

Working Paper
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DETERMINANTS OF INDUSTRIAL
DISPUTES: EVIDENCE FROM INDIAN
MANUFACTURING INDUSTRY

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November 2015

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An earlier version of this paper was presented at a seminar in CDS. The author has benefited from the comments and suggestions from Prof. Manmohan Agarwal, Prof. Amit Shovan Ray, Prof. K N Harilal, Prof. K J Joseph and Dr. Vinoj Abraham. Comments and suggestions from an anonymous referee is also thankfully acknowledged.

ABSTRACT

This paper examines the determinants of industrial disputes in Indian manufacturing industry. The study is in the context of drastic decline in the number and intensity of industrial disputes in India. Compared to the existing studies, determinants of three dimensions of industrial disputes, namely number of disputes, number of workers involved and number of mandays lost are examined by segregating them into strikes and lockouts. The study shows that contract labour and import competition have significant negative effect on industrial disputes. It is also found that strikes are more responsive to contract labour and lockouts are more responsive to import competition. The study also shows that female presence in the labour force is significantly reducing the number of strikes and lockouts.

Keywords: labour market, industrial disputes, contract labour, strikes, lockouts

JEL Code: J52, F16, F63, F66

Introduction

This paper examines determinants of industrial disputes in Indian manufacturing industry. There is at least two factors that motivated analysis of this issue. First, industrial disputes, consisting of strikes and lockouts, constitute an important source of disruption in production activity in India. Besides causing production loss¹, industrial disputes discourage investment and thereby slowdown economic growth.²As we shall see later, there is a drastic reduction in the number of industrial disputes and the mandays lost due to disputes in Indian manufacturing industry. It is argued that labour laws in India granted excessive bargaining power to the labour, making industrial disputes more likely (see: Besley and Burgess 2004, and Anant, Hasan, Mohapatra, Nagaraj, and Sasikumar 2006). However, this decline in industrial disputes happened without any major change in the related labour laws.³ Hence, it is curious to analyse the factors determining industrial disputes in Indian manufacturing industry. Second, there is a dearth of studies in

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1. For instance, in the year 1997 the total number of industrial disputes was 1305. Of this, 657 disputes caused a production loss of 436.25 crore and 730 created a wage loss of 49.50 crore. In manufacturing, in the same year, 281 disputes out of 744 caused production loss of 366.21 crore and 296 disputes resulted in wage loss of 24.41 crore (Labour Bureau, 1999).
 2. See Besley and Burgess (2004) for empirical evidence on the impact of industrial relations climate on manufacturing growth in the context of India.
 3. In fact, with 1982 and 1984 amendment to Industrial Dispute Act 1947 labour laws became more stringent in the pro-worker direction (see: Anant, Hasan, Mohapatra, Nagaraj, and Sasikumar, 2006).

India and in international context analysing the factors determining various dimensions of industrial disputes.⁴ In this paper, determinants of three dimensions of disputes in an industry, namely (a) number of disputes, (b) number of workers involved and (c) number of mandays lost are examined by segregating them into strikes and lockouts.

The paper is organised in the following five sections. Section one discusses trends in industrial disputes in India. Section two discusses the theoretical literature on the determinants of industrial dispute. This section also provides a brief review of the empirical literature on the determinants of industrial disputes. Section three explains the empirical model, data and variables. Section four discusses the estimation and results and the last one concludes the paper. Summary measures and additional results are presented in an Appendix.

1. Industrial Disputes in India: Data and Trend

Using the definitions given in the Industrial Disputes Act of India 1947, Labour Bureau, Ministry of Labour, Government of India collects and publishes statistics on Industrial disputes, which consist of strikes and lockouts. An industrial dispute is taken as a temporary stoppage of work in a production unit due to breakdown of understanding between workers and employers on some issue. Strike is defined as the temporary stoppage of work by a group or all employees of a production unit to express a grievance or to enforce a demand. Lockout is defined as the temporary withdrawal of work from all or a group of employees by the employer for matters relating to employment or non-employment or the terms and conditions of employment. The industrial dispute statistics exclude work-stoppages due to political strikes, sympathetic demonstrations and the like as these are not connected with any specific grievances or demand which lies within the competence of the employer concerned for redressal.

4. A brief review of the empirical literature is given at the end of section 2.

The statistics published annually by the Labour Bureau on industrial disputes covers only those disputes involving ten or more workers whether directly or indirectly. The statistics consists of number of disputes, number of workers involved, and the number of mandays lost.⁵ These information are provided separately for disputes (i.e. strikes plus lockouts), strikes and lockouts.⁶ Number of workers involved is the maximum number of workers affected directly or indirectly on any day during the entire period of the work-stoppage. The number of mandays lost is calculated by adding up the actual resultant absence caused directly or indirectly by the work-stoppages, in each shift of the potential working day, excluding weekly off and other scheduled holidays when the establishment would have otherwise remained closed even without any work-stoppages. Number of mandays lost, a measure of the impact or cost of industrial disputes, is said to be the most comprehensive measure as it incorporates duration, size and frequency dimensions of disputes.

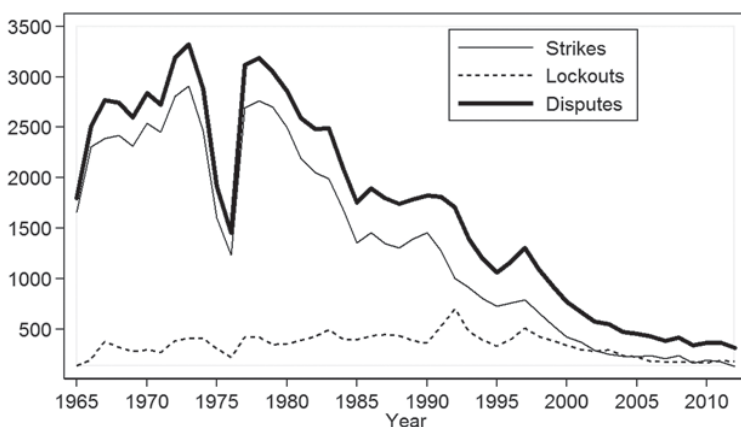


Figure 1. Number of Industrial Disputes in India (All Sectors)

5. It also gives information on wages lost and value of production lost in disputes, but not for all reported disputes.
6. For a detailed discussion on the conceptual issues behind strike statistics in India see Sundar (1994), also see Rao (1985).

Figure 1 shows the trends in the number of disputes, strikes and lockouts for all sectors during 1965 to 2012. Number of disputes is the sum of number of strikes and lockouts and number of workers involved in disputes and number of mandays lost in disputes are defined in the same way⁷. The figure shows that the period 1965–1980 recorded very high level of industrial disputes in India and strikes accounted for a larger share. Because of the higher frequency of strikes during this period some authors have characterised this as a period of labour militancy (Sundar, 2004; Saha and Pan, 1994). Lockouts, which account for a small fraction of total disputes, initially increasing and then showing a declining trend.

