BANKING AND SYSTEMIC CRISIS

LECTURE NOTES – SET #1

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INTRODUCTION

Why do financial intermediaries exists?

- Households with savings can lend to nonfinancial firms directly in stock or bond markets
- Still the direct contact between households and firms are dominated by intermediaries (securities are traded via intermediaries)
- An organizational structure (bank) should then beat the market in some respect

INTRODUCTION

- We will focus on banks as liquidity providers: they issue liquid assets (deposits) while financing illiquid ones (loans)
- Banks can improve on a competitive market by providing better risk sharing among people with different liquidity needs
- Because of the liquidity provision function, banks hold a substantial amount of liquidity risk
- The root of this risk lies in the maturity mismatch between the liability and asset sides of their balance sheet

Financial Intermediaries as Pools of Liquidity

- Diamond-Dybvig (1983):
  - Explain why banks have a role in providing agents with insurance against liquidity shocks (managing risks and transforming maturities)
  - Explain why banks offer liquid deposits and invest in illiquid loans
  - Provide a first step towards understanding bank runs and financial fragility

THE INTUITION

- Investments are illiquid and returns are long-term, while consumption needs are uncertain and subject to idiosyncratic shocks
- As long as consumption shocks are not perfectly correlated across individuals, banks may efficiently invest savings on long-term projects, providing depositors with insurance against idiosyncratic consumption shocks

The Model Set-Up

- The economy lasts three periods, $t = 0, 1, 2$
- A large number of agents are endowed with one unit of cash each, and in $t = 0$ they can either invest in a project or hold it as liquidity
- Investment projects pay off only long term (in $t = 2$). If you need to liquidate them too early (say, in $t = 1$) it would have been better not to invest, due to a liquidation cost
- Implications:
  - Agents with early liquidity needs should hold cash
  - Agent with late liquidity needs should invest in long-term projects
- The problem is that an agent does not know in $t = 0$ (when she has to invest) whether she needs liquidity early (in $t = 1$) or late (in $t = 2$)

THE MODEL SET-UP (CONT'D)

- Two types of agents
  - «early», with probability θ: $U = U(c_1) + 0$
  - «late», with probability 1-θ: $U = 0 + U(c_2)$
  - Types are i.i.d. and private information
  - Agents «learn» their type only at $t = 1$
- Law of large numbers: fraction of early types is θ, common knowledge (no aggregate uncertainty)
- The cash endowment can be stored (short-run), with a return equal to 1 …
- … or it can be invested, in an amount $0 \leq I \leq 1$, in an long-run project whose return in $t = 2$ is $R > 1$. If liquidited in $t = 1$, its return is $L < 1$

AGAIN ON INTUITION

- What do we mean by ***liquidity*** of an asset?
- Consider an asset on three dates, $t = 0$, $t = 1$, $t = 2$
- If one invests in $t = 0$, the asset will return r_2 at date 2, but only $r_1 < r_2$ at date 1.
- The ratio r_1/r_2 measures the degree of liquidity

The lower $\frac{r_1}{r_2}$ is, the less liquid is the asset

THE DEMAND FOR LIQUIDITY

- Liquidity is good for risk-averse individuals

- A numerical example
  - A consumer with utility $U(c) = 1 - \frac{1}{c}$ has a probability $\theta = 0.25$ to be «early»
  - She can invest in an illiquid asset ($r_1 = 1$; $r_2 = 2$) or a liquid asset ($r_1 = 1.28$; $r_2 = 1.82$)
- Expected utility from holding the illiquid asset

$$0.25\, U(1) + 0.75\, U(2) = 0.375$$

- Expected utility from the liquid asset

$$0.25\, U(1.28) + 0.75\, U(1.82) = 0.393 > 0.375$$

THE DEMAND FOR LIQUIDITY (CONT'D)

- If the investor is risk-neutral this result is reversed. Let $U(c) = c$

- Expected utility from holding the illiquid asset

$$0.25\,(1) + 0.75\,(2) = 1.75$$

- Expected utility from the liquid asset

$$0.25\,(1.28) + 0.75\,(1.82) = 1.68 < 1.75$$

- When the assets that risk-averse investors can hold directly are illiquid, a demand for more liquid assets arises
- By issuing demand deposits, banks create those liquid assets and offer a Pareto-improving insurance service

