Entrepreneurial Human Capital and Firm Informality

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Research Question

- This paper examines the role of entrepreneurial human capital in firm informality:

1. How does an entrepreneur's educational attainment affect a manager's incentives to operate informally?
2. To what extent is this relationship shaped by the level of financial frictions in the country?
3. How do these firm-level relationships translate into adjustments in GDP and TFP across countries?

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4. Financial development is a key determinant of firm informality in developing countries. Franjo et al. [2022]

This Paper

- We propose a life-cycle general equilibrium model of entrepreneurship (Erosa, 2001; Buera, 2009; Buera and Shin, 2013) with:
  - educational decisions (college vs. non-college);
  - credit market imperfections;
  - capital-skill complementarity; and,
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- We find empirical evidence supporting this channel in Brazil!

Model

- The economy is populated by overlapping generations of individuals who born with zero assets and die at age J. Mandatory retirement age $J_R < J$. No pensions.
- Human capital stage (age $j = 0$): educational decision (h), college or non-college $\implies$ $h \in \{s, u\}$.
- During her working life ($1 \leq j < J_R$) and based on (state variables):
  - educational attainment, h;
  - financial wealth, a; and,
  - managerial ability (conditional on education), $e_h \in \Theta_h$

  an individual chooses:
  - occupation: worker or entrepreneur; and,
  - how much to consume (c) and save (a') by maximizing her utility:

$$\sum_{j=1}^{J} \beta^{j-1} \frac{c_j^{1-\sigma} - 1}{(1-\sigma)}.$$

Model: Human Capital/Education Stage

- A newly born individual is endowed with
  - An innate ability e_u, which determines the managerial productivity of non-college-educated entrepreneurs;
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- Getting education:
  - Allows workers to supply their time endowment to the skilled labor market at the skilled wage w_s
  - Improves managerial ability according to

$$e_s = e_u + \psi e_u^{\epsilon}, \ \psi, \epsilon > 0$$

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  - The college earning premia;
  - A stochastic utility cost of attending college

$$\zeta\left(e_u, \kappa\right) = \kappa e_u^{-\phi}, \ \phi > 0$$

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- Let $\mathbb{M}^{e_u}(h)$ denote the expected lifetime utility of an individual with innate ability e_u and educational level h. Then,

$$h(e_u, \kappa) = \begin{cases} s & \mathbb{M}^{e_u}(s) - \zeta\left(e_u, \kappa\right) \geq \mathbb{M}^{e_u}(u) \\ u & otherwise \end{cases}$$

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- *Entrepreneur:* chooses between being either formal or informal $\rightarrow$ extensive margin of informality.

- Combines her managerial ability, e_h, with capital, k, skilled, l_s, and unskilled labour, l_u (Allub, Gomes, and Kuehn, 2022):

$$e_h^{\eta}\left[\mu l u^{\theta}+(1-\mu)(\iota k^{\rho}+(1-\iota) l s^{\rho})^{\frac{\theta}{\rho}}\right]^{\frac{1-\eta}{\theta}}$$

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- In the *formal sector*: ▸ Value (Formal)
  - Imperfect credit markets $\rightarrow$ collateral constraint: $k \leq \lambda a$.
  - Taxes on personal income (y): $T(y) = \tau_y y$.
- In the *informal sector*: ▸ Value (Informal)
  - No credit markets $\rightarrow$ financial autarky: $k \leq a$.
  - No taxes (hidden production). Fined by a surcharge factor, s, with probability: $p(k) = 1/(1 + p_1 exp(-p_2 k))$.

Model: Closing the model

- *Financial Intermediaries* (perfectly competitive):
  - Receive deposits from households at a risk-free interest rate, r, and rent capital to firms at rental rate r_k. In equilibrium:

$$r_k = r + \delta$$

- *Corporate sector*:
  - Pays an operational fixed cost (ϕ_f); cannot engage in informal activities; and, no borrowing constraints. Net output:

$$Y_c = A\left(\mu L_{c,u}^{\sigma} + (1-\mu)[\iota K_c^{\rho} + (1-\iota)L_{c,s}^{\rho}]^{\frac{\sigma}{\rho}}\right)^{\frac{1-\eta}{\sigma}} - \phi_f$$

- *Government*:
  - The government raises income and consumption taxes to finance public expenditures.
  - Consumption is taxed at a flat-tax rate τ_c.
  - No public debt.

