Trade Liberalization, Technology and Labor Market Outcomes: Evidence from India

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ABSTRACT. This paper looks at the impact of trade liberalization on labor market outcomes using data on Indian firms. Specifically, it examines the impact on employment and wages of reductions in tariffs that: (i) increase the import competition faced by domestic firms due to a fall in output tariffs; and (ii) lower the cost of importing foreign technology embedded in raw material and capital imports due to a fall in input tariffs. Further, motivated by recent studies that highlight the importance of firm level heterogeneity in understanding the impact of policy changes on firm behaviour and outcomes, our paper allows trade and labor market outcomes to differ by firm-characteristics, including their location across environments with rigid versus flexible labor regulations and the industry in which they operate.

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1. Introduction

A large literature highlights the role played by trade liberalization in influencing firm performance. While one strand of the literature focuses on the impact of a fall in the output tariff (the tariff on the final good produced by a firm) and heightened import competition on firm behaviour and industrial performance, another focuses on the impact of a fall in input tariffs, which can improve the access of domestic firms to foreign technology via imported intermediate inputs and capital goods.

A fall in the output tariff can lead to increased firm productivity and quality upgrading in firms (Topalova and Khandelwal (2011), Amiti and Khandelwal (2013)). Increased competition resulting from a fall in protection can also lead to reallocation of market share from low-productivity to high-productivity firms. With increased competition, firms may see a downward shift in demand (assuming they face a linear demand curve) and a flatter demand curve given that more substitutes are now available to the consumer. High-productivity (and hence low-cost) firms may be able to expand by squeezing their mark-ups and/or may invest in R&D and upgrade quality, while low-productivity (high-cost) firms contract. This will lead to an increase in firm employment for some firms and a contraction for others. Quality upgrading is typically associated with the employment of more skilled workers, which is likely to push up the wage. Similarly, by providing access to foreign technology via imported intermediate inputs and capital goods, Amiti and Konings (2007), Topalova and Khandelwal (2011) and Shanthi Nataraj (2011) show productivity improvements for firms from trade liberalization, where a fall in the input tariff lowers the cost of importing higher-quality intermediate inputs from abroad, boosting firm performance. Goldberg, Khandelwal, Pavcnik and Topalova (2010) argue that trade liberalization and the resultant access to imported foreign intermediates can allow firms to expand the range of products they produce.

Fewer studies focus on employment and wage outcomes, though trade liberalization and the resultant access to foreign technology via imports of intermediates and capital goods can alter the mix of capital, labor and intermediates employed by firms, affecting employment and wages. In a recent paper, Krishna, Poole and Senses (2014) study the impact of trade liberalization on wages differentially across exporting and non-exporting firms. Accounting for compositional effects and allowing for endogeneous worker assignment to firms, they find an insignificant differential impact. Lee, Mitra and Ranjan (2015) look at the impact of input cost reductions on employment in Korean firms and find

that these effects differ across industries with differential substitutability between inputs and across exporters and non-exporters.

In this paper, we propose to ask similar questions, but hope to extend the analysis by arguing that domestic factor-market rigidities that affect the implicit costs of both capital and labor are likely to interact with trade liberalization effects, thereby affecting employment and wages in firms. India serves as a unique case study in this context, since institutions differ substantially across Indian states, allowing us to exploit cross-state variation in factors like the stringency of labor market regulation to identify differential impacts of trade liberalization on firm outcomes (Besley and Burgess, 2004). The detailed nature of our data also allows us to look at trade liberalization effects on the composition of labor at the firm-level between skilled and unskilled and hence on the skill premium.

We use unit (enterprise)-level data from the Annual Survey of Industries for the years 1998-2012 sourced from the Central Statistical Organization, India. The data contain information on enterprise location (state), production and non-production labor, physical capital, wages, intermediate inputs used, inputs imported, products produced and exports. Our analysis involves delving into the relationship between output and input tariff reductions and employment and wage outcomes at the firm-level in a regression framework.

