The Repression of Informal Labor: Aggregate and Transitional Effects

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The Informal Economy

- What is informality?
  - Unregistered businesses and labor contracts
  - Not criminal/illicit activity!

- Widespread in emerging markets (up to 90% of labor force)

- Significant economic impacts
  - **Workers**: more job opportunities, reduced participation on social security
  - **Firms**: non-compliance to taxation, labor laws, minimum wage
  - **Government**: lower tax proceeds

- Other social impacts (*e.g.* compromised rule of law)
The Questions

- A common proposition:
  
  *Governments should act to reduce the size of the informal sector*

  - International Labor Organization, Rec. 204, 2015
  - *World Bank Report 2013: Jobs*
  - Arguments: protection of workers’ rights, productivity gains

- Our Questions
  - What would be the economic effects of the repression of informality?
  - Who would be the potential winners and losers?
  - Is public social security capable of protecting potentially harmed workers?
Methods + Preview of Results

- Methodology
  1. Empirical patterns of income and informality (Brazilian HH-level data)
  2. Search model to replicate patterns
  3. Feed income process into heterogeneous-agent model
  4. Simulate the economy’s response to the repression of informal activity

- Main results
  - Importance of transition effects (unemployment and interest)
  - Households better off in the long run
  - Low wealth and unemployed households lose in the short-run
  - Importance of fiscal adjustment
Literature

- La Porta and Shleifer [2008], Bosch and Esteban-Pretel [2012], La Porta and Shleifer [2014], Granda and Hamann [2015], Meghir, Narita, and Robin [2015], Bosch and Esteban-Pretel [2015], Ulyssea [2018], Rocha, Ulyssea, and Rachter [2018], Albertini and Terriaud [2019], Dix-Carneiro, Goldberg, Meghir, and Ulyssea [2019], Leyva and Urrutia [2020]
  - The "parasite view"

- Contributions
  1. General equilibrium and transition effects
  2. Risk aversion and the role of worker heterogeneity
  3. Secondary: low income differentials and modelling
Data: Informality and Income

- *PNAD* - National Household Sample Survey
- Quarterly survey - 2012Q1 - 2020Q1
- Observables include: employment status, income, education, ...
- Informal worker: No employer-signed booklet
- Exclude self-employed, public employees
- Groups of workers (control labor market, human capital)

<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Avg Inc ($)</th>
<th>Share (%)</th>
<th>Education</th>
<th>Avg Inc ($)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commerce &amp; services</td>
<td>339</td>
<td>23.09</td>
<td>Elementary</td>
<td>304</td>
<td>40.38</td>
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<tr>
<td>Elementary occupations</td>
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<td>17.59</td>
<td>High school</td>
<td>392</td>
<td>41.11</td>
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<tr>
<td>Construction &amp; mechanical</td>
<td>411</td>
<td>13.71</td>
<td>Superior</td>
<td>782</td>
<td>18.51</td>
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<td>Scientists &amp; intellectuals</td>
<td>790</td>
<td>10.41</td>
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<td></td>
<td></td>
</tr>
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</table>
Data: Informality and Income

Informality decreasing in average income. 

Figure: Informality Share vs Income
Data: Income Differential

- Is there an income differential between sectors? Only among low-income workers
  - Income differential = formal avg income / informal avg income
  - Two subsamples: above and below $300 (min. wage \approx $250 in 2018)

Figure: Income Differential
Data: Transitions to Employment/Unemployment

- Informal workers transition more often to unemployment
- Transition from unemployment: ambiguous

Figure: Transitions Rates in the Data
Summary of the Data

1. Informality decreases in average income
2. High income differential among low income workers
3. Low income differential among high income workers
4. Informal workers transition more often to unemployment
5. Evidence on transitions to employment less clear

To the model!

In-Job Income Risk
Model
General Environment: An Aiyagari Model

- Heterogeneous households, heterogeneous firms, government
- Final goods, capital, one-period bonds
- Household problem:
  \[ a = \text{net wealth} \]
  \[ s = \text{exogenous state } \sim \text{Markov Chain } g(s'|s) \]

\[
J_t(a, s) = \max_{c, a'} \frac{c^{1-\gamma}}{1-\gamma} + \beta \sum_{s'} J_{t+1}(a', s')g_{t+1}(s'|s)
\]

s.t. \[ c + q_t a' \leq a + y_t(s) \]
\[ a' \geq 0 \]

