Firms, Policies, Informality, and the Labor Market

Camila Cisneros-Acevedo[a], Alessandro Ruggieri[b]

[a]University of Tubingen
[b]CUNEF Universidad

CEPR Macroeconomics and Growth Meeting

November 16-17, 2023

Introduction

- Poorly-functioning labor market in developing countries
  - employment in wage and salary jobs below 50% (Guner and Ruggieri 23)
  - over 60% of workers operate in the informal economy (Perry 21)
    - it accounts for $\approx$ 35% of GDP (Loyaza 16)
    - unproductive firms and low-paying jobs (La Porta and Schleifer 14)
    - $\approx$ 50% of informal workers are wage employees (ILO 23)

- Policy prescription is to reduce tax and regulatory burden on firms (De Soto 89, Lagarde 19)

- **What are the aggregate and the distributional implications of such policy interventions?**

This paper

- We build a model of firm dynamics subject to
  - search frictions
  - corporate income and payroll tax
  - imperfectly enforced regulation

  leading to unemployment and informality in the extensive and intensive margins

- We estimate it using firm and worker-level data from Peru
  - 70 percent of the working age population employed informally

- We validate it using cross-country evidence on corporate income tax rates
  - we document that in countries with high tax rates:
    - informality rate is higher
    - unemployment and GDP per worker are lower
  - model-based changes in tax rates account for 60% of the difference in the unemployment rate and 45% of the differences in GDP per worker

Three main effects of corporate income taxation

- Reallocation effect:
  - lower corporate tax rates prevent firms from hiding
    - increase formal jobs along the *extensive margin*
  - higher net profits allows formal firms to expand
    - formalization along the *intensive margin*

Three main effects of corporate income taxation

- Reallocation effect:
  - lower corporate tax rates prevent firms from hiding
    - increase formal jobs along the *extensive 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

Three main effects of corporate income taxation

- Reallocation effect:
  - lower corporate tax rates prevent firms from hiding
    - increase formal jobs along the *extensive 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

Welfare analysis

- Either tax policies admit a monotonic trade-off between workers' aggregate welfare and employment rate:
  - low corporate income tax rates ensure higher welfare for the same level of the unemployment rate
  - low payroll tax rates generate a lower unemployment rate for the same level of welfare

- Observed tax rates at the LHS of the peak of the Laffer Curve
  - reducing tax rates cannot simultaneously achieve output gains, employment formalization, and increase tax revenues

- Pareto-improving revenue-neutral shift of tax burden from corporate income to payroll taxes
  - corporate income tax rate from 29.5% to 22.5%
  - payroll tax rate from 22.0% to 42.1%

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)
  - large frictions in developing countries (Lagakos 20, Abebe et al. 21)
  - 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 by- 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 linear in labor

$$q(z, \ell_i, \ell_f, \mathbf{1}^f) = Az(\ell_i + \mathbf{1}^f \ell_f)$$

where A is an exogenous productivity shifter, ℓ_i and ℓ_f denote informal and formal workers, $\mathbf{1}^f$ is a formality indicator

- Industrial firms' revenues with diminishing returns

$$r(z, \ell_i, \ell_f, \mathbf{1}^f) = D^{\frac{1}{\sigma}} q(z, \ell_i, \ell_f, \mathbf{1}^f)^{\frac{\sigma-1}{\sigma}}$$

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 vacancies, V, meet through a CRS matching function

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

    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: $\tilde{\phi} = \frac{m(U,V)}{U}$

Informality costs, entry & registration decisions

- Unregistered firms forego corporate and payroll taxes subject to a cost $\kappa_i(z)$:

$$\kappa_i(z) = \gamma_0 z^{\gamma_1}, \qquad \gamma_0, \gamma_1 > 0$$

- Registered firms trade-off payroll taxes on formal workers vs. cost $\kappa_f(z, \ell_i, \ell_f)$:

$$\kappa_f(z, \ell_i, \ell_f) = \gamma_2 z^{\gamma_3} \left(\frac{\ell_i}{\ell_i + \ell_f} \right)^{\gamma_4}, \qquad \gamma_2, \gamma_3, \gamma_4 > 0$$

- Registration decision:

$$\mathcal{V}(z) = \int_{c_f \in \mathcal{C}} \max\{ \underbrace{\mathcal{V}_i(z, \underline{\ell}_i)}_{\substack{\text{firm's value} \\ \text{of informality}}}, \underbrace{\mathcal{V}_f(z, \underline{\ell}_i, \underline{\ell}_f)}_{\substack{\text{firm's value} \\ \text{of formality}}} - c_f \} \psi_c(c_f) dc_f$$

- Free-entry condition

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

Wage bargaining

- Assumptions:
  - production delay is the only credible threat (Binmore et al. 86)
  - 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:

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

- Wage of formal workers:

$$(1 + \zeta_f[\tau_w - \tau_y(1 + \tau_w)])w_f(z, \ell_i, \ell_f) = (1 - \zeta_f)b + \zeta_f(1 - \tau_y)\frac{r_f(z, \ell_i, \ell_f)}{\ell_i + \ell_f}$$

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

Data

Datasets	Years	Source
National Household Survey (ENAHO)	2007-2014	Peruvian National Institute of Statistics (INEI)
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

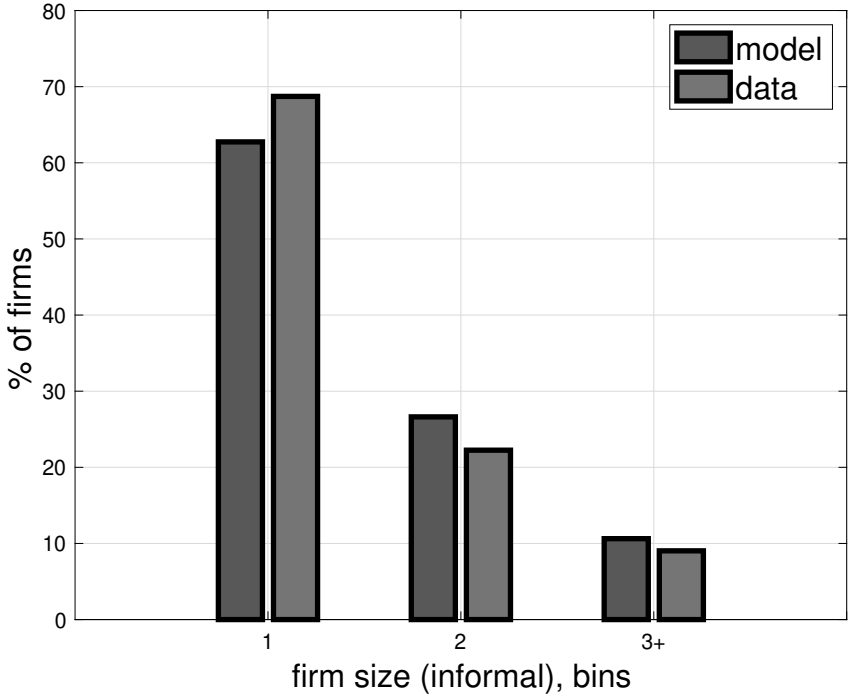
- **Fact 1** - More than 60% of wage and salary employment in Peru is informal. One-third of it is made of informal workers employed in registered firms
- **Fact 2** - Informal workers are more likely to be employed in smaller firms. The share of informal workers in registered firms declines with firm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

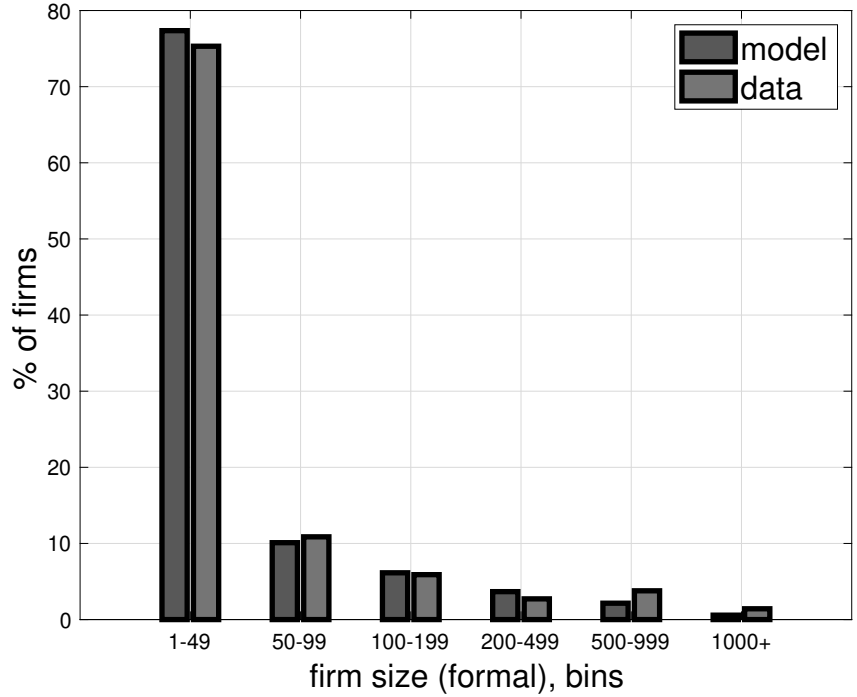
Estimation

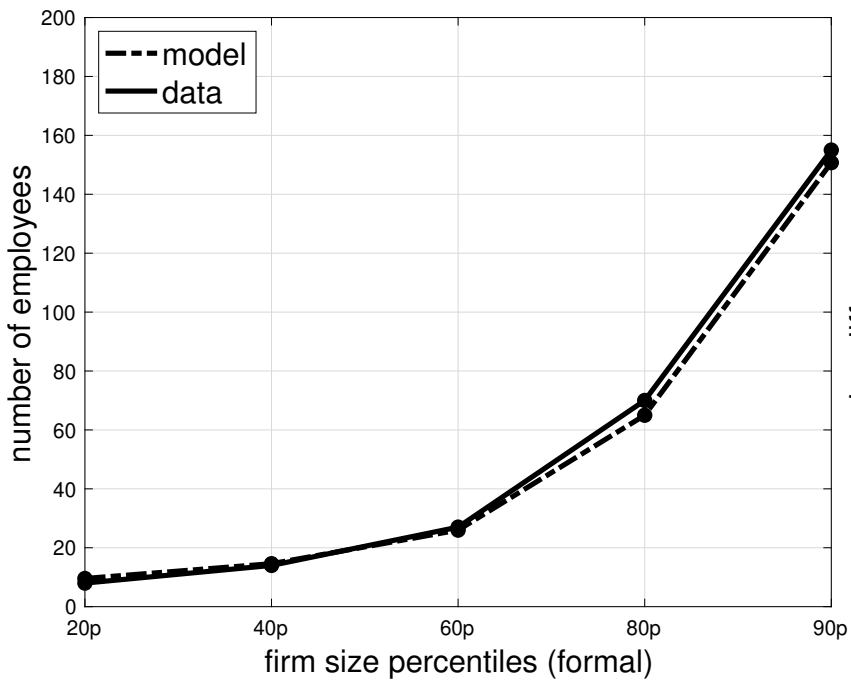
- Functional form:
  - Productivity distribution: $z \sim \log\mathcal{N}(0, \sigma_z)$
  - Registration cost distribution: $c_f \sim \mathcal{U}(0, \overline{c}_f)$
- 9 parameters calibrated outside the model
- 15 parameters estimated using MSM