From the 1980 onwards the number of disputes has been declining fastly because of the dramatic reduction in the number of strikes. In 1980, number of disputes, strikes and lockouts were respectively 2856, 2497 and 359. By 2000, these were reduced respectively to 771, 426, and 345. And further declined respectively to 318, 185, and 133 in 2012. The number of lockouts has been declining almost continuously from around mid 1990s.

Given the large fluctuations in the data, we may not be able to identify various phases in the trajectory of industrial disputes by eyeballing its graph against time. Therefore, we use Bai and Perron (1998) procedure for estimating various phases in the evolution of industrial disputes in India. The procedure essentially implies estimating the following regression model with breaks in both parameters, α and β .

$$n_t = a + bt + u_t$$

7. The long time series data on industrial disputes in India was compiled from the two annual publications of the Labour Bureau, namely *Indian Labour Statistics* and *Indian Labour Yearbook*. For manufacturing we could collect data only from 1980 onwards and that is only for total number of disputes, number of workers involved and number of mandays lost in disputes.

where n_t is the log value of number of disputes or strikes or lockouts in the t^{th} year and t is the time trend. Bai and Perron's procedure estimates the breakpoints in the above regression model by minimising the sum of residual squares and Bayesian Information Criteria (BIC) is used to determine the number of breaks ⁸.

Application of the above procedure revealed that disputes series has two breakpoints, 1976 and 1999, implying three phases 1965 to 1975, 1976 to 1998 and 1999 to 2012. We also estimate the growth rate of the number of disputes in each phase using Boyce (1986) methodology. The results are reported in the Table 1. It also reports the R^2 of the respective regression, useful for assessing the fit of the model with breaks. The number of strikes has been declining from 1976 and the rate of decline nearly doubled from 1999 onwards. However, the number of lockouts has been declining only from 1990, that is also at a relatively lower rate.

Table 1. Rate of change of number of disputes (All Sectors)

	Phase I	Phase II	Phase III	R^2
Disputes	2.9 [1965-1975]	-4.7 [1976-1998]	-9.73 [1999-2012]	0.95
Strikes	3.11 [1965-1975]	-6.46 [1976-1998]	-11.66 [1999-2012]	0.95
Lockouts	3.22 [1965-1989]	-4.9 [1990-2012]		0.69

Notes: The reported growth rates are in per cent and the brackets contains the period of the growth rates.

8. For further details on Bai and Perron's procedure see Bai and Perron (2003).

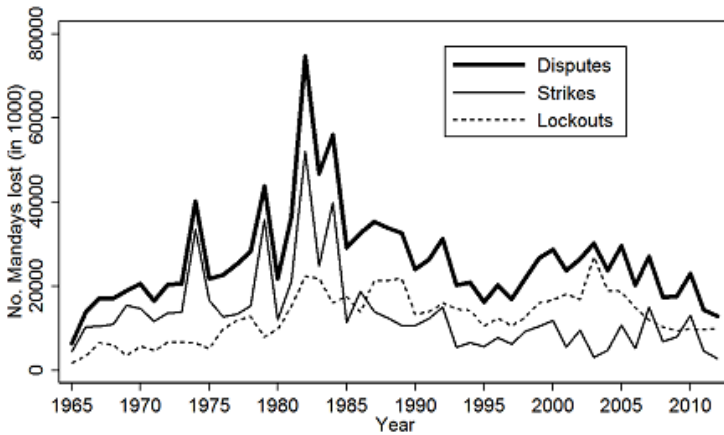


Figure 2. Number of mandays lost in disputes (All sectors)

Figure 2 presents the trends in the number of mandays lost for all sectors. The number of mandays lost was increasing till around mid 1980s and then declining with great fluctuations. From mid 1980s onwards number of mandays lost in lockouts were higher than that due to strikes except during two years after 2005. This has prompted some authors to denote the post 1980 period as a period of employer militancy (Sundar, 2004; Saha and Pan, 1994). One of the factors behind the increased number of mandays lost during the post 2000 period is the increase in the average number of workers involved in a dispute.

Table 2. Growth rate of number of mandays lost (All sectors)

	Phase I	Phase II	Phase III	R ²
Disputes	8.72 [1965-1980]	-3.62 [1981-1996]	-1.19 ⁺ [1997-2012]	0.57
Strikes	3.8 [1965-1983]	-5.05 [1984-2012]		0.46
Lockouts	10.75 [1965-1980]	0.5 ⁺ [1981-1997]	-2.46 [1998-2012]	0.75

Notes: The reported growth rates are in per cent and the brackets contains the period of the growth rates. + indicates growth rate not significantly different from zero.

Table 2 reports the period-wise growth rates of number of mandays lost. From 1984 onwards the number of mandays lost in strikes has been declining at the rate of -5.05 per cent a year and number of mandays lost in lockouts is also declining from 1998 onwards.

