

Trade Liberalization and Wage Inequality: Evidence From India

Utsav Kumar
Department of Economics
University of Maryland

Prachi Mishra
International Monetary Fund¹

¹ Contact author – Prachi Mishra, International Monetary Fund, 700 19th Street NW, Washington DC 20431. Email: pmishra@imf.org, Phone – 202-623-9409, Fax – 202-589-9409. This paper is a part of Prachi Mishra's Ph.D dissertation at Columbia University. The authors would like to thank Don Davis, David Weinstein, Nuno Limão, Judith Hellerstein, Paul Cashin, Montford Mlachila, Patrick Njoroge, Sonali Jain-Chandra, Ashish Narain, Devesh Roy and seminar participants at Columbia University for comments and suggestions. Special thanks to Debkum Das of Indian Council for Research in International Economic Relations for sharing the Indian trade data.

Abstract

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We evaluate empirically the impact of the dramatic 1991 trade liberalization in India on the industry wage structure. The empirical strategy uses variation in industry wage premiums and trade policy across industries and over time. In contrast to most earlier studies on developing countries, we find a strong, negative, and robust relationship between changes in trade policy and changes in industry wage premiums over time. The results are consistent with liberalization-induced productivity increases at the firm level, which get passed on to industry wages. Since tariff reductions were proportionately larger in sectors that employ a larger share of unskilled workers, the increase in wage premiums in these sectors implies that unskilled workers experienced an increase in their relative incomes. Thus, our findings suggest that trade liberalization has led to decreased wage inequality in India.

I. INTRODUCTION

A growing body of research indicates that trade liberalization by developing countries has raised their aggregate incomes.² Academic and policy debates on the merits and demerits of liberalization have centered on the internal distributional consequences and on the question of how trade reforms affect labor markets. This paper presents new evidence from India on the impact of trade liberalization on wages.

India offers an excellent case to study the effects of trade liberalization for two reasons. First, the magnitude of trade liberalization in India was very big. In 1991, after decades of pursuing an import-substitution industrialization strategy, India initiated a drastic liberalization of its external sector. The average tariff in manufacturing declined from 117 percent in 1990–91 to 39 percent in 1999–2000. The reduction in tariffs was much more drastic in India than in the trade liberalization episodes in Latin American countries like Mexico, Colombia, and Brazil.

In addition to tariffs, India has also reduced nontariff barriers (NTBs) since 1991. The average import coverage ratio (the share of imports subject to nontariff barriers) declined from 82 percent in 1990–91 to 17 percent in 1999–2000. In fact, according to Aghion et al., 2003, the 1991 trade reform in India represented one of the most dramatic trade liberalizations ever attempted in a developing country.

Second, the trade reforms in India were exogenous and came as a surprise to the policy makers. In response to a severe balance of payments crisis in 1991, India approached the International Monetary Fund for assistance. The IMF support was conditional on structural reforms including trade

² For example, see Frankel and Romer (1999).

liberalization, which India launched. The government's objectives when reducing trade barriers were thus given by IMF conditionalities. From an industry perspective, the target tariff rates were exogenously predetermined and policymakers had less room to cater to special lobby interests. Hence, the Indian trade liberalization episode offers an excellent natural experiment to examine the causal impact of trade reforms on the labor market.

We use a dataset that combines micro-level data from the National Sample Survey Organization (NSSO) with data on international trade protection for the years 1980–2000. The empirical strategy in this paper uses variation in industry wage premiums and trade policy across industries and over time. Industry wage premiums are defined as the portion of individual wages that accrues to the worker's industry affiliation after controlling for worker characteristics. Since different industries employ different proportions of skilled workers, changes in wage premiums translate into changes in the relative incomes of skilled and unskilled workers (Blom et. al., 2004; Goldberg and Pavcnik, 2004).

First, we analyze industry wage premiums in the manufacturing sector in India. The main finding is that large differences in wages across industries exist for seemingly similar workers in terms of observable characteristics. Also, the structure of industry wage differentials in India has changed over time. Labor market rigidities seem to be a plausible explanation for the existence of wage premiums in India.

Next, we examine empirically the impact of trade liberalization on industry wage differentials. The existing studies on the relationship between trade policy and industry wage premiums in developing countries yield mixed conclusions (e.g. Goldberg and Pavcnik, 2004, Blom et al., 2004, Feliciano, 2001). These studies find a positive or a statistically insignificant relationship between changes in trade policy and changes in wage differentials over time. In contrast, we find a strong and negative

relationship between changes in trade policy and changes in wage differentials. The negative relationship is robust to instrumenting for tariffs and to including measures of nontariff barriers. Our result is similar to Goh and Javorcik (2005) who find in the case of Poland that reduction in tariffs within an industry is associated with an increase in wage premium within that industry. However, unlike Goh and Javorcik (2005), our results are robust to using an instrumental variables strategy.

We also find that the magnitude of tariff reductions are relatively larger in sectors with a higher proportion of unskilled workers. Since the sectors with the largest tariff reductions experienced an increase in wages relative to the other sectors, this implies that the unskilled workers benefited relative to skilled workers. Thus, the findings in this paper suggest that trade liberalization has led to decreased wage inequality in India.

This paper is organized as follows. Section II presents the background of India's trade liberalization, Section III gives the predictions of the theoretical models, Section IV presents the empirical strategy, Section V describes the data and the evidence, and Section VI discusses the results. Section VII concludes.

II. BACKGROUND OF INDIA'S TRADE LIBERALIZATION

Following independence from the British rule in 1947, India embarked on a socialist strategy of development, which envisaged a heavy role for the government and the public sector in shaping India's economy and industrialization. The trade regime till the early 1980s was characterized by high nominal tariffs and nontariff barriers coupled with a complex import licensing system. In addition, India's tariff structure was very complex with a myriad of exemptions applicable to the basic duty rate. During the late 1980s, the government took the first steps towards reducing state control on the external and domestic industrial policy fronts. Steps were taken to ease industrial and import

licensing, replace quantitative restrictions with tariff barriers, simplify the tariff structure. Importantly, this was the first instance of a three-year trade policy. There were conscious efforts to dismantle the import licensing regime via reductions in the number of products listed under banned/restricted category (Das, 2003). However, these measures were less than comprehensive and left a lot to be desired. Figures 1A and 2 show that till 1991, the levels of protection were very high—in 1991, the average tariff rate was 117 percent and the import coverage ratio was 82 percent.

