Learning in the Shadows: Informality and Entrepreneurship in Brazil

CIGS End of Year Macroeconomics Conference

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December 26, 2025

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Motivation

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    - 20-80% employment, 60-70% firms, 30-70% GDP (Ulyssea 2020)

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  - High-income informal sector entrepreneurs are more likely to transition to the formal sector over time.

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Why do these highly productive individuals choose to start out informally and only later formalize?

This paper explores informality's role in entrepreneurship as **a platform for business learning** and its macroeconomic implications.

- Develop a model to reconcile these novel findings.
  - Occupation and sector choice + business learning

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- Validate the model against policy evaluation results: *IMP Program*
    1. Lower entry cost to the formal sector
       → **Limited** effects on formalization
    2. A tax cut to young firms in the formal sector
       → **Larger** declines in informality

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     $\rightarrow$ Limited effects on formalization
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- Policy counterfactual
  - Increasing the monitoring effort on the informal sector

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New facts + Model $\Rightarrow$ Structural explanation to policy evaluation results

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- **Parasite view**: Farrell (2004), Levy (2008)
- **De Soto's view**: De Soto (1989), Ulyssea (2018)
- **Stepping stone**: Erosa, Fuster, and Martinez (2023), Franjo, Pouokam, and Turino (2022)
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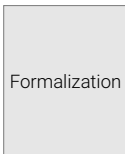# Relation to the Literature

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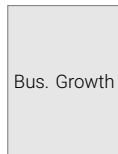 Mainly focus on *registration cost*

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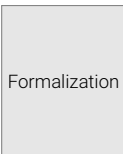 Mainly focus on *registration cost*

- **Growth promoting**: Focus on policies that could lead
  to higher growth of firms in developing countries

Formalization	Bus. Growth

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- **Growth promoting**: Focus on policies that could lead
  to higher growth of firms in developing countries

- $\rightarrow$ Our paper bridges these two strands of literature by
  examining how growth-promoting policies affect
  informality.

Formalization $\xleftarrow{\text{Our Paper}}$ Bus. Growth

Informal vs. Formal Entrepreneurs in Brazil: Motivating Facts

Data

- Data source: PNAD, PNADC, ECINF
- Non-agricultural working individuals with job records, 18-65 yrs old
- Use information from the main job (full-time) only.
- Identify entrepreneurs using occupation: SE or employer.
- Identify informality using tax registration status.

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Entrepreneur population share is 25%, 74% of them are in informal.

Informal sector firms are, on average,

- Owned by ents with lower skill measured by ave schooling yrs.
- Smaller size
- Lower productivity measured by value-added per worker.
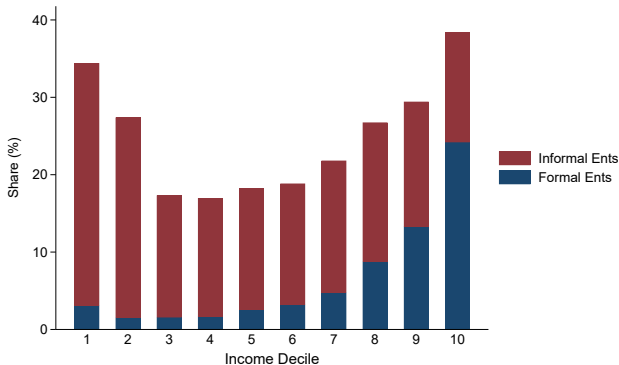
Informality Is Not Just for the Poor

Figure 1: Share of Entrepreneurs in Each Income Decile

- 37% of top income decile ents are in the informal sector.
- Top income informal ents are similar to their formal counterparts in terms of educ level, firm prod, profit.

Transition from Informal to Formal

High income informal ents are more likely to transition to formal sector.

t	Worker	$t+1$ Informal Ent	Formal Ent	Total
Informal Ent (All)	12.3	77.6	**10.1**	100
* Informal Ent (Decile 1-4)	14.1	80.2	5.7	100
* Informal Ent (Decile 8-10)	10.0	68.8	21.2	100
* Informal Ent (Top decile)	11.1	61.9	27.0	100

Table 1: Transition From Informal to Formal Entrepreneurship

- People with higher profit and larger firm size are more likely to transition.

