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Labour Disputes and the Manufacturing Sector's Growth: Recent Evidence from Indian States

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Abstract

The persistent variation among Indian states in per-capita value added from manufacturing sector has raised question whether the long-run equilibria in the manufacturing sector differ among the states. In this paper, we provide empirical evidence on whether labour disputes in the form of strikes, lock-outs, temporary closure etc., have caused any variation in these equilibria for the recent period. Available data suggests that in 9 out of 16 states in our sample, labour disputes have generally reduced between 2001 and 2017, while in others labour disputes mostly characterised as random shocks with little predictability. Our two-stage least squares estimates using states' election cycles as instrument for the labour disputes suggest that these labour disputes with little persistence did not have much influence over the inter-state differences in the equilibrium capital-labour ratios in "registered" manufacturing units between 2001 and 2017. However, 1 percent increase in labour disputes might be associated with 3.2 percent reduction in total factor productivity for the sector in states where disputes were random events. In the remaining states, where labour disputes have consistently fallen over time, this effect is significantly reduced. Our findings are robust in different sample of firms.

Keywords

Labour Disputes, Steady-State, Manufacturing, Instrumental Variable, Indian

1. Introduction

The passage of The Industrial Relations Code, 2020 has sought simplification to the labour laws in India by amalgamating various pre-existing enactments such

as The Industrial Disputes Act, 1947, The Trade Unions Act, 1926 and The Industrial Employment (Standing Orders) Act, 1946 into a concise code that reduces compliance burdens for an establishment. In turn, the code seeks to improve the dispute resolution processes in the industrial sector and thereby minimise the losses from labour disputes. Apart from the pre-existing central acts regarding the regulation of labour market, there is a plethora of legislation at the state-level in India that exerted significant influence on labour disputes. The central code on Industrial Relations, once gradually adopted by the states, are also envisaged to significantly improve the labour relations across India. Although, the issue of significant output and efficiency loss from labour disputes are well recognised in India, as evident from the amendments in central and state labour legislations from time to time, there exists hardly any quantitative measure on how much output losses from a sector are associated with labour disputes. Moreover, there exists hardly any quantitative evidence whether labour disputes in India are associated with permanent reduction in output, or the losses are only temporary. For instance, the wide variation in per-capita value-added from manufacturing sector across states in India has persisted over decades, alongside the variation in instances of labour disputes. Available data suggests that between 2000 and 2005, West Bengal lost more than 700 mandays per 1000 workers in the industrial sector every year on average, distantly followed by Kerala and Andhra Pradesh where the losses were between 100 and 130 mandays per 1000 industrial workers. Among the major states, Uttar Pradesh witnessed the lowest loss at only 3.5 mandays per 1000 industrial workers. In this paper, we build quantitative evidence on whether labour disputes are associated with any loss in output from manufacturing sector across the major states in India.

The states' average real per-capita manufacturing value added between 2000 and 2002 varied from Indian Rupee (INR) 5314 and 5099 for Maharashtra and Gujarat, respectively, to just 397 for Bihar. The figures for the period 2014 to 2016 stood at 14,139, 17,752 and 694, for Maharashtra, Gujarat and Bihar, respectively, albeit growth in the sector in most states. The persistent variation in the per-capita manufacturing output across the Indian states hints at possible differences in the equilibrium in the sector. When the long-run equilibrium outputs differ among states, that leaves no scope for an absolute convergence of the per-capita outputs to a single level. Therefore, apart from estimating the effects of labour disputes occurring at one point of time, we also identify their effects on the possible variations in equilibria across states.

This paper is related to the strand of empirical literature that estimates the impact of uncertainty on business cycles and growth. In the context of USA, Baker, Bloom and Davis (2016) show that uncertainty is associated with reduced investment and employment in policy-sensitive sectors like defence, healthcare, finance and infrastructure. Bhagat, Ghosh and Rangan (2013) show that rise in policy uncertainty has reduced aggregate growth in India after 2005. Their study

shows that if the economic uncertainties were at the levels of 2005, India's aggregate GDP growth would have increased by 0.56% and the growth in fixed investment would have increased by 1.36%. In the context of manufacturing sectors in Indian states, this area has remained largely unexplored. Although, all the states in India face economic and policy uncertainties to varied extent, it is not very clear if those uncertainties affect the states' production capacities in the long-run. A set of readily available indicators for uncertainties could be the number of strikes, lockouts, temporary closure of activities in the sector, and the associated loss in workdays. These disputes may potentially arise on account of sudden changes, or proposal for changes in regulations in the industrial sector. Although, potentially persistent and high labour disputes may reduce investment and growth prospects of a state's industrial sector, there is hardly any empirical evidence for the Indian states. Our study tries to fill this gap.

The existing literature on inter-state differences in the manufacturing sectors' performance in India broadly highlighted the case of institutional variations. Besley and Burgess (2004) show that the states that adopted labour regulation acts in the pro-worker direction, generally experienced lower growth in output, employment and investment in the registered manufacturing activities between 1958 and 1992. In analysing the effects of "delicensing", which is the process of dismantling central control over the entry and production in the manufacturing sectors, Aghion et al. (2008) also came to the similar conclusion. Aghion et al. (2008) show that, during the process of "delicensing" in 1980's and 1990's, the pro-employer states experienced faster growth in the registered manufacturing sector. In similar studies, Goldar and Veeramani (2005) and Topalova and Khandelwal (2011) also conclude that the institutional heterogeneity has resulted in uneven performance of the manufacturing sectors in different regions within India. Ahsan and Pagés (2007) estimate the effects of frictions emanating from amendments in laws related to dispute resolution, hiring and firing on the output from registered manufacturing units in India. These institutional differences may have created a more permanent variation in the sector's performance across the states (Ramsey, 1928; Solow, 1956; Koopmans, 1963; Cass, 1965) by introducing variation in equilibrium levels of output. Our paper, in contrast, tries to see if uncertainty about economic outcomes in the form of labour disputes also played any role in variation. The estimation of this effect is particularly challenging due to the fact that labour disputes are strongly correlated with the states' institutional features, e.g. nature of labour regulation, industrial relationship, governments' attitude towards labour rights and activities of labour unions etc. Our main challenge was to disentangle the effects of labour disputes as pure shock on the sector, after taking into account the effects of institutional differences on which Besley and Burgess (2004) and others had already provided quantitative evidence. Therefore, we adopt a two-stage least-squares instrumental variable approach where we use the states' election cycles as instruments for the labour disputes. The exclusion restriction that our choice of

instrument would impose is that, after applying several plausible controls including the ones that are directly determined by political outcomes, elections, that occur at precisely pre-defined intervals, and are merely political matters that are designed not to impact the general public life, would have no effect on the economic activities and output levels. However, elections may be associated with labour disputes as the political parties exert large influence on the activities of labour unions. Hence, election cycles may serve as a valid instrument in our case.

The paper is organised in the following way. In Section 2, we discuss the concepts of uncertainty and the usefulness of labour disputes as proxy. We discuss data in Section 3 and in Section 4, we discuss the empirical methodologies. In Section 5, we present our results. Section 5 is divided in the following way; first, we discuss the characteristics of labour disputes in the major Indian states and assess whether labour disputes really have caused any uncertainty in the recent period. Second, we discuss the effects of labour disputes on the states' capital-labour ratios. This is followed by the effects of labour disputes on the average firm-level Total Factor Productivities (TFPs) for the states in manufacturing sector. We conclude in Section 6 by discussing the results and further research.

2. Uncertainty and the Labour Disputes

Shocks that are high and persistent over time make future outcomes from the production activities unforeseeable, and therefore, create uncertainty in the minds of the agents (Knight, 1921; Bloom, 2014). Bloom (2014) points out that higher uncertainty reduces aggregate investment and hiring through at least two channels: "real options" (Bernanke, 1983; Brennan and Schwartz, 1985; McDonald and Siegel, 1986) and higher risk premia. In the first case, uncertainty makes firms cautious about investment and hiring due to large adjustment costs (Ramey and Shapiro (2001) and Cooper and Haltiwanger (2006), Nickell (1986) and Bloom (2009)). Firms may wait or delay their decisions when there are uncertainties regarding the future and such delay reduces potential or the equilibrium output. In the latter case, the risk-averse investors want to be compensated for the higher risk. Since uncertainty leads to increasing risk premia, they raise the cost of finance, and thus reduce investment. Uncertainty also increases the probability of default and thereby raising the default premium and aggregate deadweight cost of bankruptcy. Therefore, uncertainty reduces the equilibrium capital stocks for an economy by reducing investment activities. In contrast, risk represents a set of purely random events (Knight, 1921), and therefore, aren't persistent over time. In this case, the long-term investment paths can be decided by the agents with some degree of certainty. Hence, the equilibrium path of the economy will be affected by the events depending on whether those are persistent or not.

