Money, Financial Stability and Efficiency

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Introduction

- Important issue of role of monetary versus other policies in handling crises, e.g. ECB purchase of Greek debt and Federal Reserve's quantitative easing
- Most theories of banking crises assume contracts are written in real terms (e.g., Diamond and Dybvig (1983), Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988), Calomiris and Kahn (1991), Allen and Gale (1998, 2000) and Diamond and Rajan (2001, 2005))
- With real contracts crises arise because banks may be unable to make promised payments
- In practice contracts used in banking are in nominal terms
- This potentially means financial crises can be avoided because the central bank can create enough liquidity to allow banks to fulfil their contracts

- One view of this...

> *"Liquidity is a public good. It can be managed privately (by hoarding inherently liquid assets), but it would be socially inefficient for private banks and other financial institutions to hold liquid assets on their balance sheets in amounts sufficient to tide them over when markets become disorderly. They are meant to intermediate short maturity liabilities into long maturity assets and (normally) liquid liabilities into illiquid assets. Since central banks can create unquestioned liquidity at the drop of a hat, in any amount and at zero cost, they should be the liquidity providers of last resort both as lender of last resort and as market maker of last resort..."*

(Willem Buiter (2007))

Our approach

- The focus is on the financial system
- We assume a standard three-date banking model with aggregate liquidity and return risk but with nominal contracts
- The central bank passively supplies money in response to demand from the commercial banks
- Commercial banks take in deposits from consumers and make loans to firms
- Firms invest in a safe short asset and a risky long asset

The main results

- A competitive equilibrium implements the same fully state-contingent *efficient allocation* as the planner's problem, not merely the non-state contingent *constrained-efficient allocation*, even though deposit contracts are non-contingent and involve a fixed claim (in terms of money) on the banks.
- A central bank policy of passively accommodating the demands of the commercial banks for money is sufficient to eliminate financial crises and achieve the first best.
- The quantity theory of money holds in equilibrium: the price level at each date is proportional to the supply of money extended to the commercial banks by the central bank.

The main results (cont.)

- The central bank can control the nominal interest rate and the expected inflation rate, but it has no effect on the equilibrium allocation of goods.
- First best efficiency can be achieved by monetary policy alone when the model is extended to allow for idiosyncratic (bank-specific) liquidity risk and multiple periods.

Accommodative monetary policy alone is not always sufficient to achieve efficiency, however.

- Monetary policy alone is not sufficient to allow the sharing of idiosyncratic (bank-specific) asset return risk.

The basic setup

- There are three dates $t = 0, 1, 2$
- A single good is used for consumption and investment at each date
- Consumers have an endowment of one unit at $t = 0$ and no units at $t = 1, 2$. They have standard preferences

$$U(c_1, c_2) = \lambda u(c_1) + (1 - \lambda) u(c_2)$$

  where λ is a random variable with mean denoted by $0 < \bar{\lambda} < 1$
- Since all consumers are symmetric, $\bar{\lambda}$ is also the probability that a typical consumer is an early consumer

The basic setup (cont.)

- There are two assets: the short asset (storage) and the long asset - one unit invested at $t = 0$ produces a random return $R > 0$ at $t = 2$ where the mean of R is denoted by $\bar{R} > 1$
- We assume that the random variables λ and R have a joint cumulative distribution function F with support $[0, 1] \times [0, R^{\max}]$
- All uncertainty is resolved at the beginning of date 1: the state (λ, R) is publicly revealed and each consumer privately learns his/her type

The efficient allocation

- The efficient allocation offers each consumer a consumption profile $(c_1(\lambda, R), c_2(\lambda, R))$ where $c_1(\lambda, R)$ is consumption at date 1 and $c_2(\lambda, R)$ is consumption at date 2 in state (λ, R)
- A necessary condition for maximizing the expected utility of the representative consumer is that, given the portfolio y chosen at the first date, in each aggregate state (λ, R), c_1 and c_2 are chosen to

$$\begin{array}{ll} \max & \lambda u(c_1) + (1-\lambda) u(c_2) \\ \text{s.t.} & \lambda c_1 \leq y, \ \lambda c_1 + (1-\lambda) c_2 = y + (1-y) R \end{array}$$

Solution

- Either there is no storage, in which case

$$\lambda c_1 = y \text{ and } (1-\lambda)\, c_2 = (1-y)\, R$$

- or there is positive storage between the two dates, in which case

$$c_1 = c_2 = y + (1-y)\, R$$

- This gives the two "consumption functions,"

$$c_1(\lambda, R) = \min\left\{\frac{y}{\lambda}, y + (1-y)\, R\right\} \tag{1}$$

$$c_2(\lambda, R) = \max\left\{\frac{(1-y)\, R}{1-\lambda}, y + (1-y)\, R\right\} \tag{2}$$

