

Firms, Workers and Informality: Evidence from Peru

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## Declaration

I, Alexander Antonio Boca Saravia, hereby declare that the work presented in this dissertation is my own original work. Where information has been derived from other sources, I confirm that this has been clearly and fully identified and acknowledged. No part of this dissertation contains material previously submitted to the examiners of this or any other university, or any material previously submitted for any other assessment.

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## Classification

This piece of research is primarily:

- an empirical/econometric study
- the examination of a theoretical problem
- a critical analysis of a policy issue
- an analytical survey of empirical and/or theoretical literature

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## Abstract

Informality in Peru is among the highest in Latin America and, despite motivating seminal research on the topic, its causes remain unknown. This paper quantifies the relevance of each of the main views of informality according to the literature and measures the firm-level and aggregate effects of four strict formalization policies. Using microdata from Peru, I calibrate a general equilibrium model with heterogeneous-productive firms, workers with two skill levels and two margins of informality: the extensive margin, informal firms, and the intensive margin, informal workers within formal firms. The counterfactual analysis denotes that 33.4% of informal firms are productive enough to operate in the formal sector but are excluded by high entry costs. The firm-level effects of the formalization policies show that all of them imply winners and losers; thus, these policies should be carefully designed. The aggregate results point to large positive effects of lowering entry costs in firm formality, output, tax revenues and welfare, although productivity decreases. Monitoring formal firms increase labor formality, tax revenues and welfare, while output goes down. The positive effects of enforcement on formal firms are related to the high relevance of the intensive margin. Hence, within this framework, a desirable formalization policy in Peru jointly reduces entry costs and increases enforcement on formal firms.

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# 1 Introduction

De Soto (1989), inspired by the Peruvian informal sector, argues that informality is caused by high entry and regulatory costs. If these costs were lowered, informal firms would formalize and become more productive. The influence of De Soto's view of informality motivates the Doing Business Initiative by the World Bank that, to date, promotes the reduction of regulations around the globe. There are two other views of informality in the literature, see La Porta and Shleifer (2008, 2014). The Parasite view argues that informal firms are productive enough to formalize but decide to operate informally to earn higher profits. The Survival view posits that informal firms have very low productivity, so they cannot formalize even in the absence of entry costs. Despite the policy efforts to reduce the costs of formality, Peru is among the most informal economies in Latin America. Appendix 1 presents the costs of formality in Peru compared to other groups of countries and labor informality for Latin American countries.

Quantifying the empirical relevance of the views of informality in Peru is important to understand its economic determinants and explain the effectiveness of different formalization policies. For instance, lowering entry costs is not useful to address informality if the majority of the informal sector is conformed by Parasite or Survival firms. This dissertation contributes to the literature in the following directions: (i) calculates the relevance of each view of informality in the Peruvian informal sector, (ii) quantifies the firm-level along with general equilibrium effects of four strict formalization policies, and (iii) assesses the aggregate effects of these policies in terms of TFP, output, tax revenues and welfare.

Firms and workers with low productivity characterize the informal sector. I use the legal definition of informality that points to the economic activities carried out without meeting the legal regulations such as registration and the payment of taxes, see Perry et al. (2007). The economic relevance of informality follows from its diverse consequences. On the one hand, informality may increase output, as it frees firms and workers from wasteful regulations that prevent their operation in the market. On the other hand, tax evasion reduces the capacity of the government to offer public services, informal firms decide to remain small to avoid enforcement, and the coexistence of formal and less productive informal

firms generates a misallocation of resources that reduces total factor productivity (TFP) and output. These negative effects are particularly important because informality is high among poor and developing countries.

I use microdata from household surveys and the registry of formal firms and workers to calibrate the general equilibrium model in Ulyssea (2018). The model considers workers with two skill levels and firms with heterogeneous productivity that may benefit from informality in two margins: the extensive, enter the informal sector to avoid entry and regulatory costs, and the intensive margin, enter the formal sector but hire workers informally to avoid payroll taxes. As firms also decide on the intensive margin, policies that decrease firm informality do not always address labor informality and vice-versa. Using the calibrated model, I compute counterfactual scenarios under which I quantify the relevance of each of the main views of informality in Peru and assess, under a unified framework, the firm-level and aggregate effects of four strict formalization policies.

I find that 33.4% of the informal sector in Peru corresponds to De Soto's view, a share higher than the 9.4% calculated for Brazil by Ulyssea (2018). This result suggests that lowering entry costs have positive but limited aggregate effects. Moreover, the shares of the Parasite and Survival views are 25.4% and 41.2%, respectively. Thus, the informal sector in Peru is heterogeneous, and the views of informality in the literature are complementary rather than exclusive.

At the firm level, reducing the costs of entering the formal sector benefits formal firms, particularly those with low productivity due to the savings in entry costs. The increase in labor demand from new entrants pushes wages up, which hurts all informal firms. Increasing the supervision of formal firms reduces the value of formal firms with low productivity as these rely on hiring cheap informal workers. Labor demand and wages go down, which benefits all firms in the informal sector. Accordingly, formalization policies imply winners and losers.

With regards to the aggregate effects, lowering entry costs reduces informality among firms from 54.8% to 13.1%. However, as new entrants have low productivity, they hire workers informally, and labor informality actually increases from 56.4% to 61.8%. Higher entry also increases output and tax revenues but reduces TFP as a consequence of low-productive entrants. Monitoring formal firms, the

intensive margin, is effective in reducing labor informality. Labor informality goes down to 29.8%, but the share of informal firms increases to 61.9%. In aggregate, TFP, taxes, and welfare increase due to the increase in formal labor, while output goes down as formal firms face higher hiring costs. The positive effects of enforcement on formal firms are related to the high relevance of the intensive margin in Peru. It is worth noting that less informality in either margin does not always imply higher TFP, output, or welfare.

From a policy standpoint, I argue that a combination of policies that reduce entry costs and increase enforcement on the intensive margin might be optimal to reduce informality in Peru. The former effectively reduces the extensive margin, while the latter reduces the intensive margin; both policies increase tax revenues and welfare and have opposite effects on output that may cancel out. However, it is important to bear in mind the dimensions that the model does not consider. In specific, there is evidence that lower entry costs without good finance do not promote economic growth and that enforcement on the intensive margin may increase unemployment.

The structure of the paper is as follows. Section 2 reviews the relevant work related to the model in Ulyssea (2018), mainly causal evidence of the consequences of formalization policies and structural models of its aggregate effects; section 3 presents facts about the informal sector that motivate the assumptions in the model; section 4 and 5 contain, respectively, the empirical and counterfactual analysis; and section 6 discusses final remarks.

## **2 Literature Review**

The literature on informality in Peru focuses on the descriptive analysis of its possible causes and the effects of formalization policies without providing causal inference. For a review of recent literature on informality in Peru, see Lavado and Campos (2017). The model in Ulyssea (2018) can help to address the lack of studies that seek the causes of informality in Peru as it calculates the relevance of the main views of informality using microdata. The relevance of these views explains the relative effectiveness of formalization policies that reduce the costs



of formality and increase the costs of informality. Furthermore, the framework quantifies the effects of formalization at the firm and aggregate level in a unified general equilibrium setting. For a comprehensive review of the causes and consequences of informality for development, focusing on works that identify causal effects or simulate structural models, see Ulyssea (2020).

Ulyssea (2018) considers heterogeneous-productive firms that may choose informality in two margins: to become informal to avoid entry costs and taxes, the extensive margin, or to enter the formal sector, but to hire workers informally to avoid payroll taxes, the intensive margin. These two margins distort firms' investment decisions as it is profitable for informal firms to remain small to face the lower costs of informality without being noticed by the tax authority. Formal firms incur lower costs when hiring informally but face increasing costs of being detected by the tax authority. Thus, it is optimal to start hiring formal workers only above a certain threshold. Importantly, as firms decide along the two margins, the optimal responses to formalization policies that imply lower informality among firms are not always related to lower labor informality.

The model in Ulyssea (2018) follows from the seminal work of Melitz (2003) with endogenous entry and exogenous exit, but with some innovations in the entry structure, heterogeneity at the worker level and two margins of informality. The model also introduces the intensive margin of informality in the analysis, which, although seldom considered in the literature, accounts for 40% of informal labor in Brazil and 44% in Mexico, see Perry et al. (2007) and De la Parra (2017). In Peru, Cisneros-Acevedo (2021) finds that the intensive margin accounts for 32% of informal labor in the manufacturing sector and concludes that trade liberalization increases informality through the effect on the intensive margin.

Ulyssea (2018) estimates the parameters of the model using microdata from Brazil. The estimated model allows computing the counterfactual scenario in which there is no difference in entry costs between the informal and formal sectors. Measuring firms' values in this counterfactual, the paper finds that, in Brazil, 9.3%, 41.9% and 48.8% of the informal sector correspond to the De Soto's, Parasite and Survival view, respectively. Based on additional counterfactual scenarios, the author studies the firm-level and aggregate effects of reducing entry

costs, reducing payroll taxes, and increasing enforcement on the extensive and intensive margins. The firm-level effects conclude that all formalization policies involve winners and losers. The aggregate results of reducing entry costs and increasing enforcement on the extensive margin point to reductions of informality on both margins and increases in tax revenues and output, while their effects on TFP and welfare are in opposite directions. Thus, a combination of policies that reduce entry costs along with an increase in enforcement on the extensive margin might be desirable in Brazil, see also Ulyssea (2020).

