Anatomy of a Credit Crunch: From Capital to Labor Markets
Presented by Joshua Weiss

Francisco J. Buera, Roberto N. Fattal Jaef, and Yongseok Shin

February 9, 2016
Introduction

- How well can shocks to firm-level financial frictions explain unemployment fluctuations?
Introduction

- How well can shocks to firm-level financial frictions explain unemployment fluctuations?
- Develop a model with firm-level borrowing constraint and labor market frictions
- Calibrate to financial variables during the Great Recession and try to match unemployment fluctuations
How well can shocks to firm-level financial frictions explain unemployment fluctuations?

Develop a model with firm-level borrowing constraint and labor market frictions

Calibrate to financial variables during the Great Recession and try to match unemployment fluctuations

Heterogeneity in wealth/productivity across firms leads to misallocation in steady state and reallocation following financial tightening

A friction in the reallocation of labor across firms leads to unemployment in the interim
Overview

- Infinite-horizon discrete time
Overview

- Infinite-horizon discrete time
- Ex-ante homogeneous agents with idiosyncratic entrepreneurial productivity shocks
Overview

- Infinite-horizon discrete time
- Ex-ante homogeneous agents with idiosyncratic entrepreneurial productivity shocks
- Agents choose to be workers or entrepreneurs
Overview

- Infinite-horizon discrete time
- Ex-ante homogeneous agents with idiosyncratic entrepreneurial productivity shocks
- Agents choose to be workers or entrepreneurs
- Workers move between unemployment and competitive labor market
- Entrepreneurs rent capital and labor subject to a “collateral constraint” to produce
Overview

- Infinite-horizon discrete time
- Ex-ante homogeneous agents with idiosyncratic entrepreneurial productivity shocks
- Agents choose to be workers or entrepreneurs
- Workers move between unemployment and competitive labor market
- Entrepreneurs rent capital and labor subject to a “collateral constraint” to produce
- Agents can trade risk-free debt in zero net supply
Individual Preferences

- Individuals maximize CRRA utility

\[
\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma} - 1}{1 - \sigma}
\]

subject to natural borrowing constraint on risk-free debt holdings
Individual Preferences

- Individuals maximize CRRA utility

$$\sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma} - 1}{1 - \sigma}$$

subject to natural borrowing constraint on risk-free debt holdings
Individual Preferences

- Individuals maximize CRRA utility
  \[ \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma} - 1}{1 - \sigma} \]
- subject to natural borrowing constraint on risk-free debt holdings
- Each period, choose to be worker/unemployed and earn wage/benefits or entrepreneur and earn profits
- All agents pay lump sum taxes to fund unemployment benefits
Entrepreneurs

- Produce according to

\[ Azk^\alpha l^\theta, \]

where \( A \) is aggregate productivity, \( z \) is idiosyncratic productivity, and \( \alpha + \theta < 1 \)
Entrepreneurs

- Produce according to
  \[ Azk^\alpha l^\theta, \]
  where \( A \) is aggregate productivity, \( z \) is idiosyncratic productivity, and \( \alpha + \theta < 1 \)
- Rent capital and labor in competitive markets subject to collateral constraint:
- Capital constrained to be a multiple of wealth:
  \[ k \leq \lambda a \]
Entrepreneurs

- Produce according to
  \[ Azk^\alpha l^\theta, \]
  where \( A \) is aggregate productivity, \( z \) is idiosyncratic productivity, and \( \alpha + \theta < 1 \)
- Rent capital and labor in competitive markets subject to collateral constraint:
- Capital constrained to be a multiple of wealth:
  \[ k \leq \lambda a \]
- No adjustment costs for capital and labor
Entrepreneurs

- Produce according to
  \[ Azk^\alpha l^\theta, \]
  where \( A \) is aggregate productivity, \( z \) is idiosyncratic productivity, and \( \alpha + \theta < 1 \)

- Rent capital and labor in competitive markets subject to collateral constraint:

- Capital constrained to be a multiple of wealth:
  \[ k \leq \lambda a \]

- No adjustment costs for capital and labor

- With probability \( 1 - \psi \), idiosyncratic productivity redrawn from Pareto distribution
Value Functions

- Individual’s state is wealth and idiosyncratic entrepreneurial productivity
Value Functions

- Individual’s state is wealth and idiosyncratic entrepreneurial productivity
- Workers are indifferent between working and unemployment:
  \[ V_W(a, z) = \sup_{c \geq 0} \left\{ u(c) + \beta \mathbb{E} \left[ V(a', z') \right] \right\} \]
  \[ a' = (1 + r)(a + w - c - \tau) \]
Value Functions

