A Structural Model of Informality with Constrained Entrepreneurship

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Context

- Entrepreneurship -> crucial ingredient in promoting and sustaining economic growth: potential for creating jobs, delivering innovation and raising productivity.
- Issue with developing countries -> existence of a large informal sector (60-90% of workforce)
- Formal enterprises -> higher growth prospects, higher productivity and income potential, generate tax revenues
- Informal enterprises -> generally low-scale, largely untaxed (shortfalls in government revenues).
  -> Important avenue for job creation,incubator for business potential; stepping stone for accessibility to the formal economy (ILO 2002, Cano-Urbina 2015).

Examples of Informal Activities

Informal entrepreneurs: small and medium size enterprises.

Examples of Informal Activities

Subsistence activities: Street vending; call boxes

Examples of Informal Activities

Subsistence activities: backyard manufacturing - unpaid family work

Research Question

- How do individual and institutional attributes drive entrepreneurial choice and the formation of informal versus formal firms in developing countries?
- What policies can promote entrepreneurship and increase the share of formal firms relative to informal firms?
- What are then the consequences in terms of output and productivity?

Overview of Methodology

- I develop a theoretical model of formal and informal entrepreneurship under partial equilibrium, which is then estimated by GMM using data from Cameroon.
- Decision-making process depends on both individual characteristics (skills and initial wealth endowment) and institutional factors (entry costs, taxation, enforcement and degree of financial frictions).
- The estimated model is then used in counterfactual policy simulations to quantify the impact of several policies (registration and tax reforms, increased enforcement, etc.), on informality and aggregate income.

Preview of Findings

- Evidence of a non-monotonic, U-shaped, relationship between entrepreneurs' education and their decision to formalize.
- Evidence that initial wealth and average education drive informal entrepreneurship while higher education and parent's entrepreneurial status determine formal entrepreneurship.
- Counterfactual evidence that while registration and tax reforms generate substantial enterprise creation, increased formalization and aggregate income gains, a pure enforcement policy against informality has an overall perverse effect.

Outline

Model Description

Framework

- Three occupations: Wage-work, Formal Entrepreneurship, Informal Entrepreneurship.
- Agents differ with their initial wealth endowment z, and their entrepreneurial skills θ distributed with CDF $G(\theta)$.
- Wageworkers receive a fixed income $w > 0$.
- Entrepreneurs produce goods according to a Cobb-Douglas production technology given by

$$y = \theta k^{\alpha} l^{\beta} \epsilon \tag{1}$$

where $\alpha, \beta \in (0, 1)$, and $\gamma = \alpha + \beta < 1$.

Formal Entrepreneurship

- Taxes and registration cost. The formal entrepreneur's problem:

$$\pi^F(\theta) = \max_{k \geq 0, l \geq 0} \left\{ (1-\tau) \left[\theta k^\alpha l^\beta - wl - rk \right] - rc \right\}$$

where:

- τ is the tax rate, r is the interest rate

- c is the registration cost (sunk cost). Includes fees, bribes, administrative delays, etc.

- The formal entrepreneur's expected payoff is

$$\pi^F(\theta) = (1-\tau)(1-\gamma)\theta^{\frac{1}{1-\gamma}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\gamma}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\gamma}} - rc$$

Informal Entrepreneurship

- Low access to credit. Probability p of getting caught.
- Individuals can borrow only up to λz, ▸ endogeneizing
- The informal entrepreneur's expected payoff is

$$\pi^I(z,\theta) = \max_{0 \leq k \leq \lambda z, l \geq 0} (1-p)\left[\theta k^\alpha l^\beta - wl - rk\right]$$

where

- $\lambda \in [1, \infty)$ is the magnitude of the borrowing constraint.

Informal Entrepreneurship

- Informal Entrepreneur's payoff are given by:

$$\pi^I(z,\theta) = \begin{cases} (1-p)(1-\gamma)\theta^{\frac{1}{1-\gamma}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\gamma}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\gamma}}, & \theta \leq \theta_c(z) \\ (1-p)\left[(1-\beta)\theta^{\frac{1}{1-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\beta}} (\lambda z)^{\frac{\alpha}{1-\beta}} - \lambda r z\right] & \text{o/w.} \end{cases} \tag{2}$$

$\rightarrow$ unconstrained and constrained informal entrepreneurs.