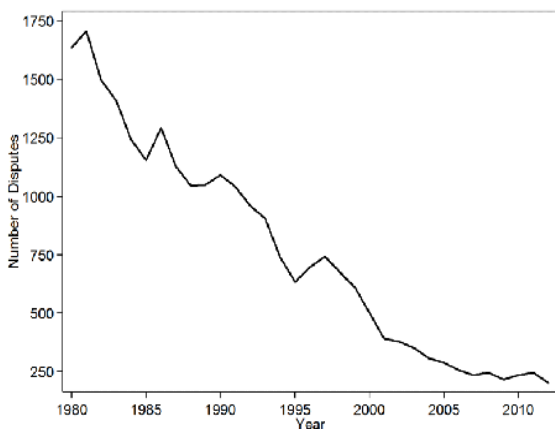


Figure 3. Number of Disputes in Manufacturing

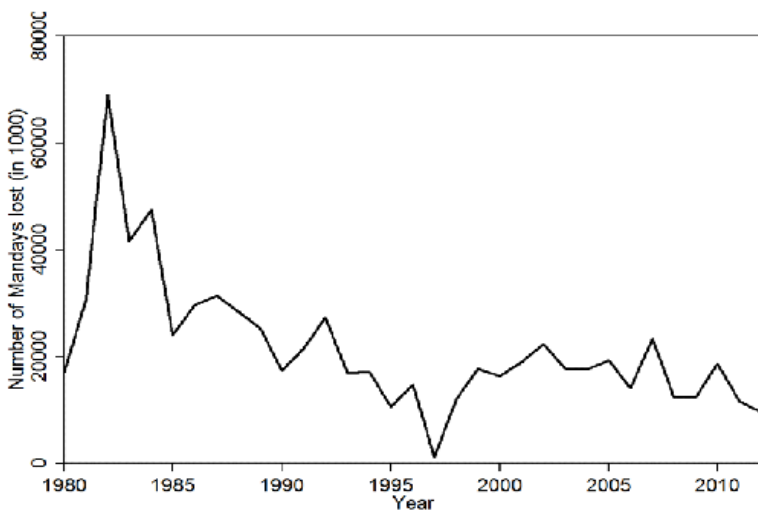


Figure 4. Number of mandays lost in disputes in manufacturing

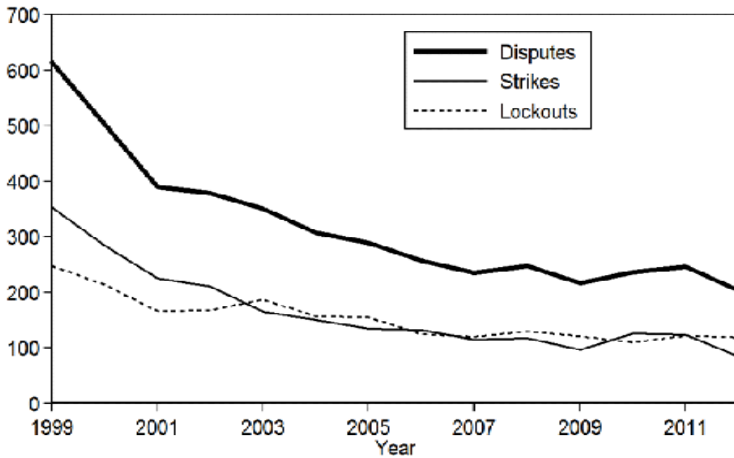


Figure 5. Number of Strikes and Lockouts in Manufacturing (1999 to 2012)

Regarding the disputes in manufacturing industry, the data show that during the period 1980 to 2012 the share of manufacturing in the total number of industrial disputes is highly stable and the average is 62 per cent. The corresponding figure for mandays lost is 75 per cent. In manufacturing the number of disputes has been declining drastically during the period 1980-2012 (see Figure 5). The decline is almost continuous from 1997 onwards. The number of mandays lost due to disputes in manufacturing has been declining from 1980 to around 1995 and then its level has gone up (see Figure 4). In manufacturing, the size of the dispute, as measured by the average number of workers involved in a dispute, is higher after the mid-1990s, resulting in increased number of mandays lost.

Table 3 presents growth rate of the number of disputes and number of mandays lost in manufacturing over two phases. It shows that from 1999 onwards the number of disputes has been declining at a faster rate. And the number of mandays lost has no significant trend after 1998 as the decline in the number of disputes has been offset by the increase in the average size of the disputes.

Table. 3 Growth rate of disputes in manufacturing (in %)

	Phase I	Phase II	R ²
Number of disputes	-6.25 [1980-1999]	-8.7 [2000-2012]	0.97
Number of mandays lost	-6.87 [1980-1997]	2.08 ⁺ [1998-2012]	0.34

Notes: The reported growth rates are in per cent and the brackets contains the period of the growth rates. + indicates growth rate not significantly different from zero.

Figure 5 presents the trends in the number of strikes and lockouts in manufacturing during 1999-2012. During this period number of both strikes and lockouts are declining almost continuously. However, during this period the number of mandays lost due to strikes and lockouts are not showing any particular trend owing to great fluctuations in the average size of a dispute .

2. Determinants of industrial disputes: Theory

Theoretical literature on strikes and lockouts are based on three sets of ideas. (1) Existence of asymmetric information when firm and union bargain over wages (Hayes, 1984; Cramton and Tracy, 1994). (2) *Joint-cost* hypothesis of Reder and Neumann (1980), and (3) Reputation building models of Calabuig and Olcina (2000); Kreps and Wilson (1982); Milgrom and Roberts (1982). The basic idea of asymmetric information models of strike is that firm has private information about its willingness to pay and union has bargaining power and strike is an instrument employed by the unions to elicit the private information of the firm. A highly profitable firm, which is really willing to pay more, prefers to avert a strike by accepting higher wage settlements. On the other hand, a less profitable firm, which is unable to pay high, chooses to endure a strike in order to settle at a lower wage. Models of lockouts, on the other hand, assume that firm has bargaining power and union

members have private information regarding their alternative wage and lockout is the mechanism firms use to force union members to truthfully reveal their alternative wage (see: Fisher, 2001).

The joint cost hypothesis, introduced by Reder and Neumann (1980), postulates that whatever be the reasons for dispute, if it is too costly to both parties combined, then they have great incentive to avert this cost by devising alternative methods of dispute resolution. In reputation models of dispute both parties lack information about the nature of the other player, whether tough or a normal player. Therefore, both firm and union have great incentive to engage in activities in order to convince each other that they are “tough” bargainers (Calabuig and Olcina, 2000; Kreps and Wilson, 1982; Milgrom and Roberts, 1982). In these models union might periodically call strikes to keep the threat of strike credible.

Against this background of general theoretical literature on disputes, following paragraphs discuss the potential determinants of industrial disputes, keeping in mind the case of Indian manufacturing industry.

Import competition: Competition from import can reduce the frequency and intensity of industrial disputes through two channels. (1) By reducing the extent of information asymmetry between firm and union. Heightened competition from import can increase the vulnerability of the firm in the market. The firm has to maintain a low cost of production to protect its market share, profitability and future growth. In this context, a firm’s position that it cannot accept the demanded wage hike because it increases cost of production drastically and thereby place the firm in a difficult situation would appear more credible to the workers. Similarly, firm’s claim that a strike, whatever be the reason, would reduce its market share, profitability and future growth would be more credible in an industry facing increased competition from import. (2) In an open trade policy regime cost of disputes can be higher for both the parties. A work-stoppage, when the firm is facing stiff competition from import, can turn some of the customers to foreign suppliers. This

would also give foreign suppliers an opportunity to set up their distribution channels and after sale service centres in the domestic market. All these can permanently reduce the firm's market share and future growth. Therefore, it is quite plausible to expect that both the firm and the union would try to avoid work-stoppage and adopt less costly methods for bargaining and negotiations.⁹ Mauleon and Vannetelbosch (2010) examines the impact of trade openness on strikes in a model in which international trade occurs between economies with imperfectly competitive product market and unionised labour market. Both the union and the firm have private information. In an integrated product market, each firm-union pair has stronger incentive to have lower wages and to concede earlier in order to gain as well as to maintain a larger market share of the product in each country.

