Entrepreneurial Human Capital and Firm Informality

Adilya Abdrazakova [1] Luis Franjo [1] Francesco Turino [1]

[1] University of Alicante

Workshop on Informality in the Latin America and the Caribbean Region
World Bank
June 2023

Motivation

- Education and informality are negatively correlated (Ulyssea, 2020).
- Recent literature focuses on workers' education and informality in search and matching models (Haanwinkel & Soares, 2021; Bobba, Flabbi, Levy, & Tejada, 2021; Bobba, Flabbi, & Levy, 2022).
- Entrepreneurs' education is also negatively correlated with informality (La Porta & Shleifer, 2014; Berniell, 2021). Figure
- Firms run by educated entrepreneurs are larger at the opening and grow faster over time (Queiró, 2022).
- Educated entrepreneurs are better at innovation and technology adoption (Nelson & Phelps, 1966; Ciccone & Papaioannou, 2009).
- To what extent is the entrepreneur's human capital responsible for firm informality in developing countries?
- How is this relationship shaped by the degree of financial frictions in the economy? (Franjo, Pouokam, & Turino, 2022)
- How these relationships at the firm level translates into adjustments in GDP and TFP?

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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,
  - limited tax enforcement.
- The model is calibrated to the Brazilian economy.
- Experiments: educational and financial markets reforms.
- Results (preliminary!):
  - $\sim$ 20% of the size of the informal economy in Brazil is accounted by entrepreneurial human capital;
  - a joint educational and financial markets reform is more effective in reducing informality;
  - entrepreneurial human capital is an important determinant of income per capita and productivity; and,
  - selection into entrepreneurship may explain the observed decrease in the entrepreneurial earnings skill premium in Brazil.

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Model: Households

- The economy is populated by overlapping generations of individuals who 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), $e_h \in \Theta_h$, constant during her lifetime and distributed according to a generalized Pareto;
- a household chooses:
  - occupation: worker or entrepreneur; and,
  - how much to consume (c) and save (a') by maximizing her utility:

$$\sum_{j=0}^{J} \beta^j \frac{c^{1-\sigma} - 1}{(1-\sigma)}.$$

Model: Human Capital/Education Stage

- Non-college individuals are endowed with a managerial ability, e_u.
- Education (linearly) improves managerial ability by a factor ψ, such that $e_s = \psi e_u$, where $\psi \geq 1$.
- An individual, conditional on e_u, chooses between getting educated or not after drawing an idiosyncratic utility cost of attending college, $c \sim U([0,1])$, augmented by κ (Heathcote, Storesletten, & Violante, 2010):

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

  where $\mathbb{M}^{e_u}(h)$ is the expected value, upon entering the working stage, for an individual of unskilled ability e_u who has chosen education level h.
- κc includes (in a reduced form) psychological and pecuniary costs of education.

Model: Occupational Choice

- *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):

$$e_h^{\eta}\left(\mu l_u^{\sigma}+(1-\mu)[\iota k^{\rho}+(1-\iota)l_s^{\rho}]^{\frac{\sigma}{\rho}}\right)^{\frac{1-\eta}{\sigma}}$$

    where $\eta,\ \mu,\ \iota \in (0,1)$.
  - In the *formal sector*:
    - Imperfect credit markets $\rightarrow$ collateral constraint: $k \leq \lambda a$.
    - Taxes on personal income (y): $T(y) = \tau_y y$.
  - In the *informal sector*:
    - No credit markets $\rightarrow$ financial autarky: $k \leq a$.
    - No taxes (hidden production). Fined by a surcharge factor, s, with probability: $p(k) = 1/(1 + p_1 exp(-p_2 k))$.
- *Worker:* is endowed with 1 unit of time that supplies inelastically and receives a gross wage (ω_s or ω_u) conditional on education.

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.

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):
  - An 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.

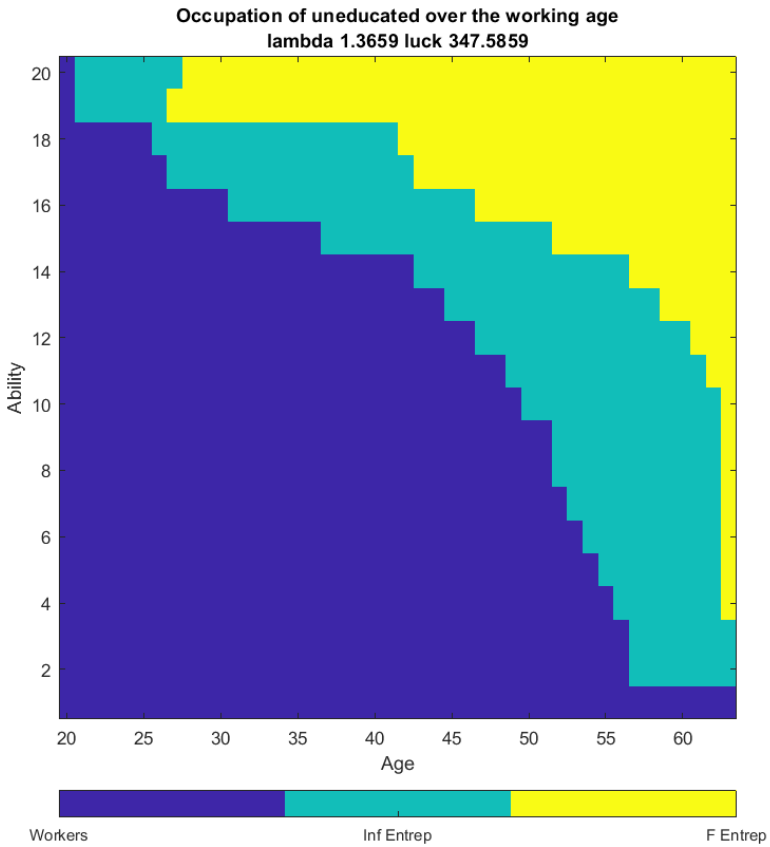
Calibration

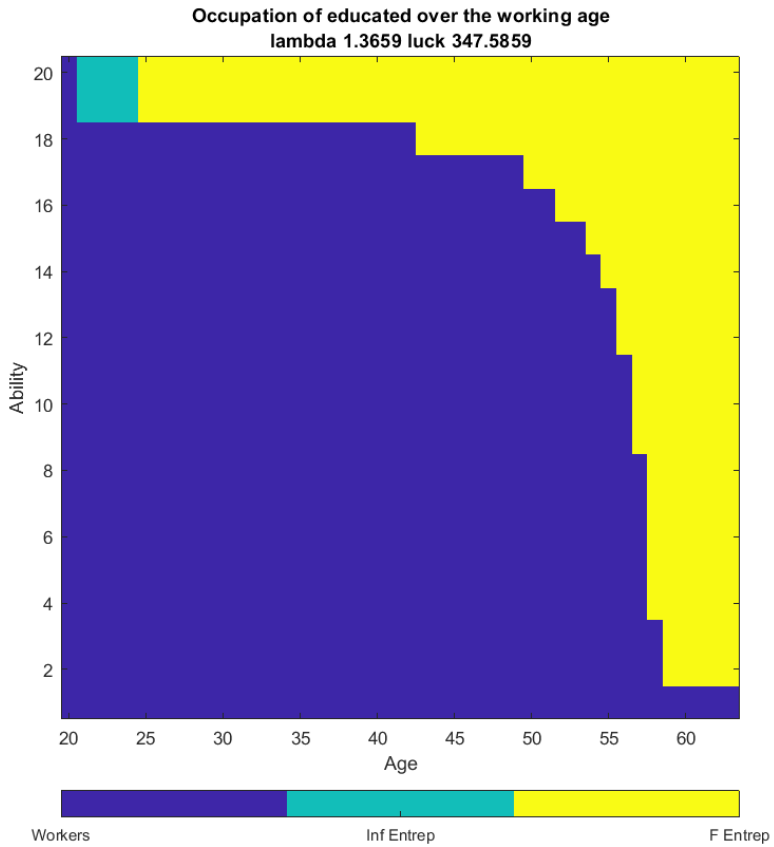
Parameters	Description	Source/ Targeted Moment	Value
(A) Externally calibrated			
σ	Relative risk aversion coefficient	Standard	1.5
δ	Capital depreciation rate	Cavalcanti and Santos (2021)	0.06
η	Span of control	Allub and Erosa (2019)	0.198
ρ	Substitutability: capital and skilled labor	Allub, Gomes, and Kuehn (2021)	-0.11
σ	Substitutability: capital and unskilled labor	"	0.6
μ	Weight of unskilled labor in production	"	0.44
ι	Weight of capital in production	"	0.61
(B) Internally calibrated			
β	Subjective discount factor	Capital-Output ratio	0.95
λ	Access to credit	Credit-Output ratio	1.36
κ	Cost to education	Completion of tertiary education	347
ψ	Human capital entrep improve	Entrepreneurial Skill Premium	2.92
τ_y	Income tax parameter	Total fiscal revenues to GDP	0.79
A	TFP in the Corporate sector	% of K used by corporations	2.06
p_1	Probability of detection	Informal output to GDP	8.e5
p_2	Probability of detection	Size distribution informal firms	6.21
μ_p	Location Pareto Distribution	Size distribution formal firms	5.07
κ_p	Scale Pareto Distribution	Size distribution formal firms	0.45
ν	Shape (tail) Pareto Distribution	Size distribution formal firms	0.08
$\Phi(e_{min})$	Probability mass in the minimum ability	Size distribution formal firms	0.44