The years 1989–91 were marked by difficulties, both on the economic and political fronts. As the new government took over in 1991, India was facing an impending external payments crisis with foreign currency assets less than US\$1 billion, just enough to cover two weeks of imports. The Government of India requested a Stand-By-Arrangement from the IMF in August 1991 and entered into an IMF-supported program. In addition to deficit reducing policies, a wide array of policies spanning the external, trade, industrial, public sector, financial and banking sectors were implemented. The export-import policy (EXIM policy) of 1992–97 reaffirmed India’s commitment to freer trade. All import licensing lists were eliminated and a “negative” list was established. Except consumer goods, almost all capital and intermediate goods could be freely imported subject to tariffs. By April 2002, all the remaining quantitative restrictions were also removed.

III. PREDICTIONS OF THE THEORETICAL MODELS

Trade liberalization could affect industry wage premiums in perfectly competitive product and factor markets if there is short-run immobility of labor (specific factors model). In this case, trade liberalization would reduce the relative returns to the factor specific to the sector in which tariffs are

reduced more. Trade liberalization could also affect wages in perfect competition models if workers are heterogeneous. Reduction in tariffs could affect relative wages by changing the composition of workers.

Introducing imperfect competition in product and factor markets introduces additional channels through which trade liberalization can affect wage premiums. Trade liberalization could affect wage premiums by affecting capital or labor rents (Katz. et. al. 1989). It is also possible that unions extract part of the rents from protection in the form of more jobs rather than higher wages (McDonald and Solow, 1981). In this case, trade liberalization might not have any effect on relative wages but only affect employment. Grossman (1984) considers what happens when random layoff rules are replaced by seniority based layoff rules. Such a system induces senior workers to push for higher wages and junior workers to push for the low wages that prevent layoffs; the impact of trade liberalization then depends on the seniority structure of the union.

Liberalization induced productivity changes at the firm level may also impact industry wages. Most empirical work has established a positive link between liberalization and productivity (e.g., Harrison, 1994, for Côte D'Ivoire; Krishna and Mitra, 1998, for India, Pavcnik, 2000, for Chile, etc.). The increased threat of foreign competition raises innovation incentives by domestic producers, forcing them to restructure and increase their productivity. To the extent that productivity enhancements are passed through onto industry wages, relative wages would be positively correlated with trade liberalization.

IV. EMPIRICAL STRATEGY

The strategy to estimate the impact of trade policy on wages follows the industry wage premium methodology. The methodology has been used extensively in the trade and labor literature (Krueger and Summers, 1988; Dickens and Katz, 1987; Gaston and Trefler, 1994; Goldberg and Pavcnik, 2004; Blom et al., 2004). The idea is to exploit variation in wages and tariffs (and other trade policy measures) across industries and over time to identify the impact of trade on wages.

The estimation has two stages. In the first stage, the log of individual worker i 's wages, $\ln(w_{ijt})$ (working in industry j and observed at time t) are regressed on a vector of the worker's characteristics (H_{ijt}) like education, age, gender, geographical location, occupation, dummy for whether the worker is self employed, and a set of industry indicators (I_{ijt}) reflecting the worker's industry affiliation:

$$\ln(w_{ijt}) = H_{ijt}\beta_H + I_{ijt}wp_{jt} + \varepsilon_{ijt} \quad (1)$$

The coefficient on the industry dummy, the wage premium (wp_{jt}), captures the part of the variation in wages that is explained by the worker's industry affiliation. Following Krueger and Summers (1988), the estimated wage premiums are expressed as deviations from the employment-weighted average wage premium. The normalized wage premium can be interpreted as the proportional difference in wages for a worker in a given industry relative to the average worker in all industries with the same observable characteristics. The exact standard errors for the normalized wage premiums are calculated using the Haisken-DeNew and Schmidt (1997) two-step restricted least squares procedure. The first stage regressions are estimated separately for each year in the sample.

In the second stage, the industry wage premiums for different years are pooled, and then regressed on tariffs, and other trade-related measures. The second stage regression is specified in first differenced form as:

$$\Delta wp_{jt} = \eta \Delta T_{jt} + \gamma \Delta D_{jt} + \pi_t + \varepsilon_{jt} \quad (2)$$

where Δwp_{jt} is the change in industry wage premium for industry j between $t-1$ and t , ΔT_{jt} is the change in tariffs in industry j between $t-1$ and t , ΔD_{jt} denotes the change in trade-related variables other than tariffs, π_t is a vector of year indicators. The first differenced specification controls for unobserved industry specific heterogeneity. The second stage regression is estimated using weighted least squares, using the inverse of the standard error of the wage premium from the first stage as weights. This puts more weight on industries with smaller variance in industry premiums.

V. DATA DESCRIPTION

A. Trade Policy in India

The international trade data on India that we use in this paper is from Das (2003). This database covers 72 three-digit manufacturing industries, according to the National Industrial Classification 1987 (NIC-1987) for the period 1980–81 to 1999–2000.

Figure 1A shows the average tariff for the 72 manufacturing industries in the 1980s and the 1990s. The average tariff in manufacturing increased from 86 percent in 1980–81 to 117 percent in 1990–91, and then declined to 39 percent in 1999–2000. In comparison, the trade reforms in Brazil reduced the

average tariff level in manufacturing from about 60 percent in 1987 to 15 percent in 1998; in Colombia, from 50 percent to 13 percent between 1984 and 1998. Between 1980 and 1990, the average tariffs in Mexico decreased from 23 percent to 13 percent. Thus, the percentage point reduction in average tariffs between 1990–91 and 1999–2000 was more drastic in India than in the Latin American countries (Figure 1B).

The level of protection also varied widely across industries. The standard deviation of the tariff rate was 0.23 in 1980–81. Imports in two most protected sectors, textiles and cotton spinning, faced tariffs of 118 percent and 115 percent respectively. There was a considerable drop in the dispersion of tariff rates in the post-reform period. In 1999–2000, the standard deviation of the tariff rates dropped to 0.05.

