Labor market policies, informality, and misallocation

Abstract

This paper constructs a theoretical model to study labor market regulations in developing countries and how it affects the allocation of resources between the less productive informal activities and more productive formal activities. When workers are risk averse and the market for insurance against labor income risk is missing, regulations that provide insurance to workers (such as severance payments) reduce misallocation. However, regulations that simply create barriers to the dismissal of workers increase misallocation and end up reducing the welfare of workers. The implications of some other issues like general regulatory burden, weak state capacity, and minimum wage regulations are analyzed as well. The paper also provides some empirical evidence broadly consistent with the theoretical results using cross-country data. While dismissal regulations increase the share of informal employment, severance payments to workers do not.

Key words: dismissal regulations, severance payments, misallocation, informal employment, minimum wage

JEL codes: O12, O17, O57, J38, J46
1 Introduction

It is commonly believed that the differences in productivity across countries are a major source of differences in per capita income and living standards. Earlier it was thought that the reason for the differences in productivity was the slow diffusion of frontier technology. However, in recent times an alternative explanation in terms of misallocation of resources across firms has acquired greater salience. Several studies, including the seminal paper by Hsieh and Klenow (2009), have shown that by reallocating resources among firms, the aggregate output can be increased significantly in developing countries.\(^2\) One manifestation of misallocation in developing countries is the large share of informal firms in employment. A predecessor of the misallocation literature is the literature on informality in developing countries (surveyed in La Porta and Shleifer, 2014) which argues that development requires a movement of resources from low productivity informal firms to high productivity formal firms. In this paper we focus on the allocation of resources between formal and informal firms. The literature on informality identifies two key causes of it.\(^3\) One has to do with taxation. That is, by remaining informal, firms can avoid taxation. The other explanation is in terms of excessive regulation. That is, firms remain informal because of onerous regulations that make it costly to become formal. One dimension of regulation that has attracted a lot of attention is with respect to labor markets. The idea is that the regulation of labor markets in developing countries can have elements, such as restrictions on firing or high minimum wages, that induce firms to avoid meeting these regulations by remaining informal/unregistered. This paper focuses on the labor market regulations without denying the importance of the taxation motive for informality.

Governments in developing countries attempt to regulate labor markets along a number of dimensions such as wages, hours of work, hiring and firing restrictions, and conditions of work.

\(^2\)See Restuccia and Rogerson (2017) for a survey of the literature on misallocation.

\(^3\)See Kanbur (2017) for a recent survey of the literature on informality.
When analyzing the desirability of any regulation, including those in the labor market, a natural question to ask is if the benefits of these regulations exceed the cost. This immediately suggests the need to develop a framework which will allow us to analyze the optimality of different labor market regulations. The standard framework to study labor market regulations in developed countries is a one sector model that analyzes how a regulation affects the demand and supply for labor, and consequently the aggregate output (e.g. Summers (1989)). This may not be appropriate in a developing country context, however. An important feature of developing countries is that a large fraction of the workforce is employed in informal/unorganized firms and as mentioned earlier⁴, it is commonly believed that the excessive regulation of labor markets is one of the key factors preventing resources from moving to more productive formal firms. The aim of this paper is to provide an analytical framework to analyze labor market regulations in developing countries and study how they affect the allocation of resources between informal and formal firms. In addition, it also provides some suggestive empirical evidence broadly consistent with the theoretical results.

In most theoretical works dealing with labor market policies, to be discussed later, workers are assumed to be risk neutral, in which case there is no role for social protection. Policies such as employment protection or unemployment insurance are viewed as distortionary by either raising the cost for employers or reducing the job search incentives for workers. Such models clearly understate the benefits of labor market regulations because if workers are risk neutral there is no need to insure them against labor market risk through social protection. Therefore, we construct a theoretical framework with two key features: risk averse workers and the existence of an informal sector. These two features allow us to study labor market regulations in a developing country context. Another feature of our model is job destruction by firms. This allows us to study labor market policies relating to the firing of workers.

⁴National Commission on Employment in the Unorganized Sector found that in 2004-05, out of a total employment of 455.7 million workers in the Indian economy, 393.3 million were in the informal sector (Kanbur (2017)). According to Ghani, Kerr and O’Connell (2013), the employment share of the unorganized sector in Indian manufacturing has remained at around 81% between 1989 and 2005.
In our model, there is a mass of entrepreneurs with heterogeneous entrepreneurial ability who can set up a firm in the informal sector using a simple technology with diminishing returns. Alternatively, they can set up a firm with a more sophisticated technology in the formal sector after meeting an entry cost. There is a mass of risk averse but homogeneous workers who can work in either sector. While workers have identical productivity in the informal sector, the productivity in the formal sector is match-specific. Firms in the formal sector commit to a level of wage in advance (similar to the competitive search literature) and hence dismiss workers with very low match-specific productivity. This is a way to capture endogenous job destruction in a static model and is similar in spirit to the framework of Blanchard and Tirole (2008). Workers who are dismissed in the formal sector can go back and take up a job in the informal sector, but they lose some time and income in doing so and hence earn less than those workers who took up a job in the informal sector to begin with. In equilibrium, workers are indifferent between getting a job in the formal sector with a risk of getting fired or in the informal sector with a guaranteed but low paying job. Therefore, wages are necessarily higher in the formal sector.

To see the role played by risk aversion in driving the results, we first derive results for the benchmark case of risk neutral workers. It is shown that if workers are risk neutral then the decentralized outcome is production efficient. That is, resources are efficiently allocated between the formal and informal firms. However, when risk averse workers face the risk of unemployment in the formal sector and markets for insurance against labor income risk are missing, the decentralized outcome is not efficient. There is misallocation of resources between the two sectors and the informal sector is too large compared to the production efficient case. As well, both the employment in the formal sector and aggregate output are decreasing in the risk aversion of workers.

Introducing policies that provide insurance to risk averse workers reduces misallocation. It is shown that if the government can mandate severance payments to dismissed workers, both the aggregate output and the amount of labor employed in the formal sector increase. Alternatively, an unemployment insurance program funded by a layoff tax achieves the same outcome. While the two are equivalent theoretically, one or the other may be superior in practice. Mandated
severance payments may suffer from non-compliance, either willful or because of the inability of a firm to pay it during crises. In this case, unemployment insurance funded by a layoff tax may be preferable. The U.S. unemployment insurance program with experience rated contribution has this feature. The downside of state provided unemployment insurance is that it may run into weak state capacity.

Since workers are facing the risk of unemployment, one may be tempted to conclude that a policy that reduces job destruction in the formal sector would be welfare improving. Employment protection policies that make it difficult for firms to dismiss workers would be one such policy. It turns out that such policies are counter-productive. While they reduce dismissals by firms in the formal sector, they end up worsening the existing distortion arising from the risk aversion of workers and consequently reduce aggregate output. Therefore, while the provision of unemployment insurance can reduce misallocation, dismissal restrictions that create administrative hurdles for dismissal increase misallocation.

It is also shown that an increase in regulatory burden that makes it costly for firms to enter the formal sector reduces the size of the formal sector in addition to reducing aggregate output. Finally, the model is extended to study the implications of minimum wage regulations in this setting. A binding minimum wage in the formal sector reduces the resources going to the formal sector thereby increasing misallocation. However, output and worker welfare increase initially before decreasing. Since the job destruction in the baseline model is sub-optimally low, a binding minimum wage increases job destruction which is a source of gain. However, this is offset by the distortionary effect of minimum wage on the profit of entrepreneurs. A binding minimum wage reduces the profit in the formal sector, and hence, the mass of entrepreneurs in the formal sector is decreasing in minimum wage. The latter effect starts dominating soon, and it turns out that a binding minimum wage doesn’t achieve production efficiency in the model.

In addition to the theoretical model, the paper also provides some empirical evidence on the relationship between labor market regulations and the share of informal employment using cross-country data. The share of informal employment is obtained from the ILO’s Key Indicators of the Labor Market (KILM) database while the measures of labor market regulations are obtained
from the dataset developed by the Centre for Business Research, University of Cambridge. The key empirical result is that stricter dismissal regulations and higher minimum wages increase informality but more generous severance payments do not. These empirical results are broadly consistent with the theoretical results.

The remainder of the paper is organized as follows. The next section provides a brief survey of the related literature. Section 3 sets up the baseline model and derives the decentralized equilibrium. Section 4 sets up the planner’s problem to study the efficiency properties of the decentralized outcome. Section 5 studies labor market regulations which is followed by empirical evidence in Section 6. Section 7 provides concluding remarks.

2 Related Literature

There is a large literature on the determinants of informality. Below we discuss only a handful of papers where labor market institutions play a key role in determining the extent of informality.

Fugazza and Jacques (2003) construct a theoretical model where the informal sector doesn’t comply with regulations and tax contributions. Workers face a subjective cost of working in the informal sector. There is directed search by workers, and therefore, workers with low subjective cost work in the informal sector while those with high cost work in the formal sector. In equilibrium, firms are indifferent between opening vacancies in the two sectors. The key result is that an increase in tax or social security contributions increases informality while increased enforcement reduces informality.

In Zenou (2008) there are two sectors: formal with search frictions and informal with competitive wages. Workers are identical and freely mobile between the two sectors. In the informal sector there is diminishing returns to labor which makes the supply of labor to each sector endogenous. In addition to the search frictions, the formal sector has an entry cost or vacancy cost and unemployment benefits. The paper performs comparative statics with respect to unemployment benefits, hiring costs etc. and finds that increases in unemployment benefits or hiring costs increase the incidence of informality.
In De Paula and Scheinkman (NBER, 2007) agents choose to become a formal sector entrepreneur or an informal sector entrepreneur or a worker. Agents differ in their entrepreneurial ability. Firms in both sectors hire capital and the cost of capital is lower for formal sector firms but they also have to pay a tax. Informal entrepreneurs can evade taxation but they are caught with a positive probability in which case the entire output is seized. The probability of getting caught depends on the size of capital. Therefore, firms requiring more capital are in the formal sector while others are in the informal sector. The highest ability entrepreneurs set up firms in the formal sector, middle ability entrepreneurs in the informal sector and those with lowest entrepreneurial ability decide to become workers. The authors perform comparative static exercises with respect to the rate of taxation and the rate of interest.

Albrecht et al. (2009) introduce ex-ante worker heterogeneity with respect to worker productivity in the formal sector and only high productivity workers work in the formal sector while others work in the informal sector. There is exogenous job destruction in the informal sector as in a standard Pissarides model but the job destruction is endogenous in the formal sector in response to an idiosyncratic productivity shock. Firms have to pay a severance tax in the formal sector in addition to a payroll tax. Severance tax increases average employment duration in the formal sector, reduces overall unemployment, reduces the number of formal sector workers, and reduces the number of workers who accept any type of offer. A payroll tax reduces average employment duration in the formal sector, reduces the number of formal sector workers and increases the size of the informal sector and the number of workers accepting any type of offer. Total unemployment rises. Severance tax decreases average productivity while the payroll tax increases it, but under both policies, net output falls.

In Bosch and Esteban-Pretel (2012) formal employment contracts involve a hiring cost, payroll tax, and a firing tax upon job destruction while informal jobs do not incur these costs but are destroyed at a higher rate. Informal jobs are also subject to government monitoring. They are detected with some probability in which case the job is destroyed and a fine is paid. Informal workers are allowed on the job search for a formal job. Informal jobs arise because for some low productivity matches it is optimal for firms and workers to establish an informal
relationship that circumvents formal regulations. Ongoing formal and informal matches draw new idiosyncratic productivity at differential rates (the rate being higher in the informal sector accounting for the higher job destruction there.) In this setting policies that decrease the cost of formal jobs, or increase the cost of informality, raise the share of formal employment while reducing unemployment.

In Meghir et al. (2015) firms in the formal sector are subject to corporate tax on profits, social security contributions for their workers and severance payments upon laying them off, and have to pay a minimum wage. Workers in the formal sector are subject to income tax and are eligible for unemployment insurance funded by taxes. Firms in the informal sector are monitored and if caught pay a fine. Firms differ in their productivity, post a wage and choose a sector in which to post vacancies. Workers are homogeneous and meet with firms randomly and accept or reject the wage offer. It is shown that tighter enforcement leads to less informality and higher output.

Ulyssea (2018) brings a new dimension to the informality literature by distinguishing between the extensive and intensive margins of informality. In his theoretical model, even formal firms can choose to hire labor informally. This is the intensive margin of informality which supplements the standard extensive margin which is the hiring of labor by formal firms. Different policies have different effects on the aggregate incidence of informal employment. For example, reducing the cost of entering the formal sector increases the mass of formal firms but informal employment may not decrease because many low productivity firms who enter the formal sector prefer to hire through informal contracts. All workers get the same wage in his framework and there is no job destruction by firms and hence there is no discussion of policies like unemployment insurance or severance payments.

While several of the papers discussed above study informality in a much richer framework than in the present paper, these studies either do not model job destruction by firms and hence cannot talk about employment protection related policies or if they allow for job destruction as in Meghir et al. (2015), then workers are risk neutral in which case there is no need for employment protection. That is, while several papers in the literature examine the role of employment
protection policies on informality and aggregate output, the rationale for employment protection (risk aversion with missing insurance market) is missing in these studies. Hence, it is difficult to carry out a normative exercise involving employment protection policies.

