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RESEARCH ARTICLE

Effect of Trade Liberalization on Gender Inequality: The Case of India

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Abstract
Using a panel of establishments from the annual survey of industries, I study the impact of the 1991 trade liberalization episode in India on the employment share of women. Contrary to the predictions of a taste-based discrimination model, I find that establishments exposed to larger output tariff reductions and import competition reduced the share of female workers. I also find that input tariff reductions neither raised nor reduced female employment share. The negative association between output tariff reductions and female employment appears to be driven by establishments which increased the number of shifts per worker. Since women in India are prohibited by law from working long hours and night shifts, this hours-constraint appears to have reduced relative employment of women. This paper is the first to provide empirical evidence of how an ostensibly pro-women policy of limiting female work hours might have unintended side effects. In order to look at the overall effects of liberalization on the gender employment share, I use Census of India data to create a district level panel. I find that districts which were more exposed to the reforms experienced a reduction in the share of female workers. This was observed for both urban and rural areas.

JEL Classification D3 · F15 · J16

1 Introduction

In this paper, I examine the link between trade liberalization and gender inequality. Gender inequality exists in many forms in both developed as well as developing countries. It manifests itself in many faces such as mortality, natality, basic facility such as education, special opportunity like access to jobs, professional, household, and ownership inequality (Sen 2001). Gender inequality is still prevalent worldwide, even though significant progress has been made in closing gender gaps

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in mortality, education, and employment in many advanced economies. Given the multiple dimensions of gender inequality, policies and programs need to be framed accordingly (Jayachandran 2015). Duflo (2012) shows that women empowerment and economic development are closely related and hence needs to be prioritized by policymakers. Establishing gender equality was set as one of the primary goals in the Sustainable Development Goals Report (UNDP 2016).

Beginning in the 1970s, many developing countries in Latin America, East and South Asia, and Africa have adopted trade liberalization policies to spur growth, not always with desirable distributional outcomes. Indeed, trade liberalization policies have, in many cases, increased skill premiums, raised income inequality, and exacerbated poverty (see Goldberg and Pavcnik 2007 for a comprehensive survey).[1] In this context, another important question that is relatively under-studied is whether trade liberalization also increases gender inequality, thus directly putting at odds the twin goals of growth and gender equity.

In one of the earlier papers, Black and Brainerd (2004) find that US industries subject to higher import competition experienced more significant reductions in the gender wage gap, a finding which they attribute to reductions in discrimination. A relatively recent paper by Ederington et al. (2010) finds similar results for Colombia. Aguayo et al. (2013) find that the signing of the North American Free Trade Agreement (NAFTA) increased demand for female labor both within and between industries in Mexico. Juhn et al. (2014) link the within-sector shift toward female labor to US tariff reductions on Mexican goods. Export tariff reductions raised exports and investments in technology, which increased the relative productivity of women in blue-collar work.

India presents a compelling case as the economy has been steadily growing in the past few decades. It is experiencing rapid changes in the form of increased urbanization, fertility declining, a fall in the gender gap in education, and an increase in returns to education. However, female labor force participation (FLFP) in India has been low and even falling ever since the 1990s. This is a puzzle that many scholars are only beginning to understand (see Fletcher et al. 2017). Klasen and Pieters (2015) conclude that the reasons are both from the demand and supply sides. Several studies look at the household level data and present numerous explanations from the supply side. These include raising household income and husband's education, own education of women, greater care responsibilities, and patriarchal norms (see Klasen and Pieters 2015; Afridi et al. 2017; Klasen and Sarkar 2017). There are not many papers offering explanations from the demand side. Klasen and Pieters (2015) find that most of the growth has occurred in low skilled services and in construction, which are not women-friendly sectors. They conclude that FLFP could improve if manufacturing industries could absorb more women. Menon and Rodgers (2009) find gender wage gap increased in industries that were concentrated and more exposed to reforms. They present a theoretical model showing that with

[1] Dix-Carnerio and Kovak (2015), Revenga (1997), Hanson and Harrison (1999), Feliciano (2001), Currie and Harrison (1997) show evidence of this from a wide range of countries such as Brazil, Mexico, Morocco, Chile, Argentina, and Columbia.

discrimination, trade openness could lead to larger wage gaps. They complement their theoretical model with empirical analysis using household-level data aggregated up to the industry level. Their empirical findings show that increasing trade openness is associated with more significant residual wage gaps in more concentrated industries.

In this paper, I look at the effect of trade liberalization in the manufacturing sector. In order to do that, I look at establishment-level panel data in the formal sector.[2] Additionally, I also use employment data at the district level which includes both the formal and non-formal sectors.

I use increased import competition as a measure of trade liberalization and analyze the effect on the formal manufacturing sector on the women blue-collar workers in India. I use establishment-level panel data to understand the impact on gender composition as a result of increased competition. In the pre-liberalization era, the share of manufacturing was 28% in terms of employment and 75% in terms of value-added (see Bhalotra 1998; Sundaram and Tendulkar n.d.). Looking at the formal sector becomes important because this sector provides stable and well-paid jobs. Most of the labor regulations are also applicable to the formal sector. Hence, analysis of employment changes in response to shocks is crucial in a country like India that does not have other forms of social security. This is the first study, to the best of my knowledge, which uses establishment-level panel data to study gender inequality in employment in the formal sector. However, the bulk of the manufacturing employment in the pre-reform period was in the non-formal sector, looking only at the formal sector will give only a limited picture. Hence, I complement my analysis with district-level data on gender ratio in employment (formal and informal sectors combined) in rural and urban areas. The district-level data also include information about people working in certain industries outside the manufacturing sector like those in the Information Technology (IT) sector and in the processing, servicing, and repair industries.

I use the 1991 Indian tariff reforms to study the impact of trade liberalization. The Indian case provides an ideal setting as the tariff reductions were unexpected, large, and quickly implemented in an attempt to meet the conditions for an International Monetary Fund (IMF) rescue package. Not only were there drastic reductions in the level of tariffs, but the variance of tariff changes was also large across sectors as those sectors with the highest initial tariffs underwent the most considerable reductions. Topalova (2010) finds that the amount of industry-level tariff reductions was not correlated with initial industry characteristics. Thus the industry-level tariff reductions could be treated as plausibly exogenous.[3] I use this variation in tariff reductions as the exogenous shock that impacted female hiring by establishments.

[2] I include only large establishments in the establishment-level panel as these are the census of all establishments in that category. I aggregate both the large and small establishments at the industry level and construct an industry level panel for the formal sector manufacturing establishments. See section Data for more details.

[3] In the context of this study, I find that the output tariff change is also uncorrelated with the log female to male share in man-days in 1989, the log skill ratio in 1989 and log male intensity in 1989 at the industry level (the results are presented in Table 12).

For the district level analysis, I used the techniques used in Kovak (2013) and Topalova (2010) to map the industry-level tariff changes to the district level exposure to tariff reforms. The mapping was based on the district level employment statistics in the pre-liberalization period.

Numerous papers have used these exogenous tariff reforms to study various outcomes. Topalova (2010) finds that regions with higher initial exposure to industries that underwent large tariff reductions experienced slower reductions in poverty. Khandelwal and Topalova (2011) and Goldberg et al. (2010b) find that tariff reductions raised the productivity of extant establishments, mainly by lowering the cost of imported inputs. Sharma (2018) finds evidence of skill upgrading of workers in establishments importing higher-quality inputs. The effect on employment and wages is less clear. Krishna and Mitra (1998), Kumar and Mishra (2008) and Ahsan et al. (2012) find an improvement in welfare, wages, and a fall in unemployment in some specific sectors. On the other hand, Ahsan and Mitra (2014) finds an overall decline in bargaining power of workers. Menon and Rodgers (2009) sees an increase in gender wage gaps. (Tejani 2016) shows that India has leapfrogged into a high productivity regime without the broad-based expansion of labor-intensive sectors. Bhalotra (1998) termed this growth in India in the post-reform period as jobless growth.

Most of the studies mentioned above use household data or industry-level data to study various outcome variables. In this paper, I use establishment-level panel data to look at the change in the gender composition within an establishment in response to tariff changes. The establishment-level data are from the Annual Survey of Industries (ASI) prepared by the Department of Commerce in India. The ASI is a survey of all registered establishments in the manufacturing sector[4]. The ASI is a census of big establishments and a sample of smaller establishments.[5] I use unique establishment-level identifiers to construct a panel and examine within-establishments changes between 1989 (the "before" period) and 1998 (the "after" period). I only look at the panel of the census sector, consisting of large establishments, as they are representative of establishments in this category. I compliment my panel analysis with analysis of cross sections of establishments in 1989 and 1998, aggregating them up to the industry level, to take account of entry and exit of establishments.[6,7]

Using establishment-level data gives us an advantage as we can look at the demand side. However, it also restricts trade's impact to a context narrower than

[4] See Data Section below for more details.

[5] All establishments with 100 workers or above were surveyed in 1989, and all establishments with 200 workers or above were surveyed in 1998.

[6] I aggregate up to 3-digit industry level. There are 90 industries.

[7] I also look at the panel of smaller establishments. I do not include the results for smaller establishments in the paper since, in the ASI data, only a sample of the small establishments were reported in both years. Also, the sampling technique changed between 1989 and 1998. Earlier, 1/3rd of the firms were sampled, which changed to 1/7th. So if a small establishment was not part of the panel, one is not sure if it did not exist that year or was left out sampled because of the sampling scheme. The ASI provides multipliers for sampled establishments, which is a measure of the probability of being sampled. These were used to calculate the aggregates for the industry level.

what perhaps is ideal. The gender breakup is available only for production workers in the organized manufacturing sector. Also, it does not capture the impacts of outsourcing. For example, the rapidly growing IT industry may have positively impacted women as suggested by Millett and Oster (2013). In order to address concerns of representativeness of the ASI data, I use district level employment data from the Census of India. In India, districts are considered the relevant local labor market as there is limited mobility across them. Therefore, measuring exposure to reforms at the district level has been commonly used in the literature for India's trade liberalization. Recent studies on the impacts of trade reforms for other countries also use local labor market level data to measure trade exposure (Autor et al. 2013; Kovak 2013; Kis-Katos et al. 2018). Hence, I use census of India data to analyze the effect of trade liberalization on the share of female to total employment between 1991 and 2001 to create a district-level panel. These data include workers in the organized as well as the unorganized sector. It also gives information for both rural and urban areas.[8] I complement my establishment-level analysis with the district level analysis to get a more complete picture of the effect of trade liberalization and employment share of women.

