Firms, Policies, Informality, and the Labor Market

Camila Cisneros-Acevedo^a, Alessandro Ruggieri^b

 a University of Tubingen b University of Nottingham

UAB Macro Club December 2, 2022

Introduction

- Over 60 percent of workers in the world operate in the informal economy
 - accounts for 35% of GDP in developing countries (Loayza 2016)
 - unproductive firms and low-paying jobs (La Porta and Schleifer 2014).
- Policy prescription is to reduce tax and regulatory burden on firms to discourage the creation of informal jobs and boost aggregate income (De Soto 1989, Lagarde 2019)
- What are the distributional implications of such policy interventions?
- Focus on corporate income tax rate
 - 15.4% of tax revenues in LACs, 10% in OECD countries, up to 25% in very low-income countries (OECD, 2018)
 - correlates negatively with economic growth (Lee and Gordon 2005)
 - major cause of informality (Perry 2007, Waseem 2018)

This paper

- We document how labor market outcomes vary with corporate tax rates:
 - informality is higher in countries with high tax rates
 - unemployment and GDP per worker are lower in countries with high tax rates
- We build a model of firm dynamics to interpret this evidence
 - two sectors: self-employment vs wage-employment
 - search frictions into wage employment
 - heterogeneous firms subject to imperfectly enforced regulation
 - informality along the extensive and the intensive margins
- We estimate the model using firm and worker-level data from Peru
 - 70 percent of the working age population employed informally
- Changes in tax rates account for 60% of the difference in the unemployment rate and 45% of the differences in GDP per worker
- Equity-efficiency trade-off of alternative firm-level regulations

Three main channels

- Reallocation effect:
 - lower corporate tax rates prevent firms from hiding
 - increase formal jobs along the *extensive margin*
 - $\bullet\,$ increase informal jobs along $intensive\ margin$
 - higher net profits allows formal firms to expand
 - formalization along the *intensive margin*
- Competition effect:
 - lower corporate tax rate allows formal firms to charge lower prices
 - higher competition drives low-productivity informal firms out of industry
 - higher allocative efficiency implies higher GDP per worker
- Scale effect:
 - efficiency gains in the industry implies higher wage earnings
 - no-arbitrage between value of wage employment and value of self-employment needs wage and salary jobs to concentrate on fewer firms
 - lower labor market tightness and higher unemployment

Data

- Coverage: 75 countries, 1552 country-year obs, 2010-2021
 - Malawi (2013), GDP per capita: 370 (2017, USD)
 - Barbados (2018), GDP per capita: 16950 (2017, USD)
- Corporate taxes (Tax Foundation): standard statutory corporate income tax rates levied on domestic businesses
- Informality rate (ILO-stat): own-account workers, contributing family workers, employees holding informal jobs
- Unemployment rate (World-Bank): working age workers were not in employment, carried out activities to seek employment, available to take up employment given a job opportunity
- Real GDP per worker, 2017 USD (World-Bank)
- Summary statistics

Informality across countries



Slope: 1.245 (0.156)

Unemployment across countries

Slope: -0.378 (0.053)



Real GDP per worker across countries



Evidence

- Countries with higher corporate income tax rates have:
 - higher informality employment
 - lower unemployment rate
 - lower GDP per worker
- Robustness:
 - Alternative measures of informality –
 - Alternative measures of aggregate productivity 🔵
 - Country-specific unobserved heterogeneity

Model - Key Elements

- Industry dynamics (Restuccia and Rogerson 08)
 - smaller firms in low-income countries (Bento and Restuccia 18)
 - corporate income tax as a source of misallocation (Erosa and Gonzales 20)
- Search frictions in the labor market (Bertola and Caballero 94)
 - poorly functioning labor market in developing countries (Lagakos 20, Abebe et al. 21, Amodio et al. 22)
 - frictions vary with development (Poschke 19, Martellini and Menzio 20)
- Imperfectly enforced legislation (Ulyssea 18)
 - informality as a buffer against labor market shocks (Ulyssea and Ponczek 18, Dix-Carneiro and Kovac 19)
 - extensive vs intensive margin of informality (Cisneros-Acevedo 20, Dix-Carneiro et al 22)

Demographics

- Unitary measure of homogeneous risk-neutral workers
 - infinitely lived
 - unemployed, self-employed or wage employed
 - if wage employed, workers are either formal or informal
- Endogenous measure of heterogeneous firms
 - produce differentiated varieties ω subject to monopolistic competition
 - innate productivity, z, and registration cost ξ
 - registered or unregistered
 - if unregistered, they can only hire workers off-the-book
 - if registered, they can hire workers on- and off-the-book
 - hiring informally subject to a monetary cost
 - only registered firms subject to corporate income and payroll taxes
 - entry-exit dynamics and job turnover
 - exogenous firm exit, δ_f , exogenous job separation, δ_w