The trade reform also changed the structure of protection across industries. Figure 2 plots the tariffs in 1980–81 and 1999–2000 in various manufacturing industries. The tariffs declined in all the industries, and the decline differed across industries. Table 1 shows the year-to-year correlations for the tariffs since 1990–91. The pair-wise correlations range from 0.42 to 0.96. The intertemporal correlation of Indian tariffs is significantly lower than the correlation in U.S. tariffs. The correlation between U.S. tariffs in 1972 and 1988 is about 0.98. The low year-year correlation in the case of India is comparable to that in Brazil and Colombia (Blom et al., 2004, Goldberg and Pavcnik, 2004).

In addition to tariffs, India also reduced nontariff barriers (NTBs) since 1991. The measure of nontariff barriers we use is the “import coverage ratio” which is defined as the share of imports subject to nontariff barriers. Figure 3 shows the average import coverage ratio in manufacturing in the 1980s and 1990s. The average import coverage ratio declined from 82 percent in 1990–91 to 17 percent in 1999–2000.

B. National Sample Survey Data

The household survey data is drawn from the Employment-Unemployment Schedule of the National Sample Survey Organization (NSSO) administered by the Government of India. We use data from four survey rounds conducted in 1983–84 (38th round), 1987–88 (43rd round), 1993–94 (50th round), 1999–2000 (55th round). The data are a repeated cross-section. The data provide information on weekly earnings, worker characteristics e.g., age, education, gender, marital status, occupation, industry of employment at three-digit National Industrial Classification (NIC-1987) and state of residence. We restrict attention to workers in the urban areas who work in the manufacturing sector. We include workers between the ages of 15 and 65, who are a part of the labor force and report positive weekly earnings. The measure of wages is weekly earnings in rupees, which are deflated by the consumer price index from the International Financial Statistics. Based on completed years of schooling, workers are divided into three categories—(i) primary or less: at most 5 years of schooling (ii) middle or secondary: 6–11 years of schooling (iii) higher secondary or more: at least 12 years of schooling.

VI. RESULTS

A. Estimation of Interindustry Wage Premiums

In the first stage, equation (1) is estimated separately for each round of the NSS. The logarithm of the individual worker's wages are regressed on the dummies for worker's industry affiliation, controlling for worker characteristics like age, age squared, dummies for education, marital status, gender, occupation, whether the individual is the head of the household and the state of residence. The first stage regression results are shown in Table 2.

The bottom part of the table shows the R-squared for the regressions with and without industry dummies. For example, in 1999–2000, the R-squared for the regression excluding industry dummies is 0.50 i.e., the worker characteristics and state indicators alone explain about 50 percent of the variation in log weekly earnings. Adding the industry indicators increases the R-squared to 0.55 i.e., the industry indicators account for 5 percent of the total variation in log weekly earnings. In general, the industry indicators explain about 4 to 7 percent of the variation in log weekly earnings.

The wage premiums are expressed as deviations from the employment weighted average wage premium. The standard errors are calculated by Haisken-DeNew and Schmidt (1997) procedure. The wage premiums are jointly statistically significant at 1 percent level (p -value = 0.00) in all the years. Many of the wage premiums are individually statistically significant as well.

There is moreover, considerable dispersion in the wage premiums across industries. The standard deviations range from 0.24 to 0.34 for the different years. In 1983–84, the three highest wage premium industries are zinc manufacturing, office, computing and accounting machinery, and ferro alloys, and the lowest wage industries are cotton spinning, matches, and weaving and finishing of cotton textiles on handlooms. For example, the estimate of wage premium in manufacture of fertilizer and pesticides (industry code = 301) is 0.314, and the estimate of wage premium in weaving and finishing of cotton khadi (industry code = 232) is -0.084 . These estimates imply that a worker with the same observable characteristics switching from leather footwear to khadi would observe a decline of 40 percent in weekly earnings ($0.314 - (-0.084)$).

The structure of wage premiums across industries has also changed over time. To examine the change in structure of the wage premiums, we look at their year-year correlations in Table 3. The correlation between the wage premiums in 1983–84 and 1999–2000 is 0.26, and the correlation between the

premiums in 1987–88 and 1999–2000 is 0.40. The Indian wage premiums are much less correlated over time than the wage premiums in the United States and Brazil (Krueger and Summers (1998), Goldberg and Pavcnik (2004)). The correlation coefficients are of the order of 0.9 for the United States (between 1974 and 1984) and Brazil (between 1987 and 1998). The low correlation between the wage premiums suggests that the structure of interindustry wage premiums changed significantly over time. Given that there were major trade reforms during the sample period, changes in trade policy could potentially constitute an explanation for the changing structure of the wage premiums.

One possible explanation for the existence of wage premiums in a developing country like India could be the lack of perfect mobility of labor across sectors. There is evidence of significant labor market rigidities in India (e.g., see Dutt, 2003; Fallon and Lucas, 1993). India is ranked forty-fifth for the degree of labor market flexibility in the Global Competitiveness Report (GCR, 1998). Employment security in India is regulated mainly on the basis of the Industrial Disputes Act of 1947 (IDA). According to the 1982 amendment of the IDA, any firm employing 100 or more workers requires permission from the government before laying off or retrenching its workers.

To test for evidence of labor reallocation between sectors, we also regress employment share of each industry, on tariff rates, industry and year indicators. The coefficient is 0.001 and is statistically insignificant. Thus, we do not find evidence for any significant employment sensitivity to trade shocks. This is consistent with the existence of labor market rigidities in developing countries. Various studies from other countries like Mexico and Colombia have found similar results (Revenga, 1997; Hanson and Harrison, 1999; Attanasio et al., 2004).

