Financial Intermediation and Credit Policy in Business Cycle Analysis

Mark Gertler and Nobuhiro Kiyotaki

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  Household
  Banks
  Non Financial firms
  Equillibrium

Policies

Calibration and Simulation

Results

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Current crisis has been characterised by disruptions in financial intermediation and FED used unconventional MP to handle the crisis.

Most of the previous literature focussed on models with frictionless capital markets or frictions on non financial firms.

In this paper K&G focus on a real business cycle model with some frictions (financial intermediation and liquidity risk).

How credit market frictions may affect real activity?

How various credit policies may work given crisis scenario?
Continuum of households, Continuum of firms, Continuum of bank (continuum of islands)
Goods and Capital goods producers
Government/Central Bank
Two type of island: Investing and Non investing
Capital is homogeneous

$\psi_{t+1}$ capital quality shock (Markov process), $\pi$ investment opportunity arrival (i.i.d.)
Each household has $1 - f$ "workers" and $f$ "bankers".

- Bankers exit next period with i.i.d prob $1 - \sigma$, the retained earnings is transferred to the household.
- Same number of bankers (as exiting) are born out of worker force.
- Bank pays dividends only when it exits and becomes a worker.
Household chooses consumption, labor supply, and riskless debt \((C_t, L_t, D_{ht+1})\) to maximize expected discounted utility

\[
\text{Max } E_t \sum_{i=0}^{\infty} \beta^i \left[ \ln C_{t+i} - \gamma C_{t+i-1} - \frac{\chi}{1 + \varepsilon} L_{t+i}^{1+\varepsilon} \right]
\]

s.t. \(C_t = W_t L_t + \Pi_t - T_t + R_t D_{ht} - D_{ht+1}\)

- Complete Consumption insurance: Workers and firms belong to the big group in household
- Workers and bankers return their wages and earnings, respectively, to the household
Flow-of-funds constraint: \( Q_t s_t = n_t^h + b_t^h + d \)

Expected present value of future dividends: \( V_t = E_t \sum_{i=1}^{\infty} (1 - \sigma)^{\sigma - 1} \Lambda_{t,t+i} n_{t+i}^h \)

Value of Bank satisfies the Bellman Equation:

\[
V_{t-1}(s_{t-1}, b_{t-1}, d_{t-1}) = E_{t-1} \Lambda_{t-1,t} \sum_{h=i,n} \pi^h \left\{ (1 - \sigma) n_{t}^h + \sigma \text{Max}_{s_t^h, b_t^h, d_t} \left[ \text{Max}_{s_t, b_t, d_t} V_t(s_t^h, b_t^h, d_t) \right] \right\}
\]

Incentive Constraint: \( V_t(s_t^h, b_t^h, d_t) \geq \theta (Q_t^h s_t^h - \omega b_t^h) \)

- Agency problem: Banker may divert a fraction, \( \theta \) of the total assets back to its family.
- The net worth of banks evolve as per the capital quality shock and fluctuation in the return of assets (magnified given high leverage ratio)

\[
n_t^h = [Z_t + (1 - \delta) Q_t^h] \psi_t s_{t-1} - R_{bt} b_{t-1} - R_t d_{t-1}
\]
It can be shown that the value function is linear:

\[ V_t(s_t^h, b_t^h, d_t) = V_{st} s_t^h - V_{bt} b_t^h - V_t d_t \]

Case I: Frictionless interbank mkt: At aggregate level,

\[ Q_t S_t = \phi_t N_t, \] where \( \phi_t \) is the leverage ratio.

\[ \mu_t \equiv V_{bt} = \frac{V_{st}}{Q_t} - V_t > 0 \]

\[ E_t \Lambda_{t,t+1} \Omega_{t+1} R_{kt+1} = E_t \Lambda_{t,t+1} \Omega_{t+1} R_{bt+1} > E_t \Lambda_{t,t+1} \Omega_{t+1} R_{t+1} \]

Case II: Frictional interbank mkt: At aggregate level,

\[ Q_t^h S_t^h \leq \phi_t^h N_t^h. \]

\[ \mu_t^h \equiv V_{bt}^h = \frac{V_{st}^h}{Q_t^h} - V_t^h \quad \text{and} \quad \mu_t^i > \mu_t^u \geq 0 \]

\[ E_t \Lambda_{t,t+1} \Omega_{t+1} R_{kt+1}^h > E_t \Lambda_{t,t+1} \Omega_{t+1} R_{bt+1}^h \]

\[ \geq E_t \Lambda_{t,t+1} \Omega_{t+1} R_{bt+1}^h = E_t \Lambda_{t,t+1} \Omega_{t+1} R_{t+1}^h \]
Non Financial firms

- Goods producers: CRS (Cobb-Douglas) with mobile labour, aggregate productivity $A_t$ is Markov process, objective to maximise profits.