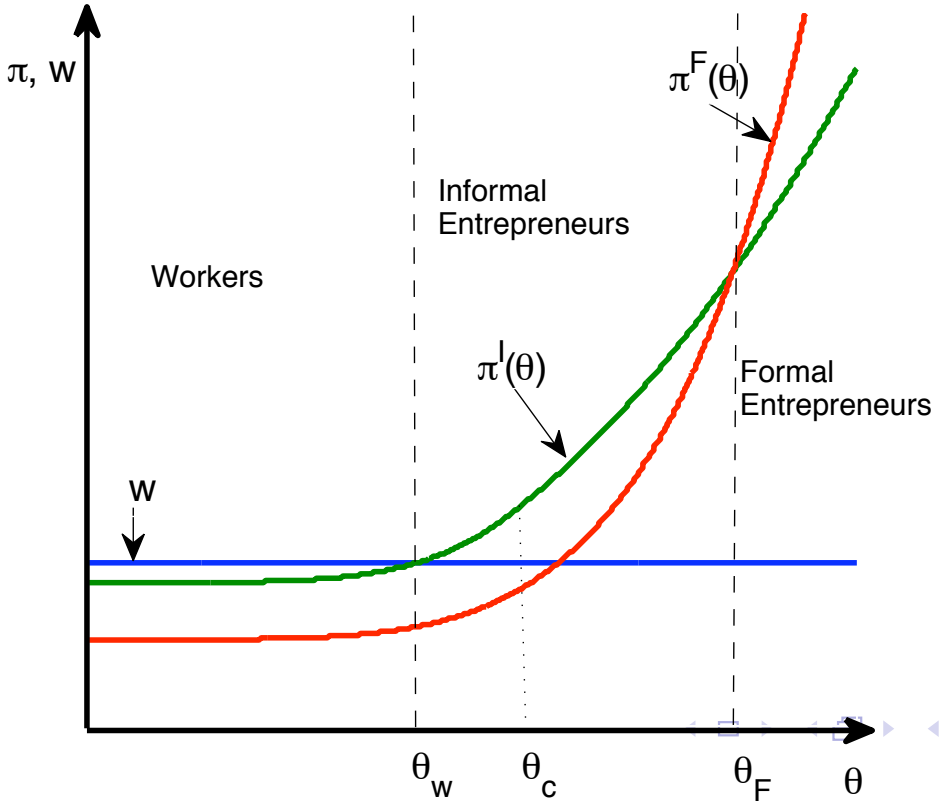
Model Implications - Occupational choice

- The expected earning of an agent with (z, θ) is given by

$$\pi(z,\theta) = \max\left\{w, \pi^{I}(z,\theta), \pi^{F}(z,\theta)\right\}$$

- The behaviour of payoff functions in given in Figure 1.

Figure: Characterization of Payoff Functions



Model Implications

Proposition

Consider an agent with characteristics θ and z. There exist three critical ability thresholds $\theta_W(z)$, $\theta_c(z)$ and $\theta_F(z)$, with $\theta_W(z), \theta_c(z) < \theta_F(z)$, such that

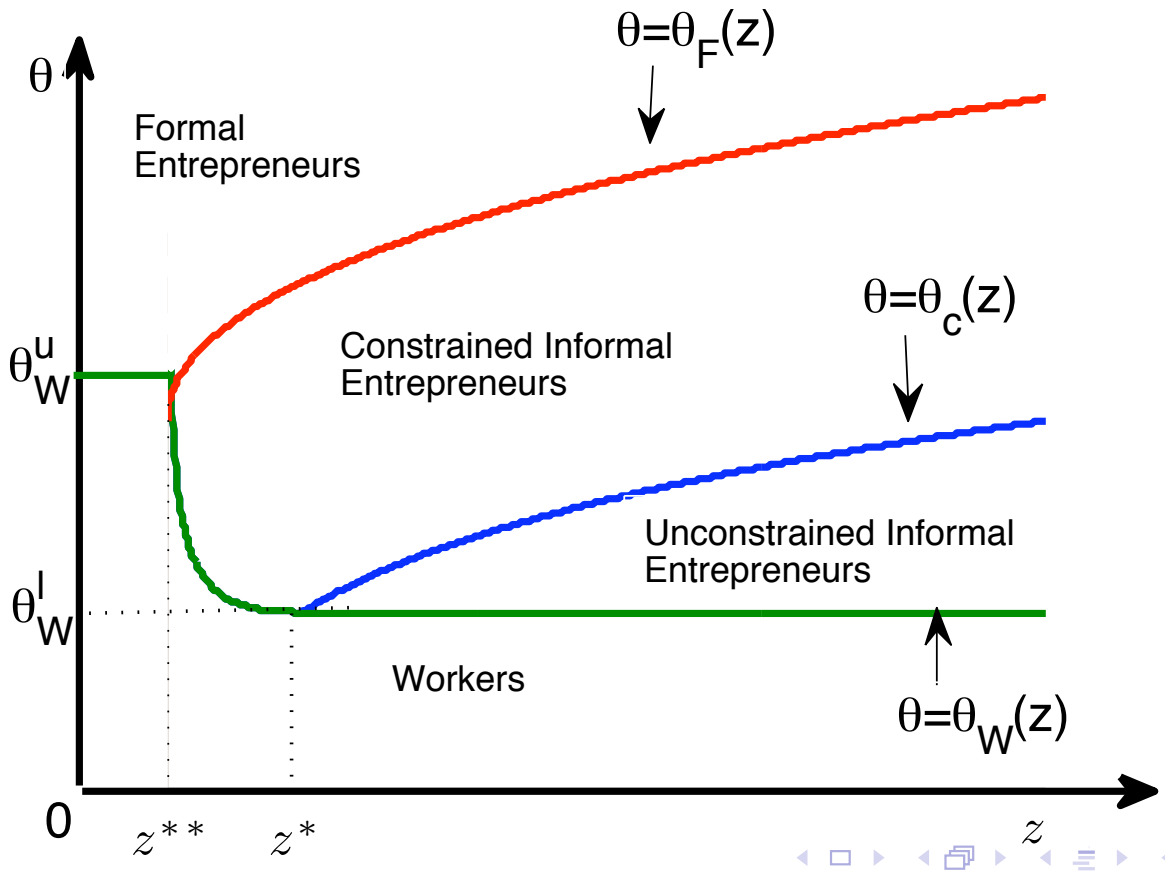
1. *If $\theta < \theta_W(z)$ the agent chooses to be a wageworker*
2. *If $\theta_W(z) \leq \theta < \theta_F(z)$ the agent is an informal entrepreneur*
3. *If $\theta \geq \theta_F(z)$ the agent is formal entrepreneur.*