Calibration

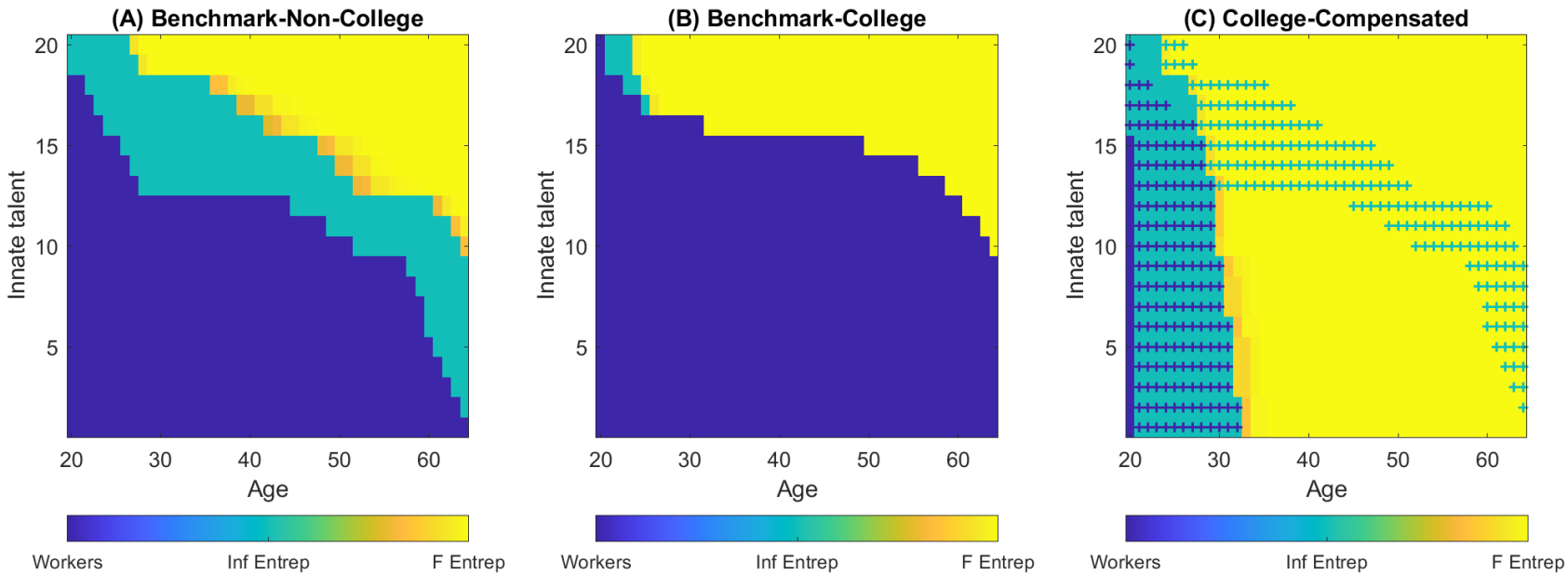
Parameters	Description	Source/ Targeted Moment	Value
(A) Externally calibrated			
σ	Relative risk aversion coefficient	Standard	1.500
δ	Capital depreciation rate	Cavalcanti and Santos (2021)	0.060
s	Surcharge factor	Brazilian law	0.750
τ_c	Consumption tax	Jung and Tran (2012)	0.150
η	Span of control	Allub and Erosa (2019)	0.198
ρ	Substitutability: capital and skilled labor	Fonseca and Van Doornik (2022)	-0.250
θ	Substitutability: capital and unskilled labor	Fonseca and Van Doornik (2022)	0.610
(B) Internally calibrated			
β	Subjective discount factor	Capital-output ratio	0.966
λ	Degree of financial frictions	Credit-output ratio	1.391
$\bar{\kappa}$	Education cost: mean of idiosyncratic component	Share of educated population	7.113
σ_κ	Education cost: s.d. of idiosyncratic component	S.d. of entrepreneurial earnings	1.746
ϕ	Education cost: curvature	Entrepreneurial skill premium	0.549
ψ	Productivity jump: coefficient	Share of educated entrepreneurs by firm size	2.376
ϵ	Productivity jump: curvature	Share of educated entrepreneurs by firm size	0.923
τ_y	Income tax rate	Total fiscal revenues to GDP	0.206
A	TFP in the corporate sector	% of K used by corporations	2.249
ϕ_f	Operational fixed cost	Zero-profits condition	10.65
p_1	Probability of detection	Informal output to GDP	1.1e7
p_2	Probability of detection	Size distribution informal firms	5.990
μ_p	Location Pareto distribution	Size distribution formal firms	2.587
σ_p	Scale Pareto distribution	Size distribution formal firms	1.362
η_p	Shape Pareto distribution	Size distribution formal firms	0.198
$\Phi(e_{min})$	Probability mass in the minimum ability	Size distribution formal firms	0.546
μ	Weight of unskilled labor in production	Wage skill premium	0.480
ι	Weight of capital in production	Share of educated workers	0.683

Calibration Results: Targeted Moments

Moments	Source	Data	Model
Capital-Output ratio (formal)	Allub and Erosa (2019)	2.100	2.107
Credit-Output ratio	World Bank Database	0.420	0.413
Informal output to GDP	Medina and Schneider (2018)	0.376	0.356
% of K used by corporations	Antunes et al. (2015)	0.300	0.302
Total fiscal revenues to GDP	OECD revenues statistics	0.320	0.325
Share of educated individuals	PNAD 2003	0.084	0.079
Share of educated workers	PNAD 2003	0.076	0.086
S.d. entrepreneurial earnings	PNAD 2003	1.053	1.035
Entrepreneurial skill premium	PNAD 2003	3.927	3.929
Wage skill premium	PNAD 2003	3.546	3.547
Share of educated entrepreneurs by firm size			
6-10 workers	PNAD 2003	0.285	0.278
$>$ 10 workers	PNAD 2003	0.368	0.373
Size distribution: informal firms			
$\leq$ 5 workers	ECINF 2003	0.998	0.979
Size distribution: formal firms			
$\leq$ 5 workers	Ulyssea (2018)	0.701	0.695
6-10 workers	Ulyssea (2018)	0.141	0.159
11-20 workers	Ulyssea (2018)	0.083	0.123
21-50 workers	Ulyssea (2018)	0.048	0.023

Properties of the Calibrated Model

Occupational Maps and Education



Experiments and Counterfactuals

- Experiments (very long-run):
  - Educational Reform: decrease the cost of getting educated ($\downarrow \kappa$) such that the proportion of college-educated individuals in the working-age population becomes the one in the US ($\sim$ 30%).
  - Financial Reform: improve access to credit by formal entrepreneurs ($\uparrow \lambda$) such that the credit-to-GDP becomes the one in the US ($\sim$ 160%).
  - Both Reforms: bring Brazil to the US in terms of credit-to-GDP and the proportion of the college-educated population.
- Counterfactual:
  - Educational reform with no entrepreneurial human capital ($\psi = 0$) in Brazil.