In light of the above classification, labour disputes would be a source of uncertainty, affecting the potential or equilibrium output levels in the long-run, only if they are persistent. On the other hand, if disputes are less persistent or purely random events with little known probabilities of occurrence, they may

not affect the production decisions in the long-run. Any event could be a mix of both risk and uncertain components (Bloom, 2014). Labour disputes are not exception. However, for practical purposes, it may be useful to identify the dominant trait in the data. We discuss these results in Section 4.

3. Data

We measure labour disputes by the number of man-days lost per 1000 workers in the industrial sector, obtained from several rounds of "Statistics on industrial disputes, closures, retrenchments and lay-offs in India", published by the Labour Bureau, Ministry of labour and employment, Government of India. These reports publish state-wise annual figures on total man-days lost in the industrial sector due to disputes such as strikes, lockouts, temporary closure of factories etc. Loss in working days due to non-dispute related causes such as natural calamities etc. are excluded from these figures. In these reports, industrial sector includes, apart from the manufacturing, the mining, construction activities, and electricity generation. We used these figures between 2001 and 2017. We estimated the number of workers in the industrial sector by multiplying the states' total population by the percent of population working in the industrial sector under their usual principal status. We obtain the percent of population working in the industrial sector from the Labour Bureau's Report on Employment and Unemployment Survey (2009-2010) and apply it for all the years. Total population for the states are available for 2001 and 2011, the years when the decadal census were conducted. The population figures for the intermediate years and the years after 2011 are obtained by applying the compound average annual growth rate of population between 2001 and 2011 for each state. In the empirical estimates, labour disputes are expressed in their natural logarithm.

Data on manufacturing activities are obtained from India's Annual Survey of Industry (ASI) rounds between 2001 and 2017. Annual Survey of Industries are the surveys of the "registered" firms which account for about 68 percent of total value added by the manufacturing activities in India (**Table A1** in Appendix). Plants are stratified within each 5-digit industry at the district level. The industrial classifications in the survey follow the National Industrial Classification (NIC) of 1998, 2004 and 2008. For the state-level aggregate regressions, the survey data has been aggregated for the corresponding 2-digit industries within each state. We refer to the plants and the 2-digit industries as "firm" and "industry", respectively. We classify manufacturing sector into these five broad industries: leather-textile, chemicals, metal products, electronics-machinery and miscellaneous other manufacturing industries. The miscellaneous manufacturing activities include all industrial activities, excluding the agriculture-based industries, food processing activities, petroleum refineries and related products, electricity generation, mining activities and construction activities. **Table A2** in Appendix presents the 2-digit NIC codes for these broad industries. Our paper includes the following states: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Guja-

rat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. We excluded Jharkhand as the data on man-days lost due to industrial disputes were not available for the state for most of the years between 2001 and 2017. The erstwhile state of Andhra Pradesh was bifurcated in 2014 into two: Andhra Pradesh and Telangana. We combined all the data series for these two states, wherever applicable. These 16 states accounted for over 91 percent of India's net value added from the manufacturing sector between 2004 and 2017. The individual shares of these states in the all-India net value added from manufacturing sector are as follow: Andhra Pradesh (4.7%), Assam (1.0%), Bihar (1.1%), Chhattisgarh (1.4%), Gujarat (15.6%), Haryana (4.9%), Karnataka (6.0%), Kerala (2.0%), Madhya Pradesh (2.6%), Maharashtra (21.3%), Odisha (1.1%), Punjab (3.7%), Rajasthan (3.7%), Tamil Nadu (10.4%), Uttar Pradesh (7.6%) and West Bengal (3.8%).

In the ASI data, we define value added by a firm as value of gross sales in India Rupee (INR) minus the total value of inputs (in INR) consumed by the firm during a year. The inputs include both purchased domestically as well as the imported ones. We measure capital stock by the value of fixed capital (in INR) installed with the firm at the beginning of the year. Where the value of fixed capital at the beginning of a year was not available, we use the value of fixed capital at the end of the year, if available. We deflated all the nominal figures the all-India consumer price index for the industrial workers (CPI-IW) with the base year 2001. We measured labour force by the total man-days worked by workers in the firm during a year. The aggregate variables are the summation of all firms for each state-industry combination. We use these aggregated data between 2001 and 2017 for each of the five industry groups in each of the 16 states. In the empirical estimates, we express aggregate value added, labour force and capital stocks in their natural logarithms.

In some regressions, we use state-level physical infrastructure and banking infrastructures. We define physical infrastructure as the underlying factor between per-capita power availability in mega-watt, aggregate lengths (in km) of state highways, national highways and railways in relation to the states' land area (sq. km). We define physical infrastructure as: 0.5077 × per capita power availability + 0.7163 × (length of state highways + national highway) + 0.1016 × length of railways, where 0.5077, 0.7163 and 0.1016 are the factor loadings for these variables, respectively. In the regressions, physical infrastructure is expressed in its natural logarithm. We define banking infrastructure as the value of outstanding bank credit into the industrial sector as percent of the net domestic product from the industrial sector of the state. Industrial sector includes, apart from manufacturing, the mining and construction activities, and electricity generation. The data on per capita power availability, lengths of highways and railways, bank credit and industrial sector net domestic product are obtained from the Handbook of Statistics on Indian States, Reserve Bank of India.

In several regressions, we use the state-level total factor productivity (TFP) for

each manufacturing industry, which we estimate as the average of firm-level TFP estimates within each state-industry combination, following Ghani et al. (2016). Since we have estimates of labour, capital and value added from the ASI, we estimated firm-TFP as the residual of a regression of value added on the use of labour and the stock of capital during a year on a cross-section of firms. A large volume of literature exists regarding the estimation of production function that precisely look at the issue of "endogeneity" in growth of capital stocks that may be correlated to unobserved factors, making their coefficient biased from such regressions. To overcome this problem, among the notable papers, Olley and Pakes (1996) and Levinsohn and Petrin (2003) suggested using the past investment rates and the growth in input, respectively, as the instrument for growth in capital stock in alternative estimation methodologies. However, the publicly available ASI data that we use for our paper is a stratified sample of firms within each defined strata, and therefore, contains a significant number of firms that are not repeated for subsequent survey rounds. Thus, it became impossible to observe the growth rates in intermediate inputs and past investment for all survey rounds across all firms. Therefore, we stick to the estimation methodologies based on Ghani et al. (2016) but we adequately control for firm-specific factors like technology and human capital to minimise the chances of estimation biases from the "endogeneity" in growth of capital stocks.

We estimated firm-level TFPs in two steps. In the first step, following, Ghani et al. (2016), we regress logarithm of the firms' value added on the logarithms of labour force and capital stocks of the firms in the ASI data (**Table A3(a)** in Appendix). Expressing variables in their natural logarithm allow us to interpret the regression coefficients in the form of elasticity, e.g. % change in dependent variable with respect to a 1% change in explanatory variable. Thus, regression coefficients become free from comparability issues on account of unit of measurement and the scale. The regression includes the following dummy variables, and the interaction of these dummies with the firms' labour force and capital stocks: four manufacturing industries viz. leather-textile, chemicals, metal products and electronics-machinery; states; whether a firm is a public limited company (including public sector) or categorised as self-employment by ASI and the firms' (percentile) position in the distribution of gross sales within each state-industry combination. Firms' human capital and technology are likely to exert positive influence on the firms' TFP. However, those could not be included in the regressions, as they could be correlated with the unobserved firm-specific factors. Since ASI is a stratified sampling of firms in each district and 5-digit industry classifications, it is not possible to observe data for a firm over all the sample years. Therefore, the regressions could not include the firm-level fixed effect dummies. When such fixed effects are not included, the coefficients of human capital and technology would be biased. Therefore, in the next step, we regress the estimated residuals from **Table A3(a)** in Appendix on the firm-level human capital and technology. Following Corvers (1997), we define human capital as

the inverse of the share of workers in the firms' aggregate man-days worked by all employees. Technology is defined as the ratio of firms' value added to the total value of inputs purchased during the year. Both technology and human capital are expressed in their natural logarithm in the regressions. These regressions are reported in **Table A3(b)** in Appendix. These regressions include dummy variables for five manufacturing industries, and the firms' percentile positions in the distribution of human capital and technology, each. The estimated residuals from the regressions in **Table A3(b)** in Appendix represent the firm-level TFPs. Following Ghani et al. (2016), we define states' aggregate firm-TFP as the arithmetic mean of these estimated firm-level TFPs. We use logarithm of gross sales as weight in regressions reported in **Table A3(a)** and **Table A3(b)**.