RESEARCH STRATEGY

- We will work through three different institutional settings
  1) Autarky allocation
  2) Market allocation
  3) Intermediary-based allocation

- Compare solutions in terms of expected utility for consumers

Recall a consumer can consume only in $t = 1$ ***OR*** in $t = 2$, depending on her being «early» or «late»

AUTARKY

- Consumers make their investment choice in $t = 0$, without any possibility to exchange assets in later periods
- Let (x, y) be the portfolio allocation of a representative investor
  - x = long asset
  - y = short asset
- The budget constraint in $t = 0$ is

$$x + y = 1$$

- The feasible consumption bundle for the two following periods is

$$c_1 = y + xL = (1 - x) + xL = 1 - x(1 - L) \qquad \text{- if «early»}$$

$$c_2 = \underbrace{y}_{} + Rx = (1 - x) + Rx = 1 + x(R - 1) \qquad \text{- if «late»}$$

Fraction of 1 unit invested in $t = 0$ in the short asset, and reinvested in the s.a. in $t = 1$

AUTARKY

- A consumer solves the following problem

$$\max_{y,c_1,c_2} \{\theta U(c_1) + (1-\theta)U(c_2)\}$$

s.t.

$$c_1 = 1 - x(1 - L)$$
$$c_2 = 1 + x(R-1)$$

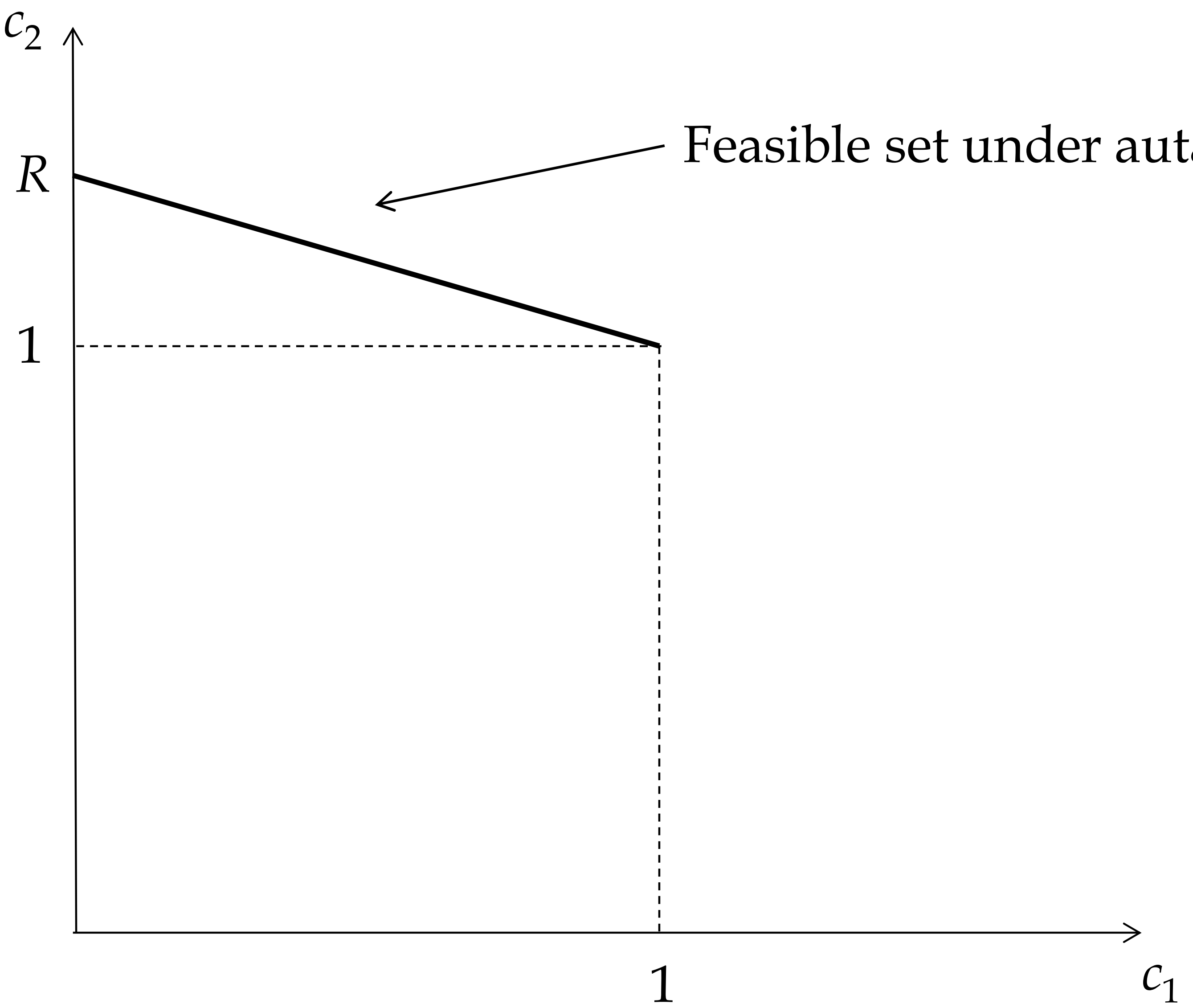
- The first-order condition is

$$-(1-L)\theta U'(c_1) + (1-\theta)U'(c_2)[(R-1)] = 0$$

that is

$$\frac{U'(c_1)}{U'(c_2)} = \frac{(1-\theta)(R-1)}{\theta(1-L)}$$

AUTARKY



AUTARKY

- In order to have an interior solution (i.e., with $x \neq 0$), it must be that $U'(c_1) > U'(c_2)$, so that the RHS of the Euler equation is greater than 1

$$(1 - \theta)R + \theta L > 1$$

- The expected return from the illiquid asset is higher than the return from the liquid one
- This implies

$$L < c_1^A < 1 < c_2^A < R \qquad \text{and} \qquad x^A > 0$$

AUTARKY

- If the consumer is sufficiently risk-averse, the corner solution $x^A = 1$, with $c_1 = 0$ and $c_2 = R$, is never optimal
- The alternative corner solution is $x^A = 0$, with $c_1{}^A = c_2{}^A = 1$