One exception is Bennett et al. (2012), which provides a theoretical model where workers are risk averse and choose between formal employment, informal employment and self employment. In contrast to our model, they assume the formal employment to be risk free while the other two are risky. Since there is no risk in the formal sector, there is no role for policies like unemployment insurance and severance payments which is the main focus of our paper.

Our theoretical model also bears similarity to an older influential paper by Khilstrom and Laffont (1979). In their model more risk-averse agents become workers while those with low risk aversion become entrepreneurs. Consistent with Khilstrom and Laffont (1979), in our setting workers are risk averse and entrepreneurs are risk neutral. What is needed for the results is that workers are more risk averse than entrepreneurs.

As far as the empirical evidence on the impact of labor regulations on informality is concerned, Chatterjee and Kanbur (2014) use firm level data from the Annual Survey of Industry (ASI) and National Sample Survey Organisation (NSSO) to study informality in India. While the ASI data captures firms registered under the Factories Act — which requires firms with more than 10 workers to be registered — the NSSO data is a survey of unregistered firms. Any firm in the NSSO data with 10 or more workers is non-compliant with the Factories Act. There may also be some NSSO firms with 9 workers who stay small and informal precisely to evade regulations. The authors find that the NSSO firms with employment of 9 or more workers constitute 2% of all firms and 11% of employment.5

Djankov and Ramalho (2009) provide a survey of the cross-country studies on the impact of labor regulations on informality following the influential paper by Botero et al. (2004). The key finding is that developing countries with more onerous labor regulations tend to have larger

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5The NSSO firms with 10 or more workers account for 1.5% of all firms and 9.8% of employment. Therefore, the number of firms that are non-compliers is much larger than the number that keep their size low to avoid regulations.
informal sectors. A key difference in our empirical exercise is in terms of the outcome variable of interest — a measure of informal employment in our case rather than the size of the informal sector in economic activity in these studies and other indicators (such as labor force participation and unemployment rates). Also, while we use actual data on informal employment, Botero et al. (2004) measure of the size of the informal sector is based on the opinion of experts who are asked to measure the size of the informal sector in their country. More substantively, our contribution to this literature lies in making the point that not all labor regulations are the same. In particular, the implications of unemployment insurance/severance payments for informality and structural transformation can be very different from administrative hurdles to dismissals.

3 The Model

Below we write down a simple model that will allow us to study the role of labor market policies such as unemployment insurance and severance payments. Since these policies are not required if workers are risk neutral, we assume workers to be risk averse. Also, since these policies are available to workers in the formal sector, in our model the income of workers in the formal sector is going to be uncertain, thereby creating a role for these policies. This is not to deny that labor income in the informal sector could be uncertain as well as is modeled in Bennett et al.(2012), but we focus on policies such as unemployment insurance which are available to formal sector workers. The model also abstracts from an empirically relevant phenomenon of formal forms hiring workers through an informal contract as in the model of Ulyssea (2018). As will be seen below, formal firms are merely compensating workers for bearing the risk of unemployment. There is no additional labor cost for formal firms that would incentivize them to use informal contracts to hire workers. Also, our model below allows us to study the implications of labor market policies on employment both at the intensive and extensive margins. That is, the number of firms in each sector as well as the amount of labor hired by firms are going to respond to policies.

There are two sectors in the economy: a formal sector with a sophisticated production
function and an informal sector with a simpler production function. The mass of workers is given by $L$. Workers can work in either of the two sectors. Workers are risk averse and their utility function is given by $U(c)$, with $U'(c) > 0$ and $U''(c) < 0$.

There is a unit mass of entrepreneurs with the distribution of entrepreneurial ability given by $G(\varphi)$ distributed over $[\underline{\varphi}, \overline{\varphi}]$. Entrepreneurs are risk neutral and decide whether to set up a firm in the formal sector or informal sector. Firms in the formal sector face a fixed cost of $F$. A part of this fixed cost could arise from meeting the regulatory requirements of the state (the so-called cost of formalization). The other part of the fixed cost should be thought of as the cost of using a more sophisticated technology. Therefore, in our setting informality can arise both due to regulatory burden and the unprofitability of modern technology for low ability entrepreneurs. Also, labor market policies are going to affect the allocation of resources at both the intensive and extensive margins, that is the mass of firms as well as the amount of labor hired by the firms is affected by policies.

The production function in the informal sector is given by

$$Z_i(\varphi) = B' \varphi^{1-\gamma} L_i(\varphi)^\gamma; \ 0 < \gamma < 1$$

(1)

where $B'$ captures the general productivity of the informal sector and is given by $B' = B 1 - \gamma \overline{\gamma}$ where $\gamma' \equiv \gamma(1 - \gamma)^{1-\gamma}$. The normalization of the constant productivity term in the above fashion reduces notational clutter. $\varphi$ is the entrepreneurial ability. $0 < \gamma < 1$ captures the diminishing returns to labor and allows for a determinate firm size. The wage in the informal sector is $w_i$ which is determined competitively. Denote the profit of an entrepreneur in the informal sector by $\pi_i(\varphi)$.

The optimal choice of labor for an informal sector firm is given by

$$L_i(\varphi) = \frac{\gamma}{1 - \gamma} \varphi B w_i^{\frac{1}{1-\gamma}}. \quad (2)$$

The profit of an informal sector entrepreneur with ability $\varphi$ is given by

$$\pi_i(\varphi) = B' \varphi^{1-\gamma} L(\varphi)^\gamma - w_i L_i(\varphi) = \varphi B w_i^{\frac{\gamma}{1-\gamma}}. \quad (3)$$

Clearly, $\pi_i(\varphi)$ is increasing in $\varphi$ and decreasing in $w_i$. 


The formal sector production function is more complicated. Firms pay a fixed cost, $F$, which covers the cost of formalization as well as investment in machinery which makes these firms more productive than informal firms. While all workers have the same productivity in the informal sector, worker productivity is match specific in the formal sector. Once a firm hires a worker the match-specific productivity is revealed. Denote the match-specific productivity of a worker by $\lambda$ which is drawn from a uniform distribution over $[0, 1]$. Once the match-specific productivity of a worker is revealed, the firm can decide whether to retain the worker or fire them. If firms use a cutoff rule whereby they retain workers with productivity above $\lambda_c$ and fire others, then the average productivity of retained workers is $\frac{1+\lambda_c}{2}$. If they hire $L_f$ workers then they retain $(1 - \lambda_c)L_f$ of them, and hence the amount of labor in efficiency units that is used in production is

$$L^e = \frac{1 - \lambda_c^2}{2} L_f.$$  

(4)

The production function is

$$Z(\varphi) = A' \varphi^{1-\gamma} (L^e)^\gamma = A' \varphi^{1-\gamma} \left(\frac{1 - \lambda_c^2}{2}\right)^\gamma L_f(\varphi)^\gamma.$$  

(5)

where $A'$ is the common productivity term and we use the normalization $A' = \frac{A_{1-\gamma}}{\gamma}$. $\varphi$ is the manager specific productivity term.

If a worker is fired by a formal sector firm, the worker can go back to the informal sector and take up a job there. However, there is a loss of income compared to the workers who decided to work in the informal sector in the first place. This loss can be thought of as the time lost in moving back to the informal sector.\(^6\) We capture this using a parameter $\delta$. That is, instead of offering one unit of labor in the informal sector, the fired worker offers only $\delta$ ($0 < \delta < 1$) units of labor and therefore, gets a wage of $\delta w_i$. The expected utility from participating in the

\(^6\)Several recent papers (e.g. Bosch and Maloney (2010), Bosch and Esteban-Pretel (2012)) have found workers transitioning back and forth between formal and informal employment in developing countries. We capture this in our framework by allowing the fired workers in the formal sector to seek employment in the informal sector. Also, since workers are not tied to any sector, in response to an exogenous shock there will be a reallocation of workers between the formal and informal sectors.
formal sector must at least be as high as the utility from working in the informal sector from the beginning: $U(w_i)$.

A formal sector firm announces a contract $(w_f, \lambda_c)$ which must satisfy the following participation constraint of workers.

$$
(1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) \geq U(w_i).
$$

That is, a worker expects to get a wage of $w_f$ with probability $1 - \lambda_c$ and with probability $\lambda_c$ (in the event that the worker is dismissed) the worker gets $\delta w_i$.

Ideally, job destruction should be modeled in a dynamic framework where workers are hired at some initial productivity and then their productivity changes due to a shock which may result in firing. However, a dynamic model with risk averse workers gets very complicated, and hence we use a static approach to modeling job destruction similar in spirit to the approach of Blanchard and Tirole (2008).\(^7\)

Now, an entrepreneur in the formal sector solves the following maximization problem:

$$
\begin{align*}
\max_{L_f(\varphi), w_f, \lambda_c} & \quad A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} L_f(\varphi)^{\gamma} - (1 - \lambda_c)w_fL_f(\varphi) \\
\text{s.t.} & \quad (1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) \geq U(w_i)
\end{align*}
$$

As is shown later, the optimal choices of $w_f$ and $\lambda_c$ are independent of the firm productivity $\varphi$, while the amount of labor, $L_f$, is not, and therefore, to reduce notational clutter we write $L_f(\varphi)$ but not $w_f(\varphi)$ and $\lambda_c(\varphi)$. Denoting the Lagrangian multiplier associated with the constraint by $\varrho$, the first order conditions are

$$
\begin{align*}
L_f(\varphi) & : \quad A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} L_f(\varphi)^{\gamma-1} = (1 - \lambda_c)w_f, \\
w_f & : \quad -(1 - \lambda_c)L_f(\varphi) + \varrho(1 - \lambda_c)U'(w_f) = 0, \\
\lambda_c & : \quad -A' \varphi^{1-\gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma-1} L_f(\varphi)^{\gamma} = \varrho(U(w_f) - U(\delta w_i)) - w_fL_f(\varphi).
\end{align*}
$$

Using (8) write (9) as

$$
A' \varphi^{1-\gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma-1} L_f(\varphi)^{\gamma-1} = w_f - \varrho
$$

\(^7\)Ranjan (2016) uses a similar model to study the implications of offshoring when workers are risk averse.
where $\psi \equiv \frac{U(w_f) - U(\delta w_i)}{U'(w_f)}$. Also note that the participation constraint will be satisfied with equality for a profit maximizing firm. That is, in equilibrium, the participation constraint is

$$(1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) = U(w_i)$$  

(11)

Since the risk aversion of workers plays a key role in the paper, it is worth clarifying its role in the firm choice of $\lambda_c$, the optimal firing threshold. For a given amount of labor, $L_f(\varphi)$, that a firm decides to hire, (10) gives the optimal choice of $\lambda_c$. It is easy to verify that the left hand side of (10) is increasing in $\lambda_c$. Next, note that if workers are risk neutral, then $w_f - \psi = \delta w_i$. For risk averse workers, however, $U'' < 0$ implies that $w_f - \psi < \delta w_i$. Therefore, the optimal choice of $\lambda_c$ in the case of risk neutral workers is higher than in the case of risk averse workers. Another way to understand this is the following. Firms in our set up are minimizing the cost of hiring an efficiency unit of labor through their choices of $w_f$ and $\lambda_c$. Given the definition of efficiency unit of labor in (4), the cost of hiring an efficiency unit of labor is $\frac{w_f}{\lambda_c}$ where $\lambda_c = \frac{1 + \lambda_c}{2}$ is the average productivity of a retained worker. That is, firms want to choose a lower $w_f$ and a higher $\lambda_c$. Essentially, firms are minimizing $\frac{w_f}{\lambda_c}$ subject to (6). Clearly, when workers are risk averse, it is costlier to choose a large $\lambda_c$ because the additional compensation that workers need to bear the risk becomes higher. We can formally establish the following lemma. (proof in the appendix)

Lemma 1: When workers are risk averse, the optimal choice of firms involves a lower $\lambda_c$ than when workers are risk neutral. Also, the greater the risk aversion, the lower the $\lambda_c$.

Coming back to the description of equilibrium, for a formal sector firm with productivity $\varphi$ the 3 endogenous variables $L_f, w_f$, and $\lambda_c$ are determined by (7), (10), and (11). Note that (7) and (10) imply

$$\frac{1 + \lambda_c}{2\lambda_c} = \frac{w_f}{w_f - \psi}. \quad (12)$$

Equations (11) and (12) determine $w_f$ and $\lambda_c$ independent of firm productivity, $\varphi$. That is, each formal sector firm offers the same $(w_f, \lambda_c)$ contract. The amount of labor hired by a formal sector firm is

$$L_f(\varphi) = \frac{\gamma}{1 - \gamma} \varphi A \left( \frac{1 - \lambda_c^2}{2} \right)^{1-\gamma} ((1 - \lambda_c)w_f)^{\frac{1}{1-\gamma}}$$  

(13)
Thus, in the model a high productivity firm is larger but pays the same wage and has the same firing threshold.