Calibration Results: Targeted Moments

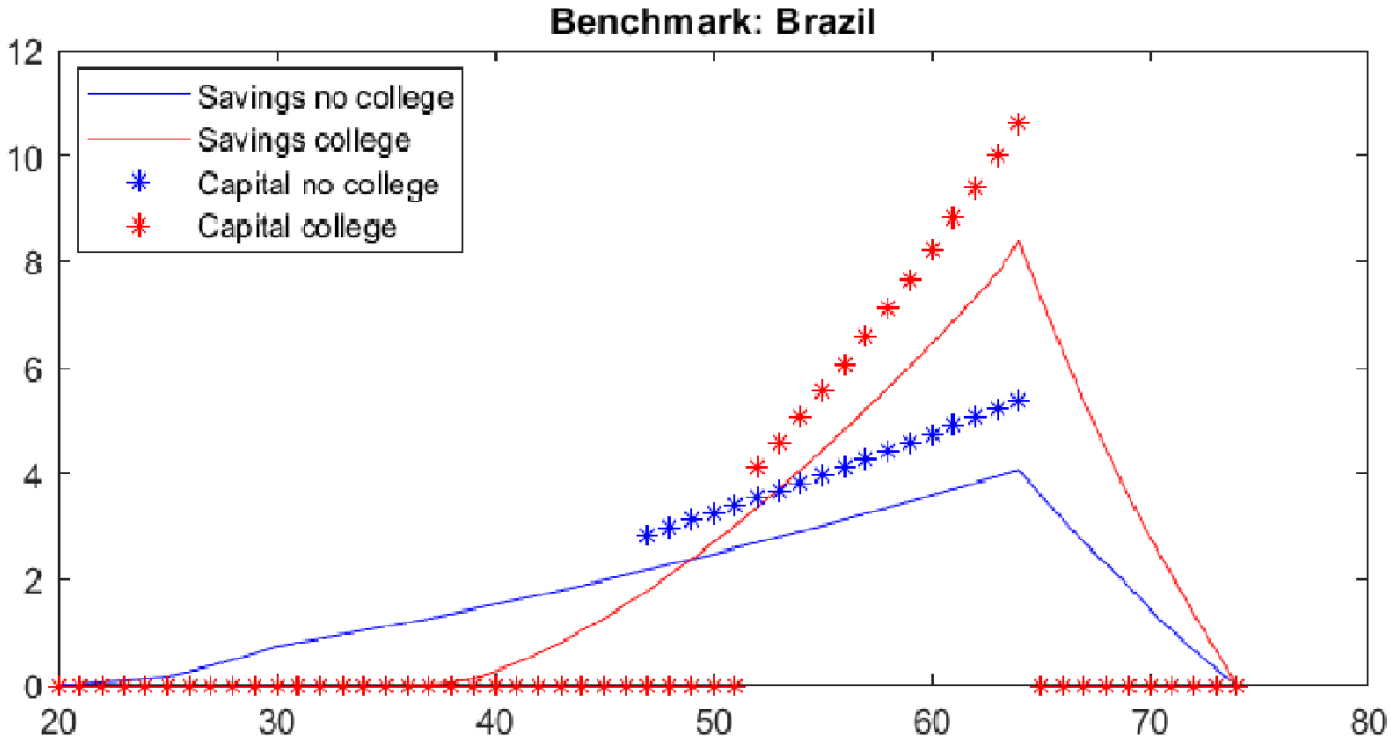
Moments	Source	Data	Model
(A) Targeted moments			
Capital-Output ratio	Allub and Erosa (2019)	2.10	2.12
Credit-Output ratio	World Bank Database	0.42	0.417
Informal output to GDP	Medina and Schneider (2018)	0.376	0.376
Completion of tertiary education	Barro and Lee (2001)	0.085	0.10
% of K used by corporations	Antunes, Cavalcanti, and Villamil (2015)	0.30	0.266
Total fiscal revenues to GDP	OECD revenues statistics	0.32	0.35
Entrepreneurial Skill Premium	PNAD 2003	4.26	2.85
Size distribution: informal firms			
≤ 2 workers	ECINF 2003	0.957	0.966
Size distribution: formal firms			
≤ 5 workers	Ulyssea (2018)	0.701	0.672
$\leq 6-10$ workers	"	0.141	0.174
$\leq 11-20$ workers	"	0.083	0.140
$\leq 21-50$ workers	"	0.048	0.012
(B) Non-Targeted moments			
Unskilled Workers Formal (% Tot Work For)	ECINF 2003	0.86	0.87
Unskilled Workers Informal (% Tot Work Inf)	ECINF 2003	0.93	0.91
Wage Skill Premium	PNAD 2003	3.81	3.07
Educated Entrep (% Tot Entrep)	PNAD 2003	0.09	0.05

Occupational Maps and Education





Entreprenurial 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 used in production. Red for college; blue for non-college.

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.
- Counterfactuals:
  - No Entrepreneurial Human Capital ($\psi = 1$). Role of Education of Entrepreneurs?
  - Perfect Tax Enforcement. Role of informality?

