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STATE-LEVEL LABOR REFORM AND FIRM-LEVEL PRODUCTIVITY IN INDIA*

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Abstract

We examine the effects of labor market reform on establishment performance in different Indian states over a contemporaneous period. Using plant-level data for a period from the late 1990s to the late 2000s, the study provides plant-level cross-state/time-series evidence of the impact of reforms of employment protection legislation (EPL) and related labor market policies on productivity in India. Identification of the effect of EPL follows from a difference-in-differences estimator inspired by Rajan and Zingales (1998) that takes advantage of the state-level variation in labor regulation and heterogeneous industry characteristics. The fundamental identification assumption is that EPL is more likely to restrict firms operating in industries with higher labor intensity and/or higher sales volatility. The results show that firms in labor intensive or more volatile industries benefited the most from labor reforms in their states. Point estimates indicate that, on average, firms in labor intensive industries and in flexible labor markets have TFP residuals 25.4% higher than those registered for their counterparts in states with more stringent labor laws. However, no important differences are identified among plants in industries with low labor intensity when comparing states with high and low levels of EPL reform.

Keywords: employment regulation legislation, labor laws, job protection, total factor productivity, firm-level volatility

JEL Classification Numbers: D24, F16, J5, J8, K31

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1 Introduction

It is well known that India's formal Employment Protection Legislation (EPL) is among the most stringent in the world. Many believe that this is one of the main reasons behind the stagnant share of manufacturing output in India's GDP during the last 40 years (OECD, 2007). Although the country has recorded impressive output growth rates since the 1970s, the share of manufactures in total output has remained between 14% and 18%. Though infrastructure and product market regulation have been major challenges, strict labor laws have been blamed in particular for the poor performance of large-scale labor intensive manufactures despite India's labor abundance (Panagariya, 2008; Conway and Herd, 2009; Dougherty et al., 2009). According to the MCI (2011), the top five goods exported during 2010-11 represented almost 50% of the country's total exports and they were all relatively capital intensive goods such as petroleum products, gems and jewelry, transport equipment, machinery and instruments, and pharmaceutical products. In contrast, ready-made garments, traditionally an unskilled-labor intensive export, has seen its share in total Indian exports decline from 12.5% to 6% between 2000 and 2010. In 2010, India was the fifth largest exporter of apparel with 3.2% of the world's exports, lagging behind China, the European Union, Hong Kong, and Bangladesh (WTO, 2011).

Industrial relations in India fall under the joint jurisdiction of central and state governments, an arrangement that has generated a degree of variation in labor regulations across states. Although all states had essentially the same starting point under the License Raj, each state has independently amended labor regulations, rules and practices during the post-Independence period. In the last decade, this "natural experiment" setting has been exploited by several empirical studies that have tried to assess the effects of labor regulation on output, employment, and productivity. However, and despite increasing interest in the topic, the evidence for India is still inconclusive and mostly limited to industry-level analysis.

One of the most influential studies of India is Besley and Burgess (2004), which constructs an index summarizing state-level amendments to the Industrial Disputes Act (IDA) between 1949 and 1992. The index, henceforth referred to as BB, is used along with several control variables to explain state-level outcomes corresponding to the organized manufacturing sector using industry-level panel data for 1958-92. The authors identify a negative impact of pro-worker regulation on output, investment, employment, and labor productivity among registered manufacturing firms. Several papers that also rely on the BB index reach similar conclusions.[1]

Nonetheless, the validity of the BB index and the econometric methodology used to identify the effect of excessive pro-worker regulation have been extensively criticized. The main concerns with the use of this index are related to problems in the coding of labor laws and its exclusive focus on formal reforms to the IDA. This study tries to overcome the shortcomings of the previous empirical evidence in the tradition of Besley and Burgess to evaluate the effect of labor regulation on the Indian organized manufacturing sector. We make use of a more comprehensive measure of labor market regulations proposed in OECD (2007) and elaborated in Dougherty (2009). We argue that this index is superior to the BB index as it includes information on formal and informal labor market reforms, not only to the IDA but in seven additional areas: the Factories Act, the State Shops and Commercial Establishments Acts, the Contract Labor Act, the role of inspectors, the maintenance of registers, the filing of returns and union representation.

Using this comprehensive EPL measure and plant-level data from the Annual Survey of Industries (ASI) for all the fiscal years between 1998-99 and 2007-08, we evaluate whether labor market regulation differences across Indian states led to a differential response in industrial performance.[2] However, one must keep in mind that differences across states in terms of labor regulation may be endogenous since a higher number of pro-employer reforms in a given state may be driven by the characteristics of the firms located in that state.

Following Rajan and Zingales (1998), we focus on the details of the theoretical mechanisms at play. As we will show below, unit labor costs increase with more stringent EPL, and more so for firms operating in industries with higher labor intensity. This implies that firms in industries with higher labor shares will suffer the most from the additional costs of hiring and firing workers. In addition, to the extent that such costs act as adjustment costs, they will have more of an effect in more volatile industries so that the productivity of firms in more

[1] See Aghion et al. (2008) and Ahsan and Pagés (2009) as examples.

[2] In this paper, EPL is used as a shorthand to refer to a customized measure of state-level labor regulation reforms in India (see Dougherty (2009)). The official OECD measure is country-specific and has a longstanding standardized definition, as most recently elaborated in Venn (2009).

volatile sectors should be more affected by strict labor laws. Thus, we implement a difference-in-difference estimator that exploits both the variation in EPL by state, as well as the variation in industry-specific characteristics related to labor intensity and volatility. By focusing on a specific mechanism through which EPL reform operates (labor intensity or volatility), this approach provides stronger evidence of causality.

Previous studies have also exploited the variation in state and industry characteristics[3] but their focus was at the industry level. To our knowledge, this is the first study of India to evaluate the direct effect of labor regulation on plant-level productivity using a longitudinal sample,[4] and is one of only a few studies on any country to examine the impact of labor regulation at the plant level.

The evidence presented here shows that firms in industries with higher labor intensity or higher sales volatility benefited the most from labor market reforms in their states. The positive effect of relaxed EPL on organized manufacturing firms in labor intensive industries is experienced through higher total factor productivity (TFP). Similarly, firms in more volatile industries that experience pro-employer labor reforms tend to have higher levels of TFP. We also identify a heterogeneous effect of EPL in labor intensive industries by plant size and ownership type. In particular, we find that smaller firms and private firms with a high usage of labor inputs tend to benefit the most from relaxation of state labor laws. In general, our results suggest that state-level reforms can help to mitigate the detrimental effects that strict federal labor laws have on industrial outcomes in the organized Indian manufacturing sector.

Our paper contributes to two strands of literature. First, its adds to the literature that focuses on the effect of labor and product regulation on industrial outcomes and economic performance, of which Besley and Burgess (2004) has been one of the most influential studies. It also contributes to some recent studies on the potential links between labor markets and comparative advantage that have received special attention in the trade literature. Within this literature, our study is particularly related to Cuñat and Melitz (2007) and Krishna and Levchenko (2009),

[3]See Gupta et al. (2008) and Bassanini et al. (2009).

[4]Harrison et al. (2013) use a similar dataset also based on the Annual Survey of Industries (ASI) to examine market share reallocations; however they focus on trade, foreign direct investment (FDI) and licensing policy reforms, and control for interactions with labor reforms.

who examine how firm-level volatility can determine the pattern of comparative advantage.

The rest of the paper proceeds as follows. Section 2 sketches out the major findings in the literature. Section 3 describes the data as well as some basic stylized facts. The empirical strategy is described in Section 4. Section 5 displays the results as well as some robustness checks while Section 6 concludes.

2 Previous Literature

Despite increasing interest in the effect of institutions and regulation in industrial performance, the theoretical and empirical evidence to support or negate the beneficial effect of EPL relaxation is still limited. Although labor market equilibrium models such as Garibaldi (1998) and Mortensen and Pissarides (1999) predict a negative effect of stricter EPL on job mobility, its effects on productivity are not that straightforward. There is even a branch of the literature which suggests that the net effects of EPL on productivity may be positive. Workers could be more willing to invest in human capital specific to the firm if their jobs are better protected. Firms may also be willing to invest more to increase labor productivity as an alternative to downsizing. Bassanini et al. (2009) provide an extensive discussion of these theoretical results, suggesting that there might be an "optimal" level of EPL.

Stricter labor regulation increases the costs of hiring and firing workers, making it more difficult for the firm to react to demand or supply shocks that require labor reallocation or staff reduction. The restriction of labor movement even in more productive firms or sectors can thus result in lower productivity levels. Poschke (2009) develops a model that takes into account firm dynamics and where firms receive idiosyncratic productivity shocks. He shows that selection eliminates the active firms with the lowest productivity, and entrants imitate more productive survivors. In this setting, strict EPL ends up reducing firm value, discouraging not only entry but also the exit of less productive firms. Product or technology innovation can also be discouraged if the firm has to face high labor costs and high layoff costs in case of failure Samaniego (2006). Moreover, growth losses tend to be larger when productivity is more volatile. This latter result is in line with previous findings of worse effects of strict EPL for firms operating in more turbulent sectors (see Bentolila and Bertola, 1990).[5]

A paper by Cuñat and Melitz (2012, 2007) studies the link between volatility, labor market flexibility, and international trade. They develop a model and test it using country-industry data and find that countries with more flexible labor markets fare better in more volatile industries, where their ability to adjust to unexpected shocks is more important. This implies that labor market reforms might have differential effects across industries and that their effects might be more beneficial among sectors with a higher dispersion of within-industry shocks.