At the establishment level, I find that larger reductions in tariffs on final goods (output tariffs) reduced the relative employment of women. This result is directly counter to what we would expect if tariff reductions led to increased competition and reduced taste-based discrimination practiced by employers, a channel suggested by Becker's model of taste-based discrimination (Becker 1957). The other possible factor is skill level. Female workers may be less skilled than male workers. Using household survey data, I also document that women who work in blue-collar manufacturing jobs have on average 5 years less formal education than their male counter-parts.[9] If skill-upgrading occurred within blue-collar jobs, female workers might have been hurt by trade liberalization through the skill-upgrading channel. However, I find a limited role of skill upgrading in the establishments which experience a decline in the female share. I also find a minimal role for tariff reductions to have shifted gender composition through the imported inputs channel. Reductions in input tariffs appear to have neither positively nor negatively impacted women in our data.[10]

What is the channel which potentially accounts for these findings? I find that women face legal constraints to work. Indian women are subject to laws that restrict the number of shifts that they could work. These restrictions are imposed by federal and state legislation. All registered manufacturing units have to follow the guidelines of the Factories Act of 1948. Section 66 of this Act limits the working hours of women and prohibits them from working night shifts. I find evidence that

[8] The more commonly used National Sample Survey data is not representative at the district level for urban areas (see Topalova 2010; Edmonds et al. 2010). Hence, I prefer to use Census data in this paper to construct the district level panel.

[9] see Appendix Table 13.

[10] In my analysis, I do not look at the change in relative wages, as I do not have information for wages for the "pre" period in the ASI. Figure 3 shows that the correlation between log ratio of female to total share in man-days and log ratio of female to total share in the wage bill for 1998 is 0.95.

establishments that experienced the largest tariff reductions responded by increasing work intensity, or the number of shifts per worker. Bhalotra (1998) also finds that increased competition led establishments to increase work hours. Using production function and wage equation estimates, she concludes that hours were more productive and less costly than hiring more workers. To the extent that women were barred from extended hours and night shifts, this would have lowered hours worked by women relative to hours worked by men. In support of this hypothesis, I find that the negative impact of tariff declines on female share was most pronounced among establishments within multi-shift plants in 1989. I also find a negative relationship between change in female share and change in the ratio of total hours worked to employment of males. The district-level analysis also shows that relative female employment declined in districts more exposed to tariffs.

This paper adds to the literature which assesses the possible impact of labor laws in the labor market empirically. Recently, there is much interest among academics, media, and policymakers about the impact of labor laws on industry and how these laws have been hampering in reaping the benefits of liberalization in India. Begum (2013) mentions that there is a restriction on night shifts for women in the manufacturing sector but not in the service sector. Although many of the laws are federal laws, the implementation is the responsibility of the state governments. I make use of heterogeneity across states to show that the results are driven by employee-friendly states (where it is more difficult to fire workers) and in which the laws are more strictly enforced using the approach followed by Adhvaryu et al. (2013) and Sapkal (2016). This paper contributes to the literature by providing empirical evidence of how an ostensibly pro-women policy of limiting working hours for women might have unintended adverse side effects in a regime of increased competition. The findings in the establishment-level data were driven by large firms where employment protection laws were more likely to be enforced. However, from the district level analysis I find that the negative effects of trade liberalization are not limited to large establishments in the organized sector. Given the heterogeneity in the types of employment and production, there could be several different channels that could be operating at the same time. For example, a rural agriculture-based establishment employing mostly unskilled workers will be differently affected than an urban IT firm which employs highly skilled workers. Each of these merits separates detailed analysis which is left for future investigation. In this paper, I focus on the channels which lead to the decline in female employment share in the large establishment in the formal manufacturing sector. My results suggest that the Indian episode of trade liberalization adversely impacted women's employment rates. Since there is now growing evidence that empowering women promotes education, health, and better outcomes for children (Thomas 1990; Duflo 2003; Qian 2008; Duflo 2012), this may also have had long-term adverse impacts. These questions are also left for future investigations.

The paper is organized as follows. Section 2 lays out the conceptual framework. Section 3 discusses the background and data. Section 4 describes the empirical specifications. Section 5 reports the main results. Section 6 discusses the mechanism. Section 7 discusses the robustness of main results. Finally, Sect. 8 presents the main conclusions of the study.

2 Background

2.1 Indian Tariff Reforms

As part of IMF conditions, India implemented economy-wide reforms in 1991, including drastic reductions in tariffs in all industries. Average output tariffs declined from 150% in 1988 to 38% in 1997. Similarly, average input tariffs declined from 147% in 1988 to 38% in 1997. As Figs. 1 and 2 illustrate, not only were there reductions in the levels of tariffs, but the dispersion of tariffs fell as well, with the largest declines occurring in industries with the largest initial tariffs.[11] Topalova (2010) documents that the initial round of tariff reductions covered all sectors and was unanticipated. The tariff reductions continued even after 1998, but Khandelwal and Topalova (2011) find that later reforms were more correlated with industry characteristics. Hence, I isolate my analysis to the tariff reductions which occurred over the 1989–1998 period, where the tariff reductions can be treated as an exogenous shock unanticipated by the establishments.

2.2 Female Employment and Wages in India

India has very low levels of female labor force participation (FLFP) which is surprising given its economic standing. Indian economy has been growing steadily in the last few decades. Most of this growth has been led by the service sector. The share of agriculture roughly halved. Given the backdrop of high growth this falling labor force participation has been a puzzle which many economists have been trying to figure out since long. However, although the service sector contributes (which includes IT services) about 53% to the GDP, its contribution to employment is 31%. The manufacturing sector has remained stagnant in India. Tejani (2016) finds that in the post-reform years India has leapfrogged into a high productivity regime without the broad-based expansion of labor-intensive sectors. India's growth has also been termed as jobless growth (Bhalotra 1998).

India ranked 127 out of 158 countries in the Gender Inequality Index (UNDP 2018) even in 2017. Labor force participation rate for females was 27.2 against 78.8 for their male counterparts. There could be several reasons which could arise both from the demand and the supply sides. On the supply side, the reason could be rising household income and husband's education. Women disproportionately bear the responsibilities of household chores as well as child or elderly care. With increasing household incomes, women prioritize housework over market work. Safety, location of workplace and lack of proper child care facilities could be other factors, besides peer effects and social norms. Women from higher economic class and castes have lower FLFP. Over the years, there could have been a cultural shift where rural women belonging to disadvantaged social groups have started to emulate elite women (see Fletcher et al. 2017 for a detailed survey). Fletcher et al. (2017) find

[11] The change in tariffs is in percentage points.

explained and unexplained wage gaps to be larger in industries where representation of women is higher. These exist in both the manufacturing and service sectors.

Klasen and Pieters (2015) , Klasen and Sarkar (2017) and Afridi et al. (2017) find a decline in labor force participation for females in both urban and rural areas. These papers find increase in income and education as some of the reasons for low FLFP. Gupta and Pieters (2018) find that the effect of exposure to trade is related to the initial level of poverty of households. They also find evidence of distress driver labor supply of women in agriculture and unpaid work. They also show that given an opportunity, women will be willing to participate in the labor market but lack they lack the credit or skills to do so. Deshpande and Kabeer (2019) arrive at similar conclusions using survey data and observe that women would like to work in salaried full time jobs in the manufacturing sector but such jobs are not available. Fletcher et al. (2017) find that job matching is more difficult for females than males.

3 Conceptual Framework

All the evidence in the empirical literature suggests that the tariff reforms had a positive effect at the industry level, in terms of productivity and product quality (see Khandelwal and Topalova 2011; Goldberg et al. 2010b) but negative effects on social outcomes, such as poverty, education and wages (see Topalova 2010; Edmonds et al. 2010). Thus, a natural question, which this paper tries to answer, is how the labor market, particularly for females, was impacted by the reforms.

In this paper, I use plausibly exogenous changes in tariff rates across industries to study the impact of trade liberalization on the hiring of men and women at the establishment level. What are some possible channels that link these changes? One possible channel is through reductions in discrimination. As suggested by Becker (1957), employers may practice taste-based discrimination and not hire women even when men and women are equally productive. Trade liberalization and reductions in tariffs may increase competition from imports and drive discriminating employers out of the market, thereby raising relative share of women employment and their wage levels. Empirically, this channel has been validated in a variety of settings. Black and Brainerd (2004) test the Becker model for the USA and find that industries subject to greater import competition experienced larger reductions in the gender wage gap. Ederington et al. (2010) find similar results for Colombia.

Tariff reductions which increase import competition may cause the less productive establishments to lose market share or drive them out of business. Surviving establishments may respond by raising productivity. Khandelwal and Topalova (2011) find that tariff reductions raised productivity of incumbent establishments through two channels. First, reductions in tariffs on final goods (output tariffs) raised productivity by increasing competition. Even more importantly, they find reductions in tariffs on imported inputs (input tariffs) had even larger impact on establishment productivity by increasing the quality and variety of goods produced and the scale of production. Increases in productivity may be accompanied by investments in new technology and the hiring of skilled workers who complement the upgraded technology. Goldberg et al. (2010b) find that trade liberalization led to quality upgrading of products. Berman et al. (2005) and Kijama (2006) find evidence of skill upgrading of workers. How would men and women be deferentially impacted in this case? If men and women differ in terms of their underlying productivity and in particular, if women are less skilled than men, then women's employment and wage prospects may worsen. In other words, skill upgrading by the establishment may manifest itself in falling share of women employment.

