Public Financing with Financial Frictions and Underground Economy

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Motivation

- Developing economies:

  - Large informal sector.

  - Underdeveloped financial markets.

  - Large fraction of entrepreneurs.

  - Difficulty in raising tax revenue.

- Informality and financial frictions **interact** in non-trivial ways:

  - Does it improve or worsen resource allocation?

  - What are the effects on tax revenue?

Informality and Financial Frictions

- Interaction amplifies negative effects on the allocation of resources.

    - *Both* create a competitive advantage for low productivity entrepreneurs.

    - Informal entrepreneurs may have a harder time obtaining credit.

- However, informality allows financially constrained entrepreneurs to operate at lower cost speeding up capital accumulation.

Informality and Financial Frictions

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  - Informal entrepreneurs may have a harder time obtaining credit.

- However, informality allows financially constrained entrepreneurs to operate at lower cost speeding up capital accumulation.

- Effects depend crucially on the type of informality (Ulyssea, AER 2018):

  (i) **Extensive margin:** the decision of entrepreneur to not register her business.

  (ii) **Intensive margin:** the decision of a formal firm to hire workers "off the books".

In this Paper...

- We develop an entrepreneurship model to assess the effects of informality on capital accumulation, occupational choice and public financing.

- **Key:** model two "margins" of informality.

- Calibrate to Brazilian micro data.
    - ▶ Entrepreneurship rate in Brazil.
    - ▶ Firm size distribution of formal and informal sector.
    - ▶ Share of formal and informal workers in formal business.
    - ▶ Relative differences in debt and capital intensities across businesses in the formal and informal sector.

- Quantitative experiments:
    - ▶ Effects of formalization policies.
    - ▶ The role of financial frictions.
    - ▶ The role of occupational choice decisions.

Preview of Results

- When cost of informality along extensive margin rise:
    - Aggregate output increases by 10.8%, capital by 13.9%, and TFP by 6.6%.
    - Tax revenue rises by 33%.

- When cost of informality along intensive margin rise:
    - Aggregate output changes by -3.6%, capital by -5.7%, and TFP by -1.9%.
    - Tax revenue changes by -6.0%.

- **Why?** The intensive margin subsidizes labor costs of all formal businesses.
    - important for credit constrained entrepreneurs who tend to use more labor.

- Without the subsidy most entrepreneurs move to the informal sector
    - Positive effects of the intensive margin depends on the option of going fully informal.

Literature

- **Aggregate consequences of informality**: Ulyssea (2018), Meghir et al (2015), de Paula and Scheinkman (2010), Prado (2011).

- **Financial frictions and misallocation**: Midrigan and Xu (2014), Buera et al. (2011), Moll (2014), Erosa (2001), and Allub and Erosa (2019).

- **Financial frictions and Informality**: Ordóñez (2014), Franjo et al (2019), D'Erasmo and Moscoso Boedo (2012), Antunes and Cavalcanti (2007).

- **Aggregate tax evasion and informality**: Di Nola et al. (2018) and Mckiernan (2019).

Evidence

Empirical Evidence

Data:

- **ECINF**: Matched employer-employee survey of small business (up to 5 employees): Formal and Informal Entrepreneurs + their employees.

- **RAIS**: Matched employer-employee administrative data on the universe of formal businesses.

- **PNAD**: Household survey.

Definitions:

- **Informal Firms**: Firms without a tax identification number.

- **Informal Workers**: Workers not entitled to receive social security benefits.

- **High-skilled**: Individual with completed high-school or more.

Occupational Structure

- The entrepreneurship rate in Brazil is large: 32%.
  - 26% is self-employed (most are informal).

Panel A: Employers and Self-Employed Entrepreneurs			
	All Entrepreneurs	Self-Employed	Employer
Fraction of the Labor Force (all)	32.2	26.7	5.6
Fraction of the Labor Force (high-skill)	26.1	18.3	7.8
Fraction of the Labor Force (low-skill)	36.8	33.0	3.8
Fraction of Informal among Small Bus. (all)	87.3	91.8	53.3
Fraction of Informal among Small Bus. (high-skill)	75.3	84.0	39.5
Fraction of Informal among Small Bus. (low-skill)	92.5	94.8	67.3

Informality Trends

Employment in Formal-Informal Businesses

- Informal businesses are **small**: more than 97% employ at most two workers. `Small Firms`
- Almost none employ more than five workers.