2. Conceptual Framework and Empirical Specification

We study the relationship between trade liberalization, captured by a fall in tariffs, and employment and wages in Indian manufacturing firms. With increased competition resulting from a fall in protection, firms may see a downward shift in demand (assuming they face a linear demand curve) and a flatter demand curve given that more substitutes are now available to the consumer. High-productivity (and hence low-cost) firms may be able to expand by squeezing their mark-ups and/or may invest in R&D and upgrade quality, while low-productivity (high-cost) firms contract. This will lead to an increase in firm employment for some firms and a contraction for others. In this way, there may be a reallocation of market share from low-productivity to high-productivity firms. As for wages, quality upgrading is typically associated with the employment of more skilled workers. This is likely to push up the wage. In summary, our hypothesis is that a lower output tariff and subsequent import competition is likely to be associated with heterogeneous effects on employment across firms and with higher wages paid to employees.

As regards the effect of lower input tariffs, the resulting access to cheaper and a wider variety and quality of intermediate inputs would be associated with an outward shift in labor

demand and hence, greater employment and wages, particularly in sectors where firms are less able to substitute toward cheaper imported inputs and where imported inputs are complementary to domestic labor. Better access to higher quality intermediate inputs from advanced economies will also lead to higher wages. Finally, we anticipate dampened effects of tariff changes on employment and wages in states without flexible labor regulation as reallocation of labor may be hampered by labor market rigidities.

To empirically analyze the relationship between tariffs and firm employment and wages, we estimate the following equation:

$$\ln(Y_{isjt}) = \beta_0 + \beta_1 Output\ tariff_{jt} + \beta_2 Input\ tariff_{jt} + \gamma_{1,is} + \mu_{1,t} + \epsilon_{1,isjt} \quad (2.1)$$

Here, Y_{ijt} refers to employment or the wage in firm i in state s industry j at time t. $Output\ tariff_{jt}$ and $Input\ tariff_{jt}$ refer to the output and input tariff for sector j at time t respectively. $\gamma_{1,i}$ and $\mu_{1,t}$ are firm and year fixed effects respectively. $\epsilon_{1,ijt}$ is the idiosyncratic error term. We also look at heterogeneous effects of the output and input tariff across industries and Indian states. We estimate:

$$\ln(Y_{isjt}) = \alpha_0 + \alpha_1 Output\ tariff_{jt} + \alpha_2 Input\ tariff_{jt} + \alpha_3 Output\ tariff_{jt} * Inflex_s + \alpha_4 Input\ tariff_{jt} * Inflex_s + \alpha_5 Input\ tariff_{jt} * X_j + \gamma_{2,is} + \mu_{2,t} + \epsilon_{2,isjt} \quad (2.2)$$

$Inflex_s$ is a dummy that equals one if labor laws are not flexible in state s. X_j for industry j includes the proportion of differentiated inputs obtained from Nunn (2007) and the average skill intensity of inputs weighted by the input share of each input industry. Firm fixed effects account for unobserved firm-specific shocks correlated with the tariff and the labor variables jointly to the extent that such shocks do not vary significantly over time. For example, firms with better management practices may be more likely to exist in sectors with lower protection and might employ more workers and pay them a higher wage. Year fixed effects control for annual shocks common to all firms in our sample.

From our discussion earlier, while we have no prior on the sign of β_1 in the case of employment, we expect $\beta_1 < 0$ in the case of wages paid. We hypothesize that $\beta_2 < 0$ for both employment and wages, α_3 and $\alpha_4 < 0$ and $\alpha_5 < 0$. Finally, the detailed nature of our data allow us to disentangle the effect of tariffs on various categories of employees including workers, managers, workers employed directly and ono contract. The latter is of interest

since rigid labor regulation might induce firms to substitute workers employed directly to employing them on flexible contractual arrangements.

3. Data

We use data on Indian manufacturing firms in fifteen major Indian states from the Annual Survey of Industries for the years 1998-99 through 2006-07. The Annual Survey of Industries collects data on registered manufacturing enterprises. Large enterprises employing more than hundred workers are sampled every year while medium and small enterprises are sampled in such a manner that each industry group is represented in each state. We use sampling weights provided with the data in all our estimations.