Denote the profit gross of the fixed cost of operations of a formal sector firm by $\pi_f(\varphi)$, which is given as follows.

$$\pi_f(\varphi) = \varphi A \left( \frac{w_f}{\bar{\lambda}_c} \right)^{\frac{\gamma}{\gamma - 1}}, \quad (14)$$

where recall that $\bar{\lambda}_c \equiv \frac{1 + \lambda_c}{2}$ is used to denote the average productivity of an employed worker and $\frac{w_f}{\bar{\lambda}_c}$ is the cost of an efficiency unit of labor. Comparing the expression for profit in the informal sector in (3) to the above expression note the similarity. The difference is that $\frac{w_f}{\bar{\lambda}_c}$ is the productivity adjusted wage in the formal sector which captures the effective labor cost for firms because workers have a match specific productivity. The net return from entrepreneurship in the formal sector is $\pi_f(\varphi) - F$. We assume that the parameters are such that an interior equilibrium exists with employment in both sectors. In this case, the marginal entrepreneur with entrepreneurial ability $\varphi^* \in (\varphi, \overline{\varphi})$ is indifferent between setting up a firm in the formal sector or in the informal sector, and this indifference condition is given by

$$\pi_f(\varphi^*) - \pi_i(\varphi^*) \equiv \left( A \left( \frac{w_f}{\bar{\lambda}_c} \right)^{\frac{\gamma}{\gamma - 1}} - Bw_i^{\frac{\gamma}{\gamma - 1}} \right) \varphi^* = F. \quad (15)$$

Note that in the above equation $\frac{w_f}{\bar{\lambda}_c}$, $w_i$, and $\varphi^*$ are all endogenous variables. In particular, if we think of $\varphi^*$ as the equilibrium cutoff, then $\frac{w_f}{\bar{\lambda}_c}(\varphi^*)$ is the corresponding equilibrium value of $\frac{w_f}{\bar{\lambda}_c}$ and $w_i(\varphi^*)$ is the equilibrium value of $w_i$. In the appendix we obtain the parametric restrictions under which an interior equilibrium exists with employment in both sectors.

Given the above set up, it is the fixed cost of setting up business in the formal sector combined with the existence of low productivity entrepreneurs that generates informality. As mentioned earlier, a part of the fixed cost is technological and a part could be regulation related. To see things clearly, suppose $F_t$ is the technology related fixed cost, say the cost of buying a sophisticated machine which allows the business to operate with higher productivity $A$ rather than the lower productivity of the informal firms, $B$. Denote the regulatory component of the fixed cost by $F_r$, which is a policy related variable. Now, even if policymakers set $F_r$ to zero, there will still be informality because $F_t > 0$. That is, for some low ability entrepreneurs it does
not pay to incur the fixed cost, $F$, and become formal.\footnote{It is worth pointing out that we are implicitly assuming that all entrepreneurs can finance the fixed cost of setting up a formal firm, $F$. In reality, borrowing constraints could prevent some high ability entrepreneurs from accessing funds to set up a formal sector firm. In this case, borrowing constraints will give rise to informality. Since our focus is on labor market issues, we abstract from borrowing constraints.}

The mass of workers who get hired in the formal sector is

$$L^F = \int_{\varphi}^{\bar{\varphi}} L_f(\varphi) dG(\varphi), \quad (16)$$

where $L_f(\varphi)$ is given in (13). As is clear from the discussion earlier, only $(1 - \lambda_c)L^F$ of these workers will be retained by firms in the formal sector while $\lambda_cL^F$ will be fired.

The total employment in the informal sector is given by

$$L^I + \lambda_c \delta L^F = \int_{\varphi}^{\bar{\varphi}} L_i(\varphi) dG(\varphi), \quad (17)$$

where $L_i(\varphi)$ is given by (2). In above, $L^I$ is the mass of workers who work in the informal sector from the beginning supplying one unit of labor each and $L^F$ is the mass of workers who first get hired in the formal sector, but a fraction $\lambda_c$ of them will be fired and they will end up offering $\delta$ units of labor in the informal sector. This also implies that the amount of unemployment is given by $\lambda_c(1 - \delta)L^F$.

Since the total amount of labor in the economy is $\bar{L}$, the following must be true.

$$L^I + L^F = \bar{L} \quad (18)$$

The model above has the following endogenous variables: $w_f, \lambda_c, w_i, \varphi^*, L^I$, and $L^F$. They will be functions of the exogenous variables: $A, B, F$, and $\bar{L}$. Equations (11), (12), (15), (17), (16), and (18) determine the 6 endogenous variables of interest.

Denote the aggregate output in the informal sector by $Z^I$ and the aggregate output in the formal sector by $Z^F$. Net output for the economy, which is our measure of production efficiency, is given by

$$Y = Z^I + Z^F - (1 - G(\varphi^*))F, \quad (19)$$
where the last term is the fixed cost of formal sector firms.

In the comparative statics below our variables of interest will be the net output, $Y$, the mass of workers who get hired in the formal sector, $L^F$, the rate of job destruction, $\lambda_c$, the mass of workers who remain employed in the formal sector, $(1 - \lambda_c)L^F$, the share of entrepreneurs in the formal sector, $(1 - G(\varphi^*))$, unemployment, $\lambda_c(1 - \delta)L^F$, and the welfare of workers, $U(w_i)$.

Before moving to a discussion of policies, we first set up the planner’s problem below to highlight the role of risk aversion of workers.

### 4 Efficiency properties of decentralized equilibrium

#### 4.1 Planner’s Problem

To show how the risk aversion of workers combined with a missing market for insurance against labor income risk creates production inefficiency in the economy we set up the problem for a planner who is interested in maximizing the aggregate output in (19). The planner can freely allocate both labor and entrepreneurs to the two sectors to maximize aggregate output. The planner recognizes the limited span of control of entrepreneurs (diminishing returns to labor) and also the fixed cost, $F$, that each entrepreneur has to incur to start a business in the formal sector. The planner undertakes the following maximization exercise.

$$
\max_{\lambda_c(\varphi), L_f(\varphi), L_i(\varphi), \varphi^*} \left\{ \begin{array}{l}
B' \int_{\varphi^*}^{\varphi^*} \varphi^{1-\gamma} L_i(\varphi)^\gamma dG(\varphi) + A' \int_{\varphi^*}^{\varphi^*} \left( \frac{1 - \lambda_c(\varphi)}{2} \right)^{\gamma} \varphi^{1-\gamma} L_f(\varphi)^{\gamma} dG(\varphi) \\
-(1 - G(\varphi^*))F + \mu (\overline{L} - L^I - L^F)
\end{array} \right\}
$$

In setting up the planner’s problem we are implicitly assuming that the planner can appropriately incentivize workers to work in either sector. This can be achieved by ensuring that workers get the same expected utility from working in either sector. The details of the planner’s maximization exercise are given in the appendix. It is shown that the solution to the planner’s problem corresponds to the decentralized outcome when workers are risk neutral. Therefore, we conclude that in the baseline model the misallocation in the decentralized case arises due to the risk aversion of workers. Later we also show that the decentralized equilibrium corresponds to the planner’s problem if firms can credibly offer severance payments to fired workers.
4.2 Inefficiency of decentralized equilibrium

While we have proved analytically that when workers are risk averse, the decentralized outcome is production inefficient, we have not answered the question of the direction of inefficiency: Are there too many workers in the formal sector or too few workers? Lemma 1 showed analytically that the firm level optimization implies a negative relationship between the degree of risk aversion and the firing threshold. Starting with the case of risk neutral workers, suppose we introduce a little risk aversion in their utility. Now, at the wage that obtains in the informal sector in an equilibrium in the risk neutral case, firms will lower $c$. Since risk aversion makes it more costly for formal sector firms to hire workers, their hiring will decrease as well as their profitability. This would mean fewer firms in the formal sector as well as fewer workers affiliated with the formal sector. We verify these results below numerically.

In Figure 1 as well as in all other numerical examples in the paper we assume a CRRA utility function of the following form: $U(x) = \frac{x^{1-\rho} - 1}{1-\rho}$ where $\rho$ is the risk aversion parameter. We vary $\rho$ from 0 (the risk neutral case) to 1.4. The other parameters in the numerical examples are as follows:

$L = 1; A = 8; B = 1; \gamma = 2/3; \delta = .5; F = .75; \varphi \sim Uniform[0, 1].$

Figures 1a-1d, respectively, verify that the aggregate net output, worker welfare, unemployment, and the share of entrepreneurs in the formal sector are decreasing in the degree of risk aversion. Figure 1b verifies that worker welfare is decreasing as is the share of the workforce in the formal sector. Figure 1e verifies that the rate of job destruction, $\lambda_c$, is decreasing in risk aversion. Figure 1e verifies that the mass of workers hired in the formal sector, $L^F$, is decreasing in risk aversion. Finally, Figure 1g shows that the mass of labor retained in the formal sector, $(1 - \lambda_c) L^F$ is also decreasing in risk aversion even though the two components, $(1 - \lambda_c)$ and

---

9In subsequent numerical exercises we hold the value of the risk aversion parameter, $\rho$, at unity. Gandelman and Hernandez-Murillo (2014) estimate risk aversion for 75 countries and conclude that the coefficient of relative risk aversion varies closely around 1. Among the 52 developing countries in their sample, they reject the null hypothesis that the coefficient of relative risk aversion equals 1 only in 10 countries.
\(L^F\), move in opposite directions. Since the total employment in the informal sector can be written as \(L - (1 - \lambda_c)L^F - \lambda_c(1 - \delta)L^F\), and we have verified that the mass of retained workers, \((1 - \lambda_c)L^F\), and unemployment, \(\lambda_c(1 - \delta)L^F\), both decrease, the total amount of labor supplied to the informal sector increases with risk aversion. Note that in Figure 1 the planner’s outcome corresponds to the risk neutral outcome (where \(\rho = 0\)).

Intuitively, when workers are risk averse and markets for insurance are missing, firms have to pay workers a higher wage to meet their reservation utility given that formal sector workers have to bear the risk of unemployment. Essentially, dismissing risk averse workers is costly for firms. Since a planner maximizing aggregate output is unconstrained by the workers’ reservation utility, the production efficient level of \(\lambda_c\) chosen by the planner is higher than the level that obtains in a decentralized equilibrium. Risk aversion of workers also reduces the profitability of firms in the formal sector leading to fewer entrepreneurs and workers in the formal sector. That is, risk aversion in our set up causes misallocation of resources across sectors, which is a key result of the paper.

So far we have not allowed firms to offer severance payments voluntarily. We have restricted the contracts offered by the firms in the formal sector to a \((w_f, \lambda_c)\) pair. What if firms can offer severance payments voluntarily or if the government mandates severance payments? We verify below that production efficiency can be attained through severance payments.

\footnote{The results shown in figure 1 are not sensitive to any particular parametric configuration. We have tried many different parametric configurations involving different ratios of productivity between the two sectors \((A/B)\), different costs of entry, \(F\), and different share parameters, \(\gamma\), and they all confirm the pattern shown in figure 1. Also, while \(A = 8\) and \(B = 1\) may give the impression that the productivity in the formal sector is 8 times that in the informal sector, recall from (1) and (5) that the scalar productivity terms in the two production functions are \(\frac{d^f}{B^f} = \left(\frac{A}{B}\right)^{1-\gamma}\) which for a \(\gamma = \frac{2}{3}\) implies \(\frac{d^f}{B^f} = 2\).}
5 Labor Market Regulations

5.1 Severance payments

Suppose firms can offer severance payments voluntarily. This takes the form of a payment, \( s \), to each dismissed worker. So, firms offer a contract \((w_f, s, \lambda_c)\) where \( s \) is the severance payment promised to each dismissed worker. Now, the firms in the formal sector will do the following maximization exercise:

\[
\begin{align*}
\max_{L_f(\varphi), w_f, \lambda_c, s} & \quad \left\{ A' \varphi^{1-\gamma} \left( \frac{1-\lambda_c^2}{2} \right) \gamma \right. \\
& \quad \left. L_f(\varphi)^\gamma - (1-\lambda_c)w_f L_f(\varphi) - \lambda_c s L_f(\varphi) \right\} \\
\text{s.t.} & \quad (1-\lambda_c)U(w_f) + \lambda_c U(s + \delta w_i) \geq U(w_i)
\end{align*}
\]

The details of the maximization exercise are provided in the appendix. It is shown that the optimal choice of severance payments by firms is characterized by \( w_f = s + \delta w_i \). In addition, since the participation constraint always binds, \( w_f = w_i \) and \( s = (1-\delta)w_i \). That is, firms fully insure workers against unemployment risk. A consequence is that optimal severance payments ensure production efficiency or achieve the outcome obtained in the planner’s problem. Intuitively, the key distortion in the baseline model discussed earlier is the lack of insurance for risk averse workers. Since severance payments involve a transfer from risk neutral firms to risk averse workers, they are efficiency enhancing. More generally, severance payments by firms are going to reduce the misallocation of resources.

If firms have an incentive to offer severance payments voluntarily, why is there a need for a mandate? If firms suffer from a credibility problem, a promise to make severance payments in the future in exchange for lower wages now may not be credible. If there are credibility problems associated with a firm’s promise, then a government mandate can have a role. In this case, if the government mandates severance payments at the appropriate level, production efficiency will be restored and misallocation will be eliminated.