The critical thresholds $\theta_W(z)$ and $\theta_F(z)$ are solutions to the equations $\pi^I(z, \theta) = w$ and $\pi^I(z, \theta) = \pi^F(z, \theta)$, respectively.

Model Implications

- The nature of the selection into occupations is depicted below.

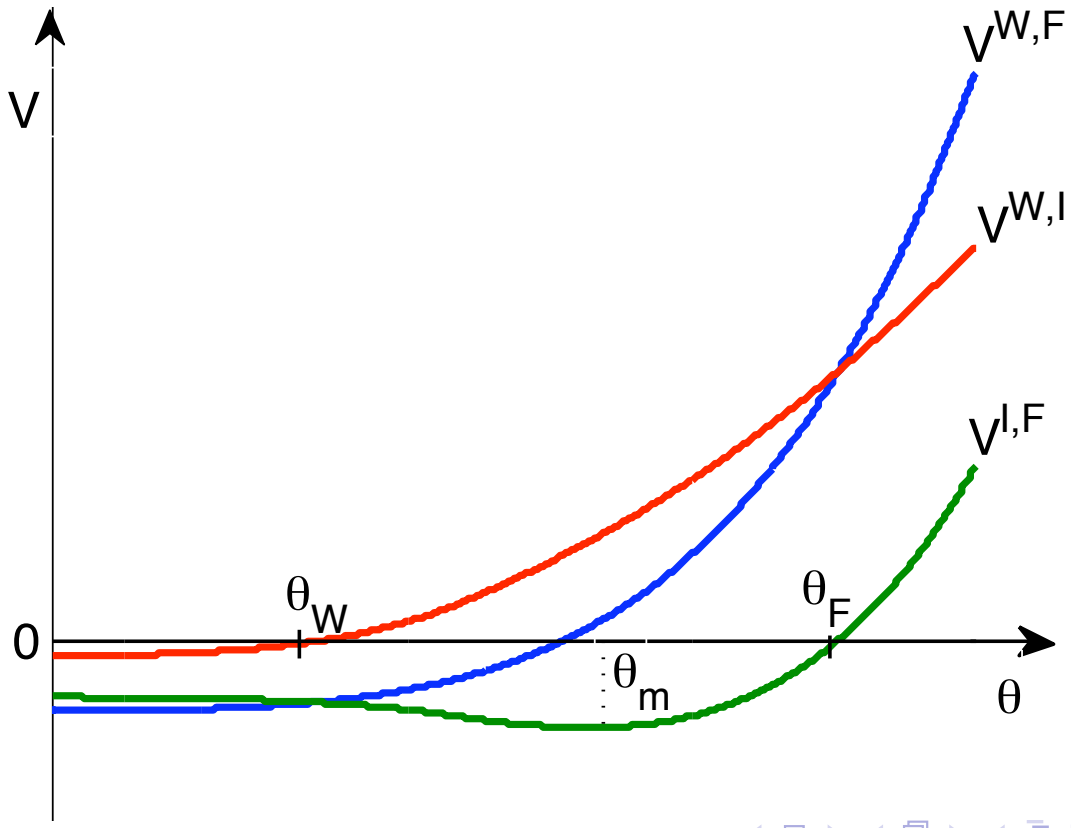
Figure: Nature of the Selection into Occupations



Model Implications

- The nature of the transition between occupations is depicted below.

Figure: Transition between Occupations



Data, Estimation and Testing

Data

- The 2005 National Survey of Employment and Informal Sector (SEIS).
- Administered by the National Institute of Statistics (NIS) with the partnership of The World Bank Group.
- Covered households in the 10 Cameroon regions distributed in both urban and rural areas.
- A cross-section of 6112 active households heads : 1.1% Formal entrepreneurs, 6.9% Informal entrepreneurs, 92.0% Workers.