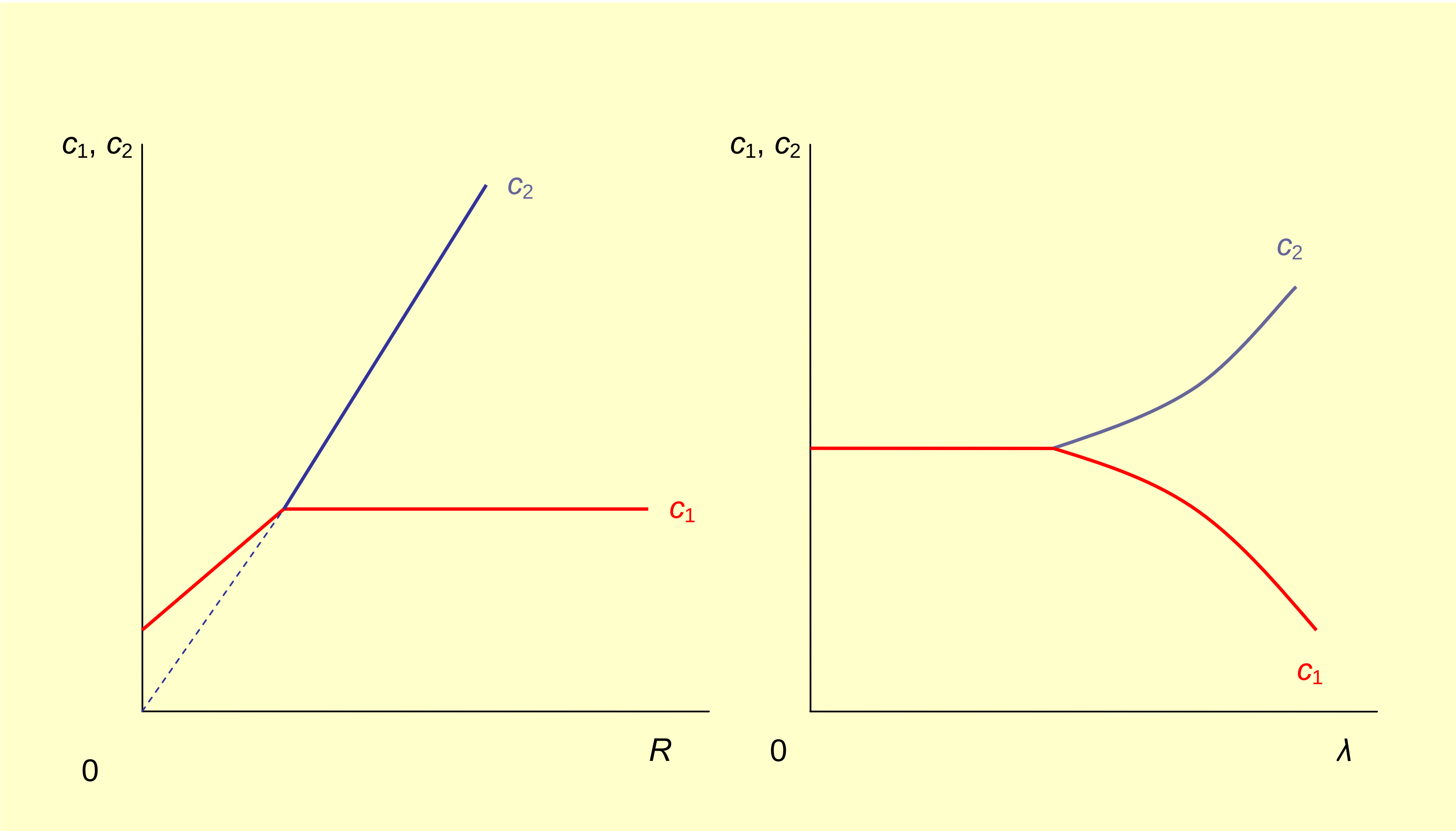

Figure 1: Consumption Functions at Dates 1 and 2

The left hand panel shows the consumption of an individual at each date as a function of R holding λ constant. The right hand panel shows the consumption of an individual at each date as a function of λ holding R constant.