The data provide information on the location of the firm, industry of operation, total employment, employment of workers, supervisory staff and managers, workers employed directly and on contract and on wages paid to employees in each of these categories, allowing us to disentangle the effect of tariffs on various types of employment. Tables 1 (a) and (b) provide mean employment and the wage rate (annual, nominal) by year for the different categories of employees[4]. We see an overall increase in total employment in Indian firms over the sample period 1998-99 through 2008-09. The total number of workers employed directly by the firm is shrinking over time, while the number of contract workers among firms employing them is rising steeply. This suggests a growing role for contract labor among Indian manufacturing firms. Table 1 (b) shows that the mean wage rate for contract workers is lower than that for workers directly employed across all years.

In Tables 1 (c) and (d), we report mean employment and wages for the year 2006 across states with flexible and inflexible labor regulation and across industries of varying levels (three quantiles) of input skill intensity and proportion of differentiated input use. From rows (1) and (2) of Table 1 (c), we observe that firms in states with more flexible labor regulation are much larger on average, particularly in the use of workers (as opposed to managerial staff). From the first two rows of Table 1 (d), these firms also pay higher wages, except for contract labor, which is paid about the same in both types of states. From rows (3) through (6) of each table, we see that firms that use more skill-intensive inputs use fewer workers and more managers and also pay higher wages across the board relative to firms in industries using less skill intensive inputs, consistent with more sophisticated technology use. Similarly, we note that firms that use the largest proportion of differentiated inputs (quantile

[4] Note that our regressions include year fixed effects to account for inflation.

3) use fewer workers relative to managers and pay higher wages in comparison to firms in industries using a smaller proportion of differentiated inputs. Results from Tables 1 (c) and (d) therefore indicate heterogeneity in employment and wages across industries and states.

Tariff data are applied tariff rates obtained from the World Bank's WITS database, which reports tariff information from the WTO's Integrated Data Base (IDB) (accessed in April 2014). Tariff rates are provided by HS4 categories, which are then matched to the product classification used in India's Input-Output transactions tables. This is then matched to the two-digit industry classification under the Indian industrial classification system (NIC 98) used in the firm data. Table 1 (e) shows a sharp fall in mean output and input tariffs during the period of our analysis. The mean output tariff fell from 33 percent in 1998 to 11 percent in 2008. The mean input tariff feel from 28 percent in 1998 to 10 percent in 2008.

Data on rigidity of labor laws across Indian states is derived from Gupta, Hasan and Kumar (2009). We define skill intensity of each input as the ratio of workers with higher secondary education or greater as a ratio of total workers in the input sector. Input skill intensity for the sector is then derived as the average skill intensity of inputs weighted by the share of each input sector derived from India's Input-Output Transactions Table (1998-99).

4. Results

4.1 Trade, Employment and Wages

Table 2 (a) presents results for specification (2.1) with employment as the dependent variable and Table 2 (b) with the firm-level wage rate as the dependent variable. Columns focus on the different categories of employees. Column (6) in Table 2 (a) estimates a linear probability model, where the dependent variable is a dummy variable that equals one if a firm employs workers on contract. Focussing on Table 2 (a), we find that the output tariff has no significant association with firm employment. This holds for all categories of workers. This is consistent with the idea that an increase in import competition is likely to have heterogeneous effects across firms, with low-productivity firms contracting at the expense of high-productivity firms.

We find that as hypothesized, the input tariff is associated with greater employment in firms. A ten percentage point decrease in the input tariff is associated with a five percent increase in total employment. This effect comes from an increase in employment of workers. Additionally, columns (5) and (6) show that a lower input tariff is associated with an increase in the likelihood of employing workers on contract and conditional on such employment, an increase in employment of workers on contract. This evidence lends support to the idea that

with rigid labor markets, like in India, firms may substitute toward employing workers on contracts for greater flexibility as they expand in response to shocks.

In Table 2 (b), we focus on wages. We find that a lower output tariff is associated with lower wages, particularly of employees employed on a contract. A ten percentage point decrease in the output tariff is associated with a decrease of five percent in the wage for contract workers. However, we find that a ten percentage point decrease in the input tariff is associated with an increase in the wage rate of eight percent among managers and of 10 percent among contract workers. Again, these results are consistent with margins of adjustments to trade occurring among contract workers rather than among workers directly employed for the firm, suggesting a role for labor regulation. Finally, the positive effect of a fall in the input tariff on the wage rate for managers is suggestive of the potential use of a wider variety and better quality of intermediate inputs being associated with changes in managerial skill composition or incentives.