▶ Switcher Characteristics ▶ Transition Rate by Firm Age

Model with Entrepreneurship, Business Learning, and Sector Choice

Demographics

- No aggregate uncertainty
- Discrete time, OLG

- Age 20-64: working age
  - Choose occupation in each period $\{W, E\}$
  - Choose sector if decides to be an entrepreneur $\{E_i, E_f\}$
- Age 65: mandatory retirement regardless of occupation
- Age 65-74: die with a mortality rate

Preference

- Discount factor: β
- Flow utility

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma}$$

- No bequest motive, only accidental bequests

Endowments

Working productivity for individual *i* at age *t*, denoted by ω_{it}, is

$$\log(\omega_{it}) = \log(g(t)) + \log(s_{it})$$
$$\log(s_{it}) = \rho_s \log(s_{i,t-1}) + \epsilon_{it}^s, \quad \epsilon_{it}^s \sim \mathcal{N}(0, \sigma_s^2)$$

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- Innate business quality: q_i
    - Drawn from $\mathcal{N}(\mu_q, \sigma_q^2)$ in every period
    - Fixed if individual chooses to be an entrepreneur
    - Unobservable to everyone

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- Transitory shock to business quality: e_{it}

  - *iid* draw from $\mathcal{N}(0, \sigma_e^2)$ in every period

Technologies

- Entrepreneurial sector (informal & formal)

$$f(k, l) = e^{Q}\left(k^{\alpha} l^{1-\alpha}\right)^{\eta}, \quad 0 < \eta < 1$$

- Corporate sector

$$F_c(K_c, L_c) = A_c K_c^{\alpha} L_c^{1-\alpha}$$

- Depreciation rate, δ, for both two sectors.

Bayesian Belief Updating

- New entrants have the initial belief $q \sim \mathcal{N}(\mu_q, \sigma_q^2)$
- Incumbents observe their inputs and outputs, thus they infer Q without separately identifying q and e.
  - Bayesian belief updating with prior $\mathcal{N}(\hat{\mu}_{q,n}, \hat{\sigma}_{q,n}^2)$

$$\hat{\mu}_{q,n+1} = \frac{\hat{\sigma}_{q,n}^2 Q_t + \sigma_e^2 \hat{\mu}_{q,n}}{\hat{\sigma}_{q,t}^2 + \sigma_e^2}$$

$$\hat{\sigma}_{q,n+1}^2 = \frac{\hat{\sigma}_{q,n}^2 \sigma_e^2}{\hat{\sigma}_{q,n}^2 + \sigma_e^2} = \frac{\sigma_q^2 \sigma_e^2}{(1+n)\sigma_q^2 + \sigma_e^2}$$

Hence, belief mean $\hat{\mu}_{q,t}$ and firm age n are state variables.

Profits

- Formal sector entrepreneurs

$$\pi^f = (1 - \tau_y)e^Q \left(k^\alpha l^{1-\alpha}\right)^\eta - (r + \delta)k - w(1 + \tau_{ss})l$$

- There is a fixed entry cost, C_{entry}^f
- Pay sales tax τ_y and payroll tax τ_{ss}
- Entrepreneurs can supply their own labor.

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  - Pay sales tax τ_y and payroll tax τ_{ss}
  - Entrepreneurs can supply their own labor.

- Informal sector entrepreneurs

$$\pi^i = e^Q\left(k^\alpha l^{1-\alpha}\right)^\eta - (r + \delta)k - wl - w\tau(l)$$

  - No entry cost, no tax. Entrepreneurs can supply their own labor.
  - Face a prob. of detection by govn't which is increasing in size.
    - This is modeled as a labor distortion: $\tau(l)$ with $\tau', \tau'' > 0$ (Ulyssea 2018)

Financial Market and Government
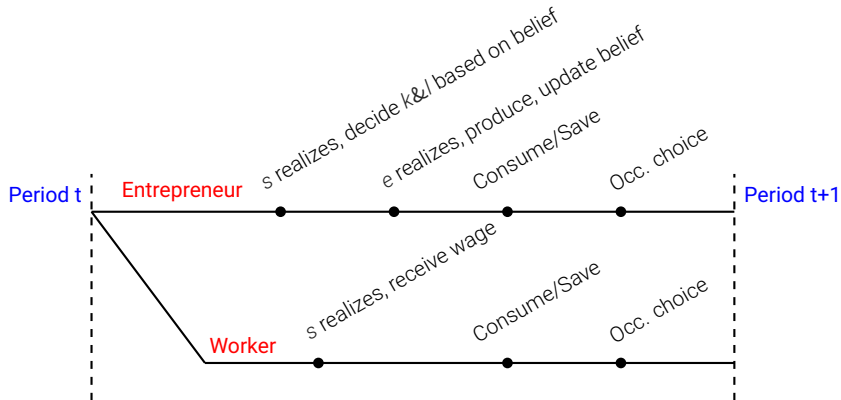
Financial Market

- Individuals cannot borrow for consumption.