Juhn et al. (2014) provide a different model which differentiates men and women. They propose that women have less "brawn-intensive" skills compared to men. Trade-induced technology upgrading increases the relative productivity of women in blue-collar work. They find that tariff reductions in Mexico associated with the North American Free Trade Agreement (NAFTA) encouraged exports, technology upgrading, and the hiring of female labor with more "brain-intensive" skills.

Yet another channel which may be relevant in the Indian context is hours constraints faced by women. Bhalotra (1998) finds that establishments did increase working hours in a more competitive regime as hours were more productive and less costly than hiring more workers. Tariff reductions and the onset of competition may change production decisions for establishments in ways that disadvantage women even when men and women have similar underlying productive capacities. If establishments increase hours of operation and number of shifts, this may disadvantage women who are constrained by family obligations or explicit government regulations that limit their hours. These constraints are similar in spirit to those in developed economies where hours requirements and inflexible schedules in certain occupations limit the advancement of women (Goldin and Katz 2011; Bertrand et al. 2010). In India, women are prohibited from working night shifts in the manufacturing sector. If the optimal hours of plant operations increase to night shifts, men are likely to expand hours of operation relative to women in such plants.

4 Data

4.1 Tariff Data

The output and input tariff data are taken from Ahsan and Mitra (2014) and Ahsan (2013), respectively.[12] These are available at the 3-digit National Industrial Classification (NIC) which resembles international classifications commonly used in other countries.[13] These data were then merged with the establishment level data using the 3-digit NIC codes, resulting in 90 industries.[14]

[12] I am grateful to Reshad Ahsan and Debashish Mitra for sharing their tariff data.

[13] These classifications were revised between 1989 and 1998. I converted all industry classifications to the 1998 NIC codes using concordance tables provided by Ministry of Statistics and Program Implementation (MOSPI).

[14] Input tariffs were constructed by Ahsan and Mitra (2014) using the formula used by Amiti et al. (2012). Consider industry j that uses inputs from industry k. In this case $\text{Input Tariff}_{jt} = \sum_k s_{jk} * \text{Output Tariff}_{kt}$, where s_{jk} is the share of input k used in producing output j. The share of inputs are obtained from the relevant input–output tables.

4.2 Establishment-Level Data

The establishment-level data are taken from the Annual Survey of Industries (ASI) made available by the Department of Commerce in India for the years 1989 and 1998. The unit of observation is an establishment or a plant, for the fiscal year from April 1st to March31st.[15] ASI covers all registered establishments in the manufacturing sector which is also known as the formal sector.[16] According to Bollard and Sharma (2013), the share of formal sector was around 60% of manufacturing GDP in 1989.[17]

The ASI data are split in two schemes. The census scheme includes all 'big' establishments which have more than 200 workers.[18] All establishments below that cutoff belong to the sample scheme where one-third of all establishments are sampled on a rotating basis.

For establishments below this size cut-offs, a stratified sampling procedure was used where the stratification was done at the state and 4-digit industrial classification level.[19]

The data for 1989 and 1998 are available as representative cross sections. In a recent release of the ASI, establishment identifiers were included which allowed me to create a panel data set in which the same establishment is observed at two points in time, 1989 and 1998.[20] I use this panel data for my main analysis and use the cross-sectional data to check the robustness of my results at the industry level.

Since the ASI data are a census of larger establishments and a sample of smaller establishments, the larger entities are more likely to be in my constructed panel data set. I do not have panel weights and therefore do not assign weights to observations in my panel. Therefore, it is likely that the smaller establishments in my panel are less likely to be representative of all establishments in this category. In addition, larger establishments are more likely to survive, leading to smaller survival bias in my estimates. I also examine separately private establishments. Since the government-owned establishments might have equity concerns apart from maximizing profits, I examine private establishments separately where I expect markets forces to have the larger impact. In 1989, around 10% of the establishments were publicly

[15] For convenience, however, I will use the terms "firm" and "establishment" interchangeably in the paper.

[16] These are registered under the Factories Act of 1948. This includes all establishments using 10 or more workers if using power and 20 or more workers if not using power.

[17] I use the detailed unit level data from the annual survey of industries. This is the most detailed version of the ASI data which gives the breakup of hours and employment by establishments for production workers. The ASI provides data at a greater level of aggregation such as summary data and industry level , all of which are used by some recent papers such as Banerjee and Veeramani (2017), Adhvaryu et al. (2013) and Nataraj (2011).

[18] All establishments with 100 workers or above were surveyed in 1989 and all establishments with 200 workers or above were surveyed in 1998.

[19] The sample scheme surveyed approximately one third of the establishments below the size cut-off every year, subject to the constraint that a sufficient number of establishments were sampled to assure representativeness at the state and industry level.

[20] The match rate and summary statistics are reported in Tables 1 and 14.

owned. For these reasons, within the panel, I mainly look at "big and private" establishments as these are the most representative of establishments of this category.[21],[22]

The ASI data contains detailed information on employment. It reports separately different categories such as directly employed, contract workers, supervisory and other workers. I have categorized direct and contract workers as “production workers” and supervisory and other workers as “non-production workers,” following the standard used by the Bureau of Labor Statistics. Man-days (corresponding to an 8-hour shift) worked over the year by males, and females are reported separately for directly employed (production) workers. Unfortunately, there is no break-down by gender for supervisory and other (non-production) workers. In addition to man-days worked, I also have the daily average numbers of workers on payroll, averaged over a year, which I refer to as “number” of workers. The ASI data also contain information on plant ownership (government or private), age and location of the plant. I also have information on the total value of imported inputs, gross sales, fixed capital and working capital.

The share of female man-days is calculated by taking the ratio of female man-days to total man-days among directly employed (production) workers. The log of this share is taken for each year and then the difference is calculated between 1989 and 1998. Similarly, I look at the share of females by dividing the number of female workers by the number of all workers. The summary statistics are presented in Table 1. Overall the share of female to total man-days remains constant. There was a slight decline in the female to total share in the numbers. The male work intensity given by the share of male man-days to male number increases from 317 .97 to 321.56. There has also been an increase in the skill ratio, share of capital and share of establishments that import.[23]

The ASI data are very rich as they contain a lot of information about establishment level characteristics such as information related to labor as well as production. At the same time, it also is a census of all big establishments and has a panel dimension which is an advantage over other data sets. These data are used by other recent papers such as Adhvaryu et al. (2013) use to aggregate the establishment level data to industry and state level.

[21] Around 43.40% of the big establishments in 1989 are matched and included in the panel data set. This is expected, given that Hsieh and Klenow (2014) find that the exit rate of large establishments is around 4% every year. The match rate among smaller establishments is even lower. Around 7% of the smaller establishments in the 1989 sample are matched and included in the panel data set.

[22] Following the size cut-offs for being in the census of establishments, I classify establishments with > 60,000 man-days as “big” establishments. This definition of the census sector is taken according to 1998. However, only 5% of these establishments were not part of the census sector in 1989. Even if I drop these 5% establishments, the results remain similar. Also, I do not find any correlation between change in tariff and the total size of establishments.

[23] The summary tables for the cross section are given in Table 15. The share of female to total man-days and numbers are slightly lesser in the panel establishments than in the cross section. In my analysis, I look at the percentage change in female shares in response to change in tariffs. When I include all the establishments and aggregate up to the industry, the direction of change is similar and statistically significant.

Table 1 Summary statistics

	1989	1998
Female man-days/total man-days	0.102	0.102
	(0.234)	(0.232)
Female number/total number	0.107	0.105
	(0.233)	(0.231)
Male man-days/male Number	317.97	319.88
	(121.29)	(56.96)
Female man-days/female number	121.18	131.00
	(171.58)	(170.01)
Skilled man-days/unskilled man-days	0.351	0.393
	(0.406)	(0.691)
Contract man-days/total man-days	0.067	0.087
	(0.158)	(0.184)
Working capital/sales‡	0.089	0.191
	(0.119)	(0.211)
Fixed capital/sales‡	0.178	0.444
	(0.226)	(0.487)
Import dummy‡	0.228	0.442
	(0.419)	(0.496)
Female dummy	0.415	0.439
	(0.492)	(0.496)
Observations	1289	1289

The table presents mean coefficients. Standard deviations are in parentheses. Female Dummy is 1 if a firm hires at least 1 female and 0 otherwise. Likewise Import Dummy is 1 if the firm imports and 0 otherwise

‡Variables are used as controls. The summary statistics for these variables are winsorized at 1%

4.3 District Level Data

I use the Census of India data for the years 1991 and 2001 for the district level analysis. The Census of India has information about the number of males and females employed by industry (at the level of 3-digit NIC) in each district[24]. There are about 400 industries across approximately 350 districts. I aggregate the number of main workers to the district level to create a district level panel for the years 1991 and 2001. Main workers are workers who had worked for the major part of the reference period (which is a year), that is, 6 months or more (183 days or more)[25] These include workers working in the formal as well as non-formal sector. These include household and non-household industry in manufacturing, processing, servicing and

[24] The 1991 census data was used by Topalova (2010) to construct the district level tariff intensity measures.

[25] This is similar to usual activity status in the NSS data.

repairs. It also includes the information technology (IT) sector. I take the manufacturing industries separately[26] and again aggregate the main workers to the district level for my analysis. I look at urban and rural areas separately. The Census data is more representative than the National Sample Survey (NSS) data available for various rounds (Thorat 2004). Particularly, the NSS data are not representative at the for urban areas at the district level as observed by Topalova (2010) and Edmonds et al. (2010). Districts are considered the relevant local labor market as there is limited mobility across districts. Measuring exposure to reforms at the district level has therefore been commonly used in the literature for India's trade liberalization. Recent studies on the impacts of trade reforms for other countries also use local labor market level to measure trade exposure (Autor et al. 2013; Kovak 2013; Kis-Katos et al. 2018).