The firm-level effects are connected to the studies of formalization policies that are based on microdata. First, regarding the reduction of the costs of formality, there is evidence that reducing entry costs has limited or null effects in promoting formalization among firms, see Bruhn and McKenzie (2014). Jaramillo (2013), based on an experiment in Lima, Peru's capital, finds that only 25% of informal firms acquire a license when offered at no cost, along with information about the process. See also De Giorgi and Rahman (2013), and Benhassine et al. (2018) for informing firms about registration and the perks of formality; De Mel, McKenzie and Woodruff (2013) and De Andrade, Bruhn and McKenzie (2016) for offering repayment of entry costs; and, Bruhn (2011), Kaplan, Piedra and Seira (2011), Piza (2018) and Rocha, Ulyssea and Rachter (2018) for large scale projects also aimed at reducing entry costs. In addition, lowering the costs of operating in the formal sector such as taxes has larger but also limited effects, see Fajnzylber, Maloney and Montes-Rojas (2011), Monteiro and Assuncao (2012), Piza (2018) and Rocha, Ulyssea and Rachter (2018). Second, policies that increase the costs of informality aim at increasing enforcement. De Andrade, Bruhn and McKenzie (2016) and De Giorgi, Ploenzke and Rahman (2018) find that inspections are a more effective formalization policy than reducing the costs of formality. However, the first work emphasizes that most of the effects are over larger firms. In terms of firms' performance, like profits or productivity, the effects of registration are not significant, see Jaramillo and Alcázar (2012), Jaramillo (2013) and Benhassine et al. (2018). Finally, unlike these studies, the model in Ulyssea (2018) adds to the analysis the general equilibrium effects of formalization that result to be substantial.

Although the firm-level effects are small, the large extension of the informal sector along with the strictness of the formalization policies generate sizable aggregate effects at the macro level. In this regard, lowering entry costs gets rid of non-productive barriers and increases the mass of firms in the economy and output; however, since the new entrants have low productivity, TFP diminishes, see Ulyssea (2010b), D’Erasmus and Moscoso Boedo (2012), Charlot, Malherbet and Terra (2015) and Ulyssea (2018). The reduction of payroll taxes has positive but limited formalization effects, while the aggregate effects over output are positive, see Ulyssea (2010b), D’Erasmus and Moscoso Boedo (2012), Ulyssea (2018) and Haanwinckel and Soares (2021). Increasing enforcement on the extensive margin generates positive aggregate effects from the reallocation of resources from the informal to the formal sector, which increases productivity and output in the economy: Ulyssea (2010a), Bosch and Esteban-Pretel (2012), Ordonez (2014), Charlot, Malherbet and Terra (2015), Meghir, Narita and Robin (2015) and Ulyssea (2018). Increasing enforcement on the intensive margin increases labor formality and reduces firm size and output since it gets riskier to hire cheap informal workers: Almeida and Carneiro (2009, 2012), De la Parra (2017) and Ulyssea (2018). Importantly, the model in Ulyssea (2018) follows this vein by quantifying the aggregate results in terms of the mass of firms, tax revenues, TFP, output and welfare.

## **3 Informality in Peru**

### **3.1 Definitions and Data**

I use the legal definitions of informality at the firm and worker level from the National Institute of Statistics and Informatics of Peru (INEI). Informal firms are not registered with the tax authority, therefore, do not pay VAT, whereas informal workers are employees who are not registered with the tax authority by their employers to evade payroll taxes. I define informal firms as employers and independent workers who operate at a fixed location outside their households. To focus on the firm’s hiring decisions, I consider as workers only the ones who are dependent or salaried. On the firm side, I restrict the analysis to the private

sector and exclude agricultural and forestry activities.

I use two datasets to calibrate the model. First, the Peruvian National Survey of Households (ENAHO) is a publicly available annual cross-section grouped into modules. ENAHO.500 contains information about the labor force such as formality status, the role of the worker and the number of workers at the workplace, and sociodemographics in both the formal and informal sectors. ENAHO.04 covers questions directly asked independent workers who run their own businesses, most of them in the informal sector. Thus, it is possible to distinguish, for example, street vendors from workshops and restaurants, which are closer to the definition of a firm. Because of the available information in ENAHO.04, ENAHO is considered a mixed household-enterprise survey, which, according to Herrera (2017), are more suitable to study the informal sector than enterprise surveys. The main reasons are that informal productive units have a high exit rate and are not based on registered or own locals, but households or public markets. Thus, any census of informal firms would become obsolete quickly. Appendix 2 details the categories in ENAHO.

Secondly, I use the Electronic Payroll Registry (*Planilla Electronica*), the registry of formal firms administered by the Ministry of Labour and Employment Promotion (MTPE), to compute the complete size distribution of formal firms. Each month, formal employers that hire 1 or more workers are obligated to complete this registry online, which is then used to calculate their obligations in terms of payroll taxes. In exchange, registered employees receive public health insurance. ENAHO is from 2019 and, since *Planilla Electronica* is a monthly registry, I take the average number of workers reported by each firm in 2019, as MTPE also reports it. Appendix 3 illustrates the data cleaning process. In the next subsections, I follow the analysis in Ulyssea (2018) to verify some facts of Peru's informal sector that contradict the hypothesis that all informal firms belong to the Survival view.

## 3.2 Firms

As discussed in La Porta and Shleifer (2008, 2014), informal firms are characterized for being smaller, less productive, paying lower wages and being run by less

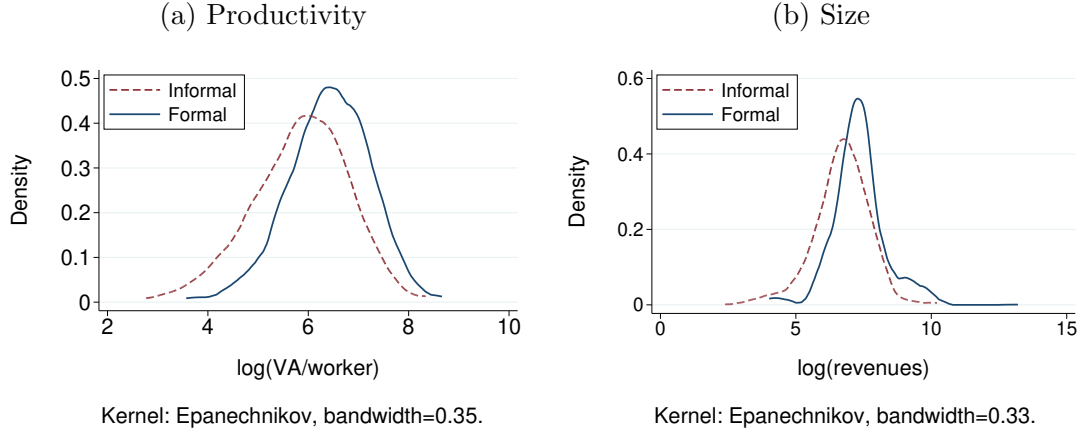


Figure 1: Productivity and Size Distributions among Small Entrants.

Notes: Source: ENAHO 2019. Small entrants are employers and independent workers with a fixed workplace outside their households and at most 1 year in the market. Productivity is calculated as the value-added per worker, and size is measured as revenues. I control for industry dummies to get both indicators.

educated entrepreneurs. Considering this evidence, the authors conclude that the informal sector in developing countries is constituted by agents with very low productivity that have few possibilities to grow and ever become formal.

Figure 1 shows the productivity and size distributions of small firms up to 1-year-old in both the informal and formal sectors. Although the distributions of formal firms are shifted to the right, there is a large overlap between the formal and informal sectors. Panel (a) proxies productivity as the value-added per worker in the firm, whereas Panel (b) measures size as revenues. The higher productivity and size of formal entrants indicate that firms sort into sectors at the moment of entry. Moreover, since there is a productivity region in which both types of firms coexist, entry is not determined completely by productivity at the moment of entry; otherwise, the distributions should be disjoint. More importantly, the amplitude of the overlap suggests that a considerable share of informal firms have similar productivity to their formal counterparts with similar size and, thus, are productive enough to enter the formal sector.

### 3.3 Workers

Informal workers usually attain lower education levels and earn lower salaries than those hired formally. Regarding the former, I call high-skilled workers those who at least finished high school and low-skilled workers those who did not complete high school. Another important fact is that informality among low-skilled workers is higher, and the share of this type of worker goes down with firm size. For Peru, see subsection 4.2.

I also examine the wage gap between formal and informal workers. Table 1 shows the results of regressing log wages on a dummy for informality and other observable characteristics. All regressions control for industry dummies at the 4-digit level. Column 1 shows that the wage gap is significant even after controlling for skill level, sex, age, and the firm's productive sector. Column 2 considers only employees, both formal and informal, who work within formal firms with at most 4 employees. Although the sample and the magnitude of the wage gap are lower, the latter is still significant at the 99 percent level. Finally, Column 3 uses the same sample as in column 2 but also controls for firms characteristics such as the district in which the firm is based and its number of workers. In this case, the wage gap is no longer statistically significant, which suggests that in small formal firms, conditional on skill levels, formal and informal workers have similar roles.