Data - A Nationwide Survey

Descriptive statistics

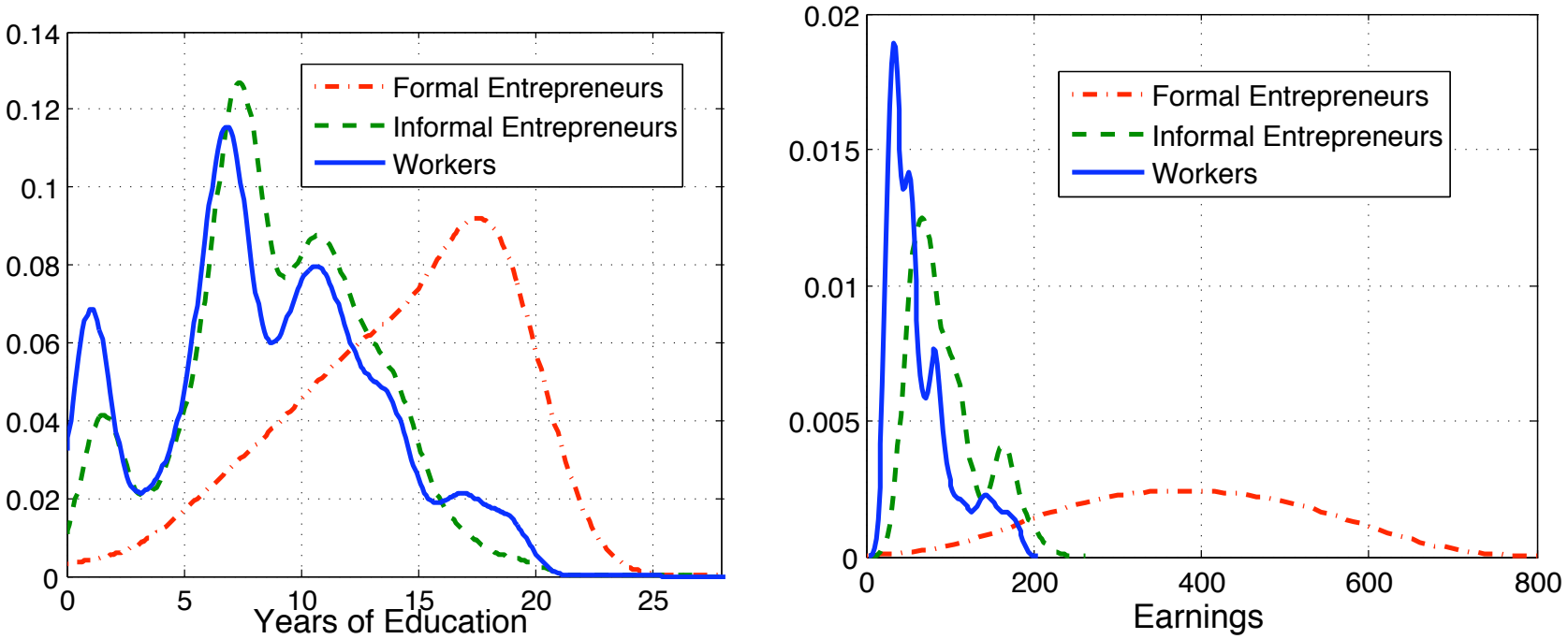
Table: Household Characteristics by Occupations

Characteristics	Occupations		
	Formal Entrepreneurs	Informal Entrepreneurs	Wageworkers /Subsisters
Num. of obs.	65	424	5 623
% of sample	1.1%	6.9%	92.0%
% of women	12.3%	37.3%	41.7%
Av. household size	6.0	6.1	5.9
Av. age of head	42.4	37.0	36.1
Years of schooling			
0-6 years	11.1%	41.3%	48.4%
7-12 years	31.5%	48.6%	36.2%
13+ years	57.4%	10.1%	15.4%
Parent Entrep.	41.5%	13.6%	3.5%
Av. monthly income*	353.3	75.3	77.2
Av. wealth*	21 792.9	4 569.7	3 007.4

*In thousands of local currency (CFA); 1,000 CFA ∼ $2 US (in 2005)

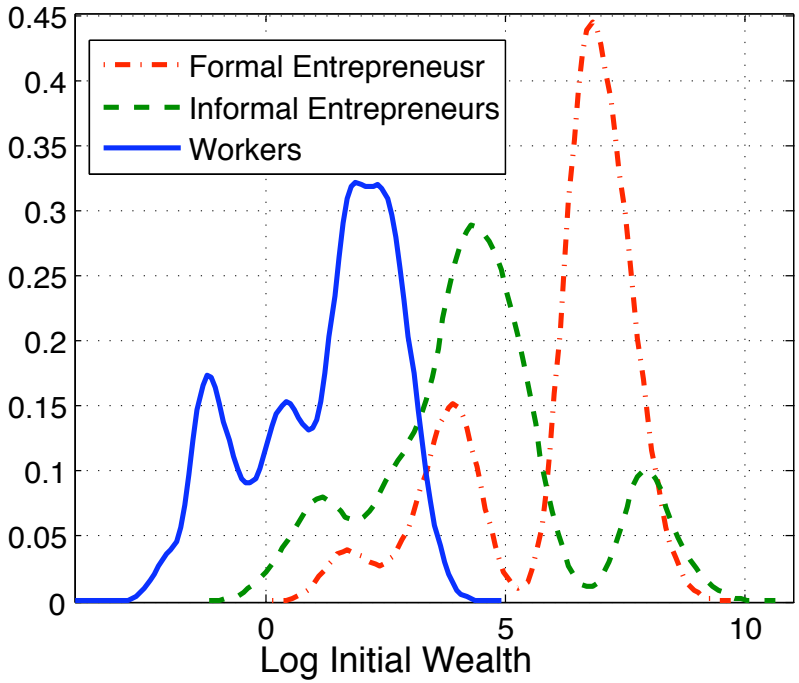
Descriptive statistics

Figure: Distribution of Education and Earnings by Occupation



Descriptive statistics

Figure: Distribution of Log Initial Wealth by Occupation



Structural Estimation - Distribution of skills

- Skills are unobservable. Assume (see Paulson et al 2006):