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Worker-Firm Status	≤ 5	≥ 6 and ≤ 10	≥ 11 and ≤ 50	≥ 51	All Firms
Formal Worker in Formal Firm (a)	42.48	69.99	82.95	91.36	78.02
Informal Worker in Formal Firm (b)	25.76	20.35	13.79	7.54	13.80
Informal Worker in Informal Firm (c)	31.75	9.66	3.27	1.11	8.18
Total Employment Share (d)	17.84	13.85	19.72	48.59	100.00
Intensive Margin (b/(a+b))	37.75	22.53	14.25	7.62	15.03

- Almost 70% of the informal workers are in formal firms!
- Informality is also present in large firms.

Capital and Debt in Formal-Informal Businesses

- Small formal firms employ more capital and hold more debt than informal firms even conditional on observables.

- Yet, there is substantial heterogeneity within sector and selection into the formal and informal sector may play a role.

VARIABLES	(1) log(Debt)	(2) log(Capital)	(3) log(Investment)
Informal	-0.538***	-0.658***	-0.505***
	(0.0760)	(0.0500)	(0.0902)
log(VA p/ worker)	0.455***	0.789***	0.673***
	(0.0276)	(0.0164)	(0.0359)
Observations	7,856	32,797	7,696
R-squared	0.414	0.615	0.584
Size FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes

The Model

Model Overview

- **Households**:
  - Infinite lifetime.
  - Heterogeneous in assets a, entrepreneurial idea s, and education $e \in \{\text{high}, \text{low}\}$.
  - s drawn from Pareto distribution, with probability $1 - \pi_s$ they make a new draw.
  - Occupational choice, o: worker, formal or informal entrepreneur.

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  - s drawn from Pareto distribution, with probability $1 - \pi_s$ they make a new draw.
  - Occupational choice, o: worker, formal or informal entrepreneur.
- **Production technology:** $q(s, k, l) = s(k^{\alpha} l^{1-\alpha})^{\theta}$.
  - l may be self-employed labor input or a composition of high and low-skilled workers.

- **Entrepreneurs**:
  - Subject to financial frictions, fixed costs and entry costs.
  - Formal: pay sales tax and payroll tax. Can hire formal and informal workers.
  - Informal: Hire only informal labor.

Profits of Informal Entrepreneurs

$$y(a, i, s, e) = \max_{k, l_1, l_2} \{q(s, k, l) - (r + \delta)k - w_1 l_1 - w_2 l_2 - \varepsilon_i - \tau_i(k, l_1, l_2)\}$$

$$\text{s.t.} \quad k \leq \lambda_i a,$$

$$l = \begin{cases} (\eta l_1^\rho + (1 - \eta)l_2^\rho)^{\frac{1}{\rho}} & \text{if } (l_1, l_2) > 0, \\ \bar{l} & \text{if } (l_1, l_2) = (0, 0), \end{cases}$$

- $\bar{l} > 0 \Rightarrow$ self-employed labor input.
- $\tau_i(k, l_1, l_2)$ gives the cost of the **extensive margin**:

$$\tau(k, l_1, l_2) = \tau_k k^2 + \sum_{e=1}^{2} w_e \tau_{i,e} l_e^2, \quad \text{where} \quad \tau_k, \tau_{i,1}, \tau_{i,2} > 0.$$

Profits of Formal Entrepreneurs

$$y(a, f, s, e) = \max_{k, l_{1,f}, l_{1,i}, l_{2,f}, l_{2,i}} \{(1 - \tau_y)q(s, k, l) - (r + \delta)k - (w_1 l_1 + w_2 l_2)$$

$$- \tau_{ss}(w_1 l_{1,f} + w_2 l_{2,f}) - \varepsilon_f - \tau_f(l_{1,i}, l_{1,f}, l_{2,i}, l_{2,f})\}$$

$$\text{s.t.} \quad k \leq \lambda_f a,$$

$$l_e = l_{e,i} + l_{e,f} \quad \text{for} \quad e = 1, 2,$$

$$l = \begin{cases} (\eta l_1^\rho + (1 - \eta) l_2^\rho)^{\frac{1}{\rho}} & \text{if} \quad (l_1, l_2) > 0, \\ \bar{l} & \text{if} \quad (l_1, l_2) = (0, 0), \end{cases}$$

