Credit and Savings Constraints in General Equilibrium: Evidence from Survey Data*

Catalina Granda  
*Universidad de Antioquia*  
BanRep & St Louis Fed

Franz Hamann

Cesar E. Tamayo  
*Inter-American Development Bank*

2018 AEA Meetings  
Philadelphia, January 4-7

*Opinions are those of the authors and do not necessarily reflect the views of the Banco de la República, the Federal Reserve System, the Inter-American Development Bank, their Boards of Directors, or the countries they represent.*
Motivation

- Financial inclusion has become a priority for development agenda
Motivation

- Financial inclusion has become a priority for development agenda
- Recently, goal of improving access to credit joined by interest in role of savings in comprehensive financial inclusion strategy
Motivation

- Financial inclusion has become a priority for development agenda.
- Recently, goal of improving access to credit joined by interest in role of savings in comprehensive financial inclusion strategy.
- Little is known about general equilibrium effects of savings constraints, or how they interact with credit frictions.
This paper... 

- Presents framework to quantify general equilibrium effects of savings constraints and study their interactions with credit frictions
This paper...

- Presents framework to quantify general equilibrium effects of savings constraints and study their interactions with credit frictions
- A model of heterogeneous agents in which financial market frictions distort credit and saving decisions by households and firms
This paper... 

- Presents framework to quantify general equilibrium effects of savings constraints and study their interactions with credit frictions.
- A model of heterogeneous agents in which financial market frictions distort credit and saving decisions by households and firms.
- Model calibrated using microdata from a household longitudinal survey (Colombia: ELCA).
This paper...

- Presents framework to quantify general equilibrium effects of savings constraints and study their interactions with credit frictions
- A model of heterogeneous agents in which financial market frictions distort credit and saving decisions by households and firms
- Model calibrated using microdata from a household longitudinal survey (Colombia: ELCA)
  - Income, saving & credit behavior (how much and where?)
This paper...

- Presents framework to quantify general equilibrium effects of savings constraints and study their interactions with credit frictions

- A model of heterogeneous agents in which financial market frictions distort credit and saving decisions by households and firms

- Model calibrated using microdata from a household longitudinal survey (Colombia: ELCA)
  - Income, saving & credit behavior (how much and where?)
  - Three waves (2010, 2013, 2016)
Empirical regularities

Saving outside the financial system is a widespread phenomenon
Empirical regularities

Colombia is no exception

Table: Incidence and composition of savings

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-savers</td>
<td>72.9%</td>
<td>73.3%</td>
</tr>
<tr>
<td>Savers</td>
<td>27.1%</td>
<td>26.7%</td>
</tr>
<tr>
<td>Formal</td>
<td>61.5%</td>
<td>62.2%</td>
</tr>
<tr>
<td>Informal</td>
<td>38.5%</td>
<td>37.8%</td>
</tr>
</tbody>
</table>
Empirical regularities

High costs and low returns are the main reasons why

- Returns are too low
- Too costly
- Bank is not always open when needed
- Lack of trust in financial system
- Too much paperwork
- Other
- No bank nearby

Comparison between 2010 and 2013
Related to the literature

- Recent micro/experimental literature studying constraints to saving...

- Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)

- Karlan, Lakshmi Ratan & Zinman (2014)

- These two phenomena may be connected in non-trivial ways...

  - High costs $\rightarrow$ low savings $\rightarrow$ low investment

  - Low productivity of investment $\rightarrow$ low returns $\rightarrow$ low savings
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)

- These two phenomena may be connected in non-trivial ways...
  - High costs $\rightarrow$ low savings $\rightarrow$ low investment
  - Low productivity of investment $\rightarrow$ low returns $\rightarrow$ low savings
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  - Karlan, Lakshmi Ratan & Zinman (2014)

- These two phenomena may be connected in non-trivial ways...
  - High costs $\rightarrow$ low savings $\rightarrow$ low investment
  - Low productivity of investment $\rightarrow$ low returns $\rightarrow$ low savings
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  - Karlan, Lakshmi Ratan & Zinman (2014)

- ...adds to lit on financial constraints and economic development...
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  - Karlan, Lakshmi Ratan & Zinman (2014)
- ...adds to lit on financial constraints and economic development...
  - Misallocation: Midrigan & Xu (2014); Buera & Shin (2013)
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  - Karlan, Lakshmi Ratan & Zinman (2014)