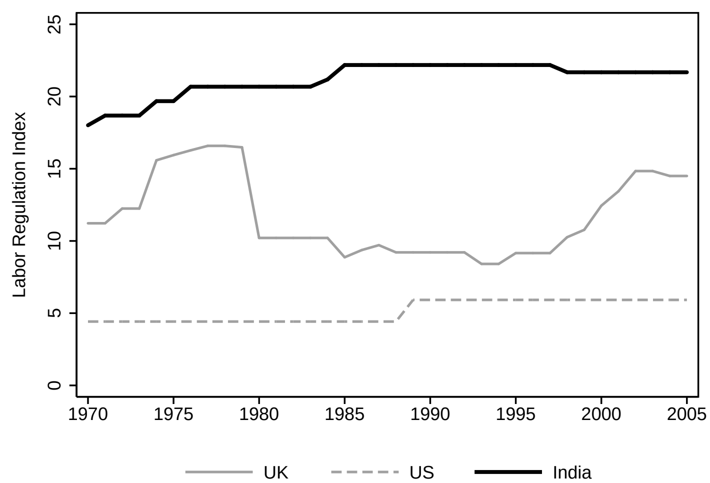
More broadly, the empirical literature is quite inconclusive and has tried to measure the effects of EPL on industrial outcomes using cross-country studies with industry-level data or industry-state-level data. Among the first group of papers, Micco and Pagés (2007) implement a difference-in-differences estimator in a cross-section of industry-level data for a sample of developed and developing countries. They are able to identify the effect of EPL by arguing that sector differences in the intrinsic volatility of demand and supply shocks can lead to differential responses to labor regulation. Their results show that EPL reduces turnover, employment, and value added in more volatile industries but they only find weak evidence of a negative relationship between labor regulation stringency and labor productivity. Similarly, Bassanini et al. (2009) use aggregate cross-country/time-series data on OECD countries to measure the differential effects of country-level EPL on industry-level productivity. They find that dismissal regulations tend to generate larger TFP growth loses among industries with a high layoff propensity relative to industries where firms rely less on layoffs to adjust labor-inputs' usage.

A recent strand in the empirical literature focuses on India, one of the countries with the strictest labor regulation in the world. Although Indian labor laws were strongly influenced by the British model inherited on independence, it is clear that Indian labor regulation is substantially more protective than the UK's present system, as shown in Figure 1. The gap between these countries broadens after 1979, which is when a conservative government committed to labor market deregulation was elected in the UK. India fares even worse when compared to the

[5] Under a general equilibrium framework, Hopenhayn and Rogerson (1993) show how the distortion induced by firing restrictions pushes firms to use resources less efficiently. EPL is likely to make it more difficult for firms to react quickly to rapid changes in technology or product demand that requires reallocation of staff or downsizing. As a result, employment levels adjust at a slower speed and productivity is reduced.

US. However, the Indian case is particularly interesting and a nice setting for empirical studies given the ability of state governments to introduce formal and informal amendments to the labor laws. Consequently, changes in the application of the law at the state-level have resulted in important variations in the stringency of EPL within the same country.

Figure 1: Evolution of Labor Law in India, UK, and the US



Source: Deakin et al. (2007).
Notes: The laws reported for India are mostly federal laws. The authors also report some state-level variations in case law, especially for the most heavily industrialized states. Their Labor Regulation Index is a score obtained out of 40 possible points, where higher values indicate more stringent regulation.

First promoted by Besley and Burgess (2004), most studies focusing on India tend to use cross-state and intertemporal variation in labor legislation as measured by state IDA amendments. These studies find that changes towards more flexible labor regulation are correlated with higher levels of manufacturing output, employment, and labor productivity in the organized industrial sector. For example, Aghion et al. (2008) find that, following delicensing in the 1980s and early 1990s, industries located in states with pro-employer labor regulations grew more quickly than those in pro-worker environments. Ahsan and Pagés (2009) also use the BB index over a similar period, but decompose it into amendments that reduce transaction costs of initiating and sustaining industrial disputes and those that increase job security and reduce labor flexibility. Their results suggest that regulations that increase the cost of settling disputes are more costly for employment than the restrictions directly imposed by the IDA.

Focusing on rural India in the same time period, Adhvaryu et al. (2012) develop a partial equilibrium model where agriculture exists alongside industry. They use rainfall fluctuations to measure exogenous unobserved demand and cost shocks, and analyze the response of states with different labor regulations as measured by the BB index. Their results show that the change in employment is significantly greater in states with laxer labor laws. However, shocks do not generate a differential response in output or profits. This is explained by a greater adjustment of the use of capital and materials in pro-worker states.

Despite its extended use in the empirical literature, the BB index has been heavily criticized. Bhattacharjea (2006, 2009) claims that the Besley and Burgess (2004) scoring system can erroneously classify a state as pro-employer or pro-worker with just one or two amendments to the IDA in the 50 years covered by the index. Nagaraj (2004) points out that the BB index focuses only on the IDA, abstracting from several other labor laws that affect industrial performance. Another important critique is its exclusive focus on *formal* amendments, which ignores changes in the actual practices and enforcement of the labor laws. In fact, most recent changes in state-level practices have resulted from judicial interpretations of the laws by the Supreme Court. It is thus not surprising that updates of the BB index, including our own, using the most recent edition of Malik (2011), show very few changes in labor regulation after 1992. In addition, Bhattacharjea (2009) emphasizes the fragility of Besley and Burgess's (2004) econometric results. In particular, Bhattacharjea criticizes the use of irrelevant state-level control variables and inadequate tests for robustness, as well as the fragility of their results once state-specific time trends are introduced in their model.

A recent study by Gupta et al. (2008) tries to overcome some of the BB index's measurement problems by using a simple majority rule across three EPL measures available in the empirical literature, including the BB index. They argue that this approach has the advantage of weeding out any measurement error, unless there are systematic mistakes in coding the states across different indicators. Using this state-level composite measure of EPL, they exploit industry-level variation in labor usage to test the differential impact of product and labor market regulations. They find that labor intensive industries in states with flexible labor regulation have higher levels of value added.

Bhattacharjea (2009) departs from Besley and Burgess's (2004) work by focusing on the legislative content of the state-level amendments as well as on the judicial interpretations to Chapter V of the IDA.[6] He critiques the earlier studies for various omissions and insufficient attention to judicial interpretations, and shows that the BB index should not relied upon to capture the variation in labor regimes. He also proposes a series of empirical tests that examine the effect of state-level labor regulation reform on the number of factories, value added, and share of contract labor. The results from these tests are mixed, and mostly inconclusive, and he highlights that his main contribution lies on his critique of the earlier literature.

All in all, the evidence on the effects of EPL on TFP and/or TFP growth in India is still scarce. This gap in the literature is even larger when we focus on the evidence available at the plant or firm level. One exception is the work by Harrison et al. (2013), which is tangentially related to our work. The authors decompose aggregate productivity gains after the trade reforms from the early nineties between market-share reallocations and average productivity improvements. They find that a very small share of the TFP gains in Indian manufacturing was due to market-share reallocations and test whether this result is explained by labor rigidities due to strict labor laws. In general, they find that labor laws, as measured by the number of close-down or layoff requests granted, do not generate a differential effect of trade reforms on productivity, measured using an index number approach. However, they find that in states where labor regulation is more rigid, foreign direct investment (FDI) reform has a larger impact on TFP. They claim that this is evidence that FDI reform only matters when labor regulation makes it more difficult for firms to optimize their production.

Besides the well-known difficulties involved in TFP estimation at the plant level, the fact that state-level changes in labor regulation may be endogenously determined requires sources of exogenous variation in the data to identify the effect of EPL on plant-level productivity. In particular, we expect differences in labor regulation to have heterogenous effects on productivity across industries with different levels of labor intensity and volatility. A Cobb-Douglas production function is assumed, specific to each manufacturing industry, $Y = AL^{\alpha}K^{1-\alpha}$, and thus the

[6] This chapter relates to firms' requirements to obtain government permission for layoffs, retrenchments, and closures.

unit cost function (which is inversely related to A, multifactor productivity) will be given by:

$$\begin{aligned} c &= \frac{R_s^\alpha}{A}\left(\frac{w}{\alpha}\right)^\alpha\left(\frac{r}{1-\alpha}\right)^{1-\alpha} \\ &= \frac{1}{A'}\left(\frac{w}{\alpha}\right)^\alpha\left(\frac{r}{1-\alpha}\right)^{1-\alpha} \end{aligned} \tag{1}$$

where w and r are the labor and capital input prices and A' is what is measured as TFP. Employment protection legislation is captured through the constant R_s, which multiplies wages in state s to capture the effective cost of labor, consistent with our view of employment protection in India as being roughly proportional to the number of workers in a firm. Whenever labor legislation imposes additional costs through layoff regulation or hiring restrictions, R_s will be above one. Clearly, A' falls as R_s rises.

The effect of EPL on measured TFP, A', is identified by taking advantage of the state-level variation in labor regulation as well as the industry-level variation in labor intensity as measured by an estimate of α.

3 Data

The data used in this study come from the Indian Annual Survey of Industries (ASI), conducted by the Indian Ministry of Statistics (MOSPI). Previous studies using the same data source have been unable to build a plant-level panel due to the lack of factory identifiers that have only been made available recently.[7] A notable exception is Harrison et al. (2013), which uses the ASI panel to examine the role of market-share reallocations in aggregate productivity growth in India's organized manufacturing sector over 1985 to 2004.

3.1 Description

We use ASI data from the 1998-99 through 2007-08 fiscal years to obtain an unbalanced panel of registered manufacturing plants. The ASI's sampling frame is constructed by the Chief

[7]We thank India's Central Statistical Organization (CSO) for providing us the data we use for this study. The confidentiality of the unit level data was maintained and adequate precautions have been taken to avoid disclosing the identity of the units directly or indirectly.