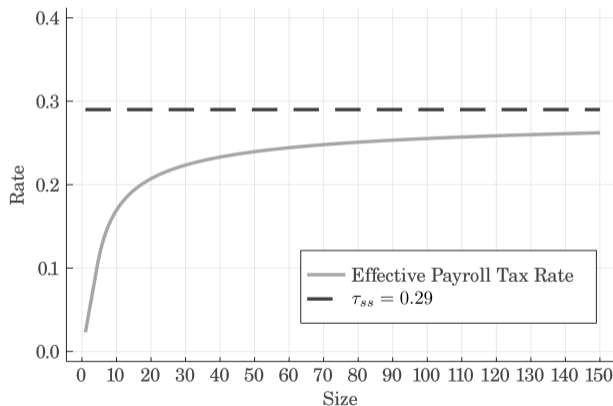- $\bar{l} > 0 \Rightarrow$ self-employed labor input.
- the costs of the **intensive margin** are:

$$\tau_f(l_{1,i}, l_{1,f}, l_{2,i}, l_{2,f}) = \sum_{e=1}^{2} w_e \tau_{f,e} \frac{(l_{i,e})^2}{(l_{f,e})^\omega} \quad \text{where} \quad \tau_{f,1}, \tau_{f,2}, \omega > 0.$$

- $\omega > 0 \Rightarrow$ number of informal workers $\uparrow$ with firm size, but the **fraction** of informal workers $\downarrow$.

Informal Workers in Formal Firms

- **Extensive margin**: τ_k implies different K/L across sectors.
- **Intensive margin**: distorts K/L within the formal sector.

- Informality acts as a size-dependent policy reallocating labor to small firms.

Dynamic Decision

- Let o be the occupation: $o \in \{\omega, f, i\}$.

- The household makes a consumption-savings decision and a **dynamic** occupational choice:

$$V(a, o, s, e) = \max_{c, a', o'} \{u(c) + \beta \mathbb{E}\left[V(a', o', s', e)|s\right]\},$$

$$\text{s.t.} \quad c + a' + \chi(o, o') = y(a, o, s, e) + (1 + r)a,$$

- where:
  - Income, $y(a, o, s, e) \Rightarrow w_e$ if worker of education e; otherwise formal/informal entrepreneurial profits.
  - $\chi(o, o') \Rightarrow$ switching costs from occupation o to o'.
  - Expectations over $s' \Rightarrow$ with probability $1 - \pi_s$ new draw from a e-specific Pareto distribution.

Equilibrium

- The economy is in a steady state competitive equilibrium.

- Let $\mu(a, s, o, e)$ be the invariant distribution across a, s, o, and e.

- Solve for factor prices (r, w_1, w_2) s.t. market clearing conditions are satisfied:

$$\sum_{(a,o,s,e)} l_e(a, o, s, e)\mu(a, s, o, e) = \sum_{a,s} \mu(a, \omega, s, e) \text{ for } e = 1, 2$$

$$\sum_{(a,o,s,e)} k(a, o, s, e)\mu(a, o, s, e) = \sum_{(a,o,s,e)} a\mu(a, o, s, e)$$

where $k(a, o, s, e)$, $l_1(a, o, s, e)$, $l_2(a, o, s, e)$ are the demands for capital, high-skill and low-skill labor.

Quantitative Analysis

Calibration

- Model is calibrated to Brazil in 2003.

- **Functional forms**: $s \sim \mathsf{Pareto}(s_{0,e}, \xi)$, log utility.

- Set $(\alpha, \theta, \delta, \pi_s, \beta)$ to standard values.

- **Taxes**: statutory values.

- No switching costs $(\chi(o, o') = 0)$ except for:
  - Entry into formal sector: $\chi(w, f) = \chi(i, f) = \chi_{entry}$.
  - No entry to informal from formal: $\chi(f, i) = \infty$.

- Calibrate 16 parameters: $\left(s_{0,1}, s_{0,2}, \xi, \bar{l}, \eta, \rho, \varepsilon_i, \varepsilon_f, \lambda_f, \lambda_i, \tau_{f,2}, \tau_{f,1}, \tau_{i,2}, \tau_{i,1}, \tau_k, \chi_{entry} \right)$.