- ...adds to lit on financial constraints and economic development...
  - Misallocation: Midrigan & Xu (2014); Buera & Shin (2013)
Recent micro/experimental literature studying constraints to saving...
  ▶ Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  ▶ Karlan, Lakshmi Ratan & Zinman (2014)

...adds to lit on financial constraints and economic development...
  ▶ Misallocation: Midrigan & Xu (2014); Buera & Shin (2013)

These two phenomena may be connected in non-trivial ways...
Recent micro/experimental literature studying constraints to saving...
- Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
- Karlan, Lakshmi Ratan & Zinman (2014)

...adds to lit on financial constraints and economic development...
- Misallocation: Midrigan & Xu (2014); Buera & Shin (2013)

These two phenomena may be connected in non-trivial ways...
- High costs $\rightarrow$ low savings $\rightarrow$ low investment
Related to the literature

- Recent micro/experimental literature studying constraints to saving...
  - Prina (2015); Kast & Pomeranz (2014); Dupas & Robinson (2013)
  - Karlan, Lakshmi Ratan & Zinman (2014)

- ...adds to lit on financial constraints and economic development...
  - Misallocation: Midrigan & Xu (2014); Buera & Shin (2013)

- These two phenomena may be connected in non-trivial ways...
  - High costs $\rightarrow$ low savings $\rightarrow$ low investment
  - Low productivity of investment $\rightarrow$ low returns $\rightarrow$ low savings
Related to the literature

- Interaction between formal and informal financial markets in developing countries
Related to the literature

- Interaction between formal and informal financial markets in developing countries
  - Wang (2014)
Related to the literature

- Interaction between formal and informal financial markets in developing countries
  - Wang (2014)

- Determinants and effects of financial inclusion and development
Related to the literature

- Interaction between formal and informal financial markets in developing countries
  - Wang (2014)

- Determinants and effects of financial inclusion and development
  - Cross-country studies: Demirgüç-Kunt & Klapper (2013)
Related to the literature

- Interaction between formal and informal financial markets in developing countries
  - Wang (2014)

- Determinants and effects of financial inclusion and development
  - Cross-country studies: Demirgüç-Kunt & Klapper (2013)
A dynamic general equilibrium model with heterogeneous agents in which financial market frictions distort credit and savings decisions

- Households save for precautionary reasons using either a deposit contract with a bank (formal) or cash (informal)

- Credit constraints $\rightarrow$ capital misallocation $\rightarrow$ lower productivity and return to formal financial instruments
Model: Overview

A dynamic general equilibrium model with heterogeneous agents in which
financial market frictions distort credit and savings decisions

- Households save for precautionary reasons using either a deposit contract with a bank (formal) or cash (informal)
- Deposit contracts are costly $\rightarrow$ savings constraints

- Entrepreneurs can access credit markets, but face collateral requirements
- Savings constraints $\rightarrow$ informal savings $\rightarrow$ lower aggregate savings
- Credit constraints $\rightarrow$ capital misallocation $\rightarrow$ lower productivity and return to formal financial instruments
Model: Overview

A dynamic general equilibrium model with heterogeneous agents in which financial market frictions distort credit and savings decisions

- Households save for precautionary reasons using either a deposit contract with a bank (formal) or cash (informal)
- Deposit contracts are costly $\rightarrow$ savings constraints
- Entrepreneurs can access credit markets, but face collateral requirements
Model: Overview

A dynamic general equilibrium model with heterogeneous agents in which financial market frictions distort credit and savings decisions

- Households save for precautionary reasons using either a deposit contract with a bank (formal) or cash (informal)
- Deposit contracts are costly $\rightarrow$ savings constraints
- Entrepreneurs can access credit markets, but face collateral requirements
- Savings constraints $\rightarrow$ informal savings $\rightarrow$ lower aggregate savings
Model: Overview

A dynamic general equilibrium model with heterogeneous agents in which financial market frictions distort credit and savings decisions