- Entrepreneurial firms rent physical capital to produce but have collateral constraint, $k \leq \lambda a$.

  Informal ents face higher degree of credit frictions: $\lambda_i < \lambda_f$.

Government

- A wasteful government expenditure G

- Linear consumption tax (τ_c) on every individual

- Linear sales tax (τ_y) payroll tax (τ_{ss}) on formal firms

- Agent's occupation choice is made w/o observing their prod. realization.
- Entrepreneur's input decision is made based on their belief about q.

$$V^i(a, s, Q, \hat{\mu}_q, n, t) = \max_{k,n,c,a'} u(c) + \beta \cdot \mathbb{1}_{t=45} \cdot (1 - \Omega_{t+1})V^r(a', t+1)$$

$$+ \beta(1 - \mathbb{1}_{t=45}) \max \left\{ \mathbb{E}[V^w(a', s', t+1)], \mathbb{E}[V^i(a', s', Q', \hat{\mu}_q', n+1, t+1)], \right.$$

$$\left. \mathbb{E}[V^f(a' - C_{entry}^f, s', Q', \hat{\mu}_q', n+1, t+1)] \right\}$$
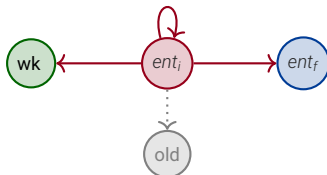
s.t. $\quad y = e^Q \left(k^\alpha l^{1-\alpha} \right)^\eta - (r + \delta)k - w(l - \omega) - w\tau(l)$

Note that k&n are decided based on $\hat{\mu}_q$

$(1 + \tau_c)c + a' = y + (1 + r)a$

$k \leq \lambda_i a$

$a' \geq 0$

Calibration Using SMM

Internally Calibrated Parameters

- Innate business quality: $q \sim \mathcal{N}(\mu_q, \sigma_q^2)$

- *iid* draw of transitory shock: $e \sim \mathcal{N}(0, \sigma_e^2)$

- Formal sector fixed entry cost: C_{entry}^f

- Formal sector borrowing constraint: λ_f

- Following Ulyssea (2018), $\tau(n) = \frac{n^2}{b}$

  o Labor distortion is assumed to be increasing and convex in firm size

Parameter	Value	Targeted Moment	Data	Model
μ_q	0.059	Population share of ents (PNAD)	0.25	0.26
σ_q	0.686	Share of formal firms with ≥ 51 employees (RAIS)	0.02	0.01
σ_e	0.368	Formal ents' profit autocorrelation after 1 yr (PNADC)	0.74	0.74
λ_f	1.440	Credit/output formal ent (Erosa et al. 2023)	0.43	0.43
C_{entry}^f	0.279	Share of formal ents (PNAD)	0.26	0.26
b	3.188	Share of informal firms with 0 emp (PNAD)	0.91	0.92

$C_{entry}^f = 0.279$ corresponds to approximately R\$4,873 ($\approx$ \$1000), which is consistent with the R\$2,000–R\$6,300 range reported in prior studies.

Non-targeted Moments	Data	Model
Share of informal ents who transition to formal	0.10	0.07
Share of informal ents in income deciles 8–10 who transition to formal	0.21	0.19
Share of top decile informal ents who transition to formal	0.27	0.24
Difference in the average age of formal & informal firms (years)	3	3.98
Difference in the average age of formal & informal ents (years)	3	3
Average years to transition from informal to formal	7	3.62
Exit rate of formal sector firms	0.13	0.18

Table 2: Model Performance: Untargeted Moments

▶ Firm Size Distribution ▶ Dispersion of MRPK

▶ Financial Friction

Perfect Information

The model **fails to generate the transition dynamics** when recalibrated with perfect information.