The summary tables are presented in Table 2. Overall there is an increase in the share of female to total main workers between 1991 and 2001 census. In urban districts, the share has remained stagnant, whereas in rural districts there has been an increase. The last row gives the mean tariff intensity index in 1989 and 1999.

I look at average education levels for males and females in manufacturing industries by using Indian Human Development Survey Data, 2005 (Desai et al. 2005).

5 Empirical Specification

5.1 Plant Level Regressions

The central question in this paper is how tariff reductions impact the share of female workers at the establishment level. While it would be instructive to examine both production and non-production workers separately, ASI unfortunately has the gender break-down for production workers only in the establishment data. The results of this paper therefore apply to production workers. I estimate the following reduced-form equation using OLS.

$$\Delta F_{ji} = \beta_1 \Delta \text{OutputTariff}_i + \beta_x X_{ji,1989} + \delta_{i'} + \Delta \epsilon_{ji} \tag{1}$$

where j refers to the establishment, i refers to 3-digit industry. ΔF_{ji} is the change in log female share. More specifically, it is the 1998 log female share less the 1989 log female share.[27] $\Delta \text{OutputTariff}_i$ is output tariff in 1998 at 3-digit NIC less output tariff in 1989. $\delta_{i'}$ refers to 2-digit industry controls. I am looking at within-establishment changes. However, the changes in log female share may vary with initial characteristics of the establishment, $X_{ji,1989}$. I include the ratio of fixed capital to sales and the ratio of working capital to sales, all measured in 1989. I also control for age of the establishment, state where the establishment is located, and dummy variable indicating whether the establishment has imported inputs. My main coefficient of

[26] NIC 1987 codes 200 to 400.

[27] I also look at the change in ratio of female to total man-days (in levels) and find no difference in results.

interest is β_1. A positive coefficient means that a decline in output tariffs (which is what occurred between 1989 and 1998) leads to a decrease in female share.

In addition to output tariffs, another important channel is input tariffs. The literature indicates that reduction in input tariffs increased productivity among establishments importing inputs. In my second set of models, I include input tariff changes as well as output tariff changes as specified in the following equation:

$$\Delta F_{ji} = \beta_1 \Delta \text{OutputTariff}_i + \beta_2 \Delta \text{InputTariff}_i + \beta_x X_{ji,1989} + \delta_{i'} + \Delta \epsilon_{ji} \tag{2}$$

Here, I run a "horse-race" between output and input tariffs by comparing β_1 and β_2. Since input tariffs also declined from 1989 to 1998, a positive coefficient means that a decline in input tariffs leads to a decrease in female share.

5.2 Industry-Level Regressions

Within-establishment changes in female share are not subject to changes in the composition of establishments which may confound my analysis. On the other hand, the results based on the balanced panel may not be representative of industry-level changes which include births and deaths of establishments. I, therefore, also run following regressions on industry-level data based on representative cross sections of establishments in 1989 and 1998.

$$\Delta F_i = \beta' \Delta \text{OutputTariff}_i + \Delta \epsilon_i \tag{3}$$

$$\Delta F_i = \beta_1' \Delta \text{OutputTariff}_i + \beta_2' \Delta \text{InputTariff}_i + \Delta \epsilon_i \tag{4}$$

5.3 District-Level Regressions

For the establishment-level data, I focus on large establishments in registered manufacturing sector. One might argue that since the bulk of manufacturing was small scale and unorganized. As long as women might have shifted from organized to unorganized sector, the overall effects might be different from what I get from the establishment level analysis. In order to have a more holistic view of the effect of trade liberalization of relative employment share of women, I complement my establishment level analysis with district level analysis. I map the variation of import tariffs across industries to a variation at the district level using the pre-reform industrial composition following (Topalova 2010), which is as follows:

For district d, industry i and time t,

$$\text{tariff}_{d,t} = \sum_i w_{i,d} \times \text{tariff}_{i,t} \tag{5}$$

Table 2 Summary statistics: district level

	1991	2001
Share of female main workers (SFMW)	0.122	0.148
	(0.064)	(0.087)
SFMW urban	0.105	0.104
	(0.047)	(0.067)
SFMW rural	0.132	0.179
	(0.079)	(0.096)
	1989	1999
Tariff exposure	0.883	0.305
	(0.095)	(0.06)
Observations	354	354

The table mean coefficients. Standard deviations are in parentheses. SFMW the share of female to total main workers in manufacturing (SFMW). Tariff means traded tariff as defined in the main text

where

$$w_{i,d} = \text{Emp}_{i,d} / \sum_i \text{Emp}_{i,d} \tag{6}$$

is the industry-level share of employment in a district before the liberalization, and $\text{tariff}_{i,t}$ are national level tariffs in an industry at time t. I take 1987 and 1998 as the pre- and post-years of liberalization which is the same as Topalova (2010)[28] Following Kovak (2013), I include only industries in the traded sector. As Kovak points out, with perfect labor mobility across sectors and full employment non-tradable sector prices change in line with the weighted average of the traded sector prices. Although perfect labor mobility within districts and full employment might not hold in the Indian context, including the non-traded sector with zero tariffs would mean no effect of the traded on the non-traded sector. The latter assumption seems even less plausible. Apart from this, including the non-traded sector might lead to problems of endogeneity as the tariff measure would be very sensitive to the share of workers in the non-traded sector which includes mostly poor cereal and oilseed growers (Topalova 2010). Topalova (2010) instruments the tariff measure including the non-traded sector with a measure of tariff that excludes the non-traded sector.

Similar to Gaddis and Pieters (2017) and Kis-Katos et al. (2018) I prefer to estimate the effect of the traded sector tariff directly as it is clearly defined and exogenous.[29]. I control for the pre-liberalization employment share of the non-traded sector in all estimations. In particular, the pre-reform district share of workers employed in agriculture, mining, manufacturing, trade, transport and services.

[28] Years for outcome variables are 1991 and 2001. Using lagged tariffs should not make a lot of difference to the analysis as most of the tariff changes occurred between 1989 and 1997 (Fig. 5).

[29] I also use the same specification as Topalova (2010) and the results remain similar.

I identify the causal effect of trade liberalization by comparing changes in the share of female to total workers across districts. For district d and time t,

$$F_{d,t} = \beta_1 \text{ tariff}_{d,t} + X_{d,t} + \delta D_d \times \tau_t + \tau_t + \mu_d + \varepsilon_{d,t} \quad (7)$$

$F_{d,t}$ is the district level share of female to total main workers. The main coefficient of interest is β_1, the estimated effect of tariff exposure. $X_{d,t}$ is a vector of control variables that includes other reform measures that took place at the same time (removal of non-tariff barriers, removal of restrictions on foreign direct investments, removal of industrial licensing, and banking sector reforms, as included by Topalova 2010). Any trend common to all districts is captured using a post-reform year fixed effect τ_t. To control for any time-invariant district characteristics, I include district fixed effects, μ_d. These estimates capture the local general equilibrium effects of the tariff reductions. A positive coefficient β_1 means that the outcome variables declined faster in districts with greater tariff reductions compared to districts with smaller tariff reductions.

There might be various characteristics of the district that correlate with changes in tariffs as well as outcome variables, such as endowments, accessibility, geography and educational facilities . I further include a vector of pre-reform district conditions interacted with post-reform indicator ($D_d \times \tau_c$) to allow for differential trends in the outcome variable according to these initial conditions. I use district's employment composition at a more aggregate level than the one used in the construction of the tariffs (namely the share of workers in agriculture, manufacturing, mining, trade, transport, and services, with construction workers being the omitted category), the share of the population that is literate, and the share that belongs to scheduled caste or scheduled tribe populations from the 43rd round of NSS as used in Topalova (2010). Along with that I also allow for differential time trends in district outcomes in states with pro-employer labor laws by including an interaction of the post-reform indicator with state labor law indicators given by Besley and Burgess (2004). In all estimations, the standard errors are clustered at the district level.

6 Results

6.1 The Effect of Output Tariffs on Female Share

Columns (1) and (3) of Table 3 give the results from estimating Equation 1. Each column represents a separate regression. Columns (1) does not include initial establishment characteristics, while I include these initial characteristics in column (3). In both specifications, the coefficient is positive which means that greater tariff reductions led to declines in female share. While the standard errors are large, the coefficients for change in output tariff are large and statistically significant at the 10 and 5% levels in columns 1 and 2, respectively.[30] The point estimate of 0.725 in

[30] I cluster standard errors at the 3-digit industry level.

column (3) implies that an establishment in an industry experiencing 10 percentage point reduction in output tariffs would reduce female share by 7%. An establishment in an industry experiencing the average output tariff decline (115%) would reduce female share by approximately 40% (from a base of 10 percentage points) relative to an establishment facing minimum tariff change (60%). These results are counter to what we expect from declining discrimination due to increased competition as laid out by the Becker model. In contrast to the theoretical prediction, I find that output tariff reductions led to declines in the relative share of female employment.

6.2 The Effect of Input Tariffs on Female Share

Columns (2) and (4) of Table 3 present the results from estimating Equation 2 where I include input tariff changes. Here again, the columns have similar representation as (1) and (3). None of the coefficients on input tariff changes are statistically significant. Thus the change in input tariffs does not have any effect on female share. The coefficients of output tariff changes remain positive and significant.[31]

6.3 Industry-Level Regressions

I report the results of industry-level regressions in Table 4. Table 4 presents results from estimating Eqs. (3) and (4) where I aggregate female man-hours and total man-hours up to the 3-digit NIC level. I do the same for columns (4), (5) and (6) of Table 4, except that I aggregate over establishments in the "big and private" category only. Since the cross sections of establishments in 1989 and 1998 are representative of all establishments in the economy, these regressions give me an idea of how results differ if I take account of all establishments including those newly born and those that do not survive.

