Topic 2
Microeconomics: Banks as Firms

Outline:

1. Models of the banking firm
   a) without risk
   b) with risk
2. Maturity mismatching and the dangers of illiquidity
3. Deposit insurance

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- Early on, portfolio choice models; perfect elasticicties; liabilities as negative assets.
  E.g. Hart and Jaffe (REStud 1974)
- Klein (Monti, Szego) indicate
  - Role of interbank markets
  - "Core" vs. "wholesale" deposit markets
  - MC vs. AC for empirical work

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Klein, JMCB 1971 "Michael A., "A Theory of the Banking Firm"*JMCB*, 3(2), Part 1, 205-218.

No uncertainty here, although Klein has some related to reserve holding.

Assets	Liabilities
Loans (L) Government Bonds (G)	Deposits (D)
	Net Worth (K_0)

3

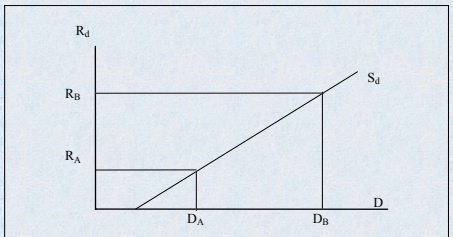

Figure 8-1: Deposit Supply Schedule

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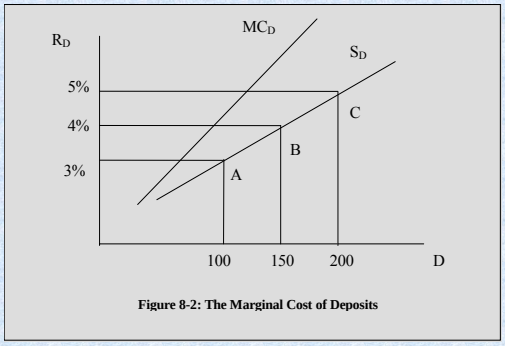

Figure 8-2: The Marginal Cost of Deposits

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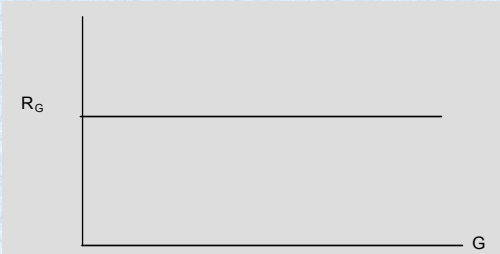

Figure 8-3: Government Bond Returns

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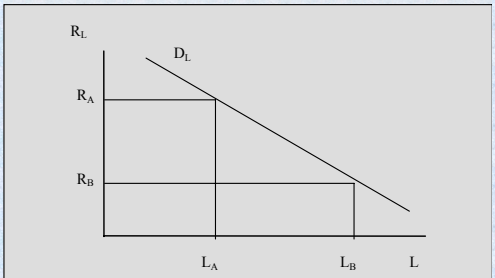

Figure 8-4: Loan Demand Schedule

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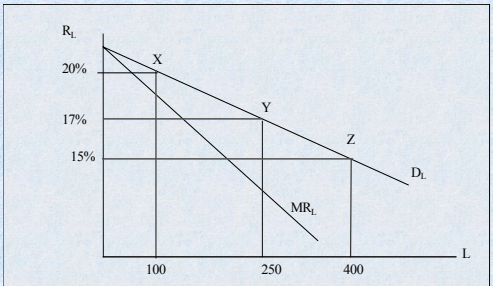

Figure 8-5: The Marginal Revenue from Loans

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Max $\pi = [R_G \cdot G + R_L \cdot \{L(R_L)\}] - R_d \cdot D(R_d)$

s.t. $L(R_L) + G = D(R_D) + K_0$

Initially, ignore non-interest costs and revenues.

1. How large should the bank be (D*, L*)
2. Profit Sources
3. Role of the interbank market

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Algebraic Solution

Max $\pi = R_G \cdot [D(R_D) + K_0 - L(R_L)] + R_L \cdot [L(R_L)] - R_D \cdot [D(R_D)]$
$\{R_D, R_L\}$