- Households save for precautionary reasons using either a deposit contract with a bank (formal) or cash (informal)
- Deposit contracts are costly $\rightarrow$ savings constraints
- Entrepreneurs can access credit markets, but face collateral requirements
- Savings constraints $\rightarrow$ informal savings $\rightarrow$ lower aggregate savings
- Credit constraints $\rightarrow$ capital misallocation $\rightarrow$ lower productivity and return to formal financial instruments
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
- **Entrepreneurs.** Own a technology

$$Y_t = A_t \left[ a \exp \left( z_t \right) \right]^{1-\mu} \left( K_t^\lambda l_t^{1-\lambda} \right)^\mu$$
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
- **Entrepreneurs.** Own a technology $Y_t = A_t \left[ a \exp \left( z_t \right) \right]^{1-\mu} \left( K_t^\lambda l_t^{1-\lambda} \right)^\mu$
  - $A_t = A_{t-1}g$ is aggregate efficiency
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
- **Entrepreneurs.** Own a technology $Y_t = A_t [a \exp (z_t)]^{1-\mu} (K^\lambda l_t^{1-\lambda})^\mu$
  - $A_t = A_{t-1}g$ is aggregate efficiency
  - $a \sim 1 - a^{-\zeta}$, $a \geq 1$ is permanent productivity (talent)
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
- **Entrepreneurs.** Own a technology $Y_t = A_t \left[ a \exp (z_t) \right]^{1-\mu} \left( K_t^\lambda l_t^{1-\lambda} \right)^\mu$
  - $A_t = A_{t-1} g$ is aggregate efficiency
  - $a \sim 1 - a^{-\zeta}$, $a \geq 1$ is permanent productivity (talent)
  - $z_t$ is a transitory shock (Markov process)
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers

- **Entrepreneurs.** Own a technology $Y_t = A_t \left[ a \exp (z_t) \right]^{1-\mu} \left( K_t \lambda l_t^{1-\lambda} \right)^{\mu}$
  - $A_t = A_{t-1}g$ is aggregate efficiency
  - $a \sim 1 - a^{-\zeta}$, $a \geq 1$ is permanent productivity (talent)
  - $z_t$ is a transitory shock (Markov process)

- Each $t$, $1 - \eta$ die and are replaced by new ones who draw from their $a$
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers
- **Entrepreneurs.** Own a technology $Y_t = A_t \left[ a \exp (z_t) \right]^{1-\mu} (K_t l_t^{1-\lambda})^\mu$
  - $A_t = A_{t-1} g$ is aggregate efficiency
  - $a \sim 1 - a^{-\zeta}$, $a \geq 1$ is permanent productivity (talent)
  - $z_t$ is a transitory shock (Markov process)

- Each $t$, $1 - \eta$ die and are replaced by new ones who draw from their $a$
- Can borrow $d$ at interest rate $r$ and save $b$ at cost $\tau$
Model: Individual problems

- Measure 1 of entrepreneurs and measure $N$ of workers

- **Entrepreneurs.** Own a technology $Y_t = A_t [a \exp (z_t)]^{1-\mu} (K_t^{\lambda}l_t^{1-\lambda})^{\mu}$
  - $A_t = A_{t-1}g$ is aggregate efficiency
  - $a \sim 1 - a^{-\zeta}$, $a \geq 1$ is permanent productivity (talent)
  - $z_t$ is a transitory shock (Markov process)

- Each $t$, $1 - \eta$ die and are replaced by new ones who draw from their $a$
- Can borrow $d$ at interest rate $r$ and save $b$ at cost $\tau$
- After de-trending ($\gamma = g^{\frac{1}{1-\alpha}}$) and re-scaling by $a$, an entrepreneur's problem is:

\[
V (b, z) = \max_{b', k, l} \frac{c^{1-\chi}}{1-\chi} + \beta \eta \gamma^{1-\chi} \sum_{z'} V (b', z') \pi (z' | z)
\]

s.t. \[c + \gamma b' + \tau = \exp (z)^{1-\mu} (k^{\lambda}l^{1-\lambda})^{\mu} - (r + \delta) k - wl + (1 + r)b\]

\[d \leq \varphi k, \quad k = b + d\]
Model: Individual problems

- **Workers.** Each supplies one unit of labor inelastically; but labor income depends upon idiosyncratic efficiency $\nu \exp(\epsilon_t)$
Model: Individual problems

- **Workers.** Each supplies one unit of labor inelastically; but labor income depends upon idiosyncratic efficiency $\nu \exp(\epsilon_t)$
  - $\nu \sim 1 - \nu^{-\omega}$, $\nu \geq 1$, is permanent ability
Model: Individual problems

- **Workers.** Each supplies one unit of labor inelastically; but labor income depends upon idiosyncratic efficiency $\nu \exp(\epsilon_t)$
  - $\nu \sim 1 - \nu^{-\omega}$, $\nu \geq 1$, is permanent ability
  - $\epsilon_t$ is a transitory shock (Markov process)
Model: Individual problems

