Banning Contract Work: Implications for Input Choices and Firm Performance *

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Abstract: What are the effects of an outright ban on fixed-term contract workers in an establishment? By strengthening job security, it could affect total employment, and severely impact firms' investment choices and the resultant productivity and profitability. We test the impact of a unique natural experiment by the Indian state of Andhra Pradesh which prohibited contract workers from engaging in core activities in manufacturing industries. Using plant-level panel data from the Annual Survey of Industries, we find robust evidence of a large decline in contract labor usage in core activities, and a modest but statistically significant increase in regular labor engaging in core activities. Capital usage increased with a small increase in total factor productivity, but revenue and profits significantly declined, potentially due to higher input costs. Placebo tests results indicate no change in contract and regular labor engaged in the firm's non-core activities that were not a part of the law change, and no effect on the treatment firms prior to the law change. Firm closures and spillovers to neighboring states were absent.

JEL Classification: D22, D24, J41, J48

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1 Introduction

Employment protection legislations (EPL) typically increase the firm's cost of worker dismissal, layoffs, and closures. Evidence across countries shows that an increase in dismissal costs for directly employed regular workers increases the firm's usage of contract or temporary workers hired through intermediaries, for whom these costs do not apply (Abraham and Taylor, 1996; Autor, 2003; Kahn, 2010; Cahuc et al., 2016; Chaurey, 2015). Given that contract work acts as a convenient labor flexibility tool, its usage is extremely popular worldwide, ranging from about 2% in the developed countries, such as the United States and Germany (Hirsch and Mueller, 2012), to about 35-50% in developing countries such as India and Bangladesh (Ramaswamy, 2013). Any restriction or regulation on the usage of contract labor could reduce labor flexibility, strengthen employment protection, and increase the labor costs for firms. These, in turn, may affect firms' input mix and consequently their performance.

In this study, we examine an outright ban on the use of contract labor through an amendment to the federal legislation called the Contract Labour Act, 1971 (CLA) of India by the Indian state of Andhra Pradesh (AP) in 2003, and its effects on firms' input choices, revenues, profits, and productivity. The original federal legislation establishes certain procedures for hiring contract workers, but does not ban or restrict contract labor usage. The amendment in 2003 by AP prohibited contract workers from engaging in firms' "core" activities. The law change did not apply any restrictions on "non-core" activities or the firm's regular workforce. As per the law, "core" activity is any activity for which the establishment is set up, and includes other activities which are essential for the core activities.[1]

This amendment in AP was applied in addition to India's key piece of employment protection legislation applicable to regular workers, the Industrial Disputes Act, 1947 (IDA).[2] In this backdrop, the AP amendment in banning contract work from the firm's core set of activities reversed the labor market flexibility offered by the CLA, and strengthened

[1]For example, core activities in a textile firm would include activities such as cutting, stitching, and pressing clothes. Non-core activities would involve activities not directly related to production, such as cleaning, gardening, and security services.

[2]The IDA imposes severance pays for regular worker dismissal, requires firms to seek government permission for layoffs and retrenchments, and asks for a minimum 60-day notification to the government for firm closures, all of which add considerably to their direct and indirect labor costs. Importantly, the IDA is applicable only to regular workers, but not to contract workers, leading to the latter's popular usage to circumvent the costly dismissal laws.

employment protection in the state.

We exploit the quasi-experimental design offered by the state-year variation from the Andhra Pradesh amendment of 2003, and use the Annual Survey of Industries (ASI), an establishment level panel data set in India between the years 1999-2000 and 2007-2008, to study the effects on contract and regular worker usage (in core and non-core activities separately), investments in plant and machinery, and firm performance measures such as revenue, profits, and productivity.

Our results indicate that there was a decline in the person-days worked by contract workers in core activities (henceforth contract core person-days) by about 20%, and an increase in person-days worked by the regular workers in core activities (henceforth regular core person-days) by 9.7%. Contract workers usage (combining both core and non-core activities) fell, regular workers usage increased, and contract to total workers ratio fell. The magnitude of change in contract and regular core person-days were particularly higher for "affected" firms, that is, those firms that used a positive amount of contract labor in core activities in the pre-treatment period and that were directly under the ambit of the law. These results collectively indicate that the amendment was successful in nudging the firms to reduce contract worker usage in their core activities. Overall, the total number of person-days worked and workers employed significantly declined particularly in "affected" firms, because the rise in regular worker person-days was smaller than the fall in contract worker person-days.

We also find evidence of capital deepening. The gross closing value of plant and machinery increased significantly by 14% as a result of the amendment, which particularly is observed in "affected" firms. Overall, the evidence indicates that firms substituted contract employment with regular employment, and also invested in plant and machinery to complement the hiring of regular workers who were potentially more skilled compared to the outgoing contract workers. We also find heterogeneous treatment effects across industry types. The reduction in contract core person-days, and the increase in regular core person-days and capital usage were larger in magnitude for firms in more volatile industries, and in industries where the elasticity of substitution between capital and labor is high.[3]

[3]The volatility measure is calculated at the four-digit industry level from the CMIE Prowess database based on firm level sales between the years 1988 and 2003, using the method described in Cuñat and Melitz (2012). The elasticity of substitution for 22 manufacturing industries at the two-digit level is obtained for India from Goldar (2013).

Firms' revenues decreased as a result of the amendment, perhaps indicating that they re-optimize and produce lower output due to the increased input costs from both capital and labor. Firm profits also declined as a result of declining revenue and increasing cost. To corroborate this, we show particularly that labor cost per unit revenue declines. Further, we find only a small increase in total factor productivity, and clearly this increase did not compensate for the higher labor costs and result in higher output and revenue for firms. Labor productivity defined as revenue per person-day fell.

Placebo tests indicate that there was no significant change in either regular or contract person-days in non-core activities, and no differential effects on contract employment in Andhra Pradesh in the pre-treatment period. The latter results satisfies the identifying assumption for the validity of using the difference-in-difference specification in this setting. We find no differential effect on the number of firm closures in the treatment state as compared to the control states, indicating that the observed productivity increase was not a result of the exit of unproductive firms. Finally, we find no evidence of spillover effects in terms of firms relocating to neighboring states, or on the overall employment, capital, and revenue of firms in the neighboring states.

A priori, it is not clear how increasing employment protection affects firms' capital investment, productivity, and output. Firms may increase their investments in capital to complement the newly hired skilled regular workers. However, because of the hold-up problem, wherein workers with their newly acquired bargaining power demand a higher share of the rents, firms may choose not to invest in capital (Besley and Burgess, 2004). The effects of strict employment protection on firm productivity are also similarly ambiguous. Productivity may decrease because of a lower threat of layoff for unproductive workers, or because firms may not be able to freely adjust the workforce during upturns and downturns (Hopenhayn and Rogerson, 1993). In contrast, productivity can increase with employment protection because better job security may increase firms' and workers investment in firm-specific human capital (Belot et al., 2007), workers provide greater effort (Ichino and Riphahn, 2005), firms only engage in most productive matches with workers (Lagos, 2006), the most efficient firms may endogenously select to stay in the market (Poschke, 2009), or due to lower wage inequality at the workplace which improves worker morale and cooperation (Breza et al., 2017). Finally, an increase in capital investment could also increase labor productivity. The changes in output and profits depend on the changes in productivity due to skilled workers

and new capital investment, and the relative changes in the cost of production due to higher capital investment and increased job security provisions.

The existing empirical evidence on the effects of strengthening employment protection on capital and firm productivity are mixed. Autor et al. (2007) exploit the adoption of wrongful-discharge protection by state courts in the United States, and Cingano et al. (2016) study a 1990 Italian reform that raised dismissal costs for firms with fewer than 15 employees, and find evidence for capital deepening. However, Besley and Burgess (2004) and Ahsan and Pagés (2009) exploit state-level differences in employment protection legislations in India, and Cingano et al. (2010) use a panel of European firms and find negative effects on capital investment. Furthermore, except Autor et al. (2007) who find an increase in labor productivity, all other studies find that labor productivity or total factor productivity decrease as a result of higher employment protection (Besley and Burgess, 2004; Cingano et al., 2010; Hijzen et al., 2017; Autor et al., 2007 (for TFP); Cingano et al., 2016; Schwab, 2016). The few studies that examined effects on firm's revenue or profitability found negative effects (Bird and Knopf, 2009; Besley and Burgess, 2004; Ahsan and Pagés, 2009).