$$\ln \theta = \delta_0 + \delta_1 s + \delta_2 P + \epsilon \tag{3}$$

-s is the log of years of education,
- P is a dummy for parent entrepreneurial status.
- ϵ is assumed $\epsilon|_{z,S,P} \sim IID(0, \sigma^2)$.

- Assume loglinear specification for registration costs:

$$c(z) = c_0 \exp(-c_1 z)$$

- Structural parameters: $\psi = [w, \delta_0, \delta_1, \delta_2, \alpha, \beta, \sigma, \lambda, c_1]$

Structural Estimation - Model predicted moments

- Occupational statuses are given by indicators (W, I, F).
- The probability and income of Formal Entrepreneurship is

$$\Pr[F = 1|X] = \Pr[\theta \geq \theta_F(z)] = H_F(\psi, X), \quad E[y|F = 1] = E[\pi^F(z, \theta)]$$

- The probability and income of non-entrepreneurship is

$$\Pr[W = 1|X] = \Pr[\ln \theta \leq \ln \theta_W(z)] = H_W(\psi, X), \quad E[y|F = 1] = w$$

- The probability and income of informal entrepreneurship is

$$\Pr[I = 1|X] = 1 - H_W(\psi, X) - H_F(\psi, X), \quad E[y|W = 1] = E[\pi^I(z, \theta)]$$

Structural Estimation - Model moments and sample analogs

	Description	Model $M_l(X_i, \psi)$	Sample m_l
1.	Prob. of formal entrep	$\frac{1}{n}\sum_{i=1}^{n}\Pr[F_i = 1\|X_i]$	$\frac{1}{n}\sum_{i=1}^{n} F_i$
2.	Prob. of formal entrep, $z < z_m$*	$\frac{\sum_{i=1}^{n}\Pr[F_i = 1\|X_i]\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\mathbf{1}[z_i < z_m]}$	$\frac{\sum_{i=1}^{n} F_i\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\mathbf{1}[z_i < z_m]}$
3.	Prob. of informal entrep	$\frac{1}{n}\sum_{i=1}^{n}\Pr[I_i = 1\|X_i]$	$\frac{1}{n}\sum_{i=1}^{n} I_i$
4.	Prob. of informal entrep, $z < z_m$	$\frac{\sum_{i=1}^{n}\Pr[I_i = 1\|X_i]\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\mathbf{1}[z_i < z_m]}$	$\frac{\sum_{i=1}^{n} I_i\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\mathbf{1}[z_i < z_m]}$
5.	Income of formal entrep	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|F_i = 1, X_i]\Pr[F_i = 1\|X_i]}{\sum_{i=1}^{n}\Pr[F_i = 1\|X_i]}$	$\frac{\sum_{i=1}^{n} y_i F_i}{\sum_{i=1}^{n} F_i}$
6.	Income of formal entrep, $z < z_m$	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|F_i = 1]\Pr[F_i = 1\|X_i]\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\Pr[F_i = 1\|X_i]\mathbf{1}[z_i < z_m]}$	$\frac{\sum_{i=1}^{n} y_i F_i\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n} F_i\mathbf{1}[z_i < z_m]}$
7.	Income of informal entrep	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|I_i = 1, X_i]\Pr[I_i = 1\|X_i]}{\sum_{i=1}^{n}\Pr[I_i = 1\|X_i]}$	$\frac{\sum_{i=1}^{n} y_i I_i}{\sum_{i=1}^{n} I_i}$
8.	Income of informal entrep, $z < z_m$	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|I_i = 1]\Pr[I_i = 1\|X_i]\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n}\Pr[I_i = 1\|X_i]\mathbf{1}[z_i < z_m]}$	$\frac{\sum_{i=1}^{n} y_i I_i\mathbf{1}[z_i < z_m]}{\sum_{i=1}^{n} I_i\mathbf{1}[z_i < z_m]}$
9.	Income of non-entrep	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|W_i = 1, X_i]\Pr[W_i = 1\|X_i]}{\sum_{i=1}^{n}\Pr[W_i = 1\|X_i]}$	$\frac{\sum_{i=1}^{n} y_i W_i}{\sum_{i=1}^{n} W_i}$
10.	Income of formal entrep, $P = 0$	$\frac{\sum_{i=1}^{n}\mathbf{E}[y_i\|F_i = 1, X_i]\Pr[F_i = 1\|X_i](1 - P_i)}{\sum_{i=1}^{n}\Pr[F_i = 1\|X_i](1 - P_i)}$	$\frac{\sum_{i=1}^{n} y_i F_i(1 - P_i)}{\sum_{i=1}^{n} F_i(1 - P_i)}$