| Panel A | | | | | |
Parameter	Value (Info Fric)	Value (PI)	Targeted Moment	Data	PI Model
μ_q	0.059	0.071	Ent share	0.25	0.25
σ_q	0.686	0.368	Formal size ≥ 51	0.02	0.01
σ_e	0.368	0.220	Formal profit autocorr	0.74	0.74
λ_f	1.440	1.304	Formal credit/output	0.43	0.43
C_{entry}^f	0.279	9.554	Formal ent share	0.26	0.26
b	3.188	0.928	Informal se share	0.91	0.91
Panel B			Untargeted Moment	Data	PI Model
			Inf $\to$ F share	0.10	0.01
			Inc decile 8-10: Inf $\to$ F share	0.21	0.03
			Top inc decile: Inf $\to$ F share	0.27	0.06

Table 3: Parameters Calibrated (Jointly) in the Model with Perfect Information

Model Validation

The IMP Program in Brazil

The *Individual Micro-Entrepreneur Program* in Brazil (Rocha et al. 2018)

1. Reducing entry costs has limited effects on formalization.

2. A tax cut to small formal firms leads to substantially larger declines in informality.

   - The increase in formal firms is mainly driven by the **formalization of existing informal businesses.**

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Validate the model against the IMP evaluation results through two counterfactuals.

1. Reduce entry costs: $C^f_{entry} \times 0.5$
2. Reduce entry costs + 20-point payroll tax cut for formal firms ≤ 3 yrs old

(1). Reducing Entry Costs

	Baseline	Reduced C_{entry}^f	
		PE	GE
Prices			
r	3.99%		3.95%
w	1.66		1.67
Informality			
Informal ents (share)	73.64%	70.13%	70.26%
Informal output (share)	20.41%	17.96%	18.69%
Aggregate Economy			
K_e	100	106.13	101.05
K	100	104.32	99.62
Y_e	100	105.82	100.22
Y	100	102.99	99.96
Measured ent TFP	27.74	27.96	27.72
Tax revenues	100	105.18	100.69

Table 4: Effects of Reducing the Formal Sector Entry Cost

Notes: Measured entrepreneurial TFP is calculated as $\frac{Y_e}{(K_e^\alpha N_e^{1-\alpha})^\eta}$.

(2). Reducing Entry Costs + Tax Cut

	Baseline	Reduced C_{entry}^f + Tax cut	
		PE	GE
Prices			
r	3.99%		3.80%
w	1.66		1.69
Informality			
Informal ents (share)	73.64%	59.41%	60.04%
Informal output (share)	20.41%	11.24%	11.40%
Aggregate Economy			
K_e	100	125.41	108.83
K	100	120.18	102.68
Y_e	100	125.61	107.22
Y	100	113.30	103.56
Measured ent TFP	27.74	28.95	28.04
Tax revenues	100	121.94	108.53

Table 5: Effects of Reducing the Formal Sector Entry Cost and a Tax Cut

(2). Reducing Entry Costs + Tax Cut

	Baseline	Reduced C_{entry}^{f} + Tax cut	
		PE	GE
Occupation			
Frac. of q_{max} ents who are formal	54.87%	59.18%	59.60%
Num. of formal q_{max} ents (mass)	100	119.91	103.46
Transition			
Num. of entrants to informal sec. (mass)	100	115.30	100.10
Num. of entrants to formal sec. (mass)	100	100	100
Num. of inf $\rightarrow$ f (mass)	100	144.29	122.31
Share of inf ent who transition	6.87%	10.83%	10.55%
Years to transition	3.62	2.14	2.14

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▶ Conclusion

When More Monitoring Backfires: The Learning Margin

Increasing the Monitoring Effort

- Increase government monitoring $[\tau(n) = \frac{n^2}{b}]$: $b \times 0.5$

	Baseline	Stronger Monitoring	
		PE	GE
Prices			
r	3.99%		4.20%
w	1.66		1.64
Informality			
Informal ents (share)	73.64%	53.42%	53.16%
Informal output (share)	20.41%	5.61%	5.26%
Aggregate Economy			
K	100	86.03	96.78
Y	100	92.23	98.95
Occupation			
Num. of ents (mass)	100	73.60	83.98
Num. of q_{max} ents (mass)	100	85.51	89.79
Transition			
Num. of entrants to informal sec. (mass)	100	79.77	90.10
Share of inf ent who transition	6.87%	13.09%	13.32%
Years to transition	3.62	1.96	2.00

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Informal output (share)	20.41%	5.61%	5.26%
Aggregate Economy			
K	100	86.03	96.78
Y	100	92.23	98.95
Occupation			
Num. of ents (mass)	100	73.60	83.98
Num. of q_{max} ents (mass)	100	85.51	89.79
Transition			
Num. of entrants to informal sec. (mass)	100	79.77	90.10
Share of inf ent who transition	6.87%	13.09%	13.32%
Years to transition	3.62	1.96	2.00

Conclusion

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A model that links entrepreneurship, sector choice, and business learning.