c_1 and c_2 are determined by the choice of y and the exogenous shocks (λ, R), so the planner's problem can be reduced to maximizing the expected utility of the representative consumer with respect to y

$$\max_{y} \quad E\left[\begin{array}{c} \lambda u\left(\min\left\{\frac{y}{\lambda}, y+(1-y)\,R\right\}\right) \\ +(1-\lambda)u\left(\max\left\{\frac{(1-y)R}{1-\lambda}, y+(1-y)\,R\right\}\right) \end{array} \right] \quad (3)$$

Since the function u is strictly concave, the maximizer y^* is **unique** and this uniquely determines $c_1(\lambda, R)$ and $c_2(\lambda, R)$

Proposition 1

The unique solution to the planner's problem consists of a portfolio choice y^* and a pair of consumption functions $c_1^*(\lambda, R)$ and $c_2^*(\lambda, R)$ such that y^* solves the portfolio choice problem (3) and $c_1^*(\lambda, R)$ and $c_2^*(\lambda, R)$ satisfy (1) and (2), respectively, so $c_1^*(\lambda, R) \leq c_2^*(\lambda, R)$.

Money and exchange

Four groups of agents:

1. A central bank that lends money to the banking sector
2. A banking sector that borrows from the central bank, makes loans and takes deposits
3. A productive sector that borrows from the banking sector in order to invest in the short and long assets
4. A consumption sector that sells its initial endowment to firms and has the proceeds deposited in its accounts in the banking sector to provide for future consumption