4.2 Heterogeneous Trade Effects

Our results in the previous section show that the effects of trade reform work as hypothesized, but primarily on contract workers employed by the firm, pointing toward a role for labor regulation in determining labor market outcomes. In this section, we explore our results further and ask if trade liberalization effects on employment and wages differ across states with rigid and flexible labor regulation. In addition, our hypothesis is that a fall in the input tariff and a greater variety and quality of imported intermediate inputs will lead to greater employment particularly in industries where these inputs are complements rather than substitutes for in-house production labor. These are likely to be industries that use differentiated or skill-intensive inputs that cannot easily be substituted with (and in fact, may complementary to) imported intermediate inputs.

We examine these hypotheses by estimating specification 2.2 Table 3 (a) presents results with employment as the dependent variable, and Table 3 (b) with wage as the dependent variable. From Table 3 (a), column (6), we observe a negative coefficient on the interaction term between the input tariff and input skill intensity, suggesting that a fall in the input tariff is associated with a greater increase in the probability of employing contract workers in industries that use more skill intensive inputs. Additionally, from column (5), conditional on employing contract workers, a fall in the input tariff is associated with a greater increase in the probability of employing contract workers in industries that use more skill intensive and differentiated inputs, consistent with our hypothesis.

Results in Table 3 (b) show that while the relationship between tariffs and the wage do not differ across industries, the positive and significant coefficient on the interaction between the input tariff and the dummy 'inflex' indicates that the input tariff is associated with a lower wage in states without flexible labor laws relative to other states, particularly for workers employed directly by the firm. One plausible reason for this differential effect is that for workers employed directly in states with stringent labor laws, firms compensate workers directly employed by providing welfare or other benefits that they are not required to pay contract workers. Overall, results in Tables 3 (a) and (b) demonstrate substantial heterogeneity in the effects of trade liberalization on employment and wages at the firm level across industries and states.

5. Conclusion

We find that the impact of trade liberalization on employment and wages at the firm level differ across industries and states with varying levels of flexibility in labor laws. While we do not find a significant relationship between a fall in the output tariff and labor outcomes, we find that a fall in the input tariff is associated with greater employment and wages, particularly in industries that use more differentiated and skill intensive inputs. The effect on wages is mitigated in states with less flexible labor laws. Results indicate that firms mainly adjust contract labor. Our study thus suggests that the impacts of trade may be heterogeneous based on technology or the institutional environment in which firms operate.

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Table 1 (a): Mean Employment

Year	Employment				
	Total	Workers	Managers	Direct	Contract
1998	75.71	55.86	12.21	50.04	51.70
1999	72.45	55.84	9.87	46.97	68.88
2000	70.81	55.10	7.31	43.72	64.93
2001	69.99	54.50	7.25	42.53	63.94
2002	71.86	56.59	7.07	43.67	68.50
2003	70.92	55.53	7.26	41.60	69.48
2004	72.69	57.42	7.26	41.90	72.07
2005	76.77	60.99	7.49	42.90	76.98
2006	80.27	63.87	7.81	44.08	77.88
2008	86.22	67.56	8.55	45.13	88.43

Annual Survey of Industries and authors' calculations

Table 1 (b): Mean Wage

Year	Annual Wage rate (Rupees, nominal)				
	Total	Workers	Managers	Direct	Contract
1998	31306.08	25639.07	69596.08	26421.40	22661.91
1999	34281.40	27780.82	79511.67	28609.39	25303.41
2000	36297.08	29316.27	86441.55	30235.71	26414.39
2001	38638.46	30569.70	95899.93	31896.78	27478.11
2002	41475.30	32535.60	104074.60	33958.83	29196.70
2003	43266.89	33726.72	108192.60	35424.71	29754.67
2004	46145.98	35396.19	121929.30	37423.44	31618.65
2005	49856.66	37278.30	137413.80	39677.88	32309.17
2006	53944.01	39833.48	155376.50	42661.52	34804.45
2008	70077.41	49157.85	219348.00	52658.60	45448.00