Financial Development, Human Capital, and Informality

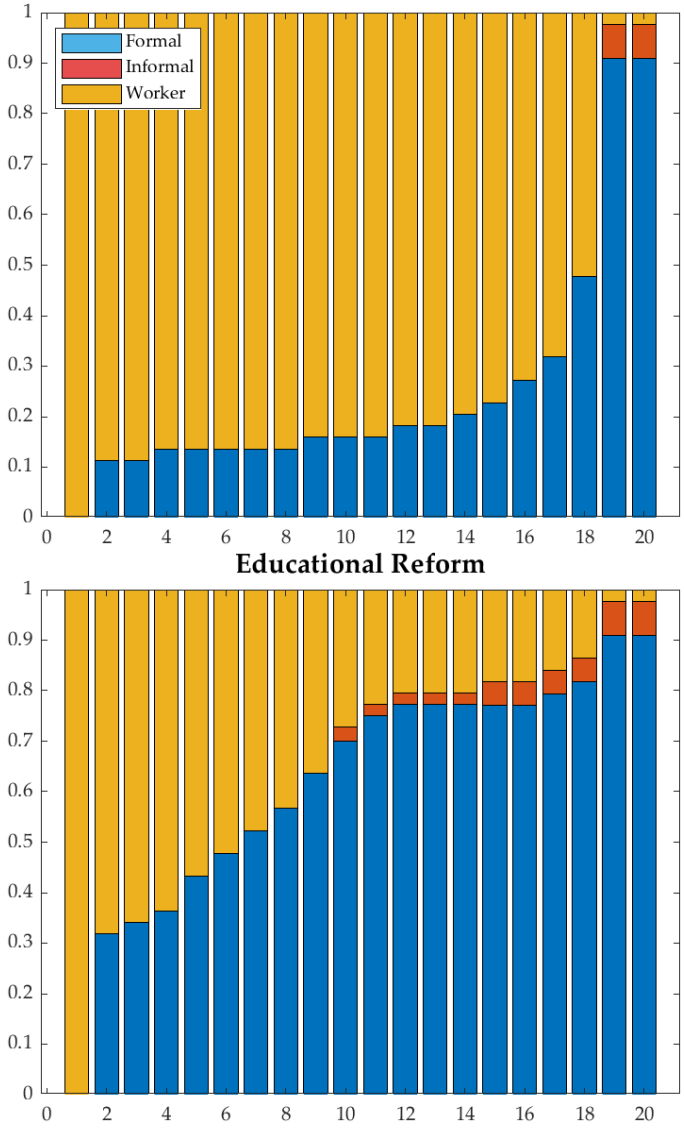
Benchmark AltRef

	Bench	Education Ref	Financial Ref	Both
Credit-to-GDP ratio	0.41	0.48	1.57	1.60
College Rate (% Population)	0.10	0.30	0.10	0.31
Size informal economy (% Official GDP)	37.6%	5.6%	17.8%	0%
Educated formal entrep (% Formal Entrep)	12.4%	79.5%	3.0%	82.7%
Δ Official GDP		72.5%	20.2%	90.8%
Δ Measured TFP		13.6%	6.8%	19.7%
Δ Wage Skill Premium		-36.4%	6.3%	-32.9%
Δ Entrepreneurial Skill Premium		-63.0%	95.5%	-84.0%
Interest Rate	-1.4%	-1.5%	4.4%	5.5%
Total formal entrepreneurs (% Population)	10.4%	14.7%	13.5	13.6
Total informal entrepreneurs (% Population)	13.7%	3.4%	7.7%	0%
Total workers (% Population)	75.9%	81.9%	78.8%	86.4%
Skilled workers (% Population)	8.3%	18.9%	9.3%	20.9%
Unskilled workers (% Population)	67.6%	63.0%	69.6%	65.5%
ΔFiscal revenues		38.8%	9.7%	51.7%
ΔTax evasion		-80.5%	-52.7%	-100%

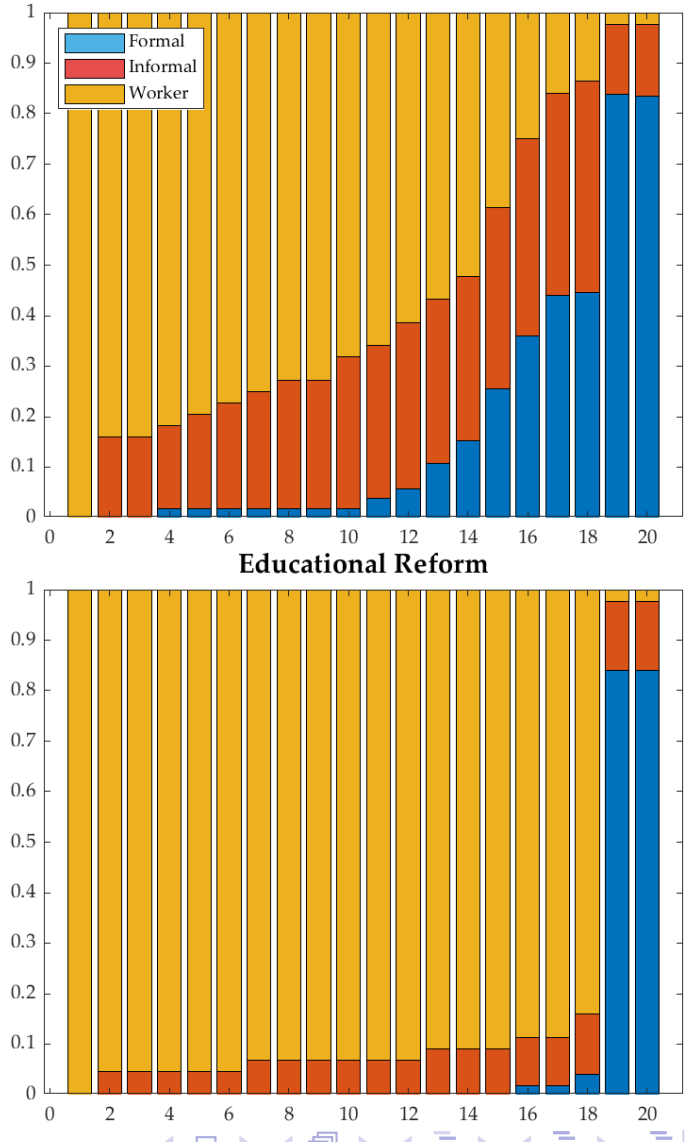
Financial Development, Human Capital, and Informality