Union Coverage: An important factor determining the industrial dispute, particularly the strikes is the coverage of the union among workers. Strikes are quite possible in industries where majority of the workers are affiliated trade unions compared to an industry in which workers are not unionised.

Concentration in the domestic market: If domestic market of an industry is highly concentrated, then firms in that industry may try to maintain that position by avoiding work-stoppages. Disruption in the supply due to work-stoppages provides other suppliers, including foreigners, to seize a part of the market share. Further, domestic market power can also result in rent sharing between workers and the firm and in this case workers may also be reluctant to adopt strategies like work-stoppages that would erode firm's position in the market.¹⁰

9. For instance, while reviewing the emerging trends in employment relations Sundar (2010) states "There are several instances where trade unions have understood the financial position of the company and have offered their co-operation in various ways" (p.591).

10. In this context see Nickell (1999).

Wage rate: Wage is expected to have a negative effect on disputes, particularly on the number of disputes. First, a higher wage implies that cost of strikes and lockouts in terms of lost wage would be higher for the workers and therefore they may prefer to adopt alternative methods of dispute resolution. Second, workers having higher wage rate are usually more educated and trained and therefore they may be good negotiators, enabling them to conduct negotiations without disrupting production. However, a higher wage rate also give some savings to the workers enabling them to participate in strikes if a strike happens, particularly in contexts when there is no strike funds. In this case, real wage can have a positive effect on the number of workers involved and number of mandays lost in strikes.

Export status: An exporting firm has great incentives to avoid work-stoppages due to strikes and lockouts. Frequent work-stoppages disrupt supply schedules and force the importers in the foreign countries to look for alternative sources. Therefore it is of very important for the firm to maintain a healthy industrial relations and adopt efficient methods for handling differences.

Contractualisation of labour: Bargaining power of workers can be drastically reduced by employing contract workers. Contract workers are those workers who are employed by the firm not directly but through a contractor¹¹. Contract workers cannot bargain with the firm employing them. The share of contract workers in the total workers in Indian manufacturing industry increased significantly during the post liberalisation period (see: Das, Choudhury, and Singh 2015). And it is argued that it significantly reduced the bargaining power of the workers.

11. On the basis of employment status, workers can be classified into direct workers and contract workers. Direct workers are those workers who are directly employed by the firm. Total workers in a factory is the sum of direct workers and contract workers.

Presence of female workers: Large presence of female workers in the total direct workers can have a negative effect on the frequency and extent of industrial disputes. This is attributed to the widespread female aversion to militancy as well as to the fact that female workers are concentrated in industries where workers are poorly unionised (see: Tracy, 1986; Shorey, 1976).

Public sector presence in the industry: Public sector enterprises can be different when it comes to industrial disputes. The difference is attributed to the decision making structure of the public sector enterprises, sense of collective ownership on the part of the workers and the threat of privatisation that has been there during the post 1991 period. In the public sector many decisions related to workers need to be approved by the concerned department or ministry, and therefore brief strikes may be required to convey as well as to convince the higher administration about the seriousness of the issue.

Rate of profit: A higher profit in a year is expected to reduce the industrial disputes in the subsequent year. Higher profit enable a firm to accept a high wage settlement, besides giving signal to the workers about the financial position of the firm.

Size of the plant: The loss in output due temporary stoppages in production owing to disputes is higher greater the size of the plant in terms of output. Therefore, if the size of the plant is higher, firms make more efforts to avoid production stoppages.

Here we would like to review some empirical studies examining the determinants of industrial disputes. The existing studies are mainly in the context of US. For instance, Tracy (1986); Abowd and Tracy (1988); Cramton and Tracy (1994) studied the determinants of US labour disputes. These studies considered the impact of variables such as import competition, female presence in the labour force, and union coverage. In Indian context, the previous studies include Bean and Holden (1992);

Chaudhuri and Pal (2005) and Saha and Pan (1994). Bean and Holden (1992) examined the effect of union density and election year on number of strikes using time series data. Saha and Pan (1994) one considered the impact of unionisation, wage rate and average plant size on the number of mandays lost in disputes. And Chaudhuri and Pal (2005) considered the importance of state level factors in determining industrial disputes.

3. Empirical model, variables and data

This paper considers the determinants of three dimensions of industrial disputes in an industry, namely (1) Number of disputes, (2) Number of workers involved and (3) Number of mandays lost in disputes using regression. The impact on these dimensions are examined separately for disputes (strikes plus lockouts), strikes and lockouts. We take the following variables as determinants of industrial disputes in an industry.

Tariff rate and import penetration rate: To capture the impact of foreign competition on industrial disputes, we use two variables (1) tariff rate and (2) import penetration rate. Tariff rate is the weighted average of effectively applied tariff rates in the industry, where weights are the trade value of corresponding tariff line¹². Import penetration rate is defined as the ratio of import to domestic demand in an industry, where domestic demand is equal to output plus import minus export. These two variables are expected to capture different aspects of increased competition through trade openness. Lower tariff, which indicates potential competition from import, does not always generate greater competitive pressure because of other barriers to trade such as absence of distribution channels and after sale service facilities for the imported goods as well as due to cultural barriers to trade. Import penetration rate, on the other hand, captures the actual foreign competition an industry

12. Effectively applied tariff is defined as the lowest available tariff. If a preferential tariff exists, then it is the effectively applied tariff rate; otherwise the MFN tariff rates (see: World Bank, 2011, page.95). It is also noted that results are invariant to use of weighted average of MFN tariffs.

faces.¹³ Further, as we shall see in the result section the use of these two variables to capture import competition also helps us to see differential response of lockouts and strikes to tariff and import penetration.

Real wage: Real wage is obtained by deflating the average annual wage in an industry by the consumer price index for industrial workers.

Export Intensity: To capture the export status of the industry we use its export intensity, which is defined as the ratio of export to total output of the industry.

Cost share of labour: Share of wage cost in the total cost of production is used to capture the importance of labour in the production process. However, the direction of impact of this variable is not clear. Greater importance of labour in the production process can incentivise the firm to adopt efficient methods for managing its labour relationships in order to avoid disruptions in production. On the other hand, higher importance of labour can incentivise the unions to bargain more which can lead to more production stoppages. This variable is defined as the ratio of wage cost to the total cost of production in the industry.

Share of contract workers: To capture the effect of contract labours on industrial disputes we use share of contract labour in the total workers in the industry.

Share of female workers: Presence of female workers in the total workforce is captured by taking the share of female workers in the total direct workers.

Union Coverage: The extent of unionisation is captured by the union coverage, which is defined as the ratio of number of workers having union membership to total number of direct workers in that industry.

13. In our sample the correlation coefficient between import penetration rate and tariff rate is not very high, only -0.32, suggesting that they are not substitutes for our purpose.