Calibration Results: Baseline Economy

Parameters	Values	Target	Model	Data
$\bar{l}$	0.317	Entrepreneurship rate	0.319	0.320
η	0.569	Skill premium workers	0.464	0.467
ρ	0.244	Fraction high-skilled workers	0.467	0.469
$s_{0,1}$	1.619	Skill premium entrepreneurs	0.657	0.550
$s_{0,2}$	1.363	Fraction high-skilled entrepreneurs	0.352	0.348
χ_{entry}	0.051	Share of formal firms	0.222	0.242
$\tau_{f,2}$	0.119	Share of informal workers in formal firms	0.630	0.660
$\tau_{i,1}$	0.202	Share informal among high-skilled workers	0.286	0.258
$\tau_{i,2}$	0.249	Share informal among low-skilled workers	0.365	0.431
τ_k	0.078	K/Y informal	1.09	1.04
$\tau_{f,1}$	0.229	Fraction of informal workers	0.328	0.350
λ_f	1.838	Credit/GDP formal entrep. (≤ 5)	0.421	0.431
λ_i	1.450	Credit/GDP informal entrep.	0.313	0.311
(ε_f, ξ)	(0.046,7.62)	Formal size: ≤ 5	0.725	0.698
		Formal size: 6 - 10	0.133	0.141
		Formal size: 11 - 20	0.075	0.083
		Formal size: 21 - 50	0.047	0.050
ε_i	0.170	Informal size: ≤ 2	0.929	0.972
		Informal size: ≤ 5	1.0	0.998

Non-Targeted Moments: Small Firms

Variable	Model	Data
Small firms and Occupational Choice		
Fraction of Informal Firms (size ≤ 5)	86.0	86.8
Fraction of Informal Workers in Formal Firms (size ≤ 5)	39.0	32.2
Fraction of Entrepreneurs (among HS)	26.1	26.1
Fraction of Entrepreneurs (among LS)	36.2	36.8
Fraction of Self-Employed (among HS)	13.3	18.3
Fraction of Self-Employed (among LS)	33.3	33.0
Fraction of Informal Self-Employed (among all entrep.)	87.7	91.8
Fraction of Informal Self-Employed (among HS ent.)	76.7	84.0
Fraction of Informal Self-Employed (among LS ent.)	91.0	94.8

- Model replicates the **intensive** and **extensive** margin of informality in small firms.

- Model replicates fraction of SE in different skill groups.

Non-Targeted Moments: Employment Shares

Baseline Model					
Worker-Firm Status	(≤ 5)	$(\geq 6 \text{ and } \leq 10)$	$(\geq 11 \text{ and } \leq 50)$	(≥ 51)	All Firms
Formal Worker in Formal Firm (a)	24.6	67.2	77.4	87.3	67.2
Informal Worker in Formal Firm (b)	15.6	32.8	22.6	12.7	20.6
Informal Worker in Informal Firm (c)	59.8	0.0	0.0	0.0	12.1
Total Employment Share (d)	20.30	17.3	39.1	23.3	100.0
Intensive Margin (b/(a+b))	38.80	32.8	22.6	12.7	23.5
Total Employment Share (data)	24.5	14.2	61.3		100.0

- Intensive margin decreases with business size.
- Many informal workers in large formal firms.

Non-Targeted Moments: Capital, Debt and Public Finance

Variable	Model	Data
Capital and Debt Heterogeneity		
Std(K) Formal (≤ 5)	2.06	2.00
Std(K) Informal	0.39	0.39
Std(Debt) Formal (≤ 5)	1.22	0.72
Std(Debt) Informal	0.12	0.13
Public Finance and Other Moments		
Social Security Rev./GDP	0.06	0.07
Sales Tax/GDP	0.24	0.17
(Sales Tax + Income Tax)/GDP	0.24	0.24
Labor Share	0.49	0.48

- Model replicates the capital and debt heterogeneity in small firms and public finance in aggregate economy.

Understanding Informality

- The elimination of informality requires policies that directly confront it.

	Baseline	No Entry Cost	No Fin. Frictions
Informality Share			
Paid Workers	0.328	**0.326**	**0.227**
Inf. by Formal	0.630	0.642	0.970
Self-Employed	0.877	0.857	0.946
Labor Force (Workers + Ent.)	0.472	0.463	0.314
Informal Firms			
Mass	0.248	**0.241**	**0.128**
Output (Share)	0.196	0.189	0.065

- **Entry costs** $\Rightarrow$ elimination has small effects on informality.
- **Financial frictions** $\Rightarrow$ elimination reduces informality in both margins but **does not** eliminate it.

Occupational Choice

Experiment 1: Formalization Policies

Formalization Policies

- Shutting down each informality margin have **very different effects**...

