Aggregate Unemployment and Household Unsecured Debt

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What we do

Objective:

1. Provide a tractable model to study three important markets: labor, goods, household unsecured credit.

   - Start with Mortensen-Pissarides
   - Add a frictional goods market with pairwise meetings
     - sequence of markets (Berensten, Menzio, Wright (2011))
     - trade with unsecured credit or liquid assets
   - Households lack commitment to repay debt
     - incentive constrained debt $\Rightarrow$ endogenous debt limits
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Key Mechanism:

1. Credit affects job creation through firm productivity
2. (Aggregate) unemployment affects credit limit through incentive constraints
Objective:

2 Calibrate the model and ask how much the expansion of unsecured credit can explain movements in the unemployment rate?

- Unsecured debt $= \text{revolving debt outstanding} / \text{annual consumption}$
What we do

Objective:

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- Unsecured debt = revolving debt outstanding / annual consumption
- Liquid assets = M2 + treasuries / total assets
What we do

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Literature

Unemployment & Money

• Shi (1998), Berensten, Menzio, Wright (2011), Rocheteau, Rupert, Wright (2007)

Unemployment & Firm Financial Frictions


Credit, Limited Commitment & Incentive Constrained Debt


What’s new:

1. consider labor, credit, and goods markets together.

2. credit is to households not firms and in the form of limited commitment

3. punishment from default is not autarky, can still use liquid assets
Environment
Environment

- Discrete time, infinite horizon, $\beta = \frac{1}{1+r}$

- Agents
  - Unit measure of households
  - Large measure of firms

- Each period is divided into 3 sub-periods
  1. Frictional Labor Market (LM)
     - matching of workers and firms
  2. Decentralized Retail Market (DM)
     - households and firms meet pairwise and trade $y_t$ for assets or debt
  3. Centralized Settlement (CM)
     - consume/produce general good $c_t$, pay back debt
Timing

Labor Market (LM)
- matching
- wage bargaining

Retail Market (DM)
- matching
- terms of trade \( (y, \tau, d) \)

Settlement (CM)
- wage payment
- debt payment
- asset accumulation

firms enter ➞ production ➞ job separation ➞

Diagram:
- Labor Market (LM)
- Retail Market (DM)
- Settlement (CM)
Households

- Quasi-linear Utility

\[ \mathbb{E} \sum_{t=0}^{\infty} \beta^t [\nu(y_t) + c_t + \ell(1 - e_t)] \]

- DM consumption good: \( y_t \)
- CM consumption good: \( c_t \)
- value of leisure: \( \ell \)
- employment status: \( e_t \in \{0, 1\} \)

- Assets (numeraire) are storable: \( a_t \)
  - storage technology, \( Ra_t \), with \( R < 1 + r \)
  - fraction \( \nu \) can be used for payment in DM (partially liquid)
• Firms enter labor market at cost: $k$

• Production of firm/worker match: $\bar{z}$
  • firm can sell $y_t \in [0, \bar{z}]$ in DM
  • inventories $x_t = \bar{z} - y_t$ in CM

• Exogenous separation rate: $\delta$
Frictions

- Labor market
  - matching rate of workers and job openings: $m(u_t, o_t)$
  - labor market tightness: $\theta_t = o_t / u_t$

- DM Goods Market
  - all households search
  - sellers are the measure of filled (productive) firms: $n_t = 1 - u_t$
  - matching: $\alpha(n_t)$

- Lack of commitment to repay debt in CM
  - Incentive constrained debt = no equilibrium default
  - Monitoring technology
    - $\omega$ fraction of households monitored
    - $\rho$ probability that default is recorded publicly
    - focus on equilibria where upon default household is excluded from credit
Equilibrium
CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

$$W_e(d, a) = \max_{c, a' \geq 0} \left\{ c + (1 - e)\ell + \beta U_e(a') \right\}$$

s.t. $c + d + a' = ew + (1 - e)b + Ra + \Delta$
CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

$$W_e(d, a) = Ra - d + ew + (1 - e)(\ell + b) + \Delta + \max_{a' \geq 0} [-a' + \beta U_e(a')]$$

- Linear in wealth
- Independent of current assets
CM Decision Problem

- Household with debt $d$, assets $a$, and no default record

$$W_e(d, a) = Ra - d + ew + (1 - e)(\ell + b) + \Delta + \max_{a' \geq 0} [-a' + \beta U_e(a')]$$

linear in wealth

independent of current assets

- Firm with $x$ inventories, $d$ units of debt, $a$ assets, and $w$ wage promises

$$\Pi(x, d, a, w) = x + d + Ra - w + \beta(1 - \delta)J$$

total revenue

wages

value next LM
Terms of trade in DM

• Contract is a triple $(y, \tau, d)$
  • $y$: DM output transferred to household
  • $\tau$: transfer of liquid assets to firm
  • $d$: unsecured credit

• Proportional bargaining solution
  • maximize surplus $[\psi(y) - y]$
  • household and firm get constant shares
  • $\mu$: household’s share

