MACROECONOMIC EFFECTS OF FINANCIAL SHOCKS

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PPREFACE

• Financial sector as a source of business cycle fluctuations:
The role of the financial sector in propagating shocks that originate in other sectors of the
economy VS the importance of financial shocks that originate directly in the financial sector.

• The cyclical properties of firms’ equity and debt flows at an aggregate level.
EQUITY PAYOUT AND DEBT REPURCHASE ( / GDP)

- There is some substitutability between equity and debt financing.
- Recessions lead firms to restructure their financial positions by cutting the growth rate of debt and reducing the payments to shareholders.
- The procyclicality of equity payouts and the countercyclicality of debt repurchases.

Great Moderation: corresponds to a break in the volatility in many business cycle variables.

- spurred by regulatory changes, share repurchases had become more common, and this seems to have had a major impact on firms’ payout policies and financial flexibility.

<table>
<thead>
<tr>
<th></th>
<th>Standard deviation (Variable)</th>
<th>Corr (Variable, GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EquPay/GDP</td>
<td>1.13</td>
<td>0.45</td>
</tr>
<tr>
<td>DebtRep/GDP</td>
<td>1.46</td>
<td>-0.70</td>
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</table>
1. Business cycle model with explicit roles for firms’ debt and equity financing: capable of capturing the empirical cyclical properties of the financial flows.
   • Debt is preferred to equity & the firms’ ability to borrow is limited by an “enforcement constraint”
   • Enforcement constraint is subject to random disturbances
   • The disturbances affect the firms’ ability to borrow
   • Refer to disturbances as “financial shocks”

2. Two methodological approaches:
   • The first based on the construction of time series for the financial shocks: Construct series for financial shocks and productivity shocks from data using model restrictions
   • The second based on the structural estimation of the model with Bayesian maximum likelihood methods: A richer model with many more shocks and frictions

3. Evaluate the importance of financial (and productivity) shocks for macroeconomic fluctuation
FINDINGS

• Financial shocks are important not only for capturing the dynamics of financial flows but also for the dynamics of the real business cycle quantities, especially labor.
• Using a richer model financial shocks contribute to almost half of the volatility of output and about 30 percent to the volatility of working hours.
• Despite the differences in methodology—calibration versus estimation—the dynamics induced by financial shocks using the two approaches are similar.
THE MODEL

• Continuum of firms with revenue function

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

• \( z_t \) is an exogenous productivity shock
FINANCIAL STRUCTURE

• Firms raise funds with debt and equity. The cost of borrowing is: \( R_t = 1 + r_t (1 - \tau) \).

• The intera period loan contracted by the firm is: \( l_t = w_t n_t + i_t + d_t + b_t - b_{t+1}/R_t \).

• Using the firm’s budget constraint,
  \[ b_t + w_t n_t + k_{t+1} + d_t = (1 - \delta)k_t + F(z_t, k_t, n_t) + b_{t+1}/R_t, \quad \iff \quad l_t = F(z_t, k_t, n_t) \]

• Debt is preferred to equity, but there is limited enforcement:
  \[ \xi_t \left( k_{t+1} - \frac{b_{t+1}}{1 + r_t} \right) \geq l_t \]

• Higher debt, either intertemporal or intra temporal, makes the enforcement constraint tighter.

• Higher stock of capital relaxes the enforcement constraint.
FINANCIAL STRUCTURE

• The enforcement constraint can be rewritten as:

\[
\left( \frac{\xi_t}{1 - \xi_t} \right) \left[ (1 - \delta)k_t - b_t - w_t n_t - d_t \right] \geq F(z_t, k_t, n_t)
\]

• Rigidities affecting the substitution between debt and equity, Given \( d_t \) the equity payout, the actual cost for the firm is:

\[
\varphi(d_t) = d_t + \kappa \cdot (d_t - \bar{d})^2,
\]

• \( k_t \) and \( b_t \) given, variables under the control of the firm: \( n_t, d_t \).

• A negative financial shock (lower \( \xi_t \)) requires a reduction in equity payout \( d_t \): the firm is forced to increase its equity and reduce the new intertemporal debt.

• If the firm cannot reduce \( d_t \), it has to cut employment.
FINANCIAL STRUCTURE

• Whether the financial shock affects employment depends on the flexibility with which the firm can change its financial structure, i.e., the composition of debt and equity.

• Rigidities affecting the substitution between debt and equity, Given $d_t$ the equity payout, the actual cost for the firm is:

$$\varphi(d_t) = d_t + \kappa \cdot (d_t - \bar{d})^2,$$

Where $\kappa \geq 0$, and $\bar{d}$ is a coefficient equal to the long-run payout target (steady state).

• The parameter $\kappa$ is key for determining the impact of financial shocks.

• When $\kappa = 0$ the economy is almost equivalent to a frictionless economy.