4. Empirical Methodology

The empirical methodology in this paper is divided into three parts. In the first part, we analyse whether the labour disputes in the states are persistent or not. To do this, we regress labour disputes on its own one-year lagged value in a panel dataset consisting of these 16 states between 2001 and 2017. We regard labour disputes as "persistent" only if the autoregressive term for the labour dispute is close to 1 and statistically significant. This would mean, on average, state's labour disputes in a year are of similar magnitude as the previous year. Otherwise, we would regard labour disputes as non-persistent or, just random events. We additionally control for the state assembly elections and whether the state is in coalition with India's central government. We capture states' assembly elections through dummy variable that assumes value 1, if, in a year, the state had Assembly election. States' Assembly elections are generally held in every five years. However, the election cycles differ among the states. **Table A4** in the Appendix shows the years of Assembly elections for the states. Two separate dummy variables are also used for the year preceding and the year following the states' Assembly elections. A variable that indicates the number of years that a party had ruled the state in a single spell is also used. In case of change in the ruling party of the state government in a certain year, the variable starts from the value 1, increasing by 1 in the subsequent years, until the ruling party changes again. The regression also uses a dummy variable, which assumes value 1, if the state government was in coalition with India's union government in a year. The regressions control for the unobserved state and year specific effects through the state and year fixed effects dummies. **Figures 1(a)-(d)** in the next section show that the labour disputes broadly consist of some common patterns for certain groups of states. Hence, we classify the states into four groups. We discuss about the characteristics of labour dispute in these four groups of states in the next section. In the empirical models, we account for the heterogeneity in the group characteristics by including dummy variables for these groups, and also interacting the dummy variables with lagged labour dispute. In our models, group 4 serves as the reference group which means we do not include the dummy variable for the group 4 into

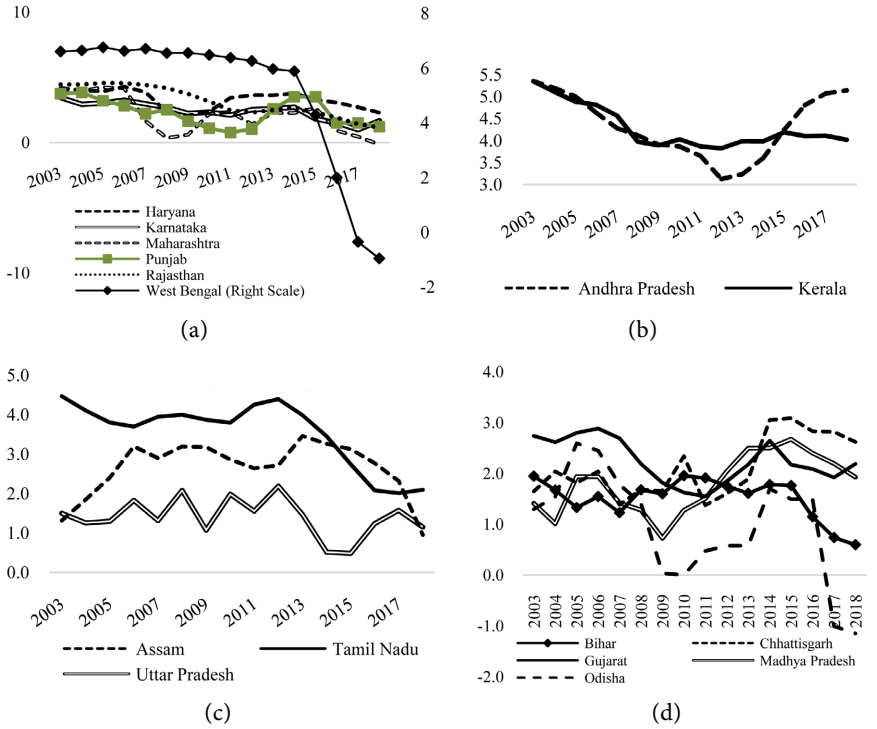

Figure 1. Labour disputes in the Indian states. (a) Labour Disputes in States: Group 1 (Logarithm); (b) Labour Disputes in States: Group 2 (Logarithm); (c) Labour Disputes in States: Group 3 (Logarithm); (d) Labour Disputes in States: Group 4 (Logarithm). Source: Authors' calculations based on data published by Labour Bureau, Government of India. Note: These figures show the measure of labour disputes with three-year end-point moving average and therefore, we lose first two years of observations. However, in the empirical models, we use data without moving average, i.e. between 2001 and 2017.

our models. The estimation results are presented in **Table 1** in the next section. The model for the first part of the empirical exercise takes the following form:

$$labdis_{it} = \alpha * labdis_{it-1} + \sum_{g=1}^{3} \alpha_g * D_g * labdis_{it-1} + \sum_{g=1}^{3} D_g + I + u_{it} \quad (1)$$

where $labdis_{it}$ represents our measure of labour disputes that we discuss in Section 3. Subscripts i, t and g represent state, year and state groups. D represents the set of dummy variables representing the state groups. I includes all the control variables that we discussed above and u represent the error term that are assumed to satisfy the assumptions of classical linear regressions.

In the second part, we examine whether higher labour disputes are associated with reduced capital-labour ratios in the manufacturing industries. A negative relationship would suggest that the higher labour disputes in a particular state in a year may have reduced the long-run equilibrium in the manufacturing sector. In order to do this, we regress the natural logarithm of the aggregate capital-labour ratios in five manufacturing industries for these 16 states on labour disputes. A test for convergence upon initial conditions, i.e. β-convergence following Barro (1991) and Barro & Sala-i-Martin (1992) presented in **Table A6** in the Appendix suggests that the states indeed converged to their respective equi-

libria. This would mean that the observed capital-labour ratios in the states' manufacturing industries broadly represent their equilibrium levels. In the regressions of states' capital-labour ratios on labour disputes, we use contemporaneous, one- and two-years lagged labour disputes as explanatory variables in separate regressions. Labour disputes are instrumented by separate dummy variables that indicate the years of states' Assembly election, the year following the assembly elections and a variable that indicate the number of years that a party had been running the government. Column 1 of **Table A5** in the Appendix shows that these instruments are statistically significant when regressed on labour disputes, and therefore serves as valid instruments. In the regression of capital-labour ratios on labour disputes, we use the fitted values of labour disputes from **Table A5** as regressors. We interact the dummy variables for state groups 1, 2 and 3 with the labour disputes. The regressions control for several state-specific characteristics. First, the regressions control for the differences in physical infrastructure among the states. The definition of physical infrastructure is provided in Section 3. Second, the regressions use one period lagged value of the ratio of outstanding bank credit to the net domestic product from the states' industrial sector as proxy for the banking infrastructure in the states. To avoid possible endogeneity of banking infrastructure with the unobserved state-specific characteristics, we use the following variables as instruments: the number of years that a party had been running the government, a dummy variable for the years of the union elections in India, and dummy variables for one year preceding and following the union elections. The validity of these instruments is reported in column 2 of **Table A5** in the Appendix. The coefficients of all these variables as regressor on the banking infrastructure are statistically significant as seen in column 2 of **Table A5** in the Appendix. In the regression, of capital-labour ratios on labour disputes, we use one year lagged fitted values of banking infrastructure from **Table A5** in the Appendix. Third, the regressions control for the aggregate firm-TFPs in the state. The estimation details of the firm-level TFPs are provided in Section 3. The aggregate firm-TFPs control for the differences in the firm-level efficiencies. We used one-year lagged capital-labour ratio as the explanatory variable to account for the stochastic trend in capital-labour ratio. As robustness check, we repeat the regression using a sample of all firms, and also after excluding both the top and bottom 10 percent and 20 percent firms from the distribution of gross sales within each state-industry combination in separate specifications. The estimation results are presented in **Tables 2(a)-(c)** in the next section. The estimation equations take the following form:

$$k/l_{i,t,k} = \alpha * k/l_{i,t-1,k} + \sum_{l=0}^{2}\sum_{g=1}^{3}\alpha_{gl} * D_g * \widehat{labdis}_{it-l} + \sum_{g=1}^{3} D_g + I + u_{it} \qquad (2)$$

where $k/l_{i,t,k}$ is the aggregate capital-labour ratios for state *i*, in the year *t* for the industry *k*. $\widehat{labdis}$ represents the fitted values of labour disputes as obtained from **Table A5** in the Appendix, where *l* represents the lag of labour disputes. D represents the set of dummy variables representing the state groups, *I* includes all the control variables that we discussed above and u represent the error

term that are assumed to satisfy the assumptions of classical linear regressions.