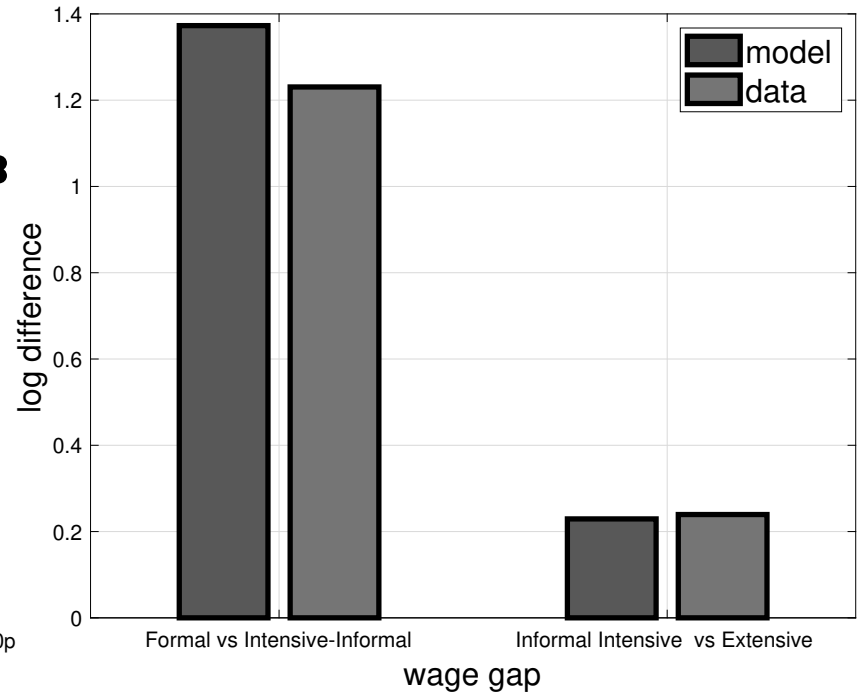
$$\vartheta := \{A_o, c_e, \overline{c_f}, c_v^i, c_v^f, \gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_4, \alpha, \varphi_z, \zeta_i, \zeta_f, \eta\}$$

  - 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, non-targeted moments


model
data
% of firms
0
10
20
30
40
50
60
70
80
1
2
3+
firm size (informal), bins


model
data
% of firms
0
10
20
30
40
50
60
70
80
1-49
50-99
100-199
200-499
500-999
1000+
firm size (formal), bins


model
data
number of employees
0
20
40
60
80
100
120
140
160
180
200
20p
40p
60p
80p
90p
firm size percentiles (formal)


model
data
log difference
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Formal vs Intensive-Informal
Informal Intensive vs Extensive
wage gap

Parameters estimates

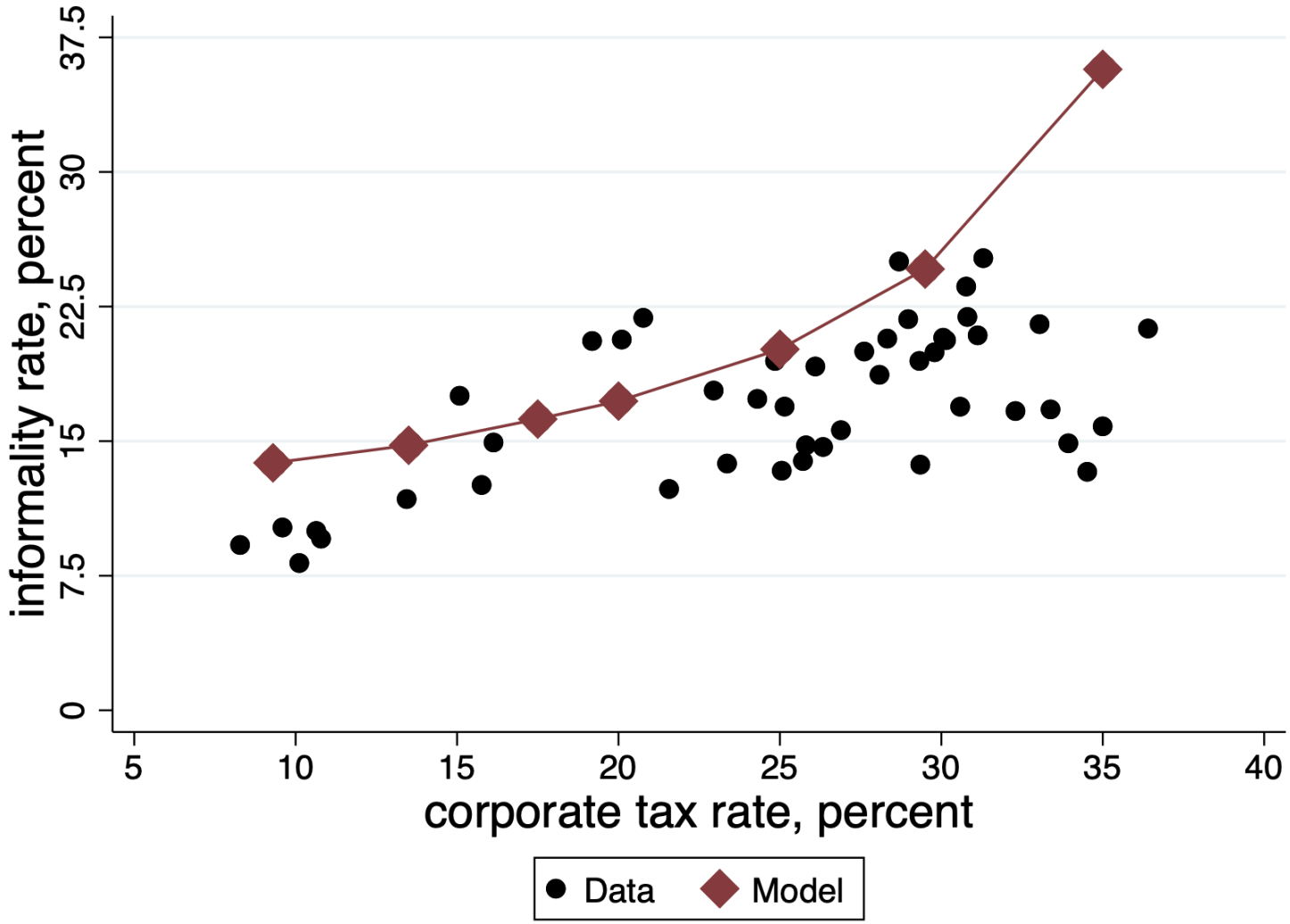
Parameters	Description	Estimates (LCU, 2010)	C.I. (± S.E.)		Estimates (USD, 2010)
c_e	Entry cost	3,832.66	3,780.66	3,884.66	1,352.9
$\overline{c_f}$	Registration cost, upper bound	98010.8	13,144.7	18,2876	34,597
c_v^i	Vacancy cost, informal workers.	10,425.8	8,491.78	12,359.9	3,680.3
c_v^f	Vacancy cost, formal workers	18,532.0	14,305.8	22,758.2	6,541.8
A_o	Self-employment efficiency	1,051.92	1,040.40	1,063.44	371.33

- The average entry cost for formal firms amounts to \$18,652.
  - comparable estimates for the manufacturing sectors are \$27,532 in Cosar et al (16) for Colombia and \$25,000 in Fagjelbaum (21) for Argentina
- The average entry cost amounts to \$1,901.
  - Dix-Carneiro et al. (21) 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 \$4,456
  - 89% of the average wage and salary earnings

Corporate income tax rates around the world

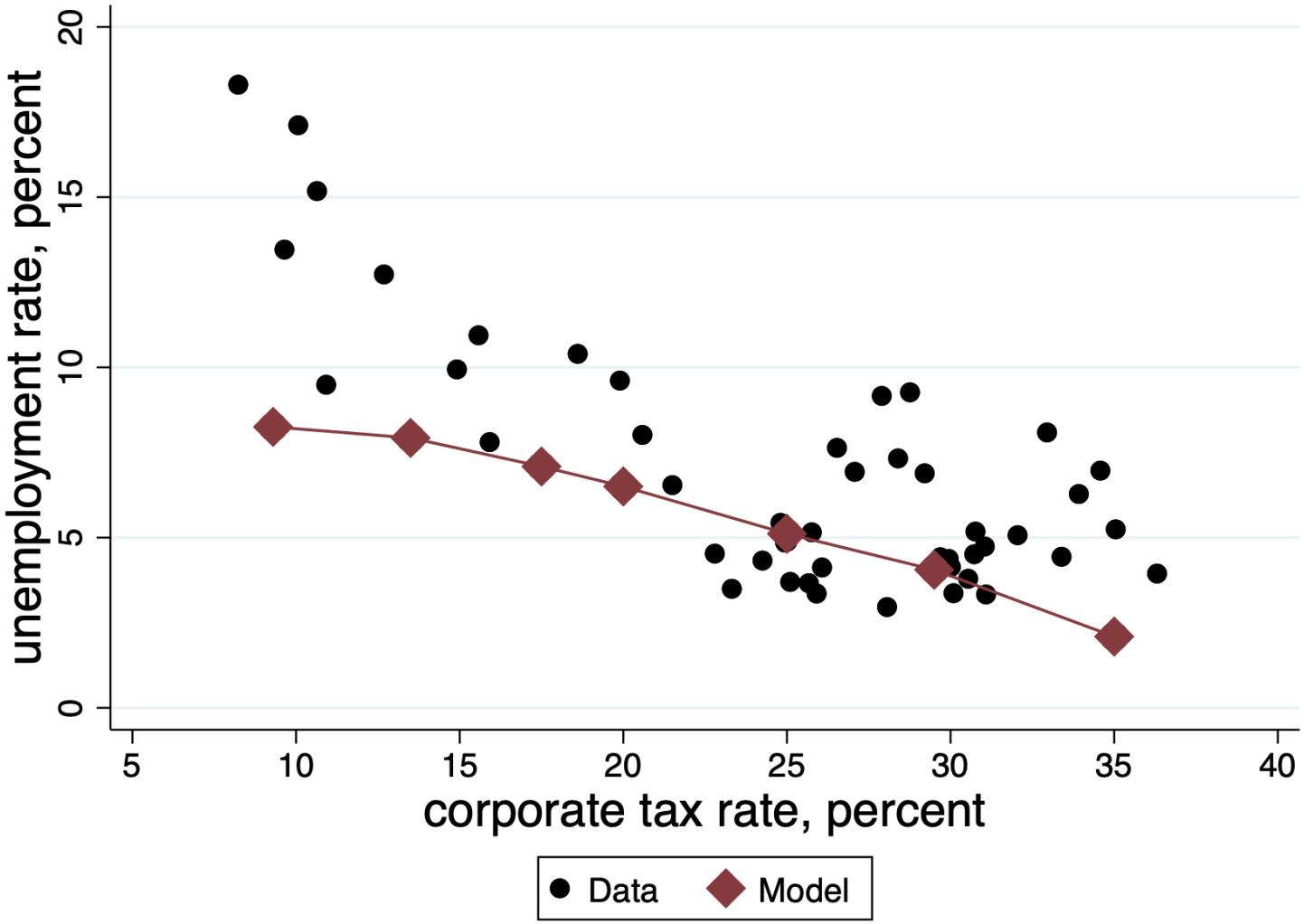
- Model experiment:
  - change corporate income tax rate, τ_y, keeping everything else constant
  - alternative counterfactual
- Evaluate model prediction against data:
  - informality rate, unemployment rate, GDP per capita
  - coverage: 75 countries, 1552 country-year obs, 2010-2021
    - Malawi (2013), GDP per capita: 370 (2017, USD)
    - Barbados (2018), GDP per capita: 16950 (2017, USD)
  - summary statistics