Another potential explanation for industry wage differentials could be varying degrees of union bargaining power across industries. If the industry wage differences are due to “strong” unions that

can raise wages without suffering severe employment losses in certain industries, we would expect to find less variability in wages across industries for nonunion workers (Krueger and Summers, 1988). However, this is not the case for India. In India, in 1993–94, non-union workers have slightly higher wage dispersion ($=0.389$) than union workers ($=0.340$).³ Additionally, there is also evidence that unions are not very powerful in India (Dutt, 2003). The Trade Union Act of 1926 provides for the registration and operation of trade unions. This act allows any seven workers to register their trade unions. This has led to multiplicity of unions with outsiders playing a prominent role. There is no procedure to determine the representative union, which would serve as a single bargaining unit. Also, the Industrial Disputes Act of 1947 confers upon the state the power to regulate labor-management relations. The inclusion of the state in the dispute settlement mechanisms complicates the bargaining process since the state itself is the dominant employer in the organized sector.

B. Industry Wage Premiums and Trade Policy

Preliminary Evidence

First we look at simple scatter plots to examine the characteristics of industries which had the greatest reduction in tariffs. Figure 4 shows the scatter plot for tariff reductions between 1983–84 and 1999–2000 and the tariffs in 1980. The raw data shows a strong and positive relationship between the tariff reduction in the two decades and the initial tariffs (coefficient= 0.66 , standard error= 0.09) i.e., the magnitude of tariff reductions were greater in those industries with the highest initial tariff in 1980. Figure 5 shows the scatter plot for tariff reductions between 1983–84 and 1999–2000, and the share of unskilled workers in 1983. Unskilled workers are defined as those having less than 12 years of completed schooling. The raw data show a strong and positive relationship between tariff reduction

³ Unfortunately, all the National Sample Survey rounds do not record the union/non-union status of the workers.

and share of unskilled workers i.e. the greatest tariff reductions were in sectors with the highest share of unskilled workers.

The tariff reductions were also the greatest in the low wage industries. Figure 6 shows the relationship between the magnitude of the tariff reductions and the wage premiums in 1983–84. There is a strong and negative correlation between the two (coefficient=-0.19, s.e.=0.12). Figures 4–6 are consistent with the evidence from Colombia, Brazil, and Mexico. The existing studies on Colombia, Brazil and Mexico have also found that the tariff reductions were the greatest in industries with high pre-liberalization tariffs, low wage premiums, and high share of unskilled workers (Goldberg and Pavcnik, 2004; Blom et al., 2004; Hanson and Harrison, 1999).⁴

Before analyzing the relationship between wage premiums and trade policy in a regression framework, we look at the scatter diagram (Figure 7) relating changes in tariffs and changes in industry wage premiums (1983–84 to 1988–89, 1988–89 to 1993–94, 1993–94 to 1999–2000). Each point in the scatter plot represents the change in tariffs and the change in wage premiums within an industry between two consecutive time periods. The plot illustrates a strong and negative relationship between changes in tariffs and wage premiums. The raw data show that the growth in wage premium is highest for those industries that had the greatest tariff reductions.

Second Stage Regressions: Wage Premiums and Tariffs

⁴ In India, sectors with high share of unskilled workers which received more protection also had lower import penetration ratio. Grossman and Helpman (1994) political economy model of protection predicts a negative correlation between import penetration ratio and protection for organized sectors. (See Goldberg and Pavcnik, 2004, for a similar explanation for Colombia).

In the second stage regression, the estimated industry wage premiums are regressed on tariffs, along with additional controls. The sample consists of all industries with available tariff information (72 industries). The results are shown in Table 4. Specification I shows the results for the first differenced specification corresponding to (2). The first differenced specification accounts for unobserved time-invariant industry specific factors. Specification II shows the results in levels without the industry indicators. Specification III shows the results in levels with industry indicators. Year indicators are included in all the specifications.

The estimate of the coefficient of tariffs is negative and statistically significant (at 5 percent in specifications I and III, and at 1 percent in specification II). The negative coefficient on tariffs implies that increasing protection in a particular industry lowers wages in that industry. A coefficient of -0.17 in Specification 1 indicates that if the tariffs are reduced from 50 percent to 0 percent in a sector, average wage in that sector increases by 8.5 percent (0.17×0.5).

Controlling for Nontariff Barriers:

As shown in Figure 3, nontariff barriers (NTBs) were also an important part of the trade liberalization process in India. We augment the basic regression to include our measure of NTBs—“import coverage ratio.” However, nontariff barriers are plagued with measurement errors and there is not much variation over time. Hence we focus on tariffs as our principal measure of trade policy and check the robustness of the coefficient on tariffs by including NTBs. We also augment the basic regression with import penetration ratios (defined as $\text{imports}/(\text{output} + \text{imports} - \text{exports})$). Some of the effects of NTBs may be captured indirectly through the import measures. The results are shown in Table 5. These regressions include only those industries for which we have data on tariffs, import coverage ratio and import penetration ratio. The coefficient on tariffs remain negative and statistically

significant (at least at 5 percent level) in all the specifications. The coefficient on the import coverage ratio is statistically insignificant in all the specifications.

C. Discussion of the Results

The negative relationship between tariffs and wage premiums in this paper is similar to the results for Poland and the United States. Goh and Javorcik (2005) also find that a decrease in industry tariff is associated with an increase in wage premium within that industry. However, unlike Goh and Javorcik (2005), our results are robust to using an instrument for trade protection. Gaston and Trefler (1994) also find a negative relationship between protection and wage premiums in the U.S. manufacturing industries in 1983. They also control for the simultaneity bias in the cross-sectional data by instrumenting for trade protection. The coefficient on tariffs becomes more negative in the instrumental variable regressions. However, unlike Gaston and Trefler who examine the relationship between trade and industry wage premiums using cross sectional data, we exploit both the variation across industries and over time which allows us to control for industry specific heterogeneity.

The results in this paper are in contrast to earlier work on Colombia, Mexico and Brazil. In case of Colombia, Goldberg and Pavcnik (2004) find a positive and statistically significant relationship between tariffs and wage premiums. In the case of Mexico, there is mixed evidence using data on workers earnings from two different sources. Revenga (1997) finds a positive relationship between industry wages and tariffs whereas Feliciano (2001) finds a negative but statistically insignificant relationship between industry wage premiums and tariffs. In their study of Brazil, Blom et al (2004) find a negative but statistically insignificant relationship between tariffs and wage premiums.