Few studies examine the effects of strengthening employment protection through the lens of reform or regulation of contract workers. Aguirregabiria and Alonso-Borrego (2014) showed that the liberalization of temporary contracts usage to any type of firm and any type of worker in Spain in 1984 resulted in large increase temporary workers, small reduction in labor productivity, and had no effect on the value-added. Baek and Park (2018) exploited the reform in South Korea which restricted temporary workers usage to up to a period of two years, and found that capital intensity and productivity increased, with no change in profits.

Our contribution to the literature is threefold. First, most studies on EPL focus on the effects on employment and worker/job flows, and hardly any examine the effects on firm's input-mix and performance.[4] We contribute to this literature by examining the impact of an increase employment protection on firm's capital investment, revenue, profitability, and productivity. Second, studies that examine the effects of EPL either conduct cross-country analysis and ignore within country heterogeneity, or use non-random variation in employment protection laws without addressing differential time trends across regions/states.

[4]Studies that examine the effect of employment protection laws on employment and job flows include Kugler and Pica (2008), Autor et al. (2006), Marinescu (2009), and Kan and Lin (2011).

In contrast, our research design is able to causally identify the effects of a decrease in labor market flexibility on the firm's input choices and performance. Further, particularly for the case of India, there are law-interpretation related issues in codifying states into pro-worker, pro-employer, and neutral categories, based on their amendments to the IDA (Besley and Burgess, 2004; Bhattacharjea, 2006).

Third, changing job security through changing dismissal costs for regular workers is usually politically infeasible due to the strong bargaining power and established political networks among these workers. Evidently, and attesting this, the IDA in India has not been amended in more than 20 years. Contrarily, changes to laws related to contract workers are relatively more frequent in many settings, and consequently, studying contract workers related regulation or reforms are likely to be more policy-relevant, looking forward.[5] Studies that directly examine contract workers related laws are few. Unlike the two other studies examining reforms/regulation on contract workers, we consider a complete ban on contract workers (Aguirregabiria and Alonso-Borrego, 2014; Baek and Park, 2018).

Our paper is related to multiple strands of literature including the one relating employment protection with job flows and mobility across the world and specifically in India[6], the literature which examines whether contract work acts as a stepping stone to future permanent employment[7], and our effects on capital deepening particularly to the literature on the effects of increasing automation across the world (Acemoglu and Restrepo, 2017, 2018).

The rest of the paper is organized as follows. Section 2 examines the labor laws complex in India; section 3 describes the empirical methodology; section 4 provides the overview of the data used, and provides basic descriptive statistics; section 5 presents the results and the robustness checks; and section 6 concludes the paper.

[5]In India, the CLA has been amended recently by many states to change the firm size cutoff above which the Contract Labour Act is applicable. Other examples of regulations and reforms related to contract/temporary workers include the regulation of payment of wages and duration of contract for temporary workers in Germany in 2003, and the regulation of length of employment and the type of firms that can employ temporary workers in Spain in 1984.

[6]See Garibaldi, 1998; Mortensen and Pissarides, 1999; Autor et al., 2006, Autor et al., 2004, Gómez-Salvador et al. (2004), Kugler and Saint-Paul (2004), Boeri and Jimeno (2005), Bauer et al. (2007), Messina and Vallanti (2007), Kugler and Pica (2008) and Marinescu (2009) for across the world, and Adhvaryu et al. (2013); Aghion et al. (2008); Hasan et al. (2007)) for India.

[7]See Booth et al. (2002) for Britain; Ichino et al. (2008) for Italy; Jahn and Rosholm (2014) for migrants in Denmark; Kvasnicka (2008) for Germany, and Autor and Houseman (2010) in the United States, and the studies that more generally explore the impact of labor market institutions (Freeman, 2010

2 Background and Policy Details

The Industrial Disputes Act, 1947 makes dismissal, layoffs, and closures expensive. The law applies to the firm's directly hired regular workers. According to the law, a firm retrenching a worker must offer severance pay or seek government permission if it is large, and issue advance notification in case of closures.[8] Although the IDA is a federal government legislation, it has been amended several times by state governments. Some amendments have made the states more employer-friendly by making it relatively easier to hire and fire workers ("pro-employer" states) and some have made them more worker-friendly by increasing job security for laborers ("pro-worker" states), and others are somewhat neutral ("neutral states"). This classification was conceived by Besley and Burgess (2004) based on the number and nature of these amendments made by each of these states. Based on this classification, Andhra Pradesh is a pro-employer state. Although Andhra Pradesh is a pro-employer state based on its costs relative to other states, it still faces employment protection regulations at an absolute level because of the terms of the federal legislations.

Contract or fixed-term workers are not covered under the IDA. Contract workers are those who are not employed directly by an employer, but by a third party contractors through fixed term temporary contracts. These workers do not have direct work contracts with the firm and do not appear in its payroll records, but have formal or informal contracts with licensed contractors who pay them. The Contract Labour Act, 1970 (CLA) allows the use of contract workers in any firm with a minimum of twenty or more workmen, and mandates that establishments should register with the government to use contract workers, and that contractors should obtain a license to operate.

Due to the absence of the applicability of the IDA to contract workers, firms hire contract workers to circumvent the high dismissal costs. Several studies have empirically shown that the rising share of contract workers in India could be attributed to stringent employment protection laws across Indian states (Chaurey, 2015; Ahsan and Pagés, 2009).

[8]Section V-A of the IDA lays down regulations for establishments with 50 or more workers. For example, a retrenched worker is entitled to compensation equalling 15 days' average pay for each year of service, and for layoffs, every worker is paid fifty percent of the basic wages and a dearness allowance for each day that they are laid off (maximum of 45 days). Section V-B mandates that no worker may be laid-off or retrenched in large firms (of size 100 and above) without prior permission of the government. Establishments that want to close down are also required to issue a sixty days (Section V-A) or ninety days (Section V-B) notification to the government prior to the shutting down. Both these sections of the IDA make it costly for firms to fire workers.

Saha et al. (2013) further show that the usage of contract workers particularly rose around and after the time international trade began to be liberalized in the 1990s.

Historically, the usage of contract labor has not been regulated in India. The section 10 of the CLA however, allows the relevant government to prohibit the usage of contract workers for certain activities through a formal amendment or notification.[9] The federal law remains vague on the type of activity that can be prohibited, but provides a suggestive list of factors to be considered. This include factors such as whether the work is incidental or necessary for the establishment, whether the work is perennial or temporary in nature, and whether it is done ordinarily through regular workers in that establishment or similar establishments.

The policy discourse on contract labor initially focused on limiting the use of contract labor in non-perennial jobs (as opposed to perennial jobs), but the discussion later shifted to another important distinction, namely core versus non-core jobs. Despite these considerations, no notification to prohibit contract labor under any type of activity was issued by any government for a long time after the central act was established in 1970. The Andhra Pradesh state government in 2003 was the only government that issued a notification to ban contract workers from engaging in core work. Core activity is defined as any activity for which the establishment is set up, and includes any activity which is essential or necessary to the core activity. Every other activity incidental to the firm is defined as a non-core activity. The full list of non-core activities in which contract work is permitted in Andhra Pradesh is listed in the appendix section A1.

3 Empirical methodology

In this paper, we empirically test whether the amendment by the Andhra Pradesh government to prohibit contract workers from doing core activities led to differential firm-level responses in Andhra Pradesh as compared to the control states. We use the 2003 amendment in a difference-in-differences (DID) setup, by comparing firm-level outcomes before and after the policy change (2003) in the treated state (AP) with the control areas. To the best of our knowledge, no other policy was implemented in Andhra Pradesh in 2003 that affected firm level outcomes differentially more or less than in other states, and this helps us identify the

[9]The relevant government could be the federal or the state government, depending on the sector of operation as well as the location of the plant.

treatment effect of banning contract workers in the state.