F.O.C. ➔

$$R_G = [R_D + D\frac{dR_D}{dD}] \equiv MC_D$$

$$R_G = [R_L + L\frac{dR_L}{dL}] \equiv MR_L$$

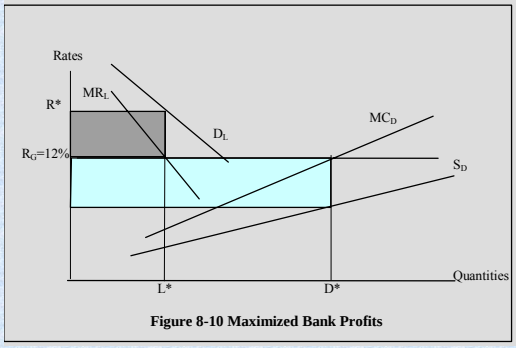

Figure 8-10 Maximized Bank Profits

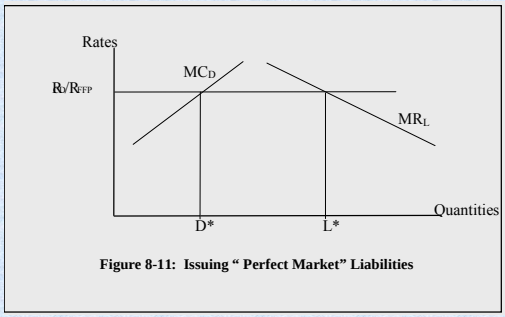

Figure 8-11: Issuing " Perfect Market" Liabilities

Extensions (#1 of 3)

Reserves against Deposits

Assets	*Liabilities*
Cash (= kD)	Deposits
G-bonds	
Loans	K_0

Now the balance sheet constraint is slightly different:

$$G = (1 - k)[D(R_D)] + K_0 - L(R_L)$$

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Now the FOC for deposits is:

$$MC_D = R_G(1-k)$$

Lower equilibrium deposit rate; lower deposits.

Also, distinguish "deposits" vs. "loanable funds" and the interest cost of each.

$$R_{LF} = \frac{R_D}{1-k} > R_D$$

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Extensions (#2 of 3)

Remove reserve requirements.

Introduce Operating Costs and Loan Losses

c_D = proportional cost of servicing deposits

c_L = same, for loans

σ = expected loan loss rate

$$\text{Deposit FOC}: \quad R_G - c_D = MC_D$$

$$\text{Loan FOC}: \quad R_G + c_L + \sigma = MR_L$$

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Extensions (#3 of 3): Marketing (or bancassurance?)

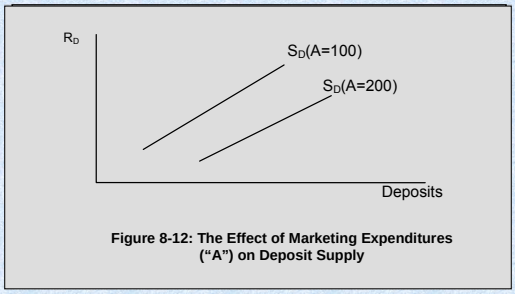

Figure 8-12: The Effect of Marketing Expenditures ("A") on Deposit Supply

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5) Equity Capital and Bank Profitability

Deposit Supply: $D = -1000 + 200R_D$

Loan Demand: $L = 1200 - 100R_L$ K_0 = various levels.

$R_G = 8\%$ Loan Losses: σ = 1% or 1.5% or 0.5%

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Table 8-1: Maximized Profits and ROE for Alternative Capital Levels

K0	D*	L*	Leverage	E(ROE)	Std(ROE)
$ 30	$ 300	$ 200	11	$ 8.90	3.33%
$ 40	$ 300	$ 200	8.5	$ 9.70	2.50%
$ 50	$ 300	$ 200	7	$ 10.50	2.00%
$ 60	$ 300	$ 200	6	$ 11.30	1.67%
$ 70	$ 300	$ 200	5.29	$ 12.10	1.43%
$ 80	$ 300	$ 200	4.75	$ 12.90	1.25%
$ 90	$ 300	$ 200	4.33	$ 13.70	1.11%

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Concepts illustrated by Klein-Monti model

1. Profit sources
2. Interbank market
3. Core and wholesale funding sources
4. Cost control, underwriting ability, leverage.

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A Bank Model with Risk: Portfolio/Leverage Choices

By put-call parity

$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t)$$

Where K = equity contribution
D = promised debt repayment (zero coupon)
A = current market value of assets (Note: A < K + D)
σ = asset volatility
r_f = riskless rate of interest
t = maturity date of the option (or examination date)

Modigliani-Miller: ex ante, the owners get $K for every $K they put into the firm. Neither leverage nor asset risk adds value.

Ex ante, A = K + D_0

$$D_0 = De^{-r_f t} - PUT(K, D, \sigma, r_f, t)$$

$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t)$$

Hence, if bondholders anticipate appropriately, MVEQ = K for any choice of leverage, risk.