As shown in Table 4, when all establishments are included, I obtain a coefficient on output tariff change of 0.400 which is significant at the 10% level (column (1)). When both output and input tariffs are included, output tariff change still has a positive effect, while input tariff change now has a negative effect, although neither coefficient is significant. In columns (4), (5) and (6) of Table 4, I focus on establishments which are "big and private." The coefficient on output tariff change alone is now no longer significant. When both tariff changes are included, the coefficient on output tariff change becomes large, positive and significant, while the coefficient on input tariff change are negative and insignificant. This is similar to the pattern found in the panel-level regressions in Table 3.

Overall, I find that the industry-level regression results are broadly consistent with the results from panel data, especially for output tariff change. I find that coefficients on output tariff changes, while not always significant, are consistently positive, implying a negative association between tariff reductions and female employment

[31] I have also interacted the importer dummy with input tariff changes to check for differential effects and found none of the interactions to be statistically significant.

Table 3 Female share and tariffs

	(1)	(2)	(3)	(4)
Dependent variable: change in log of female to total ratio in man-days				
ΔOutput tariff	0.720*	0.810*	0.725**	0.765***
	(0.415)	(0.445)	(0.354)	(0.284)
ΔInput tariff		− 0.485		− 0.214
		(1.246)		(1.021)
WorkCap/sales			−31.28***	− 31.23***
			(1.497)	(1.543)
FixedCap/sales			19.98***	19.11***
			(1.518)	(1.475)
Observations	1289	1289	1289	1289
R^2	0.057	0.057	0.071	0.071

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). Δ Input Tariff represents (input tariff in 1998—input tariff in 1988). WorkCap/Sales is the ratio of working capital to sales in 1989. FixedCap/Sales is the ratio of fixed capital to sales in 1989. All regressions include controls for imported inputs, age of the establishment, 2-digit industry and states. The control for imported inputs is a dummy which takes the value 1 if the establishment imports in 1989. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

share. In the case of "all establishments" which includes smaller establishments, the industry-level regression may be more representative of the population of establishments.[32] Banerjee and Veeramani (2017) look at the effect of trade liberalization on female share at the industry level using multiple years post-1990s. They find that trade liberalization led to a decline in female share at the industry level. Banerjee and Veeramani (2017) look at the effect of trade liberalization on female share on employment at the industry level using multiple years from 1998 to 2008. Although they look at a much more aggregate level and do not use establishment level data, they also find that trade liberalization led to a decline in female share at the industry level.

6.4 Effect of Tariff Exposure on Female Share at the District Level

I report the results of district level regression in Table 5. The coefficient of traded tariff is positive and significant in all columns. In column 1, my estimates imply that a one standard deviation stronger tariff reduction (roughly 0.10; see Table 2) caused a 2.2 percentage point reduction in the share of female to male main workers. As can be seen from columns 2 and 3, I find that the negative effects of tariffs were stronger

[32] Figure 4 shows that the correlation between output and input tariff is 0.61.

Table 4 Female share and tariff-industry level

	All			Big & Private		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: change in log of female to total ratio in man-days						
ΔOutput tariff	0.400*		0.467	0.916		2.04**
	(0.237)		(0.323)	(0.745)		(1.01)
ΔInput tariff		0.562	− 0.256		− 0.641	− 4.20
		(0.621)	(0.838)		(1.92)	(2.59)
Observations	89	89	89	86	86	86
R^2	0.031	0.010	0.033	0.017	0.002	0.049

Standard errors in parentheses. Dependent variable is the (log(total female man-days in the industry in 1998/total man-days in the industry in 1998)—log(female man-days in the industry in 1989/total man-days in the industry in 1989)) *100. I aggregated the cross section of establishments up to the 3-digit NIC industry level in columns (1), (2) and (3). In columns (4), (5) and (6), I aggregated "big" (establishments with > 60000 man-days) and private establishments from the cross section of establishments. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). Δ Input Tariff represents (input tariff in 1998—input tariff in 1988)

***, **, *Significance at 1%, 5%, 10% levels, respectively

in rural areas. In the district level analysis, I estimate the local general equilibrium effects of tariff reductions. Overall, the share of female to total workers declined faster in districts more exposed to tariffs. These effects were stronger in rural areas but were also positive and significant for urban areas.

7 Mechanisms

Section 1 established that output tariff decline led to a decline in female employment share. In this section, I explore the mechanisms through which output tariff reductions adversely impact female employment.

7.1 Plant Operations and Shifts per Worker

In India, women are restricted from working extended hours and night shifts in the manufacturing sector. All registered manufacturing units have to follow the guidelines of the Factories Act of 1948. Section 66 of this Act limits the working hours of women and prohibits them from doing night shifts (Begum 2013).[33] One possibility is that with tariff reductions and import competition, establishments increased the

[33] The IT sector is not subject to these restrictions. Begum (2013) studies the effect of night shifts on the health of women in the IT sector. Recent newspaper articles reported that states are actively considering repealing this section of the Act. The state governments have been given authority to make amendments to the law.

Table 5 District level analysis

	All (1)	Urban (2)	Rural (3)
Dependent variable: share of female main workers to total main workers			
Tariff	0.224***	0.072**	0.258***
	(0.062)	(0.029)	(0.083)
Observations	703	689	703
R^2	0.458	0.342	0.529
Dependent variable: share of female main workers to total main workers in manufacturing			
Tariff	0.221***	0.064**	0.256***
	(0.063)	(0.030)	(0.083)
Observations	702	697	702
R^2	0.464	0.434	0.531

Standard errors clustered at the district level. In column (1) I take the share of female to all main workers from census 1991 and 2001 data. In column (2), I take the share of female to total main workers in urban areas. In column (3), the share of female to total main workers is presented for rural areas. All regressions include district fixed effects and controls for other reforms, pre-reform district conditions, and state level labor law indicators as described in the main text. In the lower panel, I take the manufacturing industries only which are between NIC200 and NIC400

***, **, *Significance at 1%, 5%, 10% levels, respectively

number of shifts worked. Since women are constrained in terms of the maximum number of hours they can work, both because of the legal constraints described above, and also possibly because of family obligations, this change in plant operations would reduce the relative employment of women. In this section, I investigate whether this could be a possible channel through which tariff reductions negatively impacted female employment.

To begin, I examine whether tariff reductions have similar negative impact on female hiring when I define female share based on number of workers. The establishments report "man-days" which is defined as the number of 8-hour shifts worked over the year. I have so far focused on this measure of employment. But establishments also report daily average number of workers, which I call "number of workers." An alternative measure of female share is the ratio of "average number of female workers" to "average number of all workers." I use this alternative measure of female share as our dependent variable and report the results in column (1) of Table 6. Unlike the conclusions using man-days, I find no clear evidence that output tariff reductions adversely impacted female employment share based on this alternative measure. For example, the coefficient is 0.111, which is not statistically significant. This leads me to hypothesize that the negative impact of tariff reductions is operating through work intensity or shifts per worker.

Column (2) of Table 6 examines (yearly) shifts per worker among males. I divide the number of man-days by the average number of workers. The table shows the results from regressing this variable on output and input tariff changes. The table shows that shifts per worker increased faster in establishments facing larger declines in output tariffs. The coefficient is − 0.133 which suggests that the average tariff decline of 115 percentage points led to a 7% increase in shifts per worker compared to an establishment with minimum tariff decline (60%). Since the average in 1989 was approximately 317, this amounts to 22 extra 8-hour shifts per worker compared to an establishment which experienced minimum tariff decline and 44 extra 8-h shifts per worker compared to an establishment with no output tariff decline.

In column (3), I look at the change in female shifts per worker. I again divide female man-days by the average number of female workers. The coefficient for change in output tariff is positive and significant.

The establishments which were running multiple shifts before would have a higher propensity to increase their shifts as a result of tariff reductions. Hence we would expect establishments with higher initial shifts to experience greater decline in female share.

Table 7 examines how the effect of output tariffs on female share varies with establishment's work intensity or number of shifts per worker. I run separate regressions for establishments with initial male shift per worker in 1989 below the median value and for establishments with initial male shift per worker above the median value. Table 7 shows that the negative impact of output tariff declines on female share is driven by establishments with high initial shift per worker. Even if I take initial female share at the establishment level as a control, the results remain similar as can be seen in Table 20. Thus if we assume that establishments which were running multiple shifts earlier would be the ones that would increase shifts further. These establishments also saw the greatest reduction in female share.

The rise in work intensity associated with output tariff declines are likely to be disadvantageous for female workers. As discussed above, women are explicitly barred from working long hours and night shifts. In addition, women may have household obligations which limit their ability to work long hours. These types of hours constraints appear to have worked particularly against female workers. In Table 8, I look at the relationship between change in female share and change in male intensity. I find the relationship to be negative and highly significant at 1% level of significance. This means that other things remaining the same, higher male intensity leads to a fall in female to total share of workers.

7.2 Heterogeneity of Labor Laws Across States

If indeed, the above changes are due to labor regulations, we should find differences across states based on differential implementation. Although the labor laws are federal in nature, the implementation and enforcement vary across states. There is a body of literature which shows that there are differences across states in flexibility and enforcement of labor laws across states which influence the effect of trade liberalization on various outcomes[34] Besley and Burgess (2004) in a well-known paper classify states into flexible and non-flexible based on amendments to the Industrial

[34] see Hasan et al. (2007), Ahsan et al. (2012), Ahsan (2013) which look at demand elasticity, unemployment and productivity as some outcomes.