Ideally, we would like to compare plants in the treated states to an observationally similar control group. We consider two sets of control groups for the analysis. First, we compare firm-level outcomes in the treated states to all major states in India taken together, and then to a set of neighbouring states of Andhra Pradesh. The identifying assumption of the DID estimator is that the treatment and control groups should have had similar trends before the law change occurred, which we show holds true in subsection 5.1.

To estimate the effects of the policy, we estimate the following regression estimation at the firm level.

$$Y_{ijst} = \beta_0 Treat_i + \beta_1 Post_t + \beta_2 Treat_i X Post_t + X_{it} + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \quad (1)$$

where i,j,s,t index firm, industry (3-digit level), state, and year. Y_{ijst} represents firm-level outcome variables such as contract and regular workers person-days in core activities and non-core activities, total employment and person-days, revenue, gross closing value of plant and machinery, and total factor productivity. $Post_t$ is an indicator variable that takes on a value of 1 in the years in which the law change was in place (2004-2008), and 0 otherwise (2000-2003), and $Treat_i$ is an indicator variable that takes on a value of 1 if the firm belongs to the treated group (Andhra Pradesh) and 0 if it belongs to the control group (major or neighbor states). The firm fixed effects (κ_i) control for any time-invariant unobserved heterogeneity at the firm level, and year fixed effects (γ_t) control for year specific unobserved events. Note that $Post_t$ will be completely absorbed by the year fixed effects, γ_t, while $Treat_i$ will be completely absorbed by firm fixed effects, γ_t. X_{ijt} refers to the control variables, namely pre-treatment based firm size interacted with time trends, and firm ownership type interacted with time trend. Finally, ϵ_{ijt} is the error term. We cluster standard errors at the state level and also report bootstrap standard errors for robustness.

Although the difference-in-difference methodology may control for time invariant omitted variables, a concern may be that banning contract labor in core activities in Andhra was correlated with time-varying differences in trends across different industry groups. We address this concern by including 3-digit industry X time trends ($\delta_j t$) in the regression specifications. Similarly, state-specific time trends ($\theta_s t$) account for state-level differences in the trends which may have induced the passage of the amendment in Andhra Pradesh.

The coefficient of the interaction term $Treatment_i$ X $Post_t$, β_2 captures the differential impact of the law on the treatment group relative to the control group, and hence is the parameter of interest. We run the above regressions only for firms that are open and operating throughout the study period. So these regression results can only be interpreted as the intensive margin of the policy change.

The observed results may be more pronounced in "affected firms". Affected firms are those that had a non-zero number of contract workers working in the pre-treatment period, and which are more likely to be affected by the law change compared to those firms that did not use contract labor. We run a triple-difference specification to examine this possibility. We run regressions of the form:

$$Y_{ijst} = \beta_0 Treat_i + \beta_1 Post_t + \beta_2 Treat_i X Post_t + \beta_3 Post_t X Affected_i + \beta_4 Treat_i X Post_t X Affected_i + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \quad (2)$$

In equation 2, we test whether affected and non-affected firms responded differentially after the policy relative to before in AP as compared to the same difference in other control states. If the triple interaction ($Treat_i$ X $Post_t$ X $Affected_i$) coefficient, β_4, was indeed significant, it implies that the law change was effective in directly impacting those firms that it intended to. For these triple-difference estimations, we cluster standard errors at the factory level.[10]

We further test whether the effects of the contract labor ban are heterogeneous, based on whether the firms are in industries whose sales are deemed to be inherently volatile, and based on their elasticities of substitution between capital and labor. The formal specifications for this set of tests are discussed in detail in the results section.

4 Data

The data used in the study are from the Annual Survey of Industries (ASI), administered by the Ministry of Statistics and Programme Implementation (MoSPI), Government of India. The ASI is a survey of firms registered under The Factories Act, 1949, a central piece of

[10]We also conduct additional robustness checks by estimating a double difference equation by comparing affected and non-affected firms within Andhra Pradesh to check if the law had an effect on affected firms (Table **??**).

legislation regulating manufacturing firms in India.[11] The ASI data comprises a census sector and a survey sector for the whole of India. The census sector is a census of all large firms with a size above 100, and actively operating. Firms not in the census sector are randomly sampled using a systematic circular sampling technique within each state x Industry x Sector x 4-digit NIC-2008 stratum, and comprise the survey sector. [12]

We utilize a panel data set from ASI for 9 years between 1999-2000 to 2007-2008 for this study. Reference period for ASI is the accounting year of the industrial unit ending on the last day of the fiscal year between April to March. For instance, the data for the year 2006-2007 corresponds to all activities between 1^{st} April 2006 and 31^{st} March 2007. Uniquely, the dataset contains firm level information on the number of contract and regular workers, and the person-days spent working by each. person-days data are further desegregated at the activity level, and are available for core and non-core activities. Core activities involve core factory jobs directly relevant to production, and the latter involves peripheral work such as security, catering, or cleaning services. This distinction is important as the ban on contract labor in Andhra Pradesh is specific to core activities. Thus, we have four categories of activities at the firm level: contract-core, contract non-core, regular-core, and regular non-core. This availability of such detailed data enables us to examine firm responses for each category, letting us specifically check if the amendment had a bite in curtailing contract workers from doing core jobs.

The ASI also contains detailed data on a variety of details at the plant level, including capital, material inputs used, and revenue. We measure capital by the gross closing value of plant and machinery at the end of the accounting year. A plant's revenue is simply the nominal rupee value of production plus revenue earned from all other sources. Profit is revenue minus all input and wage costs. We estimate total factor productivity (TFP) measures using the residual method, and the Levinsohn and Petrin (2003) methodology.

For the heterogeneity analysis, (i) we use measures of elasticity of substitution in 22 manufacturing industries (at the 2-digit level) for India from Goldar et al. (2013), and (2)

[11] All manufacturing firms employing 10 workers or more (without using electricity) or employing 20 workers or more (with or without using electricity), are required to register under The Factories Act.

[12] Apart from the large firms, the census sector also comprises of: (1) All industrial units belonging to the six less industrially developed states/ UTs viz. Manipur, Meghalaya, Nagaland, Sikkim, Tripura and Andaman & Nicobar Islands; (2) All factories filing Joint Returns. (3) After excluding the above units, as defined above, all units belonging to the strata (State x District x Sector x 4 digit NIC - 2008) having less than or equal to 4 units are also considered under the Census sector.

construct measures of industry volatility of sales at the 4-digit level, using pre-amendment years data between 1988 and 2003 from the CMIE's Prowess database. We also calculate sales volatility based on the method in Cuñat and Melitz (2012), based on industry-level standard deviations of firm sales over time.

5 Results

In this section, we first present firm-level results from our difference-in-differences specification of the effects of the Andhra Pradesh government's ban on contract labor in core activities on employment outcomes such as the ratio of contract person-days to total person-days in core and non-core activities, and the number of regular, contract, and total person-days and workers. Essentially, we compare the difference in the employment outcomes for firms in Andhra Pradesh relative to firms in the control states before and after the law change. Then, we also confirm that the law change had a differentially larger effect on the set of firms that used contract workers prior to the law change ("affected" firms) compared to firms that did not use contract workers using a triple-difference framework. After confirming that the law change had a larger impact on affected firms, we look at the effects of the law change on fixed capital (plant & machinery) investment. To strengthen our claims on employment and capital investment, we focus on heterogeneous treatment effects across high and low volatile industries, as well as industries with high and low elasticities of substitution between labor and capital, using triple differences specifications. Finally, we look at how the law change affected firm performance measures such as revenue, profits, total factor productivity, and labor productivity. We use major states as the control group in these main set of results; the corresponding results using neighbor states as the control group are provided in the appendix. In all our specifications, we control for firm fixed effects, year fixed effects, state-specific time trends, industry-specific time trends, as well as pre-treatment level size-based trends and firm ownership type based trends.