Corporate income tax rates and informality



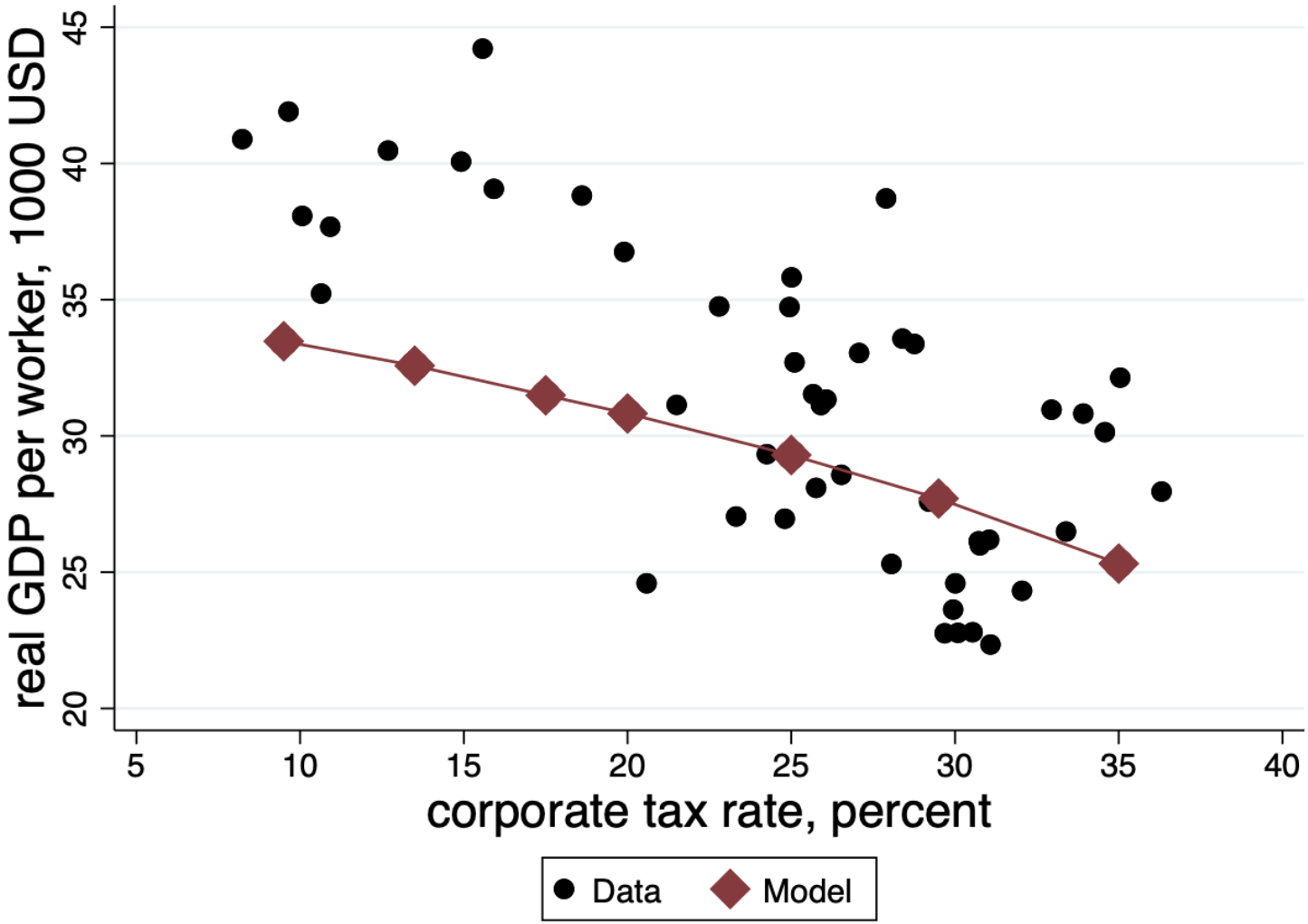
- Data slope: 0.789, Model slope: 0.371

Corporate income tax rates and unemployment



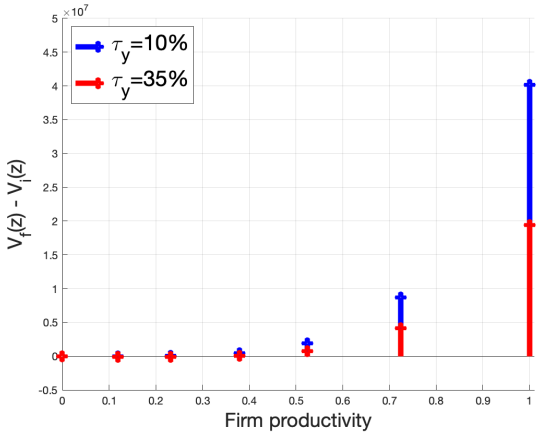
- Data slope: -0.378, Model slope: -0.244

Corporate income tax rates and GDP p.c.