Table 6 Change in female share in number of employees and intensity

Dependent variable	Δ Female share in number	Δ Log of male intensity	Δ Log of female intensity
Δ Output tariff	0.111	− 0.133***	0.178**
	(0.0974)	(0.0379)	(0.0855)
Δ Input tariff	0.0679	0.0468	0.0145
	(0.297)	(0.174)	(0.305)
Observations	1289	1289	1289
R^2	0.053	0.051	0.077

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable for column (1) (log(Number of Female98/Total Workers)—log(Number of Female89 / Total Workers))*100. The dependent variable for column (2) (log (Total Male Man-days in 98/Total Male Workers)- log(Total Male Man-days in 89/ Total Male Workers))*100. The dependent variable for column (3) (log (Total female Man-days in 98/Total Female Workers)- log(Total Female Man-days in 89/ Total Female Workers))*100. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). Δ Input Tariff represents (input tariff in 1998—input tariff in 1988). WorkCap/Sales is the ratio of working capital to sales in 1989. FixedCap/Sales is the ratio of fixed capital to sales in 1989. All regressions include controls for imported inputs, age, 2-digit industry and states. The control for imported inputs is a dummy which takes the value 1 if the establishment imports. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

Dispute Act in the period 1958 and 1992. The states are classified as employer friendly if the amendments make hiring and firing easier and employee friendly if the amendments make hiring and firing more difficult. In this section, I use an index of labor regulations similar to Adhvaryu et al. (2013) which is based on the cumulative index of Besley and Burgess (2004).

I also use an index of enforcement intensity of the Indian states used by Sapkal (2016). This index is prepared based on an interaction term based on the labor regulations index and the number of labor inspectors per one thousand workers in a state[35].I classify the states above and below the median level of enforcement intensity measure. Thus, above median states are those that have more rigid laws and stricter enforcement than the states which are below median. The results are presented in Table 11. I find that the coefficient in the states with above median level of enforcement intensity is positive and significant at 1 % level of significance. This is indicative that most of the changes are coming from states where the enforcement of labor laws is higher.

[35] The years are 2000 to 2007 which is much after our reference period. I assume here that the enforcement intensity in states have not undergone major changes.

Table 7 Effect of female share on output tariff by initial male intensity distribution

	Multi-shift plants	Single-shift plants
Dependent variable: change in log of female to total ratio in man-days		
ΔOutput tariff 98-89	1.187***	0.255
	(0.378)	(0.622)
Observations	654	635
R^2	0.093	0.101

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Column (1) includes all establishments which had more than 365 shifts a year in 1989. Column (2) includes establishments which had 365 shifts or less in a year. All regressions include controls for imported inputs, age, 2-digit industry and states. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). The control for imported inputs is a dummy which takes the value 1 if the establishment imports. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

Table 8 Effect of female share on output tariff by change in male intensity

Dependent variable: change in log of female to total ratio in man-days	
ΔMaleIntensity	− 1.252***
	(0.351)
Observations	1289
R^2	0.084

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. The independent variable of interest is (log (Total male man-days in 98/Total Male Workers)- log(Total Male Man-days in 89/ Total Male Workers)). All regressions include controls for imported inputs, age, 2-digit industry and states. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). The control for imported inputs is a dummy which takes the value 1 if the establishment imports. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

8 Robustness of the Main Results

In the sections above, I find that the decline in output tariff leads to a decline in female share in jobs in the organized manufacturing sector. I attribute hours constraint faced by females as the main reasons for that. In this Sect. 1, I discuss several threats to the identification strategy. I consider possible alternate channels and ways to rule them out.

8.1 How do we Ensure Causality?

I argue in Sect. 2 that the tariff changes were not correlated with industrial characteristics as shown by Topalova (2010) and several others thereafter. This ensures that the reforms were exogenous. In the context of this study, I find that the output tariff change is also uncorrelated with the log female to male share in man-days in 1989, the log skill ratio in 1989 and log male intensity in 1989 at the industry level (the results are presented in Table 12). Hence, this enables us to establish causal interpretation.

Additionally, the results hold even after controlling for changes in alternative measures of protection such as district's exposure to industrial delicensing, FDI and non-tariff barriers (shown in Appendix Table 16).

8.2 Could the Results be Explained by Skill Upgrading?

If women were less skilled than men and trade liberalization brings about skill-biased technological change, I would expect trade liberalization to increase gender inequality. In this section, I examine whether output or input tariff changes indeed lead to skill upgrading. The skill ratio is defined as the ratio of non-production to production workers. Non-production workers include supervisors and clerical workers. Production workers on the other hand include directly employed and contract workers. I look at the change in skill ratio in terms of man-days. In column (1) of Table 9 I find that the coefficient on output tariff change is negative. However, it is not significant. This suggests that the skill upgrading channel is not working for these sets of establishments.[36]

8.3 Could Establishment Level Characteristics Matter?

It can be argued that tariff reductions and share of females are correlated with establishment level characteristics. Export and import status of the establishment could be one example. In this work, I use a balanced panel of establishments and hence look at the same establishment before and after. Additionally I control for establishment level characteristics for the initial year.[37] Thus, I argue that I am able to control for establishment level characteristics. Additionally, I take initial gender employment mix as a control and the results remain similar (see Table 21).

[36] In Table 17 columns (4) and (5), I look at the change in log ratio of plant and machinery to man-days and the change in log ratio of fixed capital to sales as alternative measures of skill upgrading. However, I do not observe evidence of skill upgrading with respect to output tariff changes.

[37] I take controls for import status of the establishment in the initial year. As mentioned earlier, I do not have information on the export status of establishments. In order to take care of this issue, I take the share of fixed capital to sales and working capital to sales and use them as a proxy for exports.

8.4 Could Sampling Problems Lead to Selection Bias?

One might argue that there could be selection bias in the sample of establishments used for main analysis. In my main result, I look at the establishments which are census of establishments in "big and private" category and hence are not subject to sampling biases. However, in the panel of my main specification I look at establishments that are big and survived over a decade. There could be something particular about surviving establishments and they might not be representative of other establishments which are similar in size but were not in the panel. I do not include the smaller establishments in the panel as only a sample of smaller establishments were surveyed in the ASI data. The sampling technique also changed over the years. As a result, if a small establishment in not included in a panel, one cannot distinguish if the establishment was simply not surveyed that year. The ASI provides multipliers (it is the inverse of the probability of the establishment sampled) for each small establishment. Using these, one can aggregate the establishment level data up to the industry level (see Sect. 6.3). Even after including small establishments and other big establishments which are not in the panel, the coefficient of the change in tariff is positive and significant at 10% level of significance as seen in table as seen from column 1 of Table 4. In column 6, I take big and private establishments only and include both changes in output and input tariffs. Here also the results are positive and significant at 5% level of significance (Table 10).

8.5 Could There be Changes in Industrial Composition?

One can argue that sectors which employed more women grew much less than those which employed more men. This could be one of the factors driving our results at the establishment and industry level. In my main specification[38], I take an additional control of ratio of man-days worked by females to males for 1989 (which is the "pre" year) at 3-digit industry level (results are presented in column (2) of Table 9). I find that the results remain very similar. Additionally I do not find an effect of output and input tariff on overall man-days worked as seen in column (1) of Table 17. Also there does not seem to be a significant change in log sales as can be seen from column (2) of the same table.[39] So, as such we do not find any significant change in industrial composition as a result of change in tariff (Table 11).

8.6 Could There be a Shift from Direct to Contract Workers?

One can argue that the decline in female to total workers might be due to employers hiring more contract workers. My data do not have the gender decomposition of contract workers and thus I cannot comment on the gender ratio of the contract

[38] Equations (1) and (2).

[39] In column (3), I look at the change in log ratio of total sales to man-days and find that there is a decline overall with respect to a decline in output as well as input tariffs.

Table 9 Robustness checks

	Skill ratio (1)	Sectoral control (2)	District control (3)	Contract share (4)
Dependent variable: change in log of female to total ratio in man-days				
ΔOutput tariff	− 0.0291	0.754***	0.766***	0.00680
	(0.0442)	(0.268)	(0.284)	(0.486)
Observations	1289	1289	1289	1289
R^2	0.041	0.071	0.071	0.087

Standard errors clustered at 3-digit industry level in parentheses. In column (1) I take the change in the share of log skilled to unskilled man-days worked. In Column (2), I take the 3-digit industry level share of female to total man-days as a control. In Column (3), I take control for each district. The other specifications are the same as 3. In column (4), I take the change in log share of contract to total workers as the dependent variable. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). Δ Input Tariff represents (input tariff in 1998—input tariff in 1988). WorkCap/Sales is the ratio of working capital to sales in 1989. FixedCap/Sales is the ratio of fixed capital to sales in 1989. All regressions include controls for imported inputs, age of the establishment, 2-digit industry and states. The control for imported inputs is a dummy which takes the value 1 if the establishment imports in 1989. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

workers. But I look at the change in share of contract to total workers (in man-days) and do not find any significant changes with respect to changes in tariffs (see column (4) of Table 9). Moreover, I look at establishment level data and there is no reason to believe that the shift from direct to contract workers would be proportionally larger for females.

8.7 What are the Effects from the Supply Side?

I look at the period between 1989 and 1998. This coincides with the emergence of the IT industry in India. Millett and Oster (2013) mention how the increase in IT jobs increased the relative hiring and education of girls. In this context, one can argue that females are probably shifting from formal manufacturing to the IT sector. However, various studies using household data have shown that labor force participation is stagnant or even declining in India (see Klasen and Pieters 2015; Afridi et al. 2017; Klasen and Sarkar 2017).

Apart from that, females working in blue-collar manufacturing jobs would highly unlikely to be absorbed by the IT sector which requires employment of very high skilled professionals. In Table 13, one can see that the average education of women across all blue-collar occupations is only 2.93 years.