Product Market

• Self-employed produce a homogeneous good with a technology linear in labor,

$$y_o = A_o L_o$$

where A_o is an exogenous productivity shifter

• Industrial firms' technology:
$$\begin{cases} q_i(z, \ell_i) = Az\ell_i & \text{if unregistered} \\ q_f(z, \ell_i, \ell_f) = Az(\ell_i + \ell_f) & \text{if registered} \end{cases}$$

where A is an exogenous productivity shifter and ℓ_i and ℓ_f denote informal and formal workers

• Industrial firms' revenues: $\begin{cases} r_i(z,\ell_i) = D^{\frac{1}{\sigma}} q_i(z,\ell_i)^{\frac{\sigma-1}{\sigma}} & \text{if unregistered} \\ r_f(z,\ell_i,\ell_f) = D^{\frac{1}{\sigma}} q_f(z,\ell_i,\ell_f)^{\frac{\sigma-1}{\sigma}} & \text{if registered} \end{cases}$

where D in an endogenous revenue shifter and $\sigma>1$ is the elasticity of substitution between varieties

Labor market

- Jobless workers have the option of searching for a wage and salary job
 - if they do not search, they become self-employed and earn their marginal product, $w_o = A_o$
- Industrial labor market subject to search and matching frictions
- Job seekers U, and open vacancies, V, meet through a CRS matching function

$$m(V,U) = rac{VU}{(V^{\eta} + U^{\eta})^{rac{1}{\eta}}} \qquad \eta > 0$$

where $V = V_{ii} + V_{if} + V_{ff}$ are measures of informal and formal vacancies posted by unregistered and registered firms, respectively.

- Probability of filling a vacancy: $\phi = \frac{m(U,V)}{V}$
- Probability of finding a job: $\tilde{\phi} = \frac{m(U,V)}{U}$

Problem of the unregistered firm

$$\mathcal{V}_i(z,\ell_i) = \max_{v_i} \quad \pi_i(z,\ell_i) - c_v^i v_i + \frac{1-\delta_i}{1+r} \mathcal{V}_i(z,\ell_i')$$

s.t.
$$\ell'_i = (1 - \delta_w)\ell_i + \phi v_i$$

 $\pi_i(z, \ell_i) = r_i(z, \ell_i) - w_i(z, \ell_i)\ell_i - \kappa_i(z)\ell_i$
 $\kappa_i(z) = \gamma_0 z^{\gamma_1} \qquad \gamma_0 > 0, \gamma_1 > 0$

- c_v^i denotes the cost of posting informal vacancies
- $\kappa_i(z)$ denotes a per-worker expected cost of informality

Problem of the registered firm

$$\mathcal{V}_{f}(z,\boldsymbol{\ell}) = \max_{v_{i},v_{f}} \quad \pi_{f}(z,\boldsymbol{\ell}) - \sum_{j \in \{i,f\}} c_{v}^{j} v_{j} + \frac{1-\delta_{f}}{1+r} \mathcal{V}_{f}(z,\boldsymbol{\ell}')$$
s.t. $\ell_{j}' = (1-\delta_{w})\ell_{j} + \phi v_{j} \quad \forall j \in \{i,f\}$
 $\pi_{f}(z,\boldsymbol{\ell}) = (1-\tau_{y})r_{f}(z,\boldsymbol{\ell}) - \sum_{j \in \{i,f\}} w_{j}(z,\boldsymbol{\ell})\ell_{j}(1+\tau_{w}^{j}) - \kappa_{f}(z,\boldsymbol{\ell})\ell_{i}$
 $\kappa_{f}(z,\boldsymbol{\ell}) = \gamma_{2}z^{\gamma_{3}} \left(\frac{\ell_{i}}{\ell_{i}+\ell_{f}}\right)^{\gamma_{4}}$

- $\boldsymbol{\ell} = (\ell_i, \ell_f)$
- τ_y denotes corporate income tax rate
- τ_w^j denotes payroll tax rate $(\tau_w^i = 0, \tau_w^f > 0)$
- $\kappa_f(z, \ell)$ denotes a per-worker expected cost of informality for formal firms

Entry and registration decisions

• Registration decision:

$$\mathcal{V}(z) = \int_{c_f \in \mathcal{C}} \max\{\mathcal{V}_i(z,\underline{\ell}_i), \mathcal{V}_f(z,\underline{\ell}) - c_f\}\psi_c(c_f)dc_f$$

where $\underline{\ell}$ are minimum employment levels, $c_f \sim \psi_c$ denotes the registration cost