Share of public sector workers: This is the ratio of workers in the public sector enterprises to total workers in the industry.

Number of factories: This variable is used to control for the size of the industry. The number of strikes and lockouts in an industry increases with the number of factories operating in that industry.

Herfindhal index: Herfindhal index is used to control for the concentration in domestic market and it is computed using firms' sales in the domestic market.

Share of Profit (first lag): This is the first lag of share of profit in the net value added.

Average plant size: This variable is obtained by dividing the total output by the number of factories in an industry.

Number of workers and Potential number of mandays: The number of workers involved in disputes in an industry increases with the number of workers in that industry. Therefore, this variable is used to control for the size of the industry in the regression on number of workers involved. Similarly, to control for the size of the industry in the regression on number of mandays lost, we use potential number of mandays, which is defined as the sum of number of mandays employed and number of mandays lost due to disputes.

3.1 Data sources and period of study

The study uses data from following sources. Tariff data were obtained from TRAINS database through World Integrated Trade Solution Software (WITS)¹⁴. Herfindhal Index of domestic concentration was constructed using the firm level data extracted from electronic database PROWESS of Centre for Monitoring Indian Economy (CMIE). Other variables were constructed using data collected from various issues

14. See World Bank (2011).

of the following publications; (1)Annual Survey of Industries Vol. 1; (2)Annual Survey of Industries Vol.1 (Factory Sector), both are published by the Ministry of Statistics and Programme Implementation, Government of India; (3)Annual Survey of Industries Vol. 2 (4) Report on Absenteeism, Labour Turnover, Employment and Labour Cost; (5)Indian Labour Statistics; (6)Indian Labour Year Book and (7) Trade Unions in India. The last five are published by the Labour Bureau, Ministry of Labour, Government of India. The sources of industrial disputes data are already explained above. The period of analysis is 1999-2011, the choice of which is based on the availability of data¹⁵. Further, it is also important to note that during this period the number of strikes and lockouts and consequent loss in the number of mandays are all having a downward trend. We use an unbalanced panel data consisting of 670 observations across 56 three-digit industries of NIC 2004 and 13 years. Summary measures of variables are given in the Table A1 in the Appendix.

4. Estimation and Results

Given that the dependent variables are counts, panel Negative Binomial (NB) regression model of Hausman, Hall, and Griliches (1984) has been employed for estimation. Negative binomial model assumes that dispersion of number of counts is different from its mean. We have tested this and test shows that over-dispersion parameter α is significant and different from zero in all the cases. Let n_{it} denotes the count variable for the i^{th} industry in the t^{th} year. Then Negative binomial distribution with parameters (γ_{it}, δ) can be specified as follows¹⁶:

$$Pr(n_{it}) = \frac{\Gamma(\gamma_{it} + n_{it})}{\Gamma(\gamma_{it})\Gamma(n_{it} + 1)} \left(\frac{\delta}{1 + \delta} \right)^{\gamma_{it}} (1 + \delta)^{-n_{it}}$$

15. Continuous time series on tariff data from TRAINS database is available only from 1999 onwards.

16. See Hausman, Hall, and Griliches (1984) page 922.

where $\gamma_{it} = e^{\mathbf{X}_{it}\beta}$ and \mathbf{X} the vector of explanatory variables.

In order to choose between fixed effect and random effect estimates of NB regression, the use of Hausman test is found unsuitable in the present context because of two reasons. (1) The condition of positive semi-definiteness of variance-covariance matrix is not valid in the present case, resulting in negative χ^2 values in some cases.¹⁷ (2) Fixed effect estimation dropped a number of industries as the dependent variable in these industries is zero for all the years (zero variance in the dependent variable) and random effect estimates used full sample.¹⁸ So the difference in random effect and fixed effect estimates are also due to differences in the number of observations. Therefore, this paper reports fixed effect estimates, which are consistent even if the individual effects are correlated with the explanatory variables. The random effect estimates reported in Table A2, Table A3 and Table A4 in the Appendix fully approve the conclusions drawn from the fixed effect estimates.¹⁹

In Hausman, Hall, and Griliches (1984), fixed effect estimates are obtained by maximising a conditional log likelihood function.²⁰ The estimated coefficients are reported in Tables 4, 5, and 6. In NB regression, the quantity $(e^{\beta x} - 1) \times 100$ measures the percentage change in the dependent variable due to one unit change in the explanatory variable, keeping all other variables constant (see: Hilbe, 2011, p.111). These estimates are also reported in Table 7.

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17. Schreiber (2008) shows that Hausman test statistic can be negative under alternative hypothesis even asymptotically.
 18. The number of observations dropped from the disputes, strikes and lockouts regressions are respectively 6, 15, and 45.
 19. We also modelled number of mandays lost using random effect tobit regression in which the dependent variable is the ratio of number of mandays lost to potential number of mandays. Tobit results are given in the Table A5 in the Appendix.
 20. For a critical analysis of this methodology see Allison and Waterman (2002)

Table 4. Fixed effect NB regression: Dependent variable - number of disputes

	Number of		
	Disputes	Strikes	Lockouts
Export intensity	0.0118* (1.87)	0.00873 (1.07)	-0.00387 (-0.46)
Real wage	-0.0000175*** (-3.97)	-0.0000149*** (-2.69)	-0.0000149*** (-2.78)
Cost share of labour	0.0221 (0.55)	-0.00250 (-0.04)	0.0249 (0.48)
Share of female workers	-0.0286*** (-3.80)	-0.0329*** (-3.23)	-0.0333*** (-3.37)
Share of contract workers	-0.0103** (-2.12)	-0.0208*** (-3.22)	0.00190 (0.28)
Number of factories	-0.0000178 (-0.61)	0.0000412 (1.17)	-0.000123*** (-2.75)
Share of public sector workers	0.0194*** (3.13)	0.0250*** (2.73)	0.0127* (1.91)
Union coverage	0.000144 (0.58)	0.000121 (0.30)	0.0000808 (0.27)
Tariff rate	0.00481* (1.91)	0.00581* (1.73)	0.00461 (1.39)
Import penetration	-0.0161*** (-3.00)	-0.0105 (-1.61)	-0.00631 (-0.77)
Herfindhal index	0.0790 (0.19)	0.239 (0.41)	-0.0565 (-0.10)
Share of profit (first lag)	-0.00292** (-2.34)	-0.00329** (-2.07)	-0.00236 (-1.51)
Average plant size	-0.000282 (-0.59)	0.000328 (0.58)	-0.00212** (-2.11)
Constant	4.209*** (8.31)	3.147*** (4.92)	7.661*** (2.69)
Wald Chi-square test (P- values)	153.65 (0.00)	90.89 (0.00)	107.59 (0.00)
Observations	664	655	625

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels.

