The Impact of Labor Law Reforms in Frictional Labor Markets*

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Many countries have Employment Protection Legislations (EPL) that penalize firms for hiring workers "off the books"– on temporary contracts, without employment benefits and job security. In the framework of a general equilibrium model with heterogeneous firms, we show that while these policies reduce informality on the "intensive margin" i.e. firms hire fewer informal workers, they increase informality on the "extensive margin" i.e. firms choose to remain unregistered in the informal sector instead. Moreover, these responses are amplified in frictional labor markets, where wages are rigid and cannot flexibly adjust in response to the policy. Using a difference-in-differences framework, we test the model implications of a policy reform that restricted the use of contract labor in India. Consistent with the model, we find a robust decline in the use of contract workers, but a robust growth in the size of the informal sector. Rather than a restriction on contract labor, we find that a policy counterfactual that subsidizes payroll workers' benefits decreases both margins of informality, and also has a sizeable positive impact on aggregate productivity and welfare.

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1 Introduction

Employment Protection Legislations (EPL) are a common policy tool used all over the world to protect the rights of workers, and ensure a minimum standard of living for its citizens. Typical examples of EPLs include social security and severance pay, minimum wages, hiring and firing restrictions, provision of health coverage, etc.[1] While EPLs are aimed at primarily protecting workers' rights, they also typically increase firm costs associated with worker hiring and dismissals, layoffs, and closures. A growing body of research suggests that firms respond to stringent EPLs through one of two channels– either (i) by hiring workers "off-the-books" (i.e. on temporary contracts) so that these legislations do not apply to them[2]; or (ii) by operating in the informal sector itself i.e. remaining unregistered with the government.[3] This is reflected both in a large informal sector (La Porta and Shleifer, 2008; Ulyssea, 2018) as well as the widespread use of contract workers (Eichhorst et al., 2017; ILO, 2016) across many countries, and especially in developing ones.

What are the implications of EPL reforms on firms' mix of payroll and contract workers, their decision to operate in the formal or informal sector, and consequently on aggregate productivity and welfare? Moreover, how do these implications change in the context of frictional labor markets (where for example, wages cannot respond in equilibrium), which are pervasive in developing countries? This paper sheds light on the above questions in the context of a theoretical model as well as an empirical examination of a large EPL reform that banned the use of contract workers in the state of Andhra Pradesh, India.

In the context of EPL, our theoretical framework distinguishes between the two channels of a firm's decision to manufacture: (i) whether to register and pay entry costs to operate in the formal sector, or choose to remain unregistered in the informal sector – the *extensive* margin and (ii) decision of formal firms to hire workers on payroll or "off-the-books" (as contract workers)– the *intensive* margin. We model EPL, in a reduced form way, as an increase in the marginal cost of hiring a payroll and contract worker in the formal sector. We show that our model has very different, and quantitatively important implications for how EPL reforms that target the hiring of a specific type of worker (contract or payroll) impacts

[1] The complexity and stringency of the legislation, as well as the quality of its enforcement vary widely across countries (Botero et al., 2004; Kanbur and Ronconi, 2018).

[2] see Abraham and Taylor (1996); Autor (2003); Kahn (2010); Cahuc, Charlot and Malherbet (2016); Chaurey (2015)

[3] see Almeida and Carneiro (2012); Bruhn and McKenzie (2014); Wahba and Assaad (2017)

informality, TFP and welfare. Moreover, we show that in labor markets where wages cannot flexibly adjust in equilibrium[4], the productivity and welfare implications of these policy changes can be very different.

The theoretical model is similar in spirit to Melitz (2003) and Ulyssea (2018). Firms are ex-ante heterogeneous in productivity, pay a fixed cost of entry and decide whether to enter the informal or formal sector (or not enter at all). With labor as the only input in production, firms in the informal sector can hire workers on temporary contracts and do not pay any taxes. However, they face an increasing size-dependent probability of being audited. On the other hand, firms in the formal sector pay a fixed cost of registration (over and above the entry costs), comply with payment of taxes, and can hire both payroll and contract workers. We model EPLs as two parameters that increase the marginal cost for hiring a contract or payroll worker in the formal sector. The direct relationship between productivity and firm size indicates that the more productive, larger firms sort into the formal sector, while the smaller, unproductive firms choose to remain in the informal sector. The model therefore illustrates how EPLs can affect both the intensive and extensive margins of a firm's decision. On the one hand, EPLs targeted towards a specific type of labor (say severance pay for regular workers) can not only affect the firm's input mix of contract and payroll workers in the formal sector, but can also *endogenously* change the sorting of firms between the informal and formal sectors. Moreover, EPLs can indirectly affect these margins through the resulting changes in wages and prices in general equilibrium.

In fact, the ability of wages to adjust in equilibrium is key. For example, consider a policy reform that we will discuss later – that of penalizing the use of contract workers by formal firms. Conditional on wages, firms in the formal sector now face a higher marginal cost of hiring a contract worker and hence skew their input mix towards regular workers. On the extensive margin, the marginal firms in the formal sector move to the informal sector given the increase in costs of hiring workers in the formal sector. Therefore, if wages were fixed (in the extreme case), this would result in welfare losses for the economy (as measured by real income). On the contrary, if wages were flexible in equilibrium, the resulting fall in aggregate labor demand would decrease wages, thus offsetting some of the increase in the cost of hiring a contract worker due to the policy reform, and mitigating the adverse welfare effects. This suggests that the impact of EPL reforms on informality, aggregate TFP

[4]Wage rigidity is a common phenomenon in developing countries (see Kaur, 2019).

and welfare depends directly on how laws target different types of workers, but also on how flexibly wages can adjust in equilibrium in response to changes to these policies.

A natural experiment of a EPL reform in Andhra Pradesh (AP), India allows us to not only examine causally how firms responded to the policy, but also examine whether these responses align with the theoretical predictions of our model. The policy reform, implemented in 2003, (de-jure) banned the use of contract labor in core manufacturing activities.[5] The reform was enabled through an amendment to the federal legislation called the Contract Labour Act, 1971 (CLA), and was applied in addition to India's key piece of employment protection legislation applicable to regular workers, the Industrial Disputes Act, 1947 (IDA).[6] This amendment therefore, reversed the labor market flexibility offered by the CLA, and strengthened employment protection in the state. We use establishment-level panel data from the Annual Survey of Industries (ASI) between the years 1999-2000 and 2006-2007, and a difference-in-differences specification to first examine how firm outcomes such as contract and regular worker usage, firm revenues, wages, and prices change after the reform. We then complement this analysis with various rounds of the National Sample Survey (NSS) and the Economic Census of India to understand how the policy reform affected firm entry and informality.

Turning to the results, we find a substantial decrease in the usage of contract workers, as measured by both person-days as well as number of workers, by over 60% and 15% respectively immediately after the policy reform (see figure 3). The fraction of contract workers also decreased by around 5%. The above results indicate that even though contract workers were 'banned' de-jure, the de-facto implementation of the policy was imperfect. Consistent with the predictions of the model, we find that the number of regular workers increased by 9.2%. This substitution between contract and regular workers, in the context of the model, implies an elasticity of substitution of 4.5 between payroll and temporary contract workers. Turning to other firm-level outcomes, we find that the total firm size did not change, and firm revenues declined by 12%. Lastly, the decline in revenues were driven

[5] 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.

[6] 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.

primarily by a decline in prices by 18.3%. We then use the NSS and Economic Census data and find that the probability of a worker working in the informal sector increased by 1.8 percentage points and the number of unregistered firms increased by 25 percent. We find no evidence of spatial spillovers, either in firms relocating to neighboring states, or on aggregate employment and revenue of firms in the neighboring states. We also do not find any spillovers across establishments within a multi-establishment firm. Lastly, we show that the results are robust to placebo tests in the pre-treatment period, or using AP's neighboring states as a control group.

We then quantitatively estimate the model, and consider the implications of two policy-relevant counterfactuals, both aimed at reducing the usage of contract workers. First, consider a 10% (20%) increase in the marginal cost of hiring a contract worker. Under a regime where wages can flexibly adjust in equilibrium, we find that the fraction of contract workers i.e. the intensive margin of informality, decreases by 29.7% (54.1%). On the extensive margin of informality however, the fraction of firms and workers in the informal sector increases by 7.3% (12.5%) and 9.2% (16.3%) respectively. This increase comes both from the entry of new firms (the entry threshold decreases) as well as a sorting of formal firms into the informal sector (formalization threshold increases). Consequently, wages and aggregate productivity fall by 3% (4.8%) and 1.3% (2.1%) respectively. Put together, real income falls by 1.1% (2%). On the other hand, a policy reform that penalizes the hiring of contract workers when wages are rigid exacerbates the implications on informality, and hence aggregate welfare. The fraction of firms and workers in the informal sector now increase by 8.5% (14.2%) and 11.3% (19.8%) respectively. While there is not much entry of new firms, the productivity threshold for a firm to be formal is even higher and increases by 8.5% (16.2%). To put this another way, as compared to the previous regime of flexible wages, a firm has to be even more productive to want to operate in the formal sector. Overall, real income falls by 12.8% (20.3%).