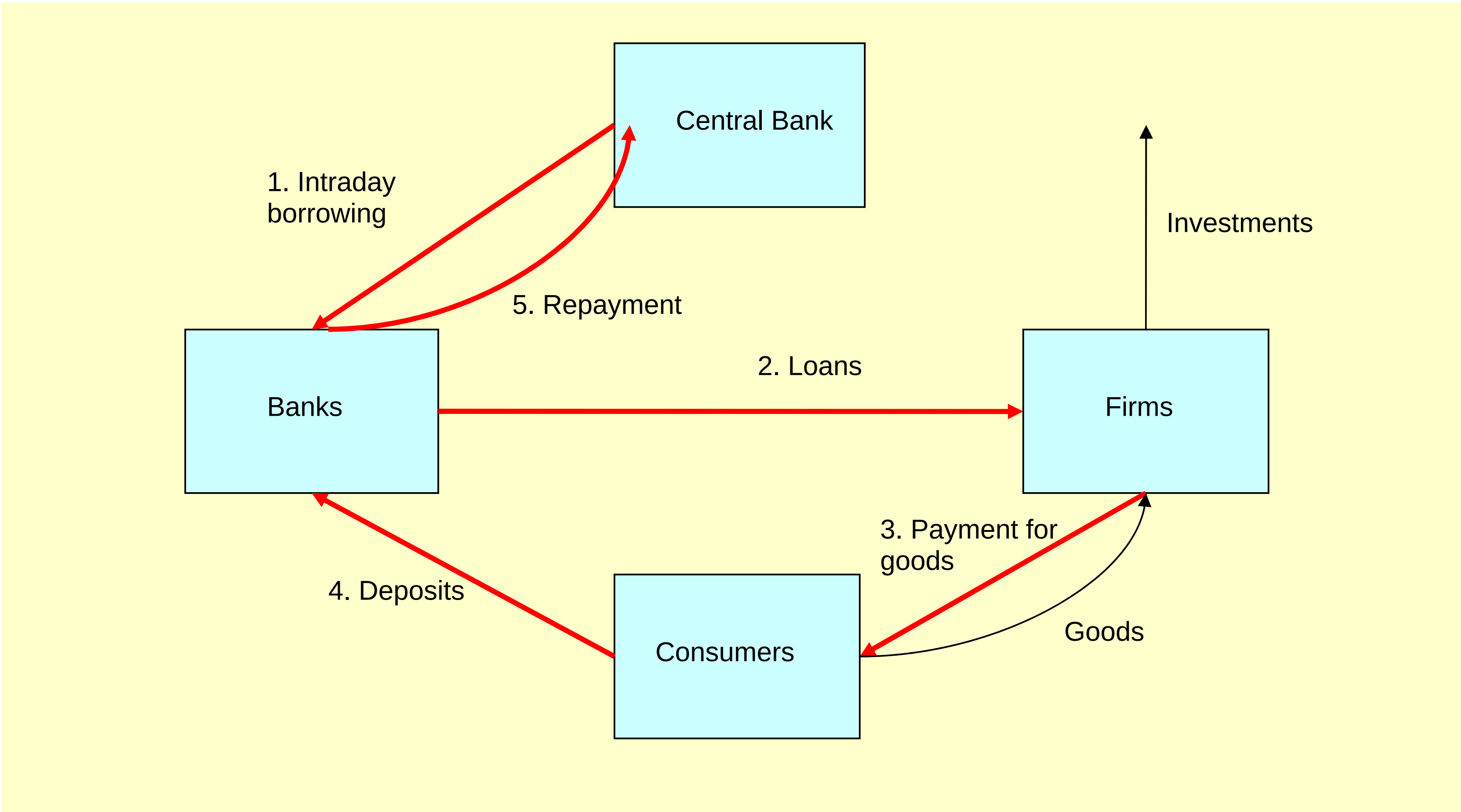

Figure 2: Flow of Funds at Date 0

1. Banks borrow cash from the central bank. 2. Firms borrow cash from the banks. 3. Firms purchase goods from the consumers. 4. Consumers deposit cash with the banks. 5. Banks repay their intraday loans to the central bank.

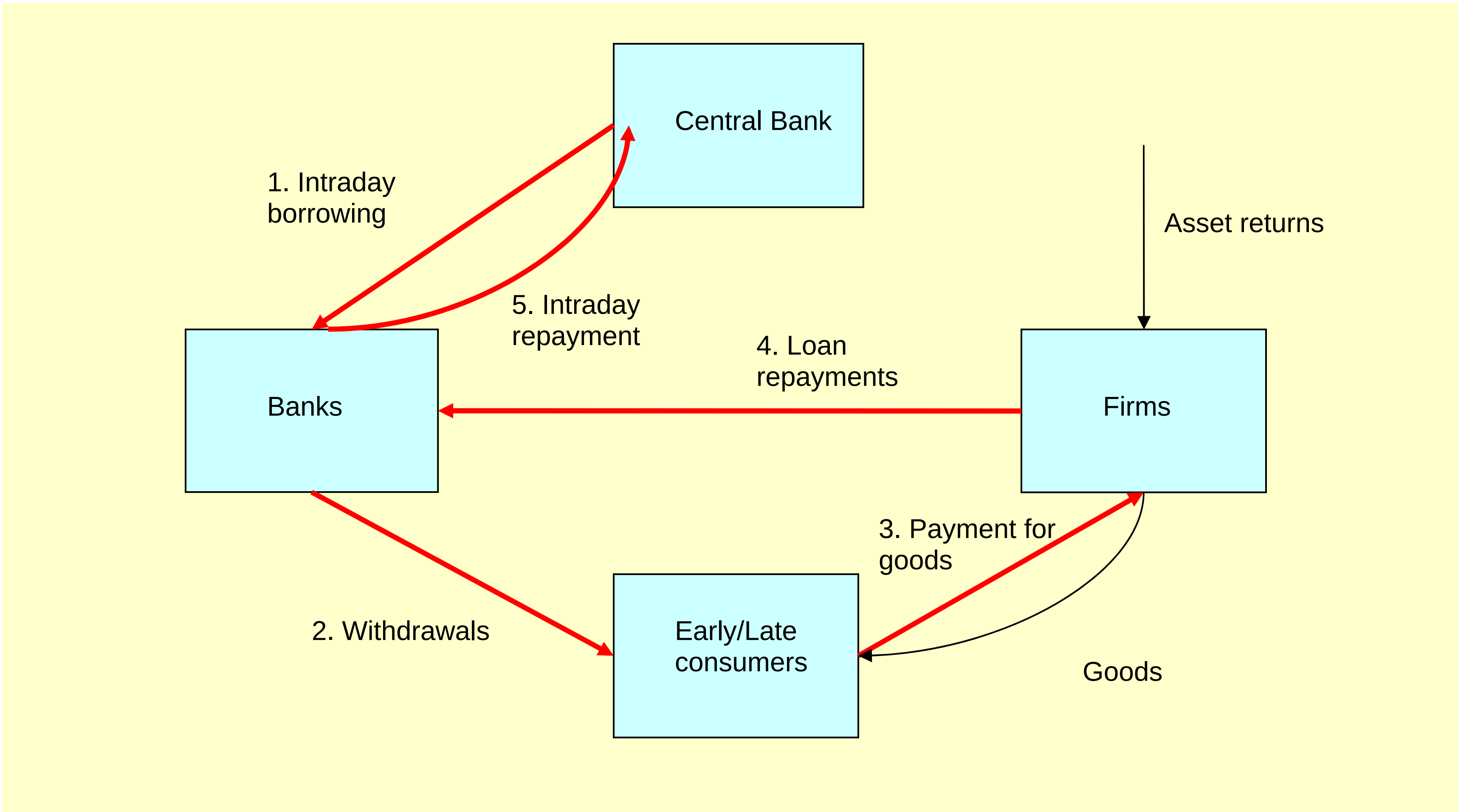

Figure 3: Flow of Funds at Dates 1 and 2

1. Banks borrow cash from the central bank. 2. Early consumers withdraw cash from the banks. 3. Consumers purchase goods from the firms. 4. Firms repay part of their loans to the banks. 5. Banks repay their intraday loans to the central bank.