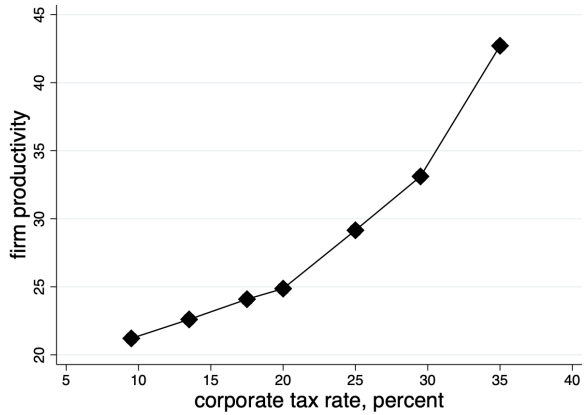


- Data slope: -0.564, Model slope: -0.262

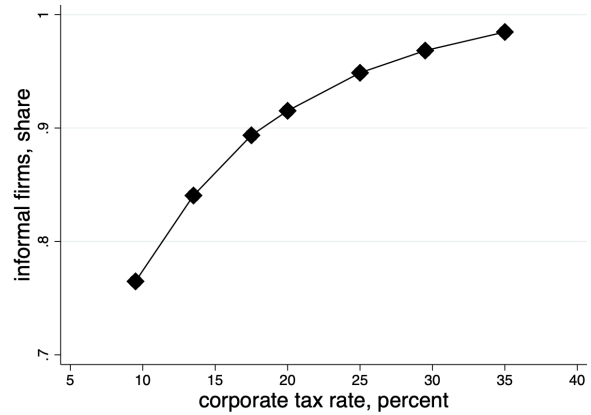
Firms and jobs reallocation



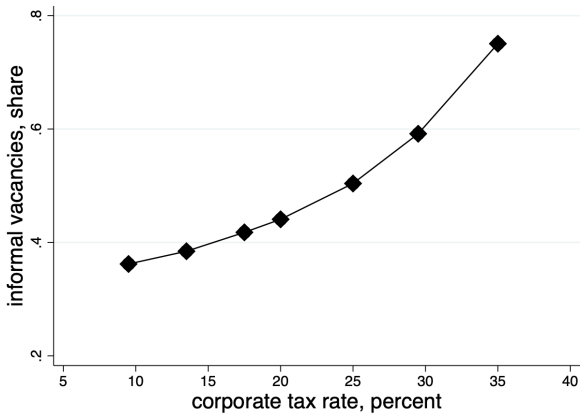
Value of registering



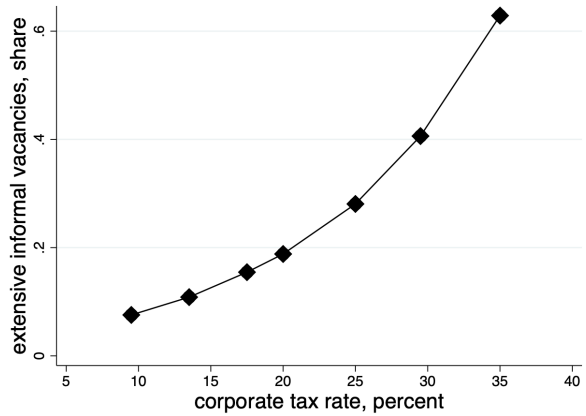
Formality threshold



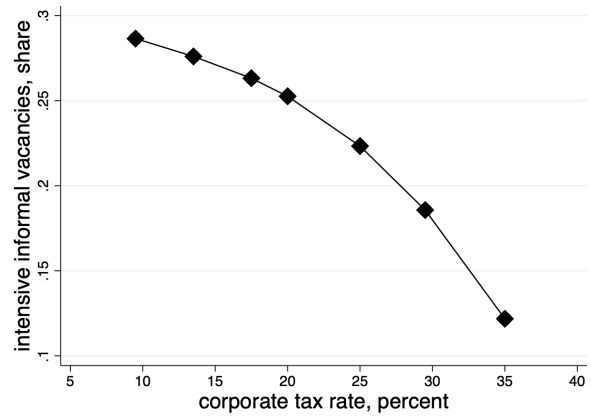
Informal firms



Informal jobs



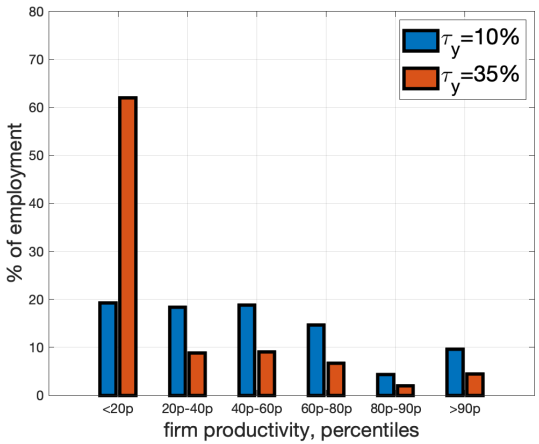
Informal jobs, extensive



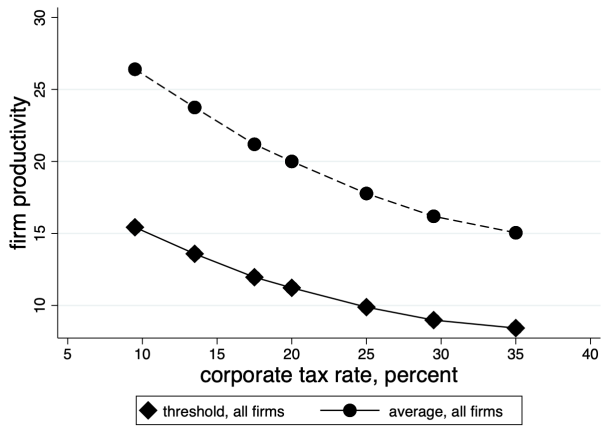
Informal jobs, intensive

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

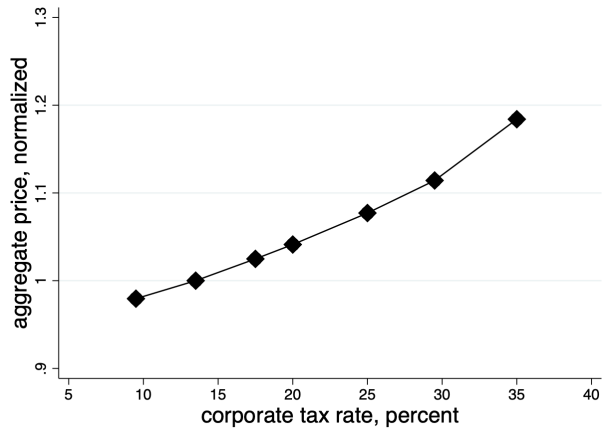
Competition in the product market



Employment distribution



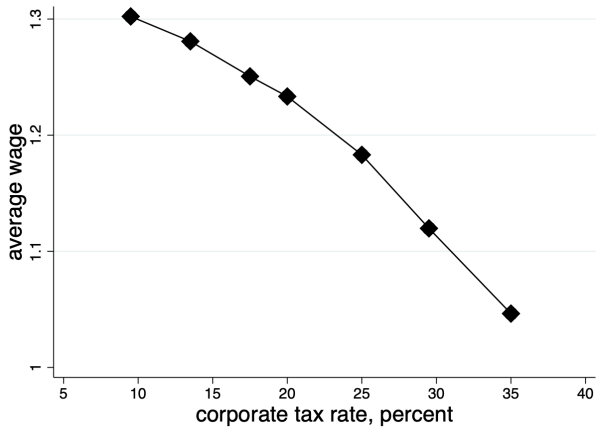
Entry threshold



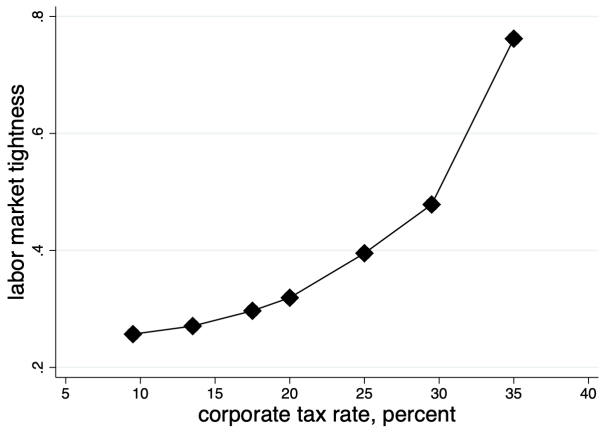
Aggregate price index

- 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

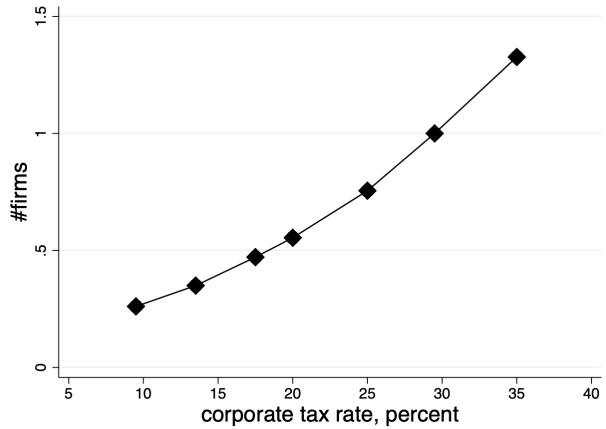
Concentration in the labor market



Wage ratio



Market tightness



Measure of firms

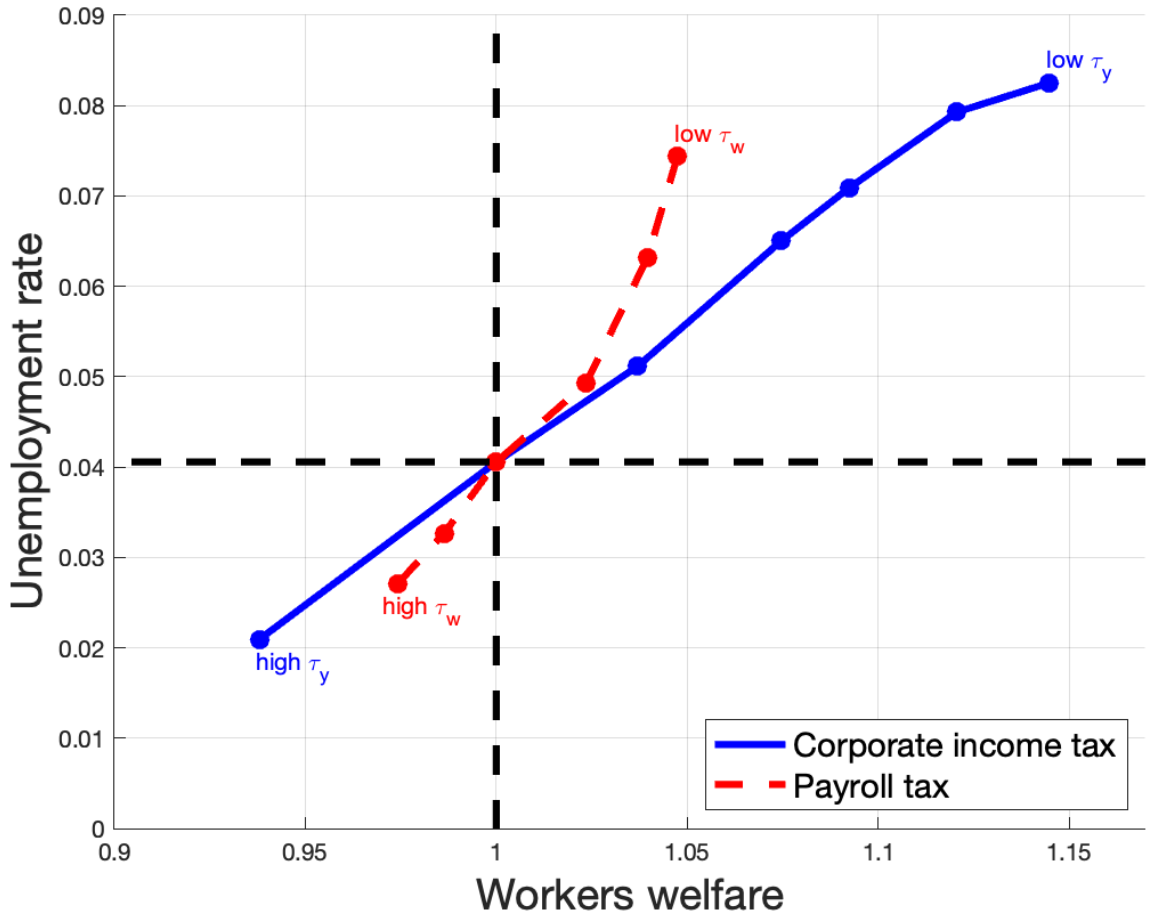
- Lower corporate taxes increase the average wage earnings, relative to earnings in self-employment
- No-arbitrage condition forces market tightness to adjust
- Employment concentrates on a smaller share of firms and jobs becomes scarcer

Corporate tax reform without informality

	Baseline (1)	Only extensive informality (2)	No informality (3)
Informality rate	-21.9	-31.7	-
Unemployment rate	+6.2	+10.7	+13.9
Real GDP per worker	+1.32	+1.44	+1.27

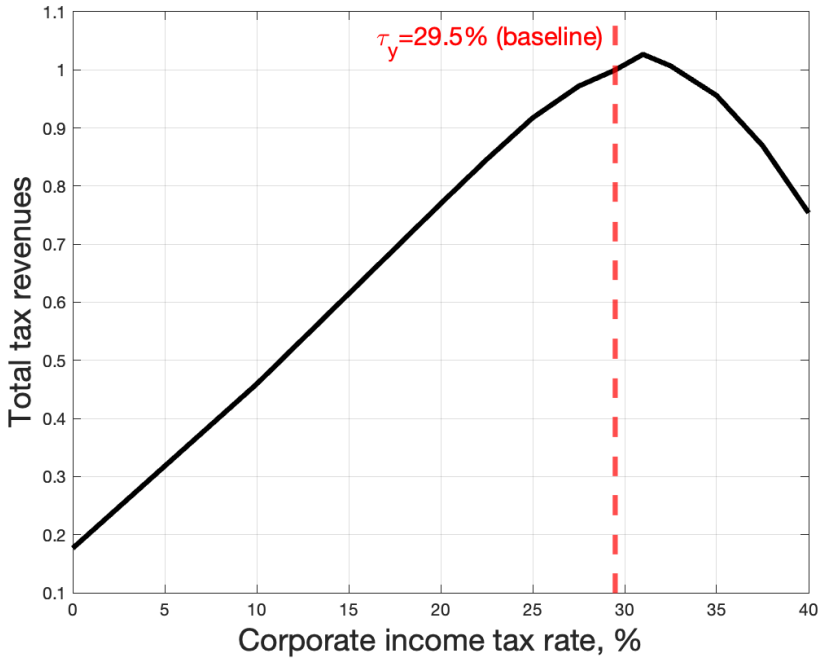
- Changes in corporate tax rates induce a much larger decline in the informality rate when only the extensive margin is considered (2) compared to baseline (1)
- *Informality as a buffer*: the response of the unemployment rate is amplified when informal jobs are not modeled
- Gains are higher when only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

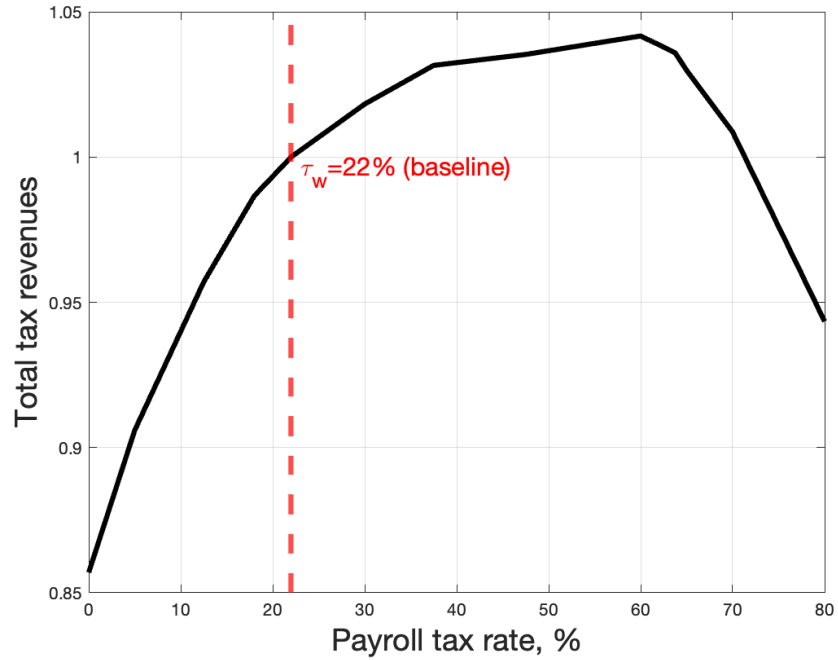
Efficiency-equity trade-off



- Both policies admit a monotonic trade-off between workers' aggregate welfare and employment rate

Laffer Curves





- Observed tax rates at the left of the peak of the Laffer curve
- Reducing tax rates *cannot* simultaneously achieve higher output gains, employment formalization and higher tax revenues

Corporate income versus payroll taxes

	Baseline	Counterfactuals				
	(1)	(2)	(3)	(4)	(5)	(6)
Corporate tax rate	0.295	0.295	0.225	0.375	0.225	0
Payroll tax rate	0.220	0	0.220	0	0.421	2.250
Aggregate tax revenues	1	0.842	0.842	1	1	1
Informality rate	0.246	0.189	0.184	0.271	0.224	0.277
Unemployment rate	0.041	0.074	0.059	0.042	0.043	0.023
Real GDP per worker	1	1.078	1.087	0.968	1.024	0.984
Welfare	1	1.048	1.056	0.982	1.021	0.998

- Revenue-neutral shift of tax burden from corporate income to payroll taxes
  - decreases informality by 2.2 p.p.
  - increases real GDP per worker and welfare by 2.4% and 2.1%
  - increase unemployment marginally 0.2 p.p.