Figure 2 shows the impact of a mandated severance payment on the labor market outcomes of interest. The relationship between severance payments and the labor market outcomes of interest is non-linear. In Figures 2a-g the labor market variables of interest increase with severance
payments and then they start decreasing beyond a point. The turning point comes at the level of severance payments that fully insures workers and is also the production efficient level of severance payments. Any severance payments in excess of this is counter-productive.

It is worth pointing out that a nonlinear relationship obtains between unemployment and the level of severance payments as well as is shown in Figure 2c. Note that the impact on unemployment, measured by $\lambda_c(1 - \delta)L_f$, is a composite effect of changes in the share of labor in the formal sector and the rate of job destruction. As shown in Figures 2e and 2f, both the rate of job destruction, $\lambda_c$, and workers hired by the formal sector, $L_f$, increases first and then decreases with severance payments, and unemployment follows the same pattern in Figure 2c.

Figure 2d shows the impact of severance payments on the fraction of entrepreneurs in the formal sector. Since this corresponds to the number of firms in the formal sector, this can be thought of as the impact of severance payments on the extensive margin of employment. One advantage of our large firm model is that we can study the implications of a policy on firm level employment as well, that is, we can study the impact of a policy on the intensive margin as well. Figure 2h compares firm level retained labor (hired workers who are not fired) with and without optimal severance payments in place. The solid black line captures the no policy intervention case while the dashed red line captures the optimal severance payments case.\(^{11}\) The lines to the left of the point of discontinuity capture the employment of informal firms while the line to the right capture the retained labor of formal sector firms. The point of discontinuity is lower with optimal severance payment which simply captures the extensive margin effect. That is, there are more formal sector firms and less informal sector firms with optimal severance payments. At each level of productivity, the employment level of informal sector firms is lower with optimal severance payments (dashed red line) than without it (solid black line). This is a consequence of higher equilibrium informal wage with optimal severance payments. What is interesting to note in Figure 2h is that the amount of retained labor at formal sector firms is lower with optimal severance payments (dashed red line) than without it (solid black line). In Figure 2g we

\(^{11}\) For the chosen parameter values the optimal level of severance payments is 0.586. At this level of severance payments, the wages in the 2 sectors are 1.17.
showed that the aggregate retained labor in the formal sector is higher with optimal severance payments. This is driven by the extensive margin effect (more firms in the formal sector). If we look at the hired labor at the intensive margin, we find that it is slightly higher with optimal severance payments than without it. The reason for the retained labor to decrease as shown in Figure 2h is the higher rate of firing as shown in Figure 2e. That is, formal sector firms hire and fire more with optimal severance payments in place. Therefore, optimal severance payments increase formal sector hiring both at the extensive and intensive margins but reduce the amount of retained labor at the intensive margin.

Figure 2 clearly shows the role of severance payments in reducing misallocation. A small severance payment reduces misallocation by increasing the share of entrepreneurs and the share of labor going to the formal sector. It also increases worker welfare even though the unemployment rate increases.

While we have talked about mandated severance payments as a policy intervention, it is equivalent to an unemployment insurance program funded by a layoff tax. To see this, suppose the government imposes a layoff tax of $s$ and transfers the proceeds to unemployed workers. The outcome is equivalent to the case when $s$ is the level of mandated severance payments. While the two are equivalent theoretically, one or the other may be superior in practice. Mandated severance payments may suffer from non-compliance, either willful or because of the inability of firms to pay it during crises. In this case, unemployment insurance funded by a layoff tax may be preferable. The U.S. unemployment insurance program with experience rated contribution has this feature.

Next, we study dismissal restrictions in the model and show how the results differ from

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12. To keep the picture uncluttered we do not plot hired labor in Figure 2g.

13. We are abstracting from any moral hazard issues associated with unemployment insurance. Our static model is not suitable for analyzing moral hazard issues. See Alvarez-Parra and Sanchez (2009) for an interesting model of optimal unemployment insurance with moral hazard where unemployed workers can secretly participate in an informal labor market. The option of working in the informal sector raises important issues in the design of optimal unemployment insurance.
severance payments.

5.2 Administrative Burden of Dismissal

To see how we can study dismissal (or firing) restrictions in the model, suppose that firms in the formal sector have dismissal costs which are in the nature of administrative burden denoted by $b$. It is important to note that the administrative burden is not a transfer to workers. The administrative burden of firing, $b$, should be distinguished from the severance payments, $s$. The latter are a transfer to workers while the former simply makes it costlier for firms to dismiss workers and in that sense act as a firing tax. They should be thought of as the cost of complying with the dismissal regulations.

Now firms do the following maximization exercise:

$$\max_{L_f(\varphi),w_f,b} \left\{ A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma L_f(\varphi)^\gamma - (1 - \lambda_c) w_f L_f(\varphi) - \lambda_c b L_f(\varphi) \right\}$$

subject to

$$(1 - \lambda_c) U(w_f) + \lambda_e U(\delta w_i) \geq U(w_i)$$

The details of this maximization exercise are provided in the appendix. The key idea here is that since these regulations do not result in a transfer to workers, they merely make firing more costly and distort the optimal choice of the firing threshold by formal sector firms. This simply adds to the existing distortion arising from the risk aversion of workers and results in even less resources going to the formal sector.

The results for various levels of firing taxes/dismissal regulations are shown in Figure 3. Note from Figures 3a-c that firing taxes reduce aggregate net output and welfare even though they reduce unemployment. Unemployment decreases because the rate of job destruction decreases as shown in Figure 3e and the mass of labor hired in the formal sector decreases as shown in Figure 3f. The share of entrepreneurs in the formal sector decreases as shown in Figure 3d. Even though the rate of job destruction decreases, because of lower hiring, the amount of retained labor in the formal sector also decreases as shown in Figure 3g. Therefore, not only is this policy inefficient from the point of view of production efficiency, but the general equilibrium effect is such that the welfare of workers decreases as well. It fails to provide protection to workers in
addition to worsening the misallocation of resources.

Analogous to Figure 2h discussed earlier, Figure 3h shows the impact of the administrative burden of dismissal on the intensive margin (firm level) of employment. The solid black line is the baseline case of zero firing taxes and the dashed red line is for the case of $b = 0.25$. The point of discontinuity is higher with the burden of dismissal which captures the extensive margin effect shown in Figure 3d. That is, there are less formal sector firms if firing workers is onerous. Looking at firms in the informal sector first, note that the dashed red line lies above the solid black line to the left of the point of discontinuity suggesting that informal firms are larger than in the absence of a firing tax. This is just a reflection of the general equilibrium effect of lower informal wages. Looking at formal sector firms, note that their retained labor is more with a firing tax than without it. This is because of a lower rate of job destruction as shown in Figure 3e. It turns out that these firms hire fewer workers but because of a large decrease in the firing rate, they retain more workers. Therefore, the overall decrease in the retained workers in the formal sector shown in Figure 3g is again driven by the extensive margin effect.

Anecdotal evidence suggests that it is difficult for formal sector firms to dismiss workers in many developing countries including India and Sri Lanka. That is, $b$ is high enough that $\lambda_c \to 0$. The results in Figure 3 suggest that this policy is clearly inefficient and more importantly it fails to raise the welfare of workers who are the intended beneficiaries of such policies.

Given the results obtained in this section, one may be tempted to conclude that a firing subsidy could improve efficiency because the distortion takes the form of the firing threshold being too low. However, we show in the appendix that a firing subsidy cannot restore efficiency. Since the underlying distortion arises from the risk aversion of workers, and a firing subsidy does not target this distortion, it is unable to restore efficiency.

To sum up, while the administrative burden of firing that is not a transfer to workers is counter productive, severance payments or unemployment insurance funded by a layoff tax have an important insurance role in reducing the misallocation of resources.
5.3 Increase in General Regulatory Burden

Any regulation that reduces the incentive to enter the formal sector is going to exacerbate the misallocation of resources as we show in this section. The effects of a general regulatory burden such as the ease of doing business can be captured through $F$. A decrease in $F$ can capture the ease of doing business or it could capture a technological change that allows firms to operate at a smaller scale, making smaller firms viable in the formal sector.

Figure 4 captures the impact of a change in $F$ on several variables of interest. It is shown that the aggregate output (Figure 4a), the welfare of workers (Figure 4b), unemployment (Figure 4c), and the share of entrepreneurs in the formal sector (Figure 4d) decrease with $F$. A change in the fixed cost for formal sector firms does not affect the rate of job destruction, $\lambda_c$, as is shown in Figure 4e. However, since there are fewer firms in the formal sector, they hire less labor as shown in Figure 4f. An unchanged job destruction rate along with less hired labor in the formal sector results in lower unemployment (Figure 4c) and less retained labor (Figure 4g). The impact on the intensive margin is shown in Figure 4h where the solid black line corresponds to $F = 0.75$ while the dashed red line corresponds to $F = 0.8$. An increase in $F$ increases hiring by both the informal and formal firms as a result of the general equilibrium effect of reduced wages. Since the rate of job destruction is unchanged, formal sector firms retain more labor the larger the $F$. Once again, the decrease in overall retained labor in the formal sector shown in Figure 4g is driven by the extensive margin effect of fewer firms in the formal sector.

Therefore, a reduction in regulatory burden increases the share of resources going to the formal sector and hence reduces misallocation. This shows up in an increase in aggregate output as well as an increase in the welfare of workers.

The model that we have developed in the paper can also study the implications of regulations/policies that become applicable for firms above a certain size. For example, the Factories Act in India requires firms (using power) with more than 10 workers to register. Similarly, the Industrial Disputes Act in India requires firms employing more than 50 workers to provide severance payments and firms employing more than 100 workers to seek permission from the government before dismissing any worker. In Sri Lanka the firing restrictions apply to firms
with 15 or more workers.

To see the implications of such regulations in the context of our model suppose the firm size above which the dismissal regulation is binding is $\hat{L}$. The qualitative results are going to be similar to the ones described above. One difference will be that now some formal sector firms will have an incentive to reduce their firm size to $\hat{L}$ to avoid paying firing taxes. That is, the size distribution of formal sector firms will have a hole around $\hat{L}$.\textsuperscript{14}

### 5.4 Minimum Wage Regulation

We can also study the implications of a minimum wage regulation in the model. It must be stated at the outset that the welfare analysis becomes more complicated in this case because we already have a distortion arising from risk aversion and now we are introducing another distortion in the form of a minimum wage.

Suppose that the government imposes a binding minimum wage in the formal sector and assume that the minimum wage regulation is not binding in the informal sector. Denote the minimum wage by $w_i$. Firms in the formal sector take this as given and perform the following maximization exercise.

$$\max_{L_f(\varphi), \lambda_c} \left\{ A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} L_f(\varphi)^{\gamma} - (1 - \lambda_c)wL_f(\varphi) \right\}$$

s.t. $(1 - \lambda_c)U(w) + \lambda_cU(\delta w_i) \geq U(w_i)$

The first order conditions are\textsuperscript{15}

$$L_f(\varphi) : A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} L_f(\varphi)^{\gamma-1} = (1 - \lambda_c)w,$$  

$$\lambda_c : -A' \varphi^{1-\gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma-1} L_f(\varphi)^{\gamma} = \varrho(U(w) - U(\delta w_i)) - wL_f(\varphi).$$

\textsuperscript{14}Abidoye et al. (2014) find evidence that some firms in Sri Lanka try to keep the firm size below the threshold where firing restrictions start binding. Chatterjee and Kanbur (2014) find similar evidence for India.

\textsuperscript{15}For the above problem to make sense it must be the case that $w > w_i$; that is why we assumed that the minimum wage doesn’t bind in the informal sector, and therefore, it doesn’t directly affect the informal sector.
The above two equations along with 
\[(1 - \lambda_c)U(w) + \lambda_cU(\delta w_i) = U(w_i)\] 
determine \(L_f, \lambda_c, \) and \(\varphi\) for a given \(w\) and \(w_i\). Essentially, \(\lambda_c\) for all firms is given by

\[
\lambda_c = \frac{U(w) - U(w_i)}{U(w) - U(\delta w_i)}
\]  

(22)

The variables for the informal sector are determined as before which allows us to determine \(w_i\) and \(\varphi^*\) along with \(\lambda_c\) and the share of workforce in each sector. The relevant equations are obtained simply by replacing \(w_f\) by \(\bar{w}\) in equations (24)-(27) in the appendix.

Numerical simulations reveal that the impact of a binding minimum wage on aggregate net output is non-monotonic as shown in Figure 5a. To understand the intuition behind this result we need to first see the impact of a binding minimum wage on other variables of interest. A binding minimum wage leads to decreases in the hired (Figure 5f) and retained (Figure 5g) labor in the formal sector. It also reduces the share of entrepreneurs in the formal sector (Figure 5d), however, a binding minimum wage leads to an increase in job destruction (Figure 5e). Since the formal sector firms are forced to pay a higher wage, they can satisfy the reservation utility of workers by keeping the firing threshold higher. A consequence of increased job destruction combined with reduced hiring in the formal sector is that unemployment increases first and then starts decreasing as shown in Figure 5c. The impact on worker welfare is shown in Figure 5b. It is not obvious from the figure but we verify that starting from no regulation of wages, a binding minimum wage initially increases worker welfare before reducing it. The reason for the initial increase in worker welfare is the general equilibrium effect of the increase in demand for labor in the informal sector. However, it is soon overtaken by the negative effect due to a reduced demand in the formal sector.