- Capital goods producers: Aggregate production function is DRS in the SR, as are subjected to adjustment cost and is CRS in the LR.

- Goods producer borrows from the bank and buys new capital, at the price $Q_t^i$.

  Law of Motion: $K_{t+1} = \psi_{t+1}[I_t + (1 - \delta)K_t]$

  Capital good Producer: $\max E_t \sum_{t=t}^{\infty} A_{t,t} \left\{ Q_t^i I_t - \left[1 + f\left(\frac{I_t}{I_{t-1}}\right)\right] I_t \right\}$

- Lump sum distribution of profits (capital good producers) to the households.

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- Households, Banks and Non financial firms maximise utility and profits, respectively.
- Markets clear in both type of islands (Securities, Labor, Goods, Interbank loans, riskless govt. bonds)
- If $\omega$ indexes (inversly) the relative degree of frictions in interbank market.
  - $\omega = 1$, Frictionless economy: Banks do not face any idiosyncratic liquidity risk (aggregate bank lending is constrained by the aggregate bank capital).
  - $\omega = 0$, Frictional economy: Banks constrained balance sheet disrupts credit flows and thus depresses real activity
The central bank is not 'balance sheet' constrained.

Govt budget const: $G_t + Q_t S_t = T_t + R_t S_{t-1}$

3 possible credit policies ($S_t$)

- Direct Lending (DL): Expansion of the supply of funds in the market at no subsidised rate.
- Direct window lending (liquidity facility) (DWL): Expands total level of assets intermediated by banks on investing islands (CB can enforce repayment)
- Equity injection (EI): Expands value of asset intermediated 1-1

High efficiency cost (evaluation and monitoring).
Lump sum taxes (distortionary) and net earning/profits through participation.
Calibration

- Total 11 parameters (7 are standard preference and technology parameters: $\beta, \gamma, \chi, \epsilon, \alpha, \delta, \eta$)
- They consider both $\omega = 0$ and $\omega = 1$ case
- Crisis simulation
  - Initiation of crisis: Deterioration in value of intermediary portfolios. A 5% unanticipated decline in capital quality with an autoregressive factor of 0.66.
  - Magnification: Leverage ratio, decline in asset value and net worth, asset prices, balance sheet tightens
Table 1 Parameter Values for Baseline Model

<table>
<thead>
<tr>
<th>Households</th>
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<tr>
<td>$\beta$</td>
<td>0.990</td>
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<tr>
<td>$\gamma$</td>
<td>0.500</td>
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<tr>
<td>$\lambda$</td>
<td>5.584</td>
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<tr>
<td>$\epsilon$</td>
<td>0.100</td>
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<th>Financial intermediaries</th>
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<tr>
<td>$\pi'$</td>
<td>0.250</td>
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<tr>
<td>$\theta$</td>
<td>0.383</td>
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<tr>
<td></td>
<td>0.129</td>
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<tr>
<td>$\xi$</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>0.002</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.972</td>
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<th>Intermediate good firms</th>
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<tbody>
<tr>
<td>$\alpha$</td>
<td>0.330</td>
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<tr>
<td>$\delta$</td>
<td>0.025</td>
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<tr>
<th>Capital producing firms</th>
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</thead>
<tbody>
<tr>
<td>$f''/f'$</td>
<td>1.500</td>
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<th>Government</th>
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<tr>
<td>$\frac{G}{Y}$</td>
<td>0.200</td>
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With no credit policy:

- RBC economy: Modest downturn in output and consumption, and high return to capital induces increase in investment and employment.
- Frictionless interbank: Output, investment and employment decline more than in the RBC case.
- Frictional interbank: Overall deterioration is further magnified. Sharp rise in credit spread.

With credit policy (DL):

- Frictionless interbank: Dampening of overall decline in output, investment and rise in spread.
- Frictional interbank: Policy effectively dampens the overall deterioration and is in fact much more effective as compared to the previous case.
Figure 1 Crisis experiment: Perfect interbank market.
Figure 2 Crisis experiment: Imperfect interbank market.
Figure 3 Lending facilities: Perfect interbank market.
Figure 4: Lending facilities: Imperfect interbank market.

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