Conclusion

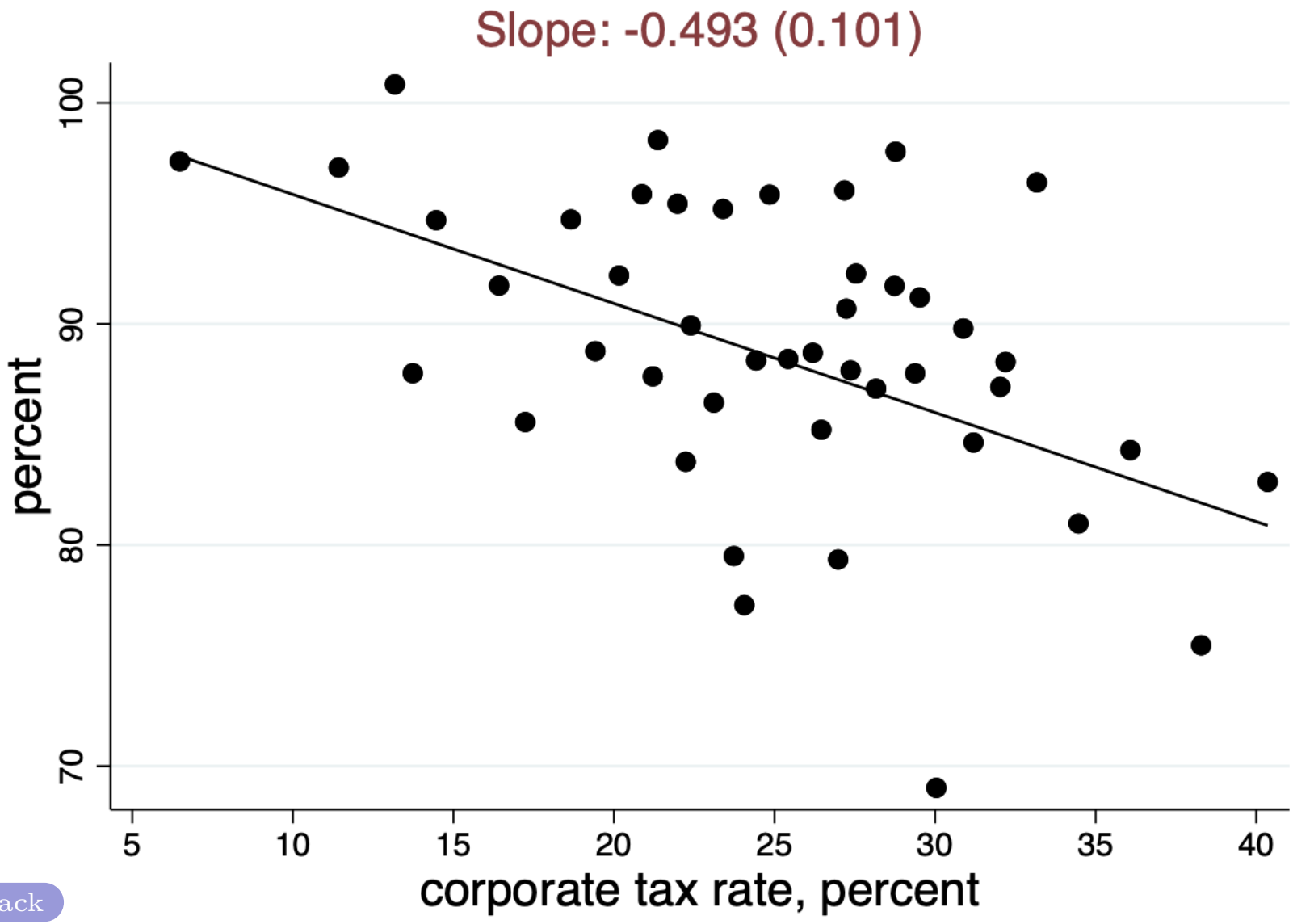
- Understanding how growth-oriented reforms can influence income distribution is a first-order question for developing countries
- Document how labor market outcomes vary with corporate income tax rates across countries
- Build a two-sector model of firm dynamics with search frictions and informality 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	326	5677.28	3897.49	370.301	16950.3
GDP per worker, 2017 USD	326	31124.1	16035.1	2583.41	72420.6
TFP, PPP (US=100)	326	59.1	19.1	23.3	124.9
Corporate tax rate, %	326	24.9	7.36	9.21	38.5
Informality rate, %	326	17.0	11.1	0	47.4
Unemployment rate, %	326	6.88	6.22	0.21	29.3