In Figure 5h we show the intensive margin effect of minimum wage where the solid black captures the no minimum wage case while the dashed red line captures the case with a binding minimum wage. There is a slight decrease in the informal wage which accounts for a slight increase in the employment for informal firms. For formal firms there is a slight increase in

\[16\text{ The minimum wage is set at } 1.27\text{ for Figure 5h. The formal sector wage in the absence of any intervention is } 1.208.\]
hiring (not shown) but a decrease in the amount of retained labor because of the increased rate of job destruction. Therefore, the amount of retained labor decreases both because of fewer formal firms and each firm retaining less labor.

The most intriguing result in Figure 5 is the non-monotonic response of aggregate net output to increases in minimum wage shown in Figure 5a. A rough intuition for this result is as follows. Since job destruction in the formal sector is sub-optimally low in the decentralized equilibrium without intervention, an increase in job destruction induced by a binding minimum wage is a source of gain. However, a higher wage reduces profitability which forces least productive formal sector firms to exit. For a minimum wage only slightly above the decentralized equilibrium formal sector wage, the former effect dominates, resulting in a greater aggregate output. But soon the exit of formal sector firms starts decreasing aggregate output. Numerical simulations reveal that a binding minimum wage doesn’t achieve production efficiency in the model. That is, as the minimum wage is increased, aggregate output starts decreasing before reaching the efficient level. Therefore, in this second best world, minimum wage increases aggregate net output, but it is not appropriately targeted and hence fails to increase output to the efficient level.

Having discussed the theoretical results we provide some suggestive empirical evidence.

6 Empirical Exercise

We now turn our attention to an empirical investigation of the relationship between the prevalence of informal employment and the three elements of labor regulations discussed in this paper, i.e., regulations that constrain firms from dismissing workers; govern severance payments; and relate to minimum wages.

We pool country-level information across 6 developing country regions and the years 2000 to 2014 to estimate regression equations of the following type

\[
Share_{inf\emp_{it}} = \alpha + \beta_1 \ln Y_{it} + \beta_2 Labor\_reg_{it} + \beta_3 X_{it} + u_R + u_t + \varepsilon_{it} \quad (23)
\]
where $i$ refers to country, $t$ refers to time, $\text{Share_{inf_emp}}$ is the share of informal employment, $Y$ is GDP per capita, $\text{Labor_{reg}}$ refers to one of the three elements of regulation we consider, $X_{it}$ captures various controls, $u_R$ and $u_t$ capture region and year fixed effects, respectively and $\epsilon_{it}$ is the error term.

Two points may be noted regarding our analysis. First, it is along the lines of Botero et al. (2004), the first cross-country study on the effects of labor regulations that covered developing countries, and the more recent work of Djankov and Ramalho (2009). However, our work differs in terms of the outcome variable of interest — a measure of informal employment in our case rather than the size of the informal sector in economic activity\footnote{Also, while we use actual data on informal employment, Botero et al. (2004) measure of the size of the informal sector is based on the opinion of experts who are asked to estimate the size of the informal sector in their country.} and other indicators (such as labor force participation and unemployment rates) in these studies. Additionally, our main interest is in understanding how different aspects of labor regulation affect our outcome variable. Second, the objective of our empirical analysis is simply to examine whether the predictions of the theoretical model developed in this paper match the broad patterns in cross-country data. We do not seek to establish causality. This relatively modest goal is necessitated by several factors, including the patchiness of the data available, especially on informal employment, and the lack of within-country variation in our measures of labor regulations over the relevant time periods (mostly due to the fact that regulations are often slow to change).

6.1 Data and variables

Share of informal employment

Our measure of the share of informal employment is drawn from the ILO’s Key Indicators of the Labor Market (KILM) database. It is based on defining informal employment as the sum of own account workers and contributing family workers. This is less than ideal for two reasons. First, the measure is not available for the agricultural and non-agricultural sectors separately. The distinction is relevant for us as structural transformation typically involves a shift away
from agricultural employment; since agriculture accounts for a large portion of own account and unpaid family workers, differences in the KILM measure of informal employment over time (and across countries) may be driven more by shifts away from agriculture rather than changes or differences in the regulatory factors that are the focus of this paper. We get around this by including the share of agriculture in total employment as a control in our regressions.

Second, the KILM measure excludes several categories of informal employment. These are employers in the informal sector; wage employees employed by informal sector enterprises; and wage employees employed in the formal sector, but holding “informal” jobs in terms of the employment relationship—for example, jobs that do not come under the purview of labor regulation. Employers typically represent around 0.75% to under 7% of total employment in developing countries. The other two categories omitted from the KILM measure are harder to quantify.

Data availability is the obstacle to obtaining a more comprehensive measure of informal employment, with many developing countries’ labor force surveys not distinguishing between the type of enterprise a wage employee is employed in (formal or informal sector enterprise) and lacking details on the nature of the employment relationship. For example, for the years 2000, 2005, and 2010, the number of countries with information on the share of informal employment (comprehensive definition) in non-agricultural activities was only 5, 11, and 18, respectively. The corresponding number of countries with data on informal employment defined as the sum of own account workers and contributing family workers (the KILM measure) was 63, 71, and 78 for these years. Fortunately, both variables are strongly correlated when data are pooled for the year 2000 and beyond (correlation coefficient of 0.7), which gives us confidence in our measure of informality.

While data from KILM covers well over 100 developed and developing countries from 1980 to 2014, there are many data gaps between years. To avoid these, we restrict our analysis to the period between 2000 and 2014 and interpolate values for missing years for countries that have at least 3 observations over these years. Restricting attention to developing countries which are also covered by the main database we rely on for labor regulations (see below), we are left with
Measures of labor regulation

We capture regulatory restrictions on employee dismissal and the generosity of severance (or redundancy) payments using the CBR Labour Regulation Index (CBR-LRI) dataset developed by the Centre for Business Research, University of Cambridge (Adams, Bishop, and Deakin, 2015). The database codes five aspects of labor regulation in 117 countries over the period from the 1970s to the present day. Each of the five are themselves based on 40 sub-components of regulation.

We focus on the “regulation of dismissal” aspect of labor regulation, itself composed of nine distinct sub-components. One of the sub-components is a measure of legally mandated redundancy compensation, which is the amount of compensation payable to a worker made redundant after 3 years of employment, expressed in weeks of pay. The variable is normalized such that zero weeks of pay is assigned a value of zero and twelve weeks of pay is assigned a value of one. We use this variable as our measure of generosity of severance pay, or redundancy compensation.

Next, we average the remaining eight variables to construct a measure of the severity of dismissal regulations which we call the index of dismissal regulation. Like the measure of generosity of severance pay, higher values of the index of dismissal regulations are more pro-worker. Given the country and year coverage of our dependent variable, the two measures used from the CBRLRI dataset cover 53 countries over 2000-2014.

To examine the effect of minimum wages on informal employment, we compute the ratio of minimum wages to GDP per capita. Like our other two measures of labor regulation, higher values of this ratio represent a more pro-worker regulatory regime. Our source of cross-country information on (monthly) minimum wages is the ILOSTAT database. The database excludes minimum wages determined by collective bargaining. In cases where the minimum wages differ across sub-national regions, either the minimum wage for the capital city or an average of regional wages is used. For countries that mandate minimum wages by sector, the minimum wage for manufacturing or unskilled labor is applied. We compute the ratio by first converting
the monthly minimum wage data from ILOSTAT, expressed in current local currency, into current US dollars using market exchange rates from the World Development Indicators (World Bank). These are divided by 1/12th of GDP per capita to arrive at the ratio of the monthly minimum wage to GDP per capita. This ratio is computed for 56 developing countries from 2000-2013.

Other variables

Aside from GDP per capita and the share of agriculture in total employment (Agrishare), both of which are from the WDI database, respectively, we also include as controls measures of the ease of paying taxes and access to credit provided in the World Bank’s Doing Business (DB) database. Both the tax regime and access to credit are widely believed to influence firms’ decision to formalize or not (see, for example, the work of Djankov et al. 2008). Controlling for these is, therefore, important, especially as countries with relatively flexible labor regulations are likely to have a general regulatory environment that is business friendly. We do so by using the DB database’s country-specific “distance to frontier” measure for the ease of paying taxes and access to credit variables, and for which lower values represent better regulatory environments. We use the average of the distance to frontier values per country across DB years to allow for better coverage when estimating equation (23). This is not too much of a loss as much of the variation in these measures appears across countries rather than over time for the period we consider.

Finally, we control for the enforcement of regulations in some of our analyses. We experiment with two measures of enforcement, namely: (i) the number of labor inspectors per 10,000 employed persons, sourced from the ILOSTAT database and available for 26 developing countries and various years between 2009 to 2014; and the (ii) the Rule of Law Index from the World Bank’s World Governance Indicators, which is available for 2000, 2002-2015 for 215 countries, and measures the confidence of agents in the rules of society, the quality of contract enforcement, property rights, the police, the courts and the likelihood of crime and violence. Higher values represent greater adherence to the rule of law.

The relationship between these measures of enforcement and informal employment may well
differ; it is also likely to be complex. For example, a larger number of inspectors is likely to imply greater enforcement of labor regulations; if labor regulations impose constraints on the formalization process, then greater enforcement would be associated with greater informal employment. On the other hand, the other two enforcement measures capture more qualitative aspects of regulatory institutions. Higher scores on these are likely to be associated with regulatory systems that are conducive to formalization and a decline in informal employment.

Table 1 provides summary statistics for the main variables of interest—the share of informal employment based on the KILM measure and the three elements of labor regulation—plus GDP per capita. There is considerable variation in the prevalence of informal employment across the developing world, with shares largest in South Asia and Sub-Saharan Africa (around 55%) and lowest in developing countries in Europe and Central Asia (around 16%) over the period considered. As for labor regulations, Latin America and South Asia tend to have greater restrictions on dismissal and more generous severance pay. Minimum wages tend to be higher relative to GDP per capita in the Middle East and North Africa and Sub-Saharan Africa.

As one would expect, a simple scatter plot of the KILM measure of informal employment and GDP per capita shows a strong inverse relationship between the two variables (first panel of Figure 6). That is, informality declines as we observe countries at higher levels of development. Below we run some regressions to study the relationship between labor market policies and the share of informal employment.

### 6.2 Results

We perform three separate regressions to isolate the effect of the two regulations and minimum wages on the share of informal employment. GDP per capita and the share of agriculture in total employment are introduced as controls in all specifications. We begin with a baseline specification and then add more controls. A first set of these additional controls pertain to the regulatory environment (access to credit and paying taxes from the World Bank’s Doing Business database), and the second pertains to measures of enforcement and rule of law.

The positive and statistically significant estimated coefficient on the index of dismissal reg-
ulations in column 1 of Table 2 implies that tougher dismissal laws are associated with a higher share of informal employment (own account workers). In panel b of Figure 6 we plot the partial relationship between the share of informal employment and dismissal regulations based on the regression run in column I of table 2. That is, on the vertical axis we have the residual of the regression of share of informal employment on the right hand side variables in column I except dismissal regulations against the residual from the regression of dismissal regulations on the other right hand side variables listed in column I. The two residuals are positively related as expected from the positive and significant coefficient on dismissal regulation in column I of table 2.

Adding controls for the business environment by introducing “distance to frontier” measures for access to credit and the tax regime, widely believed to be important determinants of informality, does not alter the positive association between tougher dismissal laws and the share of informal employment (columns 2 and 3). (Interestingly, the estimated coefficient of only the tax regime is positively signed, suggesting that in our sample, at least, and with controls for incomes and agricultural employment included, a weaker tax regime but not weaker access to credit is associated with greater informal employment.  

Since enforcement regimes can vary considerably, it is useful to control for these, something done in the specifications reported in columns 4 and 5. A direct measure of enforcement of labor regulations— the number of labor inspectors per 10,000 employees — is available for only 22 of our sample 53 countries. Nevertheless, the results are interesting. While the dismissal regulation variable on its own is statistically insignificant (and negatively signed), its interaction with the inspection rate is positive and significant (column 4), suggesting that in countries with stricter enforcement of labor regulation, tougher dismissal regulations have a bite and dampen the creation of formal employment opportunities. Thus, consider the 25th and 75th percentile

18Recall that a low value of these variables captures a better regulatory environment. Therefore, a positive association between informal employment and ease of paying taxes implies that a better regulatory environment is positively associated with formal employment, a result consistent with the impact of regulatory burden on formal employment discussed in the theoretical model.
values of the inspection rate across the 73 observations used in generating column 4. These values are 0.3 and 0.6, respectively. While the former (the average value for Brazil) implies that a 0.1 point increase in the strength of dismissal regulation leads to an increase of 1.1 percentage points in the share of informal employment, the latter (the average value for Sri Lanka) implies an increase of 3.2 percentage points in the share of informal employment. Stricter inspection itself is negatively associated with informal employment. These findings are repeated qualitatively, and with greater force, in column 5 where the inspection rate variable is substituted with the rule of law index. Here, dismissal regulation is associated with greater informal employment both on its own as well as in countries with a stronger rule of law.