• Free-entry condition

$$\mathcal{V}^e = \int_{z \in \mathcal{Z}} \max{\{\mathcal{V}(z), 0\}} \psi_z(z) dz \le c_e$$

where c_e denotes the entry cost

Wage bargaining

- Assumptions:
 - production delay is the only credible threat (Binmore et al. 1986)
 - workers collectively bargain with their employer
- Wage of informal workers in unregistered firms:

$$w_i(z,\ell_i) = (1-\zeta_i)b + \zeta_i \frac{r_i(z,\ell_i)}{\ell_i}$$

• Wage of informal workers in registered firms:

$$w_i(z, \boldsymbol{\ell}) = (1 - \zeta_i)b + \zeta_i(1 - \tau_y)\frac{r_f(z, \boldsymbol{\ell})}{\ell_i + \ell_f}$$

• Wage of formal workers:

$$(1 - \zeta_f \tau_w^f) w_f(z, \boldsymbol{\ell}) = (1 - \zeta_f) b + \zeta_f (1 - \tau_y) \frac{r_f(z, \boldsymbol{\ell})}{\ell_i + \ell_f}$$

where b denotes unemployment benefits, while ζ_i and ζ_f are informal and formal workers' bargaining powers

Equilibrium

Recursive stationary competitive equilibrium:

- *optimality*: policy functions solve the problem of workers and firms, and value functions attain their maximum;
- *no-arbitrage*: workers non-employed in a wage and salary job are indifferent between searching for a wage and salary job or being self-employed;
- *free-entry*: the measure of entrants is such that the free entry condition holds with equality;
- *bargaining*: wages are determined as the solution to the bargaining problems;
- *aggregate consistency*: the distributions of firms and workers replicate themselves over time through the policy functions, firm dynamics and job turnover.
- *market clearing*: the labor market for salary job and product market for the self-employment good clear

Data

Datasets	Years	Source
National Household Survey (ENAHO)	2007-2014	Peruvian National
Enterprise Survey (ES)	2006, 2010, 2017	World-Bank
Informal Enterprise Survey (IFS)	2010	World-Bank

- Sample selection: 25-60 y.o. wage and salary employees in non-military occupations, reporting positive hours worked
- Formal companies defined as those registered with the Peruvian Tax Collection Agency (SUNAT)
- Informal workers:
 - *extensive margin* those who declare to be employed by a firm that does not keep books in the online platform or software required by SUNAT
 - *intensive margin* salaried workers in registered firms who declare i) SUNAT does not deduct their income in any way and ii) employers do not pay health insurance on their behalf

Informality in Peru

- Fact 1 More than 60% of wage and salary employment in Peru is informal. One-third of it is made of informal workers employed in registered firms
- Fact 2 Informal workers are more likely to be employed in smaller firms. The share of informal workers in registered firms declines with firm size
- Fact 3 Formal firms are more productive than informal firms igodot
- Fact 4 Formal workers are paid on average higher wages than informal workers, even among workers in registered firms

Estimation

- Functional form:
 - Productivity distribution: $z \sim \log \mathcal{N}(0, \sigma_z)$
 - Registration cost distribution: $c_f \sim \mathcal{U}(0, \overline{c}_f)$
- 9 parameters calibrated outside the model 🔵
- 15 parameters estimated using MSM

$$\vartheta := \{A_o, c_e, \overline{c_f}, c_v^i, c_v^f, \gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_4, \alpha, \varphi_z, \zeta_i, \zeta_f, \eta\}$$

- A_o: self-employment efficiency
- c_e : entry cost
- $\overline{c_f}$: registration cost, upper bound
- c_v^i, c_v^f : vacancy costs, informal and formal
- $\gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_4$:: informality costs
- α : consumption share
- φ_z : productivity dispersion
- ζ_i, ζ_f : bargaining power
- η : matching elasticity, informal and formal
- 40 worker- and firm-level targets \bigcirc , non-targeted moments \bigcirc





D i	D 1.0	Estimates	C	.I.	Estimates
Parameters	Description	(LCU, 2010)	(± 3)	5.E.)	(USD, 2010)
c_e	Entry cost	3832.66	3780.66	3884.66	1352.9
$\overline{c_f}$	Registration cost, upper bound	98010.8	13144.7	182876	34597
c_v^i	Vacancy cost, informal workers.	10425.8	8491.78	12359.9	3680.3
c_v^f	Vacancy cost, formal workers	18532.0	14305.8	22758.2	6541.8
A_o	Self-employment efficiency	1051.92	1040.40	1063.44	371.33

- The average entry cost for formal firms amounts to \$18652.
 - comparable estimates for the manufacturing sectors are \$27532 in Cosar et al (2016) for Colombia and \$25000 in Fagjelbaum (2021) for Argentina
- The average entry cost amounts to \$1901.
 - Dix-Carneiro et al. (2021) estimate it equal to \$1,818 and \$705 for manufacturing and service sector firms in Brazil
- The estimate for A_0 implies a yearly earnings from self-employment of \$4456
 - 89% of the average wage and salary earnings