Annual Survey of Industries and authors' calculations

Table 1 (c): Mean Employment for 2006

	Employment				
	Total	Workers	Managers	Direct	Contract
Inflex states	77.39	59.84	8.19	39.84	73.28
Flex states	83.65	68.61	7.37	49.07	84.26
Input skill intensity: 1	88.53	76.66	5.47	54.60	75.32
Input skill intensity: 2	78.14	57.99	9.55	38.79	85.07
Input skill intensity: 3	70.65	52.25	9.12	35.12	73.83
Input differentiation: 1	101.58	82.12	9.35	57.35	100.87
Input differentiation: 2	44.83	36.12	4.05	20.58	50.13
Input differentiation: 3	92.62	71.29	10.17	53.52	89.59

Annual Survey of Industries and authors' calculations.
Inflex state is a state with labor laws that are not flexible (pro-employer). Input skill intensity refers the proportion of medium and high skilled workers from India's employment survey employed in industries used as inputs, weighted by the input share of each industry from the IOTT 1998. Input differentiation refers to the proportion of inputs used in production that are differentiated, obtained from Nunn (2007). Numbers 1, 2 and 3 refer to quantiles 1, 2 and 3 with 1 being the lowest and 3 the highest.

Table 1 (d): Mean Wage for 2006

Year	Annual Wage rate (Rupees, nominal)				
	Total	Workers	Managers	Direct	Contract
Inflex states	49813.82	37521.55	140860.70	39474.02	35175.23
Flex states	57458.25	41800.62	168078.80	45432.35	34291.57
Input skill intensity: 1	39414.24	32119.59	112232.50	34273.65	28534.36
Input skill intensity: 2	59092.97	42055.28	162064.40	44868.41	38056.34
Input skill intensity: 3	69089.69	48525.11	203453.20	51134.95	42602.68
Input differentiation: 1	51813.47	38105.43	145788.30	40524.73	35161.74
Input differentiation: 2	43613.00	33916.72	123066.30	36870.40	29629.54
Input differentiation: 3	69498.64	49469.53	201643.30	51809.77	43955.47

Annual Survey of Industries and authors' calculations.
Inflex state is a state with labor laws that are not flexible (pro-employer). Input skill intensity refers the proportion of medium and high skilled workers from India's employment survey employed in industries used as inputs, weighted by the input share of each industry from the IOTT 1998. Input differentiation refers to the proportion of inputs used in production that are differentiated, obtained from Nunn (2007). Numbers 1, 2 and 3 refer to quantiles 1, 2 and 3 with 1 being the lowest and 3 the highest.

Table 1 (e): Output and Input tariffs

Year	Mean Output Tariff	Mean Input Tariff
1998	33.1	28.1
1999	33.6	30.3
2000	33.2	29.7
2001	31.2	28.5
2002	28.2	25.9
2003	28.1	25.9
2004	28.1	25.9
2005	16	16.8
2006	13.8	12.5
2008	11.3	10

Tariff data are applied tariff rates obtained from the World Bank's WITS database, which reports tariff information from the WTO's Integrated Data Base (IDB) (accessed in April 2014).

Table 2 (a): Tariffs and Employment

	(1) Total	(2) Workers	(3) Managers	(4) Direct	(5) Contract	(6) P(Contract)
Output tariff	0.000	0.001	0.001	-0.001	0.008	0.001
	[0.002]	[0.003]	[0.002]	[0.002]	[0.009]	[0.001]
Input tariff	-0.005*	-0.007**	-0.003	-0.004	-0.025*	-0.003*
	[0.003]	[0.003]	[0.003]	[0.003]	[0.013]	[0.001]
Observations	234,099	234,099	199,849	220,418	62,313	234,099
R-squared	0.952	0.941	0.914	0.939	0.931	0.821

Data are for the years 1998-2008 (minus 2007) for Indian registered manufacturing firms from the ASI. Tariffs are two digit industry tariffs. Total employment does not include unpaid family workers or the proprietor. Column (6) uses a dependent variable that is a dummy equal to one if the firm employs a positive number of contract production workers. Column (5) only includes those firms that use contract workers. Regressions include firm and year fixed-effects. Standard errors are clustered at the 2 digit industry level.