- Search block determines income \( y_t(s) \) and transition \( g_t(s'|s) \)
- In equilibrium, household savings finance capital and public debt
General Environment: Search Block

- One worker per household
  - Skill type $h \sim H$ (constant over time)
- One firm = one vacancy
  - Productivity $z \sim G_z$ (constant over time)
  - Production function $A k^\alpha (zh)^{1-\alpha}$
- Standard search-and-match environment
  - Directed search to workers of given skill type $h$
  - Free entry, Nash bargaining, on-the-job search
- Government activity
  - Minimum wage $\omega$
  - Flat taxes: sales ($\tau_y$), payroll ($\tau_w$) and income ($\tau_{hh,t}$)
  - Unconditional transfer $\varsigma$ (Bolsa Familia program)
  - Unemployment insurance $\upsilon$
Formality Choice

- After drawing state, firm chooses a formal or informal vacancy
- Non-negotiable, unchangeable
- Upsides of informality:
  - No taxes
  - No minimum wage
- Downsides of informality:
  - No unemployment insurance
  - Higher separation rate $\lambda_i > \lambda_f$
  - Lower productivity
The Single State Model

- Generates large informality among low-income workers
- Can’t generate income differential pattern
Hiding Ability: A New Layer of Heterogeneity

- Firms have different hiding ability \( e \in [0, 1] \)
  - Differences in hiding costs and reputational costs
- Lower efficiency units of labor \( ezh < zh \)
  - Keep numerical convenience: firms effectively draw two levels of \( z \)
Firm Value Functions

Firm Value in the Baseline Calibration

- Formal
- Informal

Firm Value (US$)

Worker Value

Firm Value
Income Differentials: Data vs Model

- Income differential = formal avg income / informal avg income

(a) Inc. Differential (< $300)

(b) Inc. Differential (> $300)
Equilibrium

- Endowment process $y_t(s), g_{t+1}(s'|s)$ consistent with search block
- Firms purchase capital and value workers according to $q_t = 1/(1 + r_{t+1})$
- Households solve consumption savings problem
- Capital market clears:
  \[ K_{t+1} = q_t \left[ \int a'_t(a,s)dx_t - D - Q_{t+1} \right] \]
  - Market clearing in goods market
  \[ Y_t = C_t + C_{gov,t} + Inv_t + VC_t \]
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Interpretation</th>
<th>Source/Target</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preferences</strong></td>
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<tr>
<td>$\beta$</td>
<td>Intertemporal discounting</td>
<td>$r = 15%$ annual</td>
<td>0.95458</td>
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<tr>
<td>$\gamma$</td>
<td>Relative risk aversion</td>
<td>Literature standard</td>
<td>3</td>
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<td><strong>Technology</strong></td>
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<tr>
<td>$A$</td>
<td>Model scale</td>
<td>$P = 1$</td>
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<td>$\alpha$</td>
<td>Capital income share</td>
<td>Literature standard</td>
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<td>$\delta$</td>
<td>Rate of depreciation</td>
<td>$\delta K/Y = 0.1$</td>
<td>0.0155</td>
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<td><strong>Public Policy</strong></td>
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<tr>
<td>$\tau_y$</td>
<td>Sales tax rate</td>
<td>Tax law</td>
<td>0.272</td>
</tr>
<tr>
<td>$\tau_w$</td>
<td>Payroll tax rate</td>
<td>Tax and labor law</td>
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<tr>
<td>$\tau_{hh}$</td>
<td>Household income tax rate</td>
<td>Tax law</td>
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<td>$\omega$</td>
<td>Minimum wage</td>
<td>Labor law</td>
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<td>$\upsilon$</td>
<td>Unemployment insurance</td>
<td>Social security</td>
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<tr>
<td>$\varsigma$</td>
<td>Unconditional transfer</td>
<td>Bolsa Família program</td>
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</tr>
<tr>
<td>$D$</td>
<td>Public Debt</td>
<td>Debt-to-GDP = 42%</td>
<td>0.6583</td>
</tr>
</tbody>
</table>
### Symbol Interpretation | Source/Target | Value
---|---|---
### Labor Market
- $\lambda_f$ Separation rate (formal) | Transition unemployment | 0.04
- $\lambda_i$ Separation rate (informal) | Transition unemployment | 0.098
- $\kappa$ Vacancy cost | Market tightness = 1 | 0.064
- $\mu$ Matching function constant | Unemployment rate = 16% | 0.255
- $1 - \varepsilon$ Job-finding rate elasticity | Literature average | 0.375
- $\eta$ Worker’s “bargaining power” | Hosios condition | 0.625
- $\zeta_0$ Leisure | Income differential (low inc.) | 0.03
- $\zeta_1$ Leisure | Income differential (low inc.) | 0.16