Counterfactual corporate tax reform



- Counterfactual economies differ from benchmark only in corporate tax rates, τ_y
- The model explains 60% of cross-country variation in unemployment rate and 45% of real GDP per worker
- Slope coefficient: model VS data 🔵
- Alternative counterfactual

Firms and jobs reallocation



• Corporate taxes act as a distortion on firms' output which forces them to hide

Competition in the product market



- High-productivity (formal) firms charge a lower price and expand
- Low-productivity (informal) firms driven out of the industry
- Employment reallocation increases allocative efficiency and lowers aggregate price

Concentration in the labor market



- Lower corporate taxes increase the average wage earnings, relative to earnings in self-employment
- No-arbitrage condition forces market tightness to adjust
- Employment concentrates on a smaller share of firms and jobs becomes scarcer

Corporate tax reform with and without informality

	Baseline (1)	Only extensive informality (2)	No informality (3)
Informality rate Unemployment rate Real GDP per worker	-38.32 + 6.158 + 1.322	-65.52 +10.72 +1.443	+13.89 +1.271

- Changes in corporate tax rates induce a much larger decline in the informality rate when only the extensive margin is considered (2) compared to baseline (1)
- *Informality as a buffer*: the response of the unemployment rate is amplified when informal jobs are not modeled
- Gains are higher when only extensive margin is considered (2) and lower when no informality is considered (3)

Alternative policies

- Evaluation of alternative firm-policy interventions
 - taxes on formal workers payroll in registered firms, τ_w^f
 - monetary costs of hiring informal workers for unregistered firms

$$\kappa_i(z) = \gamma_0 z^{\gamma_1}$$

monetary costs of hiring informal workers for registered firms

$$\kappa_f(z,\ell_i,\ell_f) = \gamma_2 z^{\gamma_3} \left(\frac{\ell_i}{\ell_i + \ell_f}\right)^{\gamma_4}$$

- Labor market policy interventions
 - unemployment benefits, b
 - minimum wage, <u>w</u>

Efficiency-equity trade-off



- Extensive margins policies admit a monotonic trade-off between workers' aggregate welfare and employment rate
- Low monetary fines to registered firms for hiring workers off-the-book unambiguously dominate low payroll taxes

Conclusion

- Understanding how growth-oriented reforms can influence income distribution is a first-order question for developing countries
- Document how labor market outcomes varies with corporate income tax rates across countries
- Build a two-sector model of firm dynamics with search frictions and informality along the intensive and extensive margin
- Show that lower corporate income taxes induce
 - reallocation of jobs from low- to high-productivity firms
 - better allocative efficiency
 - higher concentration of employers in the labor market
- Characterize the efficiency-equity properties of various policy interventions

Summary statistics

	Obs	Mean	St.dev.	Min	Max
GDP per capita, 2017 USD GDP per worker, 2017 USD TFP, PPP (US=100)	1552 1552 800	5677.28 31124.1 59.1	$3897.49 \\ 16035.1 \\ 19.1$	370.301 2583.41 23.3	16950.3 72420.6 124.9
Corporate tax rate, $\%$	1552	24.9	7.36	9.21	38.5
Informality rate, % Unemployment rate, %	$367 \\ 735$	$\begin{array}{c} 60.4 \\ 6.88 \end{array}$	$\begin{array}{c} 21.6 \\ 6.22 \end{array}$	$9.90 \\ 0.21$	$96.9 \\ 29.3$

back

Informality across countries



Unemployment across countries



GDP per worker across countries



Firms formally registered when they started operations



Employed workers covered by social security



Total factor productivity



Country unobserved heterogeneity

				Fo	rmal firms th	hat	Em	ployed work	ters
	Inform	al employm	ent, %	start	ed informall	y, %	w/o social security, %		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Corporate tax rate, τ_{it}	0.301* (0.174)	0.280 (0.174)	0.290 (0.177)	-0.316*** (0.120)	-0.272*** (0.121)	-0.242* (0.128)	-0.632* (0.341)	-0.548 (0.379)	-0.615 (0.396)
Observations	370	370	370	139	139	139	132	132	132
R-squared	0.370	0.394	0.397	0.256	0.277	0.299	0.354	0.393	0.417
Continent FE	\checkmark	✓	✓	~	~	✓	~	\checkmark	~
Time FE		~	~		~	~		~	~
Continent trend			~			√			\checkmark