A second policy-relevant counterfactual aimed at reducing the usage of contract workers is to subsidize the hiring of payroll workers instead. To make the impacts comparable, we decrease the cost of hiring payroll workers such that the impact on the hiring of contract workers (intensive margin) is the same across both policies. We find that the effect of the policy on the extensive margin however, is very different. While the previous policy increased informality on both the intensive and extensive margins, this policy reduces both

margins of informality. Under a regime where wages are flexible, the fraction of firms and workers decreases by around 7.5%. Moreover, more informal firms now sort into the formal sector (formalization threshold decreases) and the resulting changes operating through higher wages (3.4% increase) implies that the unproductive marginal firms in the informal sector exit (entry threshold increases). Overall, aggregate productivity increases by 1.2% and real income increases by 1%. Finally, the implications are again exacerbated under rigid wages. The fraction of firms and workers in the informal sector decreases by 9-10% and real income increases by around 18% instead.

Put together, the above analysis has two key takeaways. First, although policymakers are usually interested in reducing hiring of temporary, contract workers through EPL reforms, our analysis suggests that the targeting of the policy is important. Taxing/penalizing hiring contract labor does reduce the hiring of these workers, but also pushes the marginal firms into the informal sector on the extensive margin, which may not be desirable. On the other hand, polices that ease the hiring of workers on payroll can reduce informal hiring on both the intensive and extensive margins. Second, the ability of wages to adjust in equilibrium is key. The indirect effects of the policy reform through wage adjustments in equilibrium help in mitigating the direct effect of the policy. To put it another way, penalizing hiring of contract workers can be detrimental from a welfare perspective if wages are rigid. On the contrary, EPL reforms targeted at hiring of regular workers can be even more beneficial. This insight highlights the role of these direct and indirect channels in substantially altering the impact of EPL reforms on informality and welfare.

This paper contributes to the following strands of the literature. First, while previous studies have focused on the impact of EPL reforms on workers, jobs and employment (Kugler and Pica, 2008; Autor et al., 2006; Marinescu, 2009; Kan and Lin, 2011.), there is little evidence on how EPL reforms affect firm performance, informality, TFP, and welfare. Moreover, we highlight how frictional wage adjustments in equilibrium can play an important role in affecting the impact of EPL. Second, the policy reform in India allows us to improve on existing literature in the causal identification of the impact of EPLs, thus contributing to large literature on the effects of EPLs (Botero et al., 2004; Cingano et al., 2010; Bassanini et al., 2009; Besley and Burgess, 2004; Autor et al., 2007). Third, our paper contributes to a growing literature that examines the effects of changing employment protection through temporary and contract labor (Aguirregabiria and Alonso-Borrego, 2014; Baek and Park,

2018; Blanchard and Landier, 2002; Cahuc and Postel-Vinay, 2002). Lastly, to the extent that growing automation might increase the need and use of flexible work arrangements and contracts (Acemoglu and Restrepo, 2018), our paper highlights the role of well-targeted EPLs in stimulating the productivity of workers and firms, while protecting the rights of workers.

The rest of the paper is organized as follows: section 2 develops the theoretical model and section 3 provides the context for our empirical application by discussing the EPL reform in India. Section 4 then describes the data and empirical methodology, and section 5 presents the results and the robustness checks. Section 6 discusses the calibration of the model and section 7 offers a short conclusion.

2 Theory

An economy consists of J industries and two sectors in each industry, namely formal and informal. There is a continuum of potential firms in each industry, with mass N_j, $j \in J$. Each firm is indexed by its productivity $z \sim F_j(z)$. Labor is the only input in production, and firms can hire homogeneous workers at a competitive wage w. However, workers can be hired either on a regular payroll or on temporary contracts i.e. "off-the-books". We refer to this margin as the "intensive" margin of informality. Apart from the composition of its workers, firms also endogenously decide whether to enter at all, and conditional on entry, whether to enter the informal or formal sector, $s \in \{i, f\}$. We refer to this as the "extensive" margin of informality. The goods market is perfectly competitive and products from the formal and informal sectors are perfectly substitutes in consumption[7].

The key difference between the two sectors (as we will discuss below) is that in the informal sector, a firm chooses to remain unregistered with the government, and hence does not pay taxes and can only hire workers on temporary contracts. However, it faces a size-dependent probability of being audited, and if caught, is penalized and shut down. On the other hand, in the formal sector, firms comply with taxes and regulations, and can endogenously decide the composition of its workers on payroll and temporary contracts. With this setup, we now turn to discussing the details of the model. Section 2.1, we begin with a the production decision of incumbent firms in the formal and informal sectors. In

[7]We can extend the model to have imperfect competition in the goods sector (such as monopolistic competition for example). The main insight of the model does not change.

section 2.2, we discuss entry decisions of a firm and define equilibrium in section 2.3. Lastly, we discuss the implications of a policy that taxes (or subsidizes) contract labor in section 2.4. Moving forward, we drop firm and industry subscripts for notational clarity.

2.1 Incumbents

Output of a firm with productivity z, denoted by $y(z)$, is given by a decreasing returns to scale production function $y(z) = zl^{\rho}$, where $0 < \rho < 1$ and l is the labor used in production. We now discuss the distinctions of manufacturing in the formal and informal sectors below:

Formal sector: Two features define the manufacturing decision in the formal sector. On the one hand, firms must comply with paying a per-unit sales tax t, on the other, firms can hire workers on both a regular payroll (l_r) as well as informal contracts (l_c). Both types of workers are imperfect substitutes in production with an elasticity of substitution ν, such that $l_f = \left[l_r^{\frac{\nu-1}{\nu}} + l_c^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}}$. However, firms pay an additional per-unit cost given by $b_r w$ and $b_c w$ to hire a regular and contract worker respectively. This is therefore a reduced form way of incorporating, for example, EPLs (such as hiring/firing costs, etc.) for regular workers, as well as search costs, intermediary contract worker payments, etc. for the contract workers.[8] The variable profit of a firm manufacturing in the formal sector is therefore be given by:

$$\pi_f(z) = (1-t)pzl_f^{\rho} - wb_r l_r - wb_c l_c$$

Define $w_f = \left[b_r^{1-\nu} + b_c^{1-\nu} \right]^{\frac{1}{1-\nu}} w$. The ratio of contract to regular workers and the variable profit of the firm in the formal sector can therefore be given by:

$$\frac{l_c}{l_r} = \left(\frac{b_c}{b_r} \right)^{-\nu} \tag{1}$$

$$\pi_f(z) = (1-\rho) \left[\frac{\rho}{w_f} \right]^{\frac{\rho}{1-\rho}} \times \left[(1-t)pz \right]^{\frac{1}{1-\rho}} \tag{2}$$

See proof in appendix B.1.

[8] Alternately, one can also view them as differential productivity for each type of labor in production. In the absence of separate production and cost data, we will not be able to distinguish between these two channels.

Informal sector: Firms in the informal sector are unregistered with the government and tax authorities. Therefore, they can only hire contract workers, but do not have to pay taxes, or comply with EPL regulations (b_c and b_r). However, they face a size-dependent probability of being audited (and potentially penalized) by the government. We approximate this distortion in the form of a convex cost function $c(l_i) = wl_i^\theta$, where l_i is firm-size and $\theta \geq 1$.[9] The variable profit function of a firm in the informal sector is therefore given by:

$$\pi_i(z) = pzl_i^\rho - wl_i^\theta$$

Define $\tilde{\rho} = \rho/\theta < 1$. The optimal profit of the firm is then:

$$\pi_i^*(z) = (1-\tilde{\rho})\left[\frac{\tilde{\rho}}{w}\right]^{\frac{\tilde{\rho}}{1-\tilde{\rho}}} \times (pz)^{\frac{1}{1-\tilde{\rho}}} \tag{3}$$

See proof in appendix B.2.