Inspector of Factories and the Labor Commissioner in each State or territory. It includes all factories employing 10 or more workers using power, or 20 or more workers without using power. In general, the ASI's basic strategy over the years has been to divide the survey frame into census and sample sectors, where the census sector includes larger plants. Although this strategy has remained intact, the definition of census and sample sectors has undergone some changes over the years. Between the 1998-1999 and 2007-2008 rounds, the size threshold for the census sector fluctuated between 50 and 200 workers, so that only plants employing 200 or more workers are *always* surveyed during the years analyzed.[8] The remaining plants are randomly sampled. For more details about the sampling design changes as well as a detailed description of the data problems present in ASI see Bollard et al. (2013); Harrison et al. (2013) discuss the new longitudinal sample specifically.

The data provide factory reports on output, value added, fixed capital, investment, materials, fuel, labor, and labor expenditures. It also provides information on the type of ownership, the type of organization, as well as the start-up year of each plant. The ASI reports the book value of fixed capital both at the beginning and at the end of the fiscal year, net of depreciation. Our measure of fixed capital will be the average of the net book value of fixed capital at the beginning and at the end of the fiscal year, while all other variables are measured at the end. The data collected from the ASI are at current prices and must be corrected for price changes over time. Details on the specific deflators used for each variable can be found in the Annex to Dougherty, Frisancho and Krishna (2011).

The raw data consist of about 384,000 observations over 10 years, with an average of about 38,000 plants surveyed each year. We remove observations corresponding to non-operative plants (26,553) and plants with non-positive values of output and negative values of fixed capital stock (499). Table 1 shows that following this, on average, 26% of the observations in each round have missing values for output, value added, materials, fuels, fixed capital, or labor. After removing these observations, we also drop three manufacturing industries (2-digit NIC) with too few observations: other mining and quarrying, recycling, and office, accounting, and communication

[8] All industrial units belonging to the five least industrially developed states (Manipur, Meghalaya, Nagaland, Tripura and Andaman & Nicobar Islands) were also included in the census sector.

Table 1: Percentage of missing observations in each ASI round

Year	Total Obs.[a/]	Missing Obs.[b/]	% Missing
1998-1999	23,620	4,290	18.2
1999-2000	24,684	6,944	28.1
2000-2001	31,053	8,349	26.9
2001-2002	33,387	8,579	25.7
2002-2003	33,800	8,625	25.5
2003-2004	45,429	12,483	27.5
2004-2005	39,714	11,503	29.0
2005-2006	43,675	10,039	23.0
2006-2007	43,304	12,812	29.6
2007-2008	38,439	10,777	28.0
Total	357,105	94,401	26.4

[a/] After removal of non-operative plants and plants with non-positive values of output and fixed capital stock. Only 7% of all observations are dropped for these reasons.
[b/] Observations are coded as missing when the factory does not have data on output, value added, materials, fuels, fixed capital, labor, or labor expenditures.

equipment. Following Aghion et al. (2008) and Gupta et al. (2008), we also drop "other" manufacturing industries. This category groups different activities which are likely to vary across states, making it incomparable across states. Finally, we also drop the states and union territories of Jammu & Kashmir, Chandigarh, Nagaland, Manipur, Tripura, Meghalaya, Daman & Diu, Dadra & Nagar Haveli, Pondicherry, and Andaman & Nicobar Islands due to lack of information on employment legislation. We also exclude Lakshadweep due to lack of data in the ASI and Goa given its economy's dependence on tourism.

The final sample consists of 239,921 plant-year observations with data on 103,478 plants in 20 states. Almost 60% of the observations and 74% of the plants in our data come from the sample sector. Moreover, almost 50% of the plants appear in only one round of the survey. As expected, these are smaller plants, with an average of 48 workers. This is an important limitation of the ASI; since plants in the sample sector are not deliberately followed over time, entry and exit for smaller plants is missed. Due to changes in the census threshold size, exit and entry is only consistently observed for census plants with at least 200 workers. We call this sample the *restricted* census sample which contains 49,895 plant-year observations on 11,343 plants. Basic statistics on the final sample are presented in the Annex.

We rely on the restricted census sample to obtain TFP estimates but use information on all the plants surveyed to measure the effect of EPL on productivity. To take into account simultaneity and selection biases, we obtain production function estimates using the Olley-Pakes estimator. Since this approach uses information on plants' exits and lagged values of some variables, we only apply it to the restricted census sample. We then apply estimates of the production function's parameters to the full sample of plants and obtain TFP residuals for all plants in ASI's census and sample sectors.

An additional problem posed by ASI data is the substantial number of outliers. To reduce their influence in our estimates, we "winsorized" the data, following Bollard et al. (2013). This procedure basically implies top-coding and bottom-coding the 1% tails for each plant-level variable. In other words, for each year and each variable we replace outliers in the top 1% tail (bottom 1% tail) with the value of the 99^{th} (1^{st}) percentile of that variable. This procedure was applied separately to each 2-digit industry.[9]

A final issue with the ASI data is that it only provides information at the plant level. Many may argue that plants are not independent units but that instead, most production decisions are made at the firm level.[10] In any case, as Harrison et al. (2013) also point out, the difference between *plant* and *firm* in the ASI data is likely to be negligible since most firms are single-plant. In our final pool of plants, an average of 4.5% of them are under the control of a multiplant firm each year.

Our measure of labor reform comes from the OECD index which summarizes state-level indicators of procedural changes to the implementation of labor laws either through formal amendments or through *de facto* practices (Dougherty, 2009).[11] The OECD, with the support of the All-India Association of Employers (AIOE), surveyed 21 Indian states in 2007. The EPL

[9] We do not remove these outliers because we would have generated an additional loss of 59,896 observations, about 25% of the complete sample.

[10] Unfortunately, there is no firm-level data source with an adequate sample frame in India. The only alternative would be the Prowess dataset, from the Centre for Monitoring Indian Economy (CMIE). However, this database only covers publicly traded companies, some unlisted public and private limited firms, and a few unregistered companies. Their primary source of data are the Annual Reports of individual firms, which implies that their sample frame is biased towards much larger firms.

[11] Unfortunately, while it would have been desirable to separate the *de facto* from the *de jure* procedural changes, as Davies and Vadlamannati (2013) do in a different context, it is not possible to do so given the questionnaire design.

index reflects the extent to which procedural or administrative changes have reduced transaction costs in relation to labor issues. It is constructed using data from a survey instrument developed to identify areas in which Indian states have experienced specific changes to the implementation and administration of labor laws over the 1990s and 2000s. The survey covered 50 specific subjects of possible reform in seven major areas of labor regulation in addition to the IDA: the Factories Act, the State Shops and Commercial Establishments Acts, the Contract Labor Act, the role of inspectors, the maintenance of registers, the filing of returns and union representation. We use the ordinal EPL count index, rebased and rescaled from zero to one, which is essentially the percentage of areas in which pro-employer labor reform occurred. It is worth emphasizing that, although the OECD index can be separated by its subcomponents, we rely on the aggregate measure of labor reform since the index was designed to capture a state's general stance towards labor regulations, more than the character of specific reforms.

It is imporant to emphasize that the index only incorporates rules that relate to issues that affect the transaction costs of labor market arrangements, but not those related to worker health or safety. As such, rules that increase the rigidity or reduce the flexibility of mutually-beneficial employer-employee agreements, and reduce red tape are coded as pro-employer reforms. Moreover, even in the case of union representation, the issues covered relate to rules that give clear and cohesive representation to unions. More details can be found in Dougherty (2009).

To add state-level controls to our estimates, we gathered time series data on population, telephone availability, installed electric capacity, and paved road length. State population comes from census population data for 1991, 2001, and 2011, and it is linearly interpolated for other years. Time series data on fixed and mobile phones per 100 population comes from the Ministry of Statistics and Programme Implementation's (MOSPI) website. Installed electric capacity, measured as kilowatts per million people on the state, is obtained from the Annual Report of the Indian Ministry of Power for the years 1997-98, 2000-01, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, and 2007-08. State-wise surfaced road length is obtained from two sources: i) the Basic Road Statistics of India report from the Ministry of Road Transport and Highways for the years 2004-05, 2005-06, 2006-07, and 2007-08, and ii) the Planning Commission's 9th and 10th Five Year Plans. Road density is measured as paved kilometers per thousand people in the state.

We also include an OECD measure of state-level product market regulation as a time-invariant control to take into account the potential role of product regulation as a complement (or substitute) of labor market laws. The product market regulation index is taken from OECD (2007) and it contains information on state intervention and legal or administrative barriers to entrepreneurship (see Conway and Herd, 2009).

In our robustness checks, we will also make use of the BB index that we update through 2008 using Malik (2011) as well as Gupta et al.'s (2008) labor market regulation composite index. The latter is based on a simple majority rule across three sources: Besley and Burgess (2004), Bhattacharjea (2006), and Dougherty (2009). States are coded as pro-labor, pro-business, or neutral if the majority of the studies considered classified them as such. Additionally, we check the robustness of our results using industry-level layoff propensity instead of the measure of labor intensity captured by the estimated αs. Layoff propensities are measured for the US between 2002 and 2003 with data from the 2004 CPS Displaced Workers Supplement (see Table A.3 in Bassanini et al. (2009)).[12] Using these propensities, we construct a dummy variable for above and below the median industry.