Goldberg and Pavcnik (2004) find that the coefficient on tariffs is negative when industry indicators are not included in the estimation. When industry indicators are included, or when the regression is estimated in first differences, they find that the sign of the coefficient is reversed from negative to positive. The reversal of the sign of the coefficient when the model is estimated in first differences is interpreted as the importance of time invariant political economy determinants of tariffs. Similar to Pavcnik and Goldberg (2004), we also find that the coefficient is negative when we estimate the regression without differencing (i.e., without controlling for time invariant industry specific heterogeneity (see Table 4, Column II). However, unlike them, we find that the coefficient remains negative even after first differencing (Table 4, Column I), but the magnitude of the coefficient does in fact decrease.

Dutt (2003) also looks at the impact of trade liberalization on wages in India. Unlike this paper which uses detailed micro level data allowing us to control for worker characteristics, Dutt (2003) uses highly aggregated data on wages by industry. He finds a negative and statistically significant relationship between growth rate of wages and tariffs within a sector. He finds that reduction in tariffs is associated with an increase in wage growth within a three-digit industry. However, he does not find a statistically significant relationship between changes in wage levels and changes in tariffs.

Why has the impact of trade reform on worker wages in India been different from Colombia, Brazil and Mexico? Unlike Mexico and Colombia, in Brazil, the structure of industry wages in India did not change over time. Blom et al (2004) suggest that this could be one possible explanation for the insignificant relationship between tariffs and industry wages in Brazil. Given that the structure of industry wage premiums has changed over time in India as well, the significant relationship between trade policy and industry wage premiums is not surprising. However, what is striking is the negative sign of the coefficient on tariffs unlike other developing countries.

The negative relationship between trade liberalization and industry wage differentials in the Indian case is consistent with liberalization induced productivity changes at the firm level. There is evidence that the 1991 trade reforms led to higher firm productivity in India (Krishna and Mitra (1998), Aghion et al. (2003), Topalova (2004)). Krishna and Mitra (1998) use firm-level data in the manufacturing sector from 1986-1993 and find some evidence of an increase in growth rate of productivity in the years following the reform. Aghion et. al. (2003) use state-industry level data from 1980 to 1997 and find that the 1991 liberalization in India had strong inequalizing effects, by fostering productivity and output growth in 3-digit industries that were initially closer to the Indian productivity frontier and which were located in states with more pro-employer labor institutions. Both Krishna and Mitra (1998) and Aghion et. al. (2003) use a post-reform dummy to capture the effect of liberalization. Topalova (2004) uses a panel of firm-level data and detailed trade data from 1989-2001 to examine the effect of India's trade reforms in the early 1990s on firm productivity in the manufacturing sector. She finds that a reduction in tariffs leads to higher levels and growth of firm productivity. To the extent that productivity enhancements are passed on to industry wages, reductions in trade barriers would be associated with increase in wages within an industry.

The relationship between trade policy and industry wage premiums has important implications for the impact of trade liberalization on wage inequality. Since different industries employ different shares of skilled workers, changes in industry wage premiums translate into changes in relative incomes of skilled and unskilled workers. Since the tariff reductions were relatively larger in sectors with a higher proportion of unskilled workers (Figure 5) and these sectors experienced an increase in relative wages, the unskilled workers experienced an increase in incomes relative to skilled workers. Thus, the findings in this paper suggest that trade liberalization has led to decreased wage inequality in India.

D. Endogeneity Issues

The industry fixed effects control for time-invariant unobserved industry specific heterogeneity. However, if there are unobserved time-varying industry specific factors that affect wages, they are not controlled for in the empirical specification. If the time varying, industry-specific factors are uncorrelated with the tariff rates, then the coefficient of interest would be unbiased. However, if they are correlated with the tariff rates, then the estimates would be biased. Some examples could be political economy factors that simultaneously affect tariff formation and industry wages or tariff changes in other industries etc. To address this concern, we apply an instrumental variables strategy. An ideal instrument should be highly correlated with tariffs and uncorrelated with the industry specific time-varying unobserved component of wages.⁵

To construct industry-specific time varying instruments, we look at what constitutes variation in tariffs across sectors, and over time. The post-1991 trade reforms in India were in response to a severe balance of payments crisis. By mid-1991, the foreign exchange reserves were only enough to sustain two-weeks of imports. India took external assistance from the IMF, and the trade reforms that followed were a part of the structural conditionalities agreed by India. Hence, the variation in foreign exchange reserves can be expected to be correlated with tariff changes over time. Figure 8 shows the evolution of foreign exchange reserves in India over time.

To explain the variation in tariff changes across sectors, following Goldberg and Pavcnik (2004), we use pre-reform tariffs in 1980 (1980 is the earliest period for which we have the tariff data), and the share of unskilled workers by industry (in 1983) as a determinant of tariff changes. We construct two

⁵ Since tariff rate is our principal measure of trade policy, we focus on instrumenting for the tariffs, assuming that NTBs are exogenous.

industry-specific time varying instruments for tariff reductions: (i) interactions of foreign exchange reserves with tariff rates in 1980 (ii) interactions of foreign exchange reserves with share of unskilled workers in 1983.

Table 6 shows the results from the instrumental variable regressions. The first stage regression results are shown in Table 6b. In the first stage, we relate the changes in tariffs (1983 to 1987–88, 1987–88 to 1993–94, 1993–94 to 1999–2000) to the instruments. Nontrade barriers and import coverage ratio are also included in the regressions. The first stage results indicate a strong and statistically significant relationship between the change in tariffs and the two instruments. The R-squared of the first stage regression is 0.65. The two identifying instruments are also jointly statistically significant in the first stage regression (F-statistic = 13.1, p-value = 0).