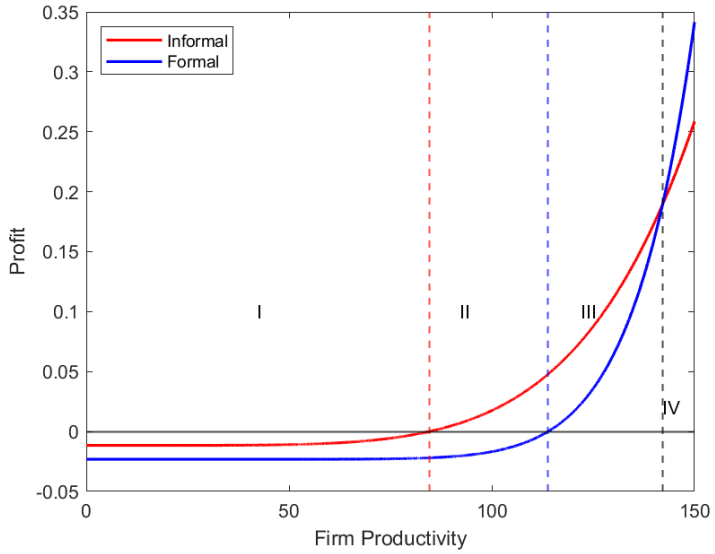
2.2 Firm entry

Let there be a mass of potential entrants N (we drop j for notational ease) of potential firms indexed by a productivity $z \sim F(z)$. We assume that $F(z)$ is continuous with support $(0, \infty)$, has finite moments and is independent across firms. For a sector $s \in \{i, f\}$, let E_s be the fixed cost of entry in units of output that a firm has to pay to enter the sector. We assume that entry costs in the formal sector are higher than the informal sector so that $E_f = E_i + E_r$, where E_r capture excess costs associated with registration and formalization of the firm.

Figure 1 shows the entry decision of a firm by plotting the profit functions in the informal and formal sector as a function of firm productivity (see appendix B for the mathematical details). The red line plots the profit in the informal sector, while the blue line plots the profit in the formal sector. Intuitively, firms (based on their productivity draw) will manufacture in the sector that earns them the highest non-negative profit, or not manufacture at all. This implies firms can be categorized into four types, based on thresholds $\{z_i^*, z_f^*, z_s^*\}$. In area I, productivity is too low to operate in either the formal or informal sector i.e. $z \leq \min\{z_i^*, z_f^*\}$ and these firms do not enter. In area II, manufacturing in the informal sector is viable, but not in the formal sector i.e. $z_i^* \leq z \leq z_f^*$. In areas III and IV,

[9] Appendix B.3 relates the convex-costs to a size-based probability of detection.

Figure 1: Firm entry decisions



Parameter values: $E_i = 0.5; E_f = 1; w = 1; \tau = 0.2; \sigma = 3; b_p = b_c = 1; \rho = 0.9; \theta = 1.1$

manufacturing in both sectors in viable i.e. $\max\{z_i^*, z_f^*\} \leq z$. However, in area III, firms prefer to manufacture in the informal sector to avoid paying taxes i.e. $z < z_s^*$, while in area IV (the most productive firms) will prefer to manufacture in the formal sector i.e. $z > z_s^*$. These thresholds $\{z_i^*, z_f^*, z_s^*\}$ are all endogenous and will be determined in equilibrium.[10]

2.3 Equilibrium and Welfare

Consumers inelastically supply labor (no disutility from labor) and do not save. So total consumption (and hence real income) is a natural measure of welfare. Consumer income simply aggregates wage income, profits and taxes across the economy. Therefore, total income will be given by $w\bar{L} + \Pi + T$. Π is the total profits aggregated across all firms in the economy (net of entry costs). T is the total tax revenues collected from firms in the formal sector, which are repatriated back to the consumer. We take the price of the final consumption good (P) to be the numeraire. Therefore, in a baseline case, an equilibrium is characterized by a set of prices for each industry $\{p_j\}_{\forall j}$ and wages w such that:

(i) goods market clear in each industry – the total output produced in a sector is equal to

[10]The above pattern is not true for the universe of parameters. For example if the monitoring cost θ was very large, it is possible that no firm wants to enter the informal sector. However, we rule out such possibilities by assumption since we always observe non-zero entry of firms in both sectors, and that the larger firms also tend to be formal on average.

the consumer demand $\kappa_j(I/p_j)$ and the output spent in fixed entry costs in the formal and informal sectors $M_{ij}E_{ij} + M_{fj}E_{fj}$.
(ii) labor market clears so that the total labor demand across industries and the informal and formal sector is equal to the stock of aggregate labor in the economy i.e. $\sum_j (L_{ij} + L_{fj}) = \bar{L}$.
(iii) zero-profit conditions holds in both the informal sector and the indifference condition holds in the formal sector so that $\pi_i(z_i^*, p, w) = pE_i$ and $\pi_i(z_s^*, p, w) = \pi_f(z_s^*, p, w) - pE_r$.

2.4 Impact of EPL reforms with frictional wage adjustments

EPL across the world are aimed at encouraging firms to hire more workers on payroll, thus providing them with the necessary social security benefits, and discourage hiring them informally on temporary contracts. In this section, we consider the impact of two such policies, one that is aimed at penalizing the hiring of contract workers and another that subsidizes the hiring of permanent workers. From the perspective of the model, this corresponds to an increase (decrease) in the b_c (b_r) .

We also incorporate the role of wage rigidity in affecting the adjustments in the economy. To elaborate, we define χ as the degree to which wages can adjust in equilibrium, in response to a policy reform i.e. $w_{new} \in (1 \pm \chi)w_{base}$ where w_{base} is the wage in a baseline scenario prior to the policy reform, and w_{new} is the wage after. $\chi = 0$ therefore indicates completely inflexible wages whereas as $\chi \to \infty$, wages are completely flexible. Any $\chi \in (0, \infty)$ reflects the degree of rigidity in the labor market. This introduces a slackness condition in the labor market clearing condition such that:

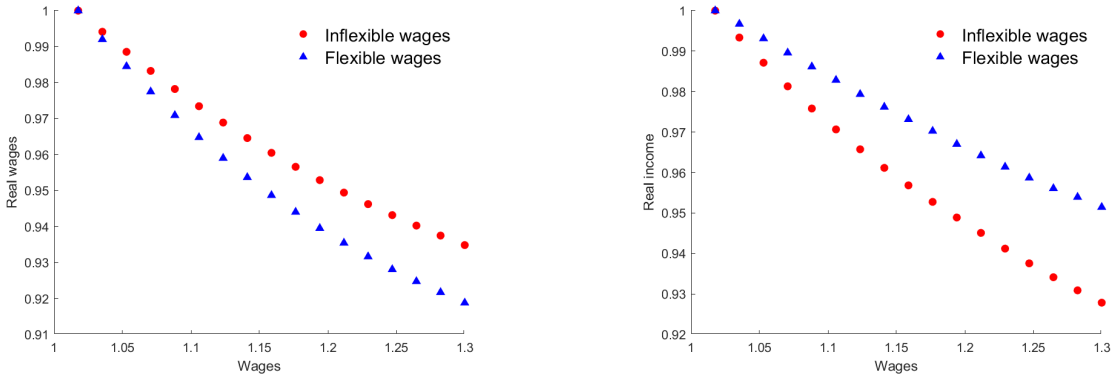
$$(w_{new} - w_{base})(\bar{L}_{new} - \bar{L}_{base}) = 0$$
$$\text{where: } w_{new} \in (1 \pm \chi)w_{base}$$

We now evaluate and discuss the impact of the two policy reforms discussed above, in the context of different wage-flexibility regimes. We fix some parameter values and simulate the model in equilibrium to examine the impact of the policy reform on real wages and real income (a proxy for welfare).

Penalizing hiring contract labor

Consider a policy counterfactual where we increase the penalty on hiring contract workers i.e. we start with a baseline scenario where $b_c = 1$ (say) and increase b_c with each counterfactual.

Figure 2: Impact of increasing penalty on hiring contract workers



(a) Change in Real Wages

(b) Change in Real Income

$E_i = 0.25$; $E_r = 2.5$; $\tau = 0.1$; $\sigma = 0.5$; $\nu = 4.5$; $\rho = 0.74$; $\theta = 1.3$; $N = 10k$; $L = 1m$
Note: The above graphs plot b_c on the horizontal axis and real wages (income) on the vertical axis in the first (second) graph.

Furthermore, consider the two extreme scenarios, one where wages are completely rigid and another where wages are completely flexible. Figure 2 shows impact of the policy, first on real wages in figure 2a and then on real income in figure 2b. As we can see from the figure, real wages fall in equilibrium as b_c increases. However, the they fall more when wages can also respond, as opposed to when wages cannot. This is because an increase in the penalty for hiring a contract worker (b_c) increases the marginal cost of hiring a worker in the formal sector and all else constant, pushes the marginal firm on the extensive margin into the informal sector. This implies a fall in demand for labor, which creates a downward pressure on wages. Turning to welfare, real income unambiguously decreases as b_c increases, but decreases much more when wages are rigid. Intuitively, the decrease in wages in equilibrium mitigates the increase in b_c, thus muting the impact on firm decisions. Moreover, firms in the informal sector can also hire workers at a cheaper rate. This mechanism mitigates the adverse effect on welfare. On the other hand, if wages cannot fully adjust to an increase in b_c, then the indirect mitigating channel through wage adjustments does not exist and hence a fall in labor demand implies lesser income and welfare unambiguously falls.

