Banks, Liquidity Management, and Monetary Policy

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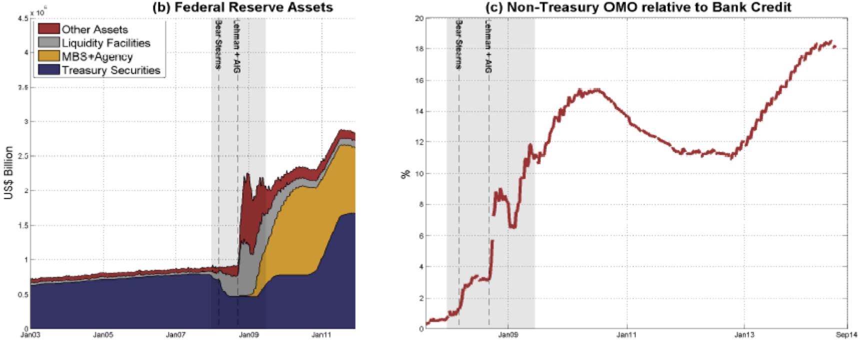
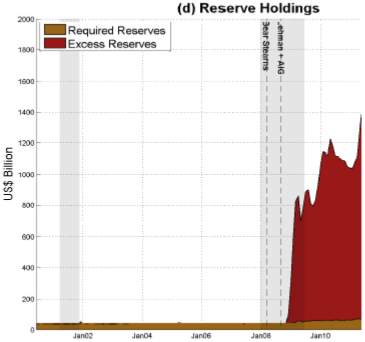
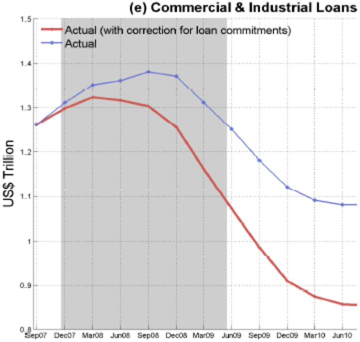
Motivation


(b) Federal Reserve Assets
x 10^6
Other Assets
Liquidity Facilities
MBS+Agency
Treasury Securities
Bear Stearns
Lehman + AIG
US$ Billion
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Jan03
Jan05
Jan07
Jan09
Jan11
(c) Non-Treasury OMO relative to Bank Credit
Bear Stearns
Lehman + AIG
%
0
2
4
6
8
10
12
14
16
18
20
Jan09
Jan11
Jan13
Sep14

Motivation


(d) Reserve Holdings
Required Reserves
Excess Reserves
Bear Stearns
Lehman + AIG
US$ Billion
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan02
Jan04
Jan06
Jan08
Jan10


(e) Commercial & Industrial Loans
Actual (with correction for loan commitments)
Actual
US$ Trillion
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
Sep07
Dec07
Mar08
Jun08
Sep08
Dec08
Mar09
Jun09
Sep09
Dec09
Mar10
Jun10

Motivation

- In response to these unprecedented policy interventions, banks seem to have accumulated central bank reserves without renewing their lending activities as intended. Why?
- Can central banks do more to stimulate lending?

Outline

The Mechanism

- The main building block of our model is a liquidity management problem
- Bank's liquidity risk
- Trade-off between profiting from lending and incurring additional liquidity risks

Model Features

- We introduce this liquidity management problem into a dynamic stochastic general equilibrium model with rational, profit-maximizing banks

- We are able to reduce the state space into a single aggregate endogenous state: the aggregate value of bank equity

Quantitative Application

The theoretical framework to investigate qualitatively and quantitatively why banks are not lending despite all the policy efforts

- Hypothesis 1 - Bank Equity Losses: Lack of lending responds to an optimal behavior by banks given the equity losses suffered in 2008.

- Hypothesis 2 - Capital Requirements: The anticipation of higher capital requirements is leading banks to hold more reserves and simultaneously lend less.

Quantitative Application

- Hypothesis 3 - Increased Precautionary Holdings of Reserves: Banks hold more reserves because they now face greater liquidity risk.