As an additional check, I take control for each district and find that the results remain broadly similar (see column (4) of Table 9). The district is a much smaller geographical location and thus if employment opportunities arose in certain districts

Table 10 Effect of female share on output tariff-differential labor regulations across states

	Employee friendly	Neutral	Employer friendly
Dependent variable: change in log of female to total ratio in man-days			
ΔOutput tariff 98-89	1.080***	0.008	0.072
	(0.305)	(0.815)	(0.715)
Observations	373	266	520
R^2	0.154	0.103	0.059

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Column 2 includes all establishments in states which had employee friendly laws. Column 3 includes states which were neutral, and column 4 had employer-friendly laws. The definitions of states are according to Adhvaryu et al. (2013). Δ Output Tariff represents (output tariff in 1998—output tariff in 1988)

***, **, *Significance at 1%, 5%, 10% levels, respectively

Table 11 Effect of female share on output tariff-differential labor law flexibility and enforcement across states

	Above median	Below median
Dependent variable: change in log of female to total ratio in man-days		
ΔOutput tariff 98-89	1.042***	0.602
	(0.584)	(0.445)
Observations	724	575
R^2	0.072	0.122

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Column 2 includes all establishments which were in states which had employee-friendly labor laws and had strict enforcement. Column 3 includes establishments in states where there were employer friendly labor laws and no strict enforcement. The interaction of labor laws and enforcement index is calculated similar to Sapkal (2016). All regressions include controls for imported inputs, age, 2-digit industry and states. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). The control for imported inputs is a dummy which takes the value 1 if the establishment imports. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

in the non-manufacturing sector, taking district level controls would ensure that we look at changes within a district.

Gupta and Pieters (2018) show that women will be willing to take participate in the labor market but lack the credit or skills to do so in rural areas. Deshpande and Kabeer (2019) using survey data show that women would like to work in salaried manufacturing jobs, but those are not available.

8.8 Urban Rural Differences

The IT and other service sectors employing mostly skilled workers are mostly located in urban areas. In the district level regressions I look at urban and rural areas separately. The coefficient is negative and significant in both areas. However, the negative effect of tariff exposure is stronger for rural areas (see Table 5). In the establishment level data, I include an indicator of whether the establishment is located in an urban area. The main results remain similar (see Table 21.)

9 Conclusion

The larger question addressed in this paper is how trade liberalization policies in India impacted gender inequality. While this is the larger question at hand, in practice, my empirical work addresses the narrower question of how tariff reductions impacted the relative hiring of women by employers in the manufacturing sector. Unfortunately, the establishment data gives the breakdown of female and male employment only for production workers. In order to analyze the overall effect of trade on female share of employment, I use census data to analyze impacts at the district level. The district level analysis provides support to the establishment level analysis. The initial trade shocks could feed through the economy through input–output linkages to impact other sectors, and hence the district level analysis helps us in understanding the final impact of tariff on female employment share.

My findings suggest that larger tariff declines reduced the relative hiring of women. This appears to be the case for all establishments in our panel data. The district level analysis also gives similar results. This result is directly counter to what I would expect if tariff reductions led to increased competition and reduced taste-based discrimination practiced by employers. I also find tariff reductions had little role in changing gender composition through the imported inputs channel, as suggested by a number of papers (Goldberg et al. 2009, 2010a, b ; Khandelwal and Topalova 2011). Reductions in input tariffs appear to have neither positively nor negatively impacted women in my data.

What are the possible channel for my finding? I find that work intensity, or shifts per worker, rose more rapidly among establishments facing steep tariff reductions in their sector. This finding is similar to Bhalotra (1998) who shows that firms increase working hours when faced with increased competition as hours were more productive and less costly than workers. Since women are explicitly barred from working extended hours and night shifts by law and constrained from long hours of work due possibly to family obligations, I hypothesize that this development would also have deterred the hiring of women. Consistent with this hypothesis, I find that tariff reductions negatively impacted women among establishments which had high initial levels of work intensity in 1989. The negative impact is also more pronounced in states where labor laws are more strictly enforced and are pro employee making firing difficult. I use the enforcement and regulations across states similar to Adhvaryu et al. (2013) and Sapkal (2016).

My analysis suggests that women did not benefit from trade liberalization policies and in fact these policies may have increased, rather than decreased, gender inequality. This is broadly consistent with the conclusions of Topalova (2010), Edmonds et al. (2010) and Menon and Rodgers (2009) who find exposure to trade liberalization policies had relatively slower reductions in poverty, child labor and increase in gender inequality in wages. This study might provide an important link to the recent puzzle about the stagnant or declining female labor force participation in India that is being talked about in the recent literature (Klasen and Pieters 2015; Afridi et al. 2017; Klasen and Sarkar 2017).

Appendix

See Figs. 1, 2, 3, 4, 5 and Tables 12, 13, 14, 15, 16, 17, 18, 19, 20, 21.

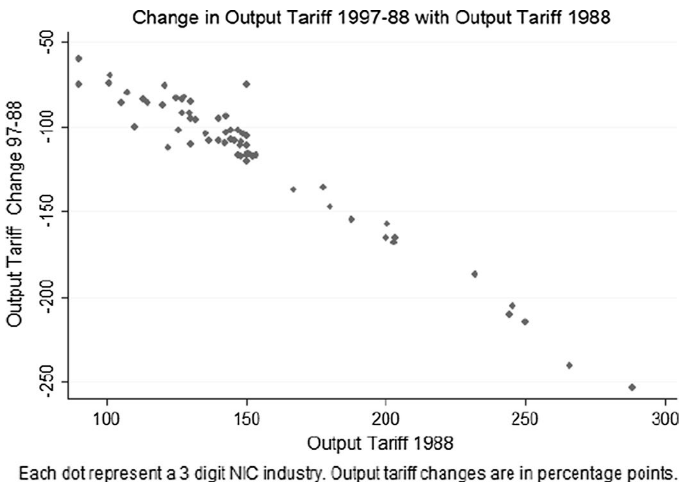

Fig. 1 Change in output tariff and initial output tariff in 1988

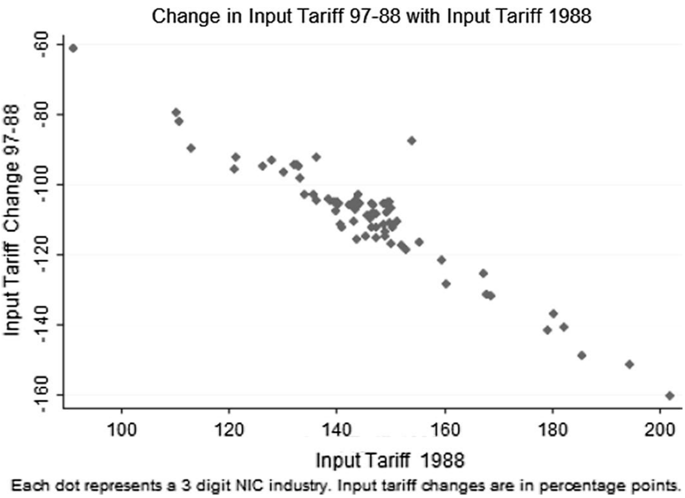

Fig. 2 Change in input tariff and initial input tariff in 1988

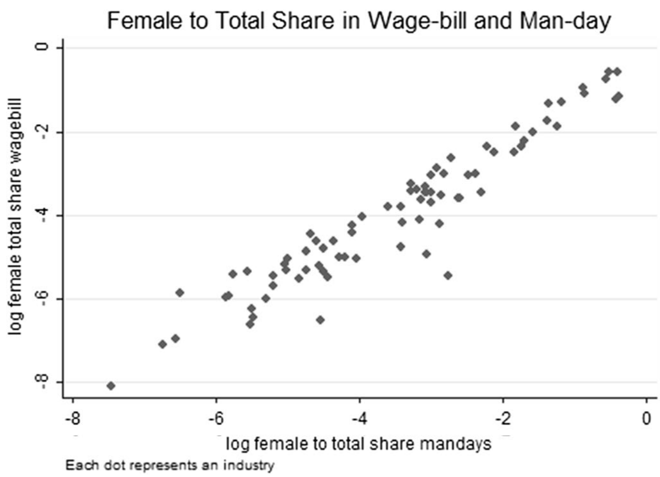

Fig. 3 Relationship between log Wage Bill share and log man-day share in 1998

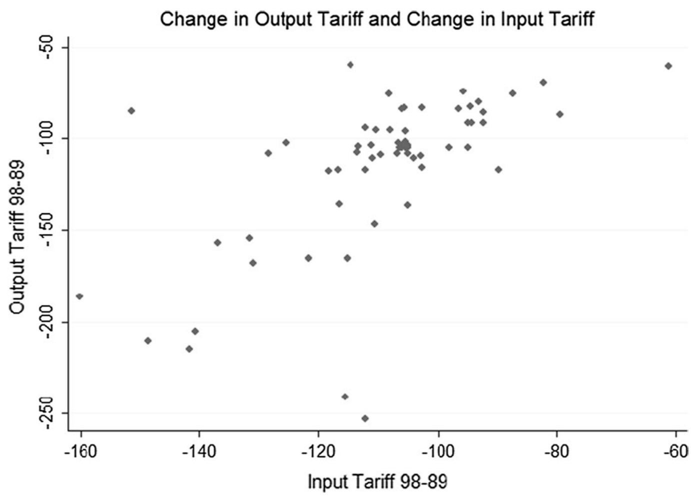

Fig. 4 Relationship of output tariff and input tariff change

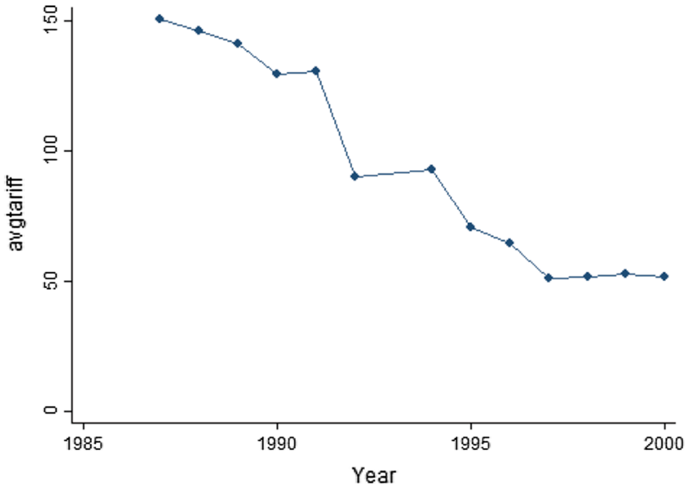

Fig. 5 Change in average output tariff

Table 12 Exogeneity of tariff change

	(1)	(2)	(3)
Dependent variable: change in output tariff			
$\text{Ln}\left(\frac{\text{Female Man-days89}}{\text{Total Man-days89}}\right)$	1.03		
	(2.93)		
$\text{Ln}\left(\frac{\text{Non-Production89}}{\text{Production 89}}\right)$		− 12.652	
		(8.556)	
$\text{Ln}\left(\frac{\text{Male Man-days89}}{\text{Male Number89}}\right)$			1.25
			(14.46)
Observations	90	90	90
R^2	0.001	0.004	0.000