Third, we repeat the regressions that we run for the capital-labour ratios as above, for the aggregate firm-TFPs. In this case, we use the same set of explanatory variables as above, except that we use 1-year lagged aggregate firm-TFP as an explanatory variable by replacing the 1-year lagged capital-labour ratios. We use aggregate firm-TFP as the dependent variable. The estimation results are presented in Table 3. The estimation equation takes the following form:

$$tfp_{i,t,k} = \alpha * tfp_{i,t-1,k} + \sum_{l=0}^{2}\sum_{g=1}^{3}\alpha_{gl} * D_g * \widehat{labdis}_{it-l} + \sum_{g=1}^{3} D_g + u_{it} \qquad (3)$$

where $tfp_{i,t,k}$ is the aggregate firm-TFP for state i, in the year t for the industry k, as discussed in Section 3. Other variables are same as Equation (2).

The regressions reported in Tables 2(a)-(c) and Table 3 are run on a pooled data across five manufacturing industries in 16 states for the years 2001 to 2017. Since the state-specific characteristics and labour disputes are available only at the aggregate state level, we repeat the series on labour disputes and state-specific characteristics for the five manufacturing industries. Therefore, the regression coefficients for labour disputes are the "average" effects across the five manufacturing industries.

5. Results

5.1. Labour Disputes: Persistent or Random Events?

The average number of man-days lost per 1000 workers due to disputes in the industrial sector stood at staggeringly high of over 503 for West Bengal for the whole sample period, followed by Kerala (152) and Andhra Pradesh (112). On average, Bihar registered the lowest labour disputes at about 5.7, preceded by Uttar Pradesh and Madhya Pradesh, each at about 7.3. Albeit fluctuations, labour disputes have generally declined over time for Haryana, Karnataka, Maharashtra, Punjab, Rajasthan and West Bengal. We categorise these states as Group 1. Although Kerala and Andhra Pradesh displayed very high levels of man-days lost due to industrial disputes prior to 2007, the levels have greatly moderated after 2007, except for a spike in 2009 in case of Andhra Pradesh. We categorise Kerala and Andhra Pradesh as Group 2. Assam, Uttar Pradesh and Tamil Nadu do not display much discernible pattern and hence are classified as one group i.e. Group 3. The remaining states viz. Bihar, Chhattisgarh, Gujarat, Madhya Pradesh and Orissa are classified as Group 4. For the states in Group 4, the man-days lost due to the industrial disputes generally moderated between 2007 and 2011 from the prior years, before rising again since 2012.

Despite some degree of commonality, labour disputes have exhibited significant inter-year fluctuations across the sample period for most of the states (Figures 1(a)-(d)). For the entire sample period, i.e. between 2001 and 2017, the coefficient of variation of labour disputes measured by the ratio of standard deviation to the simple average was highest for Kerala and Andhra Pradesh, at 1.7 and 1.3, respectively, to 0.5 for West Bengal. Given such inter-year variations within a state, generally it is difficult to infer with simple statistical tools, wheth-

er labour disputes possess any persistence over time. Therefore, we adopt an econometric exercise that we elaborated in Section 4. Our estimation results from Equation (1) in Section 4 are presented in Table 1.

Our estimates in models 1 and 2 in Table 1 show that the average autoregressive coefficient or the AR(1) term across all states are positive for the whole sample, but significant only at 10 percent level of significance. The standard errors of the coefficients are generally high, which reflect high volatility in labour disputes over time and across states. In general, the findings in models 1 and 2 in Table 1 suggest a somewhat weak persistence of labour disputes at the aggregate

Table 1. Determinants of labour disputes in the Indian states' groups. Dependent variable: Labour disputes.

	No Groups		All Groups		Groups 1 and 2 combined		Groups 2 and 3 combined	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Labour Disputes—1-year lag	0.35*	0.83*	0.11*	0.65	0.13*	0.67	0.11	0.67
	(0.14)	(0.31)	(0.038)	(0.32)	(0.041)	(0.31)	(0.047)	(0.31)
Labour Disputes—1-year lag interacted with dummy variables								
Group 1			0.49***	0.49***	0.53***	0.53**	0.50**	0.48**
			(0.046)	(0.059)	(0.034)	(0.062)	(0.067)	(0.060)
Group 2			0.18	0.18			0.53**	0.52**
			(0.10)	(0.091)			(0.068)	(0.076)
Group 3			0.32***	0.36**	0.29**	0.33*		
			(0.052)	(0.081)	(0.043)	(0.081)		
Other explanatory variables								
Year of state Assembly elections—Dummy	0.54**	0.54**	0.49*	0.51**	0.44*	0.46**	0.46	0.47*
	(0.14)	(0.10)	(0.19)	(0.11)	(0.10)	(0.060)	(0.26)	(0.15)
Year before state Assembly elections—Dummy	0.24*	0.34*	0.26	0.37*	0.31	0.40	0.28	0.39
	(0.089)	(0.12)	(0.12)	(0.16)	(0.17)	(0.17)	(0.14)	(0.20)
Year after state Assembly elections—Dummy	0.46	0.46	0.44	0.43	0.43	0.41	0.44	0.43
	(0.23)	(0.36)	(0.20)	(0.30)	(0.21)	(0.31)	(0.22)	(0.36)
No. of years the incumbent part in the state government	0.078**	0.080*	0.059***	0.063**	0.047***	0.053**	0.057**	0.061**
	(0.016)	(0.032)	(0.0083)	(0.011)	(0.0041)	(0.0085)	(0.011)	(0.013)
State is in coalition with the union government—Dummy	0.048	0.080	0.043	0.069	0.17	0.18	0.047	0.071
	(0.20)	(0.26)	(0.22)	(0.29)	(0.20)	(0.29)	(0.18)	(0.25)
Year FE interacted with states/groups	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	251	251	251	251	251	251	251	251
R-squared	0.64	0.69	0.63	0.67	0.60	0.65	0.60	0.65
Root MSE	1.12	1.08	1.12	1.09	1.15	1.12	1.15	1.12

Notes: ***, ** and * indicate statistical significance of the coefficients at 1%, 5% and 10%, respectively. Values in parentheses indicate the standard errors. Regressions include dummy variables for state groups. Group 4 is the reference group.

level. In models 3 and 4, we interact AR(1) term with the dummy variables representing state groups 1, 2 and 3 as above. The dummy variable for Group i assumes a value 1 if the state belongs to Group i, 0 otherwise. Group 4 serves as the reference group in the regressions. In the specifications, as we do not interact the autoregressive term with the dummy variable for state group 4, the coefficient without an interaction represents the effects for that group.

The AR(1) term of labour disputes interacted with the Group 1 dummy variable are 0.49 in models 3 and 4 and are statistically significant. This means, the number of man-days lost per 1000 workers due to disputes in the industrial sector in a year is roughly 49 percent of the previous year's level in Group 1 states, after controlling for the states' elections and some other factors. This is consistent with the broad pattern in **Figure 1(a)**. The AR(1) term interacted with the Group 3 dummy variable is 0.32 and 0.36 in models 3 and 4, respectively, and are significant too. This means for the states in this group, labour disputes in a year generally reduce to between 32 and 36 percent, of the previous year's levels. The coefficient of AR(1) term interacted with the Group 2 dummy variable is statistically insignificant. This means, for the group of states, i.e. Andhra Pradesh and Kerala, labour disputes do not display any definite pattern over the sample period. The AR(1) coefficient without any interaction term represents the reference group, i.e. Group 4. Although the coefficients are positive, the statistical significance of the coefficient is much weaker. Models 3 and 4 in **Table 1** imply that the labour disputes have generally declined in states represented by Groups 1 and 3 during 2001 to 2017. States in Group 1 generally display slightly higher persistence as compared to the states in Group 3, as the AR(1) coefficient for states in Group 1 are larger. States in Groups 2 and 4 do not display any persistence in their labour disputes as their coefficients are generally not statistically significant.

