Lecture: Liquidity Provision by Intermediaries and Bank Runs

Advanced Macroeconomics
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Some Characteristics of Financial Intermediaries

1. Borrow from one group of economic agents and lend to another.

2. Well-diversified with respect to both assets and liabilities.

3. Transform assets.

4. Diamond-Dybvig (1983) “Bank Runs, Deposit Insurance, and Liquidity”, JPE

The Diamond-Dybvig banking model

- Three periods, 0, 1, and 2.
- Two types of consumers: *impatient* (consume in period 1) and *patient* (consume in period 2)
- In period 0 they do not know their type. They learn their type in period 1
- Asymmetric information: Types are consumers private information
- Efficient economic arrangement is for consumers to set up a bank in order to share risk.
- Given the bank's deposit contract, the bank is open to a *run*, which is a bad equilibrium.

Assumptions (I)

Each consumer has 1 unit of the good in period 0.

Production technology takes 1 unit of good in period 0 and converts into (1 + r) units of the consumption good in period 2.

However, this production technology can also be interrupted in period 1.

If interruption occurs in period 1, then 1 unit of consumption goods can be obtained for each unit of the good invested in period 0.

Assumptions (II)

In period 0, each consumer knows that he or she has a probability t of being an early consumer and probability $1 - t$ of being a late consumer

In period 1, tN consumers learn that they are early consumers and $(1 - t)N$ consumers learn that they are late consumers. We have $0 < t < 1$.

In period 0 consumers maximize expected utility:

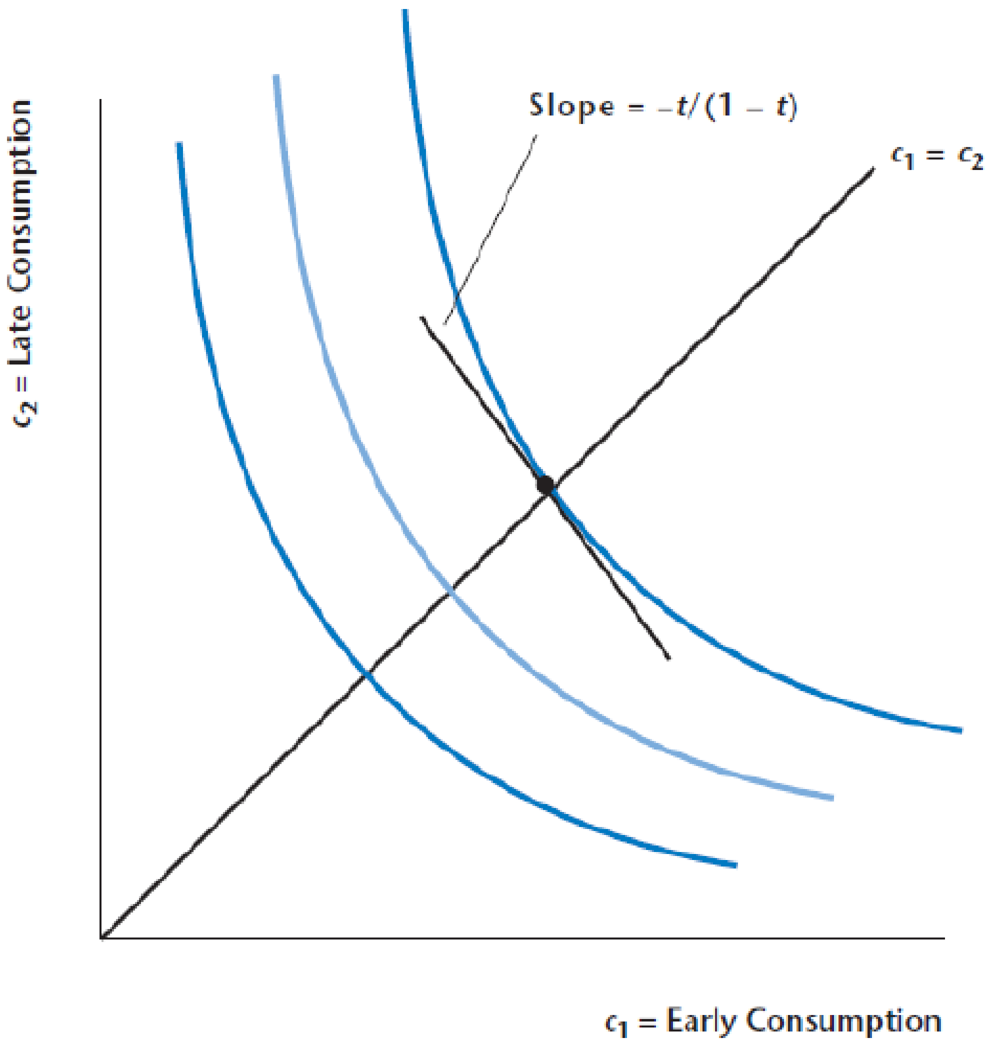
$$u(c_1, c_2) = u(c_1) \text{ with prob. } t \text{ if impatient or}$$
$$u(c_1, c_2) = u(c_1 + c_2) \text{ with prob. } 1 - t \text{ if patient}$$