### 3.4 The Extensive and Intensive Margins of Informality

Figure 2 shows that both the extensive and intensive margins of informality decrease with firm size, which is compatible with the findings in other countries, see Perry et al. (2007) and Ulyssea (2018). This stylized fact reflects that informality incentives firms to remain small to avoid being caught by the tax authority. For computations, I deem the sample size in ENAHO useful to study informality in firms with at most 6 workers. Panel (a) shows that the extensive margin by firm size from ENAHO.04 and *Planilla Electronica* decreases with firm size. The rationality behind this result is twofold. On the one hand, enforcement is increasing in firm size. On the other hand, smaller firms have lower productivity and, thus, enter the informal sector as they are less able to pay the costs of formality. Panel

Table 1: Formal-Informal Wage Gaps

|                        | log(wage)          |                    |                    |
|------------------------|--------------------|--------------------|--------------------|
|                        | (1)                | (2)                | (3)                |
| Formal contract        | 0.4525<br>(0.014)  | 0.3056<br>(0.060)  | 0.0911<br>(0.167)  |
| High skill             | 0.1578<br>(0.018)  | 0.0626<br>(0.052)  | -0.0483<br>(0.177) |
| Male                   | 0.1981<br>(0.015)  | 0.1884<br>(0.048)  | 0.1225<br>(0.109)  |
| Age                    | 0.0492<br>(0.003)  | 0.0342<br>(0.010)  | 0.0093<br>(0.028)  |
| Age squared            | -0.0005<br>(0.000) | -0.0004<br>(0.000) | -0.0001<br>(0.000) |
| N                      | 12,235             | 1,164              | 1,164              |
| R <sup>2</sup>         | 0.517              | 0.483              | 0.451              |
| Firm's characteristics | No                 | No                 | Yes                |

Notes: (1): ENAHO 2019: All employees. (2)-(3): ENAHO 2019: Formal firms with less than 4 workers. All regressions control for industry dummies at the 4-digit level.

(a) also shows that informality among firms with 1 to 3 employees is higher than 50%, whereas this share decreases rapidly as firms get larger than 5 employees.

Panel (b) shows the intensive margin of informality, that is, the share of informal workers within formal firms by firm size from ENAHO.500. I argue that the intensive margin of informality is particularly large in Peru due to the existence of regulations that allow small formal firms to hire workers informally. Based on a survey of small formal firms that operate under the Law for Promotion and Formalization of Micro and Small Enterprises (*Ley Mype*), Chacaltana (2017) finds that 50% does not register their employees in *Planilla Electronica*, i.e., only hire informally. Moreover, Arias (2017) claims that formal firms under the New Unified and Simplified Tax Regime (NRUS), which replaces VAT with a fixed monthly payment, hire all employees informally as they do not have payroll obligations. There is a need for more research on whether these tax regimes are cost-effective to reduce firm informality and to what extent facilitate labor informality. Panel (b) indicates that the intensive margin of informality gets smaller as firms get larger; however, because of relatively low enforcement, even formal firms with 6 employees hire almost 80% of total employees informally.

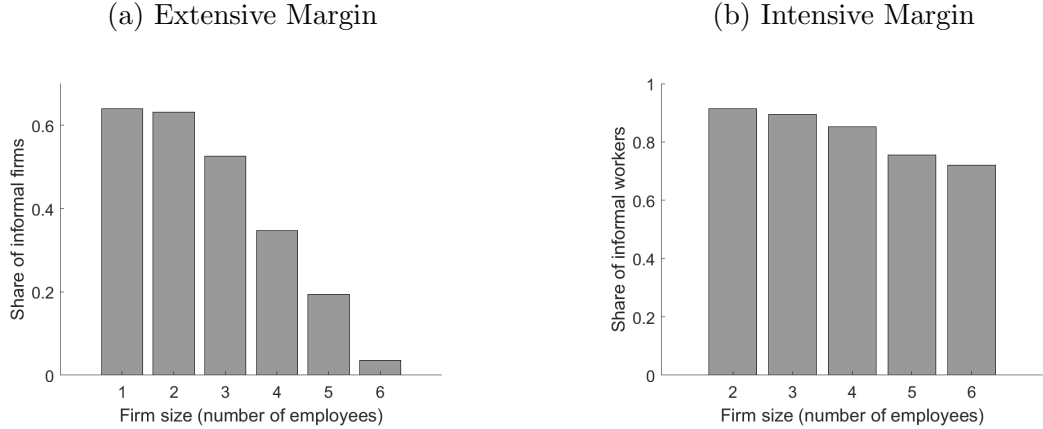


Figure 2: The Margins of Informality by Firm Size.

Notes: Source: ENAHO and *Planilla Electronica* 2019. Panel (a) displays informality among firms and Panel (b) shows labor informality in the formal sector.

## 4 Quantitative Analysis

### 4.1 Model

I use the general equilibrium model with heterogeneous firms and workers with two skill levels in Ulyssea (2018). To avoid the costs of formality, firms can choose to enter the informal sector, the extensive margin, or to be formal, but hire workers informally, the intensive margin.

Firms are ex-ante heterogeneous, characterized by a productivity parameter,  $\theta$ , and have equal technologies in both sectors that use labor as only input:  $y(\theta, \ell) = \theta q(\ell)$ , where  $q(\cdot)$  is twice differentiable, increasing and concave. Moreover, firms are price-takers, sell a homogeneous good and hire workers of two different skills: high and low. To make the exposition simpler, the model is introduced abstracting from labor heterogeneity, as the introduction of skill levels does not change the main properties of the model.

Informality adds a size-dependent distortion to the model. On the one hand, informal firms avoid entry costs and taxes but face increasing labor costs,  $\tau_i(\ell)$ , where  $\tau_i(\cdot)$  is increasing and convex because larger firms are easier to be detected by the tax authority. Thus, it is optimal for informal firms to remain small. The profits of informal firms is defined by:



$$\Pi_i(\theta, w) = \max_l \{\theta q(\ell) - w\tau_i(\ell)\}.$$

On the other hand, formal firms are subject to payroll taxes,  $\tau_w$ , when hiring formally. To avoid these costs, formal firms can hire informal workers but also face an increasing probability of being caught, i.e.,  $\tau_{fi}(\ell)$ , where  $\tau_{fi}(\cdot)$  is increasing and convex. Therefore, it is optimal for formal firms to hire informal workers and, only in excess of a threshold,  $\tilde{\ell}$ , some formal workers. The profits of formal firms are denoted by:

$$\Pi_f(\theta, w) = \max_\ell \{(1 - \tau_y)\theta q(\ell) - C(\ell)\},$$

where

$$C(\ell) = \begin{cases} \tau_{fi}(\ell)w & \text{for } \ell \leq \tilde{\ell} \\ \tau_{fi}(\tilde{\ell})w + (1 + \tau_w)w(\ell - \tilde{\ell}) & \text{for } \ell > \tilde{\ell}, \end{cases}$$

and where  $\tau_y$  and  $\tau_w$  are the VAT and payroll tax rates, respectively. Finally, in addition to labor costs, entrants pay a fixed cost of operation each period:  $\bar{c}_s$ ,  $s = i, f$ . The net profit function is  $\pi_s(\theta, w) = \Pi_s(\theta, w) - \bar{c}_s$ .

Given the costs introduced by informality, intuitively, both the extensive and intensive margins are decreasing in firm size in the model. Thus, the model is compatible with one of the stylized facts about informality discussed in the previous section.

Each period, there are  $M$  potential entrants with productivity drawn from a distribution  $\nu \sim G$ , where  $\nu$  is i.i.d. and  $G$  is absolutely continuous with support  $(0, \infty)$ . Firms also need to pay constant entry costs to enter either of the sectors, where  $E_f > E_i$ . The difference in entry costs,  $E_f - E_i$ , represent any minimum investment needed to start operations in the formal sector, such as regulations, licenses and fees.

Next, after entering either of the sectors, firms observe their actual productivity,  $\theta$ , from a distribution  $F(\theta|\nu)$  and decide whether to stay or exit immediately.  $F(\theta|\nu)$  is such that higher pre-entry productivity,  $\nu$ , implies a greater probability of drawing a high  $\theta$ . This is consistent with the fact that the entry decision in either of the sectors is permanent and fundamental to explain the overlap in productivity between firms in the formal and informal sectors. If productivity

were completely determined before entry, the productivity and size distributions would be disjoint. Actual entrants with a constant productivity  $\theta$  face each period an exit probability  $\kappa_s$ ,  $s = i, f$ . The value function of a firm with actual productivity  $\theta$  is:

$$V_s(\theta, w) = \max\left\{0, \frac{\pi_s(\theta, w)}{\kappa_s}\right\},$$

where, intuitively,  $\kappa_f < \kappa_i$  and the difference between exit rates represent the relative benefits to belong to the formal sector. Firms stay in the market after entry only if  $V_s > 0$ . The expected value before entry of a firm with signal  $\nu$  is:

$$V_s^e(\nu, w) = \int V_s(\theta, w) dF(\theta|\nu), \quad s = i, f.$$

It is possible to enter the formal sector if  $V_f^e(\nu, w) - E_f \geq \max\{V_i^e(\nu, w) - E_i, 0\}$ , whereas entry into the formal sector occurs if  $V_i^e(\nu, w) - E_i > \max\{V_f^e(\nu, w) - E_f, 0\}$ . Cases in which entry is possible in both sectors require:

$$\begin{aligned} V_i^e(\bar{\nu}_i, w) &= E_i, \\ V_f^e(\bar{\nu}_f, w) &= V_i^e(\bar{\nu}_f, w) + E_f - E_i, \end{aligned}$$

, where  $\bar{\nu}_s$  is lowest pre-entry signal among the firms that enter sector  $s = i, f$ .

