Anatomy of a Credit Crunch: from Capital to Labor Markets

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Background and Questions

- Understand macro and firm-level implications of credit crunches

1. Why do financial crises lead to severe recessions, and sustained rise in unemployment?
   - Great Depression, 2007-2008 recession (Reinhart and Rogoff, 2009)
   - Propose theory integrating credit and labor market frictions
Background and Questions

- Understand macro and firm-level implications of credit crunches

1. Why do financial crises lead to severe recessions, and sustained rise in unemployment?
   - Great Depression, 2007-2008 recession (Reinhart and Rogoff, 2009)
   - Propose theory integrating credit and labor market frictions

2. Which type of firms are more strongly affected by credit crunch?
   - Age/size as indicators of financial constraints of firms
   - Employment growth in small/young businesses falls relative to old/large
   - Fort, Haltiwanger, Jarmin and Miranda (2012)
   - Explore role of age and size in the model
Model Economy

- Heterogeneous agents in entrepreneurial productivity and wealth
  - run an individual specific technology,
  - work for the wage $w_t$ if employment opportunity,
  - search for a job and earn subsidy $w_t$ (unemployed).

- Capital expenditures financed by:
  - internal funds
  - external funds, subject to collateral constraint (Buera and Shin, 2009)

- Labor market friction:
  - Walrasian equilibrium with matching frictions (Veracierto, 2009)
Main Results

- Credit crunch $\implies$ reallocation of factors from constrained to unconstrained entrepreneurs
  - Reduction in TFP (misallocation)
  - Increase in unemployment, as reallocation is mediated by labor friction
- Reallocation process well captured by firm age and size:
  - small/young businesses: more likely to be constrained, higher return to $K$
  - net employment growth falls relative to old/large entrepreneurs
- Aggregate TFP shock has no effect on unemployment (flexible prices)
Literature Review

  - credit frictions and amplification of aggregate shocks

- Credit shocks and macroeconomic dynamics: Jermann and Quadrini (2009)
  - representative agent model, explicitly model debt and equity financing

  - frictionless labor markets

- Cyclical behavior of firms: Gilchrist and Gerlter (1994); Chari, Christiano and Kehoe (2007); Moscarini Postel-Vinay (2012); Fort, Haltiwanger, Jarmin and Miranda (2012)
Worker (and Unemployed)'s Problem

\[ v_t^W (a, z) = \max_{c, a' \geq 0} u(c) + \beta E [v_{t+1} (a', z')] \]

\[ c + a' = w_t + (1 + r_t) a - \tau_t \]

- full insurance against unemployment risk
- Lump-sum taxes \( \tau_t \) financing unemployment subsidies
- continuation value: \[ v_{t+1} (a', z') = \max \left\{ v_{t+1}^W (a', z'), v_{t+1}^E (a', z') \right\} \]
Entrepreneur’s Problem

\[ v_t^E (a, z) = \max_{c,k,l,a'} u (c) + \beta E [v_{t+1} (a', z')] \]

\[ a' + c = A_t z k^\alpha l^\theta - w_t l - (r_t + \delta) k + (1 + r_t) a - \tau_t \]

\[ k \leq \lambda_t a \]

- Time series for \( \lambda_t \) and \( A_t \) \( \implies \) non-stationary problem
Process of Entrepreneurial Productivity

\[ z' = \begin{cases} 
  z & \text{w/ prob. } \psi \\
  \xi & \text{w/ prob. } 1 - \psi
\end{cases} \]

\[ \xi \overset{iid}{\sim} \eta \xi^{-\eta-1}, \; \xi \geq 1 \]

- Stationary CDF of productivity: \( \mu(z) = 1 - z^{-\eta} \).
Description of Labor Market Friction

- workers hired in centralized, competitive labor market
- Friction: only a fraction of unemployed matched to hiring markets
- Wages adjust to equalize demand and supply in hiring market
- it takes time for fired, unemployed, agents to match with the centralized hiring market
Mechanics of Labor Market Friction

- $M_t$ unemployed workers matched to the hiring market

\[ M_t = \gamma (U_t + J D_t) \]

- evolution of unemployment

\[ U_{t+1} = U_t - M_t + J D_t \]
Competitive Equilibrium

Given $G_0 (a, l_{-1}, z)$ and a sequence $\{\lambda_t\}_{t=0}^{\infty}$, a competitive equilibrium consist of sequences of distributions $\{G_t (a, l_{-1}, z)\}_{t=1}^{\infty}$, allocations, lump-sum taxes, unemployment, and prices $\{w_t, r_t\}_{t=0}^{\infty}$ such that:

- Allocations solve individuals’ problem given prices
- Government budget is balanced, $\tau_t = w_t U_t$
- Capital and hiring markets clear

\[
\int k_t (a, z) G_t (da, dl_{-1}, dz) = \int aG_t (da, dl_{-1}, dz)
\]

\[
\int l_t (a, z) G (da, dl_{-1}, dz) + U_{t+1} = L
\]

- Unemployment evolves according to

\[
U_{t+1} = U_t - M_t + JD_t
\]

- The joint distribution $G_t (a, l_{-1}, z)$ evolves according to the equilibrium mapping...
Calibrating Preference and Technologies