Benchmark: Educational Reform

College

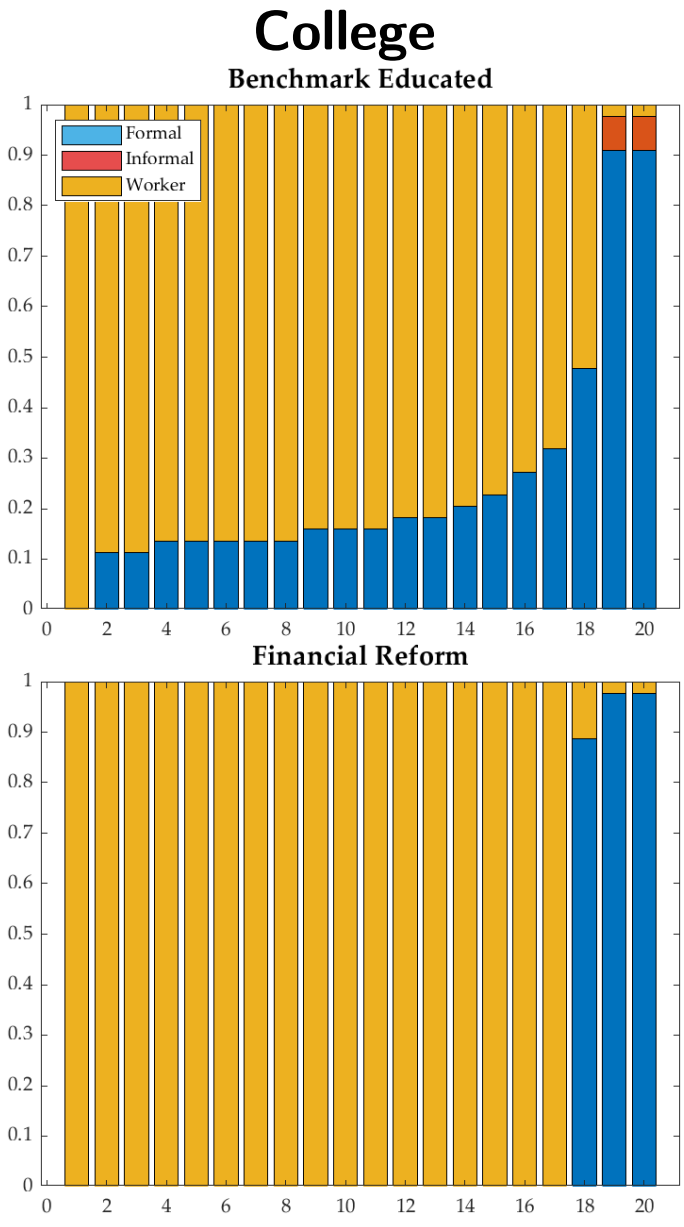


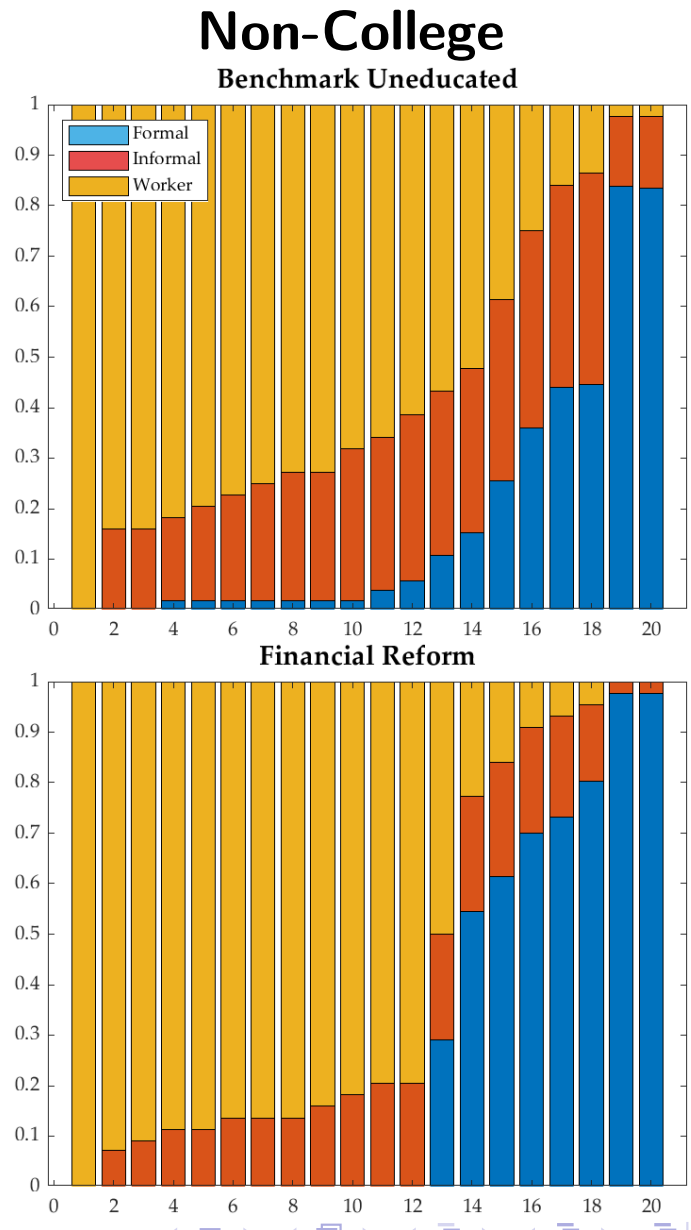
Non-College



Financial Development, Human Capital, and Informality

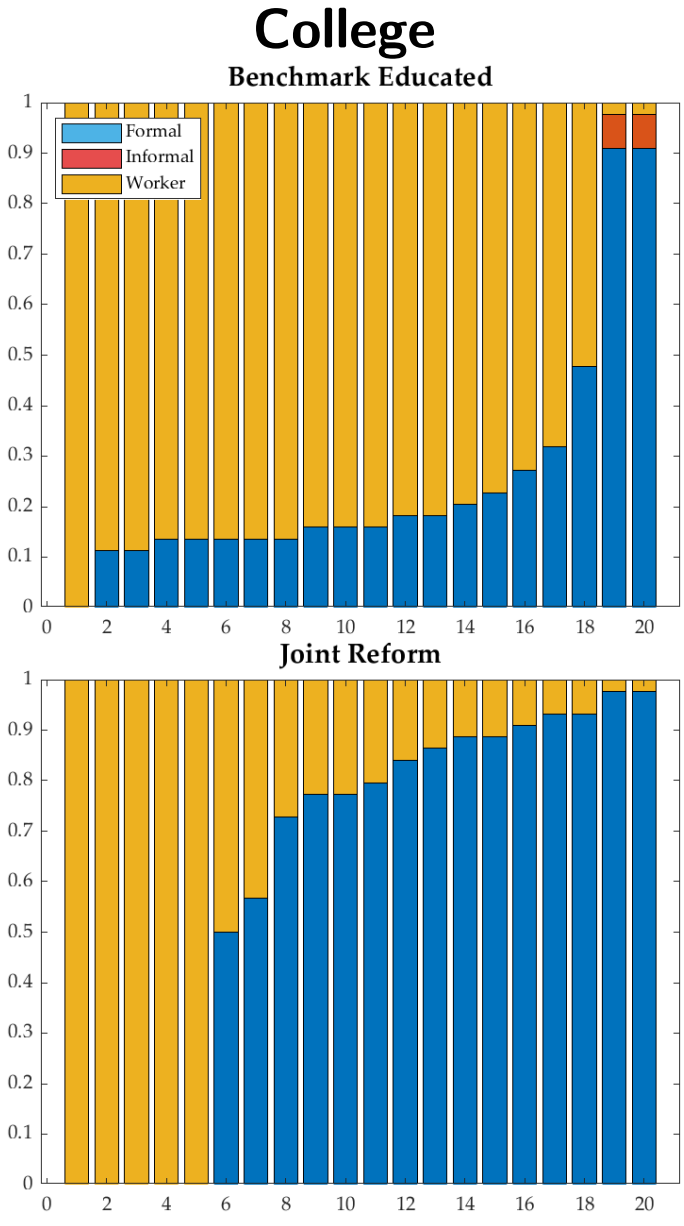
Benchmark: Financial Reform

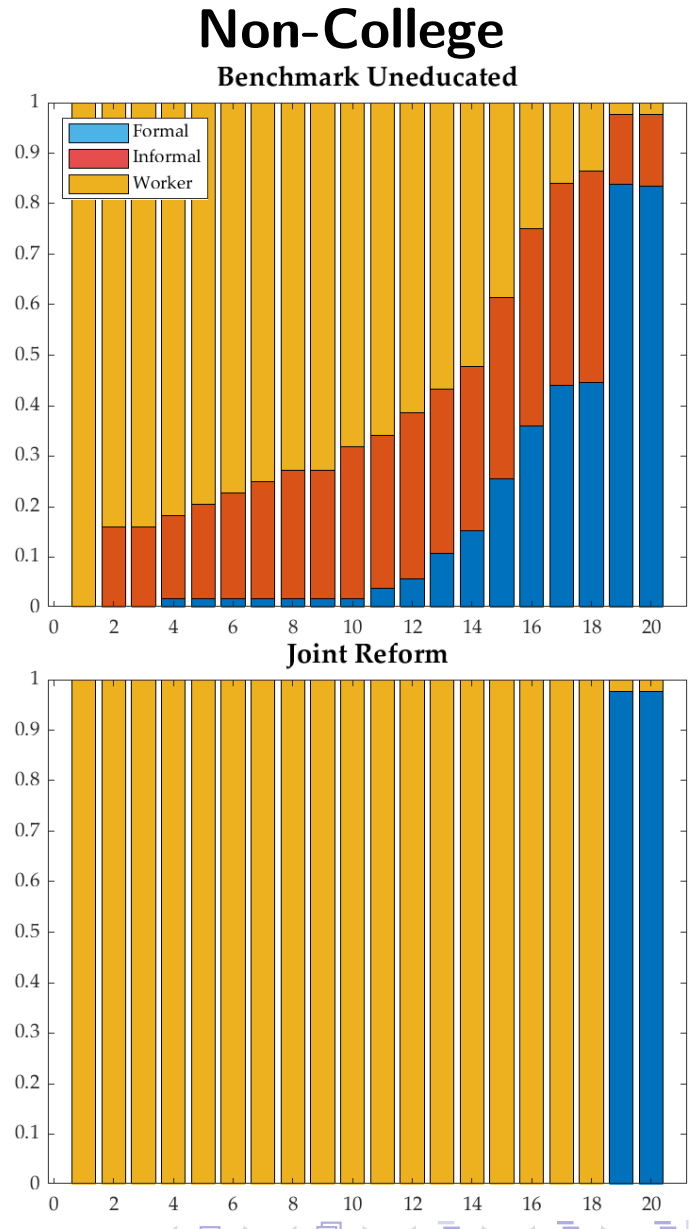




Financial Development, Human Capital, and Informality

Benchmark: Joint Reform





Human Capital and Informality

Educational Reform ($\downarrow \kappa$)

