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.
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

1. Model Description
2. Structural Estimation and Testing
3. Counterfactual Simulations
4. Conclusion
Model Description
Framework


- Agents differ with their initial wealth endowment $z$, and their entrepreneurial skills $\theta$ distributed with CDF $G(\theta)$.

- Wagemakers receive a fixed income $w > 0$.

- Entrepreneurs produce goods according to a Cobb-Douglas production technology given by

$$y = \theta k^\alpha l^\beta \epsilon$$

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

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Formal Entrepreneurship

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

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

where:

- \( \tau \) 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 $\lambda z$.
- 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:

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

(2)

→ unconstrained and constrained informal entrepreneurs.
Model Implications - Occupational choice

- The expected earning of an agent with \((z, \theta)\) is given by
  \[
  \pi(z, \theta) = \max \{ w, \pi^I(z, \theta), \pi^F(z, \theta) \}
  \]
- The behaviour of payoff functions is given in Figure 1.

Figure: Characterization of Payoff Functions
Proposition

Consider an agent with characteristics $\theta$ 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.
The nature of the selection into occupations is depicted below.

Figure: Nature of the Selection into Occupations
The nature of the transition between occupations is depicted below.

**Figure:** Transition between Occupations
Data, Estimation and Testing
Data


- 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

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

*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

![Graph showing the distribution of log initial wealth by occupation](image-url)
**Structural Estimation – Distribution of skills**

- Skills are unobservable. Assume (see Paulson et al 2006):
  \[
  \ln \theta = \delta_0 + \delta_1 s + \delta_2 P + \epsilon
  \]  
  \(s\) is the log of years of education,
  - \(P\) is a dummy for parent entrepreneurial status.
  - \(\epsilon\) 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

<table>
<thead>
<tr>
<th>Description</th>
<th>Model $M_i(X_i, \psi)$</th>
<th>Sample $m_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prob. of formal entrep</td>
<td>$\frac{1}{n} \sum_{i=1}^{n} \Pr[F_i = 1</td>
<td>X_i]$</td>
</tr>
<tr>
<td>2. Prob. of formal entrep, $z &lt; z_m^*$</td>
<td>$\frac{\sum_{i=1}^{n} \Pr[F_i = 1</td>
<td>X_i]1[z_i &lt; z_m]}{\sum_{i=1}^{n} 1[z_i &lt; z_m]}$</td>
</tr>
<tr>
<td>3. Prob. of informal entrep</td>
<td>$\frac{1}{n} \sum_{i=1}^{n} \Pr[I_i = 1</td>
<td>X_i]$</td>
</tr>
<tr>
<td>4. Prob. of informal entrep, $z &lt; z_m$</td>
<td>$\frac{\sum_{i=1}^{n} \Pr[I_i = 1</td>
<td>X_i]1[z_i &lt; z_m]}{\sum_{i=1}^{n} 1[z_i &lt; z_m]}$</td>
</tr>
<tr>
<td>5. Income of formal entrep</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>F_i = 1, X_i] \Pr[F_i = 1</td>
</tr>
<tr>
<td>6. Income of formal entrep, $z &lt; z_m$</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>F_i = 1] \Pr[F_i = 1</td>
</tr>
<tr>
<td>7. Income of informal entrep</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>I_i = 1, X_i] \Pr[I_i = 1</td>
</tr>
<tr>
<td>8. Income of informal entrep, $z &lt; z_m$</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>I_i = 1] \Pr[I_i = 1</td>
</tr>
<tr>
<td>9. Income of non-entrep</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>W_i = 1, X_i] \Pr[W_i = 1</td>
</tr>
<tr>
<td>10. Income of formal entrep, $P = 0$</td>
<td>$\frac{\sum_{i=1}^{n} \mathbb{E}[y_i</td>
<td>F_i = 1, X_i] \Pr[F_i = 1</td>
</tr>
</tbody>
</table>
### Structural Estimation—Institutional Parameters

**Table: Characteristics of the Institutional Environment**

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

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:**
  \[ p = \frac{\# \text{tax inspections}}{\# \text{firms}} \times \text{Degree of Integrity of tax inspectors} = 0.78\% \]
### Table: Structural GMM Estimates of the Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Name</th>
<th>Estimate</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage income</td>
<td>$w$</td>
<td>70.303</td>
<td>117.1</td>
</tr>
<tr>
<td>Log Ability Parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>$\delta_0$</td>
<td>-2.8372</td>
<td>0.0118</td>
</tr>
<tr>
<td>Education</td>
<td>$\delta_1$</td>
<td>0.4013</td>
<td>0.0210</td>
</tr>
<tr>
<td>Parents</td>
<td>$\delta_2$</td>
<td>0.0241</td>
<td>0.0079</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>$\sigma$</td>
<td>2.4610</td>
<td>0.0380</td>
</tr>
<tr>
<td>Technology and Constraints</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital share</td>
<td>$\alpha$</td>
<td>0.2201</td>
<td>0.059</td>
</tr>
<tr>
<td>Labor share</td>
<td>$\beta$</td>
<td>0.4502</td>
<td>0.092</td>
</tr>
<tr>
<td>Borrowing constraint</td>
<td>$\lambda$</td>
<td>11.417</td>
<td>3.410</td>
</tr>
<tr>
<td>Cost parameter</td>
<td>$c_1$</td>
<td>0.0007</td>
<td>0.0004</td>
</tr>
<tr>
<td>$J$-statistic</td>
<td></td>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>Number of Obs.</td>
<td></td>
<td>6112</td>
<td></td>
</tr>
</tbody>
</table>

Standard errors are calculated using bootstrap samples
### Reduced-Form Results

**Table**: Probit Estimates of Choice Between Occupations

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

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

Figure: Impact of a Registration Reform
Assume reductions in tax rates of magnitude $d$, such that

$$\tau' = \tau - d, \quad 0 \leq d < \tau.$$
The effect of increased law enforcement is quantified as

\[ p' = p + e, \quad 0 \leq e < 1 - p \]

**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.
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
  - \( \phi \) is the probability of being caught,
  - \( \nu \) 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
  \( k \leq \frac{\phi(1 + \nu)}{r}z \).