Table 2 (b): Tariffs and Wages

	(1) Total	(2) Workers	(3) Managers	(4) Direct	(5) Contract
Output tariff	-0.001	-0.001	0.000	-0.001	0.005***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]
Input tariff	-0.004***	-0.001	-0.008***	-0.002	-0.010***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.003]
Observations	234,099	234,099	199,376	220,411	62,290
R-squared	0.930	0.906	0.892	0.910	0.904

Data are for the years 1998-2008 (minus 2007) for Indian registered manufacturing firms from the ASI. Tariffs are two digit industry tariffs. Regressions include firm and year fixed-effects. Column (5) only includes those firms that employ contract production workers. Standard errors are clustered at the 2 digit industry level.

Table 3 (a): Trade and Employment – Interaction effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Workers	Managers	Direct	Contract	P(Contract)
Output tariff	0.001	0.001	0.003	0.001	0.004	-0.000
	[0.003]	[0.003]	[0.003]	[0.003]	[0.009]	[0.001]
Output tariff x Inflex state	-0.000	-0.000	-0.002	-0.000	-0.005	0.001
	[0.003]	[0.003]	[0.003]	[0.004]	[0.007]	[0.002]
Input tariff	-0.000	-0.001	-0.004	-0.006	0.032**	0.004
	[0.009]	[0.009]	[0.010]	[0.010]	[0.014]	[0.003]
Input tariff x Inflex state	0.005	0.004	0.005	0.005	0.003	-0.000
	[0.004]	[0.004]	[0.003]	[0.005]	[0.009]	[0.002]
Input tariff x Skill intensity	-0.010	-0.011	0.000	-0.001	-0.047*	-0.011**
	[0.014]	[0.014]	[0.014]	[0.017]	[0.024]	[0.005]
Input tariff x Nunn measure	-0.000	0.000	-0.000	0.000	-0.019***	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.006]	[0.001]
Observations	208,469	208,469	177,180	196,402	53,826	208,469
R-squared	0.958	0.948	0.922	0.947	0.937	0.833

Data are for the years 1998-2006 (minus 2007) for Indian registered manufacturing firms from the ASI. Tariffs are two digit industry tariffs. Total employment does not include unpaid family workers or the proprietor. Nunn measure refers to the proportion of inputs used in production that are differentiated. Skill intensity refers to input skill intensity and is the proportion of medium and high skilled workers from India's employment survey employed in industries used as inputs, weighted by the input share of each industry from the IOTT 1998. Inflex state is a state with labor laws that are not flexible (pro-employer). Column (5) only includes firms using contract workers. Regressions include firm and year fixed-effects. Standard errors are clustered at the 2 digit industry level.

Table 3 (b): Trade and Wages – Interaction effects

	(1)	(2)	(3)	(4)	(5)
	Total	Workers	Managers	Direct	Contract
Output tariff	0.000	0.001	0.001	0.001	0.007
	[0.002]	[0.002]	[0.003]	[0.002]	[0.006]
Output tariff x Inflex state	-0.001	-0.002	0.001	-0.002	-0.005
	[0.002]	[0.002]	[0.003]	[0.002]	[0.007]
Input tariff	-0.003	-0.006	0.002	-0.004	-0.002
	[0.006]	[0.006]	[0.007]	[0.006]	[0.011]
Input tariff x Inflex state	0.004	0.006**	0.000	0.006**	0.008
	[0.002]	[0.002]	[0.004]	[0.003]	[0.008]
Input tariff x Skill intensity	-0.004	0.001	-0.017	-0.003	-0.013
	[0.008]	[0.008]	[0.011]	[0.009]	[0.011]
Input tariff x Nunn measure	0.000	-0.000	0.003	0.000	-0.001
	[0.002]	[0.001]	[0.003]	[0.002]	[0.003]
Observations	208,469	208,469	176,733	196,399	53,809
R-squared	0.934	0.912	0.899	0.915	0.910

Data are for the years 1998-2006 (minus 2007) for Indian registered manufacturing firms from the ASI. Tariffs are two digit industry tariffs. Total employment does not include unpaid family workers or the proprietor. Nunn measure refers to the proportion of inputs used in production that are differentiated. Skill intensity refers to input skill intensity and is the proportion of medium and high skilled workers from India's employment survey employed in industries used as inputs, weighted by the input share of each industry from the IOTT 1998. Inflex state is a state with labor laws that are not flexible (pro-employer). Column (5) only includes firms using contract workers. Regressions include firm and year fixed-effects. Standard errors are clustered at the 2 digit industry level.