### Distributions
- $\xi$ Skill distribution parameter | Formal income histogram | 0.61
- $\sigma_z$ Productivity dispersion | Income variance and differential | 100%
- $\phi$ Probability of $e = 0$ | Informality share | 0.75
- $\nu$ Hiding ability distribution | Avg. hiding cost of 10% | 9
Informality Share and Targets

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data/Target</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment rate</td>
<td>0.16</td>
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<tr>
<td>Market tightness</td>
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<td>1.001</td>
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<tr>
<td>Formal to unempl.</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Informal to unempl.</td>
<td>0.075</td>
<td>0.075</td>
</tr>
</tbody>
</table>

Table: Performance

Income Distribution

Informality Share
Simulation
The Simulation

- Effects of repression of informal activity?
- Distribution of hiding abilities $G_{e,t}$ captures repression of informality
- $e = (1 - \text{Dummy}_{\text{Surveillance},t}) \times \text{Beta}[\nu, 1]$
  \[ \Pr(\text{Dummy}_{\text{Surveillance}} = 1) = \phi_t \]
- $\phi = 0.75$ in the baseline equilibrium
- Repression of informality: $\phi_t$ increases to 1 linearly over next five years
  - 400 period (100 years) transition
- No cost to the government
- Fiscal adjustment via income tax $\tau_{hh,t}$:
  \[ C_{gov} + UB_t + TR_t = T_{y,t} + T_{w,t} + T_{hh,t} + (q_t - 1)D \]
Simulation results

- More productive firms in the market: higher average income and capital demand
- Increase in interest rates in the short run

(a) Efficiency units of labor

(b) Average Income

(c) Aggregate Savings

(d) Interest rate
Simulation results

- Lower job finding rates (short and long run); greater change for low income
- Higher average income

(a) Job-finding rate

(b) Unemployment rate

(c) Long run: Change in job-finding rate

(d) Long run: Change in (log) avg. income
Evaluating Welfare

- Consumption equivalent: (Lucas [1987])

\[
E \sum \beta^t u((1 + m)c_t^{\text{baseline}}) = E \sum \beta^t u(c_t^{\text{no informality}})
\]

- \( m > 0 \): household better off with fight against informality

- In practice: \( m_t(a, s) = \left[ \frac{V_t(a, s)}{V_1(a, s)} \right]^{\frac{1}{1-\gamma}} - 1 \)

- Fix \( a \), aggregate across households of set \( s \in \Omega \)

\[
\int_{s \in \Omega} m_t(a, s) dx_t
\]
Consumption Equivalent: Long Run

- Households benefit in the long run...
- ... but will they support policy adoption today?

![Graph showing consumption equivalents for different skill levels and net wealth categories.](image)

**Figure:** Consumption Equivalents - Long Run
Consumption Equivalent: Short Run

- Huge importance of net wealth position (buffer against unemployment shocks)
- Low wealth, unemployed net losers

Figure: Consumption Equivalents - Short Run
Second Simulation: No Tax Adjustment

- Large income tax adjustment ($\tau_{hh} = -19\%$)
  - Average transfer of $77$ per month
- What if the government doesn't adjust income taxation?
  - Potentially large surveillance costs
  - Additional costs of running social security
  - Political costs of reducing tax rates
  - Other uses for additional revenue
- New simulation: adjustment via public consumption $C_{gov,t}$:

$$C_{gov,t} + UB_t + TR_t = T_y,t + T_w,t + T_{hh},t + (q_t - 1)D$$
No Tax Change: Simulation results

- Long-lasting effects on interest and unemployment
- Job-finding rates decline more, income increases less

(a) Interest rate

(b) Unemployment rate

(c) Long run: Change in job-finding rate

(d) Long run: Change in (log) avg. income
No Tax Change: Consumption Equivalent - Long Run

- No-informality equilibrium hurts low-wealth households in the long run!