Additional notation and assumptions

- The nominal interest rate on loans between periods t and $t+1$ is denoted by r_t
- We set nominal interest rates to zero: $r_0 = r_1 = 0$ (this assumption is relaxed in the extensions)
- M_0 = money supply at date 0
- $P_0 = 1$ price level at date 0
- $M_t(\lambda, R)$ = money supply at date $t = 1, 2$ in state (λ, R)
- $P_t(\lambda, R)$ = price level at date $t = 1, 2$ in state (λ, R)
- D_t = money value of deposit at date $t = 1, 2$ promised by bank at date 0.

The main decentralization result

We use a constructive approach to show the existence of an efficient equilibrium

- y^* and $\left(c_1^*(\cdot), c_2^*(\cdot)\right)$ are from the planner's solution
- The money supply, prices, and deposit contracts can be defined to satisfy the usual equilibrium conditions
- Then goods market-clearing conditions and are satisfied by construction
- All agents are optimizing
- The exchange of money for goods determines their price at both dates

$$P_1^*(\lambda, R) = \frac{1}{c_1^*(\lambda, R)} \tag{4}$$

$$P_2^*(\lambda, R) = \frac{1}{c_2^*(\lambda, R)} \tag{5}$$

- Competition among banks will ensure they make zero profits and offer depositors the most attractive deposit contracts

$$\lambda D_1 + (1-\lambda) D_2 = 1$$

- This can only be satisfied for multiple realizations of λ if

$$D_1^* = D_2^* = 1$$

- The central bank accomodates the banks' demand for money

$$\begin{aligned} M_0^* &= P_0^* = 1 \\ M_1^*(\lambda, R) &= \lambda D_1^* = \lambda \\ M_2^*(\lambda, R) &= (1-\lambda) D_2^* = 1-\lambda \end{aligned}$$

- The representative firm borrows one unit of the good at date 0 and chooses a portfolio y^* such that $P_1^*(\lambda, R)\, y^* + P_2^*(\lambda, R)(1-y^*) R = 1$ for every (λ, R), makes zero profits and there is no more profitable choice.

Proposition 2

An equilibrium consisting of the price functions $\left(P_0^*, P_1^*\left(\lambda, R\right), P_2^*\left(\lambda, R\right)\right)$, the money supply functions $\left(M_0^*, M_1^*\left(\lambda, R\right), M_2^*\left(\lambda, R\right)\right)$, the portfolio choice y^*, the consumption functions $\left(c_1^*\left(\lambda, R\right), c_2^*\left(\lambda, R\right)\right)$ and the deposit contract $\left(D_1^*, D_2^*\right)$ such that the equilibrium conditions are satisfied is **first best efficient**.

Extensions

Nominal interest rates can be set at any level. The real rates of interest, which are all that matter when money is not held as a store of value outside the banking system between periods, are independent of the nominal rate as long as the price levels are adjusted appropriately.

Idiosyncratic liquidity risk and the interbank market Bank specific shocks can be dealt with using the interbank market in the usual way.

Multi-period model The analysis can be extended to the multi-period case.

Idiosyncratic return risk This cannot be dealt with by monetary policy alone. Institutions or markets allowing real transfers are necessary but these are fraught with problems of moral hazard and other incentive problems.

Concluding remarks

- We have developed a model of banking with nominal contracts and money.
- A wide range of different types of uncertainty, including aggregate return uncertainty, aggregate liquidity shocks, and idiosyncratic (bank-specific) liquidity shocks are introduced.
- With nominal contracts and a central bank, it is possible to eliminate financial instability and achieve the first best allocation through the central bank following a policy of accomodative monetary policy.
- The one type of risk that cannot easily be dealt with is idiosyncratic return shocks. This requires that the a government or private institution make transfers between banks with high and low returns to achieve the first best. Implementing this type of scheme is problematic as it creates moral hazard and other incentive problems.