Switching from dismissal regulation to severance pay changes results dramatically (Table 3). In no specification is having a more generous redundancy compensation associated with greater informal employment. This is also shown graphically in Figure 6c which plots the partial relationship between the share of informal employment and redundancy compensation. In the only case where a term involving redundancy compensation appears with a statistically significant effect — in interaction with the rule of law in column 5 — the estimated coefficient is negatively signed. The negative coefficient of the interaction term suggests that in countries with a stronger rule of law a stronger redundancy compensation lowers informal employment.

While we do not get a statistically significant association between severance pay and informal employment, it is worth reiterating that the results are significantly different from that for dismissal regulations, which was one of the key points of the theoretical model. While the theoretical model showed that severance payments can promote structural transformation by providing insurance to risk averse workers, it also showed that there exists an optimal level of severance payments and a severance payment more generous than this level would impede structural transformation. No such ambiguity exists regarding dismissal regulations and therefore the empirical results are broadly consistent with the theoretical model.

As for minimum wages, the results reported in Table 4 are similar to those for dismissal regulations. Countries with higher minimum wages relative to aggregate income levels as captured by GDP per capita tend to have higher shares of informal employment. Figure 6d shows the
partial relationship between the share of informal employment and minimum wage based on the baseline regression reported in column I of Table 4. The positive and significant association remains even when we include our various controls. The only exception is when we work with the inspection rate as a control for the enforcement regime. Switching from the inspection rate to the rule of law index as our control for the enforcement regime, however, yields qualitatively very similar results to Table 2: relatively high minimum wages in countries with strong rule of law seem to add to informality.

Overall, these results, though suggestive, do match up broadly with the theoretical predictions of this paper’s model of the process of structural transformation in developing countries.

7 Concluding Remarks

Determining what types of labor market regulations are optimal for developing countries is challenging. In this paper, we constructed a theoretical model to get a better understanding of the issues involved. Our results suggest that getting rid of regulations that protect jobs and not workers is a good idea. Creating administrative hurdles for firms seeking to dismiss or layoff workers—such as through India’s Industrial Disputes Act 1947 (see Anant et al. (2006) for details)—is a prime example of a policy protecting jobs and not workers. It is shown that mandated severance payments or unemployment insurance funded by a layoff tax can provide social protection and reduce misallocation by increasing the fraction of workers employed in the more productive formal sector and reducing informality. While in principle it is a good idea for the state to provide social protection to workers, whether it can actually execute such policies depends on state capacity. As well, regulatory burden of a general kind that imposes a cost on formalization also increases misallocation. Finally, in a world with pre-existing distortions arising from the risk aversion of workers, the introduction of a binding minimum wage could increase aggregate output. Empirically we find that labor market regulations that make it more difficult to fire workers increase informality while regulations that mandate severance payments to workers do not. Higher minimum wages also increase informality.
References


8 Online Appendix

8.1 Proof of Lemma 1

As mentioned in the text, the optimal choice of \((\lambda, w_f)\) pair for the firm involves minimizing the cost of minimizing an efficiency unit of labor, \(\frac{2w_f}{1+\lambda_c}\), subject to the participation constraint of workers: \((1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) = U(w_i)\). Easily verify that the slope of the objective function in the \((\lambda, w_f)\) space is \(\frac{dw_f}{d\lambda_c} = \frac{w_f}{1+\lambda_c} = \frac{\psi}{2}\) for a given \(\bar{\lambda}\). That is, the slope is positive and constant along each contour line where a contour line is given by the equation \(\frac{2w_f}{1+\lambda_c} = \bar{\lambda}\) for a given \(\bar{\lambda}\). Also, the lower the \(\bar{\lambda}\) the further to the right the contour line. The slope of the constraint is \(\frac{dw_f}{d\lambda_c} = \frac{1}{\psi \lambda_c}\) where \(\psi = \frac{U(w_f) - U(\delta w_i)}{U'(w_f)}\). Easily verify that \(\frac{d^2w_f}{d\lambda_c^2} > 0\). That is, the participation constraint is convex and therefore a well defined solution exists and is given by the tangency between the lowest possible contour line and the participation constraint. Also, verify that in the \((\lambda, w_f)\) space, the curves representing the participation constraints of a risk neutral worker and a risk averse worker start at the same point \((0, w_i)\) but the latter is steeper than the former. That is, for any increase in \(\lambda\) a risk averse worker demands a larger wage increase than a risk neutral worker. The same is true for an increase in risk aversion. That is, an increase in risk aversion implies that the worker needs to a larger wage increase to compensate for the increase risk.

Now, in the risk neutral case, the solution is characterized by

\[
\frac{w_f}{1+\lambda_c} = \frac{\psi}{1-\lambda_c} = \frac{w_f - \delta w_i}{1-\lambda_c}
\]

where the last equality follows from the fact that \(\psi \equiv w_f - \delta w_i\) for linear utility. Denote the solution pair by \((\lambda^*, w_f^*)\). Now, at this \(\lambda^*\), denote the \(w_f\) satisfying the participation constraint of a risk averse worker by \(w_f^r\). We are going to verify that at \((\lambda^*, w_f^r)\) the slope of the objective function is smaller than the slope of the participation constraint. Therefore, the optimal solution with risk averse utility function will involve a smaller \(\lambda\). To see this, note that the slope of the objective function at \((\lambda^*, w_f^r)\) is \(\frac{w_f^r}{1+\lambda^*_c}\). The slope of the constraint at that point is \(\frac{\psi}{1-\lambda^*_c}\) where
\[ \psi = w_f^r - \delta w_i + x \] where \( x \) is something positive. Therefore, we want to show that

\[ \frac{w_f^r - \delta w_i + x}{1 - \lambda_c^o} > \frac{w_f^r}{1 + \lambda_c^o} \]

or

\[ \frac{w_f^r - \delta w_i + x}{w_f^r} > \frac{1 - \lambda_c^o}{1 + \lambda_c^o} = \frac{w_f^o - \delta w_i}{w_f^o} \]

where the last equality follows from the optimality of \((\lambda_c^o, w_f^o)\) for the risk neutrality case. It follows that the inequality above is true because \( w_f^r > w_f^o \). A similar argument holds for an increase in risk aversion.

### 8.2 Key Equations

The key equations derived in the text are as follows under the assumption of uniform distribution for \( \lambda \).

The aggregate labor market condition, (18) is given by

\[
\frac{\gamma}{2(1 - \gamma)} \left( B w_i^{1-\gamma} \varphi^{*2} + A \left( \frac{1 - \lambda_c^2}{2} \right)^{\frac{1}{\gamma}} (1 - \lambda_c) w_f \right)^{\frac{1}{\gamma-1}} (1 - \varphi^{*2}) \right) = L
\]  

(24)

The informal sector output is

\[
Z^I = B' \int_0^{\varphi^*} \varphi^{1-\gamma} (\varphi) \gamma dG(\varphi) = B \frac{w_i^{1-\gamma}}{1 - \gamma} \int_0^{\varphi^*} \varphi dG(\varphi) = \frac{B \varphi^{*2} w_i^{1-\gamma}}{2(1 - \gamma)}
\]  

(25)

while the formal sector output is

\[
Z^F = A' \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} \int \varphi^{1-\gamma} L_f(\varphi) \gamma dG(\varphi) = \frac{A}{2(1 - \gamma)} \left( \frac{1 - \lambda_c^2}{2} \right)^{\frac{1}{\gamma-1}} (1 - \lambda_c) w_f \left( 1 - \varphi^{*2} \right)
\]

(26)

The aggregate net output can be written as

\[ Y = \frac{w_i}{\gamma} \left( L^I + \lambda_c \delta L^F \right) + \frac{(1 - \lambda_c) w_f L^F}{\gamma} - (1 - \varphi^*) F \]

(27)
8.3 Conditions for the existence of an interior equilibrium

The conditions for the existence of an interior equilibrium with $\varphi^* \in (\underline{\varphi}, \overline{\varphi})$ are as follows.

Suppose $\varphi^* \geq \overline{\varphi}$ so that all resources are in the informal sector. What is the informal sector wage in this case? In this case, $w_i$ is determined by the following condition:

$$\frac{\gamma}{1 - \gamma} B w_i^{\frac{1}{\gamma - 1}} \int_{\underline{\varphi}}^{\overline{\varphi}} \varphi dG(\varphi) = T. \quad (28)$$

Let us denote the solution to the above equation by $\hat{w}_i$. Now the following must be true for this to be an equilibrium

$$\left( A \left( \frac{w_f}{\lambda c}(\hat{w}_i) \right)^{\frac{1}{\gamma - 1}} - B \hat{w}_i^{\frac{1}{\gamma - 1}} \right) \overline{\varphi} \leq F, \quad (29)$$

where $\frac{w_f}{\lambda c}(\hat{w}_i)$ denotes the optimal value of $\frac{w_f}{\lambda c}$ when the informal sector wage is $\hat{w}_i$. That is, at $w_i = \hat{w}_i$ the gross profit of even the most productive firm in the formal sector is not enough to cover the fixed cost. Therefore, if the parameters are such that $\left( A \left( \frac{w_f}{\lambda c}(\hat{w}_i) \right)^{\frac{1}{\gamma - 1}} - B \hat{w}_i^{\frac{1}{\gamma - 1}} \right) \overline{\varphi} > F$, then $\varphi^* = \overline{\varphi}$ cannot be an equilibrium.

Next, suppose $\varphi^* = \underline{\varphi}$ so that all resource are in the formal sector. If there are no firms or workers in the informal sector, then there is some indeterminacy in the model because the formal sector firms take the informal sector wage $w_i$ as given while choosing their optimal $w_f$ and $\lambda c$. To get around this problem, let us assume a wage floor of $w_{\text{min}}$ so that when there is no informal sector employment, formal sector firms take this as given in their optimization. This could also be the outside opportunity of workers (say the value of leisure in units comparable to wage). So, now for $\varphi^* = \underline{\varphi}$ to be an equilibrium we need

$$\left( A \left( \frac{w_f}{\lambda c}(w_{\text{min}}) \right)^{\frac{1}{\gamma - 1}} - B w_{\text{min}}^{\frac{1}{\gamma - 1}} \right) \underline{\varphi} \geq F. \quad (30)$$

That is, even the least productive firm makes enough gross profits to cover the fixed cost. Now, if $A \left( \frac{w_f}{\lambda c}(w_{\text{min}}) \right)^{\frac{1}{\gamma - 1}} - B w_{\text{min}}^{\frac{1}{\gamma - 1}} < 0$, then no firm is viable in the formal sector, hence $\varphi^* = \underline{\varphi}$ cannot be an equilibrium. So, suppose $A \left( \frac{w_f}{\lambda c}(w_{\text{min}}) \right)^{\frac{1}{\gamma - 1}} - B w_{\text{min}}^{\frac{1}{\gamma - 1}} > 0$. Now, if

$$\left( A \left( \frac{w_f}{\lambda c}(w_{\text{min}}) \right)^{\frac{1}{\gamma - 1}} - B w_{\text{min}}^{\frac{1}{\gamma - 1}} \right) \underline{\varphi} < F$$

then $\varphi^* = \underline{\varphi}$ cannot be an equilibrium. Therefore, we need the following restrictions on parameters to ensure an interior equilibrium.

$$\left( A \left( \frac{w_f}{\lambda c}(\hat{w}_i) \right)^{\frac{1}{\gamma - 1}} - B \hat{w}_i^{\frac{1}{\gamma - 1}} \right) \overline{\varphi} > F > \left( A \left( \frac{w_f}{\lambda c}(w_{\text{min}}) \right)^{\frac{1}{\gamma - 1}} - B w_{\text{min}}^{\frac{1}{\gamma - 1}} \right) \underline{\varphi} \quad (30)$$
where \( \hat{w}_i \) is the solution to (28) and \( w_{\min} \) is the wage floor. One can derive the exact conditions in the risk neutral case but due to the non-linearity introduced by the concave utility function which implies that non-linear equations (11) and (12) solve for \( w_f \) and \( \lambda_c \), one cannot get a more precise parametric restriction than the one given in (30).