**Figure:** Consumption Equivalents - Long Run

(a) All Households

(b) Unemployed
Conclusion

- Heterogeneous-agent model with informality
  - Income differential and firms’ heterogeneous hiding ability
- Repression of informality
  - General equilibrium effects (mismatch of capital supply and demand)
  - Large transitional effects (increases in interest and unemployment)
- Welfare: in general households better off ("parasite view")
- Importance of fiscal adjustment
  - Short-run negative effects persist in the long run!
  - Short and long run losers (unemployed, low wealth)
- Rationale for timid public responses to existence of informality
Informality among developing countries

Figure: ILO: Informality share in 2015

ILO includes subsistence work and self-employment in informal enterprises as informal labor.
Deflate CPI (2018 Q3)

Convert to Dollars: $1 = \text{BR}4$

Limit labor income to 97%

Individuals with age $\in [18, 68]$
Informality Share by Occupational Group

Relatively stable shares over time for each group

Figure: x-axis: time series quarter; y-axis: informality share
In-Job Income Risk

- Empirical density of income growth $\Delta y_t = y_t / y_{t-1}$
- Formals and informals face similar in-job labor income risk

**Figure**: Density of income growth
Search Frictions - Details

- Matching function $M(U, F) = \mu U^\epsilon F^{1-\epsilon}$
- Vacancy costs $\kappa h$
- On-the-job search (no efficiency loss)
- Free entry of new firms
- Leisure value $\zeta_0 + \zeta_1 h$ (mostly for quantitative reasons)
Wage Determination

- Wages re-negotiated every period
- Employer and employee Nash-bargain over wage

\[ \hat{w}_t^f(z) = \arg\max \left( W_t^f(z) - W_t^n \right)^{\frac{\eta}{1-\tau_{hh,t}}} V_t^f(z)^{\frac{1-\eta}{1+\tau_{hh}}} \text{ s.t. } W_t^f(z) \geq W_t^n \]

\[ \hat{w}_t^i(ez) = \arg\max \left( W_t^i(ez) - W_t^n \right)^{\eta} V_t^i(ez)^{1-\eta} \text{ s.t. } W_t^i(ez) \geq W_t^n \]

- Formal contracts respect minimum wage \( \omega \):

\[ w_t^f(z) = \max(\omega, \hat{w}_t^f(z)) \]
\[ w_t^i(ez) = \hat{w}_t^i(ez) \]

Worker and firm potentially disagree on preferred type of contract!
**Capital Choice**

- Depreciation rate $\delta$
- Given available efficiency units of labor $\ell$, capital choice solves
  \[
  \max_k A k^{\alpha\ell^{1-\alpha}} - (r_t + \delta)k
  \]
- Same capital-labor ratio $\frac{k}{\ell}(r_t)$ for all firms
- Revenue net of capital costs:
  \[
  A \left(\frac{k}{\ell}(r_t)\right)^{\alpha-1} \ell - (r + \delta) \frac{k}{\ell}(r_t)\ell \equiv P(r_t)\ell
  \]
Budget Constraint

- Public expenditure $C_{gov,t}$
- Public debt $D$ (constant over time)
- Budget constraint

\[
C_{gov,t} + UB_t + TR_t = T_{y,t} + T_{w,t} + T_{hh,t} + (q_t - 1)D
\]
Timing of the Model

Period begins → Labor Market Opens → Production → Exogenous Separation → Period Ends
Period profits:

\[
\pi^f_t(z) = (1 - \tau_y)P(r_t)zh - (1 + \tau_w)w^f_t(z)
\]

\[
\pi^i_t(\varepsilon z) = P(r_t)e\varepsilon h - w^i_t(ez)
\]

Value of a formal employee:

\[
V^f_t(z) = \pi^f_t(z) + q_t (1 - \lambda_f) \begin{cases} 
(1 - p\theta_{t+1}) & \text{No exog. separation} \\
+ p\theta_{t+1} \left( 1 - \frac{G(\Phi^f_{t+1}(z))}{G(Z_{t+1})} \right) & \text{Employee finds no job} \\
\end{cases} V^f_{t+1}(z)
\]

Analogous for informal firms
Worker Value

**Return Sets**

- Value of a formal job:
  \[
  W^f_t(z) = (1 - \tau_{hh,t})W^f_t(z) + q_t \left\{ \lambda_f W^s_{t+1}(W^n_{t+1}, \nu) + (1 - \lambda_f) W^s_{t+1}(W^f_{t+1}(z), 0) \right\}
  \]

  - Exogenous separation
  - No separation, on-the-job search

- Value of an informal job:
  \[
  W^i_t(ez) = w^i_t(ez) + q_t \left\{ \lambda_i W^s_{t+1}(W^n_{t+1}, 0) + (1 - \lambda_i) W^s_{t+1}(W^i_{t+1}(ez), 0) \right\}
  \]