	Une	Unemployment rate		Real GI	Real GDP p.w. (1000 USD)			Real TFP (US=100)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	
Corporate tax rate, τ_{it}	-0.164*** (0.0355)	-0.168*** (0.0366)	-0.167*** (0.0362)	-0.338*** (0.0840)	-0.331*** (0.0838)	-0.336*** (0.0834)	-1.058*** (0.166)	-1.067*** (0.167)	-1.070** (0.167)	
Observations	735	735	735	1552	1552	1552	800	800	800	
R-squared	0.272	0.279	0.316	0.306	0.307	0.311	0.142	0.145	0.146	
Continent FE	√	√	~	\checkmark	~	√	~	√	~	
Time FE		~	✓		√	✓		~	√	
Continent trend			√			√			√	



Country unobserved heterogeneity

				Fo	rmal firms t	hat	En	ployed worl	kers	
	Inform	al employm	ent, %	star	ed informal	ly, %	w/o	w/o social security, %		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	
Corporate tax rate, $\tau_{it} = 0$.	0.970*** (0.197)	0.958^{***} (0.194)	0.982^{***} (0.188)	-0.537*** (0.114)	-0.389*** (0.137)	-0.367*** (0.145)	-1.328*** (0.399)	-1.280*** (0.435)	-1.353*** (0.466)	
Observations	370	370	370	137	137	137	130	130	130	
R-squared	0.372	0.390	0.417	0.194	0.232	0.285	0.195	0.228	0.263	
Cluster FE	\checkmark	~	~	\checkmark	~	1	\checkmark	~	\checkmark	
Time FE		~	✓		~	~		~	~	
Cluster trend			✓			~			~	

	Unemployment rate		Real GI	Real GDP p.w. (1000 USD)			Real TFP (US=100)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Corporate tax rate, τ_{it}	-0.198*** (0.0294)	-0.203*** (0.0299)	-0.202*** (0.0299)	-0.985*** (0.0798)	-0.985^{***} (0.0799)	-0.984*** (0.0804)	-1.052*** (0.111)	-1.055*** (0.112)	-1.064*** (0.109)
Observations R-squared Cluster FE Time FE Cluster trend	728 0.229 √	728 0.240 ✓	728 0.251 ✓ ✓	1550 0.173 √	1550 0.173 ✓	1550 0.176 ✓ ✓	800 0.187 ✓	800 0.191 ✓	800 0.197 ✓



Preferences

• Utility function: Cobb-Douglas in self-employment good, s_t , and industrial composite good, c_t , i.e.

$$U = c^{\alpha} s^{1-\alpha} \quad \alpha \in (0,1)$$

• Industrial composite goods: CES function aggregate of N differentiated varieties available

$$c = \left(\int_0^N c(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right)^{\frac{\sigma}{\sigma-1}} \qquad \sigma>1$$

• Demand for self-employment and industrial consumption goods

$$s = (1 - \alpha)I(i)$$
 $c = \alpha \frac{I(i)}{P}$

• Demand shifter, common to all firms, is equal to

$$D = P^{\sigma-1} \gamma \int_0^1 I(i) di$$



Problem of jobless workers

$$\mathcal{J}^{n} = \max\left\{w_{o} + \frac{1}{1+r}\mathcal{J}^{n}, (1-\tilde{\phi})\mathcal{J}^{u} + \tilde{\phi}\mathbf{E}\mathcal{J}^{e}\right\}$$

$$\mathcal{J}^u = b + \frac{1}{1+r}\mathcal{J}^n$$

$$\begin{split} \mathbf{E}\mathcal{J}^{e} = & \frac{V_{ii}}{V} \int_{z} \int_{\ell_{i}} \mathcal{J}_{i}^{e}(z,\ell_{i})\nu_{ii}(z,\ell_{i})dzd\ell_{i} \\ & + \frac{V_{if}}{V} \int_{z} \int_{\ell_{i}} \int_{\ell_{f}} \mathcal{J}_{i}^{e}(z,\ell_{i},\ell_{f})\nu_{if}(z,\ell_{i},\ell_{f})dzd\ell_{i}d\ell_{f} \\ & + \frac{V_{ff}}{V} \int_{z} \int_{\ell_{i}} \int_{\ell_{f}} \mathcal{J}_{f}^{e}(z,\ell_{i},\ell_{f})\nu_{ff}(z,\ell_{i},\ell_{f})dzd\ell_{i}d\ell_{f} \end{split}$$

- w_o denotes self-employment earnings
- $\nu_{ii}(z, \ell_i), \nu_{if}(z, \ell_i, \ell_f), \nu_{ff}(z, \ell_i, \ell_f)$ are distributions of informal vacancies in unregistered and registered firms, and formal vacancies