Structural Estimation-Institutional parameters

Table: Characteristics of the Institutional Environment

Indicator	Starting a Business	Indicator	Paying Taxes
Number of procedures	12	Number of payments/year	44
Number of days	37	Number of days	90
Registration fees (% GNI/capita)	182.5	Total tax rate (% profit)	48.9
Min. capital (% GNI/capita)	232.0		

GNI per capita = \$640 ≈ CFA 320,000 *Source: Doing Business in 2005*

- Tax rate on firm profits:
  $\tau = 49\%$
- Entry cost :
  $c_0 = \text{Reg. fees} + \text{Number of days} \times \text{Mean daily earnings} = \$1400$
- Enforcement:
  $$p = \frac{\#\text{ tax inspections}}{\#\text{ firms}} \times \text{Degree of Integrity of tax inspectors} = 0.78\%$$

Structural Estimation-GMM estimation results

Table: Structural GMM Estimates of the Model

Parameter	Name	Estimate	Std. Error
Wage income	w	70.303	117.1
Log Ability Parameters			
Constant	δ_0	-2.8372	0.0118
Education	δ_1	0.4013	0.0210
Parents	δ_2	0.0241	0.0079
Std. Deviation	σ	2.4610	0.0380
Technology and Constraints			
Capital share	α	0.2201	0.059
Labor share	β	0.4502	0.092
Borrowing constraint	λ	11.417	3.410
Cost parameter	c_1	0.0007	0.0004
J-statistic		3.12	
Number of Obs.		6112	

Standard errors are calculated using bootstrap samples

Reduced-Form Results

Table: Probit Estimates of Choice Between Occupations

Variable	Informal vs. Formal		Worker vs. Formal		Worker vs. Informal	
	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	-3.853***	-3.129***	-3.555***	-3.571***	-1.529***	1.789***
	(0.483)	(0.564)	(0.249)	(0.354)	(0.078)	(0.094)
Education	0.149***	-0.231*	0.046***	0.050	-0.006	0.087
	(0.029)	(0.016)	(0.015)	(0.056)	(0.005)	(0.079)
Education^2/100	-	0.863**	-	-0.017	-	-0.616
	-	(0.426)		(0.256)	-	(0.412)
Parent	1.770***	1.765***	0.435***	0.434***	0.713*	0.693*
	(0.271)	(0.269)	(0.128)	(0.128)	(0.411)	(0.411)
Wealth	0.302***	0.288***	0.310***	0.002***	0.090***	0.113***
	(0.060)	(0.061)	(0.033)	(0.000)	(0.026)	(0.027)
Wealth^2	-	0.288***	-	0.003***	-	0.113***
	-	(0.061)	-	(0.000)	-	(0.027)
Experience	0.040***	0.039***	-0.003	-0.002	0.000	0.002
	(0.015)	(0.015)	(0.008)	(0.007)	(0.001)	(0.003)
Female	-0.256	-0.213	-0.308*	-0.308*	-0.153***	-0.169***
	(0.275)	(0.273)	(0.169)	(0.169)	(0.053)	(0.053)
Number of Obs.	489	489	5688	5688	6047	6047
AIC	194.43	192.54	506.37	508.37	3005.3	2974.5

Counterfactual Policy Analysis

Policy Simulation

Quantify the impact of various policies on formality, entrepreneurship and aggregate earning.