Human Capital, Financial Development, and Informality

Statistic **Human Capital** **Leverage** ***Economy***	**Benchmark** **Higher** ***Developed***	**Higher**		
Credit and education metrics				
Credit-to-GDP (%)	41.3%	50.9%	159.0%	160.0%
College rate (% of population)	7.9%	30.0%	7.9%	30.2%
Informality metrics				
Informal economy size (% of official GDP)	35.6%	4.1%	12.2%	0.0%
Informal firms (% of total firms)	53.8%	11.7%	27.3%	0.0%
Changes relative to benchmark (%)				
(i) Macro aggregates and prices				
Informal production		-78.8%	-55.1%	-100.0%
Official GDP		+42.6%	+8.5%	+54.3%
Measured TFP		+15.0%	+7.4%	+19.3%
Capital rental rate		+11.3%	+112.3%	+133.2%
Skilled wage		-34.3%	+7.0%	-32.8%
Unskilled wage		+21.0%	-0.6%	+22.1%
Wage skill premium		-45.6%	+7.6%	-45.0%
Entrepreneurial skill premium		-51.3%	-2.5%	-52.9%
(ii) Fiscal metrics				
Fiscal revenues		+43.2%	+8.8%	+55.0%
Tax evasion		-83.8%	-62.7%	-100.0%
Entrepreneurship rates (%)				
Total entrepreneurs in population	19.8%	15.8%	17.4%	12.9%
Entrepreneurs among college-educated individuals	13.0%	36.2%	10.8%	30.1%
Entrepreneurs among non-college-educated individuals	20.4%	7.0%	18.0%	5.5%
Formal entrepreneurs (% of population)	9.1%	13.9%	12.7%	12.9%
Informal entrepreneurs (% of population)	10.6%	1.8%	4.8%	0.0%
College-educated formal entrepreneurs (% of formal entrepreneurs)	10.8%	74.6%	6.7%	70.3%
Workers shares (% of population)				
Total workers	80.2%	84.2%	82.6%	87.1%
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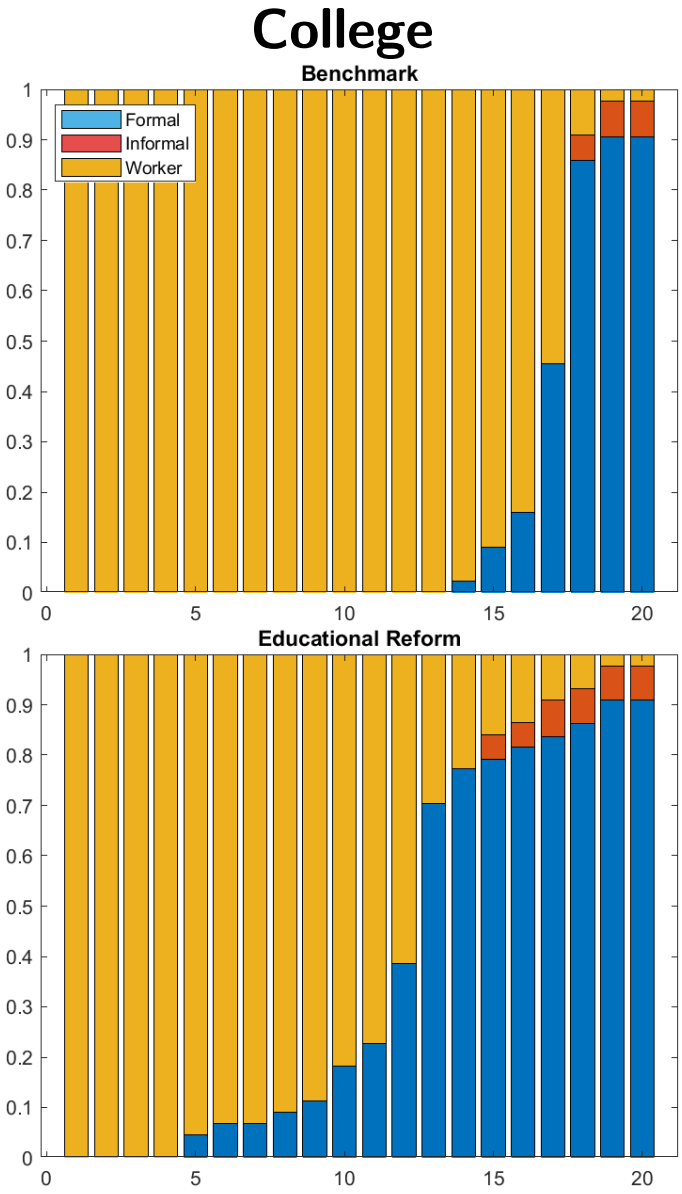