How about ex post? Once the promise to pay "D" has been sold for "D_0", the firm's incentive is to raise asset risk:

$$\frac{\partial MVEQ}{\partial \sigma} = \frac{\partial A}{\partial \sigma} + \frac{\partial PUT}{\partial \sigma} = 0$$

(0) (+)

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Now add deposit insurance, for which a premium may be charged:

$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t) - DI\Pr em(.)$$

Now, $D_0 = De^{-r_f t}$ *and so*

$$MVEQ = (K + De^{r_f t}) - De^{r_f t} + PUT(K, \sigma, ...) - DIPREM$$
$$= K + PUT(K, \sigma, ...) - DIPREM$$

"Fair" DIPREM ➔ MVEQ = K

Fixed or inaccurate DIPREM ➔ MVEQ >(<) K

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Marcus (JBF 1984)

Multi-period, with a charter value.

For expositional ease, set DIPREM=0. So

$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t) + (1 - \Pr(Fail))CV$$

Once again: $D_0 = De^{-r_f t} - PUT(K, D, \sigma, r_f, t)$

$$MVEQ = C(K, D, \sigma, r_f, t) = K + PUT(K, D, \sigma, r_f, t) + (1 - \Pr(Fail))CV$$

$$\frac{\partial MVEQ}{\partial \sigma} = \frac{\partial PUT}{\partial \sigma} - CV\left[\frac{\partial \Pr(Fail)}{\partial \sigma}\right] = 0$$

(+) (+)

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Likewise, CV limits leverage:

$$\frac{\partial MVEQ}{\partial K} = \frac{\partial PUT}{\partial K} - CV\left[\frac{\partial \Pr(Fail)}{\partial K}\right] = 0$$

(-) (-)

Finally, consider bankruptcy costs (BC), which are borne by shareholders (in expectation)

$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t)$$
$$(1 - \Pr(Fail))CV - \Pr(Fail)BC$$

CV and BC have similar effects:

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$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t)$$
$$(1 - \Pr(Fail))CV - \Pr(Fail)BC$$

Summary:

Risk, leverage choices affected by

- deposit insurance and its pricing
- charter value (Keeley (AER 1990)
- bankruptcy costs

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Re-Capitalization

If Marcus' bankers can re-capitalize instantaneously, the possible loss of CV loses its bite.

Common assumption, affecting:

- Bank's need for a capital buffer when supervisor specifies minimum required capital
- Models of credit spreads
  - Merton 1974
  - Collin-Dufresne and Goldstein (JF 2001)
  - Models of "fair" deposit insurance pricing (Pennacchi (JMCB 1987)

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Illiquidity Risk

Liquid deposits (short-term liabilities) financing illiquid loans: an odd couple?

Today, liquid deposits fund even more opaque assets:

Tranches
Credit exposures to OTC counterparties
FX, equity, commodity, credit risk

- Interest rate risk can be hedged
- Risk premium changes canNOT be hedged
- Availability?

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Who cares about illiquidity risk?

A. Just those directly involved?
B. Or are there serious external effects of a single firm's funding risk or failure?
   1) Runs, contagion
      a) Continental Illinois
      b) 1997 Asia
   2) Poor risk diversification
      a) Continental Illinois (1984)
      b) Bear Stearns
      c) Upper and Worms, etc. (red herring)
   3) Price dynamics depart from fundamentals: firms cannot renew debt, must sell assets.
      a) LTCM
      b) 2007-8
      c) Limits to arbitrage

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Why combine short-term deposits with longer-term, illiquid loans?

1. Required for inter-temporal risk-smoothing
2. Deposit insurance makes it possible, and profitable
3. Optimal contracts between depositors and bank shareholders
4. Scope economy between DD and credit lines' reserve management

1. Risk-Smoothing: Diamond and Dybvig (JPE 1983)

First theoretical explanation of why demandable deposits were valuable.

"Banks" solve an insurance problem

- Early vs. late consumers
- Convex return to real investment

See also Bryant 1980.

- Early vs. late diers; all prefer to spread consumption
- Zero return from 0 to 1
- High return from 0 to 2
- Imminent early death not observable to others.
- Demandable debt allows early withdrawals – no questions asked

- All works perfectly if # early deaths known ex ante.
- Stochastic # of early withdrawals can cause havoc.
- The early guys get out whole, so run: "sequential service constraint" (SSC).
- Fear of others' actions become self-fulfilling.
- "Deposit insurance" is claw-back from early withdrawers – reversing SSC.
- This paper has inspired many(!) others.
- Still, real-world implications are more limited than most people understand.