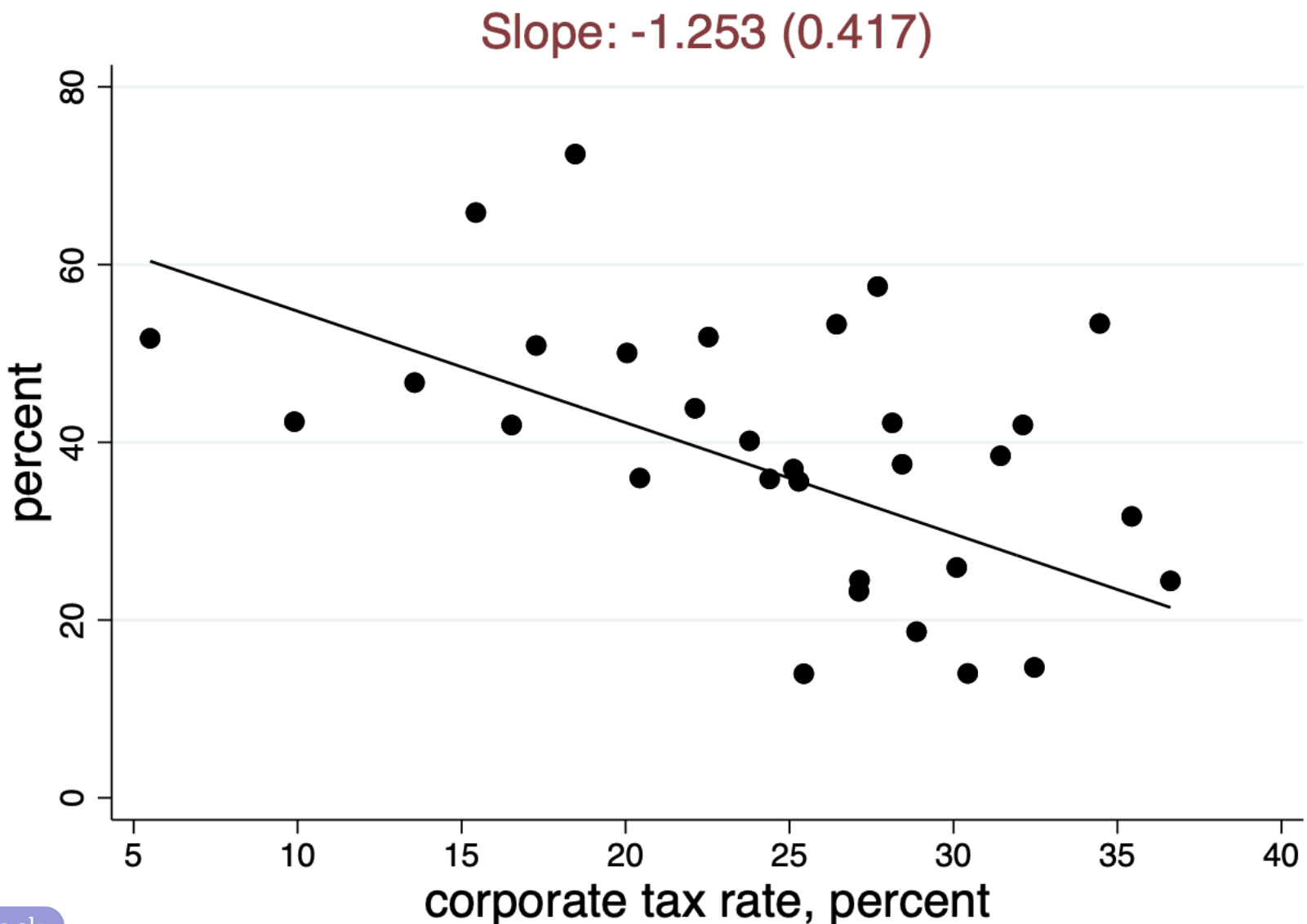
back

Firms formally registered when they started operations



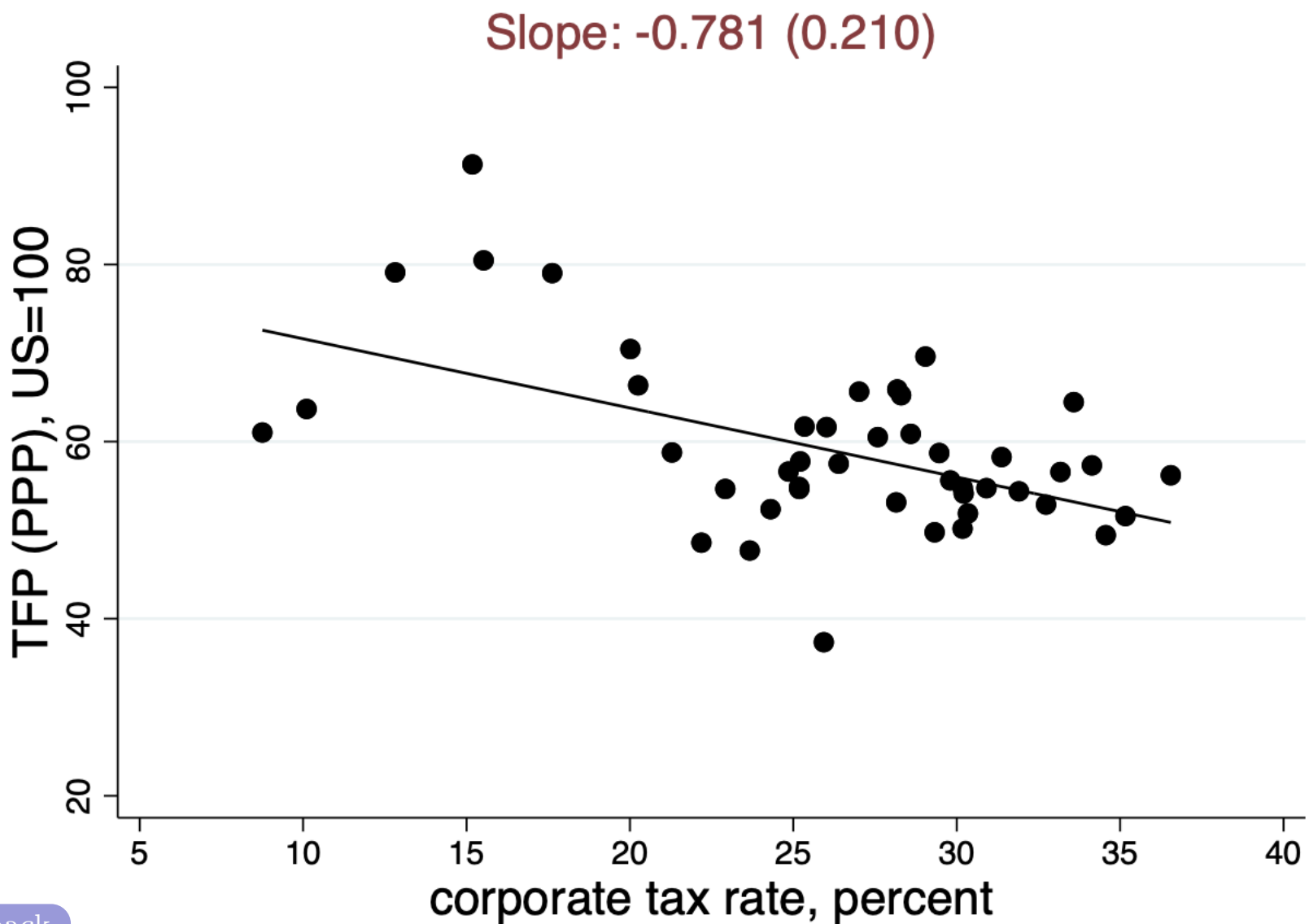
back

Employed workers covered by social security



back

Total factor productivity



back

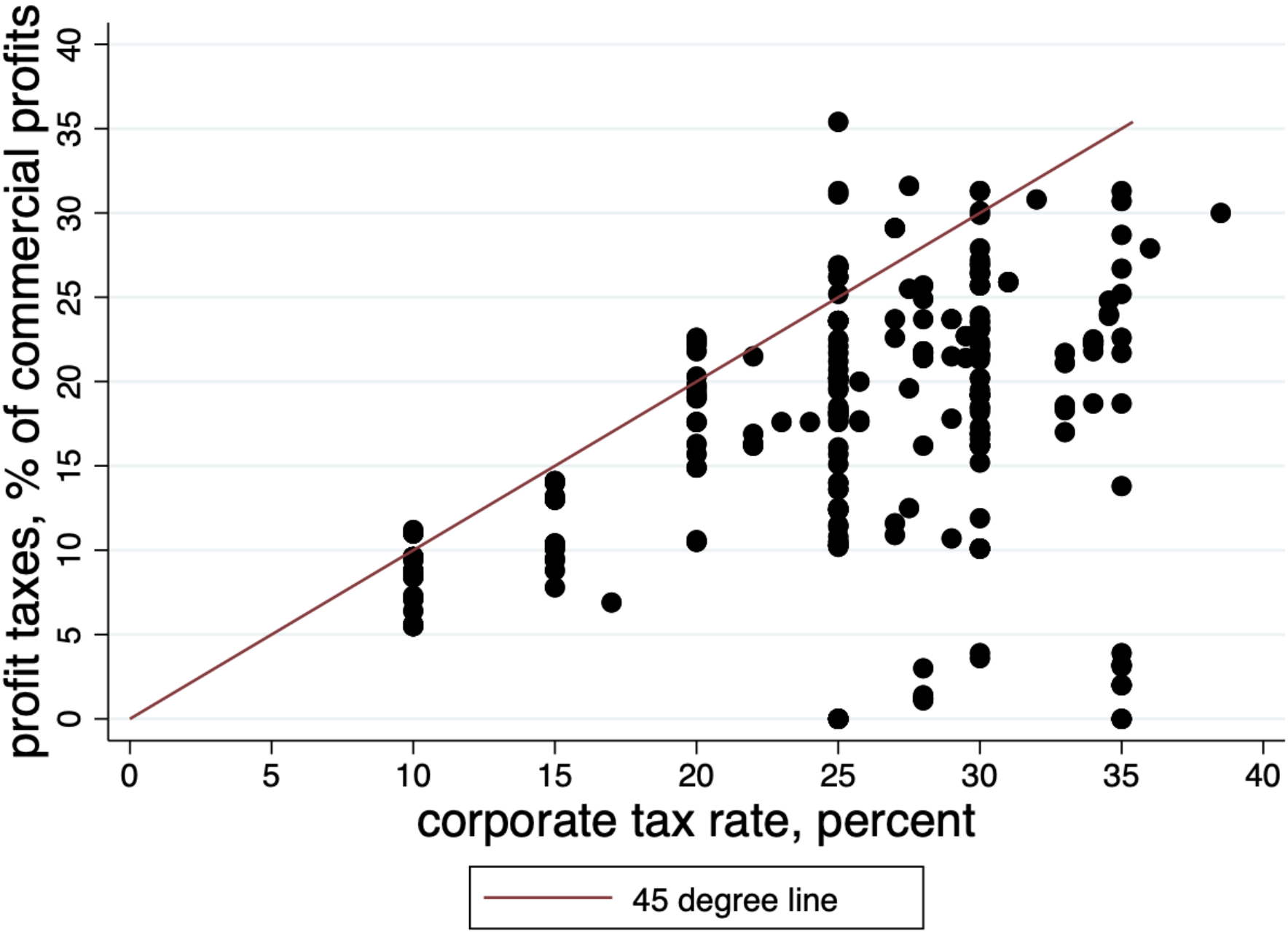
Country unobserved heterogeneity

	Informal wage employment			Unemployment rate		
	(1)	(2)	(3)	(1)	(2)	(3)
Corporate tax rate, τ_{it}	0.377***	0.394***	0.383***	-0.198***	-0.203***	-0.202***
	(0.111)	(0.112)	(0.115)	(0.0294)	(0.0299)	(0.0299)
Observations	326	326	326	326	326	326
R-squared	0.372	0.390	0.417	0.229	0.240	0.251
GDP p.c. cluster FE	✓	✓	✓	✓	✓	✓
Time FE		✓	✓		✓	✓
GDP p.c. cluster trend			✓			✓

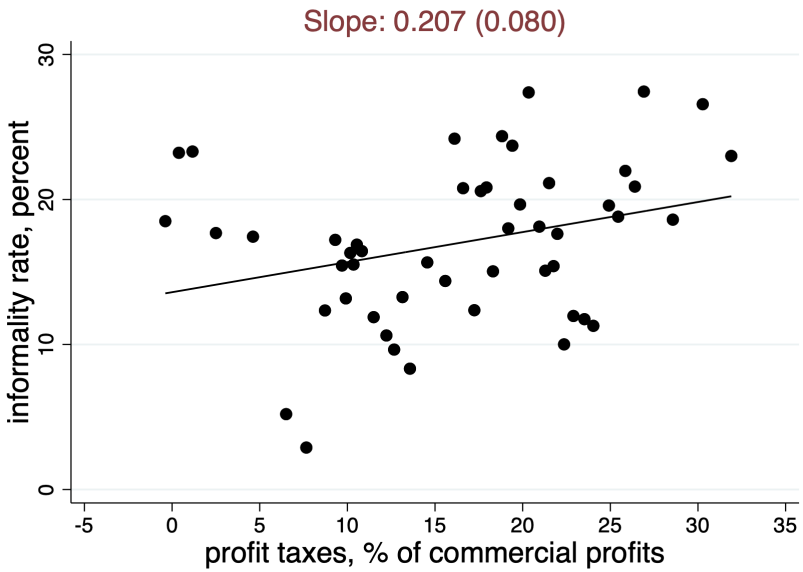
	Real GDP p.w. (1000 USD)			Real TFP (US=100)		
	(1)	(2)	(3)	(1)	(2)	(3)
Corporate tax rate, τ_{it}	-0.985***	-0.985***	-0.984***	-1.052***	-1.055***	-1.064***
	(0.0798)	(0.0799)	(0.0804)	(0.111)	(0.112)	(0.109)
Observations	326	326	326	326	326	326
R-squared	0.173	0.173	0.176	0.187	0.191	0.197
GDP p.c. cluster FE	✓	✓	✓	✓	✓	✓
Time FE		✓	✓		✓	✓
GDP p.c. cluster trend			✓			✓

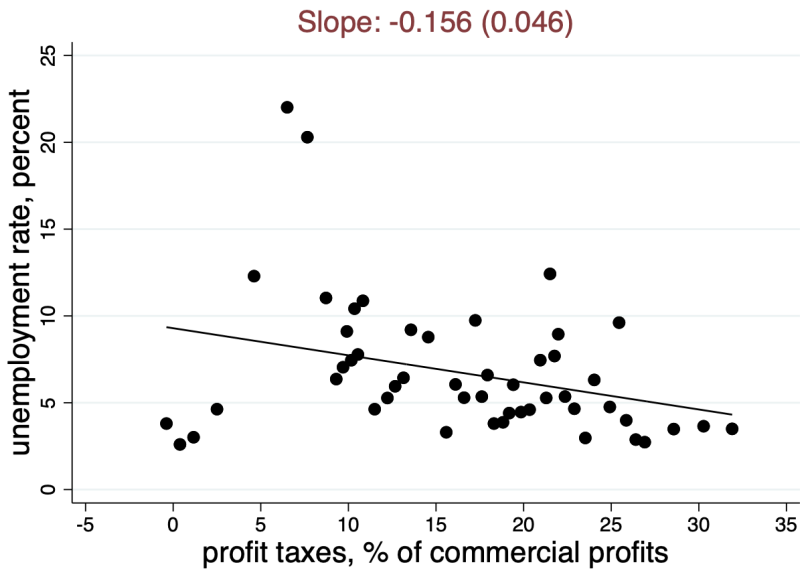
back

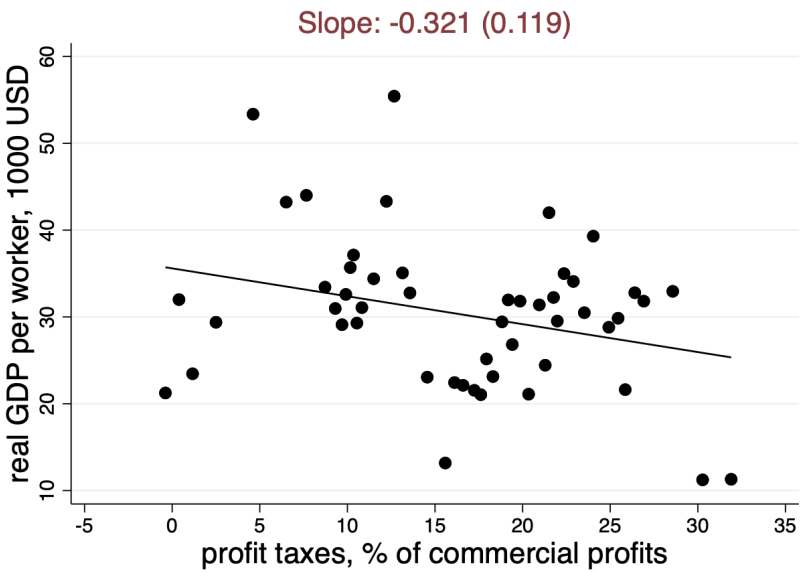
Marginal VS Average Profit Tax

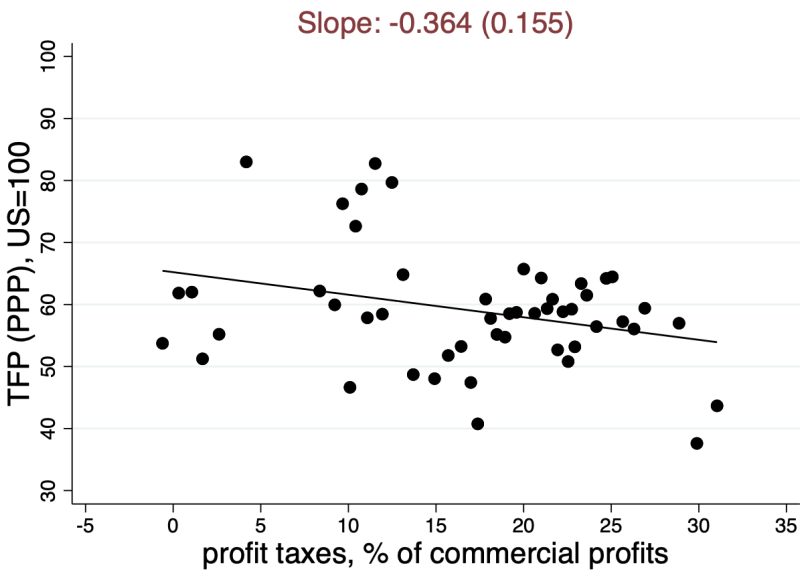


Average Profit Tax









Self-employment across countries

	Self-employment rate, %		
	(1)	(2)	(3)
Corporate tax rate, τ_{it}	0.131	0.106	0.100
	(0.105)	(0.106)	(0.108)
Observations	326	326	326
R-squared	0.741	0.746	0.752
GDP p.c. cluster FE	✓	✓	✓
Time FE		✓	✓
GDP p.c. cluster trend			✓

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

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

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

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

back

Problem of the unregistered firm

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

$$\begin{aligned} \text{s.t.} \quad & \ell_i' = (1-\delta_w)\ell_i + \phi v_i \\ & \pi_i(z,\ell_i) = r_i(z,\ell_i) - w_i(z,\ell_i)\ell_i - \kappa_i(z)\ell_i \\ & \kappa_i(z) = \gamma_0 z^{\gamma_1} \qquad \gamma_0 > 0, \gamma_1 > 0 \end{aligned}$$

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

back

Problem of the registered firm

$$\mathcal{V}_f(z,\boldsymbol{\ell}) = \max_{v_i, v_f} \quad \pi_f(z,\boldsymbol{\ell}) - \sum_{j\in\{i,f\}} c_v^j v_j + \frac{1-\delta_f}{1+r}\mathcal{V}_f(z,\boldsymbol{\ell}')$$

$$\text{s.t.} \quad \ell_j' = (1-\delta_w)\ell_j + \phi v_j \qquad \forall j \in \{i,f\}$$

$$\pi_f(z,\boldsymbol{\ell}) = (1-\tau_y)\left[r_f(z,\boldsymbol{\ell}) - w_f(z,\boldsymbol{\ell})\ell_f(1+\tau_w^j)\right] - w_i(z,\boldsymbol{\ell})\ell_i - \kappa_f(z,\boldsymbol{\ell})\ell_i$$

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

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

back

Problem of jobless workers

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

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

$$\begin{aligned}\mathbf{E}\mathcal{J}^e =& \frac{V_{ii}}{V}\int_z\int_{\ell_i}\mathcal{J}^e_{ii}(z,\ell_i)\nu_{ii}(z,\ell_i)dzd\ell_i \\ &+\frac{V_{if}}{V}\int_z\int_{\ell_i}\int_{\ell_f}\mathcal{J}^e_{if}(z,\ell_i,\ell_f)\nu_{if}(z,\ell_i,\ell_f)dzd\ell_i d\ell_f \\ &+\frac{V_{ff}}{V}\int_z\int_{\ell_i}\int_{\ell_f}\mathcal{J}^e_{ff}(z,\ell_i,\ell_f)\nu_{ff}(z,\ell_i,\ell_f)dzd\ell_i d\ell_f\end{aligned}$$

- 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

back

Problem of a wage and salary employees

$$\mathcal{J}^e_{ii}(z,\ell_i) = w_i(z,\ell_i) + \frac{[(\delta_w + (1-\delta_w)\delta_i)\mathcal{J}^n + (1-\delta_w)(1-\delta_i)\mathcal{J}^e_{ii}(z,\ell_i)]}{1+r}$$