• When $\kappa > 0$, the substitution between debt and equity becomes costly and firms readjust the sources of funds slowly: As a result, financial shocks will have nonnegligible short-term effects on the production decision of firms.
RECURSIVE PROBLEM

\[
V(s;k,b) = \max_{d,n,k',b'} \{d + Em'V(s';k',b') \}
\]

subject to

\[(1 - \delta)k + F(z,k,n) - wn + \frac{b'}{R} = b + \phi(d) + k' \]

\[\xi \left(k' - \frac{b'}{1 + r} \right) \geq F(z,k,n). \]

\[
\{n\} \quad F_n(z,k,n) = w \cdot \left( \frac{1}{1 - \mu \varphi_d(d)} \right),
\]

\[
\{k_{t+1}\} \quad Em' \cdot \left( \frac{\varphi_d(d)}{\varphi_d(d')} \right) [1 - \delta + (1 - \mu \varphi_d(d'))F_k(z',k',n')] + \xi \mu \varphi_d(d) = 1,
\]

\[
\{b_{t+1}\} \quad Re'm' \cdot \left( \frac{\varphi_d(d)}{\varphi_d(d')} \right) + \xi \mu \varphi_d(d)\left( \frac{R}{1 + r} \right) = 1.
\]
HOUSEHOLD SECTOR

• There is a representative consumer with standard preferences: \[ E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, n_t), \]

• Budget constraint:

\[ \begin{align*}
\{ n_t \} & \quad w_t U_c(c_t, n_t) + U_n(c_t, n_t) = 0, \\
\{ b_{t+1} \} & \quad U_c(c_t, n_t) - \beta(1 + r_t) EU_c(c_{t+1}, n_{t+1}) = 0, \\
\{ s_{t+1} \} & \quad U_c(c_t, n_t)p_t - \beta E(d_{t+1} + p_{t+1})U_c(c_{t+1}, n_{t+1}) = 0.
\end{align*} \]

\[ p_t = E_t \sum_{j=1}^{\infty} \left( \frac{\beta^j \cdot U_c(c_{t+j}, n_{t+j})}{U_c(c_t, n_t)} \right) d_{t+j}. \]

• Firms are owned by households, so that: \[ m_{t+j} = \beta^j U_c(c_{t+j}, n_{t+j}) / U_c(c_t, n_t). \]
SOME CHARACTERIZATION OF THE EQUILIBRIUM

• PROPOSITION 1: if $\tau > 0$ the enforcement constraint binds in a steady state.
  • As long as there is a tax benefit of debt, the enforcement constraint is binding in a steady state.
  • With uncertainty, the constraint may not be always binding because firms could reduce their borrowing in anticipation of future shocks.
  • The constraint is always binding if $\tau$ is sufficiently large and the shocks are sufficiently small.
SOME CHARACTERIZATION OF THE EQUILIBRIUM

• PROPOSITION 2: With $\tau = 0$ and $\kappa = 0$, changes in $\xi$ have no effect on employment $n$ and next period capital $k'$. 
  • when $\tau = 0$ and $\kappa = 0$, business cycle fluctuations are driven only by productivity. The model
    becomes a standard RBC where firms are indifferent between debt and equity.
CONSTRUCTING THE SHOCKS

• Productivity shocks are standard Solow residuals

\[ \hat{\zeta}_t = \hat{y}_t - \theta \hat{k}_t - (1 - \theta) \hat{n}_t, \]

• Financial shocks are measured with the linearized enforcement constraint

\[ \xi_t \left( k_{t+1} - \frac{b_{t+1}}{1 + r_t} \right) = y_t. \]

• Based on constructed time series (1984-2009.1) we estimate

\[ \begin{pmatrix} \hat{\zeta}_{t+1} \\ \hat{\xi}_{t+1} \end{pmatrix} = A \begin{pmatrix} \hat{\zeta}_t \\ \hat{\xi}_t \end{pmatrix} + \begin{pmatrix} \epsilon_{\zeta, t+1} \\ \epsilon_{\xi, t+1} \end{pmatrix}, \]
Findings
TIME SERIES OF SHOCKS TO PRODUCTIVITY AND FINANCIAL CONDITIONS

- Level of productivity, $z$
- Level of financial conditions, $\xi$
- Lagrange multiplier, $\mu$

- Innovations to productivity, $\epsilon_z$
- Innovations to financial conditions, $\epsilon_\xi$
- Index of tightening standard
RESPONSE TO PRODUCTIVITY SHOCKS ONLY
RESPONSE TO FINANCIAL SHOCKS ONLY

- GDP
- Hours worked
- Debt repurchase
- Equity payout
RESPONSE TO BOTH PRODUCTIVITY AND FINANCIAL SHOCKS
EXTENDED MODEL AND STRUCTURAL ESTIMATION

• Business Sector

\[
V(s;p_{-1},i_{-1},k,b) = \max_{d,n,u,p,i,k',b'} \left\{ d + Em'V(s';p,i,k',b') \right\}
\]

subject to

\[
P[F(k,u,n;s) - \Psi(u)k] + \frac{b'}{R} - b = Wn + PG(p_{-1},p;s)
\]

\[
\quad + P\varphi(d) + Pi
\]

\[
\xi \left( k' - \frac{b'}{P(1 + r)} \right) \geq F(k,u,n;s)
\]

\[
\frac{p}{P} = D(k,u,n;s)
\]

\[
(1 - \delta)k + \Upsilon(i_{-1},i;\zeta) = k'.
\]
FINDINGS

• Financial shocks contribute significantly to the volatility of the growth rate of output (46 percent), investment (25 percent), and labor (33 percent).
• Financial shocks, however, contribute only marginally to the volatility of consumption.
THANK YOU