

# Financial Intermediation

**Irina A. Telyukova**

UCSD ECON 213  
Advanced Monetary Theory

Spring 2008

## Introduction

- In most monetary search models we have seen, where agents are subject to trading shocks (don't know buyer/seller type in advance), there is an ex-post inefficiency: some agents are holding idle balances, while others are liquidity-constrained.
- Agents in such models typically cannot redistribute money holdings upon shock realization: anonymity and lack of record-keeping preclude lending and borrowing.
- This readily suggests a role for financial intermediaries: firms that may have access to record-keeping in a way that allows redistribution of financial assets, even when agents in bilateral trades are themselves anonymous.

## Berentsen, Camera, Waller (2007)

- Idea: let financial intermediaries (banks) in the economy reallocate money between constrained and unconstrained agents by allowing banks to keep track of agents' financial histories.
- This introduces credit in the economy: banks will loan money to constrained agents.
- A highly non-trivial matter: for money to be essential, lack of record-keeping is key; for credit to exist, record-keeping is necessary. (Credit may then drive out money). Solution: banks cannot observe *trading* histories, so credit between agents still not possible and money remains essential.
- Also: once credit is introduced, issues of repayment and enforcement become important.

# Questions

1. How can money and credit co-exist in an economy where money is essential?
2. Can financial intermediation improve the equilibrium allocation?
3. What is the optimal monetary policy if trade is voluntary (when there is no enforcement)?

## Environment

- Lagos and Wright (2005) with competitive pricing. Bargaining also evaluated.
- Each period: DM followed by CM, but both are perfectly competitive markets.
- $[0, 1]$  continuum of agents producing one perishable good.
- Trade in DM is supported (necessary) because all agents can only produce or consume, never both. (It is enough to impose this on *some* of the agents).

## Environment

- At beginning of  $t$ , agents get a preference shock: probability  $n$  that agent wants to consume and cannot produce (buyer);  $1 - n$  - can produce and does not want to consume.
- In DM,  $u(q)$  - buyers' utility of consumption.  $c(q)$  - sellers' disutility of production. Agents trade at prices posted by Walrasian auctioneer.
- In CM, all agents consume and produce, with utility  $U(x)$ , and linear disutility of labor.
- Central bank controls supply of fiat money:  $M_{t+1} = \gamma M_t$ . Distributed to agents via lump-sum transfers.
- Transfers at  $t$ :  $\tau_1 M_{t-1}$  in DM,  $\tau_2 M_{t-1}$  in CM, for  $\tau = \tau_1 + \tau_2$ . Allow central bank to treat buyers and sellers differently:  
 $\tau_1 = (1 - n)\tau_b + n\tau_s$ .

## Enforcement

- Two regimes: perfect enforcement and no enforcement.
- Under enforcement, banks can force agents to repay their debts at no cost. Also: central bank can levy nominal taxes to extract cash from the economy ( $\tau < 0$  possible, and  $\gamma < 1$ ). Central bank can force agents to trade, but cannot impose quantities to be consumed and produced.
- Under no enforcement, banks cannot force repayment, and hence can only punish defaulters by excluding them from financial system forever. In addition, central bank does not have power to tax, so  $\gamma \geq 1$ .

## Banks / Record Keeping

- Banks are perfectly competitive intermediation firms who accept nominal deposits and make nominal loans.
- These firms operate at 0 cost a technology that allows them to record financial histories of agents. This rules out direct credit between agents in trades - keeping money essential.
- All financial contracts are one-period contracts (innocuous assumption given the CM quasilinearity).
- Buyers and sellers deal with the bank at the beginning of DM, prior to trading, after preference shock is realized. Buyers do not face a cash-in-advance constraint: can borrow additional funds from bank, at nominal interest rate  $i$ .

## Banks / Default

- In the full-enforcement regime, agents face no credit constraints; banks post interest rates for deposits  $i_d$  and loans  $i$  that clear the market.
- In the no-enforcement regime, there may be credit rationing: credit limit determined endogenously. Equilibrium conditions would impose voluntary repayment of debts.