As robustness check, we rerun these regressions by combining Groups 1 and 2 in models 5 and 6, respectively, and by combining Groups 2 and 3 in models 7 and 8, respectively. The coefficient of the AR(1) term interacted with Group 1 state dummy variable remains robust and retains statistical significance in all these models. The coefficient of the Group 4 mostly remains statistically insignificant. The coefficient of AR(1) term interacted with the Group 3 dummy broadly remains robust and significant at 5 percent in models 5 and 6. The coefficient of AR(1) term interacted when groups 2 and 3 are combined turns statistically significant in models 7 and 8. In this case, however, it shows a dominant effect of group 3 over group 2 states. The robustness checks broadly confirm our previous observations about the persistence of labour disputes among the state groups. Labour disputes in the states in India generally have not shown persistence in the recent period. Labour disputes have, in fact steady declined over the sample period in Haryana, Karnataka, Maharashtra, Punjab, Rajasthan and West Bengal as indicated by the coefficient for their autoregressive term which is only around 0.5, much lower than 1. Labour disputes in Assam, Uttar Pradesh and

Tamil Nadu have also shown a declining pattern over the sample period. For these three states, in fact, the coefficient is much smaller in magnitude than the previous group, indicating a much sharper decline in labour disputes between consecutive two years (models 3 - 6 in Table 1). Hence, labour disputes have shown a lower degree of persistence in Assam, Uttar Pradesh and Tamil Nadu as compared to Haryana, Karnataka, Maharashtra, Punjab, Rajasthan and West Bengal. However, in case of Assam, Uttar Pradesh and Tamil Nadu, the coefficients are generally significant at higher levels of significance due to higher standard errors of the coefficients. This means, although labour disputes in Assam, Uttar Pradesh and Tamil Nadu have generally fallen between two years, there is high volatility in that speed among the states and between the years for these states. In nutshell, however, states represented by both these groups displayed a tendency towards reduction in the labour disputes over time. The effects persist even when the groups are combined with Group 2 states in models 5 to 8. The AR(1) coefficient, when interacted with the Group 2 dummy variable alone, do not show statistical significance (models 3 and 4). Similarly, the AR(1) coefficients that are not interacted with any of the state Group dummies do not display any robust pattern while only some of them significant only at 10 percent level of significance. This means that labour disputes in Andhra Pradesh, Kerala, Bihar, Chhattisgarh, Gujarat, Madhya Pradesh and Odisha generally have not shown any persistence between 2001 and 2017. In these states, labour disputes occurred mostly in the form of random events that do not generally repeat with similar magnitude in the subsequent years. These conclusions hold even after we control for the years of states' Assembly election, which are associated with increase in labour disputes in the range of 45% - 55%. Also, one more year of a political party running the state government is generally associated with about 5% - 8% increase in the labour disputes.

5.2. Labour Disputes and Capital-Labour Ratios

As Section 2 discusses, non-persistent labour disputes may have almost no impact on a sector's long-run equilibrium capital stocks and the output levels. Table 2(a) shows the estimated coefficients from a regression of the aggregate capital-labour ratio in the five manufacturing industries for the states on labour disputes (Equation (2) from Section 4). The capital-labour ratios are in natural logarithm. The regressions in Table 2(a) control for the group specific unobserved characteristics by Group 1, 2 and 3 dummies. Group 4 serves as the reference group.

Regressions in columns 1 - 3 in Table 2(a) do not include aggregate firm-TFP while regressions in columns 4 - 6 include aggregate firm-TFPs. The coefficients of labour disputes are statistically insignificant in all specifications. This means that the labour disputes generally did not have much effect on the equilibrium capital-labour ratios in the manufacturing industries between 2001 and 2017. In other words, labour disputes generally did not have any significant influence on

Table 2. (a) Impact of labour disputes on steady-state K/L (All Firms). Dependent variable: Capital-labour ratio; (b) Impact of Labour Disputes on Steady-state K/L (10 - 90th Percentile Firms). Dependent variable: Capital-labour ratio; (c) Impact of Labour disputes on steady-state K/L (20 - 80th Percentile Firms). Dependent variable: Capital-labour ratio.

(a)

	Without Firm TFP			With Firm TFP		
	(1)	(2)	(3)	(4)	(5)	(6)
Capital-Labour ratio—1-year lag	0.87*** (0.024)	0.87*** (0.024)	0.87*** (0.024)	0.87*** (0.023)	0.87*** (0.023)	0.88*** (0.022)
Firm TFP				0.025 (0.078)	0.00095 (0.074)	−0.039 (0.072)
Physical Infrastructure	0.064** (0.027)	0.067** (0.027)	0.068** (0.028)	0.049** (0.025)	0.054** (0.025)	0.052* (0.026)
Banking Infrastructure	0.075*** (0.025)	0.072*** (0.025)	0.067*** (0.024)	0.065*** (0.025)	0.063** (0.025)	0.057** (0.024)
Labour Disputes	0.029 (0.032)			0.032 (0.029)		
Labour Disputes—1-year lag		0.014 (0.029)			0.0094 (0.033)	
Labour Disputes—2-years lag			−0.024 (0.021)			−0.024 (0.028)
	Labour Disputes Interacted with Group Dummies					
Group 1	−0.010 (0.033)	0.0011 (0.030)	0.034 (0.023)	−0.017 (0.030)	0.0018 (0.033)	0.029 (0.028)
Group 2	−0.043 (0.038)	−0.024 (0.034)	0.022 (0.031)	−0.059 (0.038)	−0.031 (0.034)	0.0042 (0.034)
Group 3	−0.052 (0.035)	−0.035 (0.032)	0.0064 (0.021)	−0.053 (0.034)	−0.029 (0.034)	0.012 (0.026)
Number of observations	1220	1225	1225	1140	1150	1155
F-statistic	616.1	592.3	626.8	783.8	727.8	693.4
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.89	0.89	0.89	0.89	0.89	0.89
Root MSE	0.31	0.32	0.32	0.31	0.31	0.31

Notes: ***, ** and * indicate statistical significance of the coefficients at 1%, 5% and 10%, respectively. Standard errors are clustered within industries in each state. Regressions include constant term, state-group and industry-dummies. Parentheses indicate standard errors. Regressions include one-year lagged valued of the logarithm of capital-labour ratios which are not reported.

(b)

	Without Firm TFP			With Firm TFP		
	(1)	(2)	(3)	(4)	(5)	(6)
Capital-Labour ratio—1-year lag	0.83*** (0.040)	0.83*** (0.041)	0.82*** (0.044)	0.83*** (0.041)	0.83*** (0.042)	0.82*** (0.045)

Continued

Firm TFP				0.25** (0.10)	0.23** (0.10)	0.18* (0.10)
Physical Infrastructure	0.080*** (0.029)	0.075** (0.032)	0.087** (0.035)	0.067** (0.029)	0.062* (0.033)	0.075** (0.037)
Banking Infrastructure	0.066** (0.026)	0.073*** (0.026)	0.065** (0.028)	0.056** (0.027)	0.063** (0.027)	0.055* (0.028)
Labour Disputes	−0.0015 (0.030)			0.021 (0.030)		
Labour Disputes—1-year lag		0.026 (0.030)			0.044 (0.034)	
Labour Disputes—2-years lag			−0.0067 (0.031)			0.014 (0.033)
Labour Disputes Interacted with Group Dummies						
Group 1	0.021 (0.031)	−0.0023 (0.031)	0.031 (0.034)	−0.0049 (0.030)	−0.023 (0.034)	0.0065 (0.036)
Group 2	0.017 (0.039)	−0.060* (0.036)	−0.0082 (0.039)	0.0012 (0.038)	−0.072* (0.038)	−0.029 (0.044)
Group 3	−0.011 (0.032)	−0.048 (0.034)	−0.0048 (0.036)	−0.026 (0.033)	−0.059 (0.037)	−0.016 (0.037)
Number of observations	1220	1225	1225	1140	1150	1155
F-statistic	239.1	238.3	214.7	206.7	209.2	200.6
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.81	0.81	0.80	0.82	0.81	0.80
Root MSE	0.35	0.36	0.36	0.35	0.35	0.36

Notes: ***, ** and * indicate statistical significance of the coefficients at 1%, 5% and 10%, respectively. Standard errors are clustered within industries in each state. Regressions include constant term, state-group and industry-dummies. Parentheses indicate standard errors. Regressions also include one-year lagged valued of the logarithm of capital-labour ratios which are not reported.