	Bench	$\psi = 1$	**Perf Enforc**
Credit-to-GDP ratio	0.48	0.48	0.47
College Rate (% Population)	0.30	0.31	0.26
Size informal economy (% Official GDP)	5.6%	14.3%	0%
Educated formal entrep (% Formal Entrep)	79.5%	14.8%	4.9%
Δ Official GDP	72.5%	49.9%	11.5%
Δ Measured TFP	13.6%	3.6%	-2.4%
Δ Wage Skill Premium	-36.4%	-57.0%	-40.3%
Δ Entrepreneurial Skill Premium	-63.0%	-41.1%	-85.4%
Total formal entrepreneurs (% Population)	14.7%	18.7	15.0
Total informal entrepreneurs (% Population)	3.4%	7.2%	0%
Total workers (% Population)	81.9%	74.2%	85.0%
Skilled workers (% Population)	18.9%	24.9%	23.4%
Unskilled workers (% Population)	63.0%	49.2%	61.6%
ΔFiscal revenues	38.8%	21.8%	13.8%
ΔTax evasion	-80.5%	-51.7%	-

Conclusions

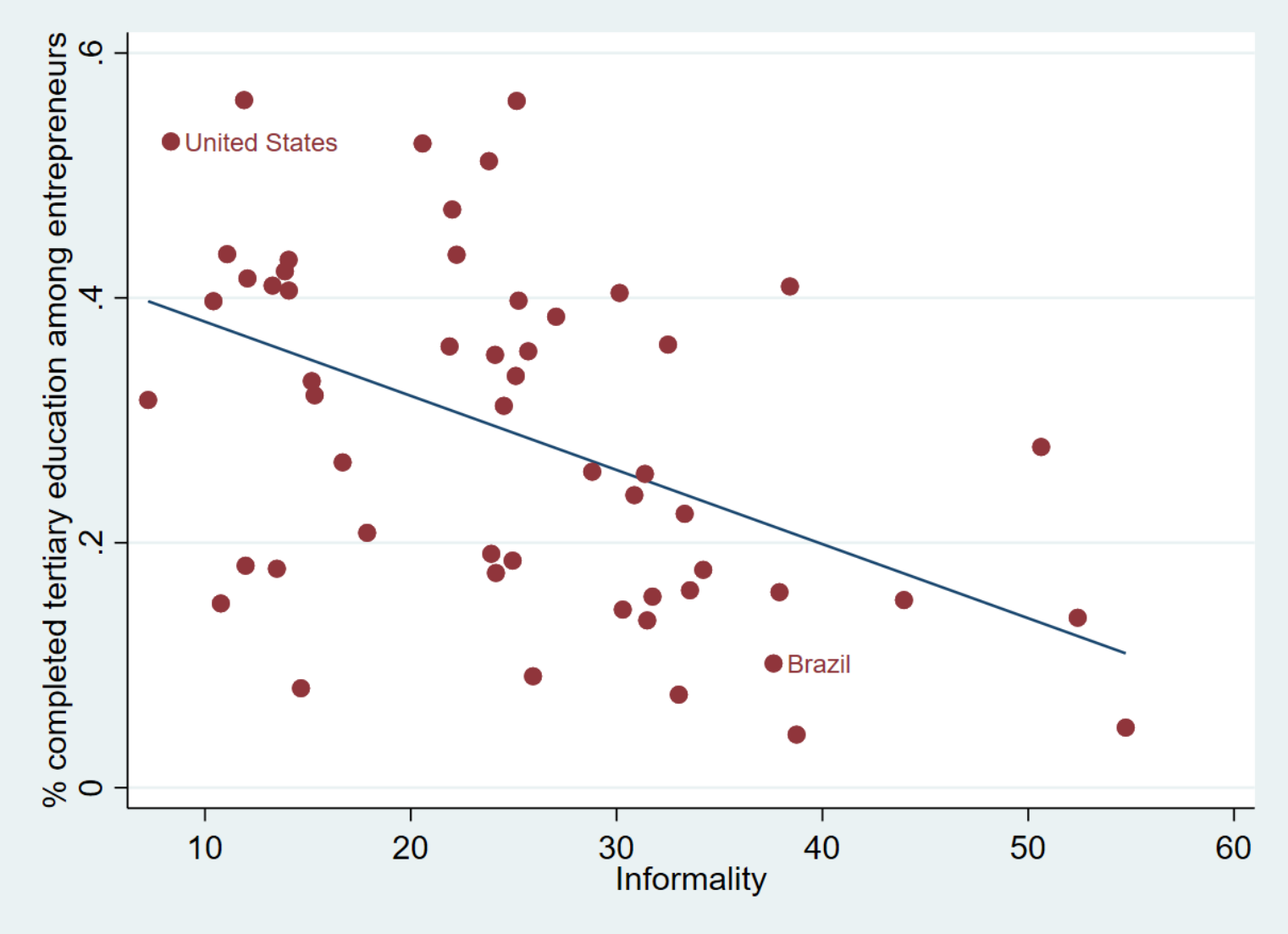
- Structural dynamic model of occupational choice with human capital (both workers and entrepreneurs) and firm informality.
- A financial reform or an educational reform, separately, does not eliminate informality (larger effect of educational reform).
- A joint reform further reduces informality because of capital-skill complementarity.
- Entrepreneurial human capital potential important determinant for informality, official GDP, measured TFP, and fiscal revenues.
- Accounting for informality is crucial for the reforms:
  - Amplification effect: from informal to formal.
  - $\uparrow$ extensive margin.
- Education accounts for a large proportion of informality ($\sim$ 85%, in the counterfactual with the US college rate);
  - $\sim$ 20% explained by entrepreneurial human capital.
- Selection into entrepreneurship may explain the observed decrease in the entrepreneurial earnings skill premium.

Next Steps

- Calibration:
  - Improve (targets?).
  - Production function.
  - $\psi(e)$. Proportion of educated entrepreneurs by firm size.
- Empirical Analysis:
  - Cross-country comparisons.
  - Educational reforms in Brazil (Haanwinkel & Soares, 2021).
- Transitional Dynamics:
  - Policy evaluation. Persistence of informality through educational choices.
  - Welfare analysis.

Entrepreneurial Terciary Education and Informality

back



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

Financial Development, Human Capital, and Informality

Benchmark: Alternative Reforms

back

	Bench	Ed Ref Brazil 2012	Both (US entrep ed rate)
Credit-to-GDP ratio	0.41	0.44	1.49
College Rate (% Population)	0.10	0.20	0.18
Size informal economy (% Official GDP)	37.6%	15.7%	4.7%
Educated formal entrep (% Formal Entrep)	12.4%	47.7%	39.0%
Δ Official GDP		39.5%	49.9%
Δ Measured TFP		6.9%	11.6%
Δ Wage Skill Premium		-19.1%	-12.7%
Δ Entrepreneurial Skill Premium		-39.3%	-54.4%
Interest Rate	-1.4%	-1.5%	5.0%
Total formal entrepreneurs (% Population)	10.4%	12.0%	12.5
Total informal entrepreneurs (% Population)	13.7%	7.9%	2.6%
Total workers (% Population)	75.9%	80.1%	84.9%
Skilled workers (% Population)	8.3%	12.4%	13.6%
Unskilled workers (% Population)	67.6%	67.7%	71.4%
ΔFiscal revenues		32.9%	39.2%
ΔTax evasion		-49.8%	-86.1%

Skill Premia

	PNAD 2003	**PNAD C 2012**
Entrepreneurial Skill Premium	4.26	1.8
Wage Skill Premium	3.81	1.569

College Share

Category	PNAD 2003	PNADC 2012
Workers + Entrepreneurs	0.079	0.2273
Workers	0.0719	0.2366
Entrepreneurs (incl se)	0.0963	0.2012
Employers (excl se)	0.2181	0.3404
SE	0.0621	0.1634

Data Sources

- Global Entrepreneurship Monitor Database: 54 countries, 2009-2015.
- Medina & Scheinder Informality Database: 157 countries, 1991-2017.
- ECINF 2003 (Pesquisa de Economia Informal Urbana).
- PNAD 2003 (Pesquisa Nacional por Amostra de Domicilios).
- PNAD-C 2012.