5.1 Parallel Trends

Before presenting the results of the estimated causal effects of the program, we seek to first establish that the parallel trends assumption holds between treatment and control states. In Figure 1 we graphically represent the de-trended values of contract person-days (the

main outcome variable affected by the law amendment) for both treated and control states. Visually, the trends are parallel until 2003 and diverge thereafter. As a formal placebo regression test, we verify using the following regression specification as to whether there are potential treatment effects before the law change in the pre-treatment years (before 2003-04).

$$Y_{ijst} = \beta_0 Time + \beta_1 Treat_i Xtime + X_{it} + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \tag{3}$$

If treatment and control states were indeed on parallel trajectories with respect to contract person-days ratio in core activities, then we should expect to see that β_1, the coefficient on the interaction between treat and year, to be zero. Results in Table 1 indicate indeed that the point estimate is statistically indistinguishable from zero, and increases our confidence that the results are not picking up spurious effects.

5.2 Employment

Andhra Pradesh amended the Contract Labor Law in April 2003 to prohibit the use of contract workers by firms in their core activities. The results of the amendment on worker person-days in core and non-core activities are presented in panels A and B respectively of Table 2.

The outcomes studied are log of contract person-days, log of regular person-days, ratio of contract person-days to total person-days, and log of total person-days, all for core activities. In columns 1 and 2, panel A, we find that firms in Andhra Pradesh differentially reduced the number of contract person-days in core activities by 20% compared to firms in other major states, after relative to before the law change. This suggests that the law change prohibiting the use of contract workers in core activities had a larger impact on firms in Andhra Pradesh relative to other states. Furthermore, firms in Andhra Pradesh responded to this law-induced reduction in contract workers by increasing the number of regular (permanent) workers. Columns 3 and 4 show that the usage of regular worker person-days in core activities increased by about 10% after relative to before the law change compared to firms in control states. Not surprisingly, the contract to total person-days ratio in core activities declined in Andhra Pradesh compared to other major states after compared to before the amendment by about 2%. The total (contract plus regular) person-days in core activities also declined by about 2.3-3%. Taken together, panel A in Table 2 shows that firms in Andhra Pradesh used less contract worker person-days in core activities, and substituted

towards using more regular worker person-days in core activities after the law change. In summary, the law change was successful in its goal of reducing the use of contract workers in firms' core activities.[13]

Panel B in Table 2 shows the effects of the law amendment in non-core activities of the firm. There were no significant effects of the amendment in Andhra Pradesh compared to other major states after compared to before the amendment on the firm's log of contract person-days, log regular person-days, contract to total person-days, and log of total person-days. These results are not surprising since the law change notification did not directly affect the firm's non-core activities. This null result further testifies as a successful placebo test as the amendment only affected the activities within the firm that it was legally supposed to affect (i.e. in core activities).

Table 3 presents the estimated results on employment. Since the ASI does not identify workers based on the activity type they are involved in, the results presented here are for workers involved in all activities. The outcomes studied are log of contract workers (columns 1 and 2), log of regular workers (columns 3 and 4), contract to total workers ratio (columns 5 and 6), and log of total workers (columns 7 and 8). Results here mirror the results on person-days in Table 2. We see that the log of contract workers declined by about 5%, the log of regular workers increased by about 3%, and contract workers ratio decreased by about 1.9% in Andhra Pradesh compared to other major states, after relative to before the amendment. However, there were no significant changes in the total number of workers in Andhra Pradesh at the firm level as a result of the law change.

Next, we show the results on how the "affected" firms – those firms that used non-zero levels of contract labor in the pre-treatment period—, are different from "unaffected" firms (Table 4). The triple difference estimates based on Equation 2 indicate that the affected firms decreased log of contract core person-days, log of contract workers, contract to total core person-days ratio, contract to total workers ratio, log total core person-days, and log of total workers, and increased regular core person-days and log of regular workers, compared to unaffected firms, in Andhra Pradesh compared to other major states, in post- compared to pre-treatment period. This confirms that the law change had a larger effect on affected firms, which again testifies that the law change made an impact on those firms directly under

[13]Note that these results use the major states in India as the control group. We also report all the results using neighboring states as the control group in the appendix tables A1-A7.

the ambit of the law.

5.3 Plant and Machinery

Having confirmed that the law amendment indeed had a bite and changed the worker composition in core activities, we examine the effects on capital investment at the firm level. In Table 5, columns 1 and 2 present double-difference estimates only in affected firms, and columns 3 and 4 present triple-difference results comparing affected and non-affected firms. The gross value of plant and machinery at the end of the accounting year increased significantly by about 14% in affected firms. The triple difference estimates show that indeed the effects are particularly arising from affected firms where the effects are about 15-16%. These results indicate that firms invested in plant and machinery to complement the newly hired and potentially skilled regular workers in core activities. This result is consistent with Autor et al. (2007) and Cingano et al. (2016) who found that an increase in employment protection induced capital deepening among the firms in the US and Italy respectively.

5.4 Heterogeneity based on Industry Characteristics

Firms in industries that face higher volatility in product sales are more likely to use more contract workers in order to deal with product market uncertainty, as firing regular workers during downturns is expensive because of the stipulations of the IDA. Hence, as a result of the ban, the decline in contract workers and person-days should be differentially larger in high-volatile industries as compared to low volatile industries. To formally test this, we estimate the following regression specification.

$$\begin{aligned} Y_{ijst} = \beta_0 Treat_i + \beta_1 Post_t + \beta_2 High\ Volatile_i + \beta_3 Treat_i X Post_t + \\ \beta_4 Post_t X High\ Volatile_i + \beta_5 Post_t X High\ Volatile_i + \\ \beta_6 Treat_i X Post_t X High\ Volatile_i + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \quad (4) \end{aligned}$$

We measure volatility in sales at the 4-digit industry level, based on the method proposed in Cuñat and Melitz (2012), using firm sales data from the CMIE prowess database between the years 1988 and 2003. By using the volatility measure before the amendment period, we are able to capture the inherently existing sales volatility in these industries. We divide these 4-digit industries into two groups: low volatile and high volatile, based on the median

volatility as the cutoff.

The results in Table 6 indicate that indeed the firms in volatile industries had a larger decline in contract workers and contract core person-days ratio as a result of the ban, in Andhra Pradesh relative to other major states, after compared to before the ban. Interestingly, the firms also invest in more plant and machinery to complement the newly hired regular workers and substitute the outgoing contract workers.

We expect firms to decrease contract workers and increase capital investment as a results of the amendment, particularly in industries where the elasticity of substitution between labor and capital is high. To check this, we use measures of elasticity of substitution for 22 manufacturing industries at the 2-digit level for India from Goldar et al. (2013). The list of industries along with the elasticities are provided in Table A11. We divide these industries into two groups: ones with low values of elasticity of substitution, and the ones with high values of elasticity of substitution based on the median value of elasticity as the cutoff. We then use a triple difference specification to compare the effects on the treated firms before and after the law change in the firms in industries with high elasticities of substitution compared to those firms with low elasticities of substitution. Formally, we estimate the following regression specification.

$$\begin{aligned} Y_{ijst} = \beta_0 Treat_i + \beta_1 Post_t + \beta_2 High\ Substitution_i + \beta_3 Treat_i X Post_t + \\ \beta_4 Post_t X High\ Substitution_i + \beta_5 Post_t X High\ Substitution_i + \\ \beta_6 Treat_i X Post_t X High\ Substitution_i + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \quad (5) \end{aligned}$$

Results from Table 7 show that contract person-days core ratio and contract workers ratio decreased, and plant and machinery usage increased for plants that were in high elasticity of substitution industries compared to low substitution industries in Andhra Pradesh versus the other major states, and after compared to before the law change. This is consistent with the expectation that industries where easy substitution between capital and labor is possible, indeed saw a greater level of substitution between contract workers and capital investment. Having confirmed that the law change indeed led to a reduction in contract workers, and a subsequent increase in both regular workers and capital investment, we next consider the effects on firm performance measures.

5.5 Performance Measures

We use the framework in Equation 1 to estimate the effects of the contract labor ban on firm performance measures, such as revenue and profits. The estimated effects on revenue and productivity are shown in Table 8. Considering only the affected firms, the amendment had a negative impact on both revenue (column 1 and 2) and productivity (column 5 and 6). Using a triple difference framework, we show that in Andhra Pradesh compared to other major states, and after the amendment compared to before, affected firms had less revenue (column 3 and 4) and profits (column 7 and 8) compared to unaffected firms.