The results show that tariff rate has a significant positive effect on the number of disputes and on the number of strikes. Similarly, it has a significant positive effect on the number of workers involved and number of mandays lost in strikes and lockouts. The estimates suggest that one percentage point reduction in tariff reduces the number of strikes by 0.58 per cent and number of mandays lost due to strike by 1.20 per cent and the number of mandays lost due to lockouts by 0.90 per cent (see Table 7). Import penetration rate is significant and negative in number of disputes, number of workers involved in disputes and lockouts and in number of mandays lost due to lockouts. One percentage point increase in the import penetration rate reduces the number of disputes by 1.60 per cent and number of mandays lost due to lockouts by 1.57 percent. In the case of lockouts, import penetration is found to have more effect than tariff reduction and the effect of import penetration is more than that of an increase in the share of contract workers, which is argued to be one of the prominent factor contributed to the declining incidence of disputes in Indian manufacturing industry. The results also suggest that in general strikes are responding to tariff rates and lockouts are responding to both tariff rates and import penetration.

Share of contract workers has significant negative effect on number of strikes, number of workers involved in strikes and number of mandays lost in strikes. One percentage point increase in the share of contract workers reduces the number of strikes by 2.82 per cent, and number of workers involved and number mandays lost in strikes by 1.68 percent. The evidence supports the argument that increased use of contract workers is contributing to declining bargaining power of labour in Indian manufacturing industry (Anant, Hasan, Mohapatra, Nagaraj, and Sasikumar, 2006; Das, Choudhury, and Singh, 2015; Sundar, 2004, 2010).

Table 5. Fixed effect NB regression: Dependent variable – Number of workers involved

	Number of workers involved in		
	Disputes	Strikes	Lockouts
Number of workers	0.00000180*** (3.96)	0.00000211*** (4.76)	0.00000208*** (3.79)
Export intensity	0.00680* (1.84)	0.00523 (1.25)	0.0143*** (3.37)
Real wage	0.00000396 (1.19)	0.0000107*** (3.21)	-0.00000838* (-1.91)
Cost share of labour	-0.0665* (-1.83)	-0.118*** (-2.73)	-0.0380 (-0.87)
Share of female workers	-0.00908* (-1.76)	-0.00178 (-0.31)	-0.0319*** (-4.91)
Number of factories	0.000112*** (4.77)	0.0000894*** (3.39)	0.0000526** (2.11)
Share of contract workers	-0.00986** (-2.51)	-0.0169*** (-3.66)	-0.00412 (-0.81)
Share of public sector workers	-0.00222 (-0.36)	-0.00840 (-1.17)	0.0286*** (3.67)
Union coverage	0.000123 (0.55)	0.0000258 (0.08)	0.000339 (1.38)
Tariff rate	0.0143*** (6.24)	0.0128*** (4.49)	0.00881*** (3.66)
Import penetration	-0.00611* (-1.81)	-0.00175 (-0.47)	-0.0143*** (-3.22)
Herfindhal index	-0.721* (-1.91)	-1.182*** (-2.63)	-1.229*** (-2.61)
Share of profit (first lag)	-0.00111 (-0.58)	-0.000320 (-0.16)	-0.00102 (-0.48)
Average plant size	-0.000378 (-0.72)	-0.000418 (-0.76)	-0.00306** (-2.54)
Constant	-1.351*** (-4.32)	-1.981*** (-5.41)	-0.854** (-2.34)
Wald Chi-square test (P- values)	306.43 (0.00)	225.14 (0.00)	256.38 (0.00)
Observations	664	655	625

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels

The share of public sector workers has a significant positive effect on the number of strikes and lockouts. In the regressions on number of workers involved and in the number of mandays lost, it is significant and positive in the case of lockouts only and in the case of strikes it is negative but not significant. As we have already hypothesised, this result may be the outcome of the decision making structure of the public sector enterprises, the sense ownership on the part of the workers and threat of privatisation prevailing during the post 1991 period. In the public sector, many decisions related to workers need to be approved by the concerned department or ministry, and therefore brief strikes may be required to convey as well as to convince the higher administration about the seriousness of the issue. On the other hand, when it comes to the loss due to strikes workers may have tendency to minimise it either because of the sense of shared ownership or because of the threat of privatisation.

The share of female workers has significant negative impact on the number of disputes, strikes and lockouts. A one percentage point increase in the share of female workers reduces the number of strikes by 3.23 per cent and lockouts by 3.27 per cent. In number of workers involved and number of mandays lost regressions, it is significant and negative only in the case of lockouts. These results in general suggest that female presence in the workforce is reducing the incidence of industrial disputes.

Real wage has significant negative impact on the number of strikes and lockouts. It has positive and significant effect on the number of workers involved and number of mandays lost due to strikes. As we have hypothesised, higher wage may be deterring the occurrence of strikes and lockouts because of the higher cost in terms of lost wages. At the same time higher wage allows workers to participate in strikes when strikes happen as a higher wage allows them to meet the living expense during the period of strikes. First lag of share of profit in the net value added has a significant negative effect on the number of disputes, strikes

Table 6. Fixed effect NB regression: Dependent variable – Number of mandays lost

	Number of mandays lost due to		
	Disputes	Strikes	Lockouts
Potential mandays	0.0149*** (9.62)	0.0185*** (8.51)	0.0122*** (6.58)
Export intensity	0.0116*** (3.22)	0.00511 (1.20)	0.0123*** (3.05)
Real wage	0.0000111*** (3.25)	0.0000136*** (4.25)	-0.00000258 (-0.61)
Cost share of labour	-0.0626* (-1.73)	-0.0872** (-2.15)	-0.0401 (-0.91)
Share of female workers	-0.00115 (-0.23)	0.00641 (1.17)	-0.0146** (-2.40)
Share of contract workers	-0.00760* (-1.89)	-0.0169*** (-3.52)	0.00139 (0.27)
Number of factories	0.000195*** (13.48)	0.000151*** (8.19)	0.000162*** (9.74)
Share of public sector workers	-0.00464 (-0.77)	-0.00756 (-1.06)	0.0262*** (3.49)
Union coverage	0.0000662 (0.29)	0.0000865 (0.28)	0.000270 (1.13)
Tariff rate	0.0164*** (7.83)	0.0120*** (3.88)	0.00893*** (4.17)
Import penetration	-0.00858** (-2.52)	-0.00372 (-1.01)	-0.0158*** (-3.68)
Herfindhal index	-0.934** (-2.43)	-1.810*** (-3.93)	-1.889*** (-3.97)
Share of profit (first lag)	-0.00182 (-1.07)	0.000505 (0.25)	-0.00169 (-0.82)
Average plant size	-0.000848 (-1.61)	-0.000263 (-0.47)	-0.00325*** (-2.91)
Constant	-2.231*** (-7.28)	-2.521*** (-6.86)	-1.709*** (-4.93)
Wald Chi-square test (P- values)	483.11 (0.00)	299.63 (0.00)	432.21 (0.00)
Observations	664	655	625

