Liquidation, Asset Prices and the Recycling Channel of Bank Lending

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Non-Performing Loans in the banking system:

Failure in collecting all payments on time

Bank choices:

Liquidation

Reposses collateral and sell in asset markets

Rollover

Allow to operate without collecting interest or principal

Japanese "evergreening" case - non-recognition of problem loans
Asset price effects:

Liquidation depresses asset prices by increasing supply.

liquidation stops when asset prices too low:

Chen et al. (2006), Kobayashi et al. (2002)

Bank lending to new firms from liquidation receipts generates new demand:

Recycling channel of bank lending

Individual banks have little control over fluctuations in asset markets:

most are too small to affect collateral markets
Capital Adequacy Regulation (CAR)

Basel II minimum: Tier 1 plus Tier 2 capital at 8% of risk weighted assets

Basel Committee on Banking Supervision (2006)

Proxy for bank health

Equal to Capital/Lending in this model

Kashyap & Stein 2004: CAR regulation is procyclical

Of interest: Effects on asset price

CAR may limit the amount of lending and hence asset price
Illustration of Model

Basic setup: banks, firms, asset holders, asset market

A) without lending from liquidation

B) with lending to get asset price support

C) with CAR
Basic Setup

1) Banking sector

Numerous identical banks

Initial deposits of $d$, capital $z$, available for lending

Deposits are assumed to be amount available for lending only

Deposits pay no interest
Two period loans to $P_{-1}$ firms at $l_{-1}$ each, already in operation in period 0

Interest payments in periods 0 and 1. Principal repaid in period 1

Assumption: Banks have maximised profit by lending out all funds

$$d + z = P_{-1}l_{-1}$$
2) Firms sector

$P_{-1}$ firms. Each has endowment of $\tilde{k}$.

Must borrow from banks to purchase assets for production

Project success rate $\pi$

Rolled over projects success rate is $\theta < \pi$
3) Asset holders

Hold assets not invested in production

Absorbs assets sold by banks and bought by firms

Own marginal productivity is $H'(K - \sum k_0)$.

$$\sum k_0 = \text{total assets invested in production}$$

Satisfies neoclassical assumptions: $H'(x) > 0$ and $H''(x) < 0$
4) Asset market

The behaviour of asset prices in period 0

\[ q_0 = \frac{1}{R} H'(K - \sum k_0) + \frac{E q_1}{R} \]

The present value of a unit of asset is equal to discounted marginal return plus resale value next period

See Kiyotaki and Moore (1997)

Small individual banks do not take account of asset prices, but collectively, they influence the asset market.
A) Model without lending from liquidation

Exogenous NPL shock: \( N \) out of \( P_{-1} \) firms do not pay interest \( i_0 \)

Banks choose to liquidate \( M \) firms out of \( N \) firms, but not the asset price.

After liquidation, banks hoard the proceeds.

\[
\max_{M} \frac{1}{R} \left[ (P_{-1} - N) (1+i_1) \pi l_{-1} + (N-M) \theta (1+i_0 + i_1) l_{-1} \right] + q_0 M k_{-1} (1-c)
\]

Liquidation attracts transaction cost \( c \)
At the optimum, asset price is

\[ q_0 = \frac{\theta(1 + i_0 + i_1)l_{-1}}{Rk_{-1}(1 - c)} \]

Relationship between asset price and liquidation is negative \( (H''(x) < 0) \)

\[ q_0 = \frac{1}{R} H'(K - P_{-1}k_{-1} + Mk_{-1}) \]
B) Model with lending to get asset price support

$P_0$ new firms enter the economy in period 0. Project success rate $\pi$.

Cash inflow from interest $(P_{-1} - N)i_0l_{-1}$ & liquidation $q_0Mk_{-1}(1 - c)$

Lends out available cash at $l_0$ to each of $P_0$ new firms

Banks choose liquidation $M$ and also loan size $l_0$

Liquidation depresses asset price, new purchases support it.
Borrowing by new firms are subject to the following.