- Hypothesis 4 - Interest on Excess Reserves: Interest payments on excess reserves has led banks to substitute reserves for loans.

- Hypothesis 5 - Weak Demand: Banks face a weaker demand for loans. This hypothesis encompasses a direct shock to the demand for loans or a decline in the effective demand for loans that could follow from increases in credit risk.

Banks

$$\mathbb{E}_0 \sum_{t \geq 0} \beta^t U\left(DIV_t\right)$$

where $U(DIV) = \frac{DIV^{1-\gamma}}{1--\gamma}$ and DIV_t is the banker's consumption at date t

Loans

- Banks make loans during the lending stage
- The flow of new loan issuances is I_t

$$B_{t+1} = \delta B_t + I_t.$$

- When banks grant a loan, they provide the borrower a demand deposit account that amounts to $q_t I_t$, where q_t is the price of the loan

Demand Deposits

- Deposits earn a real gross interest rate $R^D = (1 + r^d)$
- In the balancing stage, banks are subject to random deposit withdrawals $w_t D_t$, where $w_t \sim F_t(.)$ with support in $(-\infty, 1]$
- ASSUMPTION 1. Deposits remain within the banking system: $\int_{-\infty}^{1} w_t dF_t(w) = 0, \forall t$

Reserves

- p_t = price of reserves in term of deposits
- $p_t C_t \geq \rho D_t (1 - w_t) / R^D$
- Lending rate Fed : r_t^{DW} , Borrowing rate Fed : r_t^{ER}
- $r_t^{DW} \geq r_t^{ER}$

Interbank Market

- r^{FF} : net rate of fed funds
- M^+ : mass of dollars in lending side
- M^- : mass of dollars in borrowing side
- The probability that a borrowing order finds a lending order : $\gamma^- = min(1, M^+/M^-)$
- The probability that a lending order finds a borrowing order : $\gamma^+ = min(1, M^-/M^+)$

Interbank Market

$$\frac{r^{FF} - r_t^{ER}}{(1 + r_t^{DW}) - (1 + r^{FF})} = \frac{(1-\xi)}{\xi}.$$

Lending Stage

$$\frac{\tilde{D}}{R^D} = D + qI + DIV + \varphi p - B(1-\delta).$$

Problem 2 *In the lending stage, banks solve the following:*

$$\begin{aligned}
V^l(C,B,D;X) &= \max_{I,DIV,\varphi} U(DIV) + \mathbb{E}\left[V^b(\tilde{C},\tilde{B},\tilde{D};\tilde{X})\right] \\
\frac{\tilde{D}}{R^D} &= D + qI + DIV + p\varphi - B(1-\delta) \\
\tilde{C} &= C + \varphi \\
\tilde{B} &= \delta B + I \\
\frac{\tilde{D}}{R^D} &\leq \kappa\left(q\tilde{B} + p\tilde{C} - \frac{\tilde{D}}{R^D}\right); \tilde{B},\tilde{C},\tilde{D} \geq 0.
\end{aligned}$$

Balancing Stage

$$x = \rho \underbrace{\left(\frac{\tilde{D} - \omega \tilde{D}}{R^D}\right)}_{\substack{\text{End-of-Stage} \\ \text{Deposits}}} - \underbrace{\left(\tilde{C}p - \frac{\omega \tilde{D}}{R^D}\right)}_{\substack{\text{End-of-Stage} \\ \text{Reserves}}}.$$

$$\chi_l = \gamma^+ r^{FF} + \left(1 - \gamma^+\right) r_t^{ER}.$$

$$\chi_b = \gamma^- r^{FF} + \left(1 - \gamma^-\right) r_t^{DW}.$$

Balancing Stage

Problem 3 *The value of the bank's problem during the balancing stage is as follows:*

$$\begin{aligned}
V^b(\tilde{C},\tilde{B},\tilde{D};\tilde{X}) &= \beta\mathbb{E}\left[V^l(C',B',D';X')|\tilde{X}\right]\\
D' &= \tilde{D}(1-\omega)+\chi(x)\\
B' &= \tilde{B}\\
x &= \rho\left(\frac{\tilde{D}-\omega\tilde{D}}{R^D}\right)-\left(\tilde{C}p-\frac{\omega\tilde{D}}{R^D}\right)\\
C' &= \tilde{C}-\frac{\omega\tilde{D}}{p}.
\end{aligned}$$