8.4 Planner’s problem

The planner’s objective function is as follows.

\[
\begin{align*}
\max_{\lambda_c(\varphi), L_f(\varphi), L_i(\varphi), \varphi^*} & \quad B' \int_{\varphi}^{\varphi^*} \varphi^{1-\gamma} L_i(\varphi)^\gamma dG(\varphi) + A' \int_{\varphi}^{\varphi^*} \left( \frac{1-\lambda_c(\varphi)^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi)^\gamma dG(\varphi) \\
& \quad - (1 - G(\varphi^*)) F + \mu (L - \int_{\varphi}^{\varphi^*} L_i(\varphi) dG(\varphi) + \delta \int_{\varphi}^{\varphi^*} \lambda_c(\varphi) L_f(\varphi) dG(\varphi) - \int_{\varphi}^{\varphi^*} L_f(\varphi) dG(\varphi))
\end{align*}
\]

The first order conditions are as follows.

\[
\begin{align*}
L_i(\varphi) & : \gamma B' \varphi^{1-\gamma} L_i(\varphi)^{\gamma-1} - \mu = 0 \quad (31) \\
L_f(\varphi) & : \gamma A' \left( \frac{1 - (\lambda_c(\varphi))^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi)^{\gamma-1} - \mu (1 - \lambda_c(\varphi) \delta) = 0 \quad (32) \\
\lambda_c(\varphi) & : \gamma A' \lambda_c(\varphi) \left( \frac{1 - (\lambda_c(\varphi))^2}{2} \right)^{\gamma-1} \varphi^{1-\gamma} L_f(\varphi)^{\gamma-1} - \mu \delta = 0 \quad (33) \\
\varphi^* & : B' \varphi^{1-\gamma} L_i(\varphi)^{\gamma} g(\varphi^*) - A' \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi)^{\gamma} g(\varphi^*) + g(\varphi^*) F + \mu (L_f(\varphi^*) (1 - \delta \lambda_c(\varphi^*) - L_i(\varphi^*)) g(\varphi^*) = 0 \quad (34) \\
& \quad + g(\varphi^*) F + \mu (L_f(\varphi^*) (1 - \delta \lambda_c(\varphi^*) - L_i(\varphi^*)) g(\varphi^*) = 0 \quad (35)
\end{align*}
\]

Dividing (33) by (32) obtain

\[
\frac{2 \lambda_c(\varphi)}{1 - (\lambda_c(\varphi))^2} = \frac{\delta}{1 - \lambda_c(\varphi) \delta} \quad (36)
\]

From the above note that \( \lambda_c(\varphi) \) doesn’t depend on \( \varphi \). Next, (34) can be re-written as

\[
B' \varphi^{1-\gamma} L_i(\varphi)^{\gamma} - A' \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi^*)^{\gamma} + F + \mu (L_f(\varphi^*) (1 - \delta \lambda_c(\varphi^*) - L_i(\varphi^*)) = 0 \quad (37)
\]

Below we verify that the planner’s solution corresponds to the decentralized solution with risk neutral workers.
8.5 Decentralized solution in the risk neutral case

The equations for the decentralized equilibrium in the risk neutral case are easily obtained from the ones derived in the text by setting $U(x) = x$. We gather the key first order conditions in the decentralized case below.

\[ L_i(\varphi) = \gamma B' \varphi^{1-\gamma} L_i(\varphi)^{\gamma-1} - w_i = 0 \]  \hspace{1cm} (38)

\[ L_f(\varphi) = \gamma A' \left( \frac{1 - (\lambda_c(\varphi))^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi)^{\gamma-1} - (1 - \lambda_c)w_f = 0 \]  \hspace{1cm} (39)

\[ \lambda_c = \gamma A' \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{-1} \varphi^{1-\gamma} L_f(\varphi)^{\gamma-1} - \delta w_i = 0 \]  \hspace{1cm} (40)

In addition, the no arbitrage condition for workers is

\[ (1 - \lambda_c)w_f + \lambda_c \delta w_i = w_i \]  \hspace{1cm} (41)

Using (41) re-write (39) as

\[ A' \varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma L_f(\varphi)^{\gamma-1} = (1 - \lambda_c \delta)w_i \]  \hspace{1cm} (42)

The condition for $\varphi^*$ in the decentralized case is given by

\[ B' \varphi^{1-\gamma} L_i(\varphi^*)^{\gamma} - w_i L_i(\varphi^*) = A' \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi^*)^{\gamma} - (1 - \lambda_c)w_f L_f(\varphi^*) - F \]  \hspace{1cm} (43)

Using (41) re-write above as

\[ B' \varphi^{1-\gamma} L_i(\varphi^*)^{\gamma} - A' \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma \varphi^{1-\gamma} L_f(\varphi^*)^{\gamma} + F + w_i (L_f(\varphi^*)(1 - \delta \lambda_c(\varphi^*) - L_i(\varphi^*)) = 0 \]  \hspace{1cm} (44)

A comparison of the conditions above with the planner’s problem shows that they are identical if $\mu = w_i$.

Note from (32) and (42) that $L_f(\varphi)$ is the same function of $\lambda_c, \delta$, and $\varphi$ in both cases. $L_i(\varphi)$ is same in both cases if $\mu = w_i$. Therefore, the two equations determining $\lambda_c$ and $\varphi^*$ become identical in the two cases, and hence, they give the same solution which in turn implies $\mu = w_i$.

Therefore, if the system of equations has a unique solution, then clearly the planner’s problem corresponds to the decentralized equilibrium when workers are risk neutral.
8.6 Severance Payments by firms (voluntary and mandatory)

Below we show that voluntary severance payments allows production efficiency. Denoting severance payments by $s$, the firms do the following maximization exercise.

$$\begin{align*}
\text{Max} & \quad A'\varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma L_f(\varphi)^\gamma - (1 - \lambda_c) w_f L_f(\varphi) - \lambda_c L_f(\varphi) s \\
\text{s.t.} & \quad (1 - \lambda_c) U(w_f) + \lambda_c U(s + \delta w_i) \geq U(w_i)
\end{align*}$$

The first order conditions are

$$\begin{align*}
L_f(\varphi) & : \quad A'\varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma L_f(\varphi)^{\gamma-1} = (1 - \lambda_c) w_f + \lambda_c s \\
w_f & : \quad -(1 - \lambda_c) L_f(\varphi) + \varrho (1 - \lambda_c) U'(w_f) = 0 \\
s & : \quad -\lambda_c L_f + \varrho \lambda_c U'(s + \delta w_i) = 0 \\
\lambda_c & : \quad -A'\varphi^{1-\gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma-1} L_f(\varphi)^{\gamma-1} = \varrho U((w_f) - U(s + \delta w_i)) - w_f L_f(\varphi) + L_f(\varphi)
\end{align*}$$

From (46) and (47) verify that $U'(w_f) = U'(s + \delta w_i)$, and hence, $w_f = s + \delta w_i$. Therefore, (45) and (48) can be written as

$$\begin{align*}
A'\varphi^{1-\gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^\gamma L_f(\varphi)^{\gamma-1} & = \, w_f - \lambda_c \delta w_i \\
A'\varphi^{1-\gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma-1} L_f(\varphi)^{\gamma-1} & = \, w_f - s = \delta w_i.
\end{align*}$$

Since the participation constraint always binds and $w_f = s + \delta w_i$, it follows that $w_f = w_i$ and $s = (1 - \delta) w_i$. Next, verify that the above are same as (40) and (42) in the case of risk neutral workers. Therefore, production efficiency is achieved if firms can offer severance payments voluntarily.

The case of government mandated severance payments is similar to the one discussed above. In this case firms in the formal sector take $s$ as given and choose $L_f, w_f$, and $\lambda_c$. If the government wants to attain production efficiency it can choose $s$ such that $w_f(s) = s + \delta w_i$ where $w_f(s)$ is the formal sector wage as a function of mandated severance payments $s$ chosen by the government.

Note from (45) that the amount of labor employed by a formal sector firm is given by

$$\begin{align*}
L_f(\varphi) & = \, \frac{\gamma}{1 - \gamma} A \varphi \left( \frac{1 - \lambda_c^2}{2} \right)^{\frac{\gamma}{\gamma-1}} ((1 - \lambda_c) w_f + \lambda_c s)^{\frac{1}{\gamma-1}}.
\end{align*}$$

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The profit of a formal sector firm is given by

$$\pi_f(\varphi) = \varphi A \left( \frac{1 - \lambda_c^2}{2 ((1 - \lambda_c) w_f + \lambda_c s)} \right)^{\gamma}$$  

(52)

Therefore, the aggregate labor market condition in this case is given by

$$\frac{\gamma}{2(1 - \gamma)} \left( B w_i^{\frac{1}{\gamma}} - A \left( \frac{1 - \lambda_c^2}{2} \right)^{\frac{1}{\gamma}} \left( (1 - \lambda_c) w_f + \lambda_c s \right)^{\frac{1}{\gamma - 1}} \right) = L$$  

(53)

The indifference condition of entrepreneurs is given by

$$\varphi^* \left( A \left( \frac{1 - \lambda_c^2}{2 (1 - \lambda_c) w_f + \lambda_c s} \right)^{\frac{1}{\gamma - 1}} - B w_i^{\frac{1}{\gamma - 1}} \right) = F$$  

(54)

The informal sector output is same as in (25) above but the formal sector output is given by

$$Z^F = A' \left( \frac{1 - \lambda_c^2}{2} \right) \gamma \int \varphi^{1 - \gamma} L_f(\varphi)^\gamma dG(\varphi) = \frac{A}{2(1 - \gamma)} \left( \frac{1 - \lambda_c^2}{2} \right)^{\frac{1}{\gamma - 1}} \left( (1 - \lambda_c) w_f + \lambda_c s \right)^{\frac{1}{\gamma - 1}} (1 - \varphi^*) L^F$$  

(55)

And the aggregate output is given by

$$Y = \frac{w_i \left( L^I + \lambda_c \delta L^F \right)}{\gamma} + \frac{(1 - \lambda_c) w_f + \lambda_c s}{\gamma} L^F - (1 - \varphi^*) F$$  

(56)

### 8.7 Administrative burden of dismissal

If the government imposes a firing tax of $b$, the first order conditions in the formal sector are given by

$$\max_{L_f, w_f, \lambda_c} \left\{ A' \varphi^{1 - \gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma} L_f(\varphi)^\gamma - (1 - \lambda_c) w_f L_f(\varphi) - \lambda_c b L_f(\varphi) \right\}$$

s.t. $(1 - \lambda_c) U(w_f) + \lambda_c U(\delta w_i) \geq U(w_i)$

The first order conditions are

$$L_f(\varphi) : A' \varphi^{1 - \gamma} \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma - 1} L_f(\varphi)^{-1} = (1 - \lambda_c) w_f + \lambda_c b$$  

(57)

$$w_f : -(1 - \lambda_c) L_f(\varphi) + \varrho (1 - \lambda_c) U'(w_f) = 0$$  

(58)

$$\lambda_c : -A' \varphi^{1 - \gamma} \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma - 1} L_f(\varphi)^\gamma = \varrho U'(w_f) - U(\delta w_i) - w_f L_f(\varphi) + L_f(\varphi) b$$  

(59)
Using (58), (59) can be written as

\[
A' \varphi^{1-\gamma} \gamma \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma - 1} L_f(\varphi)^{\gamma - 1} = w_f - \psi - b 
\]  

(60)

where \( \psi \equiv \frac{U(w_f) - U(\delta w_i)}{U'(w_f)} \).

Next, (57) and (60) give us the key equation

\[
\frac{w_f (1 - \lambda_c) + \lambda_c b}{w_f - \psi - b} = \left( \frac{1 - \lambda_c^2}{2 \lambda_c} \right) \tag{61}
\]

Again, (61) and \((1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) = U(w_i)\) determine \(w_f\) and \(\lambda_c\) independent of \(\varphi\).

For numerical simulation, the aggregate labor market condition, the indifference condition, and the expression for aggregate output are obtained simply by replacing \(s\) by \(b\) in equations (53), (54), and (56).

### 8.7.1 Firing subsidy cannot restore efficiency

It is clear from the discussion in the section on severance payments that to restore efficiency using \(b\) we need the following two conditions to be satisfied.

\[
A' \varphi^{1-\gamma} \gamma \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma - 1} L_f(\varphi)^{\gamma - 1} = w_i - \lambda_c \delta w_i \tag{62}
\]

\[
A' \varphi^{1-\gamma} \gamma \lambda_c \left( \frac{1 - \lambda_c^2}{2} \right)^{\gamma - 1} L_f(\varphi)^{\gamma - 1} = \delta w_i \tag{63}
\]

It follows from (57) and (60) that we need \((1 - \lambda_c)w_f + \lambda_c b = w_i - \lambda_c \delta w_i\) and \(w_f - \psi - b = \delta w_i\).

Suppose the policymaker chooses \(b\) such that \(w_f - \psi - b = \delta w_i\). This implies \(-b = \psi - (w_f - \delta w_i) > 0\). The last inequality follows from the concavity of the utility function. Therefore, a firing subsidy can be chosen to satisfy (63). At that level of \(b\) we also need \((1 - \lambda_c)w_f + \lambda_c b = w_i - \lambda_c \delta w_i\).