  - Exogenous separation
  - No separation, on-the-job search

- Value of unemployment:
  \[
  W^n_t = \zeta_0 + \zeta_1 h + \varsigma + q_t W^s_{t+1}(W^n_{t+1}, 0)
  \]
Relevant Sets

Firm Value  Worker Value  Return

- Firm posts formal vacancy: \( Z^f_t = \{(e, z) | \rho^f_t(z)V^f_t(z) \geq \max(0, \rho^i_t(ez)V^i_t(ez))\} \)
- Firm posts informal vacancy: \( Z^i_t = \{(e, z) | \rho^i_t(ez)V^i_t(ez) > \max(0, \rho^f_t(z)V^f_t(z))\} \)
- Firm posts at all: \( Z_t = Z^f_t \cup Z^i_t \)
- Formal worker changes jobs:
  \[
  \Phi^f_t(z) = \{(\tilde{e}, \tilde{z}) \in Z^f_t | W^f_t(\tilde{z}) > W^f_t(z)\} \cup \{(\tilde{e}, \tilde{z}) \in Z^i_t | W^i_t(\tilde{e}\tilde{z}) > W^f_t(z)\}
  \]
  Change to formal job  Change to informal job

- Informal worker changes jobs:
  \[
  \Phi^i_t(ez) = \{(\tilde{e}, \tilde{z}) \in Z^f_t | W^f_t(\tilde{z}) > W^i_t(ez)\} \cup \{(\tilde{e}, \tilde{z}) \in Z^i_t | W^i_t(\tilde{e}\tilde{z}) > W^i_t(ez)\}
  \]
  Change to formal job  Change to informal job
To state workers’ value function, it useful to first define value of searching in the labor market with reservation value $W$ and insurance $ub$:

$$W^s_t(W, ub) = (1 - p\theta_t)(W + ub) + p\theta_t \int_{Z^f_t} \max(W, W^f_t(z)) \frac{dG_t}{G_t(Z_t)}$$

No job found

$$+ p\theta_t \int_{Z^i_t} \max(W, W^i_t(ez)) \frac{dG_t}{G_t(Z_t)}$$

Offer of informal job

Offer of formal job
Free entry condition

- Match-finding rate to a firm $p_t(h)$
- Free-entry condition:

$$p_t(h)q_t \int \max \left\{ 0, \rho_{t+1}^f(z, h)V_{t+1}^f(z, h), \rho_{t+1}^i(\varepsilon z, h)V_{t+1}^i(\varepsilon z, h) \right\} dG = \kappa h$$

- Probability of acceptance depends on firm $(\varepsilon z, h)$:

$$\rho_t^f(z) = \left[ U_{t-1} + \lambda_f E_{t-1}^f + \lambda_i E_{t-1}^i + (1 - \lambda_f) E_{t-1}^f(\Psi_{f,t}(z)) + (1 - \lambda_i) E_{t-1}^i(\Psi_{i,t}(z)) \right]$$

$$\rho_t^i(z) = \left[ U_{t-1} + \lambda_f E_{t-1}^f + \lambda_i E_{t-1}^i + (1 - \lambda_f) E_{t-1}^f(\Psi_{f,t}(z)) + (1 - \lambda_i) E_{t-1}^i(\Psi_{i,t}(z)) \right]$$

Probability worker accepts job
Distributions

- **Skill levels**: \( h = h_1 < h_2 < \cdots < h_{10} = \bar{h} \)

\[
H(h_{i+1}) = \xi H(h_i)
\]

- **Firm productivity**: \( G_z \sim \text{LogNormal}(-\sigma^2_z/2, \sigma^2_z) \)

- **Hiding ability**: mixture \( e = e_1 e_2 \)
  - \( e_1 = 0 \) with probability \( \phi \), 1 otherwise
  - \( e_2 = \text{Beta}(\nu, 1) \)
Income Distribution

Income Distribution

- Formal
- Informal
- Model - Formal
- Model - Informal

Income Bin Lower Limit (US$ Monthly)

0.0
0.1
0.2
0.3
0.4
0.5
0.6

0 500 1000 1500 2000

Income Distribution
Other Transition Paths

(a) Output

(b) Capital

(c) Consumption

(d) Income tax rate
No Tax Change: Consumption Equivalent - Short Run

(a) All Households

(b) Unemployed

Figure: Consumption Equivalents - Short Run
References