Subsidizing hiring of regular workers

Now consider another counterfactual, where instead of imposing penalties on hiring contract labor, the policy subsidizes the hiring of regular workers i.e. b_p decreases. The mechanisms

are exactly the same as discussed in the previous section, only in the opposite direction – real wages increase as b_p increases, and more so when wages can flexibly respond in equilibrium, thus counteracting the direct effect of the subsidy. Flexible labor markets therefore see a *lesser* increase in welfare relative to when wages are rigid.

To summarize the above discussion, the theoretical model provides a nuanced insight into how the flexibility of labor markets can help mitigate the impact of a EPL reform. To put it another way, the nature of the EPL reform becomes even more important in cases where labor market adjustments are imperfect since they can exacerbate the impact of the policy. With this intuition, we now turn to discussing the context of our empirical application – a large, EPL reform in the state of Andhra Pradesh, India.

3 Context of the EPL reform in India

The Industrial Disputes Act, 1947, of India 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.[11] 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. 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

[11] 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.

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). 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.[12] 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.[13] 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 A.

[12]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.

[13] 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.

4 Data & Empirical methodology

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 legislation regulating manufacturing firms in India.[14] 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.[15]

We utilize a panel data set from the ASI between 2000-2001 to 2006-2007 for this study. The 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 2005-2006 corresponds to all activities between 1^{st} April 2006 and 31^{st} March 2007. Uniquely, the dataset contains establishment-level information on the number of contract and regular workers, and the person-days spent working by each. Data on person-days are further disaggregated 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. The availability of such detailed data therefore enables us to examine firm responses for each category.

The ASI also contains detailed data on a variety of details at the plant level, including revenue, wages, and prices. Regular worker wages are not directly reported but are derived by dividing total salary costs provided for regular workers at the firm level by the total regular person-days of work. Revenue includes revenue from product sales and revenue from other miscellaneous activities. Prices are calculated by dividing total output value by the total quantity sold for the most important product of the firm (defined based on the highest revenue product).

[14] 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.

[15] 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.

We complement our analysis by using the employment-unemployment module of the National Sample Survey data for the years 1999-2000 and 2004-2005 and from the Economic Census of India (universe of all firms) for the years 1998 and 2005. These data help us examine the impact of the policy reform on the size of the informal sector by examining the number of unregistered firms, as well as informal workers. The summary statistics for the main outcome variables are presented in table **??**.

Empirical methodology: 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 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 states in India taken together, and as a robustness check, 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 figure 3. To quantify the effects of the policy, we estimate the following regression at the firm level:

$$Y_{ijst} = \beta Treat_s X Post_t + \kappa_i + \theta_s t + \delta_{jt} + \varepsilon_{ijst} \tag{4}$$

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, total employment and person-days, revenue, wages, and prices. $Post_t$ is an indicator variable that takes on a value of 1 in the years in which the law change was in place (2004-2006), 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 (all states or the neighbor states). The firm fixed effects (κ_i) control for any time-invariant unobserved heterogeneity at the firm level. 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 year fixed effects (δ_{jt}) 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. We cluster standard errors at the state level to allow for correlations across firms within the state. β is our coefficient of interest, as it captures the differential impact of the policy reform on the treatment group relative to the control group. Due to the inclusion of firm fixed effects, these regression results can only be interpreted as the intensive margin of the policy change, i.e. the effect of the policy change on incumbent firms.

A recent econometric literature has identified that the single coefficient in difference-in-differences models that summarizes the effects over time is a weighted average of treatment effect parameters between different groups over time.[16] de Chaisemartin and D'Haultfœuille (2020) show that in particular, when the treatment effects are heterogeneous over time, some ATEs (average treatment effects) may be assigned negative weights, and may bias the coefficient estimate. They propose an estimator (henceforth DIDM estimator) that is valid under heterogeneous treatment effects. We extend our analysis to also report the de Chaisemartin and D'Haultfœuille (2020) DIDM estimators.[17]

A specific test of the model in the context of penalizing the hiring of contract workers implies that empirically, prices should fall more steeply after the policy reform in a context where wages are rigid. We test this using a triple-difference framework of the following form:

$$Y_{ijst} = \beta_0 Treat_i + \beta_1 Post_t + \beta_2 Treat_i X Post_t + \beta_3 Post_t X Below - medianMWgap_i \quad (5)$$
$$+ \beta_4 Treat_i X Post_t X Below - medianMWgap_i + \kappa_i + \gamma_t + \theta_s t + \delta_j t + \epsilon_{ijst}$$

The variable $Below - medianMWgap$ takes the value 1 if the gap between the firm's wage and minimum wage is smaller than the median gap, and takes the value 0 otherwise. β_4 is our coefficient of interest and the model predicts that this should be positive.

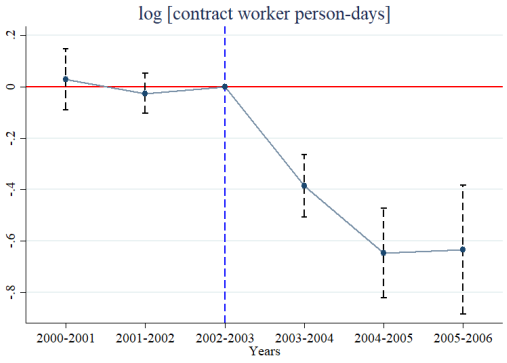
5 Empirical Results

Before presenting the results from the difference-in-differences specification, we first test for the parallel pre-trends assumption in Figure 3 for contract person-days and contract workers. As is visually clear, we find no evidence for differential pre-trends, lending credibility to our difference-in-differences results.

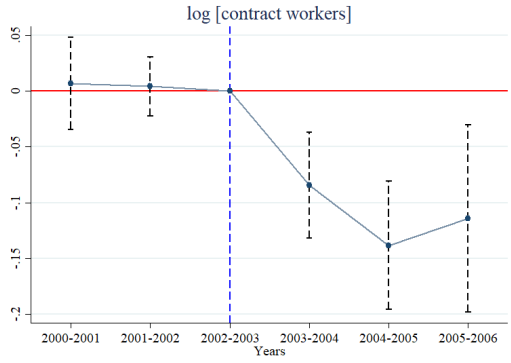
[16] See Goodman-Bacon (2019), and Callaway and SantAnna (2020).

[17] We use the Stata command *did_multiplegt* to implement their methodology.

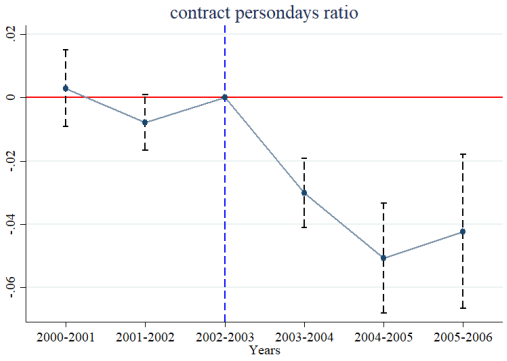
Figure 3: Impact on the use of contract workers



(a) Log contract person-days



(b) Log Contract Workers



(c) Frac. of contract person-days

(d) Frac. of contract workers)

Notes: The above graphs plot the regression coefficients from a difference-in-differences specification discussed in equation (4). 95% confidence intervals, clustered at the state-level are indicated in the bars around the point estimate. The coefficient for 2002-2003, the year before the reform has been normalized to zero.

The impact of the amendment on contract person-days and contract workers are presented in Table 2. From columns 1 and 2, we find that firms in Andhra Pradesh differentially reduced the number of contract person-days in core activities by 39% and contract share in total person-days by 3.1%, compared to firms in other major states, after relative to before the law change. Contract workers and share of contract workers fell by 9% (column 3) and 2.8% (column 4) respectively. In summary, the law change was successful in its goal of reducing the use of contract workers in firms' core activities.[18]

Furthermore, Table 3 shows that firms in Andhra Pradesh increased the number of regular workers and persondays by 9.2% and 14.3% respectively (columns 1 and 2). These results

[18] Note that these results use all states in India as the control group. We also report all the results using neighboring states as the control group in the appendix tables A3.

indicate that firms substituted towards using more regular workers and regular-person-days in core activities after the law change.There was no change in size of the total workforce at the firm level, as seen in columns 3 and 4, that present the effects on workers and total worker persondays respectively.

Columns 5-7 indicates that firm revenues fell by 12%, regular worker wages fell by 3%, and prices fell by 18.3%. The fall in revenues indicates that firms optimize and cut down on production due to higher input costs, both from labor and capital.

Consistent with the theoretical model, table Table 4 shows that there is a shift from the informal to the informal sector. Specifically column 1, based on the National Sample Survey data shows that the amendment increases the probability of a worker working in the informal sector, and column 2 shows that the amendment is associated with an increase in the number of unregistered firms in the economy.