Problem of a wage and salary employees

$$\mathcal{J}_{i}^{e}(z,\ell_{i}) = w_{i}(z,\ell_{i}) + \frac{[(\delta_{w} + (1-\delta_{w})\delta_{i})\mathcal{J}^{n} + (1-\delta_{w})(1-\delta_{i})\mathcal{J}_{i}^{e}(z,\ell_{i})]}{1+r}$$

$$\mathcal{J}_{i}^{e}(z,\ell_{i},\ell_{f}) = w_{i}(z,\ell_{i},\ell_{f}) + \frac{\left[(\delta_{w} + (1-\delta_{w})\delta_{f})\mathcal{J}^{n} + (1-\delta_{w})(1-\delta_{i})\mathcal{J}_{i}^{e}(z,\ell_{i},\ell_{f})\right]}{1+r}$$

$$\mathcal{J}_{f}^{e}(z,\ell_{i},\ell_{f}) = w_{f}(z,\ell_{i},\ell_{f}) + \frac{\left[(\delta_{w} + (1-\delta_{w})\delta_{f})\mathcal{J}^{n} + (1-\delta_{w})(1-\delta_{f})\mathcal{J}_{f}^{e}(z,\ell_{i},\ell_{f})\right]}{1+r}$$

- δ_w denotes workers separation
- δ_i denotes firm exit



Composition of formal and informal employment



Informal employment

Employment in registered firms

- More than 60% of wage and salary employment in Peru is informal.
- More than one-third of it is made of informal workers employed in registered firms



Firm size across formal and informal workers



• Informal workers are more likely to be employed in smaller firms. The share of informal workers in registered firms declines with size.

back

Productivity of formal and informal firms



- Sales per employee of formal firms are 2.3 log-points higher compared to informal firms.
- Labor payroll of formal firms is on average 0.85 log-points higher than that of informal firms.

back

Earnings gap of informal workers

	Ι	log month	y earning	8
	(1)	(2)	(3)	(4)
$1[\text{Formal}]_{it}$	0.984	1.129	0.583	0.828
	(0.004)	(0.006)	(0.006)	(0.009)
$1[\text{Int.Mg.Inform}]_{it}$		0.316		0.335
		(0.007)		(0.009)
Observations	127,640	127,640	$67,\!253$	67,253
R-squared	0.3145	0.3297	0.5635	0.5743
Time F.E.	\checkmark	\checkmark	\checkmark	\checkmark
Controls			\checkmark	\checkmark

• Formal workers are paid on average higher wages than informal workers, even within registered firms.



Parameters calibrated outside the model

Parameters	Description	Value	Source/Targets
r	Interest rate, %	1.08	Real lending rate= 13.80%
A	Aggregate productivity	1	normalization
σ	Elasticity of substitution	6.40	Anderson and Van Wincoop (2001)
δ_f	Exit rate, % formal firm	5.68	Average age $= 17.62$ y.o. (WB-ES)
δ_i	Exit rate, % informal firm	10.4	Average age= 9.61 y.o. (WB-ES)
δ_s	Workers' separation rate, %	7.60	Reynaga and Ramirez-Rondan (2021)
$\underline{\ell}_i$	minimum scale, informal worker	1	assumption
$\underline{\ell}_{f}$	minimum scale, formal worker	1	assumption
$ au_y$	Corporate tax rate, %	29.5	SUNAT (2016)
$ au_w$	Payroll tax rate, %	22.0	SUNAT (2016)
<i>b</i>	Unemployment benefits	0	OECD (2016)

back

Estimation fit



Targeted moments

Moment	Data	Model	Moment	Data	Model
Firm-level moments			Worker-level moments		
Informal firms			Labor market outcomes		
Average log-revenues, $E[\log R_i]$	7.061	8.146	Wage employment rate	0.450	0.444
Average log-size, $E[\log \ell_i]$	0.266	0.186	Wage employment, share extensive-informal	0.436	0.395
Log-size dispersion, $\%$ std $[\log \ell_i]$	0.425	0.295	Wage employment, share intensive-informal	0.221	0.189
Share of firms, 1 employee	0.687	0.628	Share intensive informal, 1-19 employees	0.544	0.429
Share of firms, 2 employees	0.223	0.266	Share intensive informal, 20-49 employees	0.461	0.379
Share of firms, 3+ employees	0.090	0.106	Share intensive informal, 50-99 employees	0.351	0.349
			Share intensive informal, 100-199 employees	0.281	0.317
Formal firms			Share intensive informal, 200+ employees	0.166	0.268
Average log-revenues, $E[\log R_f]$	11.97	11.76			
Average log-size, $\mathbf{E}[\log(\ell_i + \ell_f)]$	3.227	3.186	Wage gaps		
Log-size dispersion, $std[log(\ell_i + \ell_f)]$, %	1.303	1.187	Formal vs informal intensive	1.130	1.231
Log-size, 20th cutoff	2.079	2.257	Informal intensive vs extensive	0.316	0.240
Log-size, 40th cutoff	2.639	2.678			
Log-size, 60th cutoff	3.296	3.256	Aggregate outcomes		
Log-size, 80th cutoff	4.249	4.173	Job finding rate (overall)	0.437	0.437
Size, 20th cutoff	8	9.567	Job finding rate (informal)	0.283	0.260
Size, 40th cutoff	14	14.59			
Size, 60th cutoff	27	25.98			
Size, 80th cutoff	70	64.99			
Size, 90th cutoff	155	150.7			
Share of firms, 1-49 employees	0.753	0.774			
Share of firms, 50-99 employees	0.109	0.101			
Share of firms, 100-199 employees	0.059	0.062			
Share of firms, 200-499 employees	0.027	0.037			
Share of firms, 500-999 employees	0.038	0.022			
Share of firms, 1000+ employees	0.014	0.006			