Table 6A shows the second stage regression results. The coefficient of tariff rate is negative and statistically significant at 1 percent. The magnitude of the estimate is bigger than the comparable non-IV estimate in Table 4 (Column I). Gaston and Trefler (1994) also find that the tariff coefficient becomes more negative when they instrument for trade protection using industry characteristics. We also do a test of over identifying restrictions to check the validity of the instruments. We fail to reject the over-identifying restrictions at 1 percent and 5 percent levels, thus supporting the validity of the instruments.⁶

⁶ The chi-squared test statistic is 0.1056 when we exclude difference in reserves interacted with share of unskilled workers in the IV regression, and is 0.2992 when we exclude difference in reserves interacted with tariffs in 1980 in the IV regression. The critical values of chi-squared with one degree of freedom is 6.64 and 3.84 at 1 percent and 5 percent levels respectively.

E. Additional Robustness Checks

One time varying and industry specific variable which can be expected to affect wage premiums and also be correlated with tariff changes is sector-specific capital. To check the robustness of the results, we include gross fixed capital formation by sector as an additional regressor. Goldberg and Pavcnik (2004) also use gross fixed capital formation as a measure of capital accumulation in their study on Colombia. The data on gross fixed capital formation is taken from the Annual Survey of Industries (2002). The results are shown in Table 7. Gross fixed capital formation is included in levels for 1983–84, 1987–88 and 1993–94. The coefficient on tariffs is very similar to those in Tables 4 and 5 (Column 1). The coefficient on our measure of nontariff barriers is also very similar to that in Table 5 (Column 1). Thus, the negative correlation between tariffs and wage premiums is not driven by our measure of capital accumulation.

VII. CONCLUSIONS

This paper investigates the effects of trade policy on wages in Indian manufacturing industries in the last two decades. The data set combines micro labor market data from the National Sample Survey with data on tariff and nontariff barriers. Our results suggest that there is a significant relationship between trade policy and industry wage premiums. We find that increasing protection in a sector lowers wages in that sector. In sectors with largest tariff reductions, wages increased relative to the economy-wide average. The results are consistent with liberalization induced productivity increases at the firm level, which get passed onto industry wages.

The findings in this paper are in contrast to studies on other developing countries like Colombia, Brazil, and Mexico, which have found either a positive or an insignificant relationship between trade policy and industry wage premiums. Our result is similar to the Gaston and Trefler (1994) study for

the United States and Goh and Javorcik (2005), who find a negative relationship between tariffs and industry wage premium. However, unlike Gaston and Trefler who use a cross-sectional data, our results are identified by using variation in wages and tariffs across industries as well as over time.

Since the tariff reductions were relatively larger in sectors with a higher proportion of unskilled workers and these sectors experienced an increase in relative wages, these unskilled workers experienced an increase in incomes relative to skilled workers. Thus, the findings in this paper suggest that trade liberalization has led to decreased wage inequality in India.

Table 1. Correlations of Tariffs Over Time

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00
1990-91	1									
1991-92	0.9	1								
1992-93	0.74	0.77	1							
1993-94	0.69	0.71	0.69	1						
1994-95	0.51	0.45	0.63	0.52	1					
1995-96	0.62	0.52	0.72	0.65	0.8	1				
1996-97	0.54	0.44	0.54	0.42	0.66	0.86	1			
1997-98	0.57	0.47	0.61	0.47	0.67	0.83	0.96	1		
1998-99	0.58	0.52	0.63	0.5	0.7	0.84	0.91	0.95	1	
1999-00	0.61	0.54	0.61	0.57	0.62	0.78	0.81	0.84	0.91	1

Table 2. Results From the Earnings Regression

	1983-84	1987-88	1993-94	1999-00
Age	0.0551*** (0.0038)	0.0651 *** (0.0043)	0.0553*** (0.0050)	0.0492*** (0.0041)
Age squared	-0.0006*** 0.0000	-0.0007*** (0.0001)	-0.0006*** (0.0001)	-0.0005*** (0.0001)
Female	-0.5760*** (0.0225)	-0.5151*** (0.0252)	-0.5067*** (0.0281)	-0.4107*** (0.0237)
Married	0.1109*** (0.0176)	0.1057*** (0.0205)	0.0906*** (0.0239)	0.0945*** (0.0195)
Self-employed	-0.2147*** (0.0526)	-0.0578 (0.0610)	-0.3348*** (0.0642)	-1.2940*** (0.1266)
Household head	0.1772*** (0.0169)	0.0979*** (0.0191)	0.1935*** (0.0220)	0.1293*** (0.0176)
Middle or secondary school	0.2811*** (0.0151)	0.2887 *** (0.0170)	0.2464*** (0.0197)	0.2251*** (0.0157)
Higher secondary or more	0.6849*** (0.0316)	0.6734*** (0.0302)	0.6128*** (0.0277)	0.6002*** (0.0216)
Constant	-0.1599 (0.0316)	-1.1028* (0.6576)	-0.6918*** (0.1734)	-0.3932*** (0.0943)
State indicators	Yes	Yes	Yes	Yes
Occupation indicators	Yes	Yes	Yes	Yes
Industry Indicators	Yes	Yes	Yes	Yes
R-squared with industry indicators	0.59	0.56	0.5	0.55
R-squared without industry indicators	0.52	0.5	0.44	0.5
Number of observations	9,309	9,083	8,570	7,855

***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Table 3. Correlation Matrix for Industry Wage Premiums

	1983–84	1987–88	1993–94	1999–00
1983–84	1			
1987–88	0.4788	1		
1993–94	0.3648	0.4767	1	
1999–00	0.2619	0.4033	0.4337	1

Table 4. Tariffs and Industry Wage Premiums

Dependent Variable: Inter-Industry Wage Premium

	I	II	III
Tariff rate	-0.174** (0.07)	-0.435*** (0.10)	-0.153** (0.07)
Year indicators	Yes	Yes	Yes
Industry indicators	No	No	Yes
First differencing	Yes	No	No
Number of observations	209	281	281

***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Table 5. Tariffs and Industry Wage Premiums: Controlling for Nontrade Barriers and Import Penetration Ratios

Dependent variable: Inter-Industry Wage Premium

	I	II	III
Tariff rate	-0.198** (0.0790)	-0.386*** (0.1000)	-0.146** (0.0720)
Nontariff barrier (import coverage ratio)	0.0000 0.0000	0.0000 (0.0010)	0.0000 0.0000
Import penetration ratio	-0.129 (0.1010)	0.114 (0.1180)	0.081 (0.1190)
Year indicators	Yes	Yes	Yes
Industry indicators	No	No	Yes
First differencing	Yes	No	No
Number of observations	176	236	236