While column 7 in table 3 showed that prices fell by 18%, we further investigate if there is a heterogeneity in the decline in table A2. Column 1 indicates that the decline in prices is less steep in firms that are below the median wage, columns 2 indicates that the decline in prices is less steep in those firms who gap between the minimum wage and wage are below median. This is indicated by the positive sign of the triple interaction terms. These results are consistent with the theoretical predictions that in regimes with wage ridigities, the policy can lead to welfare losses.

Table A1 shows the effects of the law amendment separately in core and non-core activities of the firm. Columns (1)-(3) indicate a strong decline in contract person days, regular persondays or the share of contract persondays in core activities. The effect is however absent in non-core activities (columns (4)-(6)). These results are not surprising since the law change notification did not directly affect the firm's non-core activities. This null result further increases our confidence as a successful placebo test as the amendment only affected the activities within the firm that it was legally supposed to affect.

6 Quantitative estimation of the model

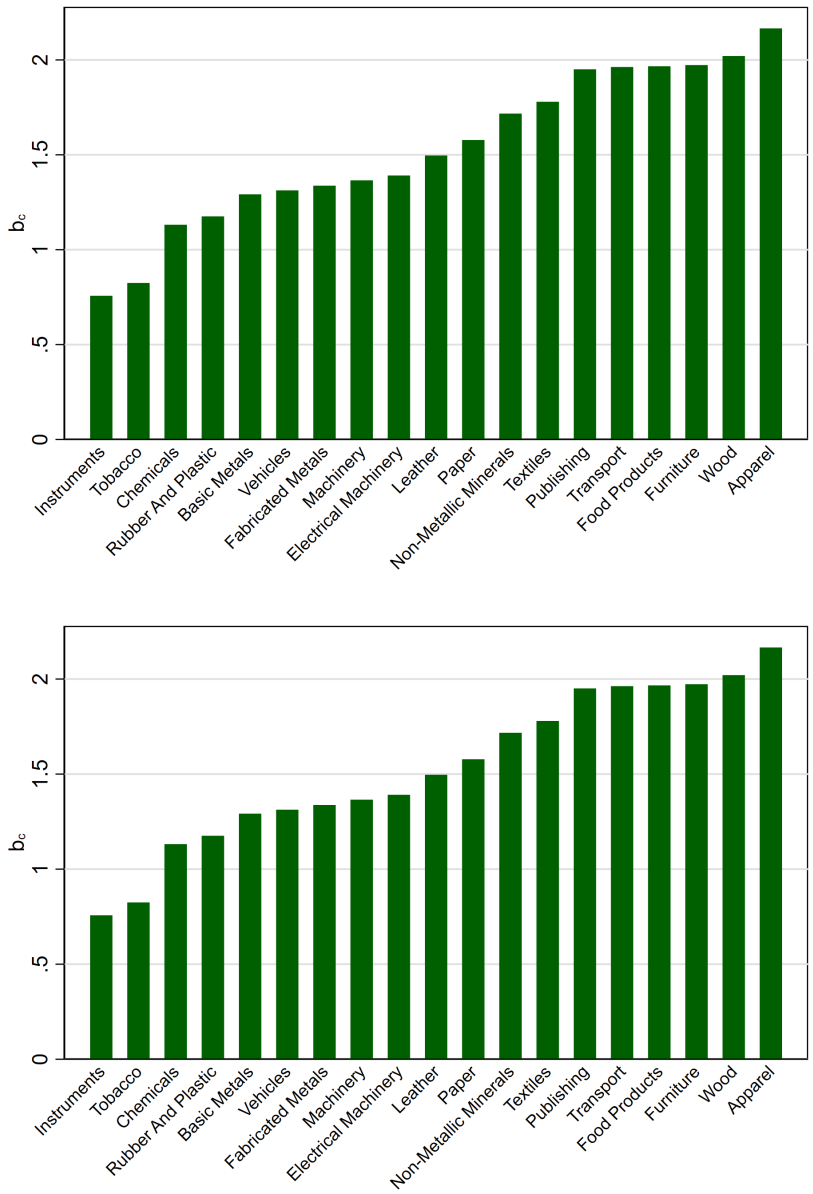
Calibration details: Each industry is defined at the two-digit NIC level and we have 19 industries. We begin by defining the parameterization of the model. First, we assume that firm productivity in each industry follows a log-normal distribution i.e. $z \sim \log N(0, \sigma^2)$. We therefore have the following set of parameters $\{\rho, \nu, \theta, \sigma\}$ and $\{\kappa_j, b_{cj}, b_{rj}, E_{ij}, E_{rj}, t_j\}_{\forall j \in J}$. ρ

is the decreasing returns to the production function and is set to 0.738, the average labor share in output from the ASI data. We set the elasticity of substitution between contract and regular workers (ν) to be 4. The share of consumer income allocated to each industry (κ_j) is got from the share of sales in industry j as a fraction of total sales. Sales tax t_j is the average tax paid by a firm in an industry j in the ASI. Lastly, within each industry, we use the (i) number of firms in the formal and informal sectors; (ii) the average firm size in the formal and informal sector; (iii) variance of firm size in the formal and informal sector; (iv) average fraction of contract workers within a firm, along with the equations of the theoretical model to calibrate the remaining parameters of the model. While appendix C provides details on the calibration exercise, we provide an intuition for identifying some of the key parameters here. With the distributional assumption, the number of firms in each sector allows us to calibrate the productivity thresholds for entry into each sector, which then coupled with the variance of firm-size (conditional on entry), allows us to identify the variation in productivity (σ^2) and the monitoring intensity in the informal sector (θ). Furthermore, the difference in the average firm size between the formal and informal sectors can then identify either b_c (or b_r), coupled with the fraction of contract workers within a firm helps identify b_c and b_r separately. Lastly, the fixed costs of entry are then identified from the zero-profit condition in the informal sector and the indifference condition for entering the formal sector.

Results: Figure 4 shows the distribution b_c and b_r across the 19 industries in our sample. As discussed before, they capture the additional cost of hiring a unit of labor (contract and regular) in the formal sector, as compared to the informal sector. As shown in the figure, there is a lot of variation across industries in the costs faced in hiring contract and regular workers. While there are no significant differences in hiring workers in the formal sector for the tobacco industry, hiring contract workers in the formal sector for the furniture or transport industry is at least twice as expensive. Similarly, hiring regular workers in the wood and leather industries is more than three times more expensive than hiring workers in the informal sector for these industries. As discussed previously, this difference could reflect either underlying barriers, costs associated with policies (such as firing and search costs) or productivity differences of workers. Given the limitations of the data, we are not able to disentangle these channels.

Figure 5 then shows the fixed costs of entry (E_i) and registration (E_r) across the 19