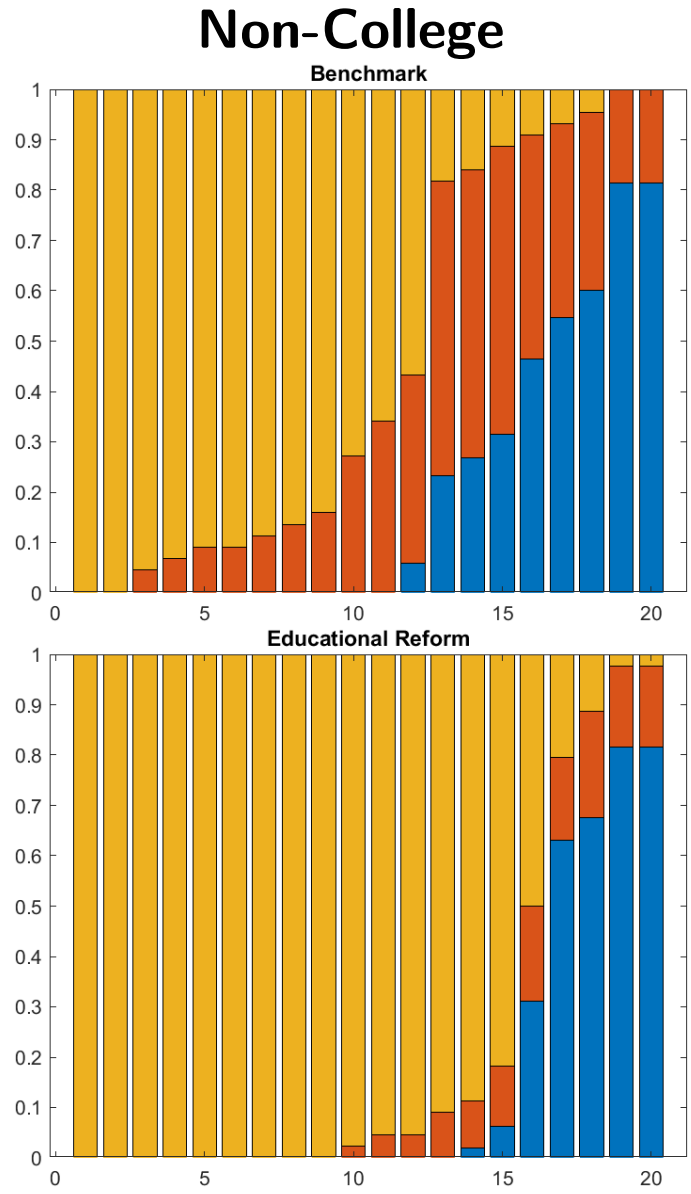

Human Capital, Financial Development, and Informality

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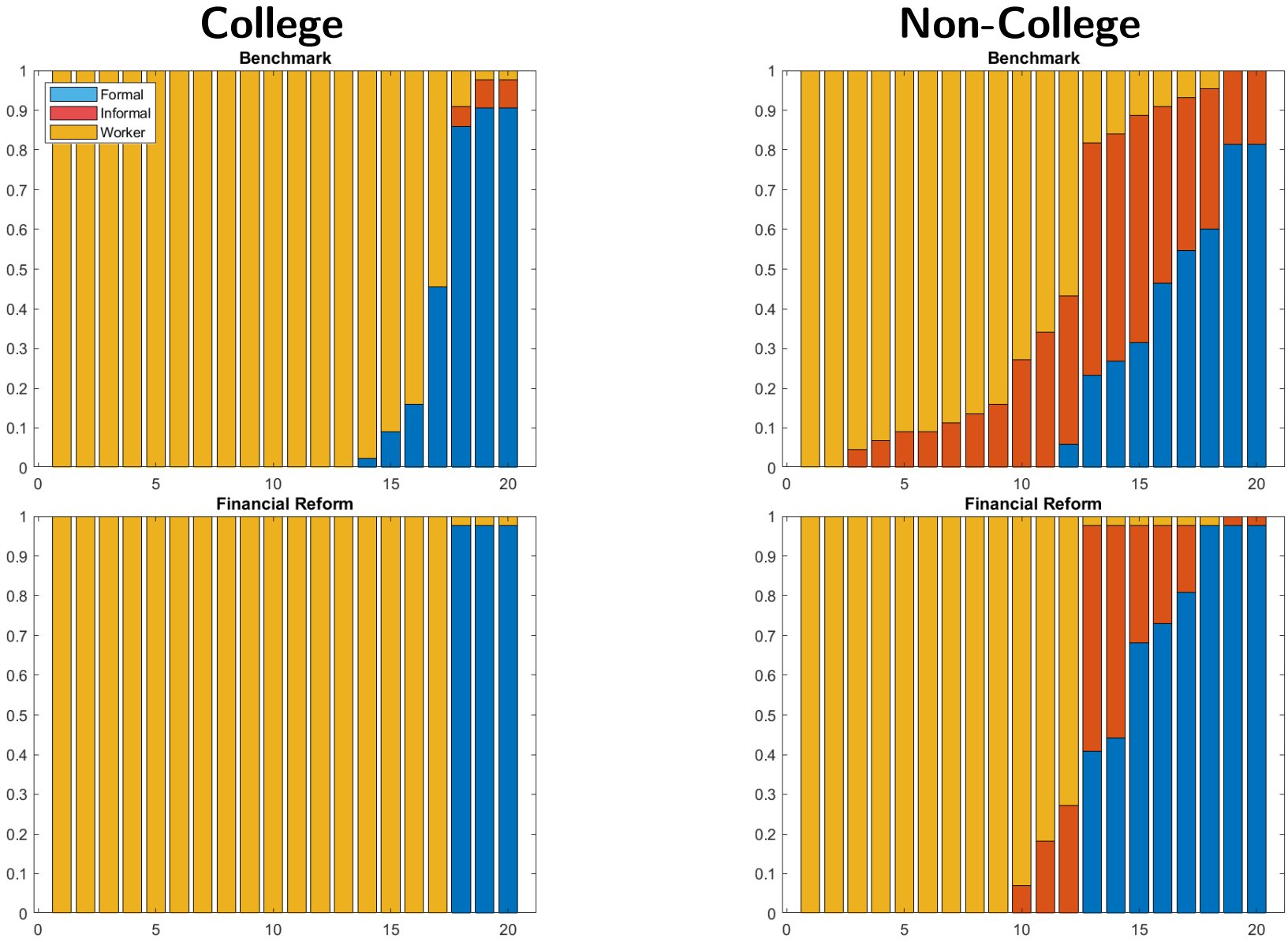

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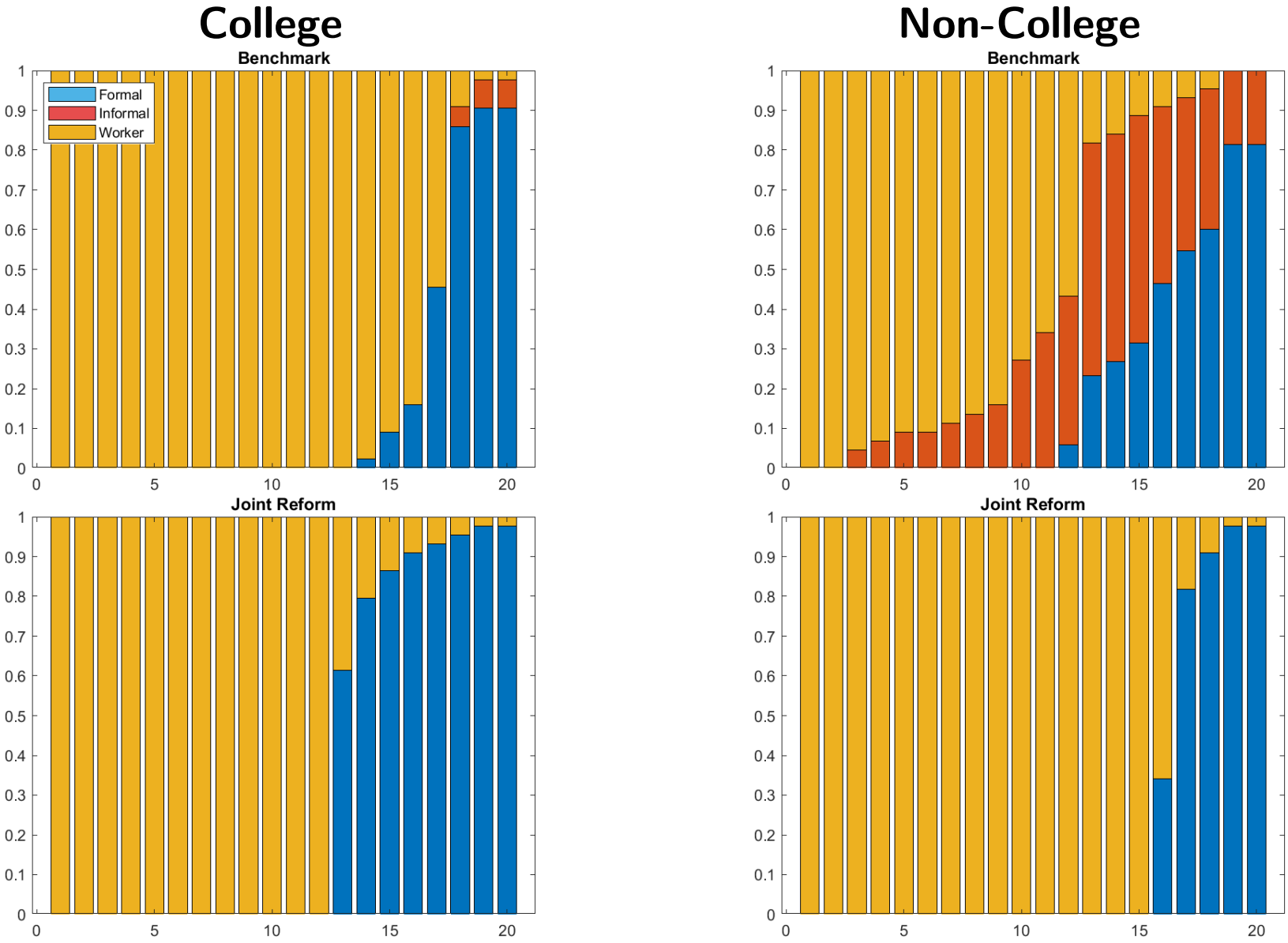
Benchmark vs Joint Reform