(c)

	Without Firm TFP			With Firm TFP		
	(1)	(2)	(3)	(4)	(5)	(6)
Capital-Labour ratio—1-year lag	0.78*** (0.052)	0.78*** (0.051)	0.78*** (0.052)	0.77*** (0.051)	0.78*** (0.051)	0.77*** (0.052)
Firm TFP				0.17 (0.11)	0.17 (0.11)	0.16 (0.11)
Physical Infrastructure	0.098** (0.043)	0.088** (0.044)	0.093** (0.045)	0.093** (0.043)	0.083* (0.044)	0.089* (0.045)
Banking Infrastructure	0.087*** (0.031)	0.094*** (0.030)	0.090*** (0.032)	0.080** (0.031)	0.087*** (0.030)	0.082** (0.032)

Continued

Labour Disputes	0.0079 (0.030)			0.020 (0.032)		
Labour Disputes—1-year lag		0.035 (0.037)			0.050 (0.038)	
Labour Disputes—2-years lag			0.0032 (0.044)			0.014 (0.047)
Labour Disputes Interacted with Group Dummies						
Group 1	0.017 (0.029)	−0.0097 (0.038)	0.017 (0.047)	0.0063 (0.031)	−0.022 (0.038)	0.0071 (0.049)
Group 2	−0.021 (0.041)	−0.13*** (0.045)	−0.032 (0.056)	−0.030 (0.045)	−0.15*** (0.043)	−0.047 (0.059)
Group 3	−0.030 (0.034)	−0.071 (0.045)	−0.026 (0.053)	−0.035 (0.035)	−0.077* (0.046)	−0.029 (0.054)
Number of observations	1220	1225	1225	1140	1150	1155
F-statistic	105.4	103.6	100.4	115.0	114.7	102.5
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.74	0.75	0.74	0.74	0.75	0.74
Root MSE	0.42	0.42	0.43	0.42	0.42	0.43

Notes: ***, ** and * indicate statistical significance of the coefficients at 1%, 5% and 10%, respectively. Standard errors are clustered within industries in each state. Regressions include constant term, state-group and industry-dummies. Parentheses indicate standard errors.

the states' manufacturing sector's growth for the period. The conclusions are robust in different sample of firms as reported in Table 2(b) and Table 2(c). Table 2(b) and Table 2(c) report similar regressions for the aggregate capital-labour ratios after excluding both the top and bottom 10 percent and 20 percent firms, respectively, from the distribution of gross sales within each state-industry combination. These results are consistent with our earlier finding that labour disputes were generally found not to be persistent during the sample period. In 9 out of 16 states, labour disputes have declined while in other 7 states, disputes were mostly random events. As discussed in Section 2, labour disputes that are less persistent are less likely to affect the long-run investment adversely. Tables 2(a)-(c) broadly corroborate these arguments.

5.3. Labour Disputes and Aggregate TFP

Labour disputes, however, affect the production process when they occur. Higher labour disputes reduce the availability of worker strength by reducing working days, delayed operations, temporary shutdown etc. If the scales of labour disputes are not known a priori, capital stocks are planned and mostly acquired at the end of the preceding periods without taking into account the possible re-

duction in operations due to labour disputes. In such cases, when the disputes occur, a portion of that capital stock remains unutilised. This is an efficiency loss for the firms. Effectively, this causes a reduction in firms' output from the levels that could have been achieved using the available capital stocks. Strikes, temporary closure and lockout also reduce firms' capacity expansion and upgradation of technological abilities for that period. In economic term, unanticipated labour disputes reduce the total factor productivities, or TFP for the firms. Our estimates of Equation (3) from Section 4 presented in Table 3 broadly support this case. Table 3 provides estimates of the effects of labour disputes on aggregate firm-TFPs in the states. In order to avoid any endogeneity issues, we instrumented labour disputes in the same way as in the regressions in Tables 2(a)-(c). We also interact labour disputes with the dummy variables representing the states in Groups 1, 2 and 3. Therefore, the coefficient of labour disputes that is not interacted represent the effects for the states in Group 4. We account for the stochastic trend in TFP by incorporating its one-year lagged value as a regressor. Column 1 in Table 3 suggests that, with 1 percent increase in the labour

Table 3. Impact of Labour disputes on average firm-level TFP. Dependent variable: Average Firm-level TFP.

	All Groups		10 - 90 percentile Firms		20 - 80 percentile Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Average Firm-level TFP—1-year lag	0.87***	0.87***	0.88***	0.87***	0.86***	0.86***
	(0.024)	(0.026)	(0.026)	(0.026)	(0.028)	(0.025)
Labour Disputes	−0.032**		−0.034**		−0.040**	
	(0.013)		(0.014)		(0.017)	
Labour Disputes—1-year lag		−0.018		−0.020		−0.024
		(0.013)		(0.016)		(0.019)
Labour Disputes Interacted with Group Dummies						
Group 1	0.027*	0.018	0.027*	0.018	0.032*	0.023
	(0.014)	(0.015)	(0.016)	(0.017)	(0.019)	(0.021)
Group 2	0.014	0.0085	0.019	0.013	0.028	0.020
	(0.015)	(0.019)	(0.016)	(0.023)	(0.019)	(0.027)
Group 3	0.028*	0.018	0.029*	0.016	0.034*	0.018
	(0.014)	(0.015)	(0.016)	(0.018)	(0.018)	(0.021)
Number of observations	1220	1225	1220	1225	1220	1225
F-statistic	154.3	123.2	139.6	129.5	106.2	119.8
Prob > F	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.80	0.80	0.81	0.81	0.79	0.79
Root MSE	0.15	0.15	0.17	0.17	0.19	0.19

Notes: ***, ** and * indicate statistical significance of the coefficients at 1%, 5% and 10%, respectively. Standard errors are clustered within industries in each state. Regressions include constant term, state-group and industry-dummies. Parentheses indicate standard errors.

disputes, aggregate firm-level TFP in the states represented by Group 4 decline by about 3.2 percent in the same period. The interaction terms with Groups 1 and 3 are positive and only marginally smaller than the above coefficient. This suggest that these effects tend to be smaller in states that are in Groups 1 and 3. The estimated coefficient of the interaction term with the Group 2 dummy is not statistically significant, which means, the effects for the states in Group 2 are not statistically different from states in Group 4. In nutshell, our findings from column 1 in Table 3 suggest that with 1 percent increase in labour disputes, aggregate firm-TFP decline by about 3.2 percent on average, in Andhra Pradesh, Kerala, Bihar, Chhattisgarh, Gujarat, Madhya Pradesh and Odisha. There states are represented by Groups 2 and 4. As Table 1 suggests, labour disputes in these states were broadly random events between 2001 and 2017, the magnitude and occurrence of which could not be ascertained based on the past data. On the other hand, Table 1 had suggested that in the remaining states, viz. Haryana, Karnataka, Maharashtra, Punjab, Rajasthan, West Bengal, Assam, Tamil Nadu and Uttar Pradesh, labour disputes had broadly shown a declining trend over the sample period. Column 1 in Table 3 suggest that the decline in aggregate firm-level TFP in response to increase in labour disputes is reduced in these states as compared to the states classified as Groups 2 and 4.

These effects, however, disappear in the subsequent period, as the coefficient of one-year lagged labour dispute is statistically insignificant (Column 2 in Table 3). The estimates in Columns 1 and 2 are repeated for different sample of firms in Columns 3 to 6. The coefficient of labour disputes without an interaction term increases in magnitude when some firms from the tails of the distribution of gross sales are excluded. For instance, a 1 percent increase in labour dispute is associated with 3.4 percent and 4.0 percent decline in aggregate firm-TFP when 10 percent and 20 firms are excluded from the both tails of the distribution of gross sales, respectively, as compared to 3.2 percent decline in TFP, when all firms are included in our estimates. These regressions also controlled for the physical and banking infrastructure at the states, similar to regressions reported in Tables 2(a)-(c). We do not find the coefficients of these variables to be robust and statistically significant across different specifications.

Evidence so far suggests that labour disputes generally have not affected the capital-labour ratios in the states' manufacturing industries during 2001 to 2017. However, in the very short term, labour disputes are associated with reduced TFPs, a measure of efficiency of the firms. This, in turn, may have reduced output for a particular year from what could have been achieved with the available capital stocks in the absence of such disputes. However, these effects are significantly reduced for the states where labour disputes have declined over the sample period.