- **Workers.** Each supplies one unit of labor inelastically; but labor income depends upon idiosyncratic efficiency $\nu \exp(\epsilon_t)$
  - $\nu \sim 1 - \nu^{-\omega}$, $\nu \geq 1$, is permanent ability
  - $\epsilon_t$ is a transitory shock (Markov process)

- Can save in one-period deposit contracts, $q$, at a fixed cost $\tau$, or in cash, $s$, at zero cost
Model: Individual problems

- **Workers.** Each supplies one unit of labor inelastically; but labor income depends upon idiosyncratic efficiency $\nu \exp(\epsilon_t)$
  - $\nu \sim 1 - \nu^{-\omega}, \nu \geq 1$, is permanent ability
  - $\epsilon_t$ is a transitory shock (Markov process)
- Can save in one-period deposit contracts, $q$, at a fixed cost $\tau$, or in cash, $s$, at zero cost
- After de-trending and re-scaling by $\nu$, a worker’s problem is:

\[
W(q, s, \epsilon) = \max_{q', s'} \frac{c^{1-\chi}}{1-\chi} + \beta \gamma^{1-\chi} \sum_{\epsilon'} W(q', s', \epsilon') \psi(\epsilon' | \epsilon)
\]

s.t. \quad c + \gamma q' + \gamma s' = w \exp(\epsilon) + (1 + r) q + s - \tau \mathbb{I}_{\{q' > 0\}}

\[
q \geq 0, \quad s \geq 0
\]
Calibration: Assigned parameters

<table>
<thead>
<tr>
<th>Param</th>
<th>Value</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.96</td>
<td>Discount factor</td>
<td>DGE literature</td>
</tr>
<tr>
<td>$\chi$</td>
<td>2.3</td>
<td>Risk aversion coefficient</td>
<td>Prada &amp; Rojas (2010)</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.85</td>
<td>Share of variable inputs</td>
<td>Zuleta et al. (2010)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.46</td>
<td>Capital share in production</td>
<td>Zuleta et al. (2010)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.075</td>
<td>Capital depreciation rate</td>
<td>Hamann &amp; Mejía (2013)</td>
</tr>
<tr>
<td>$1 - \eta$</td>
<td>0.07</td>
<td>Exit rate for entrepreneurs</td>
<td>Eslava et al. (2013)</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>1.038</td>
<td>Trend output growth rate</td>
<td>Stats Office (DANE)</td>
</tr>
</tbody>
</table>
Calibration: Parameters used to match moments

<table>
<thead>
<tr>
<th>Description</th>
<th>Target</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\omega$</td>
<td>Tail Pareto workers % income in top 1% (workers)</td>
<td>7.2%</td>
<td>7.1%</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>Tail Pareto firms % income in top 1% (all)</td>
<td>11.3%</td>
<td>11.1%</td>
</tr>
<tr>
<td>$\rho_\epsilon$</td>
<td>AR(1) labor prod % of workers who do not save</td>
<td>73.3%</td>
<td>62.9%</td>
</tr>
<tr>
<td>$\sigma_\epsilon$</td>
<td>S.D. of labor prod Workers saving rate</td>
<td>12.1%</td>
<td>12.0%</td>
</tr>
<tr>
<td>$\rho_z$</td>
<td>AR(1) entrep prod % of entrep who do not save</td>
<td>76.1%</td>
<td>20.8%</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>S.D. of entrep prod Entrepreneurs saving rate</td>
<td>23.9%</td>
<td>19.4%</td>
</tr>
<tr>
<td>$\tau$</td>
<td>Cost of formal saving % of formal savers</td>
<td>62.2%</td>
<td>63.1%</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>% of pledg collateral Credit-to-output ratio</td>
<td>31.8%</td>
<td>31.2%</td>
</tr>
</tbody>
</table>
## Policy experiments: Main results