- The informal sector serves as a **platform for learning**.

- The model replicates **new empirical patterns** on transition dynamics in Brazil.

- It helps explain the effects of formalization policies documented in the literature.

- **Learning is central for policy**: incorporating it reverses the aggregate effects of stricter informal-sector enforcement.

Thank you!

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Appendix

Business registration information is not available in PNAD.

- The IBGE defines firm informality according to registration status.

- A firm is considered informal if it is not registered with the tax authority under a CNPJ.

- Registered firms are subject to formal tax obligations, including contributions to the social security system.

- These contributions are mandatory under Brazilian law and form part of the broader "encargos sociais" (social charges) within the payroll tax system.
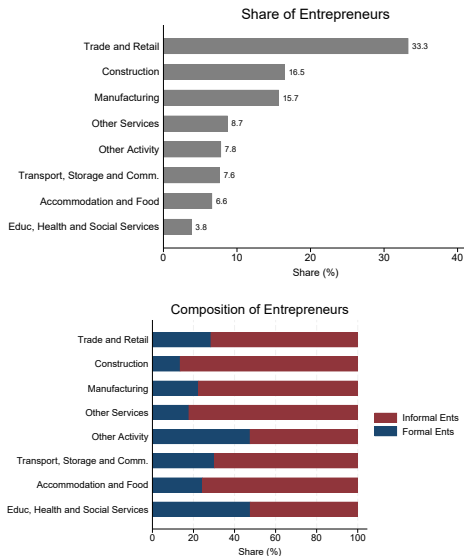
Figure 2: All Entrepreneurs: Industry Shares and Informality Composition
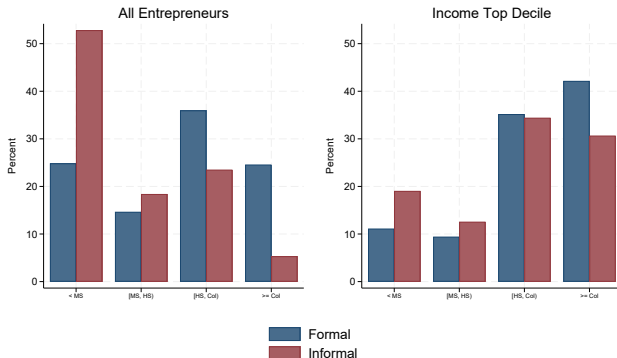
Figure 3: Entrepreneurs' Education Level

Notes: This figure shows the share of informal ents and formal ents across different educ levels. Educ is categorized into four groups: < MS, [MS, HS), [HS, Col), >= Col.
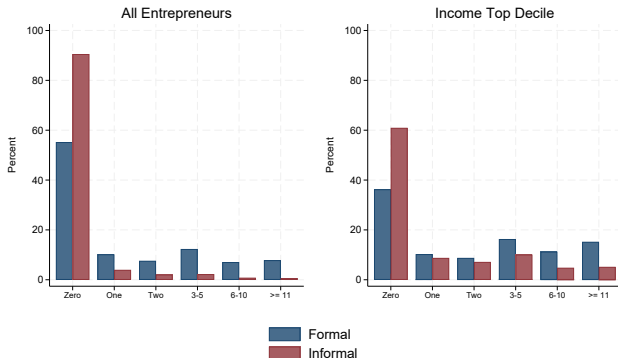
Figure 4: Firm Size Distribution

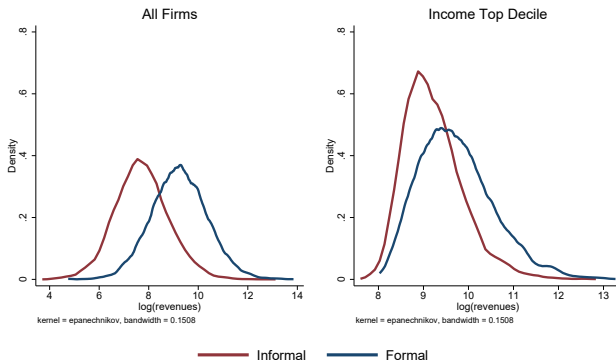*Notes*: This figure shows the share of informal ents and formal ents across different firm size categories.