We must emphasize that the ASI only provides data on organized manufacturing plants. In a country where the informal sector constitutes a majority of the labor force and the unorganized sector produces a third of total manufacturing value added, there is also a need to understand how EPL reforms have affected unorganized plants. A source of data on these plants is the National Sample Survey Organization's (NSSO) survey, but it is only carried out every five years. This lack of data comparable to the ASI forces most researchers to focus exclusively on the registered, or organized sector. However, this focus is also appropriate since labor market rigidities in the organized sector constrain the absorption of formal workers, who tend to be more productive, receive higher wages, and face better working conditions than workers in the informal sector (see Gupta et al., 2008). Moreover, Goldar and Aggarwal (2010) provide some evidence on the effects of labor market reforms in the unorganized manufacturing sector. Using the OECD labor market reform index for Indian states, they find a negative and significant

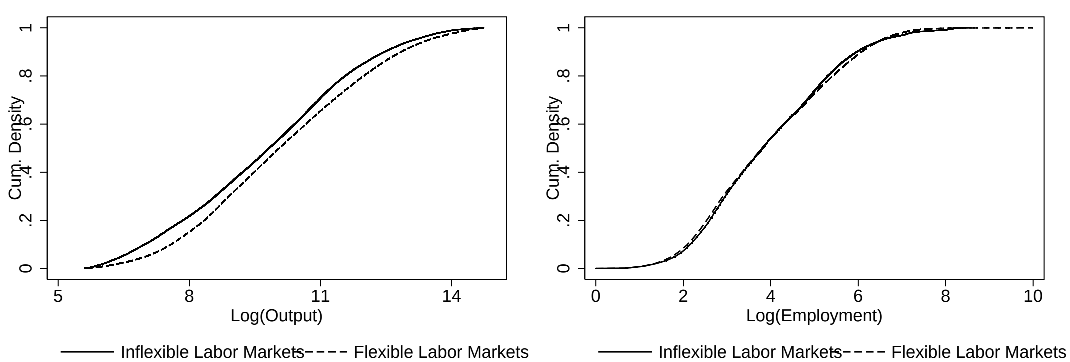
[12] The industry classification in this data (ISIC Rev. 3) does not exactly match the 2-digit industry classification of the ASI, so in some cases we had to merge Indian industries to make them comparable to those in the United States.

relationship between labor laws' flexibility and the probability of being a casual worker both in the formal and informal manufacturing sector, although the effect in the former is far stronger.

3.2 Basic Patterns

Using the OECD index, we classified states as having flexible labor markets when they were above the median state according to the degree of labor regulation reforms carried out. Figure 2 plots the cumulative distribution of output and employment by labor laws' rigidity. Panel (a) suggests that the variation in labor standards across states may have allowed some states to fare better than others; the distribution of output in states with flexible labor laws first-order dominates that of states with more stringent regulation, according to a two-sample Kolmogorov-Smirnov test for equality of distributions. Specifically, the test cannot reject the hypothesis that output for states with stringent labor regulation is smaller than for states with more flexible laws, and the test rejects that output is higher in strict versus flexible states. However, panel (b) of Figure 2 suggests that EPL does not seem to substantially influence formal employment, and this is confirmed by the corresponding Kolmogorov-Smirnov test.

Figure 2: Output, employment, and EPL in 2000

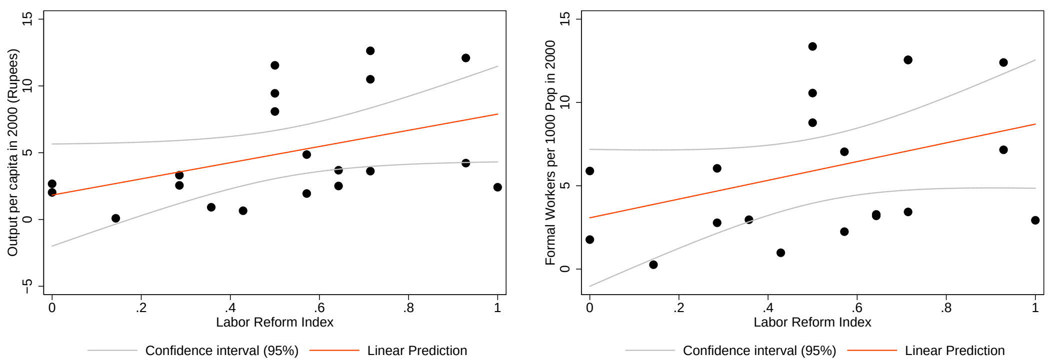


(a) Output (b) Employment

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08 rounds.

Although these patterns are suggestive, we now control for the states' total population to get a better idea of the general picture. Figure 3 plots output and employment per capita at the state level in 2000 against our EPL reform indicator.[13] Each observation in the scatter plot represents a state. Even after controlling for the state's population, Panel (a) in Figure 3 shows that there is a modest positive relationship between output per capita and the preponderance of labor law reforms in the state. However, this pattern is much weaker for formal employment per capita, as shown in panel (b).

Figure 3: Output and employment per capita and EPL in 2000



(a) Output

(b) Employment

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08 rounds.

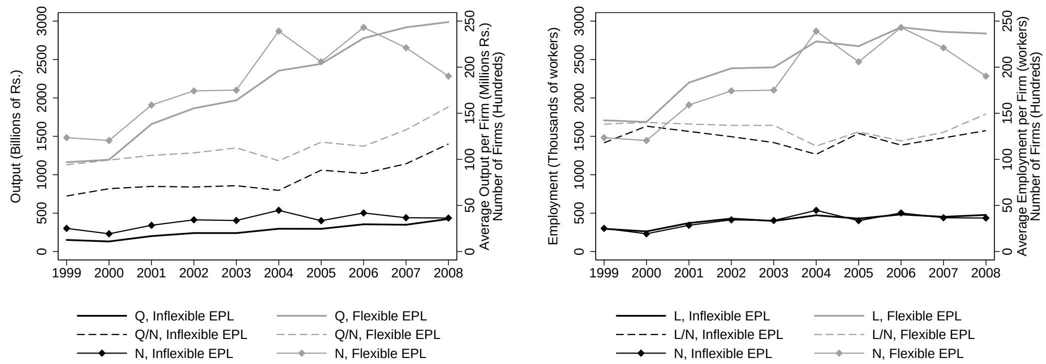
However, differences in the number of plants in each state may be driving these patterns. To deal with this, Figure 4 decomposes total output and employment by EPL flexibility into their *extensive* and *intensive* margins. While the extensive margin is captured by the number of plants (N), the intensive margin is measured by the average output or average employment per plant (Q/N or L/N). Both in terms of output and employment, states with more flexible regulation fare better than plants operating in more restrictive labor markets. However, most of this "advantage" seems to be explained by the evolution of the extensive margin. On average, intensive margin differences explain about 36% of the output gap and 9% of the employment differences between flexible and inflexible states.[14]

[13] The OECD labor reform index has been re-scaled so that zero corresponds to the lowest level of reform and one indicates the highest level of reform at the state level.

[14] Let the subscripts 0 and 1 correspond to outcomes in inflexible and flexible labor markets, respectively. Output differences can be decomposed in the following way:

$$\left(\frac{Q}{N}\right)_1 N_1 - \left(\frac{Q}{N}\right)_0 N_0 = \left[\left(\frac{Q}{N}\right)_1 - \left(\frac{Q}{N}\right)_0\right] N_1 + \left(\frac{Q}{N}\right)_0 [N_1 - N_0]$$

Figure 4: Labor market regulations and manufacturing production and employment



(a) Total output

(b) Total employment

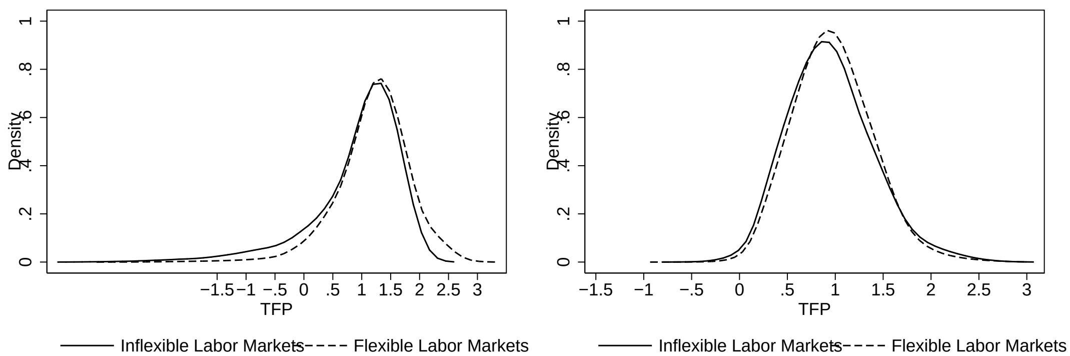
Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.

Figure 5 plots the distribution of TFP by EPL and labor intensity. We obtain TFP estimates separately for each industry (so that scaling is not an issue) using the Olley-Pakes approach in the subsample of ongoing plants in ASI's panel. Sub-section 4.1 below describes the details of the estimation of TFP residuals, which yields unbiased estimates of the production function coefficients. In particular, we rely on the output elasticity with respect to labor, α, estimated in the panel and identify labor intensive industries as those with an $\hat{\alpha}$ above the median industry. Panels (a) and (b) show that industries with high labor intensity experience a greater improvement in their TFP distribution from the relaxation of labor laws' enforcement when compared to less labor intensive industries. A two-sample Kolmogorov-Smirnov test for equality of distribution shows significant differences of the distribution of TFP across states with different labor regulation in labor-intensive industries. Specifically, we cannot reject that there are lower TFP values—but we can reject that there are higher TFP values—in strict states when compared with laxer ones. The corresponding test performed among industries with lower labor intensity shows that the distributions are different; however, the test rejects neither lower values of TFP nor higher values of TFP in strict versus flexible states.

So far, this preliminary evidence suggests that labor intensive industries benefit the most

where the first term in the right hand side captures output differences coming from the intensive margin for a fixed number of plants. The second term fixes output per plant to capture extensive margin differences.

Figure 5: Labor market regulation, labor intensity, and productivity



(a) TFP: High labor intensity

(b) TFP: Low labor intensity

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.

from EPL relaxation in Indian states. Section 5 below will test if the patterns identified for productivity remain relevant after a more rigorous analysis.