• Feasibility
  • $d \leq \bar{d}$
  • $\tau \leq \nu a$
DM output depends on total payment capacity

- $y$ is a function of household’s total payment capacity $\bar{d} + R \nu a$

- If payment capacity is high enough, trade $y = y^*$

- Otherwise, trade is constrained

$$ (1 - \mu) v(y) + \mu y = \bar{d} + R \nu a $$

- note: The price of one unit of DM output is

$$ 1 + (1 - \mu) \left[ \frac{v(y) - y}{y} \right] $$

average markup
Household with no default record, employment status $e \in \{0, 1\}$, assets $a$

\[
\begin{align*}
U_1(a) &= \alpha(n)\mu[\nu(y) - y] + (1 - \delta)W_1(0, a) + \delta W_0(0, a) \\
U_0(a) &= \alpha(n)\mu[\nu(y) - y] + pW_1(0, a) + (1 - p)W_0(0, a)
\end{align*}
\]
Job Creation - Firms

• Value of a filled job in DM

\[ J = \frac{z - w}{1 - \beta(1 - \delta)} \]

• Productivity depends endogenously on credit limit through \( y \)

\[ z = \bar{z} + \frac{\alpha(n)}{n} (1 - \mu) \left\{ \omega [v(y) - y] + (1 - \omega) [v(\tilde{y}) - \tilde{y}] \right\} \]

• Rest is as in Mortensen-Pissarides
  • free entry \( \Rightarrow k = \beta fJ \)
  • wages are determined by Nash Bargaining
Credit affects unemployment through firm productivity

- Beveridge Curve

\[ u = \frac{\delta}{m(1, \theta) + \delta} \]

- Job creation condition

\[ \frac{(r + \delta)k}{m(\frac{1}{\theta}, 1)} + \beta \lambda \theta k = (1 - \lambda)\left\{ z - \ell - b \right\} \]

- Unemployment \( u \) is decreasing in trade \( y(\tilde{d}, a) \) and \( \tilde{y}(\tilde{a}) \) through productivity.
Need to determine payments

- Asset accumulation
- Debt constraint
Asset accumulation

- Given $y(\bar{d} + R\nu a)$, households solve

$$\max_{a \geq 0} \begin{pmatrix} \alpha(n)\mu[v(y) - y] - (1 + r - R)a \\ \text{expected surplus} \\ \text{cost of holding } a \end{pmatrix}$$
Asset accumulation

- Given $y(\bar{d} + R\nu a)$, households solve

$$\max_{a \geq 0} \alpha(n)\mu [v(y) - y] - (1 + r - R) a$$

\hspace{20pt} \text{expected surplus} - \text{cost of holding } a

- FOC

$$\alpha(n)\mu \nu R \left[ \frac{v'(y) - 1}{(1 - \mu)v'(y) + \mu} \right] - (1 + r - R) \leq 0$$

\hspace{20pt} \text{liquidity premium} - \text{mc of holding } a

- Asset choice depends on $\bar{d}$ through $y$
If $\bar{d} \in [0, \bar{R} \bar{v} \bar{a})$ then hold $a > 0$ and trade $\bar{y}$
Debt Limit

- Incentive compatibility

\[ W_e(d, a) \geq \rho \tilde{W}_e(a) + (1 - \rho) W_e(0, a) \]

- Debt limit = lifetime cost of loosing access to credit

\[ d \leq \rho [W_e(0, 0) - \tilde{W}_e(0)] \equiv \bar{d} \]

- Two components of cost of loosing credit (increasing in $\bar{d}$)

\[ \bar{d} = \frac{\rho}{r} \left\{ \alpha(n) \mu \left[ \nu(y) - y \right] - \left[ \nu(\tilde{y}) - \tilde{y} \right] \right\} + (1 + r - R)(\bar{a} - a) \equiv \Gamma(\bar{d}) \]
If there is a positive debt limit, HH hold no assets
GE: Multiple Steady States

- Debt limit is decreasing with unemployment
- Unemployment decreasing with debt limit
- Strategic complementarity leads to multiple equilibria
  - credit and unemployment are negatively correlated across equilibria
Quantitative Results
Calibration

- Model period is one month, $\beta = 0.997$


- **Experiment**: Consider an exogenous change in financial technology $(\omega, \rho)$ to match unsecured debt outstanding in:
  1. 1978-1986
  2. 2011