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Colombia</th>
<th>( \tau = 0, \varphi = \text{COL} )</th>
<th>( \tau = 0, \varphi = \text{CHL} )</th>
<th>First best</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SOE</td>
<td>Closed</td>
<td>SOE</td>
<td>Closed</td>
</tr>
<tr>
<td>Savings rate workers</td>
<td>12.0%</td>
<td>11.6%</td>
<td>11.5%</td>
<td>12.3%</td>
</tr>
<tr>
<td>% of workers who do not save</td>
<td>62.9%</td>
<td>32.0%</td>
<td>62.5%</td>
<td>32.5%</td>
</tr>
<tr>
<td>Savings rate entrepreneurs</td>
<td>19.3%</td>
<td>19.3%</td>
<td>19.3%</td>
<td>19.6%</td>
</tr>
<tr>
<td>% of entrep who do not save</td>
<td>20.8%</td>
<td>20.8%</td>
<td>20.7%</td>
<td>25.3%</td>
</tr>
<tr>
<td>Credit-to-output ratio</td>
<td>0.31</td>
<td>0.31</td>
<td>0.32</td>
<td>0.71</td>
</tr>
<tr>
<td>% of formal savers (workers)</td>
<td>63.1%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>% of capital financed by firms</td>
<td>83.6%</td>
<td>83.6%</td>
<td>83.5%</td>
<td>65.4%</td>
</tr>
<tr>
<td>Output</td>
<td>1.00</td>
<td>1.00</td>
<td>1.01</td>
<td>1.05</td>
</tr>
<tr>
<td>Total factor productivity</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.01</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>6.31%</td>
<td>6.31%</td>
<td>4.66%</td>
<td>6.31%</td>
</tr>
<tr>
<td>Welfare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>1.09</td>
<td>1.02</td>
<td>1.18</td>
</tr>
<tr>
<td>Entrepreneurs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>0.99</td>
<td>1.16</td>
</tr>
<tr>
<td>Income distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% income in top 5%</td>
<td>31.6%</td>
<td>30.9%</td>
<td>31.9%</td>
<td>29.3%</td>
</tr>
<tr>
<td>% income in quintiles 3-4</td>
<td>25.4%</td>
<td>25.4%</td>
<td>24.9%</td>
<td>26.7%</td>
</tr>
<tr>
<td>% income in quintiles 1-2</td>
<td>15.2%</td>
<td>16.1%</td>
<td>15.1%</td>
<td>16.6%</td>
</tr>
</tbody>
</table>
Policy experiments: Capital allocation

In an efficient economy, losses due to misallocation disappear as credit frictions do not constrain firm size.
Policy experiments: Welfare and income distribution

Increase in welfare from combination of reforms is larger for lowest percentiles of income distribution
Conclusions

- We use recent survey data to study costs associated with savings and credit constraints through the lens of a heterogeneous agent model.
Conclusions

- We use recent survey data to study costs associated with savings and credit constraints through the lens of a heterogeneous agent model.
- In our model, costs of using financial system interact with credit frictions to generate a vicious circle of informal savings, capital misallocation and low returns to formal savings instruments.

Studies like this greatly complement growing literature on small-scale field experiments.
Conclusions

- We use recent survey data to study costs associated with savings and credit constraints through the lens of a heterogeneous agent model.

- In our model, costs of using financial system interact with credit frictions to generate a vicious circle of informal savings, capital misallocation and low returns to formal savings instruments.

- Our results point to potentially large gains in terms of production efficiency and welfare by removing these constraints.

→ Support comprehensive financial development strategies.
Conclusions

- We use recent survey data to study costs associated with savings and credit constraints through the lens of a heterogeneous agent model.

- In our model, costs of using financial system interact with credit frictions to generate a vicious circle of informal savings, capital misallocation and low returns to formal savings instruments.

- Our results point to potentially large gains in terms of production efficiency and welfare by removing these constraints.
  \[\rightarrow\] Support comprehensive financial development strategies.

- Studies like this greatly complement growing literature on small-scale field experiments.
THANKS!
ADDITIONAL STUFF
Empirical regularities

Capital misallocation stemming from borrowing constraints may be a contributing factor to such low returns

![Graph showing the relationship between % adults who save outside the financial system and % firms with financial constraints with R2 = 0.1252.]
Empirical regularities (Colombia)

Those who save informally because costs are too high save mainly in cash.
Empirical regularities (Colombia)

And so do those who think returns are too low
Most people save for precautionary motives and for investment.
Moving forward

The welfare result for formal/informal savings is strong and may depend on:

- Other mechanisms: save formally to borrow in the future?
Moving forward

The welfare result for formal/informal savings is strong and may depend on:

- Other mechanisms: save formally to borrow in the future?
- Other mechanisms: save to borrow to run a firm (occupational choice)?