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Size informal economy (% of official GDP)	35.6%	4.1%	18.4%
Informal firms (% of total firms)	53.8%	11.7%	35.9%
Changes relative to benchmark (%)			
(i) Macro aggregates and prices			
Informal production		-78.8%	-38.7%
Official GDP		+42.6%	+20.2%
Measured TFP		+15.0%	+2.8%
Skilled wage		-34.3%	-46.6%
Unskilled wage		+21.0%	13.9%
Wage skill premium		-45.6%	-53.1%
Entrepreneurial skill premium		-51.3%	-48.0%
(ii) Fiscal metrics			
Fiscal revenues		+43.2%	+18.9%
Tax evasion		-83.8%	-42.4%
Entrepreneurship rates (%)			
Total entrepreneurs in population	19.8%	15.8%	23.7%
Entrepreneurs among college-educated individuals	13.0%	36.2%	4.2%
Entrepreneurs among non-college-educated individuals	20.4%	7.0%	29.0%
Formal entrepreneurs (% of population)	9.1%	13.9%	15.2%
Informal entrepreneurs (% of population)	10.6%	1.8%	8.5%
College-educated formal entrepreneurs (% of formal entrepreneurs)	10.8%	74.6%	5.4%
Workers shares (% of population)			

Entrepreneurial Human Capital and Firm Informality

Educational Reform ($\downarrow \kappa,\ \psi = 0$)

Statistic **Human Capital** **Human Capital**	**Benchmark** **No Entrep**	**Higher**	
Education metrics			
College rate (% of population)	7.9%	30.0%	21.2%
Informality metrics			
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College-educated formal entrepreneurs (% of formal entrepreneurs)	10.8%	74.6%	5.4%
Workers shares (% of population)			

Empirical Evidence

- Use Higher Educational Reform of 1996 following Cox [2024]
- Difference-in-difference approach:
  - Exploit variation in age and geographical exposure to the reform
  - Compare young (exposed) and older (less exposed) cohorts
  - Identify commuting zones that saw excess entry relative to the potential demand of college applicants (Duflo [2001])

Empirical Evidence

- Classify commuting zones into high and low intensity areas.

$$C_j = \alpha_0 + \beta StudentPool_j + \epsilon_j \tag{1}$$

- $StudentPool_j$ is a weighted mass of individuals aged 19-33 in 2000 in a CZ j
- C_j represents a number of colleges in CZ j in 2005
- $HI_j = 1$ if $\hat{\epsilon_j} > 0$

Empirical Evidence

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- C_j represents a number of colleges in CZ j in 2005
- $HI_j = 1$ if $\hat{\epsilon_j} > 0$
- Main Equation:

$$Infe_{ij} = \alpha + X'_{ij}\theta + \beta T_i + \gamma(T_i \times HI_j) + \phi_j + \epsilon_{ij}$$

- $T_i = 1$ if an individual i was 16-30 years old in 1997
- $T_i = 0$ if an individual i was 31-45 years old in 1997
- HI_j is an indicator of whether a commuting zone j experienced disproportionate entry of colleges relative to the pool of potential college applicants.

Empirical Evidence

	(1) Infe	(2) Infe	(3) Infe	(4) Infe	(5) Infe
Born 1967-1981=1	-0.036***	-0.028***	-0.036***	-0.035***	
	(0.001)	(0.002)	(0.002)	(0.002)	
HI × Born 1967-1981=1	-0.006***	-0.020***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
Single=1				-0.009***	-0.008***
				(0.001)	(0.001)
Always lived CZ=1				-0.009***	-0.007***
				(0.000)	(0.000)
Male=1				0.051***	0.051***
				(0.001)	(0.001)
White=1				-0.000	-0.000
				(0.000)	(0.000)
FE	CZ	UF	CZ	CZ	CZ-Age
Cluster	Robust	CZ-Age	CZ-Age	CZ-Age	CZ-Age
Observations	4,345,473	4,345,473	4,345,473	4,345,467	4,345,467

* 0.10 ** 0.05 *** 0.01. Notes: standard errors are reported in parentheses. Population weights are applied.

Conclusions

- Structural dynamic model of occupational choice with human capital (both workers and entrepreneurs) and firm informality.
- A financial reform or an educational reform, separately, does not eliminate informality (larger effect of educational reform).
- A joint reform further reduces informality because of capital-skill complementarity.
- Entrepreneurial human capital potential important determinant for informality, official GDP, measured TFP, and fiscal revenues.
- Human capital of entrepreneurs accounts for a large proportion of informality:
  - $\sim$ 40% explained by entrepreneurial human capital.

Households' Problem: Timing

- Before her working life, a household decides on her educational attainment (college/skilled or non-college/unskilled).
- During her working life, at the beginning of each working year, a household chooses her occupation (worker or entrepreneur):
  - A skilled or unskilled worker makes optimal decisions for consumption and savings.
  - A college or non-college entrepreneur decides the status of her firm (formal or informal), the inputs, and how much to produce with each technology.
    - After production decisions have been taken, audits take place and fines are enforced.
    - After observing if she was detected or not, an entrepreneur makes consumption and savings decisions.