	Baseline Economy	Extensive Margin	Intensive Margin	Alleviate Int. Margin
Output	100	**10.8%**	**-3.6%**	5.4%
Capital	100	**13.9%**	**-5.7%**	9.9%
TFP	100	**6.6%**	**-1.9%**	2.5%
Credit	100	20.1%	-7.3%	13.2%
Tax Revenue	100	**33.2%**	**-6.0%**	5.0%
Mass Entrep.	0.319	0.264	0.352	0.246
Mass Self-Emp.	0.247	0.208	0.278	0.178

- Increasing monitoring of the <u>extensive margin</u> (i.e., reducing business informality) is **good**.

- Increasing monitoring of the <u>intensive margin</u> is **bad**.

- Relaxing monitoring of the intensive margin can be good (reduces business informality and SE)

Formalization Policies

- Substitution between margins of informality is important:
  - ▸ Eliminating business informality does not eliminate worker informality.
  - ▸ Eliminating worker informality rises business informality.

	Baseline Economy	Extensive Margin	Intensive Margin	Alleviate Int. Margin
Informality Share				
Paid Workers	0.328	0.242	0.222	0.628
Labor Force	0.472	0.192	0.431	0.644
Informal Firms				
Mass	0.248	**0.014**	**0.287**	0.171
Output (Share)	0.196	**0.007**	**0.246**	0.119

Experiment 2: Financial Frictions and Informality

Eliminating Financial Frictions in Alternative Economies

	Baseline Economy	High Informality Costs		
		Both Margins	Extensive Margin	Intensive Margin
Agg. Output	27.4%	21.1%	19.9%	31.0%
Agg. Capital	40.3%	30.1%	29.1%	45.4%
TFP	15.1%	**11.9%**	**11.1%**	**17.1%**
Tax Revenue	49.6%	26.1%	23.8%	61.3%

- The effect of removing financial frictions is the largest in an economy **without** the intensive margin.
- The extensive margin **reinforces** the distortions caused by financial frictions, while the intensive margin **alleviates** the distortions.

Eliminating Financial Frictions in Alternative Economies

	Baseline Economy	High Informality Costs		
		Both Margins	Extensive Margin	Intensive Margin
Agg. Output	27.4%	21.1%	19.9%	31.0%
Agg. Capital	40.3%	30.1%	29.1%	45.4%
TFP	15.1%	**11.9%**	**11.1%**	**17.1%**
Tax Revenue	49.6%	26.1%	23.8%	61.3%

- The effect of removing financial frictions is the largest in an economy **without** the intensive margin.
- The extensive margin **reinforces** the distortions caused by financial frictions, while the intensive margin **alleviates** the distortions.
- **Intuition**: highly productive but constrained entrepreneurs tend to rely more on labor!

$$\frac{K}{L} = \frac{\alpha}{(1-\alpha)} \frac{w(1+\tau_{ss})}{r + \mu(z,a)}$$

Experiment 3: Effects of Payroll Taxation

Eliminate Payroll Tax

- The output costs of the payroll tax are about twice with financial frictions (10.8% versus 4.7%).

- Payroll tax hurt borrowing constraint entrepreneurs.

	Baseline	no FF
Agg. Output	**10.8%**	**4.7%**
Agg. Capital	**11.1%**	**2.7%**
TFP	**7.4%**	**3.9%**
Total Tax Rev.	**3.8%**	**-13.6%**

- In a financially constrained economy, **the labor tax is costly**: it incentivizes informality and increases the output costs of a SS system!

Revenue Neutral Tax Reform

- Increase sales tax to compensate for the revenue losses from eliminating the payroll tax.
- **Laffer curve** in the baseline model implies that the gains from the reform are much larger.

	No payroll tax Baseline	No payroll tax no FF	Revenue Neutral Baseline	Revenue Neutral no FF
Agg. Output (change)	10.8%	4.7%	**11.9%**	**1.6%**
Agg. Capital (change)	11.1%	2.7%	**14.7%**	**-7.8%**
TFP (change)	7.4%	3.9%	7.3%	4.1%
Sales Tax Rate	0.29	0.29	0.277	0.348

Robustness

- **Robustness 1**: Model with fixed occupational choice.
  - ▶ Re-calibrate the model with fixed occupational choice.
  - ▶ Model has lower dispersion of capital and debt.
  - ▶ Similar results, somehow smaller; financial friction plays a smaller role.

