Macroeconomic Effects of Financial Shocks

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Equity payout and Debt repurchase ( / GDP)
## Business cycle properties, 1984-2009:1

<table>
<thead>
<tr>
<th></th>
<th>Std(Variable)</th>
<th>Corr(Variable, GDP)</th>
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</thead>
<tbody>
<tr>
<td><strong>Macroeconomic variables</strong></td>
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<tr>
<td>GDP</td>
<td>0.84</td>
<td>0.83</td>
</tr>
<tr>
<td>Consumption (N.D.&amp; S.)</td>
<td>0.49</td>
<td>0.83</td>
</tr>
<tr>
<td>Investment</td>
<td>5.98</td>
<td>0.87</td>
</tr>
<tr>
<td>Hours</td>
<td>1.18</td>
<td>0.81</td>
</tr>
<tr>
<td>TFP</td>
<td>0.60</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Financial variables</strong></td>
<td></td>
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<tr>
<td>EquPay/GDP</td>
<td>1.05</td>
<td>0.41</td>
</tr>
<tr>
<td>DebtRep/GDP</td>
<td>1.29</td>
<td>-0.61</td>
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</tbody>
</table>

All variables are detrended with a band-pass filter that preserves cycles of 1.5-8 years.
What do we do?

1. Extend the Real Business Cycle model: financial frictions and financial shocks

2. Construct series for ‘financial shocks’ and ‘productivity shocks’ from data using model restrictions

3. Evaluate the importance of financial (and productivity) shocks for macroeconomic fluctuations
What do we find?

- For financial flows we need financial shocks
- Financial shocks improve the model’s performance for real macroeconomic variables
- Financial shocks have played a central role in all recent recessions: 1991, 2001, and 2008
The Model

Continuum of firms with revenue function

\[ F(z_t, k_t, l_t) = e^{z_t} k_t^\theta l_t^{1-\theta} \]

\( z_t \) is an exogenous productivity shock
Financial structure

- Firms raise funds with debt and equity. The cost of borrowing is:

\[ R_t = 1 + r_t (1 - \tau) \]
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- Debt is preferred to equity, but there is limited enforcement:

\[
\left\{ 1 - \eta (1 - \psi_t) \right\} \cdot \bar{V}_t (k_{t+1}, b_{t+1}) \geq F (z_t, k_t, l_t)
\]

\[ \xi_t \]
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- Issuing/repurchasing shares and paying dividends are costly:

\[ \text{Cost of payout} : \varphi(d_t) = d_t + \kappa \cdot (d_t - \bar{d})^2 \]
Recursive problem

\[ V(s; k, b) = \max_{d, l, k', b'} \left\{ d + E m' V(s'; k', b') \right\} \]

subject to

\[ F(z, k, l) + (1 - \delta) k_t - w l + \frac{b'}{R} = b + \varphi(d) + k' \]

\[ \zeta E m' V(s'; k', b') \geq F(z, k, l) \]
Household sector

- There is a representative consumer with standard preferences:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, l_t), \text{ with } U(\cdot) = \ln(c) + \alpha \ln(1 - l)$$

- Budget constraint:

$$w_t l_t + b_t + s_t(d_t + q_t) = \frac{b_{t+1}}{1 + r_t} + s_{t+1}q_t + c_t + T_t$$

- Firms are owned by households, so that

$$m_{t+j} = \beta^j U_c(c_{t+j}, l_{t+j}) / U_c(c_t, l_t)$$
Calibration

- Some parameters are standard:
  \[ \beta = 0.9825, \alpha = 1.8991, \theta = 0.36, \delta = 0.025 \]

- Others are not standard but can be calibrated using steady state targets:
  \[ \tau = 0.35, \bar{\zeta} = 0.1965 \]

- Payout cost parameter \( \kappa = 0.246 \) to match standard deviation of empirical equity payout
Constructing the shocks

- Productivity shocks are standard Solow residuals

\[ \hat{z}_t = \hat{y}_t - \theta \hat{k}_t - (1 - \theta) \hat{l}_t \]
Constructing the shocks

- Productivity shocks are standard Solow residuals
  \[ \hat{z}_t = \hat{y}_t - \theta \hat{k}_t - (1 - \theta) \hat{l}_t \]