4 Empirical Strategy

The main objective of this study is to assess the effect of employment regulation reform in India on TFP between 1998-99 and 2007-08. The basic specification proposed to evaluate productivity performance is similar to the one used by Aghion et al. (2008), in the sense that we take advantage of state-level variation in labor regulation, but we extend it to incorporate industry-level variation. Our fundamental assumption is that EPL reform is more likely to restrict plants operating in industries with higher labor intensity, or alternatively higher volatility.

Consider the partial equilibrium effect of a change in EPL derived in equation (1). The impact on productivity is expected to be larger in industries where plants rely more on labor than in industries in which this input is relatively less important. We can also think of more volatile industries having a harder time adjusting their labor input usage when strict labor regulations are in place. To capture the effect of labor regulation reform, we use a difference-in-differences estimator inspired by Rajan and Zingales (1998). By comparing cross-industry differences in states with different levels of labor reform we can evaluate the effect of EPL changes towards pro-employer legislation on productivity levels. Labor-intensive industries will be more constrained by labor regulation so the impact of EPL reform is identified using industries with a lower output elasticity with respect to output as a control group. Relaxation in labor regulation may also interact with industry-level differences in the dispersion of plant-level shocks to generate larger TFP gains among sectors with a higher dispersion of these shocks.

Below, we briefly describe the TFP estimates used in this study. Next, we proceed to describe the econometric model used to measure the impact of labor reform on manufacturing plants.

4.1 TFP Measures

When trying to estimate a production function using observed plant-level variables, obtaining TFP measures from the residuals encompasses several measurement and econometric problems. One issue is that measurement of outputs and inputs generates an aggregation problem, especially in multiproduct plants. Another measurement issue relates to capital usage; since it is very tough to obtain data on capital consumption as an input in the production process, the researcher has to settle for the book value of total capital and machinery involved in the production process.

Although the previous problems are complex enough, there is not much the empirical researcher can do about them but try to collect better quality and more detailed micro data. In addition to these problems, several econometric difficulties arise when estimating production functions at the plant level. Two of the most prominent and serious problems are simultaneity and selection biases.

Assume a Cobb-Douglas production function like the one described below:

$$Y_{it} = A_{it} L_{it}^{\alpha} K_{it}^{\beta} M_{it}^{\gamma} F_{it}^{\lambda}$$

where Y_{it} are physical units of output and L_{it}, K_{it}, M_{it}, and F_{it} measure labor, fixed capital, materials, and fuels, respectively. Since A_{it} enters the right hand side in a multiplicative way, affecting all the other factors' marginal product simultaneously, it represents the TFP. Taking logarithms allows us to use a linear estimation model described by:

$$y_{it} = \alpha l_{it} + \beta k_{it} + \gamma m_{it} + \lambda f_{it} + u_{it} \tag{2}$$

where small letters are used for logs.

From the estimation of equation (2), we can retrieve the error term u_{it}, which is the log of plant-specific A_{it}, provided that the coefficients on the inputs are consistently estimated. OLS estimation does not yield consistent estimates if plants' choices on exit and on factor demands (when they continue operating) depend on their productivity. This fact generates both a selection and a simultaneity problem in the estimation of production functions.

Olley and Pakes (1996) deals with the simultaneity problem by using the firm's investment decision to proxy for unobserved productivity shocks.[15] It is assumed that a higher value of the productivity shock observed by the firm (but unobserved by us) will induce higher investment today. The Olley-Pakes approach also offers a correction for selection bias due to exit. In the first stage, a probit of survival is estimated as a function of a polynomial of capital and investment, and the fitted values from this regression are used in the second stage to consistently estimate the production function parameters.[16]

Since this technique requires information on exit and lagged values of some variables, we estimate the parameters in equation (2) using Olley-Pakes in the restricted census sample, for which panel data is available. We estimate the coefficients for capital, labor, materials, and

[15] See Olley and Pakes (1996). Their approach assumes a strictly monotonic relationship between output and investment so that all observations with zero investment are dropped. An alternative approach to deal with the simultaneity bias is offered by Levinsohn and Petrin (2003), who use intermediate inputs as a proxy for investment to avoid losing observations. However, only 4% of the plant-year observations in the restricted census sample used to estimate TFP have zero investment. Moreover, unlike Olley-Pakes, Levinsohn-Petrin methodology does not offer a correction for selection bias. For more details on the problems faced when estimating productivity as well as available solutions, see Arnold (2005).

[16] Recent developments in the literature offer potential avenues of future extensions. For example, Gandhi and Rivers (2013) propose a simple non-parametric estimator for the production function and productivity. They rely on the first order condition of the firm's profit maximization problem and use this information without any parametric assumption on the production function to identify productivity while dealing with the endogeneity of input choices. This is the first paper that we know of that departs from the traditional Cobb-Douglas assumption frequently used in structural methods that try to deal with the transmission and selection biases present in the estimation of TFP. Zhang (2013) also relies on the first order condition to obtain a measure of productivity that accounts for capital and labor-augmenting efficiency, separately. He claims that an advantage of his approach is that the estimation does not impose a Markov process assumption on the productivity evolution process and thus cross-sectional data suffices.

fuels separately for each industry and assume that these estimates are applicable to plants in the census as well as in the sample sector. We can then obtain TFP as a residual for all the plants using the industry-specific coefficient estimates. Estimating TFP using industry-specific regressions allows for differences in the production function's coefficients, including a constant term, which yields unit-free productivity residuals that are comparable across industries. In the end, TFP residuals are obtained as the exponential of the residual in equation (2).[17]

To estimate TFP at the plant level, we use real gross output instead of value added as the dependent variable. According to Basu and Fernald (1997) and Carlsson and Skans (2011), the use of value added is only valid for TFP estimation under perfect competition and constant returns to scale.[18] Labor is measured in number of workers and fixed capital is measured as the average of the net book real value of fixed capital at the beginning and at the end of the fiscal year. The amount of fuels and materials consumed is used to measure the usage of these inputs. Investment is measured by the gross value of additions to fixed capital. All the variables are measured in rupees at the end of the period and in 1993-94 constant prices, unless otherwise noted.

In essence, Olley-Pakes allows for a considerable more general firm-level fixed effect but the latter is nested within it. With ten years of annual observations we are sure that we have enough intertemporal variation to identify the parameters in the production function; in fact, Olley and Pakes (1996) themselves used twelve years of data while Levinsohn and Petrin (2003) relied on eight years.

4.2 Econometric Model

Our analysis of the impact of labor reform on manufacturing outcomes relies on this basic econometric model:

$$\log(\text{TFP}_{fist}) = \theta_0 + \theta_1 LI_i + \theta_2 R_s + \theta_3 (LI_i \times R_s) + \eta_t + \varepsilon_{fist} \tag{3}$$

[17]Notice that since the error is mean zero, this explains why the mean of the TFP distribution in Figure 5 is so close to one.

[18]See Appendix C in Carlsson and Skans (2011). They show that a residual measure of TFP that comes from value added is not independent of the use of intermediate inputs and factor input growth when there are increasing or decreasing returns to scale.

where TFP_{fist} is the Olley-Pakes residual for plant f, in industry i and state s, at year t. LI_i denotes industry's i labor intensity measure while state labor reform is captured by R_s.

Our indicator of R_s is a dummy variable based on the normalized count of EPL reforms in each state. We label states as having flexible regulation when their labor reform index is at or above the median state in terms of the proportion of state-level reforms (using the count index). We adopt this dummy specification because the OECD measure of labor reform cannot be considered a continuous variable but is closer to an ordinal or categorical variable. However, there are too many categories to use it as such and the dummy specification eases presentation of the results.

To measure LI_i, we construct a dummy variable for above and below the median labor-intensive industry based on the $\hat{\alpha}$s obtained from the estimation of equation (2). We believe that the use of $\hat{\alpha}$ to measure the intrinsic labor intensity in each industry is superior to the use of the share of labor expenditures in total output. The use of the estimated output elasticity with respect to labor overcomes the potential biases that the ratio of labor expenditures to output may have due to the endogeneity of the plant's input choices. Moreover, since our TFP estimation using the Olley-Pakes methodology takes into account year fixed effects, $\hat{\alpha}$ provides a clean estimate of the underlying labor intensity of each industry that is not biased by exogenous demand or supply shocks in the inputs markets.

An alternative specification of equation (3) uses industry volatility measures instead of labor intensity. In that case, we follow Krishna and Levchenko (2009) and measure industry volatility by the standard deviation of the annual growth rate of plants' output. We then construct a dummy variable for above and below the median volatile industry.

Since our measure of EPL reform is time-invariant and measured at the state level, we cannot include state fixed effects. Similarly, our labor intensity indicator is fixed at the industry level, so it restrains us from including industry fixed effects.[19] We control for year fixed effects, denoted by η_t in equation (3), and add a plant-specific trend.[20] We also incorporate additional controls in our estimates to make sure we take into account the effect of state-level characteristics.

[19] Full collinearity restrains us from including industry-year, state-year, or industry-state fixed effects.

[20] Of course, this trend is only relevant for plants present in multiple years and its removal does not quantitatively or qualitatively affect the results.

As argued by Bertrand et al. (2004), the estimation of differences-in-differences with an outcome variable measured at a lower level of aggregation when compared to the treatment variable–TFP at the establishment level and labor law reforms at the state level–may be subject to a serial correlation problem due to reduced variation within each state-year cell. Although this problem does not create an issue around the estimate of the intervention, it could understate the standard deviation and thus, the significance, of the coefficient in the interaction between the time dummy and the treatment variable, θ_3 in equation (3). To deal with this potential serial correlation problem, all our estimates allow for an arbitrary autocorrelation process when computing the standard errors. In particular, we specify the standard errors to allow for intragroup correlation within each state, relaxing the usual requirement that the observations are independent both across and within groups.[21]

The coefficient θ_3 on the interaction between LI_i and R_s will capture the heterogeneous effect of EPL reform on industries with different labor intensity. Given that R_s is higher when state labor reforms make EPL more flexible, a positive coefficient on the interaction implies that plants in industries that use labor more intensively fare better in states with pro-employer labor regulation. In the alternative specification, which uses industry volatility in place of labor intensity, the interaction term should also have a positive coefficient since more volatile plants are expected to benefit the most from laxer labor regulations.