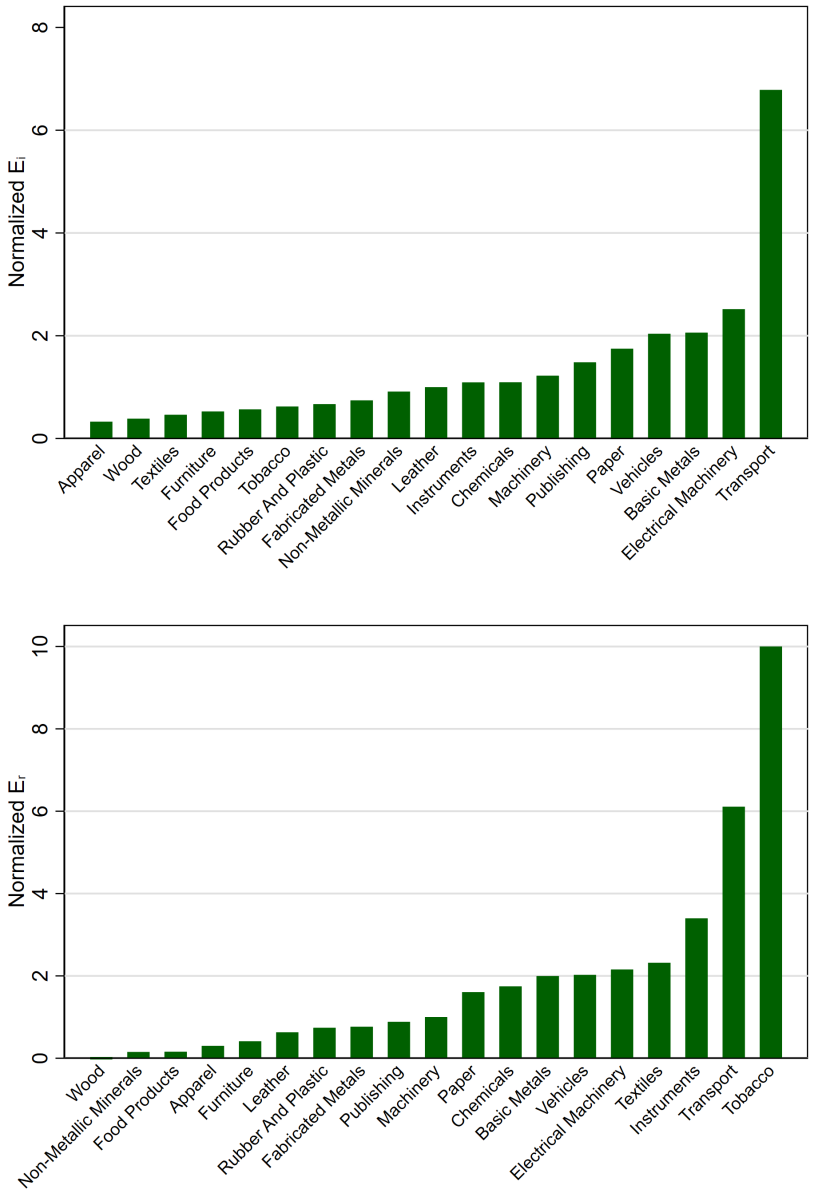
Figure 4: b_c and b_r across industries



industries. To make the comparisons across industries more meaningful, we normalize each cost by the median in the economy. As can be seen, the rubber and plastic, apparel and wood have low entry costs (two-thirds the median costs), while those in electrical machinery and transport have two-four times the median entry costs. On the other hand, wood, food products and leather industries have less than a third of the median registration costs, while textile and tobacco industries have more than four times the median registration costs.

Lastly, we estimate $\theta = 1.3$, implying that firms in the informal sector do face a convex cost of operating in the informal sector. Appendix B.3 discusses how we can relate this to a size-dependant probability of detection.

Figure 5: Fixed costs E_i and E_r across industries



Notes: The fixed costs in the informal sector E_i and registration costs E_r have been normalized by their median fixed costs in the economy.

7 Conclusion

Reforms to Employee Protection Laws (EPL) is an active area of research and public debate, especially in the light of increasing incidence of globalization and automation. On the one hand, while the nature of work has been rapidly evolving towards more flexibility in jobs, adequate protection of workers' rights are more important than ever. Prior research has suggested that firms typically respond to stringent EPLs through one of two channels– either by hiring workers "off the books" or by evading compliance with EPLs by operating in the informal sector. The implications of EPLs that target these types of workers, especially in the context of weak labor markets and rigid wages is not well understood.

This paper develops a general equilibrium model of heterogeneous firms incorporating these margins of firm decisions, namely to enter in the formal or informal sector, and conditional on operation in the formal sector, hire workers on payroll or informally on temporary contracts. EPLs are modeled as an increase in the marginal cost of hiring formal workers. A unique natural experiment in India that banned the use of contract workers in the state of Andhra Pradesh allows us to empirically test the predictions of the model. Using a difference-in-difference specification we find that the policy reform reduced the usage of contract workers and increased the usage of regular workers. Consistent with the model, we find that firm revenues, wages and prices fall as well. Lastly, the primary insight of the model shows that the impact of EPL reforms depends on two factors: (a) which workers are targeted by the reform and (b) the flexibility of wage adjustments in equilibrium. A counterfactual analysis shows that both channels have a quantitatively important impact on informality, TFP and welfare.

Put together, we conclude from our analysis that the role of EPL reforms are particularly important in contexts where labor markets are weak and wage adjustments are sticky/rigid. This highlights the importance of considering these channels carefully as countries across the world decide on appropriate EPL reforms in response to new challenges faced by globalization and automation.

References

Abraham, Katharine G and Susan K Taylor, "Firms' use of outside contractors: Theory and evidence," *Journal of Labor Economics*, 1996, *14* (3), 394–424.

Acemoglu, Daron and Pascual Restrepo, "Low-skill and high-skill automation," *Journal of Human Capital*, 2018, *12* (2), 204–232.

Aguirregabiria, Victor and CESAR Alonso-Borrego, "Labor contracts and flexibility: evidence from a labor market reform in Spain," *Economic Inquiry*, 2014, *52* (2), 930–957.

Ahsan, Ahmad and Carmen Pagés, "Are all labor regulations equal? Evidence from Indian manufacturing," *Journal of Comparative Economics*, 2009, *37* (1), 62–75.

Almeida, Rita and Pedro Carneiro, "Enforcement of labor regulation and informality," *American Economic Journal: Applied Economics*, 2012, *4* (3), 64–89.

Autor, David H, "Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing," *Journal of labor economics*, 2003, *21* (1), 1–42.

___, John J Donohue III, and Stewart J Schwab, "The costs of wrongful-discharge laws," *The Review of Economics and Statistics*, 2006, *88* (2), 211–231.

___, William R Kerr, and Adriana D Kugler, "Does employment protection reduce productivity? Evidence from US states," *The Economic Journal*, 2007, *117* (521), F189–F217.

Baek, Jisun and WooRam Park, "Firms Adjustments to Employment Protection Legislation: Evidence from South Korea," *ILR Review*, 2018, *71* (3), 733–759.

Bassanini, Andrea, Luca Nunziata, and Danielle Venn, "Job protection legislation and productivity growth in OECD countries," *Economic policy*, 2009, *24* (58), 349–402.

Besley, Timothy and Robin Burgess, "Can labor regulation hinder economic performance? Evidence from India," *The Quarterly journal of economics*, 2004, *119* (1), 91–134.

Blanchard, Olivier and Augustin Landier, "The perverse effects of partial labour market reform: fixed-term contracts in France," *The Economic Journal*, 2002, *112* (480), F214–F244.

Botero, Juan C, Simeon Djankov, Rafael La Porta, Florencio Lopez de Silanes, and Andrei Shleifer, "The regulation of labor," *The Quarterly Journal of Economics*, 2004, *119* (4), 1339–1382.

Bruhn, Miriam and David McKenzie, "Entry regulation and the formalization of microenterprises in developing countries," *The World Bank Research Observer*, 2014, *29* (2), 186–201.

Cahuc, Pierre and Fabien Postel-Vinay, "Temporary jobs, employment protection and labor market performance," *Labour economics*, 2002, *9* (1), 63–91.

——, Olivier Charlot, and Franck Malherbet, "Explaining the spread of temporary jobs and its impact on labor turnover," *International Economic Review*, 2016, *57* (2), 533–572.

Callaway, Brantly and Pedro H. C. SantAnna, "Difference-in-Differences with Multiple Time Periods," *Working Paper*, 2020.

Chaurey, Ritam, "Labor regulations and contract labor use: Evidence from Indian firms," *Journal of Development Economics*, 2015, *114*, 224–232.

Cingano, Federico, Marco Leonardi, Julian Messina, and Giovanni Pica, "The effects of employment protection legislation and financial market imperfections on investment: evidence from a firm-level panel of EU countries," *Economic Policy*, 2010, *25* (61), 117–163.

de Chaisemartin, Clment and Xavier D'Haultfœuille, "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects," *American Economic Review (forthcoming)*, 2020.

Eichhorst, Werner, Paul Marx, and Caroline Wehner, "Labor market reforms in Europe: towards more flexicure labor markets?," *Journal for labour market research*, 2017, *51* (1), 3.

Goodman-Bacon, Andrew, "Difference-in-Differences with Variation in Treatment Timing," *Working Paper*, 2019.

ILO, "Non-standard employment around the world: Understanding challenges, shaping prospects," 2016.

Kahn, Lawrence M, "Employment protection reforms, employment and the incidence of temporary jobs in Europe: 1996–2001," *Labour Economics*, 2010, *17* (1), 1–15.

Kan, Kamhon and Yen ling Lin, "The effects of employment protection on labor turnover: Empirical evidence from Taiwan," *Economic Inquiry*, 2011, *49* (2), 398–433.

Kanbur, Ravi and Lucas Ronconi, "Enforcement matters: The effective regulation of labour," *International Labour Review*, 2018, *157* (3), 331–356.

Kaur, Supreet, "Nominal Wage Rigidity in Village Labor Markets," *American Economic Review*, October 2019, *109* (10), 3585–3616.

Kugler, Adriana and Giovanni Pica, "Effects of employment protection on worker and job flows: Evidence from the 1990 Italian reform," *Labour Economics*, 2008, *15* (1), 78–95.

Marinescu, Ioana, "Job security legislation and job duration: Evidence from the United Kingdom," *Journal of Labor Economics*, 2009, *27* (3), 465–486.

Melitz, Marc J, "The impact of trade on intra-industry reallocations and aggregate industry productivity," *econometrica*, 2003, *71* (6), 1695–1725.

Porta, Rafael La and Andrei Shleifer, "The Unofficial Economy and Economic Development," *Brookings Papers on Economic Activity*, 2008, *2008* (2), 275–363.