Model: Optimal occupation and consumption-saving decisions

Accordingly, the decision problem of a household with state variables e_h and a can be written in a recursive formulation, with the beginning-of-period value function given as follows

$$V(a, e_h) = max\{V^W(a, e_h), V_f^E(a, e_h), V_i^E(a, e_h)\}$$

Workers

The function $V^W(a, e_h)$ denotes the value function for the agent who chooses to be a worker in the current period, i.e.

$$V^W(a, e_h) = \max_{c,a'}\{u(c) + \beta V(a', e_h)\}$$

subject to

$$(1 + \tau_c)c + a' = (1 - \tau_y)y^w + a$$

$$a' \geq 0$$

where $y^w = \omega_h + ra$ denotes the worker's personal income.

Model: Optimal occupation and consumption-saving decisions

Functions $V_f^E(a, e_h)$ and $V_i^E(a, e_h)$ respectively stand for the value of being a formal entrepreneur and the value of being an informal entrepreneur. back

(i) Formal entrepreneur

The decision problem of a formal entrepreneur takes the following form

$$V_f^E(a, e_h) = \max_{k, l_u, l_s, c, a'} \{u(c) + \beta V(a', e_h)\}$$

subject to

$$k \leq \lambda a$$

$$y^E = \underbrace{f(e_h, l_u, l_s, k) - w_u l_u - w_s l_s - (r + \delta)k}_{\text{Profits}} + ra$$

$$(1 + \tau_c)c + a' = (1 - \tau_y)y^E + a$$

where y^E denotes the formal entrepreneur's declared income, which amounts to her actual earnings.

Model: Optimal occupation and consumption-saving decisions

(ii) Informal entrepreneur

- Informal entrepreneurs escape taxation by concealing their production activities and reporting only their capital incomes, but they face a probability of detection $p(k)$; back
- So, let $V_d^E(a, e_h)$ and $V_{nd}^E(a, e_h)$ denote the informal entrepreneur's value functions corresponding to the cases of detection and non-detection, respectively;
- The expected value of being an informal entrepreneur can then be written as follows

$$V_i^E(a, e_h) = \max_{k, l_u, l_s} \{p(k) V_d^E(a, e_h) + (1 - p(k)) V_{nd}^E(a, e_h)\}$$

subject to

$$k \leq a.$$

Model: Optimal occupation and consumption-saving decisions

(ii) Informal entrepreneur: non-detection

The value function in the case of non-detection is given by

$$V^E_{nd}(a, e_h) = \max_{c,a'}\{u(c) + \beta V(a', e_h)\}$$

subject to

$$y^E = ra$$

$$(1 + \tau_c)c + a' = (1 - \tau_y)y^E + \pi + a$$

where π represents profits from business activities, i.e.

$$\pi = f(e_h, l_u, l_s, k) - w_u l_u - w_s l_s - (r + \delta)k$$

Accordingly, concealing production allows the informal entrepreneur to hide profit income from the tax authorities. back

Model: Optimal occupation and consumption-saving decisions

(ii) Informal entrepreneur: detection

- In the event of detection, the government forces the informal entrepreneur to pay the taxes due on the unreported income (i.e. π) scaled up by a penalty surcharge factor s. back
- Consequently, the value function of an informal entrepreneur that has been detected by the government is given by

$$V_d^E(a, e_h) = \max_{c,a'}\{u(c) + \beta V(a', e_h)\}$$

subject to

$$k \leq a$$

$$y^E = ra$$

$$(1+\tau_c)c + a' = (1-\tau_y)y^E + \pi + a - (1+s)\tau_y\pi$$

Calibration Results: Non-Targeted Moments

Moments	Source	Data	Model
(A) *Share of non-college-educated entrepreneurs*:			
All firms	PNAD 2003	0.898	0.948
In formal firms	ECINF 2003	0.826	0.892
In informal firms	ECINF 2003	0.937	0.997
(B) *Share of informal workers*:			
All workers	PNAD 2003	0.269	0.286
Unskilled workers	PNAD 2003	0.277	0.294
Skilled workers	PNAD 2003	0.171	0.195
(C) *Formal earnings premium*:			
Entrepreneurs	ECINF 2003	2.440	2.005
Workers	ECINF 2003	1.386	1.084
Share of informal firms	Ulyssea (2018)	0.698	0.538
Gini index for wealth	Franjo et al. [2022]	0.784	0.759
Average capital-output ratio across informal firms	Erosa et al. [2023]	1.040	0.914

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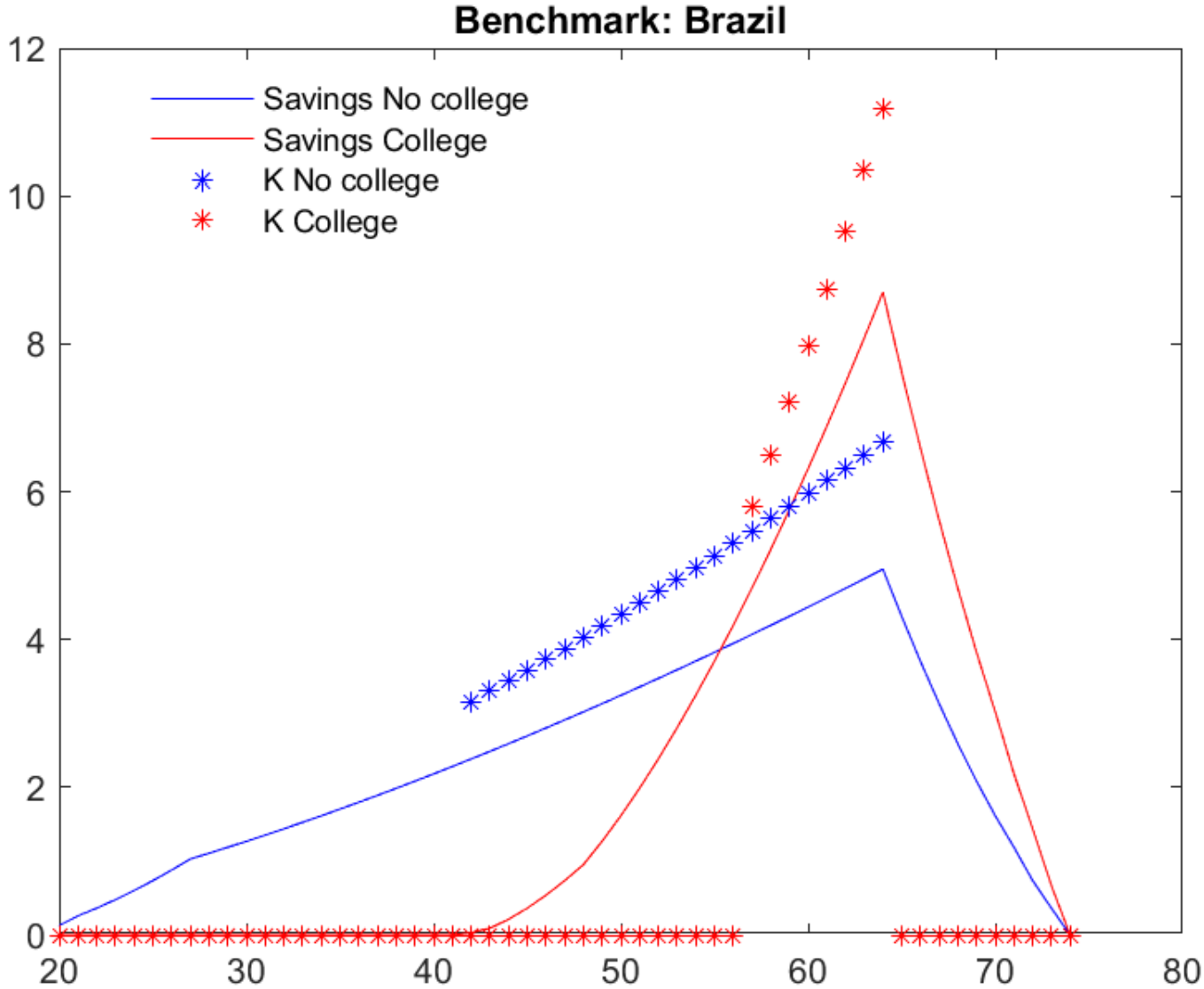
Entrepreneurial Human Capital and Firm Dynamics