The total factor productivity measure is estimated using the residual method and the Levinsohn and Petrin (2003) methodology. In order to do this, we estimate a production function using contract and regular workers, plant and machinery, and materials as inputs, and a nominal revenue measure as the output. The effects on productivity are presented in Table 9. Results indicate that total factor productivity rose marginally (2%) based on the double difference specification in affected firms (columns 1 and 3), and particularly in affected firms compared unaffected firms (columns 2 and 4). We noted earlier that there could be multiple pathways driving the relationships between employment protection and/or contract labor usage, and productivity. Although we cannot point out one specific channel for the productivity increase, we can say that the pathways with positive relationships dominated the ones with negative ones. For example, newly hired regular workers and the complementary plant and machinery installed could have improved the technological frontiers, and hence increased productivity. Hiring more permanent regular workers may increase both firms and workers willingness to invest in firm specific human capital which can enhance productivity. Further, it is also likely that since low wage earning contract workers are fewer at the workplace, there is higher worker morale and cooperation among regular workers (Breza et al., 2017). However, labor productivity defined as revenue per person-day fell by about 4-5% as a results of the amendment (columns 5 and 6) perhaps because both revenue and total worker person-days fell, but the latter fell by a higher amount.

The fall in revenues indicates that firms optimize and cut down on production due to higher input costs, both from labor and capital. We show indeed that labor costs per unit revenue, increase as a result of the amendment in Table 10. There is also a chance that prices rose due to falling supply, but clearly the rise was not high enough to increase the total nominal value of output. Further more, the small rise in productivity could not

compensate for increase in labor costs and result in higher output.

5.6 Firm Closures

We also check if there were any changes on the extensive margin. Do the firms that are unable to cope up with the high cost of labor simply close down in Andhra Pradesh? To examine the changes on the extensive margin, we run a separate regression at the 3-digit industry X state X year level.

$$Closure_{jst} = \beta_1(Treat_s \ X \ Post_t) + \gamma_t + \theta_s t + \delta_j t + \epsilon_{jst} \tag{6}$$

If β_1 in Equation 6 is positive and significant, then firms in Andhra Pradesh closed down more significantly compared to firms in other control states. We find indeed in Table 11 that β_1 is positive and statistically significant.

5.7 Spillovers to Neighboring States

It is conceivable that the results are being affected by spillovers caused by the policy in the control states. For example, firms that are less productive or are unable to deal with high labor costs may relocate from Andhra Pradesh to the control states to avoid the law. If this were the case, the treatment effects that we observe may be biased. To check whether firms close down in Andhra Pradesh and reopen in the control states, we run the following regression at the 3-digit industry X state X year level.

$$Y_{ijst} = \beta_0 Neighbor_i + \beta_1 Post_t + \beta_2 Neighbor_i X Post_t + X_{it} + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst} \tag{7}$$

If β_2 in Equation 7 is not statistically significant, it implies that there is no significant spillover in terms of firms relocating from Andhra Pradesh to the neighboring states. Considering all major outcome variables, results from Table 12 show that indeed the coefficient of post X neighbor is not statistically significantly different from zero, implying that there were no spillovers to neighboring states.

6 Discussion and Conclusion

We evaluate a ban on contract worker performing core jobs in manufacturing industries in the southern Indian state of Andhra Pradesh. The ban was implemented through a formal

law change notification in April 2003. We use a difference-in-difference specification to examine the effects of the ban on firm behavior. The results show that the usage of contract workers in core activities fell significantly and the usage of regular workers in core activities increased significantly in Andhra Pradesh compared to the other major states in the post- compared to the pre-treatment period. As a result of this law change, the treated firms' revenues fell, but capital investment and productivity rose. To interpret these results, it is important to distinguish the different ways through which employment protection laws can be strengthened or relaxed.

Employment protection levels can be changed through two broad ways: (a) directly increasing/decreasing firing costs, or (b) by allowing or prohibiting fixed term contracts while simultaneously maintaining dismissal costs for regular workers. An outright ban on fixed term temporary work in a factory's core activities is tantamount to increasing employment protection through method (b). The consequences of such a ban on firm behavior may be different from strengthening employment protection by explicitly increasing dismissal costs.

Past studies worldwide and in the Indian context have mostly focused on analyzing the effects of higher dismissal costs. In India, for example, Besley and Burgess (2004) showed that stricter dismissal costs in pro-worker states may lead to lower output, employment, investment, and productivity in registered or formal manufacturing, and higher output in unregistered or informal manufacturing increased. Although our results are consistent with theirs for output, we show opposite results on capital investment, productivity, and employment. These differential results are important to appreciate so as to guide policy makers in developing holistic policies that benefit both workers and firms.

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Figure 1: Trends in Contract person-days Ratio in Core activities for Treatment state (Andhra Pradesh) and other states

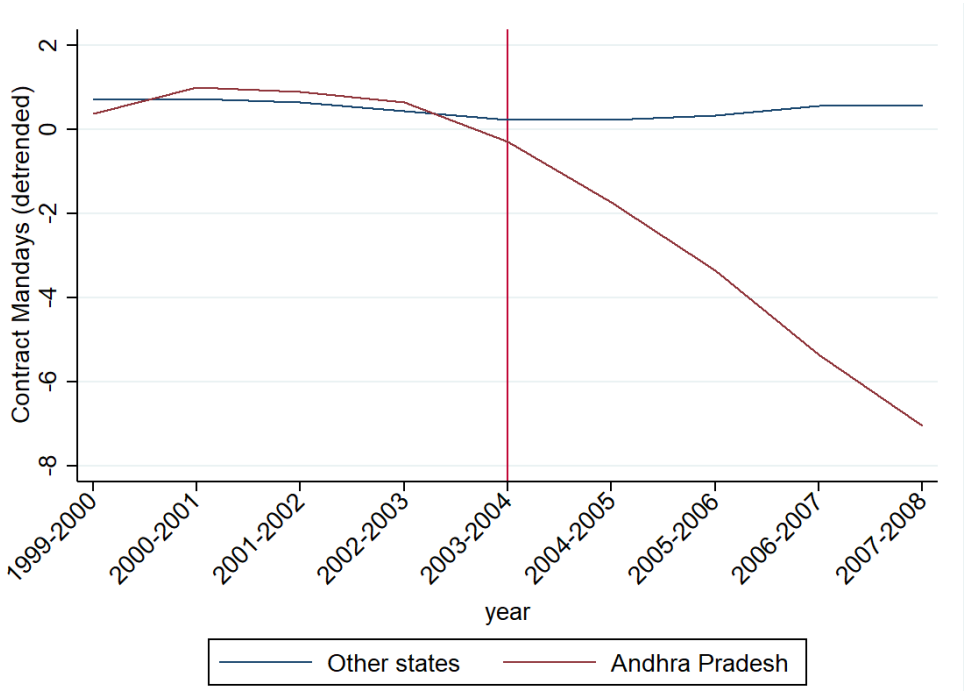

Table 1: Testing the parallel trends between control and treatment groups in the pre-treatment period

	Contract workers ratio		Contract/Total person-days			
	All activities		Core Activities		All activities	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat X Time	-0.00248	-0.00675	0.00108	-0.00200	-0.00242	-0.00671
	(0.00342)	(0.00453)	(0.00328)	(0.00440)	(0.00336)	(0.00443)
Time	-0.00923**	-0.00496	-0.0106***	-0.00736	-0.00939**	-0.00506
	(0.00362)	(0.00445)	(0.00346)	(0.00433)	(0.00356)	(0.00440)
Observations	125,785	56,103	125,831	56,118	125,831	56,118
R-squared	0.62	0.60	0.66	0.65	0.64	0.63
Number of factories	72,180	32,803	72,201	32,810	72,201	32,810
Control States	Major	Neighbor	Major	Neighbor	Major	Neighbor
Factory FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES
Sizes-trends	YES	YES	YES	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** - statistical significance at 1%; **- statistical significance at 5%; *- statistical significance at 10%.