Marginal rate of substitution

- The marginal rate of substitution of early consumption for late consumption is

$$MRS_{c_1,c_2} = \frac{tMU_{c_1}}{(1-t)MU_{c_2}},$$

The preferences of a Diamond-Dybvig consumer



Autarcy

Invests all of his or her unit of endowment in the technology in period 0.

Then, in period 1, if he or she is an early consumer, then he or she interrupts the technology and is able to consume $c_1 = 1$

If he or she is a late consumer, then the technology is not interrupted and the consumer gets $c_2 = 1 + r$ in period 2 when the investment matures.

Want to show that a bank allows all consumers to do better than this.

Constraints on the Deposit Contract

Let x be the fraction of the investment to interrupt

$$Ntc_1 = xN$$

$$N(1-t)c_2 = (1-x)N(1+r).$$

Combine the two constraints to get one:

$$tc_1 + \frac{(1-t)c_2}{1+r} = 1,$$

Rewrite the constraint

$$c_2 = -\frac{t(1+r)}{1-t}c_1 + \frac{1+r}{1-t},$$

$c_1 = 0$ implies $c_2 = \dfrac{1+r}{1-t}$

$c_2 = 0$ implies $c_1 = \dfrac{1}{t}$

Incentive compatibility constraint

The patient consumer should not want to withdraw earlier

$$c_1 < c_2$$

Characterizing the optimal alocation

Optimal allocation:
First ignore the (IC) constraint (will verify that it will hold)