Figure 5: Firm Size Distribution (Revenue Measure)

Notes: Data from ECINF. We regress the log of revenues on a set of industry dummies. This figure shows the densities of computed log residuals for formal and informal firms as a proxy for firm size.
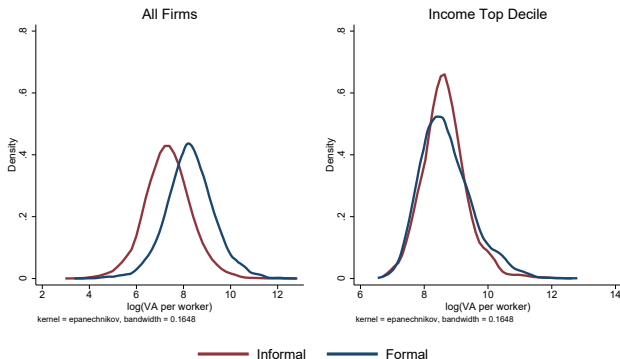
Figure 6: Firm Productivity Distribution

Notes: We regress the log of value-added per worker controlling for industry. The figure presents the density dist. of the computed log-residuals for formal and informal firms.

	PNAD		ECINF	
log(profit)	(1) All Ents	(2) Top Decile	(3) All Ents	(4) Top Decile
Formal ent	0.337***	0.036***	0.389***	0.094***
Male	0.491***	0.131***	0.430***	0.074**
Age	0.050***	0.006***	0.060***	-0.003
Age squared	-0.000***	0.000	-0.001***	0.000
Firm age	0.009***	0.003***	0.337***	0.035***
Educ level	Yes	Yes	Yes	Yes
Race	Yes	Yes	No	No
State	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Firm size category	Yes	Yes	Yes	Yes
Observations	282,544	41,302	21,356	4,165
R-squared	0.519	0.191	0.447	0.151

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6: Income Gap Between Formal and Informal Entrepreneurs

Notes: Data from PNAD and ECINF. The table reports the profit gap between formal and informal entrepreneurs when controlling for both individual and firm characteristics.
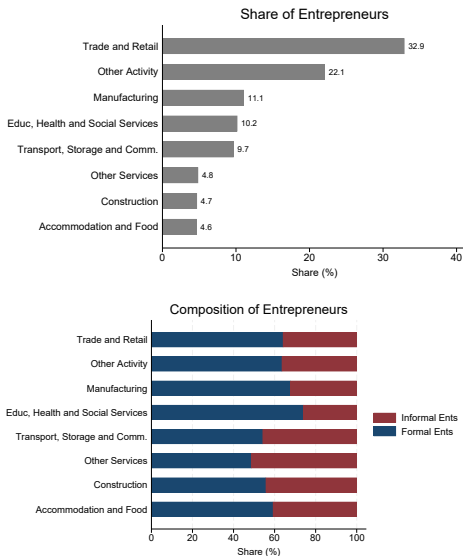
Figure 7: Top Decile Ents: Industry Shares and Informality Composition

	$1_{In \rightarrow F}$
log(income)	0.035***
Education	0.006***
Male	0.012**
Age	0.005***
Age squared	-0.000***
Firm size	0.030***
Growth	0.185***
Race	Yes
State	Yes
Industry	Yes
Observations	12,726
R-squared	0.108

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Transition From Informal to Formal Entrepreneurs