Table 2: Effect on Core and Non-core Activity person-days

	Log contract person-days		Log regular person-days		Contract/total person-days		Log worker person-days	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Core Activities								
Post X Treat	-0.200***	-0.209***	0.104***	0.0977***	-0.0205***	-0.0209***	-0.0237*	-0.0306***
	(0.0305)	(0.0284)	(0.0192)	(0.0166)	(0.00233)	(0.00228)	(0.0122)	(0.00584)
Observations	293,712	293,539	293,712	293,539	293,712	293,539	293,713	293,540
R-squared	0.773	0.759	0.852	0.837	0.796	0.774	0.906	0.907
B. Non-Core Activities								
Post X Treat	-0.0134	-0.0145	0.0168	0.01192	0.00147	0.00127	0.0200	0.0207
	(0.0110)	(0.0108)	(0.0154)	(0.0151)	(0.00141)	(0.00141)	(0.0187)	(0.0186)
Observations	293,712	293,539	293,712	293,539	293,712	293,539	293,713	293,540
R-squared	0.549	0.546	0.774	0.776	0.531	0.509	0.769	0.774
Control states	Major	Major	Major	Major	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table 3: Effects on Workers, Overall and By Type

	Log contract workers		Log regular workers		Contract/total workers		Log workers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat	-0.0507***	-0.0571***	0.0394***	0.0352***	-0.0189***	-0.0194***	0.00560	0**
	(0.0135)	(0.0122)	(0.00847)	(0.00655)	(0.00233)	(0.00225)	(0.00748)	(0)
Observations	293,713	293,540	293,713	293,540	293,638	293,465	293,713	293,540
R-squared	0.797	0.785	0.918	0.916	0.798	0.775	0.939	0.940
Control states	Major	Major	Major	Major	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State trend	YES	YES	YES	YES	YES	YES	YES	YES
Industry trend	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table 4: Heterogeneity Based on Affected Firms

	A. Person-days for core activities							
	Log contract person-days		Log regular person-days		Contract/total person-days		Log worker person-days	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat X Affected	-1.281***	-1.297***	0.324***	0.322***	-0.104***	-0.104***	-0.0860***	-0.0839***
	(0.0638)	(0.0700)	(0.0387)	(0.0404)	(0.00688)	(0.00720)	(0.0156)	(0.0145)
Post X Treat	0.725***	0.751***	-0.0987***	-0.102***	0.0455***	0.0447***	0.0430***	0.0392***
	(0.0631)	(0.0636)	(0.0293)	(0.0226)	(0.00514)	(0.00446)	(0.0122)	(0.0107)
Post X Affected	-1.685***	-1.909***	0.234***	0.314***	-0.0812***	-0.0932***	-0.0231	0.0216
	(0.0641)	(0.0876)	(0.0382)	(0.0452)	(0.00680)	(0.00856)	(0.0154)	(0.0182)
Observations	231,080	180,859	231,080	180,859	231,080	180,859	231,080	180,859
R-squared	0.779	0.768	0.853	0.837	0.799	0.779	0.929	0.931

	B. Person-days for core activities							
	Log contract workers		Log regular workers		Contract/total workers		Log workers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat X Affected	-0.420***	-0.426***	0.105***	0.107***	-0.101***	-0.101***	-0.0960***	-0.0931***
	(0.0305)	(0.0325)	(0.0167)	(0.0170)	(0.00670)	(0.00701)	(0.0145)	(0.0132)
Post X Treat	0.246***	0.254***	-0.0321**	-0.0366***	0.0455***	0.0437***	0.0576***	0.0529***
	(0.0220)	(0.0220)	(0.0117)	(0.00911)	(0.00518)	(0.00450)	(0.0105)	(0.00836)
Post X Affected	-0.516***	-0.606***	0.112***	0.171***	-0.0812***	-0.0929***	-0.0203	0.0232
	(0.0306)	(0.0378)	(0.0166)	(0.0193)	(0.00662)	(0.00836)	(0.0144)	(0.0168)
Observations	231,081	180,859	231,081	180,859	231,012	180,811	231,081	180,859
R-squared	0.800	0.790	0.918	0.916	0.801	0.780	0.939	0.940
Control states	Major	Major	Major	Major	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table 5: Effects on Plant and Machinery

	Gross Closing - Plant & Machinery			
	(1)	(2)	(3)	(4)
Post X Treat	0.135**	0.140***	-0.0733	-0.0658
	(0.0504)	(0.0502)	(0.0436)	(0.0432)
Post X Treat X Affected			0.168***	0.148***
			(0.0485)	(0.0440)
Post X Affected			0.0780	0.0797
			(0.0490)	(0.0478)
Observations	65,561	65,531	283,366	196,349
R-squared	0.75	0.62	0.75	0.80
Type	Affected	Affected	All	All
Control Group	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
State time trend	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table 6: Heterogeneity Based on Industry Volatility for Affected Firms

	Contract/total person-days (1)	Contract/total workers (2)	Plant & Machinery (3)
Post X Treat X High-volatile	-0.0231**	-0.0224**	0.217***
	(0.00957)	(0.00944)	(0.0631)
Post X Treat	-0.0538***	-0.0520***	0.0429
	(0.00942)	(0.00886)	(0.0740)
High-volatile	0.0115**	0.0130***	0.137 5
	(0.00448)	(0.00434)	(0.0857)
Post X High-volatile	-0.00394	-0.00552	0.128**
	(0.00742)	(0.00731)	(0.0556)
Treat X High-volatile	0.0175***	0.0157***	-0.153
	(0.00523)	(0.00491)	(0.0897)
Observations	67,749	67,734	65,357
R-squared	0.78	0.83	0.74
Control Group	Major	Major	Major
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
State-trends	YES	YES	YES
Industry-trends	YES	YES	YES
Firm-controls	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. The volatility measures is defined at the 4-digit industry level using sales data between 1988 and 2003 from the CMIE Prowess database adopting Cuñat and Melitz (2012). Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table 7: Heterogeneity Based on Elasticity of Substitution in Affected Firms

	Contract/total person-days (1)	Contract/total workers (2)	Plant & Machinery (3)
Post X Treat X High-substitutability	-0.0212***	-0.0247***	0.164**
	(0.0106)	(0.0100)	(0.0782)
Post X Treat	-0.0498***	-0.0454***	0.0384
	(0.00645)	(0.00597)	(0.0585)
High-substitutability	-13.21***	-12.67***	-17.03
	(4.251)	(4.166)	(43.48)
Post X High-substitutability	-0.00543	-0.00525	0.0664
	(0.00922)	(0.00893)	(0.119)
Treat X High-substitutability	-0.0256	-0.0151	-0.951***
	(0.0234)	(0.0232)	(0.246)
Observations	63,544	63,526	61,498
R-squared	0.700	0.705	0.922
Control Group	Major	Major	Major
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
State-trends	YES	YES	YES
Industry-trends	YES	YES	YES
Firm-controls	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. The elasticity measure is defined at the two-digit industry level from Goldar (2013), which are presented in Table A11. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table 8: Effects on Revenue and Profits

	(1) Log revenue	(2) Log revenue	(3) Log revenue	(4) Log revenue	(5) Log profit	(6) Log profit	(7) Log profit	(8) Log profit
Post X Treat	-0.0272***	-0.0282***	0.0237*	0.0295***	-0.0823**	-0.0843**	0.0661**	0.0662**
	(0.00646)	(0.00643)	(0.0117)	(0.0105)	(0.0347)	(0.0344)	(0.0269)	(0.0295)
Post X Treat X Affected			-0.129***	-0.125***			-0.166***	-0.162***
			(0.0148)	(0.0140)			(0.0225)	(0.0243)
Observations	47,392	47,368	213,331	144,535	47,392	47,368	213,331	144,535
R-squared	0.202	0.203	0.159	0.161	0.066	0.067	0.053	0.054
Type	Affected	Affected	All	All	Affected	Affected	All	All
Control group	Major	Major	Major	Major	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State time trend	YES	YES	YES	YES	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table 9: Effects on Total Factor Productivity and Labor Productivity