To close the model,  $\bar{L}$  labor is supplied inelastically by a representative household which utility depends solely on the consumption of the homogeneous good,  $x$ ,  $U = \sum_{t=0}^{\infty} \beta^t u(x_t)$ . The stationary equilibrium requires that the following conditions hold: (i) labor market clears  $L_i + L_f = \bar{L}$ ; (ii) the zero profit cutoff condition,  $\theta \geq \bar{\theta}_s$ , where  $\pi_s(\bar{\theta}_s, w) = 0$ , holds in both sectors; (iii) there is free entry in both sectors; and (iv) the size of both sectors does not change.

Finally, heterogeneity in labor is defined by expressing the labor input in each of the sectors,  $l_s$  as a CES aggregation of high-skill,  $l_1$ , and low-skill,  $l_2$ , workers:

$$\ell_s = (\eta_s l_1^\rho + (1 - \eta_s) l_2^\rho)^{1/\rho},$$

where  $s = i, f$  and  $\eta_s$  represents the abundance of high-skill workers in sector  $s$  and  $\rho$  is the substitution parameter. The profits of informal firms are:

$$\Pi_i(\theta, w_1, w_2) = \max_{l_1, l_2} \{\theta q(\ell_i) - \tau_i(\ell_i)(w_1 l_1 + w_2 l_2)\}$$

Formal firms, however, incur different costs when hiring workers with different skills because of institutional reasons: high-skill workers are more likely to denounce a firm if it hires them informally. The difference in costs implies that the thresholds to hire formal workers also differ by skill levels. Thus, formal firms can hire workers in three ways: (i) only hire informally when  $l_s^* \leq \tilde{l}_s$ , (ii) hire informally all low-skill workers and hire formally a few high-skill workers when  $l_1^* > \tilde{l}_1$ ,  $l_2^* \leq \tilde{l}_2$  and (iii) hire formally workers of both skill levels when  $l_s^* > \tilde{l}_s$ . The profits of formal firms:

$$\Pi_f(\theta, w_1, w_2) = \max_{l_1, l_2} \{(1 - \tau_y)\theta q(\ell) - C(l_1, l_2)\},$$

where the cost function  $C(l_1, l_2)$ :

$$C(l_1, l_2) = \begin{cases} \tau_{f1}(l_1)w_1 + \tau_{f2}(l_2)w_2 & \text{for } l_s \leq \tilde{l}_s, s = 1, 2 \\ \tau_{f1}(\tilde{l}_1)w_1 + (1 + \tau_w)w_1(l_1 - \tilde{l}_1) + \tau_{f2}(l_2)w_2 & \text{for } l_1 > \tilde{l}_1, l_2 \leq \tilde{l}_2 \\ \sum_{s=1,2} \{\tau_{fs}(\tilde{l}_s)w_s + (1 + \tau_w)w_s(l_s - \tilde{l}_s)\} & \text{for } l_s > \tilde{l}_s, s = 1, 2. \end{cases}$$

Informal firms do not pay taxes but face a trade-off when hiring informally. Large informal firms can produce more and earn additional revenues; however, they are easier to detect by the tax authority and be penalized. For this reason, informal firms choose a finite optimal level of labor of both skill levels, whereas formal firms hire some unskilled workers informally and some skilled and unskilled workers formally.

## 4.2 Calibration and Model Fit

This subsection presents the parameterization of the model, see Ulyssea (2018), the steps for calibration and how well the model replicates the distribution of informality in Peru. The pre-entry productivity follows a Pareto distribution, which is largely used to study the distributions of firms, wealth and income, see Gabaix (2016).

$$F_\nu(\nu \geq x) = \begin{cases} \left(\frac{\nu_0}{x}\right)^\xi & \text{for } x \geq \nu_0 \\ 1 & \text{for } x < \nu_0 \end{cases}$$

The actual or after-entry productivity,  $\theta = \varepsilon\nu$ , is the result of the product of the pre-entry signal with a log-normally distributed i.i.d shock  $\varepsilon$  with zero mean and variance  $\sigma^2$ . As a result,  $\theta$  follows a Pareto-Lognormal distribution, which is useful to reproduce firm size distributions, see Luttmer (2007).

The production function is  $y(\theta, \ell_s) = \theta \ell_s^\alpha$ , where  $\alpha < 1$  and  $\ell_s$  denotes the CES aggregation of both types of workers in sector  $s = i, f$ . The institutional costs of the extensive and intensive margins are, respectively,  $\tau_i(\ell_i) = (1 + \frac{\ell_i}{b_i})$ , where  $b_i > 0$  and  $\tau_{f,k}(l_k) = (1 + \frac{l_k}{b_{fk}})l_k$ , where  $k = 1, 2$  is the worker's skill level and  $b_{fk} > 0$ . Lastly, each period, firms face fixed costs of production that depend on the equilibrium wage of unskilled workers:  $\bar{c}_s = \gamma_s w_2$ ,  $0 < \gamma_s \leq 1$ .

In what follows, I explain how the parameters determine the firm size distribution and the importance of both margins of informality in the simulated stationary equilibrium. The Pareto shape parameter,  $\xi$ , models the size distribution of all firms. As  $\xi$  increases, the right tail of the distribution becomes thinner and the importance of small firms increases. The variance of the post-entry shock,  $\sigma$  reflects the overlap between the size distribution of firms in both sectors. If  $\sigma = 0$ , the size distributions are disjoint.  $b_i$  reflects enforcement on the extensive margin and determines the speed at which the share of informality among firms decreases with firm size. Similarly,  $b_{f1}$  and  $b_{f2}$  reflect enforcement on the intensive margin, thus, are related to the share of informal workers within formal firms. The exit rate in the informal sector  $\kappa_i$ , given  $\kappa_f$ , decreases the value and size of all firms in the informal sector. Entry costs into the formal sector,  $E_f$ , impact the size distribution of formal firms. If entry costs into the formal sector are higher, fewer small firms can enter the formal sector. Finally, the fixed costs in the informal sector,  $\gamma_i$ , given  $\gamma_f$ , lowers the share of small firms in the informal sector.

Using ENAHO and *Planilla Electronica*, I compute the following sample moments to target the calibration of the parameters: (a) informality share among low-skilled, high-skilled and all employees (ENAHO.500); (b) the total share of informal firms and among firms with size 1-2, 3-4, and 5-10 employees (ENAHO.04 + *Planilla Electronica*); (c) the share of informal workers within all formal firms with size 2-3 and 4-5 employees (ENAHO.500); (d) the share of informal firms

with less than 2 and less than 5 employees (ENAH0.04); and (e) the share of formal firms with 1-5, 5-10, 11-20, 21-50, and more than 50 employees (*Planilla Electronica*).

I calibrate the model starting from the statutory tax rates for payroll and VAT taxes denoted by  $\psi = \{\tau_w, \tau_y\}$ .  $\tau_w = 0.09$  is the percentage of the wage paid by the employer for each employee in *Planilla Electronica*. In exchange, registered employees receive access to public health insurance (EsSalud).  $\tau_y = 0.18$  is the VAT rate (IGV) that is collected under a credit scheme. I estimate  $\kappa_f = 0.152$  from an internal report of the flow of formal firms in 2021 by Peru’s Central Bank with data of *Planilla Electronica*.  $\nu_0 = 7.7$  such that firms can hire at least one worker. Lastly,  $\gamma_f = 0.45$  implies that fixed costs in the formal sector are half of the low-skill workers’ equilibrium wage.

Next, to calibrate the remaining parameters, I begin by simulating the model using the estimated values in Ulyssea (2018) for Brazil. I first increase the values for  $b_{f1}$  and  $b_{f2}$  to match, as discussed in subsection 3.4., the large intensive margin of informality in the sample. I further increase  $b_i$  to match the extensive margin. Since higher values of  $b_s$  imply lower regulation, the overall share of informal workers also increases to levels closer to the ones in the sample. It is possible to replicate more precisely the levels of labor informality by skill level using  $\eta_I$  and  $\eta_F$ . A higher value of  $\xi$  is compatible with the larger share of small firms in Peru. Finally, I increase  $E_f$  to replicate the right tail of the size distribution in the formal sector. Table 2 shows the calibrated parameters.

