,304	179.335	162.541	0.772	8609.266
output $\text{tariff}_{i,t}$	100,304	0.276	0.218	0	2.100
input $\text{tariff}_{i,t}$	100,304	0.152	0.056	0.057	0.301
$\text{impshare}_{f,i,t}$	100,304	0.092	0.210	0	1
$\text{impshare}_{f,i,t}$ * input $\text{tariff}_{i,t}$	100,304	0.015	0.036	0	0.301
$\ln(\text{labor})_{f,i,t}$	100,304	10.684	1.434	3.738	16.615
skill $\text{share}_{f,i,t}$	100,304	0.103	0.094	0	0.942
ratio of contract $\text{labor}_{f,i,t}$	100,304	0.207	0.328	0	1
sdp share of $\text{service}_{i,t}$	98,118	0.179	0.069	0.051	0.466

Note: Based on author's calculation using ASI and WITS data.

6. Results

This section presents the estimation results and provides the theoretical interpretation of the results.

6.1 Baseline Results

Table 3 indicates the baseline results. We include only output tariff in column 1 and input tariff in column 2. In the former case, the coefficient is negative and significant indicating that a fall in output tariff is associated with an increase in the wage inequality between nonproduction and production workers, whereas in the latter case the coefficient is negative but insignificant. These results suggest that increased wage inequality after trade liberalization is coinciding with the S-S effect wherein the unskilled labor-intensive sectors are protected the most prior to a trade reform. In column 3 where we include both output tariffs and input tariffs, the coefficient of output tariff remains negative and significant, and the coefficient of input tariff is positive but insignificant.

We further explore whether the effect of input tariff reduction is different between importers and non-importers of intermediate goods. In column 4, we include the interaction term between input tariff and the plant's input share. The coefficient of the interaction term and that of the input tariff are both insignificant. This suggests that

imported inputs do not have any effect on the wage inequality, and implies that SBTC in manufacturing does not affect wage inequality.

Our results might be biased because of some omitted variables such as time varying plant-level characteristics. Therefore, we add the skill share in column 5, the size of plant measured by the log of the plant's total labor force in column 6, and the ratio of contract labor within production workers in column 7. The coefficient on the skill share is negative and significant indicating that an increase in the share of nonproduction workers within a plant is associated with lower wage inequality. Although the size of plant does not matter for the wage inequality, the coefficient of the ratio of contract labor is positive and significant indicating that replacing regular workers with contract workers is cost cutting and widens the wage inequality between nonproduction and production workers.

Table 3. Baseline Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
output tariff$_{i,t}$	−0.0412*		−0.0415*	−0.0412*	−0.0430*	−0.0429*	−0.0392*
	(0.022)		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
input tariff$_{i,t}$		−0.059	0.009	0.033	−0.078	−0.082	−0.069
		(0.174)	(0.178)	(0.183)	(0.176)	(0.176)	(0.176)
impshare$_{f,i,t}$				0.028	0.004	0.000	−0.002
				(0.042)	(0.042)	(0.042)	(0.041)
impshare$_{f,i,t}$ * input tariff$_{i,t}$				−0.112	0.015	0.028	0.049
				(0.220)	(0.216)	(0.216)	(0.215)
skill share$_{f,i,t}$					−2.243***	−2.227***	−2.181***
					(0.054)	(0.056)	(0.056)
ln(labor)$_{f,i,t}$						0.007	−0.005
						(0.007)	(0.007)
ratio of contract labor$_{f,i,t}$							0.153***
							(0.016)
Plant FE	YES	YES	YES	YES	YES	YES	YES
State$_i$ * Year$_t$	YES	YES	YES	YES	YES	YES	YES
Constant	1.148***	1.144***	1.146***	1.139***	1.389***	1.316***	1.404***
	(0.009)	(0.032)	(0.031)	(0.033)	(0.032)	(0.084)	(0.085)
Observations	100,304	100,304	100,304	100,304	100,304	100,304	100,304
R-squared	0.032	0.032	0.032	0.032	0.097	0.097	0.1
Number of panelid	40,002	40,002	40,002	40,002	40,002	40,002	40,002

Notes: Robust standard errors in parentheses are clustered at plant level. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.2 Effect of SBTC on the Modern Service sector

The modern service sector in India is growing at a rapid pace and the demand for skilled labor in this sector is expanding along with it. The modern service sector includes communication, banking and insurance, and real estate, ownership of dwellings and business services. It is relatively easy for a skilled worker than an unskilled worker employed in the manufacturing sector to move to this sector. In other words, the labor market for skilled worker is integrated, while that for unskilled worker is fragmented between the manufacturing sector and the modern service sector. Therefore, the demand for skilled workers in the modern service sector is important for the demand for skilled workers in the manufacturing sector. In the baseline specification, we try to absorb the effect of the demand in modern service sector on wage inequality in manufacturing by the year-state dummy variable. However, in order to distinguish the effect of the increased demand of the modern service sector on wage inequality in manufacturing from other factors included in the year-state dummy variable, we include the share of the modern service sector in SDP as a proxy for the demand for skilled workers in that sector. Table 4 indicates that the output tariff reduction still increases the wage inequality. More importantly, the increase in the modern service sector's share in SDP contributes to increased wage inequality in manufacturing. This suggests that SBTC in modern service sector affects wage inequality in manufacturing.