	(1)	(2)	(3)	(4)	(5)	(6)
		Total Factor Productivity			Labor Productivity	
	Residual	Residual	LP	LP	Revenue/person-day	Revenue/person-day
Post X Treat	0.0242***	-0.00409	0.0197***	0.00122	-0.0558***	-0.0545***
	(0.00769)	(0.00669)	(0.00304)	(0.00229)	(0.0174)	(0.0111)
Post X Treat X Affected		0.0194**		0.0178***		-0.0404***
		(0.00806)		(0.00274)		(0.0103)
Post X Affected		0.0533***		-0.00593		0.0534***
		(0.00720)		(0.00430)		(0.0124)
Type	Affected	All	Affected	All	Affected	All
Control	Major	Major	Major	Major	Major	Major
Observations	60,775	198,900	56,973	177,465	66,392	225,683
R-squared	0.64	0.65	0.68	0.69	0.71	0.75
Firm FE	YES	YES	YES	YES	YES	YES
year FE	YES	YES	YES	YES	YES	YES
State time trend	YES	YES	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES	YES	YES
Firm-controls	YES	YES	YES	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Total factor productivity is obtained simply as residuals from the production function, or by using the Levinsohn and Petrin (2003) (LP) methodology.

Table 10: Effects on Labor Costs

	Labor cost/revenue (1)	Labor cost/revenue (2)	Labor cost/revenue (3)	Labor cost/revenue (4)
Post X Treat	0.0476***	0.0525***	0.0327	0.0354
	(0.0183)	(0.0128)	(0.0226)	(0.0228)
Post X Treat X Affected			0.0439*	0.0429*
			(0.0251)	(0.0250)
Post X Affected			-0.0454***	-0.0397***
			(0.00734)	(0.00773)
Observations	294,944	67,868	294,944	203,367
R-squared	0.66	0.68	0.69	0.70
Type	Affected	Affected	All	All
Control group	Major	Major	Major	Major
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
State-trends	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%.

Table 11: Effects on the Number of Firm Closures Firms

	log closed (1)	log closed (2)
Post X Treat	0.185***	0.132***
	(0.0416)	(0.0332)
Constant	-131.6**	-236.5***
	(42.96)	(36.24)
Observations	2,696	10,215
R-squared	0.730	0.613
Control group	major	neighbor
Year & State FE	YES	YES
State-trends	YES	YES
Industry-trends	YES	YES
Firm-controls	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. This regression is estimated at the three-digit industry X state X year level.

Table 12: Effects on Firm Characteristics of Neighboring-State- Firms

	(1) Log factories	(2) Log open firms	(3) Log capital	(4) Log workers	(5) Log revenue
Post X Neighbor	-0.00418	0.0815	0.0684	0.109	0.0432
	(0.0486)	(0.0820)	(0.131)	(0.0963)	(0.195)
Observations	9,728	9,728	9,728	9,728	9,728
R-squared	0.688	0.667	0.510	0.528	0.403
control group	major	major	major	major	major
Year & State FE	YES	YES	YES	YES	YES
State time trend	YES	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES	YES
Firm-controls	YES	YES	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. This regression is estimated at the three-digit industry X state X year level.

Appendix

A1 Permitted non-core activities for contract workers

1. Sanitation works, including Sweeping, Cleaning, Dusting, and Collection and disposal of all kinds of waste.
2. Watch and ward services including security service.
3. Canteen and Catering services.
4. Loading and Un-loading Operations.
5. Running of Hospitals, Educational Training Institutions, Guest Houses, Clubs and the like where they are in the nature of support services of an Establishment.
6. Courier Services which are in nature of support services of an Establishment.
7. Civil and other constructional works, including maintenance.
8. Gardening and maintenance of lawns etc.
9. Housekeeping and laundry services etc., where they are in nature support services of an Establishment.
10. Transport services including Ambulance Services.
11. Any activity of intermittent in nature even if that Constitutes a core activity of an Establishment and
12. Any other activity which is incidental to the core activity.

Table A1: Effect on Core and Non-core Activity person-days

	Log contract person-days		Log regular person-days		Contract/total person-days		Log worker person-days	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Core Activities								
Post X Treat	-0.215**	-0.237***	0.133***	0.119***	-0.0212***	-0.0223***	-0.00900	-0.0250*
	(0.0552)	(0.0379)	(0.0325)	(0.0278)	(0.00382)	(0.00299)	(0.0217)	(0.0123)
Observations	128,915	128,835	128,915	128,835	128,915	128,835	128,915	128,835
R-squared	0.760	0.750	0.838	0.831	0.769	0.753	0.906	0.906
B. Non-Core Activities								
Post X Treat	-0.0172	-0.0160	-0.0349	-0.0330	0.000449	0.000353	-0.0336	-0.0332
	(0.0127)	(0.0132)	(0.0262)	(0.0260)	(0.000931)	(0.000961)	(0.0294)	(0.0294)
Observations	128,915	128,835	128,915	128,835	128,915	128,835	128,915	128,835
R-squared	0.526	0.520	0.751	0.754	0.463	0.437	0.747	0.750
Control states	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A2: Effects on Workers, Overall and by Type

	Contract/total workers		Log contract workers		Log regular workers		Log workers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat	-0.0195***	-0.0262***	-0.0553*	-0.0832**	0.0562***	0.0584***	0.0139	0.0111
	(0.00387)	(0.00394)	(0.0252)	(0.0246)	(0.00951)	(0.00536)	(0.00963)	(0.00801)
Observations	97,837	78,115	97,858	78,131	97,858	78,131	97,858	78,131
R-squared	0.771	0.755	0.786	0.777	0.911	0.910	0.935	0.935
Control states	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%.

Table A3: Heterogeneous Results based on Affected Firms

	A. Person-days for core activities							
	Log contract person-days		Log regular person-days		Contract person-days ratio		Log worker person-days	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat X Affected	-1.217**	-1.261***	0.332***	0.345***	-0.108***	-0.111***	-0.106***	-0.099***
	(0.0905)	(0.102)	(0.0277)	(0.0308)	(0.00680)	(0.00738)	(0.0257)	(0.0242)
Post X Treat	0.747***	0.757***	-0.0802	-0.105*	0.0489***	0.0476***	0.0578**	0.0399*
	(0.0874)	(0.0998)	(0.0476)	(0.0417)	(0.00639)	(0.00645)	(0.0179)	(0.0167)
Post X Affected	-1.759***	-1.926***	0.230***	0.314***	-0.0777***	-0.0871***	-0.00225	0.0474
	(0.0919)	(0.131)	(0.0277)	(0.0327)	(0.00678)	(0.00943)	(0.0261)	(0.0320)
Observations	97,858	78,131	97,858	78,131	97,858	78,131	97,858	78,131
R-squared	0.768	0.760	0.839	0.832	0.774	0.760	0.926	0.928

	B. Workers in core and non-core activities							
	Log contract workers		Log regular workers		Contract workers ratio		Log workers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post X Treat X Affected	-0.391***	-0.410***	0.0979***	0.111***	-0.105***	-0.108***	-0.115***	-0.106***
	(0.0365)	(0.0387)	(0.0221)	(0.0218)	(0.00645)	(0.00702)	(0.0280)	(0.0261)
Post X Treat	0.251***	0.254***	-0.0172	-0.0364*	0.0492***	0.0471***	0.0724***	0.0559***
	(0.0241)	(0.0285)	(0.0164)	(0.0168)	(0.00632)	(0.00630)	(0.0134)	(0.0133)
Post X Affected	-0.548***	-0.614***	0.121***	0.183***	-0.0776***	-0.0868***	-0.00033	0.0472
	(0.0372)	(0.0495)	(0.0226)	(0.0245)	(0.00647)	(0.00914)	(0.0283)	(0.0328)
Observations	97,858	78,131	97,858	78,131	97,837	78,115	97,858	78,131
R-squared	0.790	0.783	0.911	0.911	0.775	0.761	0.935	0.935
Control states	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State-trends	YES	YES	YES	YES	YES	YES	YES	YES
Industry-trends	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table A4: Effects on Plant and Machinery