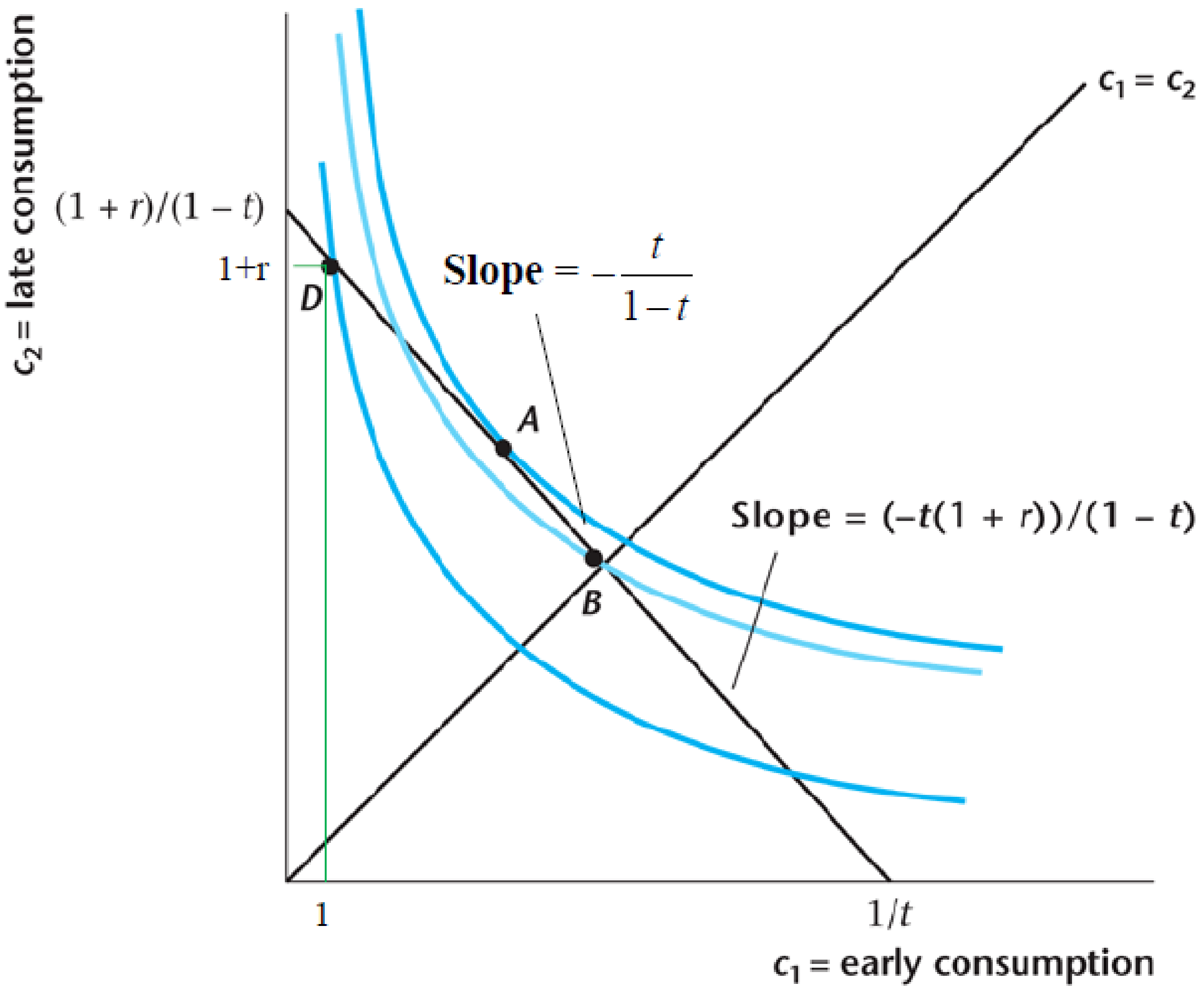
The problem is to maximize the expected utility s.t. the resource constraint. The FOC is:

$$u'(c_1^*) = (1+r)u'(c_2^*)$$

This implies: $c_1^* < c_2^*$

It follows the (IC) constraint is automatically satisfied
The optimal allocation equates the MRS to the technological price

The equilibrium contract offered by the Diamond Dybvig bank



Optimality of banks

Let the utility function be: $\log(c) = \frac{c^{1-\sigma}}{1-\sigma}$, with $\sigma > 1$

$$MU_c = c^{-\sigma}$$

$$\frac{MU_{c_1}}{MU_{c_2}} = \left(\frac{c_2}{c_1}\right)^{\sigma}$$

in autarcy the expression above is $(1+r)^{\sigma}$

Autarcy vs Optimality

The slope of the indifference curve at B is: $-\frac{t}{1-t}$

The slope of the ind. curve at D is: $-\frac{t}{1-t}(1+r)^{\sigma}$

The slope of the curve at A is: $-\frac{t}{1-t}\left(\frac{c_2}{c_1}\right)^{\sigma}$

At the optimum: $\left(\frac{c_2}{c_1}\right)^{\sigma} = (1+r)$

For $\sigma = 1$, log utility the optimum is the autarcy.

If $\sigma > 1$ then the bank provides **liquidity insurance.** Why?

Optimal contract

- Point D is autarcy $(1, 1 + r)$
- Point A is the optimal point which lies to the southeast of point D
- By accepting the banking contract, the consumer is able to consume more in period 1 at the expense of lower consumption in period 2
- The Diamond-Dybvig bank has some of the properties of financial intermediaries
- The bank holds illiquid assets and is able to convert these assets into liquid deposits

Bank Runs in the Diamond-Dybvig Model

- Suppose that a late consumer believes that all other late consumers will go to the bank to withdraw in period 1.

- If all late consumers think that then there will be a **bank run**.

- Proof: Since $c_1 > 1$ at point *A,* the amount left for period 2 would be

$$\max\{N-(N-1)c_1,0\}<1$$

- Thus, the individual late consumer prefers to go to the line hoping that he can get paid, this is a **bank-run**

How to avoid a bank run?

- Suspension of Convertibility: At date 1 only serve the first tN depositors
- Deposit insurance: The government guarantees that the promised return will be paid to all depositors