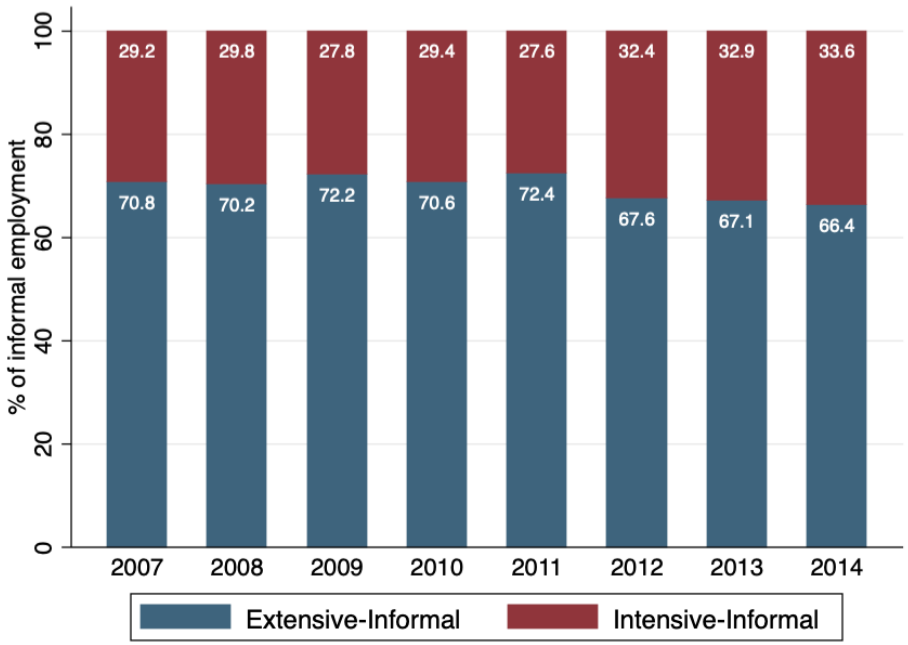
$$\mathcal{J}^e_{if}(z,\ell_i,\ell_f) = w_i(z,\ell_i,\ell_f) + \frac{\left[(\delta_w + (1-\delta_w)\delta_f)\mathcal{J}^n + (1-\delta_w)(1-\delta_i)\mathcal{J}^e_{if}(z,\ell_i,\ell_f)\right]}{1+r}$$

$$\mathcal{J}^e_{ff}(z,\ell_i,\ell_f) = w_f(z,\ell_i,\ell_f) + \frac{\left[(\delta_w + (1-\delta_w)\delta_f)\mathcal{J}^n + (1-\delta_w)(1-\delta_f)\mathcal{J}^e_{ff}(z,\ell_i,\ell_f)\right]}{1+r}$$

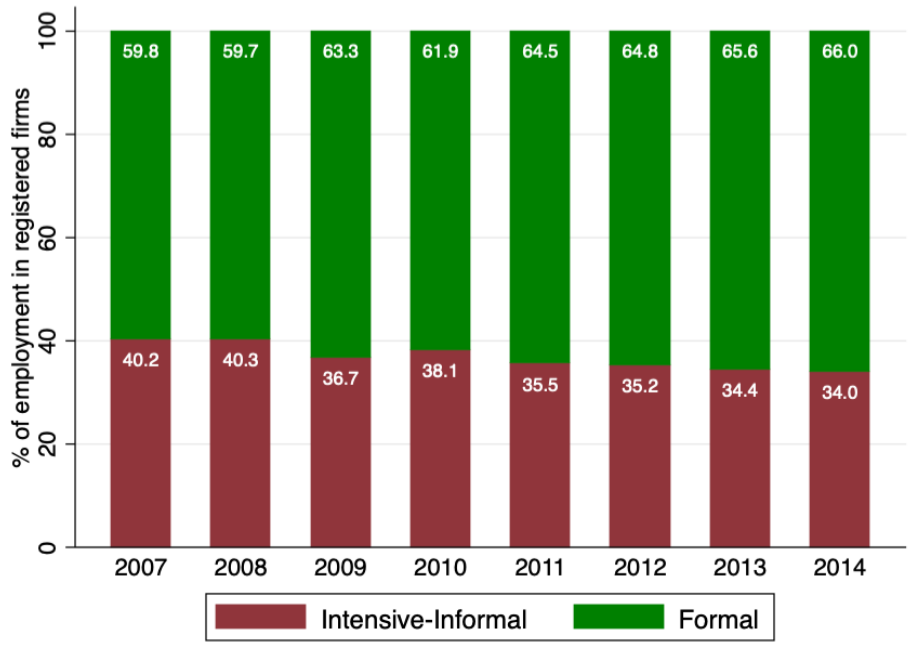
- δ_w denotes workers separation
- δ_i denotes firm exit

back

Composition of formal and informal employment



Informal employment

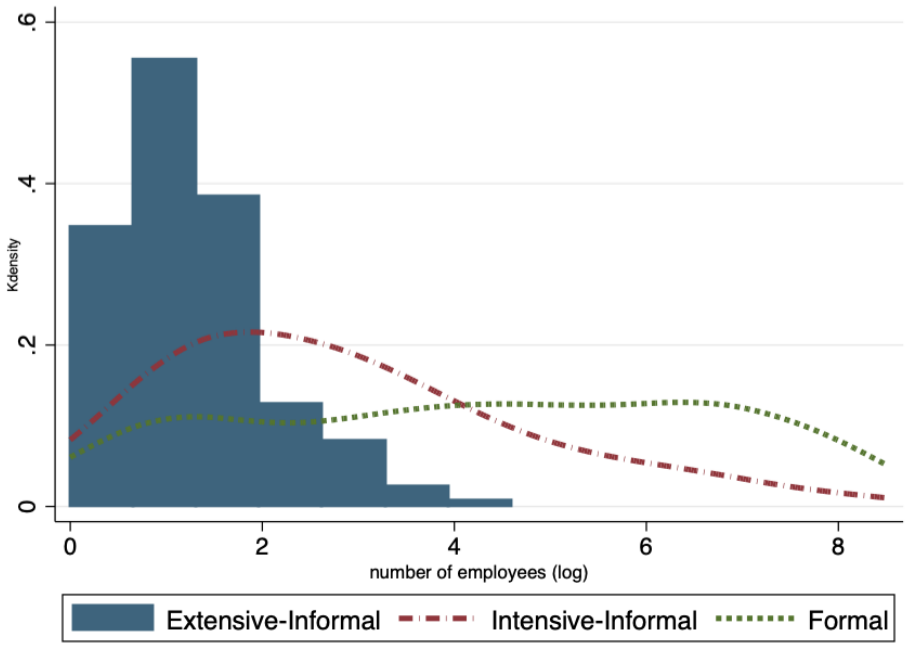


Employment in registered firms

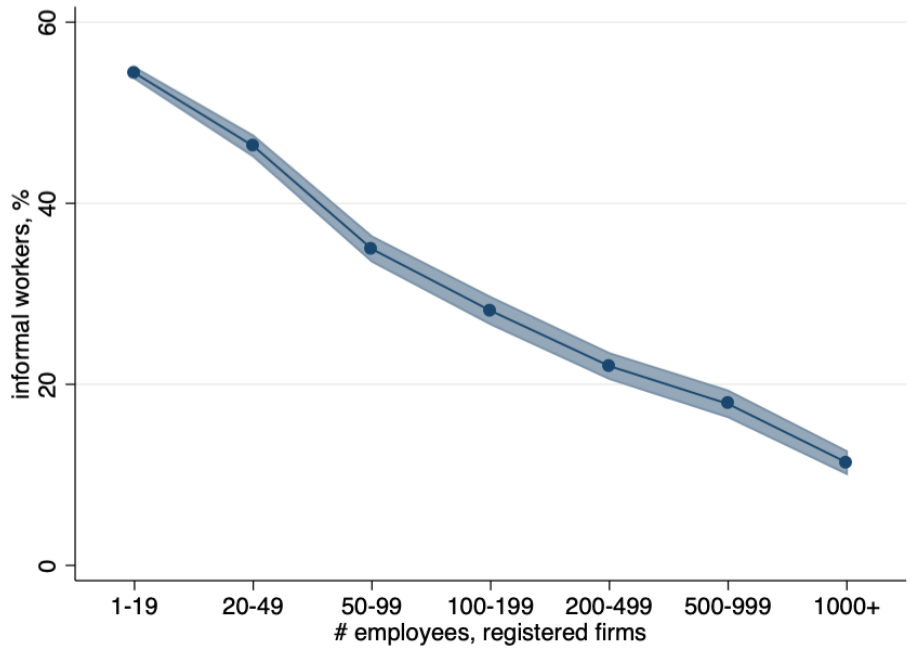
- More than 60% of wage and salary employment in Peru is informal.
- More than one-third of it is made of informal workers employed in registered firms

back

Firm size across formal and informal workers



Distribution of firm-size

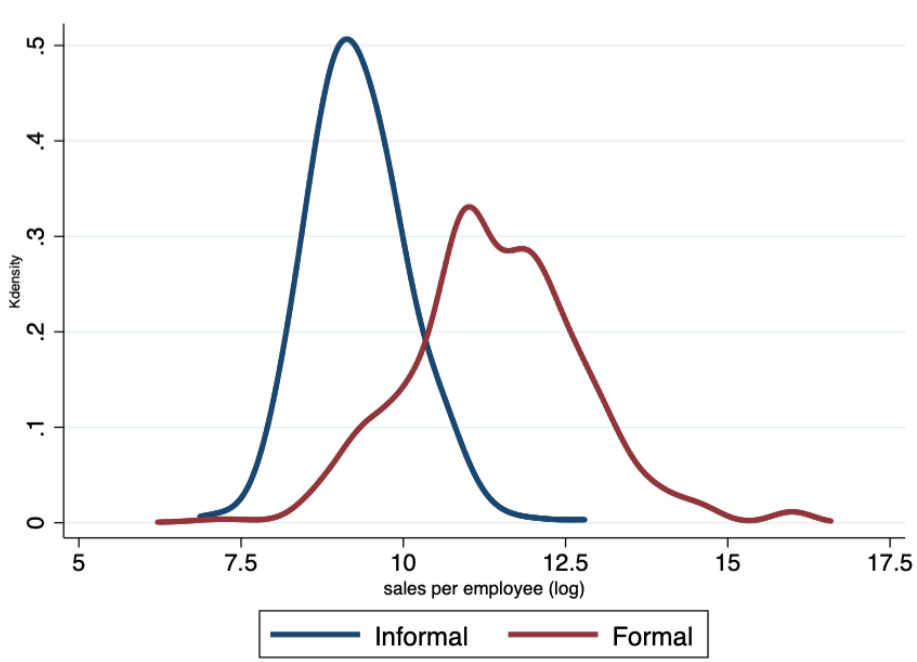


Informal workers in registered firms

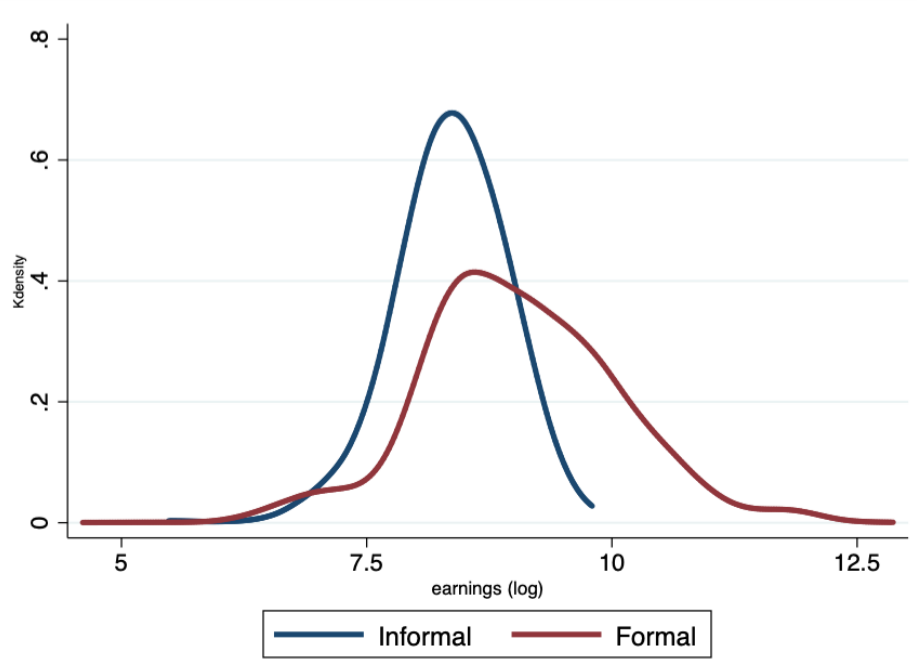
- Informal workers are more likely to be employed in smaller firms. The share of informal workers in registered firms declines with size.