	Gross Closing - Plant & Machinery			
	(1)	(2)	(3)	(4)
Post X Treat	0.166	0.173*	-0.109**	-0.115***
	(0.0853)	(0.0855)	(0.0295)	(0.0204)
Post X Treat X Affected			0.282**	0.246**
			(0.0919)	(0.0832)
Post X Affected			-0.0405	-0.0308
			(0.0897)	(0.0867)
Observations	27,368	27,354	122,553	84,664
R-squared	0.79	0.80	0.75	0.76
Type	Affected	Affected	All	All
Control Group	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
State time trend	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table A5: Heterogeneity based on Industry Volatility for Affected Firms

	Contract/total person-days (1)	Contract/total workers (2)	Plant & Machinery (3)
Post X Treat X High-volatile	-0.0192	-0.0192	0.200**
	(0.0147)	(0.0142)	(0.0696)
Post X Treat	-0.0672***	-0.0641***	0.0904
	(0.0137)	(0.0132)	(0.0992)
High-volatile	0.0118	0.0152**	0.0935
	(0.00623)	(0.00550)	(0.179)
Post X High-volatile	-0.00950	-0.0106	0.143*
	(0.0109)	(0.0105)	(0.0579)
Treat X High-volatile	0.0226**	0.0184*	-0.106
	(0.00809)	(0.00823)	(0.185)
Observations	28,493	28,487	27,279
R-squared	0.78	0.79	0.82
Control Group	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
State time trend	YES	YES	YES
Industry time trend	YES	YES	YES
Firm-controls	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. The volatility measures is defined at the 4-digit industry level using sales data between 1988 and 2003 from the CMIE Prowess database adopting Cuñat and Melitz (2012). Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table A6: Heterogeneity based on Elasticity of Substitution in Affected Firms

	Contract/total person-days (1)	Contract/total workers (2)	Plant & Machinery (3)
Post X Treat X High-substitutability	-0.0178	-0.0208*	0.302**
	(0.0106)	(0.0100)	(0.0782)
Post X Treat	-0.0634***	-0.0579***	-0.00606
	(0.00783)	(0.00765)	(0.0500)
High-substitutability	-15.68*	-15.72*	-0.117
	(7.213)	(7.035)	(75.24)
Post X High-substitutability	-0.00865	-0.00981	-0.0681
	(0.0152)	(0.0144)	(0.174)
Treat X High-substitutability	0.00285	0.0179	-1.418***
	(0.0433)	(0.0492)	(0.134)
Observations	26,491	26,484	25,452
R-squared	0.677	0.681	0.915
Control Group	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
State-trends	YES	YES	YES
Industry-trends	YES	YES	YES
Firm-controls	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%. The elasticity measure is defined at the two-digit industry level from Goldar (2013), which are presented in Table A11. Affected firms are those that use a non-zero amount of contract worker person-days in the pre-treatment period.

Table A7: Effects on Revenue and Profits

	(1) Log revenue	(2) Log revenue	(3) Log revenue	(4) Log revenue	(5) Log profit	(6) Log profit	(7) Log profit	(8) Log profit
Post X Treat	-0.0405**	-0.0416**	0.0301	0.0166	-0.152***	-0.153***	0.0217	0.00170
	(0.0121)	(0.0116)	(0.0187)	(0.0158)	(0.0296)	(0.0292)	(0.0445)	(0.0429)
Post X Treat X Affected			-0.155***	-0.144***			-0.193***	-0.179***
			(0.0209)	(0.0167)			(0.0259)	(0.0383)
Observations	19,635	19,626	91,545	62,325	19,635	19,626	91,545	62,325
R-squared	0.194	0.196	0.152	0.155	0.081	0.081	0.063	0.066
Type	Affected	Affected	All	All	Affected	Affected	All	All
Control group	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
State time trend	YES	YES	YES	YES	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses for the double difference specification, and clustered at the factory level in parentheses for the triple difference specification; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A8: Effects on Total Factor Productivity and Labor Productivity

	(1)	(2)	(3)	(4)	(5)	(6)
		Total Factor Productivity			Labor Productivity	
	Residual	Residual	LP	LP	Revenue/person-day	Revenue/person-day
Post X Treat	0.00557	-0.0152	0.0176***	-0.00261	-0.0641**	-0.0502**
	(0.0114)	(0.0151)	(0.00348)	(0.00300)	(0.0236)	(0.0150)
Post X Treat X Affected		0.00907		0.0213**		-0.0579**
		(0.0143)		(0.00671)		(0.0167)
Post X Affected		0.0598***		-0.0122		0.0670**
		(0.0121)		(0.00982)		(0.0240)
Type	Affected	All	Affected	All	Affected	All
Control	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor	Neighbor
Observations	24,781	82,960	23,650	75,632	27,986	99,161
R-squared	0.66	0.67	0.81	0.82	0.76	0.77
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
State time trend	YES	YES	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES	YES	YES
Firm-controls	YES	YES	YES	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Total factor productivity is obtained simply as residuals from the production function, or by using the Levinsohn and Petrin (2003) (LP) methodology.

Table A9: Effects on Labor Costs

	(1) Labor cost/revenue	(2) Labor cost/revenue	(3) Labor cost/revenue	(4) Labor cost/revenue
Post X Treat	0.0509***	0.0636***	0.0332	0.0304
	(0.0192)	(0.00658)	(0.0235)	(0.0238)
Post X Treat X Affected			0.0587**	0.0607**
			(0.0269)	(0.0268)
Post X Affected			-0.0613***	-0.0510***
			(0.0121)	(0.0125)
Observations	129,314	28,547	129,314	89,005
R-squared	0.65	0.66	0.69	0.69
Type	Affected	Affected	All	All
Control group	Neighbor	Neighbor	Neighbor	Neighbor
Firm FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
State time trend	YES	YES	YES	YES
Industry time trend	YES	YES	YES	YES
Firm-controls	NO	YES	NO	YES

Note: Robust standard errors clustered at the state level in parentheses for the double difference specification, and clustered at the factory level in parentheses for the triple difference specification; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A10: Effect on Affected Firms compared to Unaffected Firms within Andhra Pradesh

	(1) Contract/total person-days	(2) Log contract person-days	(3) Log regular person-days	(4) Plant & Machinery	(5) Log revenue	(6) Log profit
Post X Affected	-0.184***	-2.944***	0.556***	0.167	-0.135***	-0.142***
	(0.0105)	(0.141)	(0.0679)	(0.138)	(0.0356)	(0.0539)
Observations	25,777	25,777	25,777	23,257	25,852	17,444
R-squared	0.705	0.714	0.789	0.929	0.935	
0.916						
Firm FE	YES	YES	YES	YES	YES	YES
year FE	YES	YES	YES	YES	YES	YES

Note: Robust standard errors clustered at the state level in parentheses for the double difference specification, and clustered at the factory level in parantheses for the triple difference specification; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A11: Elasticity of Substitution between Capital and Labor from Goldar et al. (2013)

Industry code (2-digit)	Description of Industry	Elasticity of Substitution
15	Manufacture of food products and beverages	0.94
16	Manufacture of tobacco products	0.64
17	Manufacture of textiles	0.64
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.66
19	Tanning and dressing of leather; manufacture of luggage, handbags, addler, harness and footwear	0.56
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plating materials	0.97
21	Manufacture of paper and paper products	0.73
22	Publishing, printing, and reproduction of recorded media	0.93
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.84
24	Manufacture of chemicals and chemical products	0.88
25	Manufacture of rubber and plastics products	0.80
26	Manufacture of other non-metallic mineral products	0.81
27	Manufacture of basic metals	0.54
28	Manufacture of fabricated metal products, except machinery and equipment	0.81
29	Manufacture of machinery and equipment n.e.c	0.87
30	Manufacture of office, accounting and computing machinery	0.73
31	Manufacture of electrical machinery and apparatus n.e.c	0.73
32	Manufacture of radio, television and communication equipement and apparatus	0.82
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.74
34	Manufacture of motor vehicles, trailers and semi-trailers	0.86
35	Manufacture of other transport equipment	0.71
36	Manufacture of furniture; manufacturing n.e.c	0.87