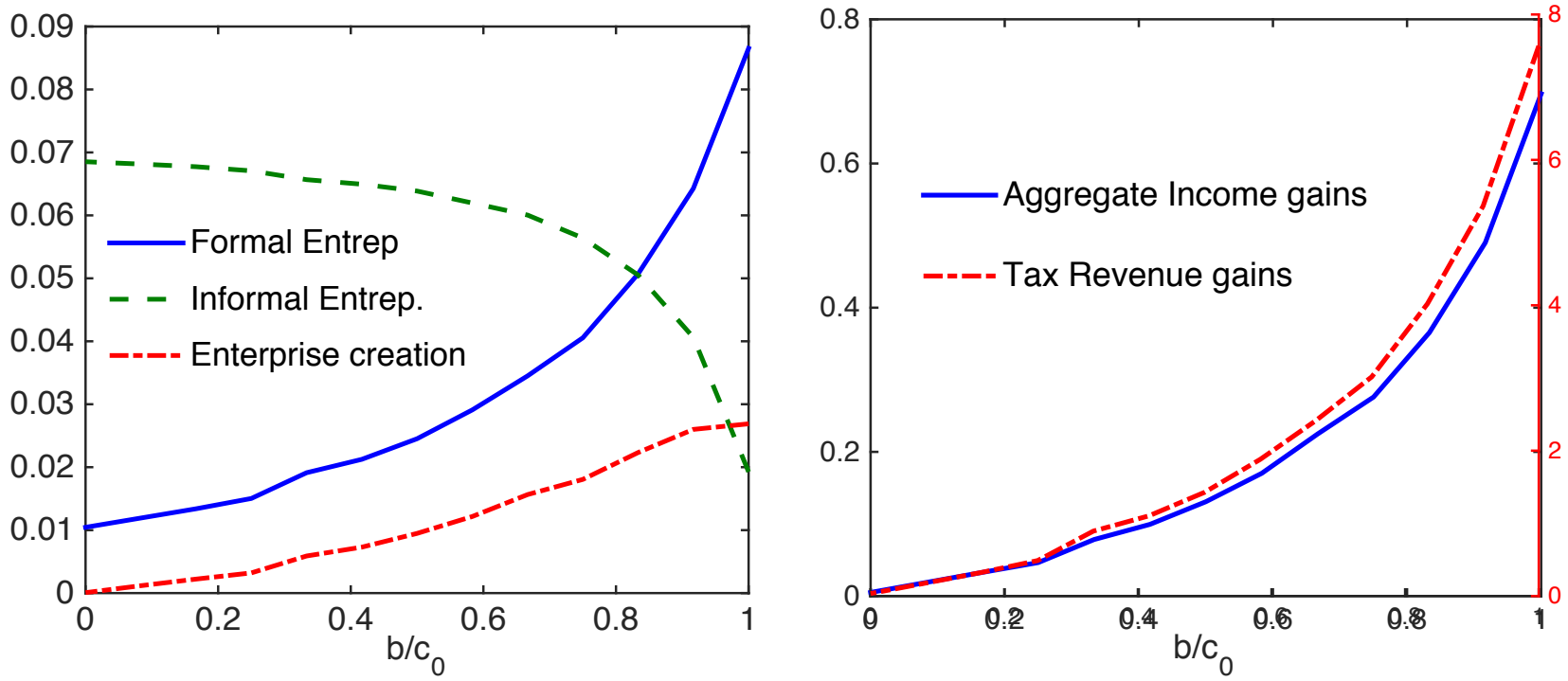
- Impact of Registration Reforms.
  (e.g. Bruhn 2011, Kaplan et al. 2011)
- Impact of Tax Reforms.
  (e.g. Monteiro and Assunção 2012, Fajnzylber et al. 2011).
- Impact of Law Enforcement
  (e.g. Almeda & Carneiro 2012)