Here χ represents the illiquidity cost, the return/cost of excess/deficit of reserves:

$$\chi(x)=\begin{cases}\chi_l x \; if \;\; x\leq 0\\ \chi_b x \;\; if \;\; x>0\end{cases}$$

Lending Stage

Problem 4 *The bank's problem during the lending stage is as follows:*

$$
\begin{aligned}
V^l(C,B,D,X) &= \max_{\{I,DIV,\varphi\}} U\left(DIV\right)\ldots \qquad (1)\\
&+\beta\mathbb{E}\left[V^l\left(\tilde{C}-\frac{\omega'\tilde{D}}{p},\tilde{B},\tilde{D}(1-\omega')+\chi\left(\frac{(\rho+\omega'\left(1-\rho\right))\tilde{D}}{R^D}-\tilde{C}p\right),X'|X\right)\right]\\
\frac{\tilde{D}}{R^D} &= D+qI+DIV_t+p\varphi-B(1-\delta)\\
\tilde{B} &= \delta B+I\\
\tilde{C} &= \varphi+C\\
\frac{\tilde{D}}{R^D} &\leq \kappa\left(\tilde{B}q+\tilde{C}p-\frac{\tilde{D}}{R^D}\right).
\end{aligned}
$$

Single State

- $E = pC + (\delta q + 1 - \delta)B - D$

Proposition 1 (Single-State Representation)

$$
\begin{aligned}
V(E) &= \max_{\tilde{C},\tilde{B},\tilde{D},DIV} U(DIV) + \beta \mathbb{E}\left[V(E')|X\right] \\
E &= q\tilde{B} + p\tilde{C} + DIV - \frac{\tilde{D}}{R^D} \\
E' &= (q'\delta + 1 - \delta)\,\tilde{B} + p'\tilde{C} - \tilde{D} - \chi\left(\frac{(\rho + \omega'(1-\rho))\tilde{D}}{R^D} - \tilde{C}p\right) \\
\frac{\tilde{D}}{R^D} &\leq \kappa\left(\tilde{B}q + \tilde{C}p - \frac{\tilde{D}}{R^D}\right).
\end{aligned}
$$

Loan Demand

$$q_t = \Theta_t \left(I_t^D\right)^{\epsilon}, \epsilon > 0, \Theta_t > 0,$$

The Fed's Balance Sheet and Its Operations

$$
\begin{aligned}
M_{t+1}^{0} &= M0_t + \varphi_t^{Fed} \\
\frac{D_{t+1}^{Fed}}{R^D} &= D_t^{Fed} + p_t \varphi_t^{Fed} + (1-\delta) B_t^{Fed} - q_t I_t^{Fed} + \chi_t^{Fed} - T_t \\
B_{t+1}^{Fed} &= \delta B_t^{Fed} + I_t^{Fed}.
\end{aligned}
$$

$$
\chi_t^{Fed} = \underbrace{r_t^{DW}\left(1-\gamma^{-}\right) M^{-}}_{\text{Earnings from Discount Loans}} - \underbrace{r_t^{ER}\left(1-\gamma^{+}\right) M^{+}}_{\text{Losses from Interest Payments on Excess Reserves}}.
$$

$$
p_t\left(M_{t+1}^{0} - M0_t\right) + (1-\delta) B_t^{Fed} + \chi_t^{Fed} = D_{t+1}^{Fed}/R^D - D_t^{Fed} + q_t\left(B_{t+1}^{Fed} - \delta B_t^{Fed}\right) + T_t.
$$