College Share by Firm Size: Formal Firms

Firm Size	No College	College	College Share	Total
1-5	0.5184	0.1997	0.2781	0.7181
6-10	0.0776	0.0521	0.4017	0.1297
11-50	0.0564	0.0487	0.4634	0.1051
>51	0.0244	0.0226	0.4809	0.047
Total	0.6769	0.3231	0.3231	1

Source: PNAD-C 2012.

College Share by Firm Size: Informal Firms

Firm Size	No College	College	College Share	Total
1-5	0.8343	0.1332	0.1377	0.9675
6-10	0.0161	0.0042	0.2069	0.0203
11-50	0.0049	0.0011	0.1833	0.006
>51	0.0049	0.0013	0.2097	0.0062
Total	0.8602	0.1398	0.1398	1

Source: PNAD-C 2012.

Entrepreneurs College Share

College-Educated Share	Formal	Informal	Total
Entrepreneurs (incl se)	0.3231	0.1398	0.2012
Entrepreneurs (excl se)	0.3824	0.1851	0.3404
Self-employed (se)	0.2634	0.1364	0.1634

Source: PNAD-C 2012.

Financial Development, Human Capital, and Informality

Benchmark

	Bench	Education Ref	Financial Ref	Both
Credit-to-GDP ratio	0.41	0.48	1.57	1.60
College Rate (% Population)	0.10	0.30	0.10	0.31
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Educated formal entrep (% Formal Entrep)	12.4%	79.5%	3.0%	82.7%
Δ Official GDP		72.5%	20.2%	90.8%
Δ Total production		34.8%	8.5%	47.6%
Δ Measured TFP		13.6%	6.8%	19.7%
Δ Unskilled Wage		18.2%	-0.7%	17.5%
Δ Skilled Wage		-24.8%	5.5%	-21.3%
Δ Wage Skill Premium		-36.4%	6.3%	-32.9%
Wage Skill Premium	3.1	2.0	3.3	2.1
Δ Entrepreneurial Skill Premium		-63.0%	95.5%	-84.0%
Entrepreneurial Skill Premium	2.9	1.1	5.6	0.5
Interest Rate	-1.4%	-1.5%	4.4%	5.5%
Total formal entrepreneurs (% Population)	10.4%	14.7%	13.5	13.6
Total informal entrepreneurs (% Population)	13.7%	3.4%	7.7%	0%
Total workers (% Population)	75.9%	81.9%	78.8%	86.4%
Skilled workers (% Population)	8.3%	18.9%	9.3%	20.9%
Unskilled workers (% Population)	67.6%	63.0%	69.6%	65.5%
ΔFiscal revenues		38.8%	9.7%	51.7%
ΔTax evasion		-80.5%	-52.7%	-100%

Financial Development, Human Capital, and Informality

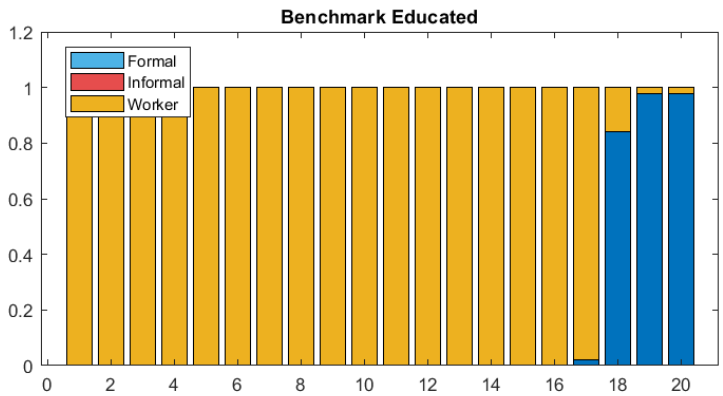
Perfect Tax Enforcement

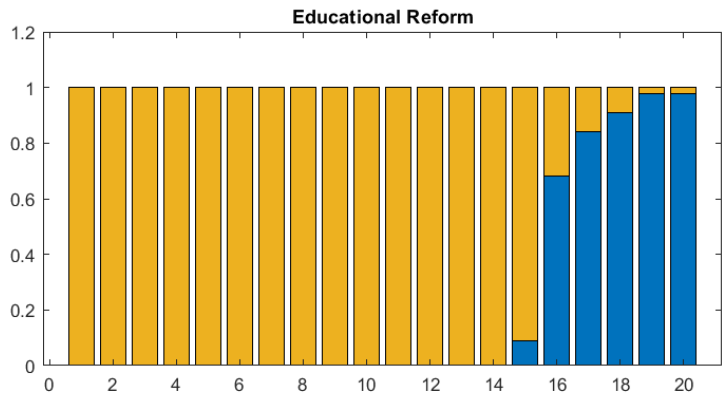
	Bench	Education Ref	Financial Ref	Both
Credit-to-GDP ratio	0.42	0.47	1.59	1.82
College Rate (% Population)	0.11	0.26	0.12	0.26
Educated formal entrep (% Formal Entrep)	0.7%	4.9%	0.3%	2.7%
Δ GDP		11.5%	3.8%	29.4%
Δ Measured TFP		-2.4%	3.3%	3.1%
Δ Unskilled Wage		13.1%	2.2%	16.4%
Δ Skilled Wage		-32.4%	15.2%	-26.9%
Δ Wage Skill Premium		-40.3%	12.6%	-37.3%
Wage Skill Premium	3.1	1.8	3.5	1.9
Δ Entrepreneurial Skill Premium		-41.1%	62.1%	-26.1%
Entrepreneurial Skill Premium	1.8	1.1	2.9	1.3
Interest Rate	-2.1%	-1.8%	3.5%	4.1%
Total formal entrepreneurs (% Population)	13.8%	15.0%	11.9	12.2
Total workers (% Population)	86.2%	85.0%	88.0%	87.8%
Skilled workers (% Population)	11.6%	23.4%	12.1%	27.0%
Unskilled workers (% Population)	74.6%	61.6%	75.9%	60.8%
ΔFiscal revenues		13.8%	6.5%	24.2%

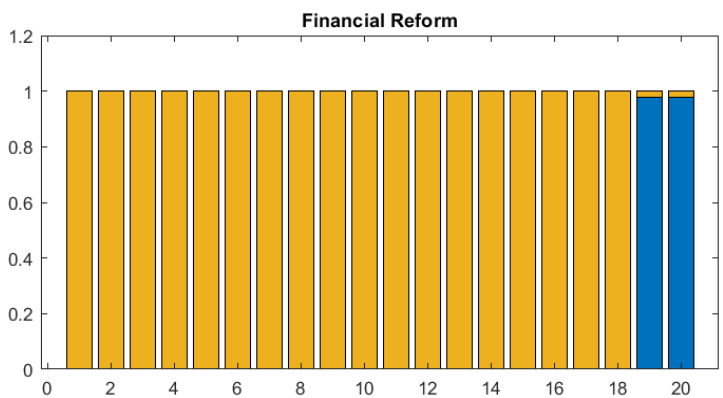
Financial Development, Human Capital, and Informality