Note that equation (3) is in no way related to the model in Sub-Section 4.1. While the latter sought to highlight the difficulties associated with measuring TFP as a residual, relying on a simple model of the firm, this section proposes an empirical strategy to identify the effect of labor regulation on productivity. To do so, we compare average multifactor productivity across states with different levels of regulation and across industries with different levels of labor intensity.

5 Results

The results presented in column (I) in Table 2 provide initial evidence of a beneficial effect of pro-employer labor reform on multifactor for labor intensive industries. The positive and significant

[21] Bertrand et al. (2004) suggest the use of this strategy as one of the best solutions to the autocorrelation within each cell over time, especially when dealing with large samples.

interaction of LI_i and R_s shows that manufacturing plants with high labor requirements that operate in states moving towards more flexible regulation exhibit larger TFP gains than plants in less labor intensive industries.

Table 2: Effect of EPL reforms on TFP by labor intensity

	(I)	(II)
Constant	0.907***	1.360***
	(0.032)	(0.328)
High labor intensity	-0.020	-0.034
	(0.074)	(0.081)
Flexible EPL	0.022	-0.027
	(0.036)	(0.044)
High labor intensity x Flexible EPL	0.246***	0.253***
	(0.082)	(0.087)
Time-variant state controls		
Log(Telephones/100 pop)		0.049**
		(0.020)
Log(Installed electricity cap./million pop)		-0.019
		(0.025)
Log(Paved roads/1000 pop)		0.017
		(0.016)
Time-invariant state controls		
Product Market Regulation		-0.067
		(0.054)
Observations	224,867	224,867
R-squared	0.059	0.065
Firm trend	yes	yes
State-level controls	no	yes
Year FE	yes	yes

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
State-level clustered standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

The point estimates from column (I) in Table 2 imply that there are important multifactor productivity gains from conducting more labor reforms, particularly for plants in labor intensive industries. In 2008, the ratio of the geometric mean of TFP for plants in states with flexible labor markets over the same mean of TFP for plants in states with inflexible labor markets is 1.31 in labor intensive industries, but it is close to one in industries with lower $\hat{\alpha}s$.[22] In other

[22] Using our estimates from column (I) in Table 2, the mean values of the trend, and the year dummy corresponding to 2008, we predict log(TFP) for 4 groups: i) plants in states with high levels of EPL reform and high $\hat{\alpha}$s, ii) plants in states with low levels of EPL reform and high $\hat{\alpha}$s, iii) plants with high levels of EPL reform and low $\hat{\alpha}$s, and iv) plants with low levels of EPL reform and low $\hat{\alpha}$s. To obtain 1.31, for example, we get the difference between the predictions of log(TFP) for group i) and ii) and exponentiate it to get the ratio of their TFP in levels.

words, a plant in a labor intensive industry that moves from an inflexible to a flexible state would get an average TFP improvement of about 31% while TFP gains are close to zero in industries with lower labor intensity.

To check the robustness of our findings, in column (II) we add a number of control variables to take into account state characteristics. These include both time-variant as well as time-invariant controls at the state level. Among the first group, we use the log of fixed and mobile phones's availability per 100 population, log of the installed electric capacity per million people, and the log of road density. Information on telephones, installed electric capacity, and road density are reasonable proxies for the general conditions of infrastructure, which are expected to be positively related to manufacturing output. We also include the OECD product market regulation index that measures how much regulations restrict competition.

Column (II) in Table 2 shows that the positive effect identified for labor intensive plants in flexible labor markets is still present for TFP once we control for state characteristics. The interaction between EPL reform and high labor intensity is positive and significant. Once state-level controls are introduced, our point estimates indicate that, on average, plants in labor intensive industries and operating in flexible labor markets have a TFP residual that is 25% higher than it is among plants in states with low levels of EPL reform and high $\hat{\alpha}$s. Among plants in industries with low $\hat{\alpha}$s, TFP *losses* from EPL reform are almost negligible, under 3%.

Next, we try to identify differential effects by plant size and type of ownership. Let X_{fist} denote a specific plant characteristic, such as size or ownership type. We extend the model in equation (3) in the following way:

$$\begin{aligned}\log(W_{fist}) &= \theta_0 + \theta_1 LI_i + \theta_2 R_s + \theta_3(LI_i \times R_s) + \\ &\quad \theta_4 X_{fist} + \theta_5(LI_i \times X_{fist}) + \theta_6(R_s \times X_{fist}) + \theta_7(LI_i \times R_s \times X_{fist}) + \eta_t + \varepsilon_{fist}\end{aligned}$$

Although θ_3 will still give us the average effect of the interaction of labor intensity and labor reform on productivity, the coefficient θ_7 becomes particularly important since it will capture any heterogeneous effects due to differences in X_{fist}.

In the case of plant size, X_{fist} will be a matrix of 4 size dummies. These are constructed using the number of workers with cutoffs at 50, 100, and 250. The first cutoff corresponds to the presence of a few labor laws that are enforced starting at this establishment size. The second cutoff is consistent with IDA's national threshold set in 1982. The last cutoff is in line with empirical evidence for India, above which plant TFP was observed to be substantially higher (see Dougherty et al., 2009). This check is particularly important since larger plants are subject to stricter labor regulation but are also more likely to subcontract workers to evade labor laws.

Let the share of contract labor in total expenditures for each plant be given by:

$$h^*_{fist} = \delta X_{fist} + \nu_i + \nu_s + \nu_t - \mu_{fist}$$

where ν_i, ν_s, and ν_t denote industry, state and year fixed effects. From this latent variable, we construct a categorical variable, h_{fist}, such that $h_{fist} = 1$ if the plant hires no contract labor, $h_{fist} = 2$ when the plant spends 20% or less of their labor costs on indirect labor, and $h_{fist} = 3$ when the plant spends more than 20% of total labor expenditures on hiring labor through contractors. Let the cutoffs for h^*_{fist} be given by $\xi_0 = -\infty$, $\xi_1 = 0$, $\xi_2 = 0.2$, and $\xi_3 = \infty$. The probability of $h_{fist} = H$ is given by:

$$\begin{aligned} \Pr(h_{fist} = H | X_{fist}) &= \Pr(\xi_{H-1} < h^*_{fist} < \xi_H | X_{fist}) \\ &= \Phi(\delta X_{fist} + \nu_i + \nu_s + \nu_t - \xi_{H-1}) - \Phi(\delta X_{fist} + \nu_i + \nu_s + \nu_t - \xi_H) \end{aligned}$$

where Φ is the normal cumulative distribution with mean zero and variance σ^2.

Table 3 reports δ estimates from an interval regression model like the one above. We find that larger plants are more likely to hire labor indirectly: the share of contracted labor increases by a factor of 0.317 when we compare plants with 250 or more workers to plants with less than 50 workers. Similarly, relative to the smallest plants, medium size plants with 50 to 99 workers and 100 to 249 workers see their share of contract labor expenditures increased by a factor of 0.268 and 0.3, respectively. Clearly, the tendency of larger plants to hire more workers through contractors helps them partially bypass labor legislation. Consequently, we expect them to benefit less from the state-labor reforms.

Table 3: Interval regression results for the share of contract labor in total labor expenditures

Plant size (base: < 50 workers)	δ	S.E.
[50 − 100[	0.268***	0.004
[100 − 250[	0.300***	0.003
250 or more	0.317***	0.003
Observations	229693	
Log likelihood	-165507.27	
σ	0.384***	
Year FE	yes	
Industry FE	yes	
State FE	yes	

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Estimates with the size dummies shown in column (I) in Table 4 confirm our initial prediction. The coefficient on the interaction between pro-employer EPL reform and labor intensity is positive and significant. Moreover, the coefficient on the triple interaction between EPL, labor intensity, and plant size (θ_7) is not significant for medium size plants but it is negative and significant for larger plants in both columns. Plants with more than 250 workers in industries with high labor intensity perform much worse than their smaller counterparts from pro-employer labor reforms. This result is consistent with the fact that larger plants face higher restrictions in inflexible labor regulation settings. Since many norms and regulations apply only to them, it looks like they have found a way out by reducing their dependence on a permanent workforce and relying more on temporary labor hired through contractors as suggested by Table 3. It has been well documented that casual or contract labor in India provides unskilled labor at wages below the minimum wage and without benefits, so the substitution of regular labor for casual labor can help larger plants reduce the labor costs imposed by more stringent EPL.

We also estimated the effects of pro-employer EPL reform separately for publicly and privately owned plants, where X_{fist} is a dummy that is equal to one when the plant is publicly owned. In the sample periods analyzed, publicly owned plants tend to have lower rates of job destruction and creation than privately owned plants. Although public plants tend to have a lower turnover rate than privately owned plants, their net contribution to employment is highly negative in half of the rounds analyzed. A proposed explanation for this lies in voluntary retirement schemes (VRS), which are used as a mutually agreeable mechanism for downsizing. Since

VRS has allowed public plants to bypass labor regulation and adjust their labor usage it may be possible that the effect of EPL within them is smaller than among private plants.