- Individual’s state is wealth and idiosyncratic entrepreneurial productivity
- Workers are indifferent between working and unemployment:
  \[ V_W(a, z) = \sup_{c \geq 0} \{ u(c) + \beta \mathbb{E} [V(a', z')] \} \]
  \[ a' = (1 + r)(a + w - c - \tau) \]
- Entrepreneurs choose optimal capital and labor subject to collateral constraint:
  \[ V_E(a, z) = \sup_{c, l \geq 0, k \in [0, \lambda a]} \{ u(c) + \beta \mathbb{E} [V(a', z')] \} \]
  \[ a' = (1 + r)(a + Azk^\alpha l^\theta - (r + \delta)k - wl - c - \tau) \]
Value Functions

- Individual’s state is wealth and idiosyncratic entrepreneurial productivity
- Workers are indifferent between working and unemployment:
  \[ V_W(a, z) = \sup_{c \geq 0} \{ u(c) + \beta \mathbb{E}[V(a', z')] \} \]
  \[ a' = (1 + r)(a + w - c - \tau) \]
- Entrepreneurs choose optimal capital and labor subject to collateral constraint:
  \[ V_E(a, z) = \sup_{c, l \geq 0, k \in [0, \lambda a]} \{ u(c) + \beta \mathbb{E}[V(a', z')] \} \]
  \[ a' = (1 + r)(a + Azk^\alpha l^\theta - (r + \delta)k - wl - c - \tau) \]
- Each period, individual makes static occupation decision:
  \[ V(a, z) = \max \{ V_W(a, z), V_E(a, z) \} \]
Labor Market

- All workers have same labor productivity
Labor Market

- All workers have same labor productivity
- Workers outside labor market (unemployed) and inside labor market
Labor Market

- All workers have same labor productivity
- Workers outside labor market (unemployed) and inside labor market
- Unemployed workers slowly enter the labor market
Labor Market

- All workers have same labor productivity
- Workers outside labor market (unemployed) and inside labor market
- Unemployed workers slowly enter the labor market
- Inside labor market is perfectly competitive
Labor Market

- All workers have same labor productivity
- Workers outside labor market (unemployed) and inside labor market
- Unemployed workers slowly enter the labor market
- Inside labor market is perfectly competitive
- Fired/new workers must leave the labor market
New/fired workers:

\[ JD_t = \int \left[ \max\{I_{-1} - l_t(a, z), 0\} + I_{l_{-1}>0}I_{l_t(a, z)=0} \right] G_t(da, dl_{-1}, dz) \]
Labor Market

- New/fired workers:

\[ JD_t = \int \left[ \max\{l_{-1} - l_t(a, z), 0\} + I_{l_{-1}>0} I_{l_t(a, z)=0} \right] G_t(da, dl_{-1}, dz) \]

- Workers entering labor market:

\[ M_t = \gamma(U_t + JD_t) \]

\[ \gamma \in (0, 1) \]
Labor Market

- New/fired workers:
  \[ JD_t = \int \left[ \max\{l-1 - l_t(a, z), 0\} + 1_{\{l-1>0\}}1_{\{l_t(a, z)=0\}} \right] G_t(da, dl_{-1}, dz) \]

- Workers entering labor market:
  \[ M_t = \gamma(U_t + JD_t) \]
  \[ \gamma \in (0, 1) \]

- Unemployed workers at end of period \( t \):
  \[ U_{t+1} = U_t + JD_t - M_t - UB_t \]

\( UB_t \) is unemployed workers from beginning of \( t \) who became entrepreneurs
Equilibrium

- Steady state equilibrium with constant $A$, wage, interest rate, and distribution $G$
- Agents behave optimally given prices
- Risk-free debt market clears: total wealth equals capital
- Labor market clears: labor demand equals measure of workers inside labor market
Overview

- Calibrate parameters to pre-crisis US data and compute steady state
Overview

- Calibrate parameters to pre-crisis US data and compute steady state
- Shock financial constraint in line with US data and compute transition path
- Shock TFP and compute transition path
Overview

- Calibrate parameters to pre-crisis US data and compute steady state
- Shock financial constraint in line with US data and compute transition path
- Shock TFP and compute transition path
- Look at aggregate and firm-level results
Calibration

- One period is a year
- CRRA: $\sigma = 1.5$
- Depreciation: $\delta = 0.06$
- Capital share: $\frac{\alpha}{\alpha + \theta} = 0.33$
- Labor market friction: $\gamma = 0.667$
- Calibrate the rest of the parameters to match moments from US data:

<table>
<thead>
<tr>
<th>Calibration</th>
<th>US data</th>
<th>Model</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10% employment</td>
<td>0.69</td>
<td>0.69</td>
<td>$\eta = 5.25$</td>
</tr>
<tr>
<td>Top 5% earnings share</td>
<td>0.30</td>
<td>0.30</td>
<td>$\alpha + \theta = 0.79$</td>
</tr>
<tr>
<td>Establishment exit rate (annual)</td>
<td>0.10</td>
<td>0.10</td>
<td>$\psi = 0.89$</td>
</tr>
<tr>
<td>Real interest rate (annual)</td>
<td>0.02</td>
<td>0.02</td>
<td>$\beta = 0.93$</td>
</tr>
<tr>
<td>Credit market instruments to non-financial assets</td>
<td>0.70</td>
<td>0.70</td>
<td>$\lambda = 7.5$</td>
</tr>
</tbody>
</table>
In $t = 0$, unexpected announcement of deterministic credit path: $\{\lambda_1, \lambda_2, \lambda_3, \lambda_4\} = \{7.5, 4.5, 3.0, 3.5\}$, then, for $t \geq 5$, $\lambda_t = 0.75\lambda_{t-1} + 0.25 \times 7.5$
Credit Shock

- Constrained entrepreneurs scale down capital and labor demand
Credit Shock

- Constrained entrepreneurs scale down capital and labor demand
- Interest rate and wage fall, encouraging unconstrained, but less productive entrepreneurs to scale up
Credit Shock

- Constrained entrepreneurs scale down capital and labor demand
- Interest rate and wage fall, encouraging unconstrained, but less productive entrepreneurs to scale up
- Labor market friction prevents immediate reallocation of labor
Credit Shock

- Constrained entrepreneurs scale down capital and labor demand
- Interest rate and wage fall, encouraging unconstrained, but less productive entrepreneurs to scale up
- Labor market friction prevents immediate reallocation of labor
- Effects are persistent as productive entrepreneurs rebuild wealth
- Unemployment is particularly persistent – labor market frictions create more unemployment as labor is reallocated back toward productive entrepreneurs
Credit Shock Results

![Diagram showing the impact of credit shocks on output, TFP, investment rate, and unemployment, with data, model, and fixed w lines compared over the years 2000 to 2015.]
Credit Shock Labor Market Flows
Credit Shock vs. TFP Shock

![Graphs showing the impact of credit and TFP shocks on various economic indicators.](image-url)
Credit Shock vs. TFP Shock

- Labor reallocation frictions creates unemployment and persistent output effects
- Sharper interest rate drop shifts wealth from constrained to unconstrained entrepreneurs
### Firm-level Results

Properties of firm age-size distribution in steady state.

<table>
<thead>
<tr>
<th></th>
<th>Fraction not constrained</th>
<th>Share of total employment</th>
<th>Fraction of firms</th>
<th>Average TFP</th>
<th>Average wealth</th>
<th>Average rate of return</th>
<th>Net employment growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small-young</td>
<td>0.057</td>
<td>0.133</td>
<td>0.405</td>
<td>0.60</td>
<td>1.8</td>
<td>0.122</td>
<td>0.42</td>
</tr>
<tr>
<td>Large-young</td>
<td>0.111</td>
<td>0.045</td>
<td>0.004</td>
<td>1.15</td>
<td>42.5</td>
<td>0.074</td>
<td>0.25</td>
</tr>
<tr>
<td>Small-old</td>
<td>0.421</td>
<td>0.315</td>
<td>0.549</td>
<td>0.56</td>
<td>5.3</td>
<td>0.028</td>
<td>-0.07</td>
</tr>
<tr>
<td>Large-old</td>
<td>0.934</td>
<td>0.507</td>
<td>0.042</td>
<td>1.16</td>
<td>157.0</td>
<td>0.022</td>
<td>-0.09</td>
</tr>
</tbody>
</table>
Collateral constraint in the steady state produces significant heterogeneity across firms.
Collateral constraint in the steady state produces significant heterogeneity across firms.

Collateral constraint shock produces large amounts of reallocation.

Reallocation and frictional labor market generate unemployment.
Collateral constraint in the steady state produces significant heterogeneity across firms

Collateral constraint shock produces large amounts of reallocation

Reallocation and frictional labor market generate unemployment

Labor market frictions aren’t internalized (no wage bargaining and each worker is indifferent)