## Planner Problem

Planner, who can force agents to produce and consume, maximizes ex-ante welfare criterion (agents' ex-ante lifetime utility) -

$$\Omega = \max_{q_s, q_b} (1 - n)u(q_b) - nc(q_s) + U(x) - x + \beta\Omega$$
$$\text{s.t. } (1 - n)q_b = nq_s$$

First-best allocation is given by:

$$U'(x^*) = 1$$
$$u'(q^*) = c' \left( \frac{1 - n}{n} q^* \right)$$
$$\text{where } q^* = q_b^* = \frac{n}{1 - n} q_s^*$$

## Centralized Market

We are studying stationary equilibria where  $\phi M = \phi' M'$  and money growth rate is constant, so  $\phi/\phi' = \gamma$ .

Let  $m$  be money holdings,  $l$  - amount borrowed in the bank (loans),  $d$  - deposits in the bank.

$$\begin{aligned}
 W(m, l, d) &= \max_{x, h, m'} [U(x) - h + \beta V(m')] \\
 \text{s.t. } x + \phi m' &= h + \phi(m + \tau_2 M_{-1}) + \phi(1 + i_d)d - \phi(1 + i)l
 \end{aligned}$$

FOC's: note that  $x$  is the same for all agents, and  $m'$  is independent of  $m$ .

$$\begin{aligned}
 U'(x) &= 1 \\
 \phi &= \beta V_m(m')
 \end{aligned}$$

## Decentralized Market

Can show that  $l_s = d_b = 0$ . Let  $l$  be loans taken out by buyers, and  $d$  be deposits made by sellers.

Value function:

$$\begin{aligned} V(m) &= (1 - n)[u(q_b) + W(m + \tau_b M_{-1} + l - pq_b, l)] \\ &+ n[-c(q_s) + W(m + \tau_s M_{-1} - d + pq_s, d)] \end{aligned}$$

## Sellers

$$\begin{aligned} \max_{q_s, d} \quad & [-c(q_s) + W(m + \tau_s M_{-1} - d + pq_s, d)] \\ \text{s.t. } d \leq & m + \tau_s M_{-1} \end{aligned}$$

- $c'(q_s) = p\phi$  - sellers produce to equalize ratio of marginal costs across markets with relative price of goods across markets.
- $q_s$  independent of  $m$  and  $d$ .
- If  $i_d > 0$ , sellers deposit all of their money into the bank (constraint binds).

# Buyers

$$\begin{aligned} \max_{q_b, d} \quad & [u(q_b) + W(m + \tau_b M_{-1} + l - pq_b, l)] \\ \text{s.t. } \quad & pq_b \leq m + \tau_b M_{-1} + l \\ & l \leq \bar{l} \end{aligned}$$

- Constraint is determined endogenously.
- If cash constraint does not bind (have enough money),  $u'(q_b) = c'(q_s)$ , so trades are efficient. If it binds, then

$$\frac{u'(q_b)}{c'(q_s)} = 1 + i + \frac{\lambda_l}{\phi}.$$

## Buyers

- If below the borrowing limit,  $\lambda_l = 0$ , and

$$\frac{u'(q_b)}{c'(q_s)} = 1 + i.$$

Buyer borrows up to the point where MB=MC, and spends all his money. If  $i > 0$ , trades are not efficient ( $i$  is tax on consumption).

- If at the borrowing limit,  $\frac{u'(q_b)}{c'(q_s)} > 1 + i$  - buyer is willing to pay more to borrow, but if banks are worried about default, they may not raise  $i$ . Still inefficient.
- All buyers have the same money holdings; thus  $q_b$  and  $q_s$  are the same for all agents, and market clearing gives

$$q_s = \frac{1 - n}{n} q_b.$$

## Banks

- Perfectly competitive with free entry. Take  $i$  and  $i_d$  as given.
- No operating costs or reserve requirements.
- Bank solves, per borrower (res. value of borrower  $\Gamma$ ):

$$\begin{aligned} \max_l \quad & (i - i_d)l \\ \text{s.t. } l \leq & \bar{l} \\ u(q_b) - (1 + i)\phi l \geq & \Gamma \end{aligned}$$

- Case 1: banks can force agents to repay.  $\bar{l} = \infty$ .
- Case 2: no enforcement. A borrower who defaults is shut out of the banking sector forever. We solve for conditions such that buyer voluntarily repays: if  $i - i_d > 0$ , the reservation value constraint will always bind. If  $l = \bar{l}$ , by market clearing,  $(1 - n)\bar{l} = nd$ .