***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Table 6A. Tariffs and Industry Wage Premiums: Instrumental Variable Regression

Dependent variable: Inter-Industry Wage Premium	
Tariff rate instrumented	-0.577*** (0.2260)
Import coverage ratio	-0.0002 (0.0004)
Import penetration ratio	-0.109 (0.0990)
Year indicators	Yes
First differencing	Yes
Number of observations	168

***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Table 6B. First Stage Instrumental Variable Regression

Dependent Variable: Tariff Rate	
Tariff rate in 1980 interacted with foreign exchange reserves	-0.295*** (0.0790)
Share of unskilled workers in 1983 interacted with foreign exchange reserves	-0.312* (0.1840)
Import coverage ratio	0.001* (0.0003)
Import penetration ratio	0.0820 (0.0860)
Year Indicators	Yes
First differencing	Yes
Number of observations	168
R-squared	0.65

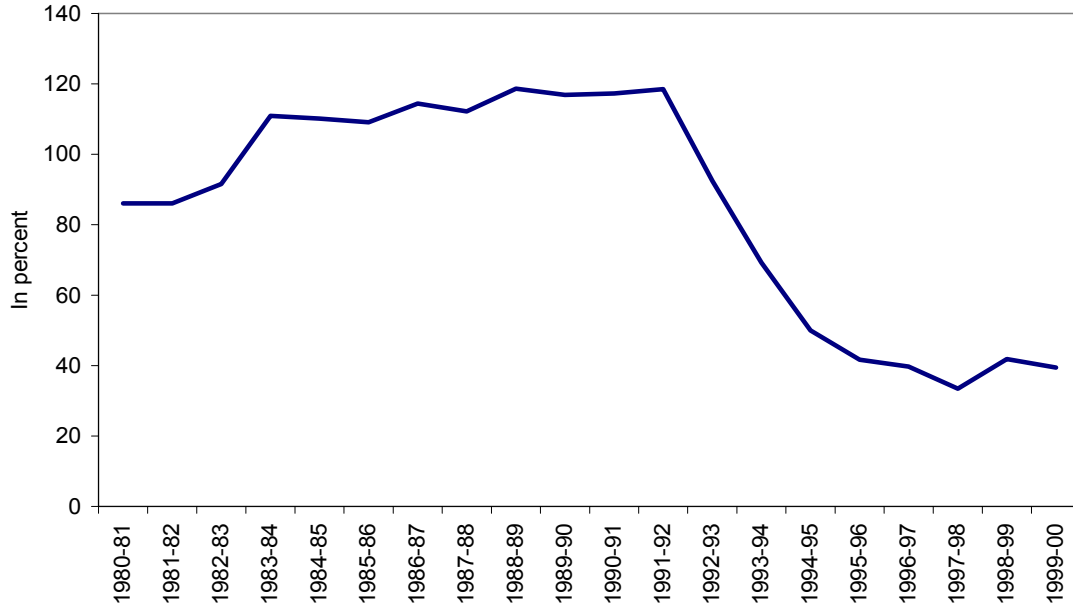
***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Table 7. Tariffs and Industry Wage Premiums: Controlling for Gross Fixed Capital Formation

	I	II
Nominal rate of protection	-0.16** (0.07)	-0.20** (0.08)
Import coverage ratio		-0.01 (0.01)
Import penetration ratio		-0.13 (0.10)
Gross fixed capital formation (in logs)	-0.01 (0.01)	-0.01 (0.01)
Year indicators	Yes	Yes
First differencing	Yes	Yes
Number of observations	199	167

***, **, * denote statistical significance at 1 percent, 5 percent, 10 percent, respectively. The standard errors are denoted in parentheses.

Figure 1A. Average Tariff Rates in Manufacturing
(1980-81 to 1999-2000)



The average tariff rates are for 72 three-digit manufacturing industries classified according to the National Industrial Classification 1987 (NIC-1987).

Figure 1B. Average Tariff Rates: India and Latin America
(1980-81 to 1999-2000)