Saha, Bibhas, Kunal Sen, and Dibyendu Maiti, "Trade openness, labour institutions and flexibilisation: Theory and evidence from India," *Labour Economics*, 2013, *24*, 180–195.

Ulyssea, Gabriel, "Firms, informality, and development: Theory and evidence from Brazil," *American Economic Review*, 2018, *108* (8), 2015–47.

Wahba, Jackline and Ragui Assaad, "Flexible labor regulations and informality in Egypt," *Review of Development Economics*, 2017, *21* (4), 962–984.

Table 1: Effect on regular and contract workers

	Andhra Pradesh			All other states		
	(1) N	(2) Mean	(3) S.D.	(4) N	(5) Mean	(6) S.D.
Contract Workers	8,987	130.19	1595.21	106,966	20.91	107.63
Regular Workers	8,987	103.96	469.43	106,966	106.52	462.24
Total Workers	8,987	234.15	1715.93	106,966	127.43	504.98
Contract Persondays ('000)	8,987	39.28	48.17	106,966	6.48	36.45
Regular Persondays ('000)	8,987	31.57	148.69	106,966	32.43	14.58
Frac. of Contract Workers	8,984	0.2	0.33	106,933	0.14	0.29
Frac. of Contract Persondays	8,987	0.2	0.33	106,966	0.14	0.29
Regular Wages (in INR)	8,549	99.66	92.93	102,200	124.75	231.37
Revenue (in million INR)	9,013	204.84	1763.24	107,544	256.41	2611.71

Notes: INR refers to Indian Rupees.

Table 2: Effect on regular and contract workers

	Persondays		Workers	
	(1) Log Contract	(2) Contract Share	(3) Log Contract	(4) Contract Share
Post X Treat	-0.394***	-0.031***	-0.093***	-0.028***
	(0.065)	(0.006)	(0.027)	(0.006)
DID_M	-0.219***	-.026***	-0.054**	-.022***
	(0.062)	(0.004)	(0.023)	(0.004)
Observations	165674	165674	165675	165646
R^2	0.794	0.810	0.817	0.810
Factory FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
State-Trend	Yes	Yes	Yes	Yes

Notes: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. The DID_M estimator is estimated based on de Chaisemartin and D'Haultfœuille (2020).

Table 3: Effect of the Amendment on Other Firm Level Outcomes

	(1) Log regular workers	(2) Log total workers	(3) Log price	(4) Log wages
Post × Treat	0.092**	0.040	-0.183*	-0.121***
	(0.044)	(0.053)	(0.109)	(0.018)
DID_M	0.067***	0.015	-0.356***	-0.035***
	(0.015)	(0.017)	(0.038)	(0.009)
N	165675	165675	122182	105,367
R^2	0.917	0.941	0.818	0.3813
Dataset	ASI	ASI	ASI	NSS
Factory FE	Yes	Yes	Yes	No
Industry-year FE	Yes	Yes	Yes	Yes
State-Trend	Yes	Yes	Yes	Yes
Year FE				Yes

Notes: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%. Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. The DID_M estimator is estimated based on de Chaisemartin and D'Haultfœuille (2020).

Table 4: Impact on the Informal Sector

	(1) Informal sector worker (binary)	(2) Informal sector worker (binary)	(3) Log wage	(4) No. Unregistered firms
Post X Treat	0.068***	0.067***	-0.145***	0.25*
	(0.010)	(0.011)	(.018)	(0.138)
Post X Treat X High-education		0.002	0.134***	
		(0.008)	(0.027)	
High-education		-0.040***	0.621***	
		(0.006)	(0.015)	
Observations	242,512	242,462	242,462	953
R-squared	0.657	0.6586	0.658	0.932
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	No
District FE	No	No	No	Yes
Industry FE	Yes	Yes	Yes	No
State-time trend	Yes	Yes	Yes	
Industry-year FE	Yes	Yes	Yes	
Data Source	NSS	NSS	NSS	Economic Census

Notes: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%. Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. NSS is the National Sample Survey. The Economic Census has been aggregated to the district-year level. High-education is a dummy variable that takes the value 1 if education is at or above higher secondary schooling, and 0 otherwise.

Table 5: Impact of penalizing hiring contract workers

Wage rigidity:		Flexible		Inflexible	
Increase in b_c:	Baseline	10%	20%	10%	20%
	(1)	(2)	(3)	(4)	(5)
b_c	1.00	1.10	1.20	1.10	1.20
Frac. Contract workers	0.61	0.43	0.28	0.43	0.28
Frac. Informal firms	0.68	0.73	0.77	0.74	0.78
Frac. Informal labor	0.52	0.56	0.60	0.58	0.62
Wage	1.00	0.97	0.95	1.00	1.00
Entry threshold	1.00	0.98	0.97	1.00	1.00
Formalization threshold	1.84	1.95	2.05	2.00	2.14
Avg. productivity	1.000	0.987	0.979	0.999	1.000
Real income (welfare)	1.000	0.989	0.980	0.872	0.797

Notes: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%. Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. NSS is the National Sample Survey. The Economic Census has been aggregated to the district-year level.

Table 6: Impact of subsidizing hiring payroll workers

Wage rigidity:		Flexible		Inflexible	
Decrease in b_p:	Baseline	10%	20%	10%	20%
	(1)	(2)	(3)	(4)	(5)
b_p	1.00	0.91	0.83	0.91	0.83
Frac. Contract workers	0.61	0.43	0.28	0.43	0.28
Frac. Informal firms	0.68	0.63	0.51	0.62	0.50
Frac. Informal labor	0.52	0.48	0.51	0.46	0.49
Wage	1.00	1.03	1.04	1.00	1.00
Entry threshold	1.00	1.02	1.01	1.00	0.99
Formalization threshold	1.84	1.79	1.69	1.74	1.63
Avg. productivity	1.000	1.012	1.007	0.997	0.990
Real income (welfare)	1.000	1.010	1.099	1.179	1.311

Notes: Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **-statistical significance at 5%; *-statistical significance at 10%. Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. NSS is the National Sample Survey. The Economic Census has been aggregated to the district-year level.

Appendix

A 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 Activities (person-days)

	Core			Non-core		
	(1) Log contract workers	(2) Log regular workers	(3) Contract share	(4) Log contract workers	(5) Log regular workers	(6) Contract share
Post X Treat	-0.384***	0.143***	-0.029***	-0.020	-0.082	-0.000
	(0.087)	(0.047)	(0.008)	(0.019)	(0.105)	(0.003)
Observations	165674	165674	165674	165674	165674	165674
R^2	0.794	0.853	0.809	0.614	0.803 height	0.617
Factory FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes
State-Trend	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. Core activity is any activity for which the establishment is set up, and includes other activities which are essential for the core activities. These are listed in the appendix section A. Non-core activities are the remaining peripheral activities. Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A2: Heterogeneous Impact on Prices

	(1) Log price	(2) Log price
Post X Treat	-0.271***	-0.252***
	(0.038)	(0.036)
Post X Below median	-0.124***	-0.053
	(0.028)	(0.039)
Post X Treat X Below median	0.273***	0.272***
	(0.038)	(0.041)
Observations	89861	89861
R^2	0.743	0.743
Factory FE	Yes	Yes
Year FE	Yes	Yes
Industry-year FE	Yes	Yes
State-Trend	Yes	Yes

Notes: Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for other states. Below-median wage in column (1) takes the value 1 if the firm's wage is below the median wage, and 0 otherwise. Median wage is 102.35. Below-median wage-gap in column (2) takes the value 1 if the gap between the minimum wage and the firm's wage is below the median, and 0 otherwise. Median wage gap is 43.98. Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

Table A3: Effect on Contract workers and person-days
using Neighboring States as the control group

	Persondays		Workers	
	(1) Log Contract	(2) Contract Share	(3) Log Contract	(4) Contract Share
Post X Treat	-0.463**	-0.041**	-0.131**	-0.038**
	(0.116)	(0.011)	(0.035)	(0.011)
Observations	68280	68280	68280	68272
R^2	0.779	0.786	0.802	0.786
Factory FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
State-Trend	Yes	Yes	Yes	Yes

Notes: Post is defined as 1 for years after 2003, and 0 before that. Treat is defined as 1 for Andhra Pradesh, and 0 for neighboring states of Andhra Pradesh that includes Tamil Nadu, Karnataka, Maharashtra, Orissa, and Chattisgarh. Robust standard errors clustered at the state level in parentheses; *** -statistical significance at 1%; **- statistical significance at 5%; *-statistical significance at 10%.