Table 3 indicates that the simulated moments replicate the ones in the data quite well. In addition, Figure 3 shows that the share of high-skilled workers increases in firm size, as in the data. Importantly, the share of high-skilled workers is high: 75% in firms with 2 employees to 78% in firms with 6 employees. Figure 4 graphs the size distribution of the (a) extensive and (b) intensive margins of informality. Although the extensive margin decreases faster in the data (Panel a), the total share of informal firms is replicated closely (Table 3). With regards to the intensive margin (Panel b), the simulated distribution follows closely the one observed in the sample.

Table 2: Parameter Values

| Parameter      | Description                              | Value   |
|----------------|--|---------|
| ${}^1\tau_w$   | Payroll tax                              | 0.090   |
| ${}^1\tau_y$   | Revenue tax                              | 0.180   |
| ${}^2\kappa_f$ | Formal sector's exit probability         | 0.152   |
| $\nu_0$        | Pareto's location parameter              | 7.7     |
| $\gamma_f$     | Fixed costs per period (formal sector)   | 0.45    |
| $\alpha$       | Cobb-Douglas coefficient                 | 0.605   |
| $b_{f1}$       | Intensive mg. cost: skilled              | 57.61   |
| $b_{f2}$       | Intensive mg. cost: unskilled            | 80.94   |
| $b_i$          | Extensive mg. cost                       | 59.01   |
| $\kappa_i$     | Informal sector's exit probability       | 0.385   |
| $\gamma_i$     | Fixed costs per period (informal sector) | 0.208   |
| $\xi$          | Pareto's shape parameter                 | 3.58    |
| $\sigma$       | Post-entry shock variance                | 0.245   |
| $\rho$         | CES elasticity parameter                 | 0.290   |
| $\eta_I$       | Informal CES share parameter             | 0.708   |
| $\eta_F$       | Formal CES share parameter               | 0.779   |
| $E_f^a$        | Formal sector's entry cost               | 4,686.2 |
| $E_i^a$        | Informal sector's entry cost             | 2,023.4 |

Notes: <sup>1</sup>Statutory values, <sup>2</sup> estimated, all other parameters are calibrated to match the sample moments. The high values for  $b_{f1}$  and  $b_{f2}$  reflect loose enforcement on the intensive margin.

## 5 Counterfactual Analysis

### 5.1 Taxonomy of the Informal Sector

The model in Ulyssea (2018) allows assessing the relevance of each of the three main views of informality according to La Porta and Schleifer (2008, 2014).

Figure 5 shows the expected value of entry net of entry costs in the informal sector,  $V_i^e - E_i$ , in solid red; in the formal sector,  $V_f^e - E_f$ , in solid black; and in the formal sector under the counterfactual scenario ( $E_f = E_i$ ),  $V_f^{e,c} - E_i$ , in dashed black. The horizontal axis is the pre-entry productivity signal,  $\nu$ . Thus, firms with  $\nu < \nu_3$  enter the informal sector in the baseline since their net expected value of entry is higher in the informal sector than in the formal one. Firms

Table 3: Simulated and Data Moments

| Moments                                  | Source                                 | Model | Data  |
|--|--|-------|-------|
| <i>Share of informal workers</i>         |  |       |       |
| All                                      | ENAH0.500                              | 0.562 | 0.562 |
| Low-skilled                              | ENAH0.500                              | 0.806 | 0.806 |
| High-skilled                             | ENAH0.500                              | 0.501 | 0.512 |
| Share of informal firms                  | ENAH0.04 + <i>Planilla Electronica</i> | 0.548 | 0.546 |
| <i>Intensive margin</i>                  |  |       |       |
| 2 – 3 employees                          | ENAH0.500                              | 0.994 | 0.903 |
| 4 – 5 employees                          | ENAH0.500                              | 0.781 | 0.798 |
| <i>Size distribution: informal firms</i> |  |       |       |
| ≤ 2 employees                            | ENAH0.04                               | 0.763 | 0.851 |
| ≤ 5 employees                            | ENAH0.04                               | 0.979 | 0.996 |
| <i>Size distribution: formal firms</i>   |  |       |       |
| 1-5 employees                            | <i>Planilla Electronica</i>            | 0.809 | 0.809 |
| 6-10 employees                           | <i>Planilla Electronica</i>            | 0.098 | 0.091 |
| 11-20 employees                          | <i>Planilla Electronica</i>            | 0.050 | 0.053 |
| 21-50 employees                          | <i>Planilla Electronica</i>            | 0.029 | 0.026 |
| 50+                                      | <i>Planilla Electronica</i>            | 0.015 | 0.021 |

Notes: ENAH0.500 and ENAH0.04 are from the Peruvian National Survey of Households, whereas *Planilla Electronica* denotes the registry of formal firms and workers. Both datasets correspond to 2019. I only consider workers who are dependent or salaried. Agriculture, Forestry and Public sectors are excluded from the analysis.

with  $\nu_2 < \nu < \nu_3$  enter the formal sector under the counterfactual scenario, and, although firms with  $\nu_1 < \nu < \nu_2$  have positive net expected value in the formal sector under the counterfactual, that is, can enter the formal sector, decide to remain informal to earn a higher value. More importantly, after entering the market, firms observe their actual productivity,  $\theta$ , and stay in the economy only if their lifetime value is positive  $V_s^c > 0$ , where  $s = i, f$ . At the same time, they formalize after entry if they gain more value in the formal sector under the counterfactual,  $V_f^c - E_f > V_i^c - E_i$ .

Hence, it is possible to define the views of informality within this framework. Considering all informal entrants in the baseline ( $\nu < \nu_3$ ), De Soto's view argues that, if there were no entry costs ( $E_f = E_i$ ), informal firms formalize because have enough productivity ( $\nu_2 < \nu < \nu_3$ ) to operate in the formal sector ( $V_f^c > 0$  or  $V_f^c - E_f > V_i^c - E_i$ ). The Parasite view posits that, if there were no entry costs ( $E_f = E_i$ ), informal firms can operate in the formal sector ( $\nu_1 < \nu < \nu_2$ ,  $V_f^c > 0$ ), but decide to remain informal to earn higher profits ( $V_f^c - E_f < V_i^c - E_i$ ). Finally, the rest of the firms that cannot enter the formal sector even if there were no

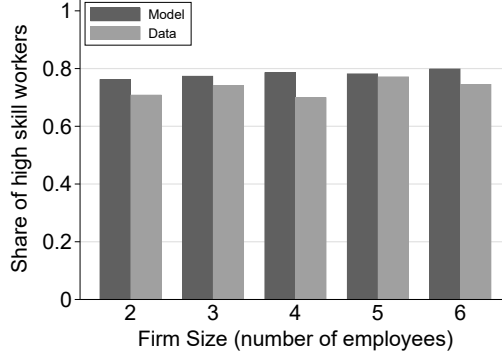


Figure 3: Share of High Skill Workers per Firm Size

Notes: High-skill workers are the ones who at least completed high school. The figure shows the share of high-skill workers within all firms with sizes 2, 3, ..., 6.

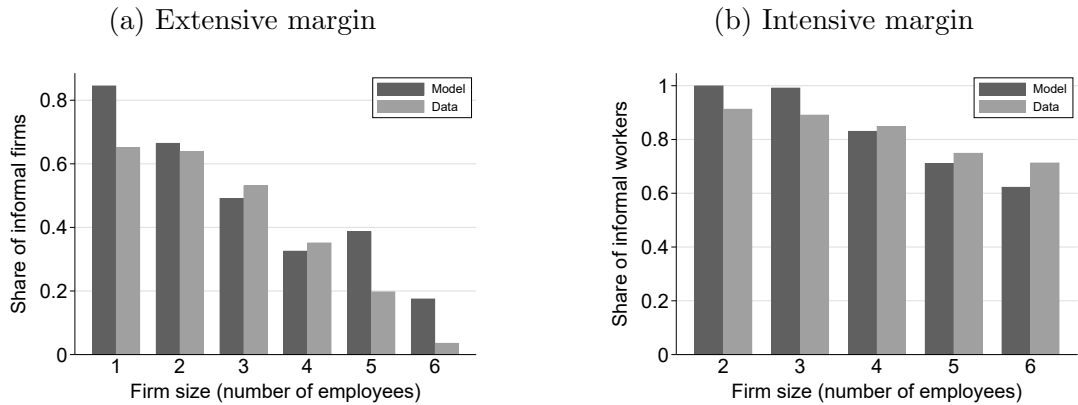


Figure 4: Extensive and Intensive Margins of Informality

Notes: Panel (a) presents the share of informal firms by sizes 1, 2, ..., 6 workers. Panel (b) presents the share of informal workers within all formal firms with sizes 2, 3, ..., 6.

entry costs,  $\nu < \nu_1$ , correspond to the Survival view.

I find that the 33.4% of the firms in the Peruvian informal sector corresponds to De Soto's view, whereas the Parasite view accounts for the 25.4%. Hence, the main views of informality according to La Porta and Shleifer (2008, 2014) are complementary rather than competitive in Peru and represent heterogeneous-productive firms in the informal sector.

The small share of firms that formalize when there are no entry costs (33.4%) is in line with the causal evidence that points to the limited formalization effect of this policy. In an experiment in Lima, Peru's capital, Jaramillo (2013) finds that only 25% of informal firms acquire a license when offered at no cost. However,



33.4% is many times larger than the 9.3% calculated in Ulyssea (2018) for Brazil. In the context of the model, this result follows from the lower ongoing costs of formality in Peru in terms of tax rates and loose regulation on the intensive margin of informality. Thus, once there are no entry costs, a larger share of informal firms find formalization easy by hiring cheap informal workers.