Mid-ability formal entrepreneur capital and savings decisions over the life cycle conditional on education. Solid lines are savings; stars are capital. Red for college; blue for non-college.

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Counterfactual: Perfect Tax Enforcement

	Bench	Financial Ref	Education Ref	$\psi = 0$
Credit-to-GDP ratio	0.43	1.61	0.53	0.52
College rate (Population)	9.23	9.20	29.86	23.14
Size informal economy (Official GDP)	0.00	0.00	0.00	0.00
Educated formal entrep. (Formal Entrep)	6.46	5.48	71.13	7.37
Δ Official GDP		0.47	37.45	20.43
Δ Measured TFP		1.69	7.36	-2.30
Δ Wage Skill Premium		10.33	-43.31	-51.56
Δ Entrepreneurial Skill Premium		2.23	-51.12	-40.63
Δ Fiscal Revenues		6.09	36.77	17.23

Informality facts: Definition and data

- **Medina and Scheinder Informality Database**: 157 countries, 1991-2017. Cross-country estimates of the informal production around the world;

- **ECINF 2003** (Pesquisa de Economia Informal Urbana) a repeated cross section of small firms (up to ten employees), which was collected by the Brazilian Bureau of Statistics (IBGE) in 1997 and 2003. Firms are directly asked whether they are registered with the tax authorities and whether each of their workers has a formal labor contract;

- **PNAD 2003** (Pesquisa Nacional por Amostra de Domicilios) a repeated cross section that is representative at the national level. Useful to compute statistics about formal and informal workers as well as aggregate labor market statistics;

- **Global Entrepreneurship Monitor Database**: 54 countries, 2009-2015. Survey data on several entrepreneurial characteristics;

Definitions

- Informal economy: production of legal goods and services that are deliberately concealed from fiscal authorities in order to avoid the payment of taxes and social security contributions;
- Informal workers: employees without a formal labor contract;
- Informal firms: firms that are not registered with the tax authorities;
- Educated agents: individuals that **have completed** tertiary education (i.e. college degree);

Stylized facts

(1) **Informal firms are smaller relative to formal firms**

Moments	Source	Value
(A) **Firms size distribution:**		
(A.1) **Informal firms**		
≤ 2 workers	ECINF 2003	0.957
≤ 5 workers	ECINF 2003	0.998
(A.2) **Formal firms**		
≤ 5 workers	Ulyssea (2018)	0.701
$6 - 10$ workers	Ulyssea (2018)	0.141
$11 - 20$ workers	Ulyssea (2018)	0.083
$21 - 50$ workers	Ulyssea (2018)	0.048

Stylized facts

(2) **The informal economy is more intense of less educated factors**

Moments	Source	Value
(A) **Small businesses**		
(A.1) *Share of college-educated entrepreneurs*:		
In formal firms	ECINF 2003	17.45
In informal firms	ECINF 2003	6.28
(A.2) *Informality rate*:		
Among college-educated entrepreneurs	ECINF 2003	57.13
Among non-college-educated entrepreneurs	ECINF 2003	80.78
(B) **All firms**		
(B.1) *Share of skilled workers*:		
In formal firms	PNAD-C 2012	13.16
In informal firms	PNAD-C 2012	2.88
(B.2) *Informality rate*:		
Among all workers	PNAD 2003	26.91
Among skilled workers	PNAD 2003	17.14
Among unskilled workers	PNAD 2003	27.72

Stylized facts

(3) **Substantial college and formal earning premia**

Moments	Source	Value
(A) **College earning premium**:		
Entrepreneurs	PNAD 2003	3.93
Workers	PNAD 2003	3.55
(B) **Formal-informal earning gaps**:		
Entrepreneurs	ECINF 2003	2.44
Workers	PNAD 2003	1.70

Stylized facts

(4) **Controlled earning gaps are still positive**

	ECINF 2003	
Variables	log(profit)	log(wage)
College (dummy)	0.482***	0.511***
	(0.0332)	(0.0608)
Formal firm (dummy)	0.697***	0.239***
	(0.0229)	(0.0222)
Male (dummy)	0.443***	0.141***
	(0.0217)	(0.0241)
Age (years)	0.0638***	0.0411***
	(0.00372)	(0.00267)
Age square	-0.000739***	-0.000377***
	(0.0000425)	(0.0000316)
Formal contract (dummy)		0.172***
		(0.0185)
Constant	3.173***	3.463***
	(0.131)	(0.170)
N	38931	11842