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels

Table 7. Estimated impact on dependent variable: $(e^{\beta}-1)\times 100$ values are reported

Explanatory variables	Number of			Number of workers involved in			Number of mandays lost due to		
	Disputes	Strikes	Lockouts	Disputes	Strikes	Lockouts	Disputes	Strikes	Lockouts
Export intensity	1.19*	0.88	-0.39	0.68*	0.52	1.44#	1.17#	0.51	1.23#
Real wage	-0.002#	-0.001#	-0.001#	0.0004	0.0011#	-0.0008*	0.0011#	0.0014#	-0.0003#
Cost share of labour	2.24	-0.25	2.52	-6.43*	-11.11#	-3.73	-6.07*	-8.35+	-3.93
Share of female workers	-2.82#	-3.23#	-3.27#	-0.90*	-0.18	-3.14#	-0.12	0.64	-1.45+
Share of contract workers	-1.03+	-2.06#	0.19	-0.98+	-1.68#	-0.41	-0.76*	-1.68#	0.14
Number of factories	0.000	0.000	-0.01#	0.01#	0.01#	0.01+	0.02#	0.02#	0.02#
Share of public sector workers	1.96#	2.53#	1.28*	-0.22	-0.84	2.90#	-0.46	-0.75	2.65#
Union Coverage	0.01	0.01	0.01	0.01	0.00	0.03	0.01	0.01	0.03
Tariff rate	0.48*	0.58*	0.46	1.44#	1.29#	0.88#	1.65#	1.20#	0.90#
Import penetration	-1.60#	-1.04	-0.63	-0.61*	-0.17	-1.42#	-0.85+	-0.37	-1.57#
Herfindhal Index	8.22	27.01	-5.49	-51.39*	-69.33#	-70.74#	-60.69*	-83.64#	-84.88#
Share of profit (first lag)	-0.29+	-0.33+	-0.24	-0.11	-0.03	-0.10	-0.18	0.05	-0.17
Average size of the plant	-0.03	0.03	-0.21+	-0.04	-0.04	-0.31+	-0.08	-0.03	-0.32#
Number of workers				0.0002#	0.0002#	0.0002#			
Potential mandays							1.50#	1.87#	1.22#

Notes: (1) #, + and * indicate that underlying regression coefficient is significant respectively at 1%, 5% and 10% levels. (2) For the unit of measurement of these variables see the table on summary measures.

and lockouts. As we have hypothesised herfindhal index of domestic market concentration has significant negative effect on the number of workers involved and number of mandays lost due to both strikes and lockouts. Average plant size has negative significant effect on three dimensions of lockouts, suggesting that output loss is acting as a strong deterrent on the incidence of lockouts.

5. Concluding Remarks

This paper examined the determinants of industrial disputes in the case of Indian manufacturing industry. The study is in the context of drastic decline in the number of industrial disputes in India. Compared to the existing literature on determinants of industrial disputes, this study considered this issue in detail by taking three dimensions of industrial disputes, namely number of disputes, number of workers involved and number of mandays lost and by segregating them into strikes and lockouts. The paper shows that import competition, captured in terms of tariff and import penetration rate, has in general negative effect on industrial disputes. In this respect, the study found that strikes are responsive to tariff and lockouts are responding to both tariff and import penetration. Another important variable is the share of contract labour, which is found to have significant negative effect on strikes. Further, the negative impact of contract labour on number of strikes and number of mandays lost in strikes are found to be higher than that of both tariff rate and import penetration rate. Only in the case of lockouts, competition from import is found to have more effect than contract labour. This result in general supports the argument that increasing contractualisation of labour in Indian manufacturing industry contributed to declining bargaining power of labour. Another important result is related to the female presence in the labour force, which is found to be reducing the incidence of industrial disputes.

APPENDIX

Table A1. Summary Measures

Variable	Mean	SD	Min	Max
Number of disputes	6.12	15.33	0.00	184.00
Number of strikes	3.22	9.12	0.00	124.00
Number of lockouts	2.90	6.75	0.00	60.00
Number of workers involved in disputes	5988.99	34011.48	0.00	372863.00
Number of workers involved in strikes	4125.54	26044.38	0.00	274062.00
Number of workers involved in lockouts	1870.59	10010.70	0.00	110255.00
Number of mandays lost due to disputes	306757.70	1614382.00	0.00	20000000.00
Number of mandays lost due to strike	93716.75	754985.80	0.00	13800000.00
Number of mandays lost due to lockout	213360.10	1061703.00	0.00	10900000.00
Export intensity (in %)	17.52	19.38	0.05	99.64
Real wage (in Rs.)	58510.62	29738.81	15278.46	240415.30
Cost share of labour (in %)	3.47	1.89	0.22	13.90
Share of female workers (in %)	13.42	13.82	0.00	75.91
Share of contract workers (in %)	27.09	15.17	0.00	78.86
Number of factories	2372.18	3068.34	10.00	19568.00
Share of public sector workers (in %)	5.18	9.47	0.00	58.76
Union coverage (in %)	44.44	178.92	0.00	3796.15
Tariff rate (in %)	22.11	17.99	0.01	159.62
Import penetration (in %)	20.82	22.22	0.03	98.92
Herfindhal index	0.20	0.19	0.01	0.99
Share of profit (first lag) (in %)	33.97	37.93	-599.98	94.13
Average plant size (in Rs crore)	44.26	137.191	0.23	1428.88
Number of workers	131424.40	179280.80	405.00	1027578.00
Potential number of mandays	358278.10	1657972.00	143.00	20400000.00

Table A2. Random effect NB regression: Dependent variable – number of disputes

Explanatory variables	Number of		
	Disputes	Strikes	Lockouts
Export intensity	0.0113** (2.23)	0.00919 (1.57)	0.0128* (1.83)
Real wage	-0.0000121*** (-3.13)	-0.00000709 (-1.51)	-0.0000121*** (-2.62)
Cost share of labour	0.00179 (0.05)	-0.0226 (-0.45)	-0.00846 (-0.19)
Share of female workers	-0.0243*** (-3.80)	-0.0197** (-2.39)	-0.0215*** (-2.82)
Share of contract workers	-0.0118*** (-2.69)	-0.0208*** (-3.74)	-0.00365 (-0.64)
Number of factories	0.0000350 (1.42)	0.0000922*** (3.22)	0.0000145 (0.43)
Share of public sector workers	0.0172*** (2.88)	0.0178** (2.12)	0.0146** (2.09)
Union coverage	0.000179 (0.74)	0.000163 (0.45)	0.000146 (0.50)
Tariff rate	0.00652*** (2.75)	0.00880*** (2.93)	0.00543* (1.69)
Import penetration	-0.0160*** (-3.45)	-0.0100* (-1.92)	-0.0226*** (-3.12)
Herfindhal index	-0.531 (-1.31)	-0.788 (-1.46)	-0.846* (-1.65)
Share of profit (first lag)	-0.00273** (-2.35)	-0.00287** (-2.06)	-0.00199 (-1.25)
Average plant size	-0.000232 (-0.50)	0.000308 (0.57)	-0.00244** (-2.39)
Constant	3.596*** (7.96)	2.319*** (4.43)	4.584*** (6.63)
Wald Chi-square test (P- values)	151.38 (0.00)	93.23 (0.00)	107.74 (0.00)
Observations	670	670	670

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels.