Table 4: Effect of EPL reforms on TFP by labor intensity and firm characteristics

	(I)	(II)
Constant	1.505***	1.432***
	(0.311)	(0.325)
High labor intensity	-0.137	-0.107
	(0.101)	(0.074)
Flexible EPL	-0.043	-0.046
	(0.037)	(0.050)
High labor intensity x Flexible EPL	0.278**	0.331***
	(0.104)	(0.081)
Firm Size (Base: ≤ 50 workers)		
$]50-100]$	0.117	
	(0.071)	
$]100-250]$	-0.031	
	(0.057)	
> 250	0.039	
	(0.055)	
High labor intensity x $]50-100]$	0.039	
	(0.109)	
High labor intensity x $]100-250]$	0.201	
	(0.153)	
High labor intensity x > 250	0.408***	
	(0.099)	
Flexible EPL x $]50-100]$	-0.055	
	(0.071)	
Flexible EPL x $]100-250]$	0.092	
	(0.062)	
Flexible EPL x > 250	0.041	
	(0.060)	
High labor intensity x Flexible EPL x $]50-100]$	0.051	
	(0.114)	
High labor intensity x Flexible EPL x $]100-250]$	-0.081	
	(0.162)	
High labor intensity x Flexible EPL x > 250	-0.215*	
	(0.117)	
Public firm		-0.006
		(0.046)
High labor intensity x Public firm		0.291***
		(0.090)
Flexible EPL x Public firm		0.070
		(0.050)
High labor intensity x Flexible EPL x Public firm		-0.311***
		(0.093)

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	(I)	(II)
Time-variant state controls		
Log(Telephones/100 pop)	0.051**	0.050**
	(0.020)	(0.020)
Log(Installed electricity cap./million pop)	-0.033	-0.023
	(0.024)	(0.026)
Log(Paved roads/1000 pop)	0.024	0.019
	(0.016)	(0.016)
Time-invariant state controls		
Product Market Regulation	-0.059	-0.074
	(0.050)	(0.054)
Observations	224,867	224,768
R-squared	0.089	0.069
Firm trend	yes	yes
State-level controls	yes	yes
Year FE	yes	yes

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
State-level clustered standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Column (II) in Table 4 presents the results obtained by ownership type. Public plants in labor intensive industries tend to have higher multifactor productivity as shown by the interaction of the ownership dummy and the labor intensity dummy. Moreover, the interaction between pro-worker EPL reform and labor intensity is positive and significant, which shows that the average beneficial effect of labor reform on labor intensive industries is higher. As we expected, the triple interaction for EPL reform, labor intensity, and public ownership is negative and significant. This implies that labor intensive public plants in flexible markets exhibit lower TFP gains from EPL reform, which is in line with the use of VRS among public plants as a strategy to circumvent labor regulation. Through this strategy, constrained public plants have been able to ameliorate the negative effects of inflexible regulation on productivity so that pro-employer labor reforms have smaller relative effects among them.

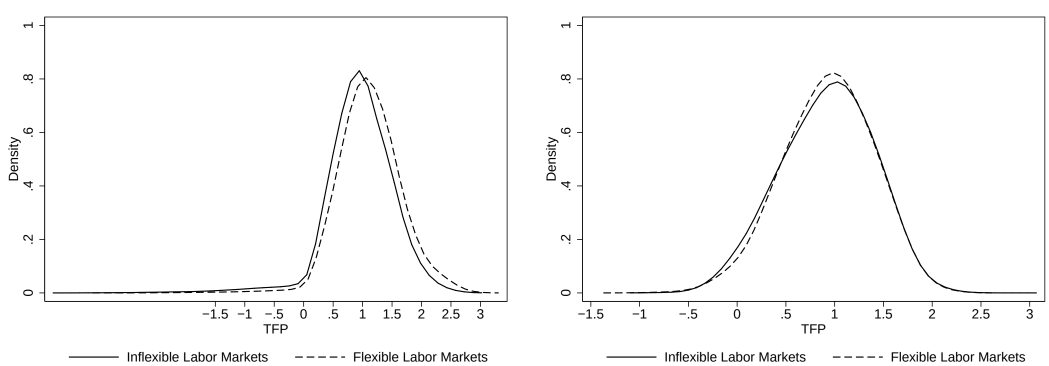
In general, the results show that there are important TFP gains for labor intensive plants that operate in states with laxer EPL. Moreover, the different strategies used by plants to overcome the constraints imposed by labor regulation generate differential effects of state-level labor reform both by plant size and type of ownership.

5.1 Volatility

We now test if laxer labor regulation benefits volatile industries relatively more as suggested by Poschke (2009) and others. Our measure of volatility is similar to Krishna and Levchenko's (2009): the standard deviation of the annual growth rate of plants' output in a given industry. Notice that we need a plant-level growth measure to quantify volatility, so we are will obtain a proxy for each industry from the restricted census sample, average it over all the ASI rounds we use, and apply it to the complete sample of plants. We then construct a dummy variable which classifies industries as highly volatile when they are at or above the median industry in terms of the average standard deviation of annual growth rate of output.

Panels (a) and (b) in Figure 6 present preliminary evidence on the existence of a comparative advantage among more volatile plants in flexible markets. State-level labor reforms seem to shift the TFP distribution to the right only in more turbulent industries, which is in line with Cuñat and Melitz (2007) findings.

Figure 6: Labor market regulation, volatility, and productivity



(a) TFP: High volatility (b) TFP: Low volatility

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.

Table 5 confirms these patterns. The interaction between EPL and volatility is positive and significant, which implies that plants in more volatile industries that operate in flexible labor markets have a comparative advantage in terms of multifactor productivity. The larger costs of hiring and firing people imposed by strict EPL seem to be particularly restrictive in sectors with higher volatility, generating an unequal distribution of the productivity gains that come from labor market deregulation.

Table 5: Effect of EPL reforms on TFP by volatility

	(I)
Constant	1.475***
	(0.386)
High volatility	0.044
	(0.052)
Flexible EPL	-0.057
	(0.043)
High volatility x Flexible EPL	0.147**
	(0.063)
Time-variant state controls	
Log(Telephones/100 pop)	0.053**
	(0.024)
Log(Installed electricity cap./million pop)	-0.016
	(0.028)
Log(Paved roads/1000 pop)	0.017
	(0.018)
Time-invariant state controls	
Product Market Regulation	-0.137*
	(0.066)
Observations	224,867
R-squared	0.048
Firm trend	yes
State-level controls	yes
Year FE	yes

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
State-level clustered standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

5.2 Robustness checks

In the previous section, we showed that plants in more labor intensive and/or more volatile industries are the big winners of pro-worker labor reforms in India. The interactions between higher levels of EPL reform and labor intensity as well as between pro-worker EPL reform and volatility were positive and significant even after the introduction of state-level controls. Moreover, the Appendix shows that our results are not sensitive to a different specification of the labor intensity measure. Including labor intensity in the model either as the value of $\hat{\alpha}$ or the relative ranking of each industry implied by $\hat{\alpha}$ does not affect the results presented above (see Table A.2).

This section provides additional robustness tests of the impact of labor regulation on organized manufacturing plants. First, we try out two alternative measures of EPL available in the literature. We use the composite measure proposed by Gupta et al. (2008), which we refer to as EPL-G, as well as the BB index updated by ourselves through 2009 using Malik (2011). Both measures classify states into inflexible, neutral and flexible in terms of their EPL strictness.

We also check if our results hold when we use industry layoff propensity instead of labor intensity. According to Bassanini et al. (2009), the firm's natural propensity to adjust through layoffs will influence the size of the costs imposed by EPL so we would expect that plants that operate in industries that are more likely to adjust through layoffs will benefit the most from more flexible labor laws, especially those pertaining to retrenchment and firing of workers.

Column (I) in Table 6 shows the estimates using Gupta et al.'s (2008) EPL indicator.[23] If we focus on the interaction effect identified for states classified as flexible by EPL-G, the estimates are very much in line with those obtained with our measure of EPL reform.

When the BB index is used, the positive effects of labor regulation previously identified among plants in labor intensive industries go away. Column (II) in Table 6 shows that when the cumulative BB index is used, the interaction effect between EPL reform and labor intensity in states with flexible regulation is negative and significant. These results are not too surprising if we consider that the BB index only captures formal amendments to the IDA, which have been scarce in recent years. In fact, there were only four pro-employer reforms registered in Gujarat (in 2004) and two pro-employer reforms in Madhya Pradesh (in 2003) after 1999. Moreover, the correlation between BB and Dougherty's (2009) proportional index is -0.25, which could be indicating that the lack of reforms to the IDA post-1990 were compensated by formal or informal state-level changes in industrial practices on the ground.

We conclude by testing if plants in industries with a higher layoff propensity benefit the most from labor reforms as suggested by Bassanini et al. (2009).[24] The evidence provided in column

[23]Compared to our final sample of states, Gupta et al. (2008) omits two states/union territories, Delhi and Himachal Pradesh, which represent 6.2% of the plant-year observations in our complete sample.

[24]Due to lack of adequate US data, tobacco industries were dropped from our original sample. This generates a loss of 1.35% of the plant-year observations.