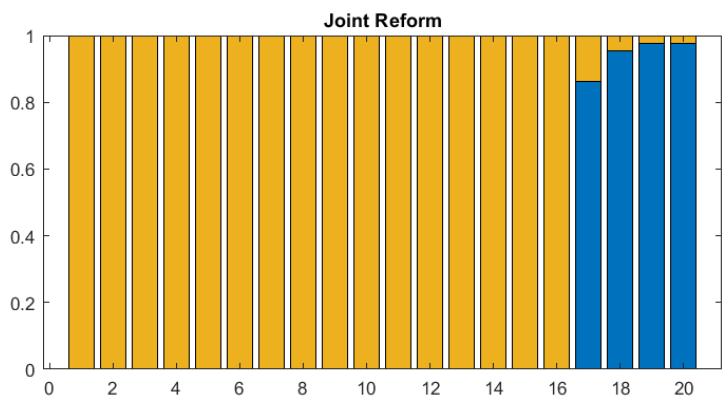
Perfect Tax Enforcement

- College individuals:





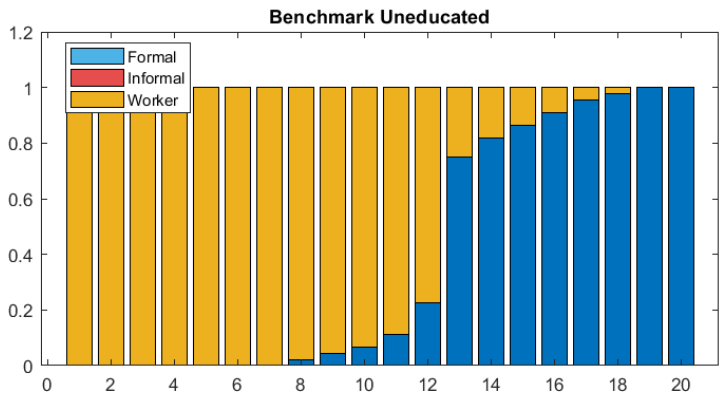


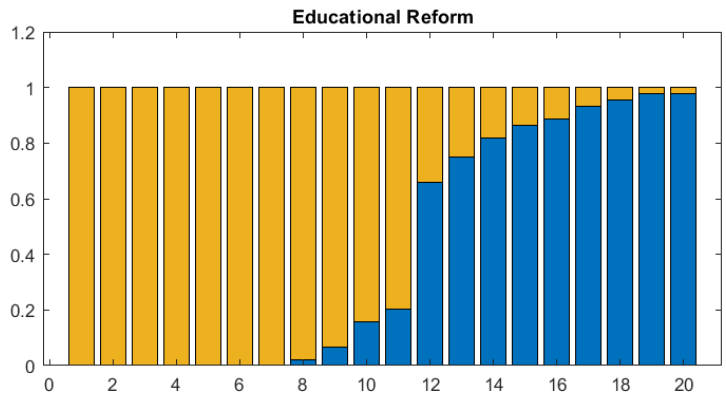


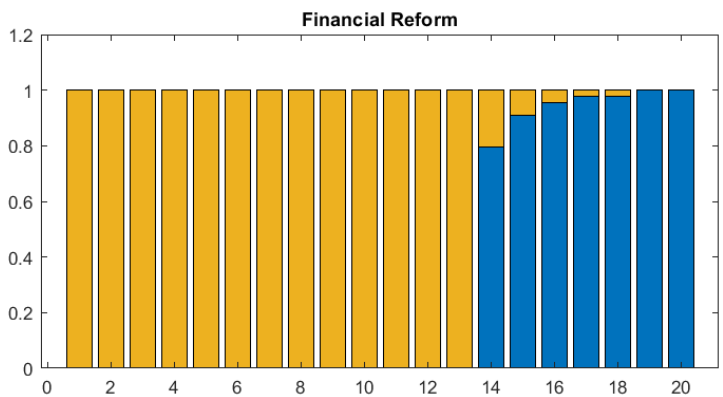
Financial Development, Human Capital, and Informality

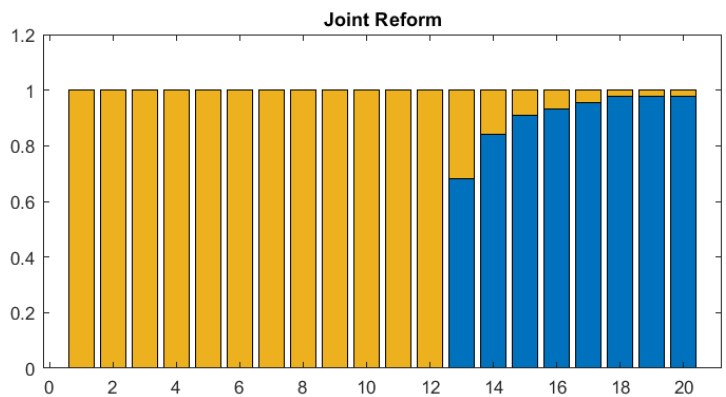
Perfect Tax Enforcement

- Non-college individuals:









Financial Development, Human Capital, and Informality

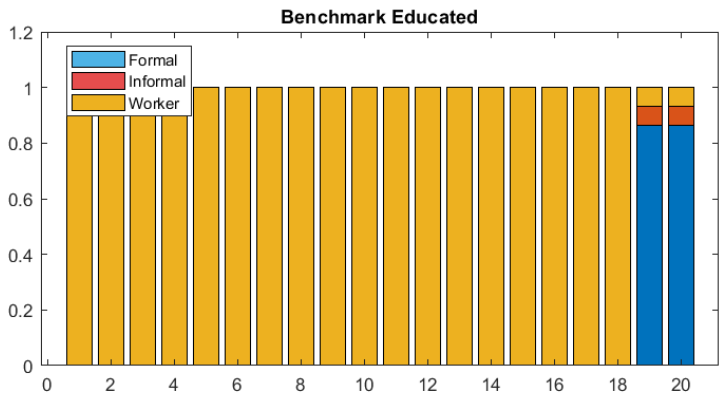
No Entrepreneurial Human Capital ($\psi = 1$)

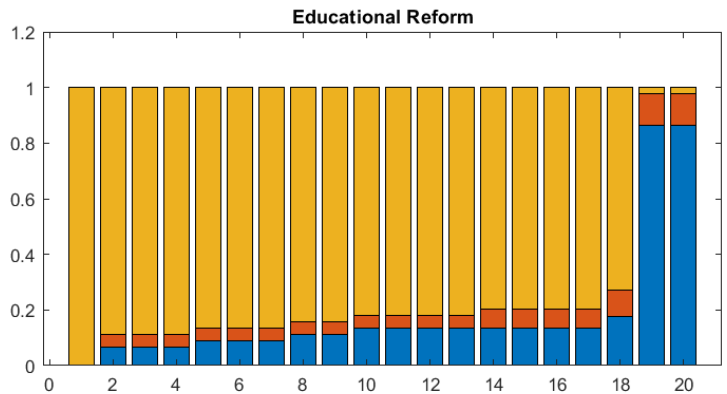
	Bench	Education Ref	Financial Ref	Both
Credit-to-GDP ratio	0.41	0.48	1.38	1.54
College Rate (% Population)	0.09	0.31	0.09	0.31
Size informal economy (% Official GDP)	41.7%	14.3%	31.2%	0%
Educated formal entrep (% Formal Entrep)	0.4%	14.8%	0.3%	0.7%
Δ Official GDP		49.9%	7.5%	82.7%
Δ Total production		20.7%	2.4%	32.7%
Δ Measured TFP		3.6%	7.2%	13.9%
Δ Unskilled Wage		18.9%	-0.4%	20.7%
Δ Skilled Wage		-48.9%	7.5%	-48.0%
Δ Wage Skill Premium		-57.0%	8.0%	-56.9%
Wage Skill Premium	2.9	1.2	3.1	1.2
Δ Entrepreneurial Skill Premium		-85.4%	-12.0%	-13.4%
Entrepreneurial Skill Premium	4.3	0.6	3.8	3.7
Interest Rate	-3.6%	-2.9%	5.7%	7.2%
Total formal entrepreneurs (% Population)	11.6%	18.7%	12.0	21.1
Total informal entrepreneurs (% Population)	13.3%	7.2%	10.7%	0%
Total workers (% Population)	75.1%	74.2%	77.2%	78.9%
Skilled workers (% Population)	8.1%	24.9%	8.2%	29.5%
Unskilled workers (% Population)	67.1%	49.2%	69.1%	49.4%
ΔFiscal revenues		21.8%	6.3%	36.2%
ΔTax evasion		-51.7%	-32.5%	-100%