Table 4. Effect of SBTC on Modern Service sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
output tariff$_{i,t}$	−0.0534**		−0.0507**	−0.0507**	−0.0508**	−0.0507**	−0.0472**
	(0.022)		(0.023)	(0.023)	(0.022)	(0.022)	(0.022)
input tariff$_{i,t}$		−0.175	−0.094	−0.084	−0.168	−0.171	−0.154
		(0.171)	(0.174)	(0.179)	(0.172)	(0.172)	(0.172)
impshare$_{f,i,t}$				0.012	−0.009	−0.013	−0.015
				(0.042)	(0.041)	(0.042)	(0.041)
impshare$_{f,i,t}$ * input tariff$_{i,t}$				−0.046	0.063	0.075	0.093
				(0.218)	(0.213)	(0.214)	(0.212)
skill share$_{f,i,t}$					−2.265***	−2.251***	−2.206***
					(0.055)	(0.058)	(0.058)
ln(labor)$_{f,i,t}$						0.006	−0.006
						(0.007)	(0.007)
ratio of contract labor$_{f,i,t}$							0.150***
							(0.016)
sdp share of service$_{i,t}$	0.801***	0.811***	0.798***	0.796***	0.810***	0.813***	0.791***
	(0.242)	(0.242)	(0.242)	(0.242)	(0.233)	(0.233)	(0.233)
Plant FE	YES	YES	YES	YES	YES	YES	YES
Year$_t$	YES	YES	YES	YES	YES	YES	YES
Constant	0.958***	0.978***	0.979***	0.977***	1.224***	1.153***	1.248***
	(0.039)	(0.054)	(0.054)	(0.055)	(0.053)	(0.096)	(0.096)
Observations	98,118	98,118	98,118	98,118	98,118	98,118	98,118
R-squared	0.023	0.023	0.023	0.023	0.09	0.09	0.092
Number of panelid	39,018	39,018	39,018	39,018	39,018	39,018	39,018

Note: Robust standard errors in parentheses are clustered at plant level. * significant at 10%; ** significant at 5%; *** significant at 1%.

7. Concluding Remarks

In this study, we analyze the relationship between trade liberalization and intra-plant wage inequality between nonproduction and production workers using plant level data in the Indian manufacturing sector. We also discuss if the effects of trade liberalization on wage inequality are consistent with the theoretical predictions of the S-S effect and SBTC. Our estimation results indicate that tariff reduction in final goods increases wage inequality, but tariff reduction in intermediate inputs does not have a statistically significant effect on wage inequality. These results suggest that the S-S effect works in India manufacturing where unskilled labor-intensive industries are protected the most prior to trade liberalization.

We also consider the increased demand for skilled worker by the modern service sector including the IT sector. Due to the requirements of computer and English

language skills, the modern service sector, which is growing at a rapid pace, demands larger number of skilled workers. This increased demand for skilled workers would widen the wage inequality in the manufacturing sector because it is relatively easy for the skilled workers in the manufacturing sector to move to the modern service sector. Moreover, a manufacturing plant needs to offer a higher wage to skilled workers. Our results indicate that the increase in the share of modern service sector in SDP contributes to an increase in wage inequality in manufacturing. This suggests that SBTC in modern service sector affects wage inequality in manufacturing.

In future studies, we plan to include variables indicating labor market conditions, such as the minimum wage, the Besley and Burguss index, and unionization rate, in our estimation in order to confirm the robustness of our results. In addition, we plan to deal with possible endogeneity of tariff rates that might have a bias on the results. For example, it could be the case that politically powerful industries are able to successfully lobby the government for trade protection.

Appendix

A. Main variables

Table A.1. Definition of main variables

Variables	Definition
$\ln(w_s/w_u)_{f,i,t}$	Log of (wage of non-production worker/wage of production worker) within factory f in industry i at year t
w_s	Daliry wage of supervisory and managerial staff
w_u	Daliry wage of factory-floor level workers counted as man days.
output $\text{tariff}_{i,t}$	Output tariff or final good tariff at 4 digit-industry level.
input $\text{tariff}_{i,t}$	Input tariff or intermidiate good tariff at 3 digit-industry level.
$\text{impshare}_{f,i,t}$	The ratio of value of imported inputs to value of all inputs invested by a factory f in industry I at year t
$\ln(\text{labor})_{f,i,t}$	Log of total employment including supervisory and managerial staffs and
skill $\text{share}_{f,i,t}$	The ratio of the number of supervisory and managerial staffs to the total number of empoyment.
ratio of contract $\text{labor}_{f,i,t}$	The ratio of the number of contract labor to the total number of factory-floor level workers
sdp share of $\text{service}_{l,t}$	The state domestic products share of modern service sector. Modern service sector includes communication, banking and insurance, and real estate, ownership of dwellings and business services.

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