Non-targeted moments

Moment	Data	Model
Wage dispersion $\operatorname{std}[\log w]$ Unemployment rate	$0.875 \\ 0.037$	$0.517 \\ 0.042$

• The model accounts for more than 60% of the observed wage dispersion across workers, and for the entire measure of unemployed workers



Estimated parameters

		Estimates	С	.I.	Estimates
Parameters	Description	(LCU, 2010)	$(\pm S)$	S.E.)	(USD, 2010)
-					
c_e	Entry cost	3832.66	3780.66	3884.66	1352.9
$\overline{c_f}$	Registration cost, upper bound	98010.8	13144.7	182876	34597
c_v^i	Vacancy cost, informal workers.	10425.8	8491.78	12359.9	3680.3
c_v^f	Vacancy cost, formal workers	18532.0	14305.8	22758.2	6541.8
A_o	Self-employment efficiency	1051.92	1040.40	1063.44	371.33
Parameters	Description	Estimates	C.I.	$(\pm S.E.)$	
-					
γ_0	Informality cost, informal firms	44.553	38.025	51.080	
γ_1	Informality cost, informal firms	1.1603	1.1148	1.2059	
γ_2	Informality cost, formal firms	96.482	77.698	115.27	
γ_3	Informality cost, formal firms	1.6464	1.4793	1.8135	
γ_4	Informality cost, formal firms	0.9486	0.9105	0.9866	
α	Share of industrial goods	0.5516	0.3128	0.7904	
φ_z	Productivity dispersion	0.9795	0.9549	1.0041	
η	Elasticity of the matching function	2.1119	1.8970	2.3267	
ζ_f	Bargaining power, formal workers	0.5065	0.3929	0.6201	
ζ_i	Bargaining power, informal workers	0.2062	0.1603	0.2521	

Counterfactual corporate tax reform

Moment	Data	Model	Explained
Informality rate	1.245	1.437	110%
	(0.480)	(0.244)	-
Unemployment rate	-0.378	-0.244	61%
	(0.154)	(0.023)	-
Real GDP per worker	-0.564	-0.262	45%
1	(0.253)	(0.017)	-
	· /	\ /	

Slope Coefficient: Model vs Data



The role of aggregate productivity

	Low-tax high-productivity (1)	High-tax low-productivity (2)	Low-tax low-productivity (3)	Explained (4)
Corporate income tax rate, τ_u	10%	35%	10%	_
Aggregate productivity, A	1.202	0.997	0.997	-
Self-employment efficiency, A_o (LCU)	1264.20	1048.76	1048.76	-
Entry cost, c_e (LCU)	4606.09	3821.16	3821.16	-
Unemployment rate	0.189	0.033	0.055	85.9%
Informality rate	0.356	0.712	0.366	2.8%
Real GDP per worker	1.443	0.916	1.205	45.2%

- Controlling for changes in aggregate productivity, corporate income tax rates account for:
 - 97.5% of differences in informality rate
 - 15% of differences in unemployment rate
 - 54.8% of differences in real GDP per worker



Payroll taxes on formal workers for registered firms

Payroll tax rate, τ_w	0	0.10	0.20	0.30	0.40
Firm-level outcomes					
Informal firms, share	0.9513	0.9614	0.9671	0.9748	0.9790
Informal vacancies, share	0.4765	0.5326	0.5778	0.6585	0.7097
Average firm size	4.1359	3.6054	3.3072	2.8946	2.7012
Aggregate Outcomes					
Informality rate	0.4706	0.5255	0.5702	0.6511	0.7025
- , extensive margin	0.2647	0.3265	0.3944	0.4766	0.5435
- , intensive margin	0.2060	0.1990	0.1920	0.1745	0.1590
Measure of firms	0.0897	0.1071	0.1200	0.1420	0.1549
Market tightness	0.2885	0.4040	0.4619	0.6319	0.6726
Unemployment rate	0.0744	0.0493	0.0419	0.0271	0.0250
Average real wage	1.2126	1.1721	1.1313	1.0913	1.0388
Real GDP per worker	1.0406	1.0309	1.0080	0.9778	0.9433