Verify that \((1 - \lambda_c)w_f + \lambda_c b\) equals \(w_f - \lambda_c \psi - \lambda_c \delta w_i\). Therefore, we need \(w_f - \lambda_c \psi\) to equal \(w_i\). Or, we need \(w_f - w_i = \lambda_c \psi\). But note that \(\lambda_c \psi\) equals \(\frac{U(w_f) - U(w_i)}{U'(w_f)}\) because \(\lambda_c \psi = \frac{\lambda_c (U(w_f) - U(\delta w_i))}{U'(w_f)} = \frac{U(w_f) - U(w_i)}{U'(w_f)}\) since \((1 - \lambda_c)U(w_f) + \lambda_c U(\delta w_i) = U(w_i)\). Therefore, we need \(w_f - w_i = \frac{U(w_f) - U(w_i)}{U'(w_f)}\) which is possible only if \(U'' = 0\). When \(U'' < 0\) we get \(w_f - w_i < \frac{U(w_f) - U(w_i)}{U'(w_f)}\). Therefore, efficiency cannot be restored using a firing subsidy.
Figure 1: Risk Aversion and Labor Market Outcomes

Figure 1a: Aggregate Output

Figure 1b: Worker Welfare

Figure 1c: Unemployment

Figure 1d: Share of entrepreneurs in formal sector

A=8, B=1, L=1, γ=2/3, δ=0.5, F = 0.75
Figure 1: Risk Aversion and Labor Market Outcomes

- Figure 1e: Rate of job destruction
- Figure 1f: Labor hired in formal sector
- Figure 1g: Labor retained in formal sector

\[ A=8, B=1, L=1, \gamma=2/3, \delta=.5, F = .75 \]
Figure 2: Severance Payments and Labor Market Outcomes

Figure 2a: Aggregate Output

Figure 2b: Worker Welfare

Figure 2c: Unemployment

Figure 2d: Share of entrepreneurs in formal sector

A=8, B=1, L=1, γ=2/3, δ=.5, F=.75
Figure 2: Severance Payments and Labor Market Outcomes

A=8, B=1, L=1, γ=2/3, δ=.5, F = .75
Figure 3: Administrative burden of firing and Labor Market Outcomes

Figure 3a: Aggregate Output

Figure 3b: Worker Welfare

Figure 3c: Unemployment

Figure 3d: Share of entrepreneurs in formal sector

A=8, B=1, L=1, γ=2/3, δ=.5, F = .75
Figure 3: Administrative burden of firing and Labor Market Outcomes

A=8, B=1, L=1, γ=2/3, δ=.5, F=.75
A=8, B=1, L=1, γ=2/3, δ=.5, F =.75
Figure 4: Regulatory Burden and Labor Market Outcomes

- Figure 4e: Rate of job destruction
- Figure 4f: Labor hired in formal sector
- Figure 4g: Labor retained in formal sector
- Figure 4h: Firm level retained labor

Equations:
- \( A=8 \), \( B=1 \), \( L=1 \), \( y=\frac{2}{3} \), \( \delta=.5 \), \( F=.75 \)
Figure 5: Minimum Wage and Labor Market Outcomes

Figure 5a: Aggregate Output

Figure 5b: Worker Welfare

Figure 5c: Unemployment

Figure 5d: Share of entrepreneurs in formal sector

\( A=8, B=1, L=1, \gamma = \frac{2}{3}, \sigma = 0.5, \tau = 0.75 \)
Figure 5: Minimum Wage and Labor Market Outcomes

A=8, B=1, L=1, \gamma=2/3, \delta=.5, F = .75
<table>
<thead>
<tr>
<th>Region</th>
<th>Share of Own Account and Contributing Family Workers</th>
<th>Dismissal Regulations as Defined in the Text</th>
<th>Redundancy Compensation</th>
<th>Minimum Wage to GDP Ratio (%)</th>
<th>GDP per Capita (real USD)</th>
<th>Number of Countries</th>
<th>Years Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Regions</td>
<td>43.05 (22.44)</td>
<td>0.51 (0.16)</td>
<td>0.66 (0.35)</td>
<td>54.95 (44.73)</td>
<td>2,950.91 (2,340.82)</td>
<td>53 (47 for minimum wage)</td>
<td>2000-2014 (2013 for minimum wage)</td>
</tr>
<tr>
<td>East Asia and the Pacific</td>
<td>54.64 (18.56)</td>
<td>0.53 (0.15)</td>
<td>0.72 (0.34)</td>
<td>55.15 (48.37)</td>
<td>2,058.63 (1,865.33)</td>
<td>7</td>
<td>2000-2014 (2013 for minimum wage)</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>29.25 (18.10)</td>
<td>0.54 (0.33)</td>
<td>0.54 (0.11)</td>
<td>26.19 (16.34)</td>
<td>4,366.95 (2,868.58)</td>
<td>13 (12 for minimum wage)</td>
<td>2000-2014 (2013 for minimum wage)</td>
</tr>
<tr>
<td>Latin America</td>
<td>38.71 (11.61)</td>
<td>0.41 (0.17)</td>
<td>0.86 (0.22)</td>
<td>61.43 (29.65)</td>
<td>3,729.53 (1,862.95)</td>
<td>13 (12 for minimum wage)</td>
<td>2000-2014 (2013 for minimum wage)</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>29.54 (14.90)</td>
<td>0.63 (0.11)</td>
<td>0.74 (0.34)</td>
<td>80.72 (73.69)</td>
<td>2,396.41 (849.97)</td>
<td>7 (6 for minimum wage)</td>
<td>2000-2013</td>
</tr>
<tr>
<td>South Asia</td>
<td>63.40 (17.49)</td>
<td>0.63 (0.13)</td>
<td>0.67 (0.32)</td>
<td>58.00 (21.67)</td>
<td>875.26 (412.61)</td>
<td>4</td>
<td>2000-2013 (2011 for minimum wage)</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>61.50 (27.84)</td>
<td>0.47 (0.12)</td>
<td>0.34 (0.32)</td>
<td>72.45 (51.76)</td>
<td>1,582.01 (1,895.09)</td>
<td>9 (6 for minimum wage)</td>
<td>2000-2013</td>
</tr>
</tbody>
</table>

GDP = gross domestic product, USD = United States dollar.

Note: Figures represent average values for all available years (with standard deviation in parenthesis).

Source: Authors’ estimates based on CBRLRI database (accessed 5 January 2016); ILO KILM. http://www.ilo.org/iloStat/faces/wcnav_defaultSelection?_afrLoop=246699509158316&_afrWindowMode=0&_afrWindowId=null!%40%40%3F_afrWindowId%3Dnull%26_afrLoop%3D246699509158316%26_afrWindowMode%3D0%26_adf.ctrl-state%3Dg2madkays_45 (accessed 5 March 2016); and World Development Indicators databases. https://data.worldbank.org/data-catalog/world-development-indicators (accessed 1 June 2016).
Figure 6: Scatter Plots: Share of Informal Employment (own account workers)

A. Log of GDP per capita

B. Dismissal regulations*

C. Redundancy compensation*

D. Minimum wage-to-GDP ratio*

Note: *The residual of labor regulation measure is graphed with the residual of informal employment share with the slope corresponding to estimates between labor regulation measure and informal employment share in model (27) using the base specification in Table 2 (dismissal regulation), Table 3 (redundancy compensation), and Table 4 (minimum wage-to-GDP ratio).

Table 2: Regression Results, Dismissal Regulations

<table>
<thead>
<tr>
<th>Share of Own Account Workers</th>
<th>Base specification (1)</th>
<th>Access to Credit (2)</th>
<th>Ease of Paying Taxes (3)</th>
<th>Inspection Rate (4)</th>
<th>Rule of Law (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln GDP per capita (real USD)</td>
<td>-5.16***</td>
<td>-4.71***</td>
<td>-5.30***</td>
<td>5.23***</td>
<td>-4.58***</td>
</tr>
<tr>
<td>Dismissal regulations</td>
<td>(0.62)</td>
<td>(0.65)</td>
<td>(0.61)</td>
<td>(2.55)</td>
<td>(0.71)</td>
</tr>
<tr>
<td>Share of employment in agriculture</td>
<td>9.51***</td>
<td>10.58***</td>
<td>11.34***</td>
<td>-9.53</td>
<td>8.85***</td>
</tr>
<tr>
<td>Access to credit</td>
<td>(2.37)</td>
<td>(2.42)</td>
<td>(2.43)</td>
<td>(12.29)</td>
<td>(2.82)</td>
</tr>
<tr>
<td>Ease of paying taxes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection rate x Dismissal regulations</td>
<td>69.76***</td>
<td>(25.93)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule of law index</td>
<td></td>
<td></td>
<td></td>
<td>-9.94***</td>
<td>(2.54)</td>
</tr>
<tr>
<td>Rule of law index x</td>
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<td></td>
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<td></td>
<td>14.21***</td>
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<tr>
<td>Dismissal regulations</td>
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<td>(4.51)</td>
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<td>East Asia and the Pacific</td>
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<td>-6.82***</td>
<td>-8.92***</td>
<td>-13.37***</td>
<td>-4.71***</td>
</tr>
<tr>
<td>(1.16)</td>
<td>(1.16)</td>
<td>(1.30)</td>
<td>(3.26)</td>
<td></td>
<td>(1.39)</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>-14.99***</td>
<td>-14.80***</td>
<td>-16.52***</td>
<td>-12.58***</td>
<td>-14.01***</td>
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<td>(0.99)</td>
<td>(0.99)</td>
<td>(1.11)</td>
<td>(2.67)</td>
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<td>(1.09)</td>
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<td>Latin America and the Caribbean</td>
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<td>-12.71***</td>
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<td>(1.28)</td>
<td>(1.44)</td>
<td>(1.37)</td>
<td>(5.67)</td>
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<td>(1.53)</td>
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<td>(1.58)</td>
<td>(1.60)</td>
<td>(4.52)</td>
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<td>(1.90)</td>
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<td>(1.45)</td>
<td>(4.24)</td>
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<td>(1.49)</td>
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<td>55.67***</td>
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<td>(5.71)</td>
<td>(5.77)</td>
<td>(25.52)</td>
<td></td>
<td>(6.39)</td>
</tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Observations</td>
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<td>595</td>
<td>595</td>
<td>73</td>
<td>545</td>
</tr>
<tr>
<td>R-Squared</td>
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<td>0.88</td>
<td>0.88</td>
<td>0.83</td>
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<td>Number of countries</td>
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<td>53</td>
<td>22</td>
<td>51</td>
</tr>
</tbody>
</table>

USD = United States dollar.

Notes: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1.
Source: Authors’ estimates based on CBRLRI database (accessed 5 January 2016); ILO KILM.
Table 3: Regression results, Redundancy Compensation

<table>
<thead>
<tr>
<th>Share of Own Account Workers</th>
<th>Base specification (1)</th>
<th>Access to Credit (2)</th>
<th>Ease of Paying (3)</th>
<th>Inspection Rate (4)</th>
<th>Rule of Law (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln GDP per capita (real USD)</td>
<td>-5.29*** (0.62)</td>
<td>-5.11*** (0.65)</td>
<td>-5.39*** (0.63)</td>
<td>4.91 (3.28)</td>
<td>-4.69*** (0.71)</td>
</tr>
<tr>
<td>Redundancy compensation</td>
<td>1.39 (1.09)</td>
<td>1.18 (1.12)</td>
<td>1.46 (1.09)</td>
<td>2.01 (5.69)</td>
<td>-1.17 (1.42)</td>
</tr>
<tr>
<td>Share of employment in agriculture</td>
<td>0.86*** (0.03)</td>
<td>0.87*** (0.03)</td>
<td>1.28*** (0.17)</td>
<td>0.86*** (0.03)</td>
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</tr>
<tr>
<td>Access to credit</td>
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<td>Inspection rate x Redundancy compensation</td>
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<td>Rule of law index</td>
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<td>Rule of law index x Redundancy compensation</td>
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<td>-3.06** (1.55)</td>
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<td>-6.45 (5.26)</td>
<td>-1.45 (1.73)</td>
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<td>Sub-Saharan Africa</td>
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<td>-10.29*** (1.44)</td>
<td>-11.63*** (1.58)</td>
<td>-9.53* (5.11)</td>
<td>-8.31*** (1.58)</td>
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<td>60.51*** (5.79)</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Observations</td>
<td>595</td>
<td>595</td>
<td>595</td>
<td>73</td>
<td>545</td>
</tr>
<tr>
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<td>0.88</td>
<td>0.88</td>
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<td>53</td>
<td>53</td>
<td>22</td>
<td>51</td>
</tr>
</tbody>
</table>

GDP = gross domestic product, USD = United States dollar.
Notes: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1.
Source: Authors' estimates based on CBRLRI database (accessed 5 January 2016); ILO KILM.
<table>
<thead>
<tr>
<th>Share of Own Account Workers</th>
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<th>Access to Credit</th>
<th>Ease of Paying Taxes</th>
<th>Inspection Rate</th>
<th>Rule of Law</th>
<th>Rule of Law x Minwage to GDP ratio</th>
<th>Inspection rate x Minwage to GDP ratio</th>
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</thead>
<tbody>
<tr>
<td>Ln GDP per capita (real USD)</td>
<td>-3.75***</td>
<td>-3.71***</td>
<td>-3.83***</td>
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<td>-4.77***</td>
</tr>
<tr>
<td></td>
<td>(0.70)</td>
<td>(0.72)</td>
<td>(0.70)</td>
<td>(3.08)</td>
<td>(0.79)</td>
<td>(6.66)</td>
<td>(1.32)</td>
</tr>
<tr>
<td>Minwage to GDP ratio</td>
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<td>0.02**</td>
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GDP = gross domestic product, USD = United States dollar.

Notes: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.