B Mathematical Proofs

B.1 Firms in the formal sector

Production decision of incumbents: The profit maximization problem of the incumbents in the formal sector can be broken into a two-step problem, where in the first step, firms maximise:

$$\pi_f = \max_{l_f}(1-t)pzl_f^{\rho} - w_f l_f$$

Define $w_f = \left[b_r^{1-\sigma} + b_c^{1-\sigma}\right]^{\frac{1}{1-\sigma}} w$. Taking the first order condition and solving, we get:

$$\begin{aligned}
l_f^*(z) &= \left[\frac{\rho(1-t)p}{w_f}\right]^{\frac{1}{1-\rho}} \times z^{\frac{1}{1-\rho}} \\
y_f^*(z) &= \left[\frac{\rho(1-t)p}{w_f}\right]^{\frac{\rho}{1-\rho}} \times z^{\frac{1}{1-\rho}} \\
\pi_f^*(z) &= (1-\rho)\left[\frac{\rho}{w_f}\right]^{\frac{\rho}{1-\rho}} \times ((1-t)pz)^{\frac{1}{1-\rho}}
\end{aligned}$$

Given this, the firm then choose l_r and l_c in a dual problem, given by:

$$\begin{aligned}
&\min\ wb_r l_r + wb_c l_c \\
&\text{s.t. } l_f = \left[l_r^{\frac{\nu-1}{\nu}} + l_c^{\frac{\nu-1}{\nu}}\right]
\end{aligned}$$

Let w_f, defined above, be the Lagrangian constant so that:

$$L = wb_r l_r + wb_c l_c - w_f\left[l_f - \left[l_r^{\frac{\nu-1}{\nu}} + l_c^{\frac{\nu-1}{\nu}}\right]\right] \tag{6}$$

Taking the first-order conditions with respect to l_c, l_r and w_f and solving, we get:

$$\begin{aligned}
wb_p l_p &= \frac{b_p^{1-\nu}}{b_p^{1-\nu} + b_c^{1-\nu}} \times w_f l_f^*(z) \\
wb_c l_c &= \frac{b_c^{1-\nu}}{b_p^{1-\nu} + b_c^{1-\nu}} \times w_f l_f^*(z)
\end{aligned} \tag{7}$$

From equation (7), the ratio of contract to permanent workers is given by:

$$\frac{l_c}{l_p} = \left(\frac{b_c}{b_p}\right)^{-\nu}$$

Entry decision: Let E_f be the fixed cost of entry (in units of output) into the formal sector. A firm can enter the formal sector as long as $\pi_f \geq pE_f$. This implies that there is a threshold productivity z_f^E where $\pi_f(z_f^E) = pE_f$. Rearranging the variable profit equation from above, we get:

$$z_f^E = \frac{\Big[E_f/(1-\rho)\Big]^1 - \rho}{(1-t)\Big(\rho p/w_f\Big)^\rho}$$

B.2 Incumbents in the informal sector

The profit maximization problem of the incumbents in the informal sector is straightforward and can be given by:

$$\pi_i = \max_{l_i} pzl_i^\rho - w_i l_i^\theta$$

Taking the first order condition and solving, we get:

$$l_i^*(z) = \left[\tilde{\rho} \times \frac{p}{w} \times z\right]^{\frac{1}{\theta-\rho}}$$

$$y_i^*(z) = \left[\frac{\tilde{\rho}p}{w}\right]^{\frac{\tilde{\rho}}{1-\tilde{\rho}}} \times z^{\frac{1}{1-\tilde{\rho}}}$$

$$\pi_i^*(z) = (1-\tilde{\rho})\left[\frac{\tilde{\rho}}{w}\right]^{\frac{\tilde{\rho}}{1-\tilde{\rho}}} \times (pz)^{\frac{1}{1-\tilde{\rho}}}$$

where $\tilde{\rho} = \rho/\theta$.

B.3 Cost function and probability of detection

An alternate way to present the model is to allow for a size-dependent probability of detection by the government in the informal sector. This implies that larger firms operating in the informal sector face a penalty for evading taxes. Let $\tau(l)$ be the probability of detection such that $\tau(0) = 0$, $\tau'(l) > 0$ and $\lim_{l\to\infty} \tau(l) = 1$. Therefore maximization problem of the firm can be written as:

$$\max_l (1-\tau(l))pzl^\rho - wl$$

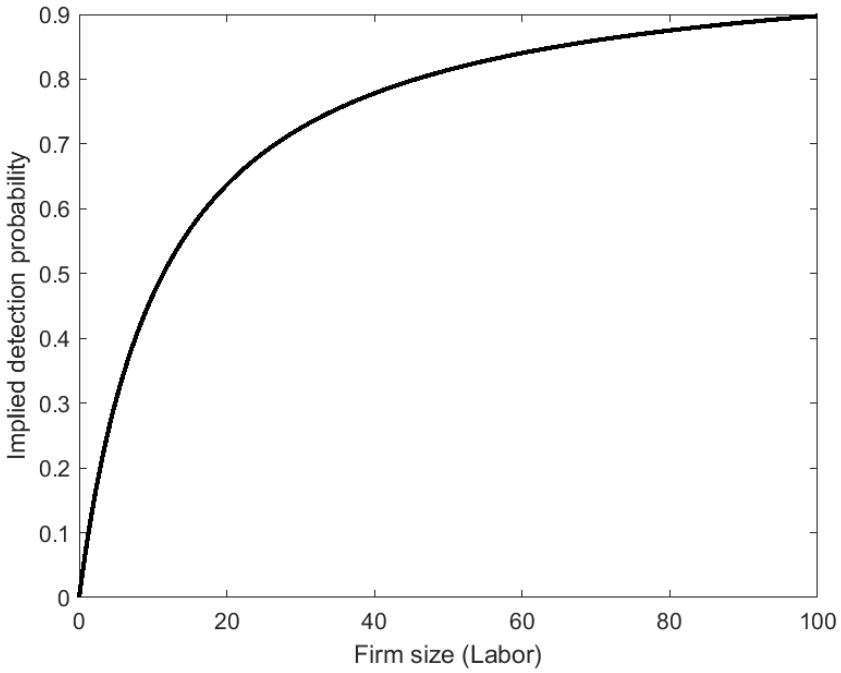
Taking the first order condition and rearranging:

$$\left[\rho\frac{(1-\tau(l))}{l} - \tau'(l)\right]pzl^\rho = w \tag{8}$$

Comparing it to the baseline model, we have:

$$\frac{\rho}{\theta l^\theta}pzl^\rho = w \tag{9}$$

Figure 6: Probability detection function



Notes: The above graph plots the probability of getting detected $\tau(l) = xl/(1+xl)$ as a function of firm-size. $x = 0.088$ is the implied value from the model calibration in the paper.

Therefore, these two can be connected through the $\tau(l)$ function. Assume $\tau(l) = xl/(1+xl)$, where x is a parameter that governs the marginal change in the probability detection as firm size increases. A larger x implies a higher probability of being detected conditional on the same firm-size (l). From the calibration exercise in the paper, we have $\rho = 0.738$ and $\theta = 1.3$ and from equations (8) and (9), this implies a value of $x = 0.088$ and a probability detection function shown in figure 6.

C Calibration Details

First, within each industry j, we use the number of firms in the informal and formal sectors, along with the variance of log-labor in the informal and formal sectors to estimate θ and σ^2. The identification stems from the fact that given our distributional assumptions, the number of firms allows us to identify the threshold productivity for entry into each sector, denoted by z_f^* and z_i^* for the formal and informal sectors respectively.

$$\frac{N_f}{M} = 1 - F(z_f^*)$$
$$\frac{N_f + N_i}{M} = 1 - F(z_i^*)$$

From the above expressions, the variance in log-labor in the formal and informal sectors will be given by:

$$Var(\ln l_f) = \frac{\sigma_f^2}{(1-\rho)^2}$$
$$Var(\ln l_i) = \frac{\sigma_i^2}{(\theta-\rho)^2}$$

where $\sigma_f^2 = Var(\ln z | z \geq z_f^*)$ and $\sigma_i^2 = Var(\ln z | z \in \{z_i^*, z_f^*\})$. We then use generalized method of moments to find the σ^2, θ that minimizes the distance between the observed and theoretical moments. Second, define r to be the ratio of contract to regular workers (that we observe in the data). Then define $\lambda \equiv (1 + r^{\frac{1-\nu}{\nu}})^{\frac{1}{1-\nu}}$. Then we can rewrite $w_f = \lambda \times b_c w$ and use the average firm size in the informal and formal sectors to calibrate the value of b_c as follows:

$$\ln b_c = \ln\left[\frac{(1-t)\theta}{\lambda}\right] + \left(\overline{\ln z_f} - \overline{\ln z_i}\right) + \left((\theta-\rho)\overline{\ln l_i} - (1-\rho)\overline{\ln l_f}\right)$$
$$b_r = r^{\frac{1}{\nu}} \times b_c$$

Lastly, we then use the zero-profit condition in the informal sector i.e. $\pi_i(z_i^*) = pE_i$ and the indifference condition in the formal sector i.e. $\pi_i(z_f^*) = \pi_f(z_f^*) - pE_r$ to calibrate the fixed cost of entry into these sectors.