Payroll tax rate in the baseline: $\tau_w = 0.22$



Expected informality cost for informal firms

Informality cost, κ_0	33.41	41.66	44.55^{*}	55.69	66.83
Firm-level outcomes					
Informal firms, share	0.9930	0.9771	0.9683	0.9322	0.8198
Informal vacancies, share	0.8698	0.6623	0.5918	0.4756	0.3863
Average firm size	2.7679	2.9469	3.2498	4.3123	8.1875
Aggregate Outcomes					
Informality rate	0.8652	0.6546	0.5842	0.4702	0.3835
- , extensive margin	0.7946	0.4916	0.3948	0.2252	0.1015
- , intensive margin	0.0706	0.1630	0.1894	0.2450	0.2820
Measure of firms	0.1563	0.1401	0.1243	0.0868	0.0436
Market tightness	1.1452	0.6012	0.4785	0.4145	0.3426
Unemployment rate	0.0108	0.0295	0.0406	0.0463	0.0586
Average wage	1.0158	1.0783	1.1198	1.2336	1.3123
Real GDP per worker	0.9308	0.9856	1	1.0279	1.0386

Cost of informality in the baseline: $\kappa_0 = 44.55$

Expected informality cost for formal firms

Informality cost, κ_2	48.24	72.36	144.72	289.45	385.93
Firm-level outcomes					
Informal firms, share	0.9259	0.9587	0.9780	0.9863	0.9884
Informal vacancies, share	0.6264	0.5966	0.6175	0.6706	0.7032
Average firm size	4.2281	3.4523	2.8811	2.5350	2.4539
Aggregate Outcomes					
Informality rate	0.6222	0.5902	0.6092	0.6618	0.6943
- , extensive margin	0.2484	0.3425	0.4819	0.5958	0.6451
- , intensive margin	0.3739	0.2477	0.1273	0.0660	0.0493
Measure of firms	0.0989	0.1182	0.1389	0.1597	0.1676
Market tightness	0.6415	0.5206	0.4506	0.4985	0.5744
Unemployment rate	0.0271	0.0364	0.0434	0.0386	0.0318
Average real wage	1.0603	1.0973	1.1105	1.0950	1.0933
Real GDP per worker	1.0060	1.0029	0.9830	0.9625	0.9567

Cost of informality in the baseline: $\kappa_2 = 96.482$

Unemployment benefits

Unemployment benefits, b	0^*	$0.05w_{o}$	$0.10w_{o}$	$0.15w_{o}$	$0.20w_{o}$
Firm-level outcomes					
Informal firms, share	0.9683	0.9680	0.9665	0.9663	0.9641
Informal vacancies, share	0.5918	0.5862	0.5713	0.5680	0.5546
Average firm size	3.2498	3.2745	3.4204	3.4115	3.5672
Aggregate Outcomes					
Informality rate	0.5842	0.5785	0.5642	0.5609	0.5480
- , extensive margin	0.3948	0.3875	0.3687	0.3653	0.3486
- , intensive margin	0.1894	0.1910	0.1954	0.1956	0.1995
Measure of firms	0.1243	0.1186	0.1090	0.1054	0.0960
Market tightness	0.4785	0.4345	0.3876	0.3360	0.2769
Unemployment rate	0.0406	0.0448	0.0506	0.0594	0.0728
Average wage	1.1198	1.1630	1.2217	1.2638	1.3197
Real GDP per worker	1	1.0150	1.0357	1.0501	1.0700

Benefit in the baseline b = 0

Minimum wage for formal workers in registered firms

Minimum wage, \underline{w}	0*	$1w_o$	$1.5w_{o}$	$2w_o$	$2.5w_o$	$3w_o$
Firm-level outcomes						
Informal firms, share	0.9683	0.9683	0.9683	0.9782	0.9860	0.9905
Informal vacancies, share	0.5918	0.5918	0.5918	0.7316	0.8572	0.9159
Average firm size	3.2498	3.2498	3.2498	2.3329	2.0616	2.0246
Aggregate Outcomes						
Informality rate	0.5842	0.5842	0.5842	0.7241	0.85202	0.9127
- , extensive margin	0.3948	0.3948	0.3948	0.5918	0.76641	0.8540
- , intensive margin	0.1894	0.1894	0.1894	0.1323	0.0856	0.0587
Measure of firms	0.1243	0.1243	0.1243	0.1772	0.2088	0.2148
Market tightness	0.4785	0.4785	0.4785	0.6043	0.7619	0.9986
Unemployment rate	0.0406	0.0406	0.0406	0.0294	0.0215	0.0139
Average wage	1.1198	1.1198	1.1198	1.0601	1.0053	1.0017
Real GDP per worker	1	1	1	0.9545	0.8960	0.8610

Minimum wage in the baseline: $\underline{w}=0$