**Binding budget constraint:**

\[ q_0k_0 = q_0\tilde{k} + l_0 \]

**Binding borrowing constraint:**

\[ l_0 = Eq_1k_0(1 - c)/R \]
Bank’s problem:

\[
\max_{M,l_0,R} \frac{1}{R} [(P_{-1} - N)(1 + i_1)\pi l_{-1} + (N - M)\theta(1 + i_0 + i_1)l_{-1} + P_0 l_0 \pi (1 + i_1)]
\]

Subject to

\[
d + z - P_{-1} l_{-1} + (P_{-1} - N) i_0 l_{-1} + q_0 M k_{-1} (1 - c) = P_0 l_0
\]
At the optimum, asset price is

$$q_0 = \frac{\theta(1 + i_0 + i_1)l_{-1}}{\pi(1 + i_1)k_{-1}(1 - c)}$$

Relationship between new loan size and liquidation is positive: \( \frac{\partial l_0}{\partial M} > 0 \)

Notice relation of \( M \) with liquidation and rollover payoffs.

There is now a larger amount of liquidation and hence new lending. The asset price is higher than the no lending case.
Proposition 1:

The asset price will rise if the proportional cost of liquidation $c$ is smaller than the down payment as a fraction of total investment $\frac{\tilde{k}}{k_0}$. Otherwise, the asset price will drop.
Relationship between asset price and liquidation with new lending

\[ q_0 = \frac{1 - c}{R} \cdot \frac{k_0}{\tilde{k} - ck_0} \cdot H'(K - P_{-1}k_{-1} + M k_{-1} - P_0 k_0) \]

Therefore:

\[ \frac{\partial q_0}{\partial M} = \left( \frac{1 - c}{R} \cdot H'(\bullet) \cdot \frac{\partial \frac{k_0}{\tilde{k} - ck_0}}{\partial k_0} \cdot \frac{\partial k_0}{\partial M} \right) + \left( \frac{1 - c}{R} \cdot \frac{k_0}{\tilde{k} - ck_0} \cdot \frac{\partial H'(\bullet)}{\partial (\bullet)} \cdot \frac{\partial (\bullet)}{\partial k_0} \cdot \frac{\partial k_0}{\partial M} \right) \]
If liquidation cost is sufficiently large:

\[ c > \frac{\tilde{k}}{k_0}, \text{ then } \tilde{k} - ck_0 < 0 \text{ and } \frac{\partial q_0}{\partial M} < 0. \text{ Otherwise } \frac{\partial q_0}{\partial M} > 0. \]

Large transaction cost means less money is lent out to new firms

Less support to asset market.

By not liquidating all bad loans, it means that there is some forbearance due solely to profit maximisation
C) Model with new lending and CAR

Minimum Capital ratio = \( CR \)

In period -1, capital ratio \( CR_{-1} = \frac{z}{P_{-1}l_{-1}} = CR \).

Assumption: Both cash and CAR constraints bind in period -1.

Assumption: Rollover of loans does not produce effect on balance sheet

Japanese case: non-recognition of problem loans

Cash inflows accrue to Capital account as profit: \( (P_{-1} - N)i_0l_{-1} + q_0Mk_{-1}(1 - c) \)

Write off reduces Capital by \( Ml_{-1} \)
## Balance sheet at end of period 0

<table>
<thead>
<tr>
<th>Cash</th>
<th>Deposits</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d + z - P_{-1}l_{-1} + (P_{-1} - N)i_0 l_{-1}$</td>
<td>$d$</td>
<td>$z + (P_{-1} - N)i_0 l_{-1} - Ml_{-1}$</td>
</tr>
<tr>
<td>$+ q_0 Mk_{-1}(1 - c) - P_0 l_0$</td>
<td></td>
<td>$+ q_0 Mk_{-1}(1 - c)$</td>
</tr>
<tr>
<td>$P_{-1}l_{-1} - Ml_{-1} + P_0 l_0$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Capital ratio is

\[
CR_0 = \frac{z + (P_{-1} - N)i_0 l_{-1} + q_0 Mk_{-1}(1 - c) - Ml_{-1}}{P_{-1}l_{-1} - Ml_{-1} + P_0 l_0} \geq CR.
\]
Bank’s problem

$$\max_{M, l_0} \frac{1}{R} \left[ (P_{-1} - N)(1 + i_1)\pi l_{-1} + (N - M)\theta(1 + i_0 + i_1)l_{-1} + P_0 l_0 \pi (1 + i_1) \right]$$