Optimal deposit contracts #2-- Calomiris and Kahn (AER, 1991)

Bank gets early signal of investment quality. Low signal → banker might abscond with the depositors' resources.

Who will monitor the bank?

Make deposits demandable with SSC.

Then, the best monitors can earn a return on their efforts by being first tin line if they see trouble.

- Monitors with a comparative advantage
- Less efficient monitors free-ride
- SSC important!

Notable because it gets the most efficient monitors to do the monitoring.

A response to opacity?

Optimal dep. contracts #3 – Flannery (AER 1994)

Long-term debt could be fashioned to roll off as loans matured. No liquidity problem, and no liquidity creation either.

But debt has a claim on <u>all</u> assets (Stulz JFE 1985, Myers JFE 1977).

So long-term debt

1. Is subject to expropriation, in general
   - Asset substitution
   - Future deposit increases (*pari pasu*).
2. Inhibit taking on safer investments.

Short-term debt minimizes exposure to expropriation. Like a "money back guarantee."

Conclusion: short-term debt is a logical requirement for a firm whose asset quality is not readily certifiable.

Aside: variable rate vs. Auction Rate bonds.

Optimal deposit contracts #4
Kashyap, Rajan and Stein (JF 2002)

Credit lines are an important loan product.

Why do banks, in particular, specialize in lines of credit (e.g. CP backup)?

L/C and DD closely related forms of liquidity
- Aussie definition of "money"
- Both products requires management of reserves

So long as loan draws and deposit flows are not too highly correlated, one firm can provide both products more cheaply than two firms could.

Maturity mismatch due to scope economies

Optimal deposit contracts #5
Gatev and Strahan (JF 2006)

As per Kashyap *et al*., banks are natural suppliers of liquidity.

Empirically, CD inflows occur when CP volumes fall in the open market.

An explanation for bank provision of CP back lines. (Who don't butchers provide this service?)

Makes banks the natural source of CP backup lines (and system-wide "liquidity"?)

Why are banks like this?

Pennacchi (JME 2006) finds no such flows before federal safety net was created in the 1930s.

Suggests value to safety net protection (either *de jure* or *de facto)*.
- O'Hara and Shaw (1990)
- "Too large to reorganize quickly."
- "Four pillars" in Australia.

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Mechanisms related to DI

- Ex ante promises
- How pay the losses?
- Closure policies
- PCA

Deposit Insurance Effects

Positive term premia make short-funding less expensive (in expectation)

DI shields banks from paying a (term) risk premium on their short-funded (mismatched) asset-liability positions.

Is this funding structure
   a) One produced by free market forces?
   b) A market response to mis-priced insurance?

DI Creates a Need for Bank Regulation

Mispriced premia ➔ private risks socialized, rewards remain private.

"Fair" (non-distortive) pricing can be implemented through risk-related

i. premia (analogous to credit default premia)
ii. capital requirement (as in Basel II)
iii. times between exams (Pyle (JBF 1986)

DI pricing not risk-based.

- Some countries don't charge at all for DI
- Even though FDIC can set premia any way it likes, the range is narrow and largely accounting-based.
- How are premia assessed in Europe? Australia?

Acharya (recent): coordinate various aspects of policy.

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Narrow Banking

If deposit insurance is unavoidably distorting, curtail it.

Analog of MMMF (Litan 1987, Pierce 1991)

Good solution, if DI is the cause of the mismatch

But if the "nonbank" financiers would optimally choose maturity mismatch, what have we solved?

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Summary

1. Klein: core deposits, interbank funds, cost economies, merger incentives.

2. Simultaneous choice of leverage, risk. Effects of
   2. deposit insurance
   3. charter value
   4. bankruptcy costs
   5. restrictions on capital contributions

1. Maturity mismatch
   a) creates liquidity
   b) good incentive effects re: bank asset choice
   c) causes risks
      i. Runs
      ii. Price contagion

2. Deposit Insurance

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$$MVEQ = C(K, D, \sigma, r_f, t) = A - De^{-r_f t} + PUT(K, D, \sigma, r_f, t) - DIPrem + (1 - \Pr(Fail))CV - \Pr(Fail)BC$$

DIPrem = explicit premium charged for deposit insurance
Pr(Fail) = probability of failure = call option's "delta"
CV = charter value (Marcus 1984)
BC = deadweight bankruptcy/insolvency costs