Table 6: Robustness Checks: Effect of alternative EPL measures on productivity and by labor intensity and layoff propensity

	(I)	(II)	(III)
Constant	1.017**	1.247***	1.261***
	(0.463)	(0.383)	(0.310)
High labor intensity	0.096***	0.246***	
	(0.014)	(0.060)	
High layoff propensity			-0.036
			(0.100)
Neutral EPL-G	0.015		
	(0.031)		
Flexible EPL-G	-0.020		
	(0.027)		
High LI x Neutral EPL-G	0.039		
	(0.053)		
High LI x Flexible EPL-G	0.163***		
	(0.045)		
Neutral EPL-BB		0.020	
		(0.030)	
Flexible EPL-BB		0.025	
		(0.034)	
High labor intensity x Neutral EPL-BB		-0.064	
		(0.066)	
High labor intensity x Flexible EPL-BB		-0.151**	
		(0.061)	
Flexible EPL			-0.029
			(0.043)
High layoff propensity x Flexible EPL			0.364***
			(0.109)
Time-variant state controls			
Log(Telephones/100 pop)	0.037	0.047**	0.052**
	(0.024)	(0.020)	(0.019)
Log(Installed electricity cap./million pop)	0.018	-0.004	-0.012
	(0.036)	(0.035)	(0.022)
Log(Paved roads/1000 pop)	-0.004	0.006	0.012
	(0.022)	(0.021)	(0.015)
Time-invariant state controls			
Product Market Regulation	-0.120*	-0.126**	-0.063
	(0.060)	(0.055)	(0.044)
Observations	215,434	224,867	224,867
R-squared	0.058	0.061	0.101
Firm trend	yes	yes	yes
State-level controls	yes	yes	yes
Year FE	yes	yes	yes

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
State-level clustered standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

(III) in Table 6 shows that, indeed, plants in industries with higher layoff propensity experience the largest TFP improvements from state-level labor reforms. The magnitude of the interaction effect of EPL reforms and layoff propensities implies that, on average, plants in industries with a high layoff propensity are 40% more productive in flexible states than in inflexible states.

6 Conclusions

Labor reform in India has taken a backseat in discussions of structural reforms on recent years, although Supreme Court decision related to contract labor have forced the issue of contract labor into the current debate (AIOE, 2012). Not long ago, the government's expressed a newfound desire to "seiz[e] the demographic dividend", which increased the potential to put labor policies as an important issue back on the reform agenda (see MF, 2013).

The collective experience of OECD countries summarized in Martin and Scarpetta (2012) suggests that flexible regulation of the labor market is essential in order to ensure that employers respond to growth of output by taking on labor rather than capital. Similarly, Dougherty (2009) found labor market reforms boosted manufacturing job creation rates in India. That analysis and compilation of state-level labor reforms suggested that it was not just the Industrial Disputes Act that was harming labor market outcomes, but rather the wider range of labor legislation. This result is consistent with the views of labor law experts that cite the complexity and uncertainty caused by the manifold overlapping laws and antiquated (often colonial-era) provisions, that are in dire need of simplification (Anant et al., 2006; Panagariya, 2008; World Bank, 2010).

Despite solid gains in overall employment in recent years, a dichotomy has emerged, with net increases in employment occurring almost exclusively in the least productive, unorganized and typically informal parts of the economy. This is partly due to uneven protection of employment between the formal and informal sectors, with the latter virtually unregulated, and job turnover rates among smaller – more often informal – firms being far higher than in larger firms (Kotwal et al., 2011). Many of the productivity gains that have occurred have taken place within large continuing firms (Sivadasan, 2009; Bollard et al., 2013) rather than through new entry, exit, and reallocation, as has been the case in most developing economies. Due to rigidities in the exit and expansion of firms, a very long tail of smaller, less productive firms has skewed firm size distribution in India (Dougherty et al., 2009; Alfaro and Chari, 2012; Hsieh and Klenow, 2012; Hasan and Jandoc, 2013).

This paper studies the extent to which the effects of EPL on productivity among registered manufacturing plants change by labor intensity and sales volatility. To do this, we rely on a difference-in-differences strategy that includes state-level EPL reforms and industry-level labor intensity interactions. Our paper thus offers a likely lower bound of the perverse effects of labor market rigidities on productivity, as it measures the differential effects of labor reform across firms with different levels of labor intensity. We find that the modest easing of regulations in Indian states that has taken place in recent years was enough for firms in the more flexible states to benefit substantially through gains in total factor productivity. Our point estimates indicate that, on average, plants in labor intensive industries and in flexible labor markets have TFP residuals 25.4% higher than those registered for their counterparts in states with more stringent labor laws. A similar, but smaller effect on TFP of plants in more volatile industries and in states that experienced more pro-employer reforms is found.

We also find that the different strategies used by plants to overcome the constraints imposed by labor regulations generate heterogeneous effects of state-level labor reform both by plant size and type of ownership. Given the extensive use of contract labor among large plants and voluntary retirement schemes among public plants, smaller plants and private plants tend to accrue the largest productivity gains from state-level labor reforms.

Our study is particularly important for three reasons. This is the first study that makes use of plant-level information from the ASI to evaluate the effect of EPL in India. Second, we take advantage of the recently available ASI panel data to obtain plant-level TFP measures that control for simultaneity and selection bias using the Olley-Pakes approach, whereas previous papers on the topic have only measured the effects of EPL on aggregate measures of TFP at the industry-level. Finally, our measure of labor regulation is much more comprehensive and appropriate for the post-1991 period analyzed than the BB index, popular in the EPL literature in India. Moreover, the "OECD" EPL reform index used takes into account both formal and informal amendments to the labor laws at the state level that are relevant to current policy.[25]

Although our labor reform indicator shows that state-level actions, both formal and informal, have already led the way in labor reform, these reforms could be taken much further. Given that the average number of state-level reforms in the EPL index is only 21 out of 50, and the most reform-minded state only has a score of 28, there are many areas in which procedural or rule changes could be made at the state level to ease the burden of these regulations.

Given the difficulty in carrying out reforms at the central level, states may be in a better position to accelerate their own labor reform processes, such as through offering special treatment for Special Economic Zones, which can provide a laboratory for demonstrating the benefits of pro-flexible reform. While some flexibility exists at present for states to make labor reforms, they can be aided through a constitutional amendment that would shift the jurisdiction of labor regulation from a concurrent central-state to just a state issue. In the absence of such a provision, it is necessary that the central government resolves ambiguities and provides greater clarity on the extent of the independence of the states to implement reform, particularly in areas such as contract labor and fixed-term contracts (see OECD, 2007).

[25] Although the coverage of our EPL reform indicator is a plus, we acknowledge the important data limitations posed by the OECD index. Our analysis could greatly benefit from a time series version of the labor reform indicator that could allow the evaluation of short versus long-term effects, as well as to include fixed effects at the state level. However, this time series is very hard to obtain, especially since the index goes beyond formal amendments to cover informal changes to labor rules and practices. Many of the latter are not systematically notified in a consolidated publication or circular, and so they are very difficult to track in time especially at the state level.

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A Appendix: Additional Tables

Table A.1: Descriptive Statistics: All years

(a) All plants

Variable	Obs	Mean	S.D	Min	Max
Output	240131	191.65	1143.22	0.00	97904.74
Value added	240131	24.04	106.64	-126.19	9533.84
Fixed capital	240131	77.95	507.85	0.00	42049.52
Number of workers	240131	175.75	420.80	0.00	21637.00
Investment	240131	10.29	95.20	0.00	13650.28
Fuel expenditures	240131	3.12	17.90	0.00	1330.33
Intermediate inputs	240131	136.21	878.35	0.00	66449.92
Share of contract labor	239934	0.09	0.20	0.00	1.00
Age of the plant	239298	20.92	19.61	0.00	208.00
Plant size dummies (based on ♯ workers)					
< 50	240131	0.52		0.00	1.00
$[50 - 100[$	240131	0.13		0.00	1.00
$[100 - 250[$	240131	0.16		0.00	1.00
≥ 250	240131	0.18		0.00	1.00
Public ownership (dummy)	239995	0.23		0.00	1.00
TFP (Olley-Pakes residuals)	239171	1.04	0.54	-6.96	5.26
Volatility (S.D. of annual growth rate of output)	240131	0.67	0.19	0.31	1.01

(b) Restricted Census sample

Variable	Obs	Mean	S.D	Min	Max
Output	49939	737.98	2416.86	0.01	97904.74
Value added	49939	96.22	216.01	-126.19	9533.84
Fixed capital	49939	318.84	1066.52	0.00	42049.52
Number of workers	49939	646.60	745.07	200.00	21637.00
Investment	49939	40.40	196.65	0.00	13650.28
Fuel expenditures	49939	12.61	37.31	0.00	1330.33
Intermediate inputs	49939	512.64	1867.88	0.14	66449.92
Share of contract labor	49917	0.10	0.18	0.00	1.00
Age of the plant	49924	28.89	25.35	0.00	208.00
Plant size dummies (based on ♯ workers)					
< 50	49939			0.00	0.00
$[50 - 100[$	49939			0.00	0.00
$[100 - 250[$	49939			0.00	1.00
≥ 250	49939			0.00	1.00
Public ownership (dummy)	49908			0.00	1.00
TFP (Olley-Pakes residuals)	49923	1.12	0.55	-6.96	4.06
Volatility (S.D. of annual growth rate of output)	49939	0.69	0.19	0.31	1.01

Table A.2: Robustness Checks: Effect of EPL reforms on TFP by labor intensity as measured by $\hat{\alpha}$ and a relative ranking based on $\hat{\alpha}$

	(I)	(II)
Constant	1.578***	1.384***
	(0.410)	(0.342)
High labor intensity ($\hat{\alpha}$)	-3.137***	
	(0.664)	
High labor intensity (ranking)		-0.010
		(0.010)
Flexible EPL	-0.154**	-0.197**
	(0.058)	(0.081)
High labor intensity ($\hat{\alpha}$) x Flexible EPL	3.257***	
	(0.768)	
High labor intensity (ranking) x Flexible EPL		0.030***
		(0.011)
Time-variant state controls		
Log(Telephones/100 pop)	0.068***	0.051**
	(0.018)	(0.018)
Log(Installed electricity cap./million pop)	-0.012	-0.016
	(0.031)	(0.026)
Log(Paved roads/1000 pop)	0.018	0.016
	(0.018)	(0.016)
Time-invariant state controls		
Product Market Regulation	-0.081	-0.056
	(0.069)	(0.056)
Observations	224,867	224,867
R-squared	0.047	0.062
Firm trend	yes	yes
State-level controls	yes	yes
Year FE	yes	yes

Source: Annual Survey of Industries (ASI) 1998-99 to 2007-08.
State-level clustered standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$