Notes: The table reports the transition from informal to formal entrepreneurship when controlling for both individual and firm characteristics.
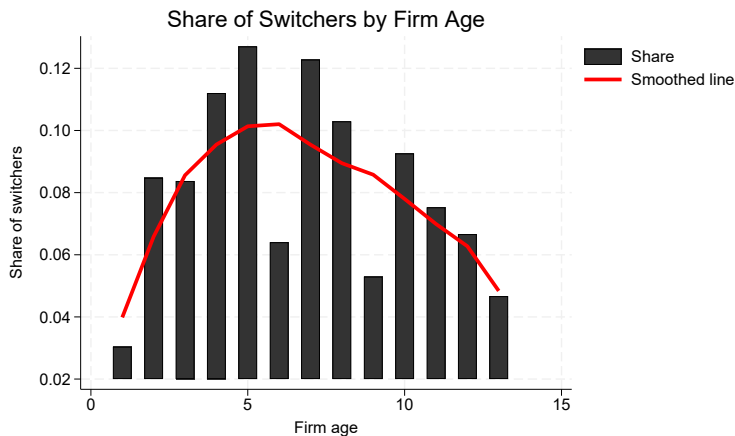
Notes: This figure plots the fraction of informal sector firms that transition to the formal sector by firm age.
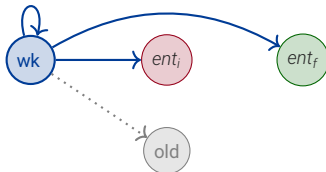
$$V^r(a, t) = \max_{c, a'} u(c) + \beta(1 - \Omega_{t+1})V^r(a', t+1)$$

s.t. $(1 + \tau_c)c + a' = (1 + r)a$

$a' \geq 0$

wk ent_i ent_f

old

$$V^w(a, s, t) = \max_{c, a'} u(c) + \beta \cdot \mathbb{1}_{t=45} \cdot (1 - \Omega_{t+1}) V^r(a', t+1)$$

$$+ \beta(1 - \mathbb{1}_{t=45}) \max \left\{ \mathbb{E}[V^w(a', s', t+1)], \mathbb{E}[V^i(a', s', Q', \mu_q, 0, t+1)], \right.$$

$$\left. \mathbb{E}[V^f(a' - C^f_{entry}, s', Q', \mu_q, 0, t+1)] \right\}$$

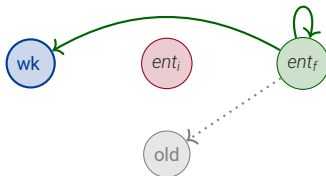s.t. $\quad (1 + \tau_c)c + a' = w \cdot \omega + (1 + r)a$

$\quad\quad a' \geq 0$

$$V^f(a, s, Q, \hat{\mu}_q, n, t) = \max_{k,n,c,a'} u(c) + \beta \cdot \mathbb{1}_{t=45} \cdot (1 - \Omega_{t+1})V^r(a', t+1)$$

$$+ \beta(1 - \mathbb{1}_{t=45}) \max \left\{ \mathbb{E}[V^w(a', s', t+1)], \mathbb{E}[V^f(a', s', Q', \hat{\mu}'_q, n+1, t+1)] \right\}$$

s.t. $y = e^Q \left(k^\alpha l^{1-\alpha} \right)^\eta - (r + \delta)k - (1 + \tau_{ss})wl + w \cdot \omega$

$(1 + \tau_c)c + a' = y + (1 + r)a$

$k \le \lambda_f a$

$a' \ge 0$

$$\max_{K_c, L_c} A_c K_c^{\alpha} L_c^{1-\alpha} - (r + \delta)K_c - wL_c$$

$$\Rightarrow$$

$$\alpha A_c K_c^{\alpha-1} L_c^{1-\alpha} = r + \delta$$

$$(1 - \alpha)A_c K_c^{\alpha} L_c^{-\alpha} = w$$

A stationary equilibrium

$$\Big(\underbrace{w, r}_{\text{prices}} \,;\, \underbrace{V^r(\cdot), V^w(\cdot), V^f(\cdot), V^i(\cdot)}_{\text{HH value func.}} \,;\, \underbrace{a'(\cdot), c(\cdot), n(\cdot), k(\cdot)}_{\text{HH policy func.}} \,;\, \underbrace{\Lambda(\cdot)}_{\text{dist.}} \Big)$$

such that in each period:

1. Given prices, agents and corporate firm optimize.

2. Government budget is balanced.

3. All markets clear: good market, labor market, and capital rental market.

4. Time-invariant distributions.

- Innate business quality: $q \sim \mathcal{N}(\mu_q, \sigma_q^2)$

- *iid* draw of transitory shock: $e \sim \mathcal{N}(0, \sigma_e^2)$

- Formal sector fixed entry cost: C_{entry}^f

- Formal sector borrowing constraint: λ_f

- Following Ulyssea (2018), $\tau(l) = \frac{l^2}{b}$

    ○ Labor distortion is assumed to be increasing and convex in firm size

Parameter	Role played in the model	Targeted Moment
μ_q	HHs decide if ent based on initial belief μ_q	Share of ents
σ_q	Determine right tail of firm size dist. of old firms (accurate belief)	Share of formal firms with emp > 50
σ_e	Cause changes in profit when ents know their q	Profit autocorr of formal ents
C_{entry}^f	Affect HHs decision to enter formal sec	Share of formal ents
λ_f	Amount of debt borrowed by formal ent	Formal sector debt / output
b	Distortion in the informal sector $\uparrow$ as $b \downarrow$	Share of informal firms with 0 emp