Simulations - Impact of Registration Reforms

Assume b decrements in entry costs to the formal sector. Then

$$c' = c - b, \qquad 0 \leq b < c,$$

Figure: Impact of a Registration Reform

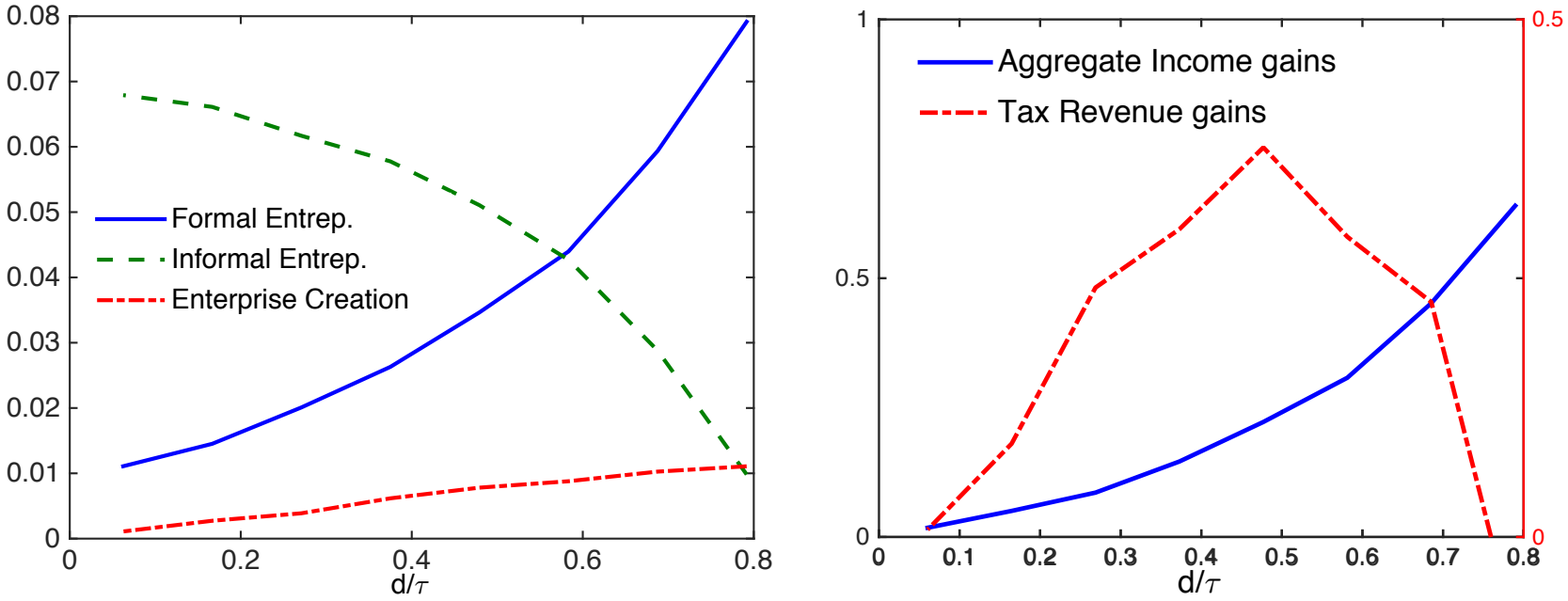


Simulations - Impact of Tax Reforms

Assume reductions in tax rates of magnitude d, such that

$$\tau' = \tau - d, \qquad 0 \leq d < \tau.$$

Figure: Impact of a Tax Reduction Policy

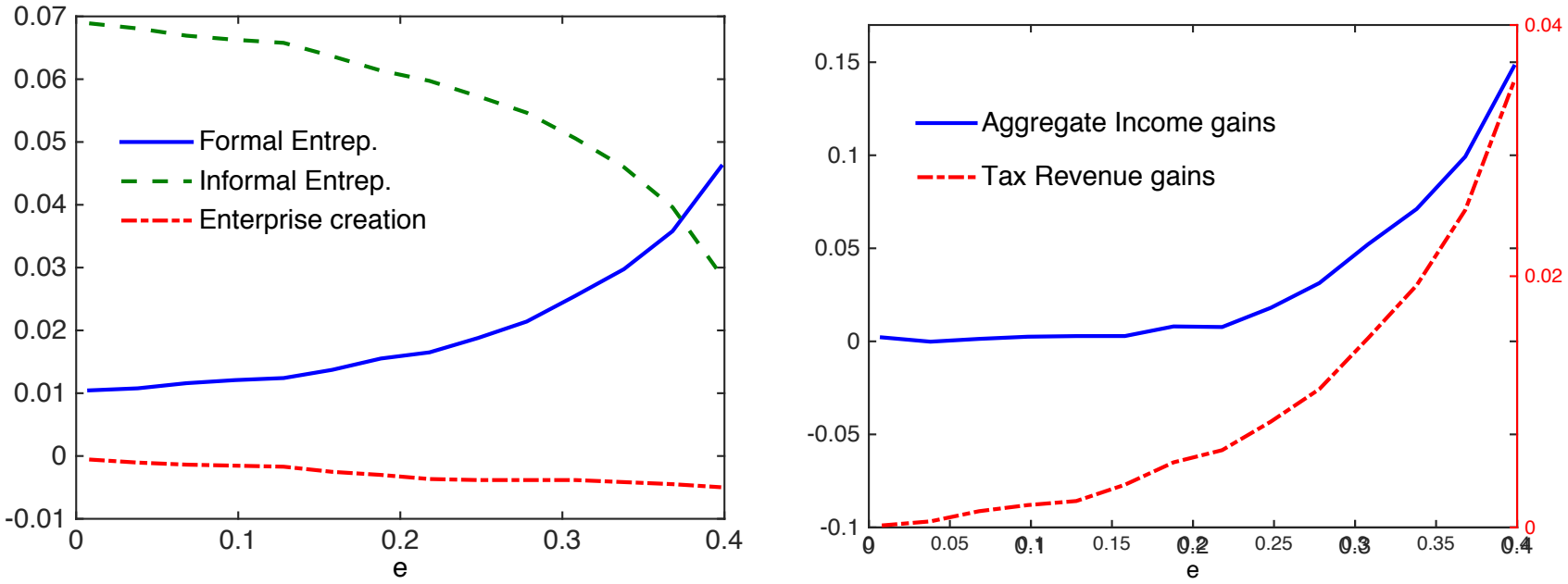


Simulations - Impact of Law Enforcement

The effect of increased law enforcement is quantified as

$$p' = p + e, \qquad 0 \leq e < 1 - p$$

Figure: Impact of Law Enforcement



Conclusion

- Estimated a structural model of occupational choice where heterogenous agents choose between formal entrepreneurship and informal entrepreneurship and non-entrepreneurial work.
- The main results are:

  → Entrepreneurs with low productivity choose informality whereas the most productive ones choose the formal sector.

  → The decision to formalize is however U-shaped in skills.

  → High registration costs act as an implicit exclusion mechanism to enterprises with low productivity.

Conclusion

- Counterfactual simulations results with Cameroon data show that:

  → Reduced entry costs can induce more formal firms and more tax revenues net of the foregone costs.

  →There exists an optimal tax rate, set at half of the current rate, that would induce twice as much formal enterprises and produce three-halves of the current tax revenues.

  → In contrast, a law enforcement policy whose objective is to increase the probability of detection would have an overall perverse effect in terms of firms and job losses.

THANK YOU!!

A Structural Model of Informality with Constrained Entrepreneurship

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Endogeneizing credit constraints

- Expected payoff for defaulters is $f(k,l) - \phi(1+\nu)z$, where
  - ϕ is the probability of being caught,
  - ν is the fraction of wealth forfeited.
- The incentive compatibility constraint is then $f(k,l) - rk \geq f(k,l) - \phi(1+\nu)z$.
- So lenders only rent to households whose wealth satisfies, $z \geq \frac{r}{(1+\nu)\phi}k$.
- Equivalently, this means that the capital available to borrowers satisfies $k \leq \frac{\phi(1+\nu)}{r}z$. Back