Standard errors in parentheses. Dependent variable is change in output tariff between 1998 and 1989. All variables are at 3-digit NIC

***, **, *Significance at 1%, 5%, 10% levels, respectively

Table 13 Education among males and females in manufacturing industries

	Male		Female	
Coal mining	6.05	(4.43)	1.12	(2.03)
Iron mining	4.97	(4.77)	0.81	(1.67)
Other metal mining	3.99	(4.43)	3.11	(3.71)
Non-metal mining	3.27	(3.86)	0.53	(1.49)
Mining services	4.03	(4.77)	1.11	(2.54)
Food products	5.75	(4.33)	2.49	(3.46)
Beverage and tobacco	4.29	(4.55)	1.65	(2.82)
Manf cotton textiles	6.28	(4.27)	2.37	(3.95)
Manufacture of wool, silk, etc.	5.80	(3.99)	2.30	(3.57)
Manufacture of jute	7.91	(5.37)	3.96	(3.13)
Manufacture of apparel	5.20	(3.82)	4.72	(4.48)
Manf wood/furniture	5.48	(4.01)	1.95	(3.72)
Manf of paper/publish	8.65	(3.49)	7.16	(3.77)
Manf of leather	6.44	(4.38)	7.04	(5.79)
Manf of chemicals	9.68	(3.46)	5.22	(5.28)
Rubber and plastic	7.86	(3.77)	3.48	(3.79)
Manufacture minerals	4.09	(4.98)	0.37	(1.24)
Manufacture basic metals	7.78	(4.04)	3.11	(4.01)
Manf of metal products	7.15	(4.31)	2.34	(3.23)
Manufacture machinery	9.38	(3.55)	2.70	(4.97)
Manf other	7.67	(4.55)	2.76	(3.31)
All blue collar	7.73	(4.25)	2.93	(3.99)

Standard deviations in parentheses. Source: Human Development Survey, 2005. Table shows the average education level among males and female blue-collar workers in manufacturing. I restrict the sample to the age 24 to 66 years. The values are weighted by sampling weights in order to be representative of the population

Table 14 Panel match rate table

	> 60,000	30,000–60,000	< 30,000
Cross section 1989	4221	2980	27038
Cross section 1998	3991	1446	13322
Panel	1832	389	1893
Match rate %	43.40	13.05	7.00

> 60,000 represents all establishments which reported > 60000 total man-days worked in a year. 30,000–60,000 represents all establishments which reported 30,000–60,000 total man-days worked in a year. < 30,000 represents establishments which reported < 30,000 total man-days in a year

Table 15 Summary statistics-big and private cross section

	1989	1998
Female man-days/total man-days	0.125	0.195
	(0.265)	(0.331)
Female number/total number	0.131	0.200
	(0.262)	(0.228)
Male man-days/male number	315.30	317.07
	(110.18)	(124.08)
Skilled man-days/unskilled man-days	0.381	0.389
	(0.622)	(0.693)
Workingcapital/sales‡	0.105	0.197
	(0.181)	(0.484)
Fixed capital/sales ‡	0.168	0.379
	(0.246)	(0.45)
Import dummy‡	0.234	0.459
	(0.424)	(0.498)
Female dummy	0.398	0.466
	(0.489)	(0.498)
Observations	3056	3164

This table reports the summary statistics for big and private establishments in the cross section. The table mean coefficients. Standard deviations are in parentheses. Female Dummy is 1 if a firm hires at least 1 female and 0 otherwise. Likewise import dummy is 1 if the firm imports and 0 otherwise.

‡ indicates these variables are used as controls. The summary statistics for these variables are winsorized at 1%

Table 16 Share of female share and tariffs including other reform controls

Δ Output tariff	0.551*
	(0.318)
Δ Input tariff	− 1.296
	(1.281)
Observations	1119
R^2	0.062

Same as Table 3

***, **, *Significance at 1%, 5%, 10% levels, respectively. Additional controls taken are change in district's exposure of industrial de-licensing, change in districts exposure to FDI and change in districts exposure to non-tariff barriers

Table 17 Tariffs and other establishment level outcomes

	Man-days	Sales	Sales/man-days	Plant and machinery/sales	Fixed cap/sales
	(1)	(2)	(3)	(4)	(5)
ΔOutput tariff	0.0341	0.286	0.675*	0.165**	− 0.364
	(0.0478)	(0.216)	(0.346)	(0.0800)	(0.361)
ΔInput tariff	− 0.0568	− 0.501	1.631	− 0.703**	− 1.875
	(0.152)	(0.582)	(1.651)	(0.274)	(1.686)
Observations	1289	1240	1289	1265	1289
R^2	0.246	0.128	0.140	0.101	0.123

Standard errors clustered at 3-digit industry level in parentheses. In column (1) I take the change in total man-days as the dependent variable. In column (2), I take the change in total sales as the dependent variable. In column (3), I take the change in the share of man-days to sales as the dependent variable. In column (4) I take change in the share of plant and machinery by sales as the dependent variable. In column (5), I take the change in the share of fixed capital by sales as the dependent variable. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). Δ Input Tariff represents (input tariff in 1998—input tariff in 1988). All regressions include controls for imported inputs, age of the establishment, 2-digit industry and states. The control for imported inputs is a dummy which takes the value 1 if the establishment imports1989. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

Table 18 10 Industries with the highest female share

Industry name	Industry code	1989	1998
Manufacture of tobacco products	1600	0.76	0.87
Manufacture of chemical products	2429	0.58	0.59
Manufacture of wearing apparel	1810	0.58	0.63
Agriculture and animal husbandry	140	0.47	0.48
Manufacture of luggage, handbags	1912	0.40	0.49
Manufacture of electronic valves and tubes	3210	0.37	0.23
Manufacture of watches and clocks	3330	0.35	0.39
Manufacture of footwear	1920	0.34	0.48
Manufacture of television and radio relievers	3230	0.28	0.44
Manufacture of electric lamps	3150	0.26	0.13

Table 19 10 Industries with lowest female share

Industry name	Industry code	1989	1998
Manufacture of agriculture and forestry machinery	2921	0.000	0.002
Manufacture and repair of ship	3511	0.002	0.000
Manufacture of aircraft and spacecraft	3530	0.002	0.132
Manufacture of manmade fibers	2430	0.002	0.000
Manufacture of rubber	2511	0.006	0.007
Manufacture of steam generators	2813	0.006	0.007
Manufacture of bicycles and invalid carriages	3592	0.007	0.005
Manufacture of machine tools	2922	0.007	0.012
Manufacture of railways and trams	3520	0.007	0.002

Table 18 shows 10 industries where female to total share of man-days worked were the highest in 1989. Table 19 shows 10 industries with least share of female to total share of man-days worked in 1989. These include all establishments in the cross section of 1989 and 1998

Table 20 Effect of female share on output tariff by initial male intensity distribution and initial female share as a control

	Above median	Below median
Dependent variable: change in log of female to total ratio in man-days		
ΔOutput tariff 98-89	0.916*	0.116
	(0.367)	(0.629)
Observations	654	635
R^2	0.117	0.120

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Column (1) includes all establishments which were above median male intensity in 1989. Column (2) includes establishments which were below median male intensity in 1989. The median value of male intensity in 1989 is 310, 8-hour shifts per male worker. All regressions include controls for imported inputs, age, 2-digit industry and states. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988). The control for imported inputs is a dummy which takes the value 1 if the establishment imports. Age is a dummy which has a value 1 if the establishment is less than 15 years old and 0 otherwise

***, **, *Significance at 1%, 5%, 10% levels, respectively

Table 21 Robustness with additional controls

	Initial female share	Urban control	No ind control
Dependent variable: change in log of female to total ratio in man-days			
ΔOutput Tariff 98-89	0.673**	0.837***	0.742**
	(0.299)	(0.311)	(0.693)
Observations	1289	1287	1289
R^2	0.156	0.07	0.046

Standard errors clustered at 3-digit industry level in parentheses. Dependent variable is the (log(female man-days in 1998/total man-days in 1998)—log(female man-days in 1989/total man-days in 1989)) *100. Column 2 includes the share of female to total share in man-days in 1989 . Column 3 includes a region indicator as a control indicating whether the firm belongs to an urban or rural area. Column 4 includes the results from estimating equation 3 without controlling for 2-digit industries. Δ Output Tariff represents (output tariff in 1998—output tariff in 1988)

***, **, *Significance at 1%, 5%, 10% levels, respectively

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