6. Conclusion

In this paper, we provide estimates on how many the increases in labour dis-

putes are associated with loss in output in the manufacturing industries across the major states in India, for the recent period. Alongside estimating the impacts of labour disputes occurring at a particular point of time, we also try to provide empirical evidence whether labour disputes have created any significant differences in the equilibrium output among the manufacturing sectors in Indian states. We carried out the analysis for 16 major states in India that account for almost 90 percent of the value added from manufacturing sector of all-India level. We cover only "registered" manufacturing units which accounts for more than 65 percent of the manufacturing sectors' value added for the sample period. We measured labour disputes by the number of man-days lost in the industrial sector due to disputes in the form of strikes, lockouts, etc., divided by the number of workers in the states' industrial sector.

We divide the analysis in the following way. First, we document the patterns of labour disputes among the states in India between 2001 and 2017. We do not find any significant sign of persistence in labour disputes in the states. After controlling for political events such as the state assembly elections and the possible year specific fixed effects that might be common across all states, we find that, in 9 out of 16 states, labour disputes have fallen since 2001. These states are Haryana, Maharashtra, Rajasthan, Karnataka, Punjab, West Bengal, Assam, Uttar Pradesh and Tamil Nadu. In the remaining states, labour disputes mostly characterised as random events, displaying wide fluctuations across years. The literature suggests that an event that is persistent, creates uncertainty in the minds of economic agents thereby reducing investment and output growth. However, in our cases, we do not see significant sign of persistence of labour disputes over the last two decades in India. While in majority of the states, labour disputes have declined, in the remaining states, they do not show any predictable pattern over the years. Second, our estimates based on two-stage least squares regressions suggest that labour disputes may not have significant impact on the equilibrium capital-labour ratios for the five manufacturing industries between 2001 and 2017. We regress labour disputes on the aggregate capital-labour ratios of the five manufacturing industries for these states. In order to avoid any estimation biases due to labour dispute's correlation with the unaccounted state-specific characteristics including the nature of labour regulations, we used states' election cycles and the length of a political party on states' power as instruments for the labour disputes in all our regressions. Labour disputes, however, reduce the workforce and bring temporary halt to the production activities, thereby reducing output from the level that could have been achieved with the available capital stock. In economic term, this results in the reduction in the total factor productivities (TFP) for the firms. Our estimates suggest that a 1 percent higher labour dispute is associated with about 3.2 percent reduction in the firm-TFP in the same year for Andhra Pradesh, Kerala, Bihar, Chhattisgarh, Gujarat, Madhya Pradesh and Odisha, where labour disputes are mostly unpredictable random events. In the remaining states, viz. Haryana, Maharashtra, Ra-

jasthan, Karnataka, Punjab, West Bengal, Assam, Uttar Pradesh and Tamil Nadu where labour disputes have consistently fallen over time, this effect is significantly reduced. The findings are robust in different sample of firms. The effects become marginally higher when we exclude 10 percent and 20 percent firms from both the tails of gross sales distribution, in successive samples. In turn, lower TFP may have reduced the output levels to certain extent for a particular year. Bloom (2014) argues that the effects on output can be large in developing countries due to the presence of low insurance for the firms. Low insurance often limits the Oi-Hartman-Abel effect (after Oi, 1961; Hartman, 1972; Abel, 1983) in which firms can easily expand and contract in response to changes in uncertainty. However, Bloom (2014) admits that the Oi-Hartman-Abel effect might not work very well in the short-run. Also, Bloom (2014) notes that when the general uncertainty rises, the productivity growth drops as reallocation freezes. Our estimates based on relatively shorter time frame between 2001 and 2017 might stand as an evidence in favour of Bloom (2014).

Our conclusion that the labour disputes generally have not resulted in much variation in the long-run equilibrium output in the manufacturing sectors across the states rest much on the fact that labour disputes generally showed limited persistence during the sample period. This also corroborates in the theoretical arguments described in Section 2. An analysis of the impact of labour disputes in particular, and economic uncertainties in general on the equilibrium output levels, therefore, may be undertaken in an extended-period sample, preferably in cross-country setup as a future research.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Abel, A. (1983). Optimal Investment under Uncertainty. *The American Economic Review, 73,* 228-233.

Aghion, P., Burgess, R., Redding, S., & Zilibotti, F. (2008). The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India. *The American Economic Review, 98,* 1397-1412. https://doi.org/10.1257/aer.98.4.1397

Ahsan, A., & Pagés, C. (2007). *Are All Labor Regulations Equal? Assessing the Effects of Job Security, Labor Dispute, and Contract Labor Laws in India* (Vol. 4259). World Bank Publications.

Baker, S., Bloom, N., & Davis, S. (2016). Measuring Economic Policy Uncertainty. *Quarterly Journal of Economics, 131,* 1593-1636. https://doi.org/10.1093/qje/qjw024

Barro, R. (1991). Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics, 106,* 407-443. https://doi.org/10.2307/2937943

Barro, R., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy, 100,* 223-251. https://doi.org/10.1086/261816

Bernanke, B. (1983). Irreversibility, Uncertainty, and Cyclical Investment. *Quarterly Journal of Economics, 98,* 85-106. https://doi.org/10.2307/1885568

Besley, T., & Burgess, R. (2004). Can Labor Regulation Hinder Economic Performance? Evidence from India. *Quarterly Journal of Economics, 119,* 91-134. https://doi.org/10.1162/003355304772839533

Bhagat, S., Ghosh, P., & Rangan, S. P. (2013). *Economic Policy Uncertainty and Economic Growth in India*. IIM Bangalore Research Paper No. 407. https://doi.org/10.2139/ssrn.2246882

Bloom, N. (2009). The Impact of Uncertainty Shocks. *Econometrica, 77,* 623-685. https://doi.org/10.3982/ECTA6248

Bloom, N. (2014). Fluctuations in Uncertainty. *Journal of Economic Perspectives, 28,* 153-176. https://doi.org/10.1257/jep.28.2.153

Brennan, M., & Schwartz, E. (1985). Evaluating Natural Resource Investments. *The Journal of Business, 58,* 135-157. https://doi.org/10.1086/296288

Cass, D. (1965). Optimum Growth in an Aggregative Model of Capital Accumulation. *The Review of Economic Studies, 32,* 233-240. https://doi.org/10.2307/2295827

Cooper, R., & Haltiwanger, J. (2006). On the Nature of Capital Adjustment Costs. *The Review of Economic Studies, 73,* 611-633. https://doi.org/10.1111/j.1467-937X.2006.00389.x

Corvers, F. (1997). The Impact of Human Capital on Labour Productivity in Manufacturing Sectors of the European Union. *Applied Economics, 29,* 975-987. https://doi.org/10.1080/000368497326372

Ghani, E., Goswami, A., & Kerr, W. (2016). Highway to Success: The Impact of the Golden Quadrilateral Project for the Location and Performance of Indian Manufacturing. *The Economic Journal, 126,* 317-357. https://doi.org/10.1111/ecoj.12207

Goldar, B., & Veeramani, C. (2005). Manufacturing Productivity in Indian States: Does Investment Climate Matter? *Economic and Political Weekly, 40,* 2413-2420.

Hartman, R. (1972). The Effects of Price and Cost Uncertainty on Investment. *Journal of Economic Theory, 5,* 258-266. https://doi.org/10.1016/0022-0531(72)90105-6

Knight, F. (1921). *Risk, Uncertainty, and Profit.* Houghton Mifflin Company; The Riverside Press.

Koopmans, T. (1963). *On the Concept of Optimal Economic Growth*. No. 163, Cowles Foundation Discussion Papers, Cowles Foundation for Research in Economics, Yale University.

Levinsohn, J., & Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *The Review of Economic Studies, 70,* 317-341. https://doi.org/10.1111/1467-937X.00246

McDonald, R., & Siegel, D. (1986). The Value of Waiting to Invest. *Quarterly Journal of Economics, 101,* 707-727. https://doi.org/10.2307/1884175

Nickell, S. (1986). Chapter 9. Dynamic Models of Labour Demand. In *Handbook of Labor Economics* (Vol. 1, pp. 473-522). Elsevier.

https://doi.org/10.1016/S1573-4463(86)01012-X

Oi, W. (1961). The Desirability of Price Instability Under Perfect Competition. *Econometrica, 29,* 58-64. https://doi.org/10.2307/1907687

Olley, S., & Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Industry. *Econometrica, 64,* 1263-1298. https://doi.org/10.2307/2171831

Ramey, V., & Shapiro, M. (2001). Displaced Capital: A Study of Aerospace Plant Closings. *Journal of Political Economy, 109,* 958-992. https://doi.org/10.1086/322828

Ramsey, F. (1928). The Mathematical Theory of Saving. *The Economic Journal, 38,* 543-559. https://doi.org/10.2307/2224098

Solow, R. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics, 70,* 65-94. https://doi.org/10.2307/1884513

Topalova, P. B., & Khandelwal, A. (2011). Trade Liberalization and Firm Productivity: The Case of India. *The Review of Economics and Statistics, 93,* 995-1009. https://doi.org/10.1162/REST_a_00095

Appendix

Table A1. Share of registered firms in manufacturing GSDP.