Parameter	Description	Source	Value
Preference			
γ	Relative risk aversion	Buera and Shin (2013)	1.50
β	Discount factor	Erosa et al. (2023)	0.92
Production			
α	$e^{Q}(k^{\alpha}l^{1-\alpha})^{\eta}$	Allub and Erosa (2019)	0.41
η		Allub and Erosa (2019)	0.80
δ	Capital depreciation rate	Guvenen et al. (2023)	0.05
λ_i	Informal sec borrowing constraint	Assumption	1.00
Productivity			
ρ_s	Working prod. persistence	Conesa et al. (2009)	0.98
σ_s	Working prod. std dev	Conesa et al. (2009)	0.17
Taxes			
τ_c	Consumption tax	Jung and Tran (2012)	0.15
τ_y	Sales tax	PIS/COFINS	0.09
τ_{ss}	Payroll tax	S.S.+Direct payroll tax	0.29

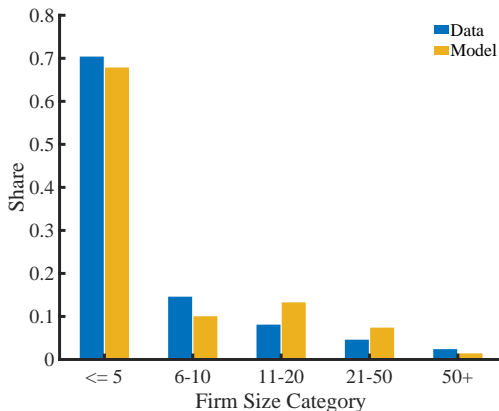Table 8: Parameters Calibrated Outside of the Model

Figure 8: Firm Size Distribution in the Formal Sector

Notes: The firm size distribution data are taken from Ulyssea (2018), who estimate it using administrative records from the RAIS dataset.

Following Feng (2025), we compute the dispersion of MRPK by firm age using data on firms' value-added and capital stock, and compare it to the corresponding model-simulated results
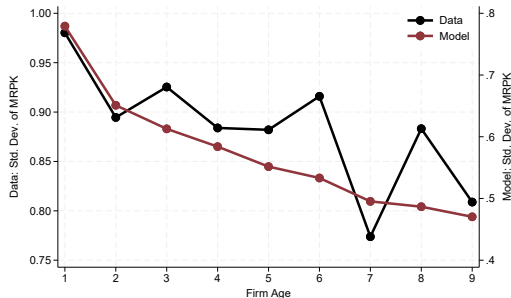

Figure 9: Dispersion of MRPK by Firm Age

Notes: Data from ECINF. The left y-axis corresponds to the empirical data, while the right y-axis corresponds to the model-simulated results.

Relaxing Collateral Constraints

	Baseline	$\lambda_f = 2$
Entrepreneurship		
Ent pop share	26.25%	35.31%
Informal ent share	73.64%	62.25%
Num. of ent entrants (mass)	100	134.47
Inf $\rightarrow$ F share	6.87%	9.94%
Years to transition	3.62	2.63
Aggregate Economy		
K_e	100	174.87
K	100	139.64
Y_e	100	153.73
Y	100	124.43
Measured ent TFP	27.74	29.13

Table 9: Relaxing Collateral Constraints

Notes: This table reports the results of a comparative statics exercise by increasing λ_f from 1.44 to 2. (i) K_e denotes the capital used in the entrepreneurial sector, while K refers to aggregate capital in the entire economy, including both the entrepreneurial and corporate sectors. (ii) Y_e and Y represent output produced by entrepreneurs and total output in the economy, respectively. (iii) Measured entrepreneurial TFP is calculated as $\frac{Y_e}{(K_e^\alpha N_e^{1-\alpha})^\eta}$, where Y_e, K_e, N_e are the aggregate entrepreneurial output, capital, labor, respectively.