- Compare steady state unemployment
## Labor Market

- Match labor flows, unemployment, vacancy rate

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<tr>
<th>Description</th>
<th>Value</th>
<th>Source/Target</th>
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<tbody>
<tr>
<td><strong>Labor Market</strong></td>
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<tr>
<td>Directly Match</td>
<td></td>
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<tr>
<td>Unemployment benefits, $b$</td>
<td>0.53</td>
<td>$b = 0.5w$</td>
</tr>
<tr>
<td>Value of leisure, $\ell$</td>
<td>0.48</td>
<td>$b + \ell = 0.95w$, Hagedorn &amp; Manovskii (2008)</td>
</tr>
<tr>
<td>Elasticity of LM matching, $\eta$</td>
<td>0.50</td>
<td>Petrolongo &amp; Pissarides (2001)</td>
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<td>Jointly Match</td>
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<tr>
<td>LM matching efficiency, $A$</td>
<td>0.50</td>
<td>Vacancy rate, JOLTS</td>
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<tr>
<td>LM bargaining, $\lambda$</td>
<td>0.50</td>
<td>Hosios condition</td>
</tr>
<tr>
<td>Job destruction rate, $\delta$</td>
<td>0.019</td>
<td>Unemployment rate, CPS</td>
</tr>
<tr>
<td>Vacancy cost, $k$</td>
<td>0.10</td>
<td>Job finding probability, CPS</td>
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Credit and Goods Market

- Survey of Consumer Finance (SCF): credit & charge cards

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<tr>
<td>DM production, $\tilde{z}$</td>
<td>1</td>
<td>Normalization</td>
</tr>
<tr>
<td>Access to unsecured credit, $\omega$</td>
<td>0.74</td>
<td>% with at least 1 cc (SCF)</td>
</tr>
<tr>
<td>Elasticity of DM matching function, $\psi$</td>
<td>0.50</td>
<td>Equal contribution in matching</td>
</tr>
<tr>
<td>Return on Assets, $R$</td>
<td>1.0025</td>
<td>Real user cost of M2 (Stl. Fed.)</td>
</tr>
<tr>
<td><strong>Jointly Match</strong></td>
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<tr>
<td>Detection Rate, $\rho$</td>
<td>0.30</td>
<td>Debt financed consumption</td>
</tr>
<tr>
<td>DM matching efficiency, $\epsilon$</td>
<td>0.24</td>
<td>Average cc utilization rate</td>
</tr>
<tr>
<td>DM bargaining, $\mu$</td>
<td>0.13</td>
<td>Retail Markup 30%</td>
</tr>
<tr>
<td>Utility level parameter, $\upsilon_0$</td>
<td>1.42</td>
<td>M2 to consumption</td>
</tr>
<tr>
<td>Utility elasticity, $\gamma$</td>
<td>0.03</td>
<td>Elasticity of M2 to cost (0.17)</td>
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<tr>
<td>Liquidity measure, $\nu$</td>
<td>0.05</td>
<td>Middle range for coexistence</td>
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Experiment: Tighten Credit

- Consider exogenous changes in financial technology
  1. Access to unsecured credit $\omega$
  2. Monitoring technology $\rho$

- 1978-1986
  - Change $\omega$ from 73% to 65%
  - Adjust $\rho$ to match fall in unsecured credit of 16 percentage points

- 2011
  - Change $\omega$ from 73% to 68%
  - Adjust $\rho$ to match fall in unsecured credit of 5 percentage points

- Compare steady state unemployment
### Credit & Goods Market

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<th>Bench.</th>
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<tr>
<td>Credit to Con., $\alpha(n)\omega \ddbar / C$</td>
<td>0.23</td>
<td>0.07</td>
<td>-0.16</td>
<td>-0.16</td>
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<tr>
<td>M2 to Cons., $(1 - \omega)R \ddbar / C$</td>
<td>0.74</td>
<td>0.93</td>
<td>0.19</td>
<td>0.14</td>
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<tr>
<td>Agg. productivity, $z$</td>
<td>1.07</td>
<td>1.03</td>
<td>-4.45%</td>
<td>-</td>
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### Labor Market

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<td>Unemployment rate (%)</td>
<td>5.13</td>
<td>6.82</td>
<td>1.69</td>
<td>2.39</td>
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*Table: Unemployment and Credit, 1978-1986*
### Credit & Goods Market

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<td>M2 to Cons., $(1 - \omega)R\bar{a}/C$</td>
<td>0.74</td>
<td>0.92</td>
<td>0.18</td>
<td>0.08</td>
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<tr>
<td>Agg. productivity, $z$</td>
<td>1.07</td>
<td>1.06</td>
<td>-1.44%</td>
<td>-</td>
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### Labor Market

| Unemployment rate (%) | 5.13 | 5.53 | 0.40 | 3.80 |

Table: Unemployment and Credit, 2011
Conclusion

- We provided a tractable model of the linkages between labor and household credit markets.

- Show there are complementarities between job creation and household unsecured credit.

- Show coexistence of liquid assets and unsecured debt

- Calibrated the model to assess the effect of a credit crunch: potentially large, but mitigated by the availability of liquidity.
Credit - Amplification Channel

- Change exogenous component of productivity, $\bar{Z}$

- Decompose changes in unemployment into
  - Mortensen-Pissarides channel
  - Credit & goods market channel
Credit amplifies exogenous productivity changes
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Credit amplifies exogenous productivity changes
Credit amplifies exogenous productivity changes
Credit amplifies exogenous productivity changes
Credit Card Limits

Source: Mian and Sufi (2012)