- Financial shocks are measured with the linearized enforcement constraint
  \[ \hat{\zeta}_t \overline{V}_t = y_t \]
  \[ \hat{\zeta}_t = c_z \hat{Z}_t + c_y \hat{y}_t + c_k \hat{k}_{t+1} + c_b \hat{b}_t^r \]
Constructing the shocks

- Productivity shocks are standard Solow residuals
  \[ \hat{z}_t = \hat{y}_t - \theta \hat{k}_t - (1 - \theta) \hat{l}_t \]

- Financial shocks are measured with the linearized enforcement constraint
  \[ \hat{\xi}_t V_t = y_t \]
  \[ \hat{\xi}_t = c_z \hat{z}_t + c_y \hat{y}_t + c_k \hat{k}_{t+1} + c_b b^r_{t+1} \]

- Based on constructed time series (1984-2009.1) we estimate
  \[ \begin{pmatrix} \hat{z}_{t+1} \\ \hat{\xi}_{t+1} \end{pmatrix} = A \begin{pmatrix} \hat{z}_t \\ \hat{\xi}_t \end{pmatrix} + \begin{pmatrix} \epsilon_{z,t+1} \\ \epsilon_{\xi,t+1} \end{pmatrix} \]
Fig 3: Productivity Shocks only: Data (thick line), No Financial Frictions (-), Financial Frictions (--)
Fig 6: Impulse Responses to Productivity Shock

$\xi V = \mathcal{F}(z, k, l)$
Fig 4: Model with Financial Shocks versus Data (thick line)
Fig 7: Impulse Responses to Financial Shock

1. Financial Shock
2. Enforcement Constraint Multiplier, $\mu$
3. Output
4. Hours Worked
5. Debt Repurchase/Y
6. Equity Payout/Y
First-order condition for labor

\[ F_l(z, k, l) = w \cdot \left( \frac{1}{1 - \mu \varphi_d(d)} \right) \]
Fig 5: Model with both Shocks and Data (thick line)
Fig 2: Productivity Shocks and Financial Shocks
New project

- Our financial frictions in a model like Smets and Wouters (2007)
- Sticky prices, sticky wages, investment adjustment cost, variable capital utilization, and Taylor rule
- 8 shocks, including our financial shock $\zeta$
Preliminary findings

Variance decomposition

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<tbody>
<tr>
<td>GDP</td>
<td>4.1%</td>
<td>20.4%</td>
<td>3.5%</td>
<td>16.4%</td>
<td>10.9%</td>
<td>2.5%</td>
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<td>42.0%</td>
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<td>Consumption</td>
<td>8.5%</td>
<td>25.4%</td>
<td>39.1%</td>
<td>2.7%</td>
<td>17.0%</td>
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<td>6.4%</td>
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<td>Investment</td>
<td>1.9%</td>
<td>13.9%</td>
<td>13.2%</td>
<td>15.9%</td>
<td>5.6%</td>
<td>2.6%</td>
<td>4.4%</td>
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<td>FF rate</td>
<td>1.0%</td>
<td>30.7%</td>
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<td>3.6%</td>
<td>10.5%</td>
<td>0.8%</td>
<td>25.7%</td>
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<tr>
<td>Hours</td>
<td>1.9%</td>
<td>19.8%</td>
<td>3.9%</td>
<td>16.7%</td>
<td>11.5%</td>
<td>2.7%</td>
<td>0.3%</td>
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<td>Wages</td>
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<td>36.7%</td>
<td>9.3%</td>
<td>8.2%</td>
<td>25.0%</td>
<td>0.9%</td>
<td>2.8%</td>
<td>13.4%</td>
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<td>Debt/Pay</td>
<td>0.7%</td>
<td>16.3%</td>
<td>0.1%</td>
<td>57.4%</td>
<td>0.6%</td>
<td>7.7%</td>
<td>0.8%</td>
<td>16.5%</td>
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<tr>
<td>Inflation</td>
<td>1.2%</td>
<td>19.4%</td>
<td>1.6%</td>
<td>8.6%</td>
<td>2.9%</td>
<td>63.8%</td>
<td>1.0%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>
Conclusion

- The model with financial shocks (and productivity shocks) replicates business cycles for real variables and financial flows reasonably well.
- The simulated model displays significant financial tightening in the recessions of 1991, 2001 and 2008, suggesting an important role for financial shocks in these downturns.