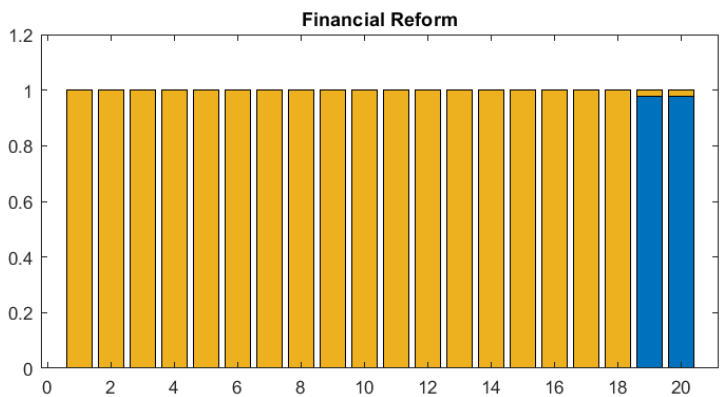
Financial Development, Human Capital, and Informality

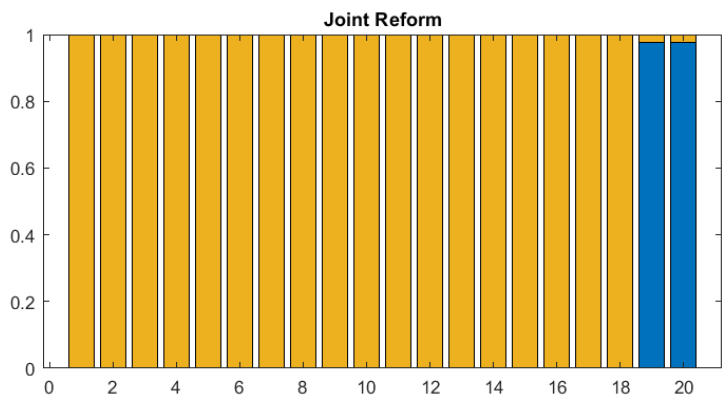
No Entrepreneurial Human Capital ($\psi = 1$)

- College individuals:





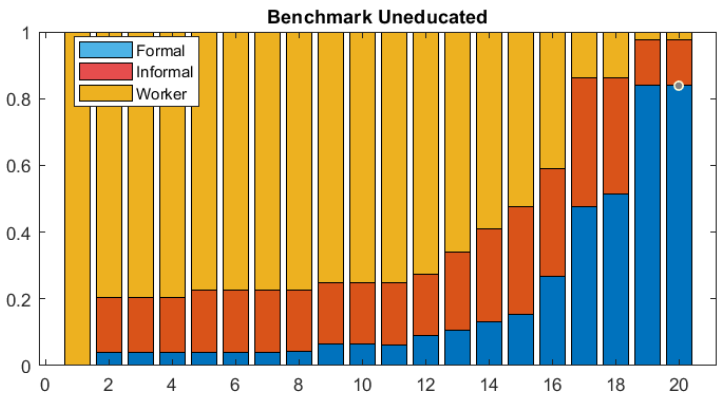


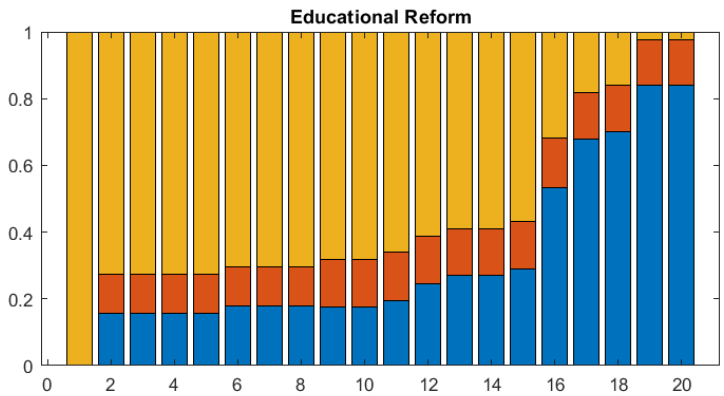


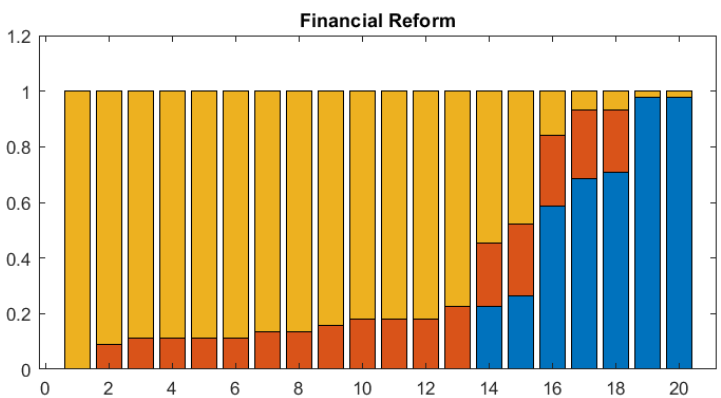
Financial Development, Human Capital, and Informality

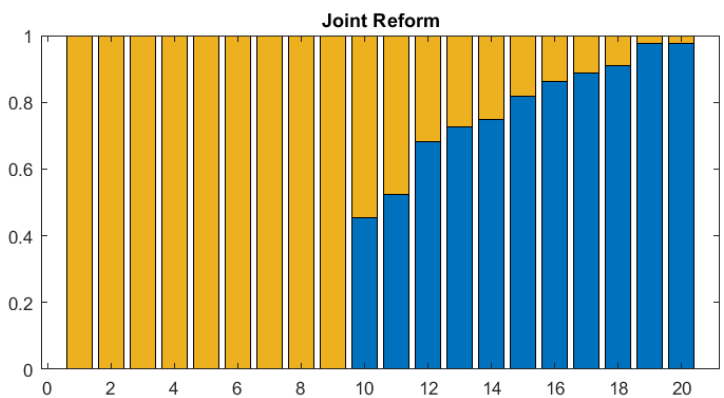
No Entrepreneurial Human Capital ($\psi = 1$)

- Non-college individuals:









Human Capital and Informality

Educational Reform ($\downarrow \kappa$)

	Bench	$\psi = 1$	**Perf Enforc**
Credit-to-GDP ratio	0.48	0.48	0.47
College Rate (% Population)	0.30	0.31	0.26
Size informal economy (% Official GDP)	5.6%	14.3%	0%
Educated formal entrep (% Formal Entrep)	79.5%	14.8%	4.9%
Δ Official GDP	72.5%	49.9%	11.5%
Δ Total production	34.8%	20.7%	11.5%
Δ Measured TFP	13.6%	3.6%	-2.4%
Δ Unskilled Wage	18.2%	18.9%	13.1%
Δ Skilled Wage	-24.8%	-48.9%	-32.4%
Δ Wage Skill Premium	-36.4%	-57.0%	-40.3%
Δ Entrepreneurial Skill Premium	-63.0%	-41.1%	-85.4%
Total formal entrepreneurs (% Population)	14.7%	18.7	15.0
Total informal entrepreneurs (% Population)	3.4%	7.2%	0%
Total workers (% Population)	81.9%	74.2%	85.0%
Skilled workers (% Population)	18.9%	24.9%	23.4%
Unskilled workers (% Population)	63.0%	49.2%	61.6%
ΔFiscal revenues	38.8%	21.8%	13.8%
ΔTax evasion	-80.5%	-51.7%	-