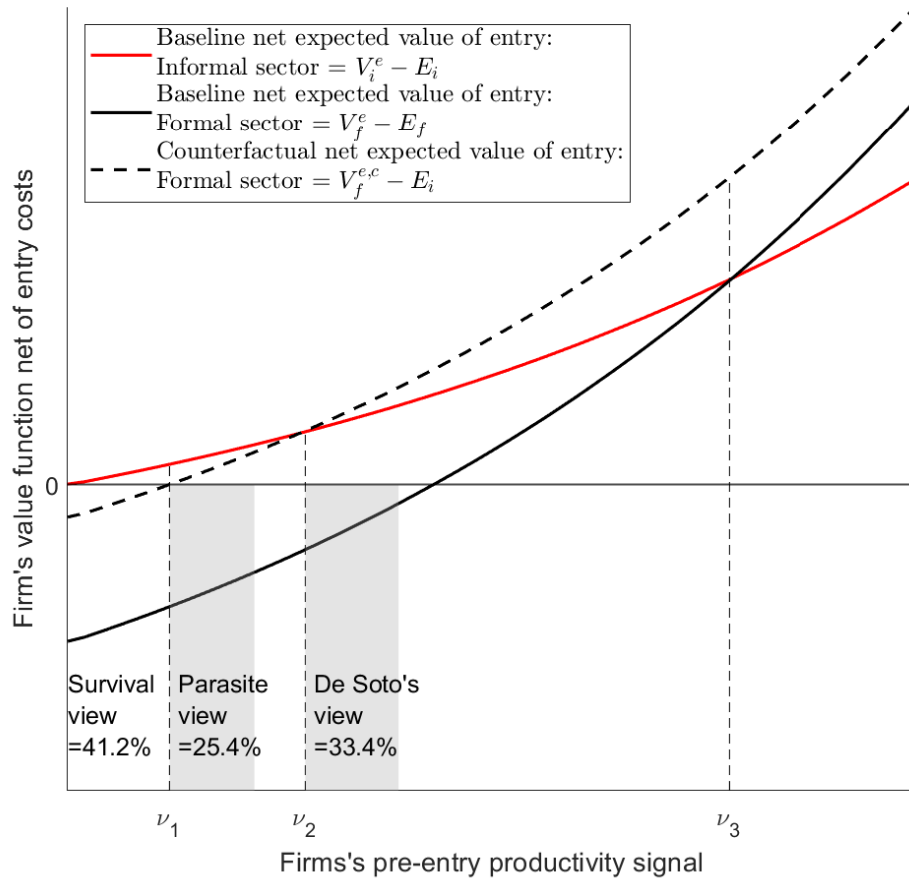


Figure 5: The Distribution of Informal Firms Types in Peru

Notes: Shaded areas represent the relevance of the views of informality based on values,  $V_s$ , after firms enter either of the sectors, observe their actual productivity,  $\theta$ , and decide whether to stay in the economy.

The shares of the De Soto's and Parasite view suggest that in Peru, the aggregate effects of lowering entry costs and increasing enforcement to get rid of parasite firms, respectively, are limited. It is important to note that Ulyssea (2018) finds an even smaller share for De Soto's view and shows that reducing entry costs have large aggregate effects because of the higher entry of new firms in the economy. Output, tax revenues and welfare increase, but TFP decreases

as new formal firms have low productivity. I assess the firm-level and aggregate effects of four strict formalization policies in the next subsection.

## 5.2 Effects of Formalization Policies

I simulate the following strict formalization policies as counterfactual scenarios: (i) Reduce the entry costs in the formal sector to the level in the informal sector ( $E_f = E_i$ ); (ii) a 6 p.p. reduction in VAT rate ( $\tau_y = 0.12$ ); (iii) increasing enforcement on the extensive margin to almost eliminate all informal firms ( $b_i = 1.75$ ) and (iv) increasing enforcement on the intensive margin to wipe informality within the formal sector ( $b_{f1} = 1.75$  and  $b_{f1} = 2.40$ ).

### 5.2.1 Firm-Level Effects

As in subsection 5.1, I compute the expected values net of entry costs, but in each counterfactual scenario (i)-(iv). The firm-level effects are defined as:

$$\Delta(\nu) = \log(V_s^{e,c}(\nu) - E_s^c) - \log(V_s^{e,b}(\nu) - E_s^b),$$

where  $\nu$  is the pre-entry productivity,  $s = i, f$ , and b and c denote the baseline and counterfactual scenarios under policies (i)-(iv), respectively.

The results are grouped as follows: (a) “always formal” are the firms that stay in the formal sector both in the baseline and policy scenarios; (b) “always informal” are the firms that stay in the informal sector in both scenarios and (c) “switchers” are the firms that are informal in the baseline, but formalize as a result to each of the policies.

Panels (a) to (c) of Figure 6 show the firm-level effects of equalizing entry costs into the formal sector to the ones into the informal sector. There is a large increase in expected lifetime value among formal firms with low productivity and the switchers, except the switchers with low productivity. The positive effect is explained by the savings in entry costs that are relatively high with respect to the expected value of the firms. Nevertheless, the new entrants promote competition for labor in the formal sector, which leads to an increase in wages for skilled workers, the most abundant factor (Table 4). The higher wages reduce the value

of all informal firms since these do not save in entry costs and of the highly-productive formal firms for which the savings in entry costs are less meaningful. Interestingly, the lower entry costs facilitate the formalization of low-productivity switchers, but the negative general equilibrium effect, higher wages, reduce their value under the counterfactual.

Next, panels (d)-(f) of Figure 6 contain the effects of reducing the VAT tax rate in 6 p.p. The savings in taxes increase the value of all formal firms and the switchers with high productivity (panels d and f). In terms of prices, there is a high increase in the wage of workers with both skill levels (Table 4). The negative impact of the higher wages hurts more the informal firms with low productivity since their initial value is small. As in the former policy, switchers with low productivity enter the formal sector because formality is cheaper but are hurt by the higher wages under the counterfactual scenario.

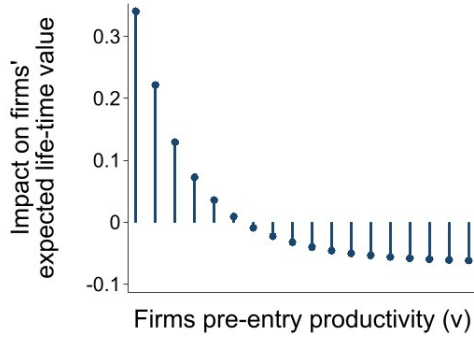
Panels (a)-(c) of Figure 7 denote that increasing enforcement over the extensive margin of informality is beneficial only for formal firms, although the effect is small. The increase in hiring costs for informal firms reduces their value which impacts more over the ones with low productivity. Some of these firms have to exit; thus, labor demand decreases along with wages for both types of workers (Table 4). Despite the lower wages, the effect over the switchers is negative: they prefer to reduce the size of their businesses and enter the formal sector rather than closing as a result of enforcement in the informal sector.

Panels (d) and (e) show that increasing enforcement over formal firms, i.e., the intensive margin, hurts most formal firms, except the ones with very high productivity. As discussed in subsection 4.2, a large share of formal firms depend on the lower costs of informal labor. As a result of lower labor demand, wages decrease (Table 4), which improves the values of all informal firms. There are no switchers as a consequence of this policy.

Thus, formalization policies must be carefully designed as all of them imply winners and losers.

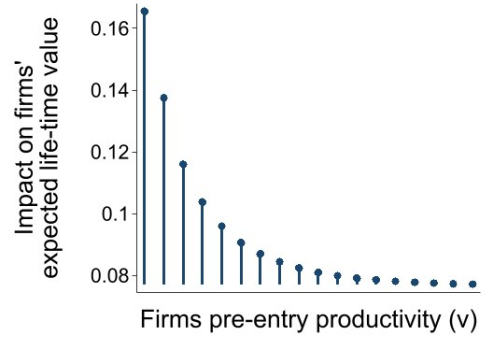
(a) Equalizing entry costs:

Always formal



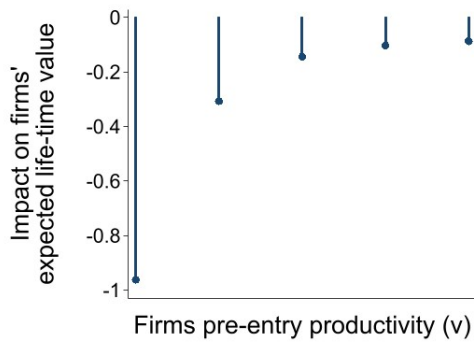
(d) Reducing VAT:

Always formal



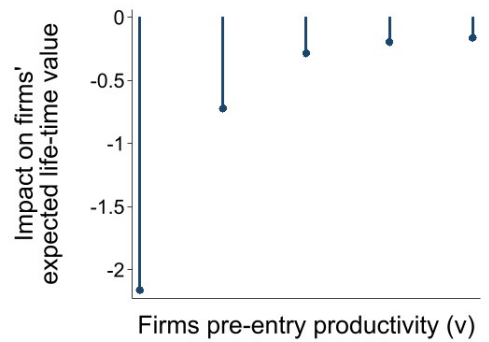
(b) Equalizing entry costs:

Always informal



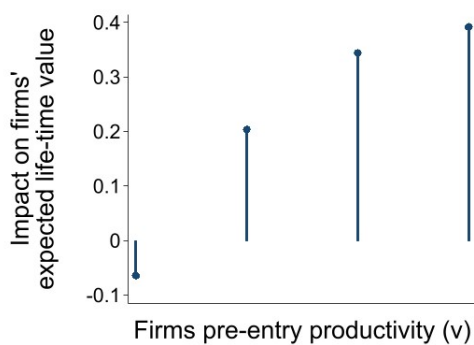
(e) Reducing VAT:

Always informal



(c) Equalizing entry costs:

Switchers



(f) Reducing VAT:

Switchers

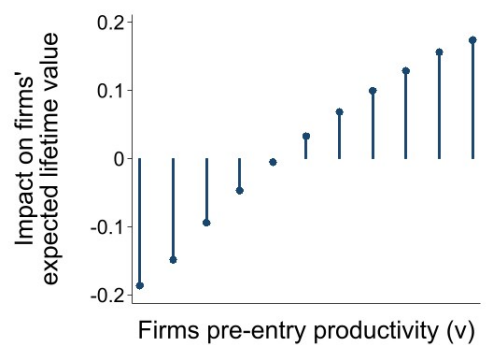
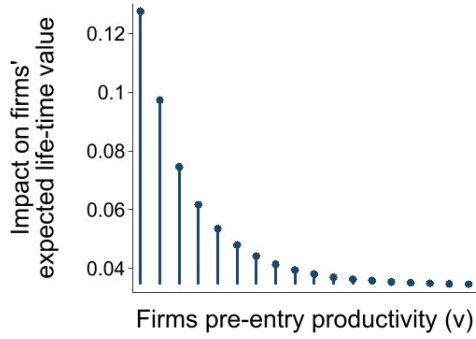


Figure 6 Firm-Level Effects: Reducing Entry Costs and VAT

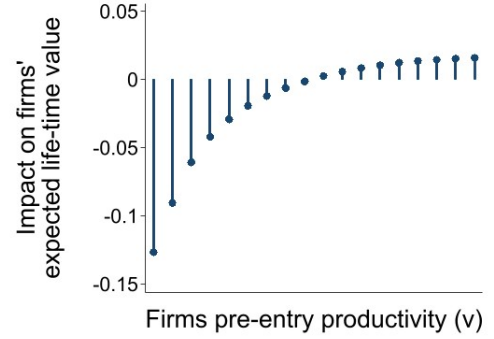
(a) Extensive margin:

Always formal



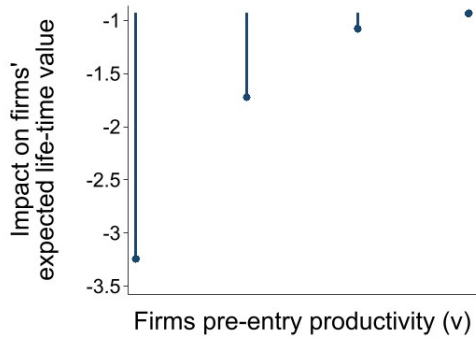
(d) Intensive margin:

Always formal



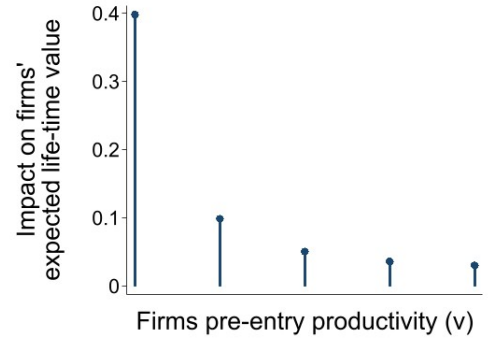
(b) Extensive margin:

Always informal



(e) Intensive margin:

Always informal



(c) Extensive margin:

Switchers

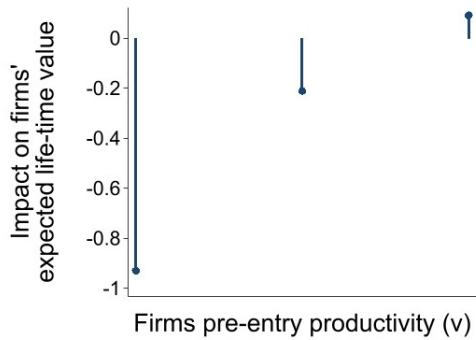


Figure 7 Firm-Level Effects: Increasing Enforcement

### 5.2.2 Aggregate Effects

Table 4 shows the aggregate effects of the formalization policies over the share of informality among workers and firms, as well as the change in the mass of firms, TFP, output, tax revenues and welfare.

Reducing entry costs is useful to reduce informality among firms (Column A). The share of informal firms decreases from 54.8% to 13.1%, whereas informality among employees increases from 56.4% to 61.8%, which follows from higher entry and demand of informal labor from the formal sector. There is an increase in the mass of firms, partially compensated by a reduction in TFP that results from the entry of more low-productivity firms, so output increases by 6.2%. As a consequence of higher output and firm formality, tax revenues go up by 23.6% and welfare increases by 10.0%.

The reduction in the VAT tax rate (Column B) makes formality more affordable. Informality among firms lowers to 36.8%, while informality among employees remains unchanged due to the higher demand from loosely monitored formal firms. The reduction of costs permits the slight increase of the mass of firms which results in higher output. However, the decrease in the tax rate dominates, and tax revenues go down by almost 21%. In consequence, welfare also decreases despite higher output and wages.

Higher enforcement on the extensive margin (Column C) reduces firm informality to 11%, whereas it is ineffective to reduce labor informality (52.5%). TFP does not vary because the exit of low-productivity informal firms is compensated by the entry of low-productivity formal firms, whereas the mass of firms decreases. Labor demand from informal firms and wages decrease, which causes a sharp decrease in welfare (25%). The reduction in wages facilitates entry into the formal sector, so output and tax revenues increase.

Finally, increasing enforcement on the intensive margin (Column D) is the most effective policy to reduce labor informality (29.8%), while informality among firms actually increases (61.9%), since it gets expensive to operate formally. The exit of low-productivity formal firms decreases the mass of firms and increases TFP. The overall effect of the former is a reduction in output. Tax revenues increase since a larger share of labor formalizes and pays taxes. The effect on

welfare is positive (5.7%) mainly as a consequence of the increase of formality among workers and tax revenues. As in Ulyssea (2018), lower levels of informality are not always associated with higher levels of tax revenues, output, or welfare.

In contrast to the results in Ulyssea (2018) for Brazil, increasing enforcement on the intensive margin in Peru is more desirable than on the extensive margin because of the prevalence of informal labor within the formal sector. Ulyssea (2018) finds that increasing enforcement on the extensive margin increases formality both among firms and workers but reduces welfare. Nevertheless, getting rid of informal firms in Peru does not affect labor informality, as most new formal firms prefer to hire informally. It also has stronger negative effects on welfare because the drop of labor demand and wages impact over more informal workers. Furthermore, Ulyssea (2018) finds that auditing formal firms promote labor formality but increases firm informality and lowers output and tax revenues. The formalization effects and the reduction in output are similar in the case of Peru. However, given the importance of the intensive margin, auditing formal firms in Peru increases tax revenues and welfare because the large gains in labor formality turn into a larger tax base. As for lower entry costs, the results are qualitatively identical to Ulyssea (2018), but the positive aggregate effects are larger in Peru, in line with the higher relevance of De Soto's view.

From a policy standpoint, a combination of policies that reduce entry costs and increase enforcement on the intensive margin increase tax revenues and welfare and effectively reduce informality at the firm and worker level, respectively. In addition, their opposite effects on TFP and output can minimize losses in these variables. Hence, this combination might be a good recipe to reduce informality in Peru. However, it is important to note that the model does not incorporate capital, and there is no unemployment as the labor market clears. Thus, the positive effects of lowering entry costs and higher audit of formal firms can be spoiled by bad finance and disemployment effects, see Lopez-Martin (2019), and De la Parra (2017) and Ponczek and Ulyssea (2021), respectively.