## Value of Money

In this model, we derive

$$V_m(m) = \phi \left[ (1 - n) \frac{u'(q_b)}{c'(q_s)} + n(1 + i_d) \right]$$

- Note that the marginal value of money consists not only of the marginal benefit it yields buyers in trade, but also, of the marginal benefit it yields to sellers through deposits.
- *Financial intermediation increases marginal value of money, because sellers can earn interest on deposits.*

## Equilibrium with Enforcement

- Banks can force repayment at no cost, and central bank can impose lump-sum taxes. Neither can dictate the terms of trade in DM.
- A monetary equilibrium with enforcement is a rate  $i$  and quantity  $q_b$  that satisfy

$$\frac{\gamma - \beta}{\beta} = i$$
$$\frac{\gamma - \beta}{\beta} = \frac{u'(q_b)}{c'(\frac{1-n}{n}q_b)} - 1$$

- If  $\gamma > \beta$ , a unique monetary equilibrium with credit exists. Consumption  $q$  is decreasing in  $\gamma$ , and  $q_b < q^*$  with  $q_b \rightarrow q^*$  as  $\gamma \rightarrow \beta$ .

## Allocation Without Credit

- Without credit, the terms of trade  $\tilde{q}_b$  satisfy

$$\frac{\gamma - \beta}{\beta} = (1 - n) \left[ \frac{u'(\tilde{q}_b)}{c'(\frac{1-n}{n}\tilde{q}_b)} - 1 \right]$$

- Clearly,  $\tilde{q}_b < q_b$  for any  $\gamma > \beta$ , so financial intermediation improves allocation and welfare away from the Friedman Rule.
- Greatest impact on welfare is for moderate values of inflation.
- Reason: near FR, there is little value to redistributing cash balances, while at high inflation rates, money is of little value. At FR, money has no cost, so agents can perfectly self-insure against consumption risk without financial intermediation.
- Gain in welfare from financial intermediation comes from allowing sellers to earn interest, NOT from relaxing the money constraint of buyers.

## Allocation Without Credit

- To elaborate on the above point: let government implement policy that taxes sellers lump-sum and gives the tax as transfers to the buyers.
- This relaxes the liquidity constraint on buyers without paying interest to sellers. This has no effect on allocation, only affecting price of money in CM - agents change the amount of money they carry into DM.
- Comparing equilibrium with credit with a bargaining setup in DM, with credit: can show that  $q_b$  under bargaining is lower than the allocation  $q_b$  in the competitive setting. (Holdup problem.) Banking still improves allocation even in the bargaining setting.

## Equilibrium Without Enforcement

- Suppose no enforcement by banks and monetary authority cannot use lump-sum taxation: cannot run deflation;  $\gamma \geq 1$ .
- For equilibrium with credit to exist, borrowers must prefer repaying loans to autarky. So bank must induce repayment, setting  $\phi\bar{l}$  to make agents just indifferent between defaulting and not:

$$U(x^*) - h_b + \beta V(m') \geq U(\hat{x}) - \hat{h}_b + \beta V(\hat{m}')$$

- Also: in equilibrium, banks lend out all their deposits, so  $\phi l = \frac{n}{1-n} \phi M$ .

## Equilibrium Without Enforcement

- Two choices for possible equilibrium: borrowing constraint does not bind for anyone (unconstrained), or binds for some (constrained) - can solve in closed form. In either case, equilibria depend on  $\gamma$ , which the monetary authority can control.
- There exists  $\tilde{\beta}$  s.t. if  $\beta \geq \tilde{\beta}$ , there is a  $\hat{i}$  such that:
  1. for  $i > \hat{i}$ , a unique unconstrained ME exists;
  2. for  $i \in (0, \hat{i}]$ , a constrained ME may exist;
  3. for  $i = 0$ , no equilibrium with credit exists.
- Intuition: at  $i = 0$ , agents can self-insure with money, so they will default - intermediation not possible. For low inflation, credit rationing occurs: cost of self-insurance low, so banks charge a below-market interest rate to induce repayment ( $i$  lower than would be with enforcement).

# Equilibrium Properties, No Enforcement

- Equilibrium with credit still improves welfare relative to no-credit equilibrium, even under rationing.
- Also, in a constrained credit equilibrium, inflation may be welfare-improving (reduces incentive to default).