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Stylized facts

(5) **Informal and formal firms coexist within industries (ECINF)**

Sector	Informal	Formal
Extraction and Processing Industry	15.32	7.38
Trade and Repair	43.83	60.21
Accommodation and Food Services	7.66	6.04
Activities Real Estate, Renting and Business Services	5.99	9.62
Education, Health and Social Services	4.36	4.28
Other community, social and personal services	6.59	11.43

Stylized facts

(6) **Informality and education across countries are negatively correlated**

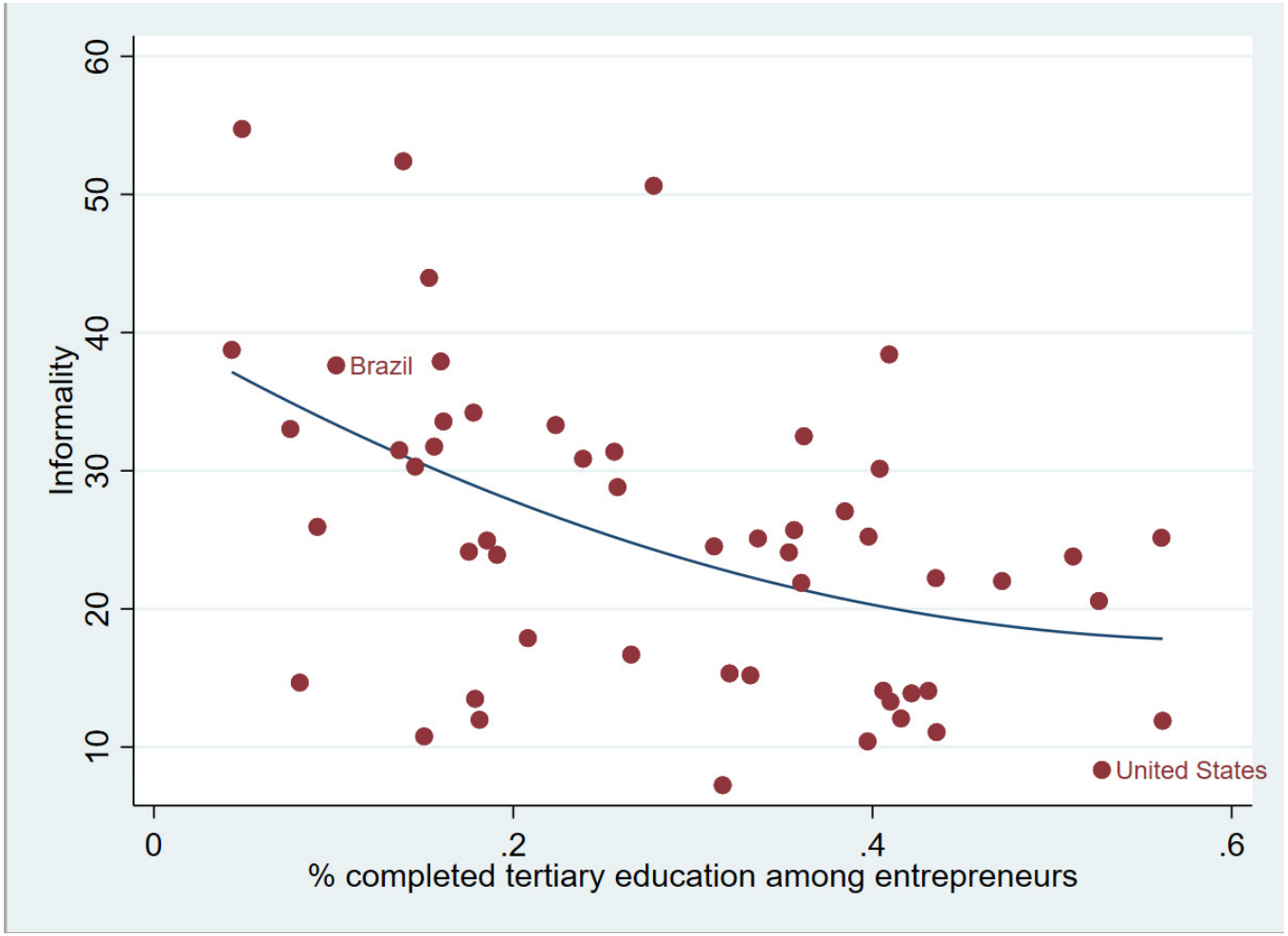

Figure: Source: Global Entrepreneurship Monitor: GEM Consortium; Medina and Schneider (2018). Correlation: -0.4856.

Empirical Evidence

- Datasets:
  - FINBRA: Accounting data of Municipalities - from 1989 to 2012
    - Available information on expenditures on tertiary education (*Ensino Superior*) starting 2005
  - PNAD-C 2012-2019: Nationally representative labor force survey with information on firm and labor informality.
- Methodology: IV Diff-in-Diff
- Treatment: Expenditures in higher education, binned into 2004-2009, 2010-2015.
- First difference: compare cohort i in region r_h with higher expenditures in higher education (high intensity treatment) compared to cohort i in region r_l (low intensity treatment)
- Second difference: compare cohort i and $i-1$ for treated and untreated regions r_h, r_l ▸ specification ▸ results

Empirical Evidence

$$Inf_{ijr} = \beta_0 + \beta_1 X_{ijr} + \beta_2 (log(Exp_{r,2005}) XCohort_{ij}) + \beta_3 (log(Exp_{r,2010}) XCohort_{ij}) + \zeta_j + \phi_r + \epsilon_{ijr}$$

where $Inf_{ijr} = 1$ if individual i born in cohort j and region r is an informal entrepreneur, 0 otherwise.

- X_{ijr} includes individual observable characteristics: age, gender, race, marital status.
- $Cohort_{ij} = 1$ if an individual was 17-23 yo (exposed) during the treatment, 0 otherwise
- $Exp_{r,2005}$ is expenditures in higher education per capita in region r for years 2005-2009.
- $Exp_{r,2010}$ is expenditures in higher education per capita in region r for years 2010-2015.

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Empirical Evidence

	Firm Informality
college_attainment	-0.693***
	(0.189)
Resident's age in the ref. date	-0.000970***
	(0.000113)
Female	0.0548***
	(0.0128)
Preta	0.0775*
	(0.0337)
Parda	0.0435
	(0.0289)
Indigenous	0.0295
	(0.0423)
Metropolitan area	-0.0207
	(0.0262)
Rest of the state	-0.0462
	(0.0239)

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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