- **Robustness 2**: The 2005 bankruptcy reform.
  - ▶ Evaluate the changes in informality and occupation choice after the 2005 bankruptcy law reform using the model.
  - ▶ Model is in line with the data. 2005 Reform

Conclusion

- We build a quantitative theory to study the effects of informality and financial frictions on public financing and the allocation of resources.

- **Regulations and policies**:

    (i) impact differently on the intensive and extensive margin of informality.

    (ii) their impact critically depends on the extent of financial frictions.

- Informality and financial frictions are crucial for understanding the high entrepreneurship rate in Brazil.

- Informality
    - increase the gains of eliminating financial frictions:
    - interacts with financial frictions differently along the extensive and intensive margins

Informal Firm Size

Table: Share of Informal Firms and Informal Workers by Firm Size

| Size	Share Inf. Firms	Inf. Workers in Formal Firms	Cum. Informal
1	0.930	-	0.898
2	0.657	0.476	0.972
3	0.449	0.463	0.988
4	0.344	0.373	0.994
5	0.296	0.262	0.998
6	0.311	0.317	1.000
7	0.069	0.165	1.000
All (≤ 7)	0.868	0.322	

Notes: Size includes paid employees plus business owners. Share of informal workers in formal firms includes paid employees only.
Source: ECINF 2003.

- 97% of informal firms have two workers or less!
- Large firms are less likely to be informal and hire less informal employment. Back

Trends in Informality

Figure: Informality and Entrepreneurship in Brazil: 2002-2015
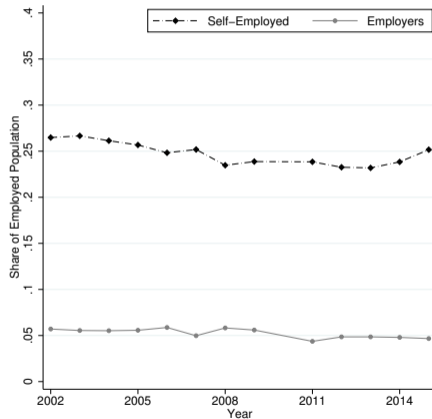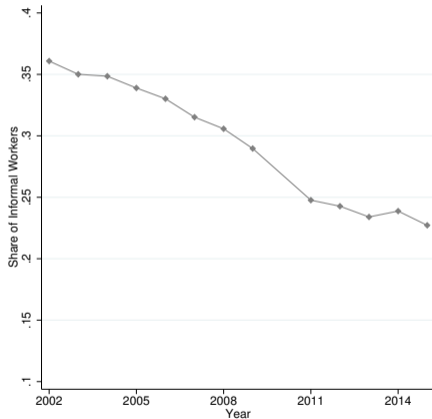
Informality, Capital and Debt

Table: Partial Correlations of Debt, Capital and Investment with Formality Status

VARIABLES	(1) log(Debt)	(2) log(Capital)	(3) log(Investment)
Informal	-0.538***	-0.658***	-0.505***
	(0.0760)	(0.0500)	(0.0902)
log(VA p/ worker)	0.455***	0.789***	0.673***
	(0.0276)	(0.0164)	(0.0359)
Observations	7,856	32,797	7,696
R-squared	0.414	0.615	0.584
Size FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes

Back

Understanding the Occupational Structure

	Baseline Economy	No Entry Cost	No Financial Frictions
Occupations			
Mass Entrep.	0.319	0.318	0.178
Mass Employers	0.072	0.072	0.045
Mass Self-Emp.	0.247	0.246	0.133

- Eliminating financial friction reduces entrepreneurship (mostly due to SE ↓).

- Effects in line with cross-country evidence on entrepreneurship and FF.

Back

Robustness: The 2005 Bankruptcy Reform

- In 2005, the Brazilian bankruptcy law changed the liquidation procedure in favor of creditors.

- Change the λ's to match the increase of 30 p.p in aggregate credit to GDP between 2003-2012.

- **Data** (2003-2012):
    - Entrepreneurship falls by 4.4 p.p; SE falls by 3.4 p.p
    - Employment share in firms ≤ 5 falls by 6.7 p.p.
    - Worker Informality falls by 11 p.p.

- **Model**:
    - Entrepreneurship falls by 5.5 p.p; SE falls by 4.3 p.p
    - Employment share in firms ≤ 5 falls by 7.3 p.p.
    - Worker Informality falls by 5.5 p.p.

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