Subject to

$$z + (P_{-1} - N)i_0 l_{-1} + q_0 M k_{-1}(1 - c) - M l_{-1} \geq CR(P_{-1} l_{-1} - M l_{-1} + P_0 l_0)$$

and

$$d + z - P_{-1} l_{-1} + (P_{-1} - N)i_0 l_{-1} + q_0 M k_{-1}(1 - c) \geq P_0 l_0$$
Assume the CAR constraint binds, but cash constraint is lax.

That means banks cannot lend out all available cash due to capital requirement.

Banks are limited from lending too much.
The asset price is

\[
q_0 = \frac{[CR\theta(1 + i_0 + i_1) + (1 - CR)\pi(1 + i_1)]l_{-1}}{\pi(1 + i_1)k_{-1}(1 - c)}
\]

Relationship between number of new loans and liquidation is also positive:

\[
M = \frac{\pi(1 + i_1)[z + (P_{-1} - N)i_{0}l_{-1} - CR(P_{-1}l_{-1} + P_{0}l_{0})]}{-CR\theta(1 + i_0 + i_1)l_{-1}}
\]
When does the CAR constraint bind?

There is only one point at which both constraints bind.

Rearrange constraints:

\[ l_0 = \frac{1}{P_0} [(P - N)k_{0}l_{-1} + q_{0}Mk_{-1}(1 - c)], \]

\[ l_0 = \frac{1}{CRP_0} \{ (P - N)k_{0}l_{-1} + M[q_{0}k_{-1}(1 - c) - (1 - CR)l_{-1}] \}. \]

Determine feasible sets and intercepts.
Proposition 2

The CAR constraint will only bind at any stage of bank liquidation if receipt from each case of sale is smaller than its write off on the balance sheet.

When this is the case, a loss recognised on the balance sheet for each sale, and the deterioration in financial position causes the CAR to bind.
Figure 1: the constraints cross when \( q_0k_{-1}(1 - c) < l_{-1} \)

Liquidation receipt per case is smaller than its write off to capital

When CAR binds, banks are constrained from liquidating too much

Figure 2: \( q_0k_{-1}(1 - c) > l_{-1} \): liquidation receipt larger than write off

Bank makes profit on balance sheet from each case of liquidation

Capital rises with each case of liquidation \( \Rightarrow \) CAR never binds
Figure 1: The cash and CAR constraints cross
Figure 2: The CAR constraint never binds
Assuming CAR constraint is tighter than cash at some range

If optimal level of liquidation is larger, based on values of exogenous parameters, than the intersection point, then only CAR binds.

If lower, then the cash constraint binds. CAR regulation does not matter.

When the CAR constraint binds: amount of liquidation drops and forbearance arises due to protection bank health, not profit maximisation.

Provides rationale for evergreening non-performing loans
Proposition 3

If minimum capital requirements are binding on banks, then the asset price rises when such capital requirements are lowered and vice versa. If it is not binding, then there is no effect.

Minimum capital requirement and asset prices

\[
\frac{\partial q_0}{\partial CR} = \frac{l_{-1}[\theta(1 + i_0 + i_1) - \pi(1 + i_1)]}{\pi(1 + i_1)k_{-1}(1 - c)}
\]

Sign is negative because CAR only binds when \(\pi(1 + i_1) > \theta(1 + i_0 + i_1)\).
Suggestions for varying capital requirements through the economic cycle to manage the economy may not be always useful.

Perception of CAR as signal of bank safety

Pressure to leave CAR at low level during upturn

Banks may shift activity off balance sheet to circumvent such policy
Conclusion

Recycling channel of bank loans:

generated by liquidation of non-performing loans

provides support to asset prices.

Two sources of forbearance:

profit maximisation - expected rollover vs liquidation payoffs

bank health concerns - binding CAR constraint from write offs

Binding capital regulation inhibits lending and hence asset price
Countercyclical variation of capital requirements can induce lending

but may not be practical as a policy lever