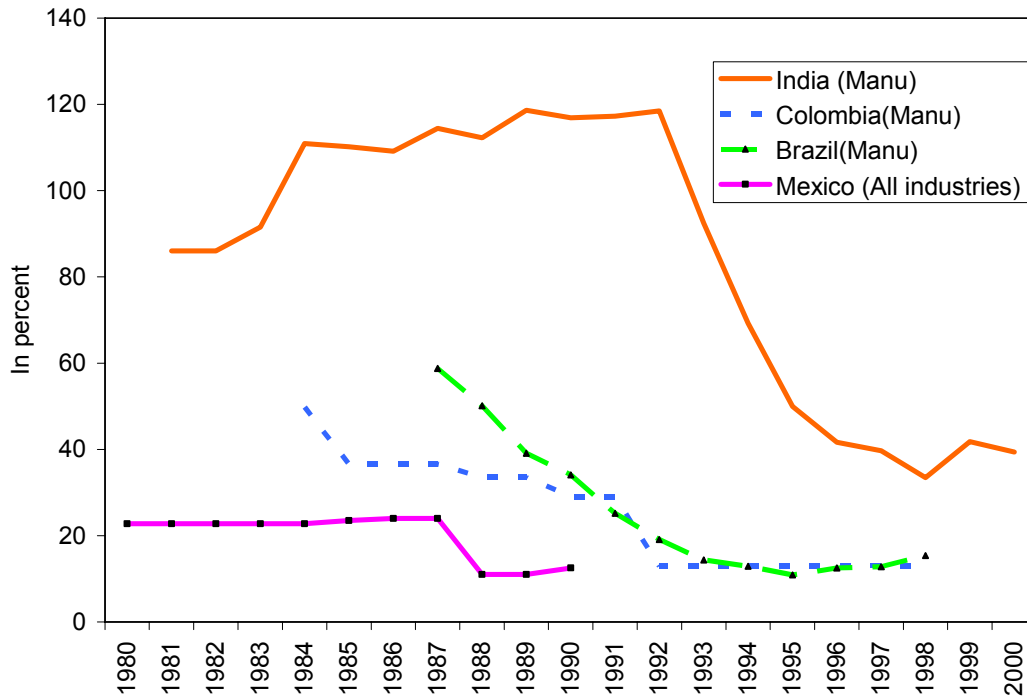


Figure 2. Tariffs Pre and Post Liberalization

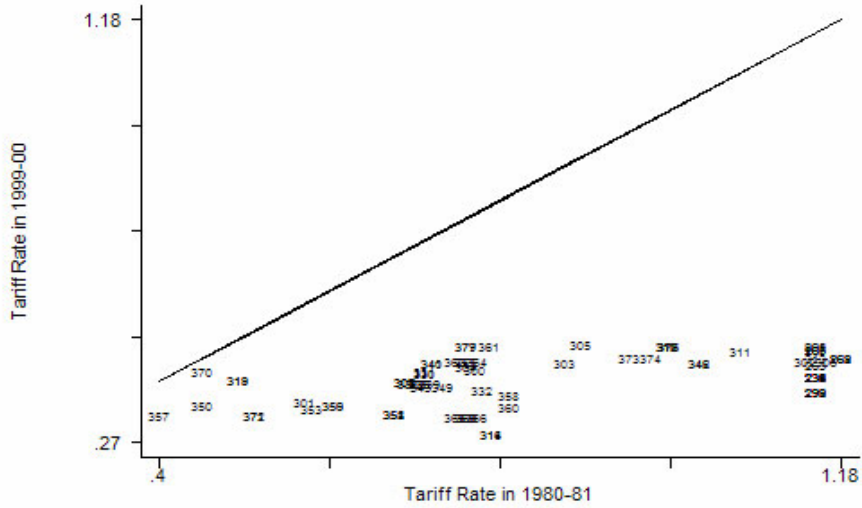
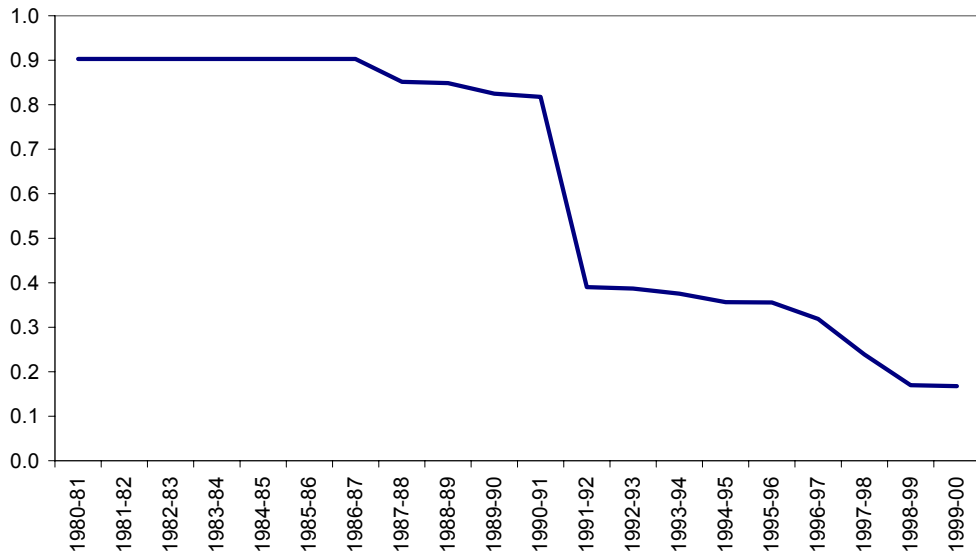
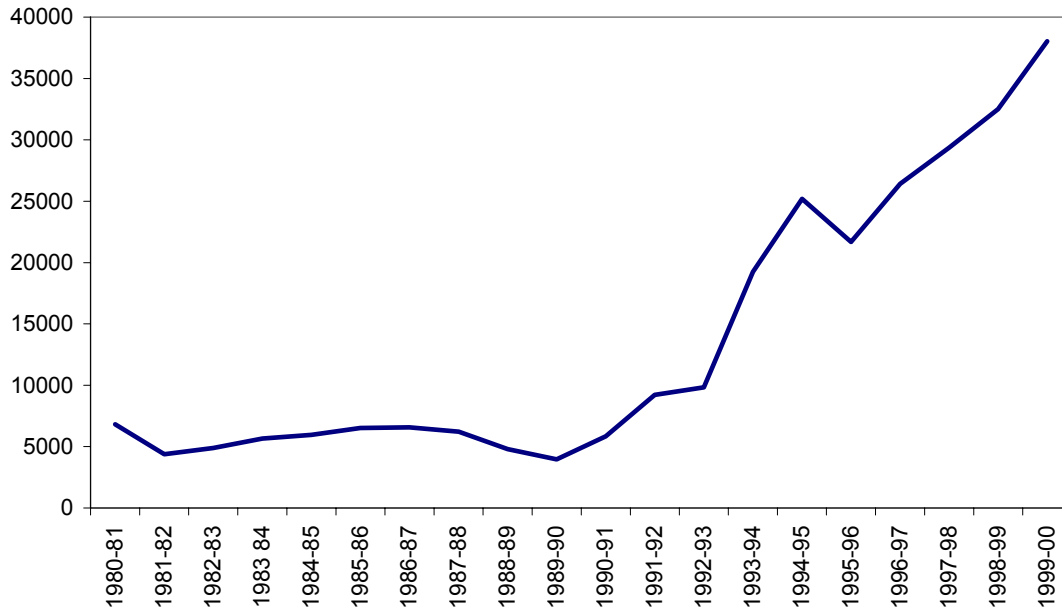


Figure 3. Non-Tariff Barriers: Average Import Coverage Ratio (1980-81 to 1999-2000)



Import coverage ratio is defined as the share of imports subject to nontariff barriers. The average import coverage ratios are for 72 three-digit manufacturing industries classified according to the National Industrial Classification 1987 (NIC-1987).

Figure 8. Foreign Exchange Reserves
(in U.S. dollar million, 1980-81 to 1999-2000)



Source: Reserve Bank of India

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