<table>
<thead>
<tr>
<th>Parameter</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</td>
<td>0.10</td>
<td>0.10</td>
<td>$\psi = 0.89$</td>
</tr>
<tr>
<td>Real Interest Rate</td>
<td>0.04</td>
<td>0.04</td>
<td>$\beta = 0.91$</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>0.05</td>
<td>0.05</td>
<td>$\gamma = 0.67$</td>
</tr>
<tr>
<td>Credit to Non-Financial Assets</td>
<td>0.70</td>
<td>0.70</td>
<td>$\lambda = 7.5$</td>
</tr>
</tbody>
</table>
MACRO IMPLICATIONS
Aggregate Implications

output

TFP

investment rate

unemployment

rigidW workerflows

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Comparison to an Exogenous TFP Shock

- Re-allocative nature of credit shock key for unemployment
Comparison to an Exogenous TFP Shock: Prices

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December 6th, 2013 17 / 22
Reallocating External Finance

model economy, by wealth

U.S. data, by sector and instrument

- low a
- high a

- corporate
- corp. bonds
- noncorp.
- corp. banks
MICRO-IMPLICATIONS CREDIT CRUNCH
Steady State Properties of Firm Age-Size Distribution

- Small/large: median employment of employment based distribution
- Young/old: 5 years since entry (Fort, Haltiwanger, et.al. 2012)

**Table: Statistics from Steady State Age-Size Distribution**

<table>
<thead>
<tr>
<th></th>
<th>Fraction Unconstr Entrepreneur</th>
<th>Fraction of Total Employment</th>
<th>Av. Prod.</th>
<th>Av. Wealth</th>
<th>Av Rate of Return</th>
<th>Net Empl. Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>YS</td>
<td>0.06</td>
<td>0.14</td>
<td>0.59</td>
<td>1.5</td>
<td>0.15</td>
<td>0.42</td>
</tr>
<tr>
<td>YL</td>
<td>0.14</td>
<td>0.05</td>
<td>1.18</td>
<td>30.49</td>
<td>0.095</td>
<td>0.28</td>
</tr>
<tr>
<td>OS</td>
<td>0.46</td>
<td>0.30</td>
<td>0.57</td>
<td>3.98</td>
<td>0.046</td>
<td>-0.10</td>
</tr>
<tr>
<td>OL</td>
<td>0.96</td>
<td>0.51</td>
<td>1.17</td>
<td>100.79</td>
<td>0.042</td>
<td>-0.12</td>
</tr>
</tbody>
</table>
Employment Dynamics by Firm Age/Size

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December 6th, 2013
Conclusions

- A credit crunch reallocates credit, capital, and labor, i.e., reallocation shock ($\neq$ TFP shock).
- Matching frictions $\Rightarrow$ reallocation results in protracted rise in unemployment.
- Age/size of firm good predictor of likelihood of being financially constrained
- Labor gets reallocated from small/young to large old/businesses
Financial Market

- Competitive financial intermediaries:
  - issue bonds with return $r_t$
  - accumulate capital
    \[ K_{t+1} = (1 - \delta)K_t + I_t \]
  - rent capital at rate $r_t + \delta$ to entrepreneurs subject to rental limit
    \[ k \leq \lambda_t a \]

(isomorphic decentralization where entrepreneurs own capital and issue debt)
Calibrating the Credit Crunch: External Finance / Capital

- model

\[
K_t = 1 - 1/\lambda_t, \text{ if all entrepreneurs are constrained}
\]

- data (non-corporate business sector)

credit market instruments

non-financial assets (historical cost)
Frictional Labor Market

- $M_t$ unemployed workers matched to the hiring market

\[ M_t = \gamma U_t^\phi V_t^{1-\phi} \]

where

\[ V_t = vJC_t \text{ (aggregate hiring investment)} \]

- evolution of unemployment

\[ U_{t+1} = U_t - M_t + JD_t \]

- Veracierto (2009)
Aggregate Implications of Crunch with Rigid Wages (Shimer, 2012)

![Graphs showing output, TFP, investment rate, and unemployment over time.](image-url)
Worker Flows: Flexible vs Rigid Wages

![Graph showing worker flows over time](image)

Anatomy of a Credit Crunch: from Capital to Labor Markets

December 6th, 2013 28 / 22
Net Employment Growth Rates by Age-Size: The Data

Figure 2

Net Growth Rates by Firm Age and Firm Size

Source: Fort, Haltiwanger, Jarmin and Miranda (2012)
Are Age and Size Independently Informative?

Size and Age alone can capture underlying reallocation
Size results consistent with Girlchrist and Gertler (1994); Chari, Christiano and Kehoe (2007)
Implementation Micro-Implications

1. Given SS equilibrium objects: (wealth accumulation decisions, occupation choices, prices)
   1. Simulate stationary economy forward. 500,000 agents
   2. Construct empirical age-size distribution
   3. Compute Job Creation and Destruction Rates, and other statistics

2. Given Equilibrium objects along crunch, and SS age-size distribution:
Macro and Firm-level Implications of financial crises:

1. Severe contraction, sustained rise in unemployment
2. Employment growth in small/young businesses falls relative to old/large

- Reinhart and Rogoff, (2009), Fort, Haltiwanger, Jarmin and Miranda (2012)
Macro and Firm-level Implications of financial crises:

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Propose model with credit and labor market frictions to understand:

- interaction between credit shocks and labor frictions for macro variables
- role of firm age and size for transmission of credit shock
- comparison of implications from TFP shocks