Table 4: Aggregate Effects

|                               | Baseline | A. Entry costs | B. VAT | C. Extensive mg. | D. Intensive mg. |
|-------------------------------|----------|----------------|--------|------------------|------------------|
| <i>Informal labor (share)</i> |          |                |        |                  |                  |
| All workers                   | 0.564    | 0.618          | 0.552  | 0.525            | 0.298            |
| Unskilled                     | 0.808    | 0.814          | 0.792  | 0.760            | 0.420            |
| Skilled                       | 0.503    | 0.568          | 0.492  | 0.466            | 0.268            |
| Informal firms (share)        | 0.548    | 0.131          | 0.368  | 0.110            | 0.619            |
| <i>Wages</i>                  |          |                |        |                  |                  |
| Skilled                       | 1.00     | 1.055          | 1.075  | 0.991            | 0.989            |
| Unskilled                     | 1.00     | 0.985          | 1.035  | 0.910            | 0.985            |
| Skill premium                 | 1.171    | 1.254          | 1.216  | 1.275            | 1.176            |
| Mass of firms                 | 1.000    | 1.348          | 1.015  | 0.962            | 0.973            |
| TFP                           | 1.000    | 0.990          | 1.001  | 1.003            | 1.002            |
| Output                        | 1.000    | 1.062          | 1.019  | 1.028            | 0.987            |
| Tax revenues                  | 1.000    | 1.236          | 0.789  | 1.242            | 1.024            |
| Welfare                       | 1.000    | 1.100          | 0.865  | 0.750            | 1.057            |

Notes: Welfare is total consumption in the economy,  $U = w\bar{L} + \Pi + T$ , where  $\Pi$  is the total profits net of entry costs, which are equal to  $M_f E_f + M_i E_i$ , where  $M_f = [1 - G(\bar{v}_f)]M$  and  $M_i = [G(\bar{v}_f) - G(\bar{v}_i)]M$  are the masses of entrants. The columns present the counterfactual scenarios: A: lower costs of entry in the formal sector,  $E_f = E_i$ . B: 6 pp. cut in VAT rate. C: reduction in  $b_i$  to 1.75. D: reduction in  $b_{f1}$  and  $b_{f2}$  to 1.75 and 2.40, respectively.

## 6 Final Discussion

Although motivating the seminal work of De Soto (1989), the causes of informality in Peru remain unknown because quantitative and causal studies are scarce. I calibrate the general equilibrium model with heterogeneous firms and workers with two skill levels in Ulyssea (2018) using microdata from Peru. The model quantifies the relevance of each of the main views of informality in the literature and computes the effects of four strict formalization policies at the firm and aggregate levels in a unified general equilibrium framework.

The results from the counterfactual analysis show that 33.4% of informal firms have enough productivity to operate formally but are excluded because of high entry costs. The firms that are also productive to formalize but choose informality to earn higher profits represent the 25.4% of the informal sector. The rest of the informal firms have very low productivity and cannot become formal, even in the



absence of entry costs. The firm-level effects show that the formalization policies should be designed carefully as all imply winners and losers.

The aggregate effects are sizeable. Equalizing entry costs between sectors increases firm formality, output, tax revenues and welfare because of higher entry in the economy. However, it increases labor informality and decreases TFP as low-productive firms are more abundant. Reducing the VAT tax rate increases firm formality, TFP and output, as makes formality cheaper. Nevertheless, tax revenues and welfare go down sharply. Enforcement on the extensive margin is effective to reduce firm formality, but labor informality is the same because of the demand from formal firms. Although output and tax revenues increase, welfare drops due to the sharp reduction in wages. Increasing enforcement on the intensive margin is the most effective to reduce labor informality, while firm informality increases. Tax revenues and welfare increase, but output goes down as some formal firms that highly rely upon cheaper informal exit the economy.

The intensive margin of informality is predominant in Peru compared to Brazil, see Ulyssea (2018). This difference implies that higher enforcement on the extensive margin is not effective in Peru, as more workers remain informal, which reduces wages and welfare more. In contrast, the benefits of auditing formal firms are bigger in Peru because more workers formalize to the extent that the effect over tax revenues becomes positive and welfare rises.

Hence, it might be desirable from a policy standpoint to jointly reduce entry costs and increase the supervision of formal firms as both reduce informality on different margins, increase tax revenues and welfare. In contrast, their effects on output and TFP are in opposite directions so that any losses can be minimized. Nevertheless, it is important to keep in mind the not-modeled factors that may spoil the positive effects of this policy recipe, such as bad access to finance and unemployment effects.

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## 8 Appendix 1

Table A1: Costs of Formality

|                       | Entry Costs <sup>1</sup> |           | Employer SSC (%) <sup>2</sup> |
|-----------------------|--------------------------|-----------|-------------------------------|
|                       | # Procedures             | # Days    |                               |
| E. Asia & Pacific     | 6.5                      | 25.6      | 9.9                           |
| E. Europe & C. Asia   | 5.2                      | 11.9      | 13.9                          |
| L. A. C.              | 8.1                      | 28.8      | 13.8                          |
| <b>Peru</b>           | <b>8</b>                 | <b>26</b> | <b>9</b>                      |
| Mid. East & N. Africa | 6.5                      | 19.7      | 14                            |
| OECD high income      | 4.9                      | 9.2       | 18.2                          |
| South Asia            | 7.1                      | 14.5      | 12                            |
| Sub-Saharan Africa    | 7.4                      | 21.5      | 6.8                           |

Notes: Entry costs in Peru are just below the average of Latin America, while the labor tax rate is almost 5 pp. below the average. <sup>1</sup> Number of procedures and days that the entrepreneur spends to get a license. Source: Doing Business Initiative, 2019. <sup>2</sup> Percentage of the wage paid by the employers. Source: KPMG: Employer Social Security Contributions, 2019.

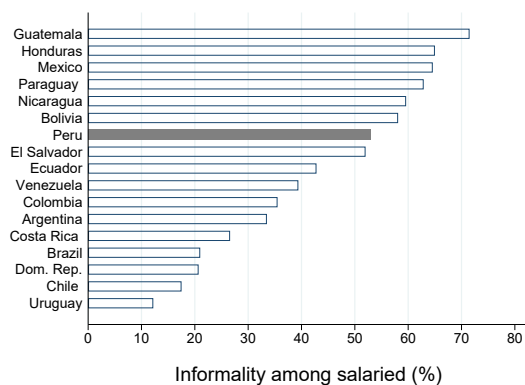


Figure A1: Labor Informality Among Salaried

Notes: Peru is among the most informal countries in Latin America. Definition: share of salaried workers who do not have a pension plan. Source: SEDLAC, 2016.

## 9 Appendix 2

Table A2: Firms and Workers: Definitions in ENAHO

| ENAHO.500, Question P507: Role in the workplace             | Freq.       |
|---|-------------|
| 1. Employer   | 4.6         |
| 2. Independent worker                                       | 38.3        |
| <b>3. Dependent-Mostly intellectual work</b>                | <b>25.6</b> |
| <b>4. Dependent-Mostly manual work</b>                      | <b>22.2</b> |
| 5. Unpaid family worker                                     | 5.4         |
| 6. Domestic worker  | 3.7         |
| ENAHO.04, Question E2: Place in which you run your business | Freq.       |
| 1. Street vendor  | 15.8        |
| 2. Clients' home  | 10.1        |
| 3. Vehicle to transport people                              | 17.9        |
| 4. Improvised stand on the street                           | 4.5         |
| 5. Improvised stand at public market                        | 1.6         |
| <b>6. Fixed place on the street</b>                         | <b>0.8</b>  |
| <b>7. Fixed stand on public market</b>                      | <b>5.8</b>  |
| <b>8. Workshop, restaurant, hotel</b>                       | <b>9.8</b>  |
| 9. Workshop inside house                                    | 9.1         |
| 10. Inside house  | 23.5        |

Notes: I study the categories in bold throughout the paper. From ENAHO.500, I consider as workers or employees only to dependent workers from options 3 and 4 of question P507. I define informal firms as employers or independent workers who run their own business at a fixed location outside their houses: options 6, 7 and 8 of question E2 in ENAHO.04.

## 10 Appendix 3

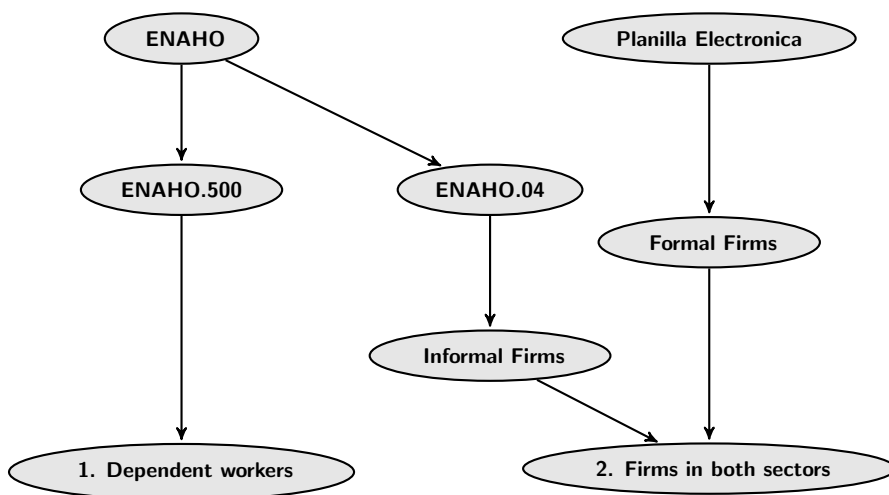


Figure A3: Data Cleaning Procedures

Notes: ENAHO is the National Survey of Households. ENAHO and *Planilla Electronica* are from 2019. From ENAHO.500, I get the subsample of dependent workers that the paper calls workers or employees (1). Combining the informal firms in ENAHO.04 and *Planilla Electronica* and using the expansion factors of ENAHO, I get the sample of firms in both sectors (2).