Table A3. Random effect NB regression: Dependent variable – number of workers involved

Explanatory variables	Number of workers involved in		
	Disputes	Strikes	Lockouts
Number of workers	0.00000210*** (4.94)	0.00000239*** (5.71)	0.00000242*** (4.72)a
Export intensity	0.00645* (1.87)	0.00451 (1.20)	0.0112*** (2.88)
Real wage	0.00000259 (0.85)	0.0000102*** (3.35)	-0.00000672* (-1.67)
Cost share of labour	-0.0717** (-2.13)	-0.122*** (-3.20)	-0.0232 (-0.59)
Share of female workers	-0.00910* (-1.83)	-0.000225 (-0.04)	-0.0278*** (-4.39)
Number of factories	0.0000948*** (4.34)	0.0000757*** (3.17)	0.0000750*** (3.24)
Share of contract workers	-0.0107*** (-2.94)	-0.0153*** (-3.68)	-0.0146*** (-3.25)
Share of public sector workers	-0.00239 (-0.41)	-0.0119* (-1.74)	0.0157** (2.34)
Union coverage	0.000128 (0.60)	0.0000182 (0.05)	0.000230 (1.00)
Tariff rate	0.0128*** (5.84)	0.0113*** (4.33)	0.00838*** (3.38)
Import penetration	-0.00531 (-1.63)	-0.00365 (-1.03)	-0.00685* (-1.71)
Herfindhal index	-1.065*** (-2.93)	-1.464*** (-3.45)	-1.228*** (-2.81)
Share of profit (first lag)	-0.000600 (-0.39)	-0.000277 (-0.14)	0.000613 (0.40)
Average plant size	-0.000127 (-0.25)	-0.000223 (-0.42)	-0.00226** (-2.11)
Constant	-1.180*** (-4.45)	-1.907*** (-6.52)	-1.106*** (-3.43)
Observations	670	670	670

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels.

Table A 4. Random effect NB regression: Dependent variable – number of mandays lost

Explanatory variables	Number of mandays lost due to		
	Disputes	Strikes	Lockouts
Potential number of mandays	0.0151 ^{***} (10.37)	0.0196 ^{***} (10.55)	0.0121 ^{***} (6.89)
Export intensity	0.0106 ^{***} (3.13)	0.00551 (1.47)	0.00991 ^{***} (2.66)
Real wage	0.00000709 ^{**} (2.33)	0.0000128 ^{***} (4.54)	-0.00000196 (-0.50)
Cost share of labour	-0.0730 ^{**} (-2.20)	-0.0735 ^{**} (-2.07)	-0.0290 (-0.75)
Share of female workers	-0.00238 (-0.48)	0.00538 (1.06)	-0.00921 (-1.59)
Share of contract workers	-0.00907 ^{**} (-2.35)	-0.0155 ^{***} (-3.63)	-0.0104 ^{**} (-2.28)
Number of factories	0.000182 ^{***} (13.35)	0.000141 ^{***} (8.60)	0.000198 ^{***} (13.37)
Share of public sector workers	-0.00122 (-0.21)	-0.00941 (-1.39)	0.0164 ^{**} (2.50)
Union coverage	0.000101 (0.48)	0.0000488 (0.15)	0.000253 (1.11)
Tariff rate	0.0151 ^{***} (7.49)	0.0105 ^{***} (3.94)	0.00966 ^{***} (4.24)
Import penetration	-0.00784 ^{**} (-2.41)	-0.00573 (-1.63)	-0.00766 ^{**} (-1.98)
Herfindhal index	-1.470 ^{***} (-3.97)	-2.276 ^{***} (-5.30)	-1.694 ^{***} (-3.89)
Share of profit (first lag)	-0.000964 (-0.70)	0.000969 (0.50)	0.000256 (0.17)
Average plant size	-0.000496 (-1.00)	-0.000211 (-0.40)	-0.00235 ^{**} (-2.32)
Constant	-1.821 ^{***} (-7.13)	-2.418 ^{***} (-8.64)	-1.985 ^{***} (-6.34)
Observations	670	670	670

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels.

Table A5. Random effect Tobit estimates: Dependent variable - Number of mandays lost

Explanatory variables	Intensity of number of mandays lost due to		
	Disputes	Strikes	Lockouts
Export intensity	0.00364** (2.15)	0.00253** (2.26)	0.00389* (1.89)
Real wage	0.000000528 (0.41)	0.000000817 (0.93)	0.000000348 (0.22)
Cost share of labour	-0.0170 (-1.18)	-0.0196* (-1.90)	-0.0101 (-0.59)
Share of female workers	-0.00318 (-1.42)	-0.00131 (-0.84)	-0.00106 (-0.39)
Share of contract workers	-0.00368** (-2.16)	-0.00316*** (-2.71)	-0.000368 (-0.18)
Share of public sector workers	0.00100 (0.40)	-0.00474** (-2.50)	0.00804** (2.49)
Union coverage	0.0000778 (0.92)	-0.0000144 (-0.18)	0.000115 (1.21)
Tariff rate	0.00361*** (2.91)	0.00225*** (2.62)	0.00222 (1.54)
Import penetration	-0.00368** (-2.17)	-0.00164 (-1.51)	-0.00503** (-2.40)
Herfindhal index	-0.150 (-1.07)	-0.102 (-0.98)	-0.328** (-1.98)
Share of profit (first lag)	-0.000771* (-1.72)	-0.000546 (-1.57)	-0.0000734 (-0.11)
Average plant size	-0.000332* (-1.82)	0.000121 (0.89)	-0.00115*** (-3.86)
Constant	0.515***	0.166**	0.222
Observations	670	670	670

Notes: (1) *t* statistics in parentheses, (2) *, **, and *** respectively indicate significant at 10%, 5% and 1% levels.

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