back

Productivity of formal and informal firms



Sales per employee



Payroll per employee

- 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

	Log monthly earnings			
	(1)	(2)	(3)	(4)
$\mathbf{1}[\text{Formal}]_{it}$	0.984	1.129	0.583	0.828
	(0.004)	(0.006)	(0.006)	(0.009)
$\mathbf{1}[\text{Int.Mg.Inform}]_{it}$		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.	✓	✓	✓	✓
Controls			✓	✓

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

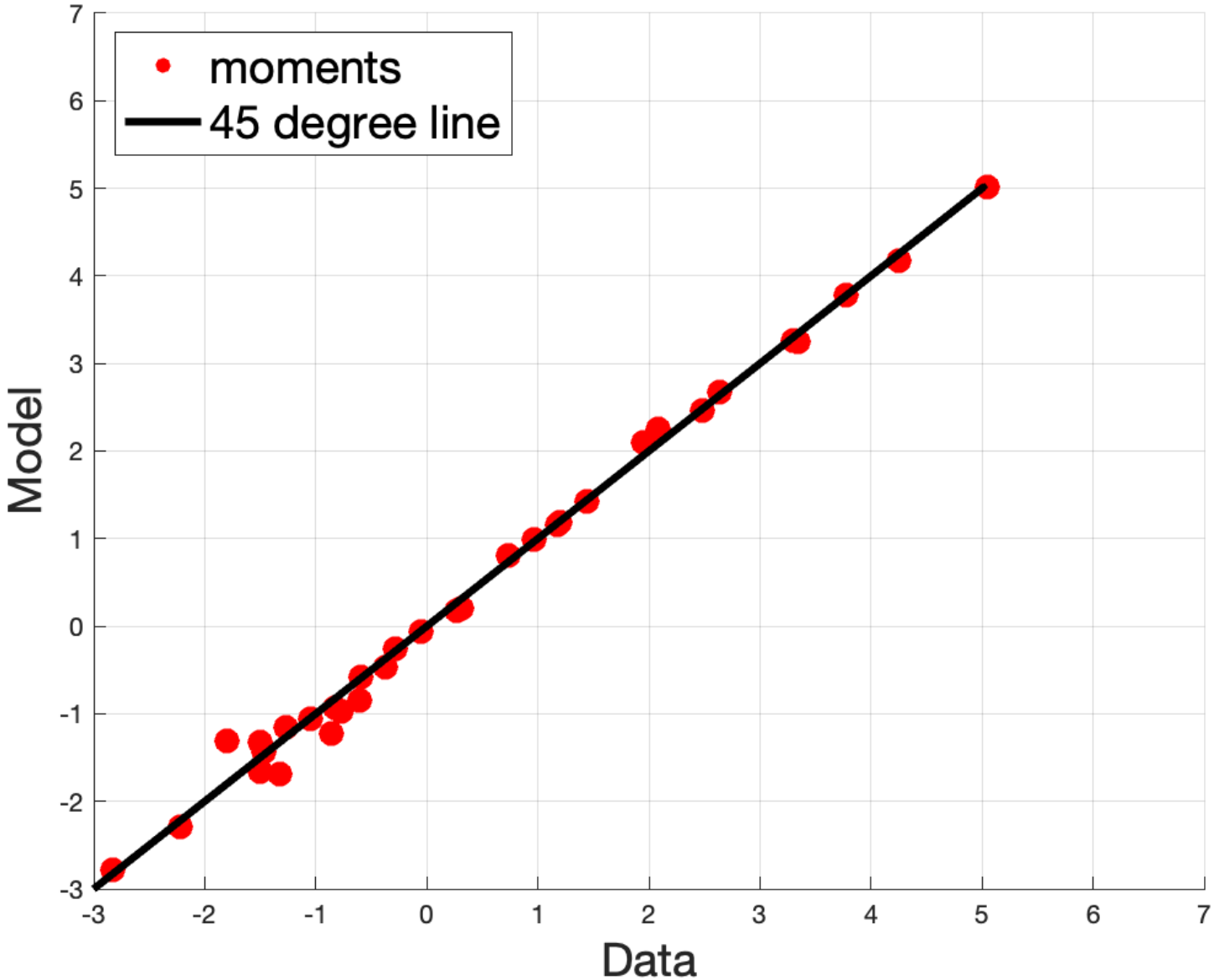
back

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 Ramırez-Rondan (2021)
$\underline{\ell}_i$	minimum scale, informal worker	1	assumption
$\underline{\ell}_f$	minimum scale, formal worker	1	assumption
τ_y	Corporate tax rate, %	29.5	SUNAT (2016)
τ_w	Payroll tax rate, %	22.0	SUNAT (2016)
b	Transfer to the unemployed	0	OECD (2019)
$\underline{w}$	Minimum wage, % of median	95.0	CEDLAS (2010-2015)

back

Estimation fit



back

Targeted moments

Moment	Data	Model	Moment	Data	Model
Firm-level moments			*Worker-level moments*		
Informal firms			*Labor market outcomes*		
Average log-revenues, $\mathbf{E}[\log R_i]$	7.061	8.146	Wage employment rate	0.450	0.444
Average log-size, $\mathbf{E}[\log \ell_i]$	0.266	0.186	Extensive-informal wage employment, share	0.436	0.395
Log-size dispersion, $\%\mathbf{std}[\log \ell_i]$	0.425	0.295	Intensive-informal wage employment, share	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, $\mathbf{E}[\log R_f]$	11.97	11.76			
Average log-size, $\mathbf{E}[\log(\ell_i + \ell_f)]$	3.227	3.186	*Wage gaps*		
Log-size dispersion, $\mathbf{std}[\log(\ell_i + \ell_f)]$, %	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			

back

Non-targeted moments

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

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

back

Estimated parameters

Parameters	Description	Estimates (LCU, 2010)	C.I. (± S.E.)		Estimates (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.	(± 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

back

Data

- Corporate taxes (Tax Foundation): standard statutory corporate income tax rates levied on domestic businesses
- Informality rate (ILO-stat): contributing family workers and 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)

back

Counterfactual corporate tax reform

Slope Coefficient: Model vs Data

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%
	(0.253)	(0.017)	-

back

The role of aggregate productivity

	Low-tax high-productivity (1)	High-tax low-productivity (2)	Low-tax low-productivity (3)	% explained by productivity (4)
Corporate income tax rate, τ_y	10%	35%	10%	-
Aggregate productivity, A	1.202	0.997	0.997	-
Productivity in outside sector, A_o	1264.20	1048.76	1048.76	-
Entry cost, c_e	4606.09	3821.16	3821.16	-
Informality rate	0.153	0.313	0.138	-10.7%
Unemployment rate	0.189	0.033	0.055	85.9%
Real GDP per worker	1.443	0.916	1.205	45.2%
Self-employment rate	0.463	0.589	0.542	-

- Controlling for changes in aggregate productivity, corporate income tax rates account for:
  - 14.1% of differences in unemployment rate
  - 54.8% of differences in real GDP per worker

back

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: $\tau_w = 0.22$

back

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: $\kappa_0 = 44.55$

back

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: $\kappa_2 = 96.482$

back

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 $b = 0$

back

Minimum wage for formal workers in registered firms

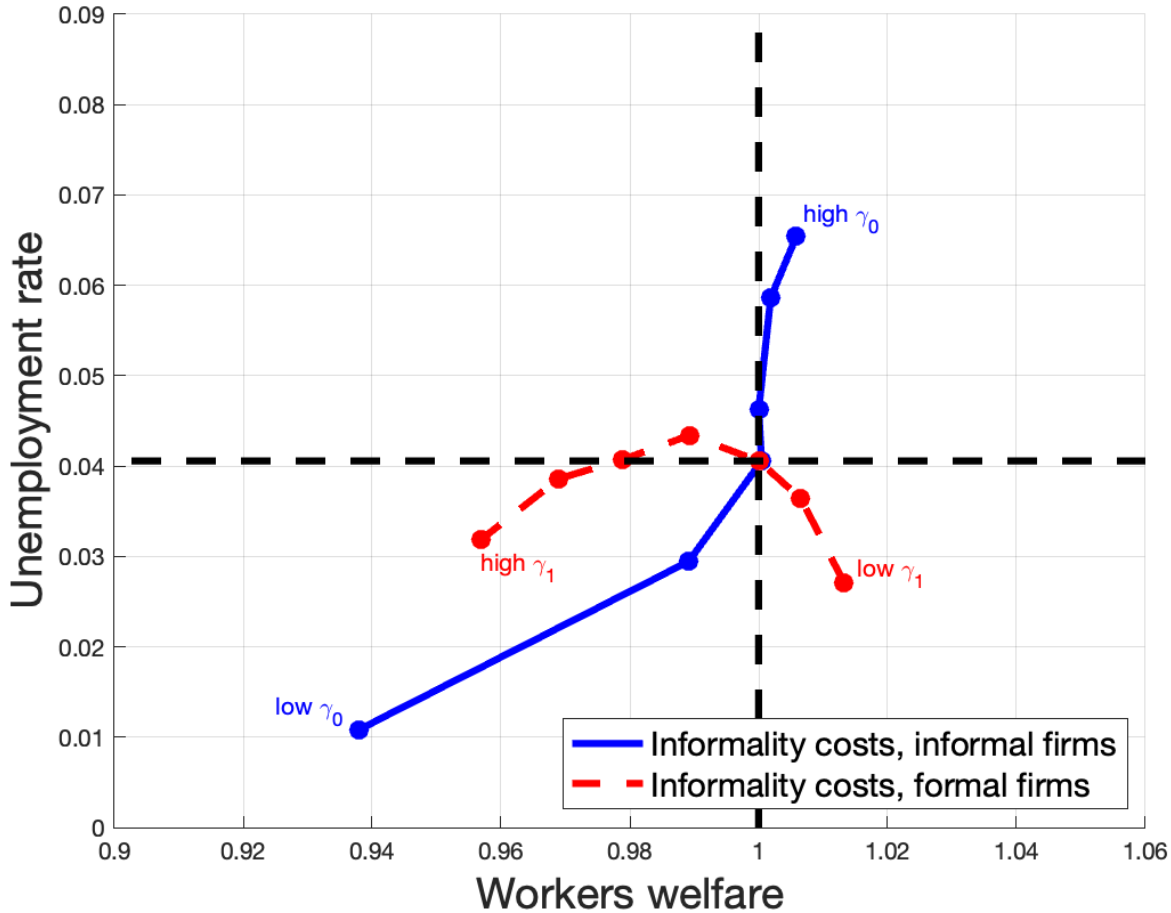
Minimum wage, $\underline{w}$	0	$1w_o$	$1.5w_o$	$2w_o$	$2.5w_o$	$3w_o$
Firm-level outcomes						
Informal firms, share	0.9683	0.9683	0.9683	0.9782	0.9860	0.9905
Informal vacancies, share	0.5918	0.5918	0.5918	0.7316	0.8572	0.9159
Average firm size	3.2498	3.2498	3.2498	2.3329	2.0616	2.0246
Aggregate Outcomes						
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: $\underline{w} = 0.95 \times \bar{w}$

back

Efficiency-equity trade-off

back



- Cost of informal workers in formal firms admit a non-monotonic trade-off between workers' aggregate welfare and employment rate