States	Average: 2000-2008	Average: 2009-2015
Andhra Pradesh	71%	77%
Assam	75%	66%
Bihar	22%	46%
Chhattisgarh	84%	86%
Gujarat	74%	81%
Haryana	72%	71%
Jharkhand	85%	79%
Karnataka	73%	79%
Kerala	51%	45%
Madhya Pradesh	66%	70%
Maharashtra	72%	71%
Odisha	77%	87%
Punjab	55%	58%
Rajasthan	58%	60%
Tamil Nadu	64%	71%
Uttar Pradesh	55%	57%
West Bengal	49%	54%
All states	**65%**	**68%**

Source: Ministry of statistics and program implementation, government of India. Note: GSDP = Gross State Domestic Product.

Table A2. NIC 2-digit codes for the Industry groups.

Industry	NIC 2008 Code	NIC 1998-2004 Code
Leather-textile	13, 14, 15	17, 18, 19
Chemical Products	20, 21	24
Metal Products	24, 25	27, 28
Electronics and Machinery	26 - 30	29 - 35
Miscellaneous	16, 17, 18, 22, 23, 31, 32	20, 21, 22, 25, 26, 36, 37

Table A3. (a): Determinants of the firm-level value added; (b) Determinants of the firm-level efficiency.

(a)

	All Firms	10 - 90 percentile firms	20 - 80 percentile firms
	(1)	(2)	(3)
Labour	0.95*** (0.011)	0.90*** (0.012)	0.89*** (0.013)
Capital	0.34*** (0.0064)	0.39*** (0.0070)	0.41*** (0.0075)
Labour interacted with the dummy variables			
Leather-textiles	−0.15*** (0.0045)	−0.17*** (0.0047)	−0.18*** (0.0054)
Chemicals	−0.18*** (0.0051)	−0.22*** (0.0054)	−0.25*** (0.0062)
Metal Products	−0.055*** (0.0050)	−0.069*** (0.0053)	−0.078*** (0.0061)
Electrical and machinery	−0.099*** (0.0046)	−0.11*** (0.0048)	−0.12*** (0.0054)
Public limited companies	0.0057 (0.0043)	−0.0027 (0.0044)	−0.014*** (0.0050)
Self-employment	−0.038*** (0.0037)	−0.042*** (0.0038)	−0.040*** (0.0041)
Capital interacted with the dummy variables			
Leather-textiles	−0.11*** (0.0033)	−0.11*** (0.0037)	−0.12*** (0.0043)
Chemicals	0.085*** (0.0037)	0.12*** (0.0042)	0.12*** (0.0049)
Metal Products	−0.013*** (0.0036)	0.0084** (0.0039)	0.0016 (0.0045)
Electrical and machinery	0.025*** (0.0034)	0.037*** (0.0036)	0.032*** (0.0041)
Public limited companies	−0.077*** (0.0038)	−0.11*** (0.0039)	−0.12*** (0.0045)
Self-employment	−0.051*** (0.0032)	−0.050*** (0.0035)	−0.039*** (0.0039)
Number of observations	408,446	326,880	245,060
F-statistic	2057961.2	1757975.8	1322574.7

Continued

Prob > F	0	0	0
R-squared	1.00	1.00	1.00
Root MSE	0.81	0.77	0.76

Standard errors in parentheses. ** $p < 0.05$, *** $p < 0.01$.

(b)

	All Firms	10 - 90 percentile firms	20 - 80 percentile firms
	(1)	(2)	(3)
Human Capital	1.93*** (0.017)	2.04*** (0.018)	2.04*** (0.020)
Technology	0.57*** (0.0029)	0.56*** (0.0030)	0.56*** (0.0035)
Human capital interacted with the dummy variables			
Leather-textiles	−0.47*** (0.013)	−0.55*** (0.014)	−0.63*** (0.015)
Chemicals	−0.45*** (0.012)	−0.50*** (0.013)	−0.50*** (0.015)
Metal Products	−0.50*** (0.014)	−0.55*** (0.015)	−0.54*** (0.017)
Electrical and machinery	−0.51*** (0.011)	−0.60*** (0.012)	−0.62*** (0.014)
Technology interacted with the dummy variables			
Leather-textiles	0.14*** (0.0038)	0.15*** (0.0038)	0.16*** (0.0043)
Chemicals	0.075*** (0.0048)	0.087*** (0.0050)	0.095*** (0.0058)
Metal Products	0.040*** (0.0043)	0.033*** (0.0046)	0.043*** (0.0052)
Electrical and machinery	0.092*** (0.0039)	0.092*** (0.0040)	0.10*** (0.0046)
Number of observations	408,444	326,879	245,059
F-statistic	9506.3	9213.2	7279.2
Prob > F	0	0	0
R-squared	0.48	0.52	0.53
Root MSE	0.58	0.53	0.52

*** indicates statistical significance of the coefficients at 1%.

Table A4. Years of assembly elections in Indian states.

States	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Andhra Pradesh				Yes					Yes					Yes			
Assam	Yes					Yes					Yes					Yes	
Bihar					Yes					Yes					Yes		
Chhattisgarh			Yes					Yes					Yes				
Gujarat		Yes					Yes					Yes					Yes
Haryana					Yes				Yes					Yes			
Jharkhand					Yes				Yes					Yes			
Karnataka				Yes				Yes					Yes				
Kerala	Yes					Yes					Yes					Yes	
Madhya Pradesh			Yes					Yes					Yes				
Maharashtra				Yes					Yes					Yes			
Odisha				Yes					Yes					Yes			
Punjab		Yes					Yes					Yes					Yes
Rajasthan			Yes					Yes					Yes				
Tamil Nadu	Yes					Yes					Yes					Yes	
Uttar Pradesh		Yes					Yes					Yes					Yes
West Bengal	Yes					Yes					Yes					Yes	

Table A5. Validity of instruments for states' labour disputes and banking infrastructure.

Explanatory variables	Dependent variable: Labour disputes	Dependent variable: Banking infrastructure
	Coefficient (S.E.)	Coefficient (S.E.)
Year of state Assembly elections—Dummy	0.47*** (0.14)	
Year after state Assembly elections—Dummy	0.46*** (0.14)	
No. of years the incumbent part in the state government	0.094*** (0.017)	−0.013** (0.0049)
Year of the union election—Dummy		0.39*** (0.080)
Year before the union election—Dummy		0.41*** (0.079)
Year after the union election—Dummy		0.43*** (0.095)

Continued

Model Properties		
Number of observations	273	288
R-squared	0.61	0.90
Root MSE	1.17	0.15

Notes: *** and ** indicate statistical significance of the coefficients at 1% and 5%, respectively. Regressions include dummy variables for states and years, and a constant term. Standard errors are clustered within states. Banking infrastructure is proxied by the outstanding bank credit at % of NSDP in industrial sector.

Table A6. β-convergence of manufacturing industries among Indian states.

	Dependent Variable: Δ Capital-Labour Ratio			Dependent Variable: Δ VA-Labour Ratio		
	All Firms	10 - 90 percentile Firms	20 - 80 percentile Firms	All Firms	10 - 90 percentile Firms	20 - 80 percentile Firms
Explanatory Variables	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)	Coefficient (S.E.)
Capital-Labour ratio at period $t-1$	−0.63*** (0.07)	−0.63*** (0.05)	−0.69*** (0.05)			
Value added per labour ratio at period $t-1$				−0.54*** (0.06)	−0.61*** (0.05)	−0.69*** (0.11)
Model Properties						
Number of observations	1120	1120	1120	1120	1120	1120
R-squared	0.42	0.40	0.42	0.33	0.36	0.40
Root MSE	0.29	0.30	0.36	0.21	0.20	0.22

Notes: *** indicates statistical significance of the coefficients at 1%, respectively. Regressions use dummy variables for each state-industry combination. Standard errors are clustered within industries in each state. All the variables are in their natural logarithm. Δ indicates change from the previous year. Regression includes a constant.