A risk-averse consumer operating in autarky either

- partially hedges herself against the liquidity risk ($y^A > 0$) and renounces to a piece of consumption in $t = 2$ if she discovers to be a «late» type …
- … or does not invest in the illiquid asset at all

If investments in physical capital are illiquid, the economy operates along its steady-state on a scale lower than its Pareto optimum: several projects with positive NPV are systematically discarded

MARKET

- Now suppose that a competitive market for assets opens at $t = 1$
- This allows to sell the illiquid asset without incurry in costly liquidation
- A consumer who discovers to be «early» can sell the illiquid assets she has in portfolio to a «late» mate, obtaining in return liquid assets (to be translated into consumption)
- Let (x, y), with $x + y = 1$, the initial portfolio, and define P the market price of the illiquid asset

MARKET

- The budget constraints in periods 1 and 2 are

$t = 1$

$$c_1 = y + \underbrace{Px}_{\text{market liquidation of the long asset}}$$

If the consumer is «early», she will sell her portion of long asset and obtains in return an amount Px of short assets

$t = 2$

$$c_2 = \left(x + \underbrace{\frac{y}{P}}_{\text{new units of long asset bought}}\right) R$$

If she is «late», the will buy from an «early» an amount y/P of long assets

MARKET

The equilibrium market price of the illiquid asset is $P = 1$

- <u>Proof</u>
  1) Suppose $P > 1$. If this is the case, all agents would hold long assets only $\longrightarrow$ $y^* = 0$

     $c_1 = y + P(1 - y) = P - (P - 1)y$ decreasing in y

     $c_2 = (x + \frac{y}{P})R = R + R(\frac{1}{P} - 1)y$ decreasing in y

  2) Suppose $P < 1$. All agents would hold only short assets $\longrightarrow$ $x^* = 0$

     $c_1 = y + P(1 - y)$ increasing in y

     $c_2 = (x + \frac{y}{P})R = R + R(\frac{1}{P} - 1)y$ increasing in y

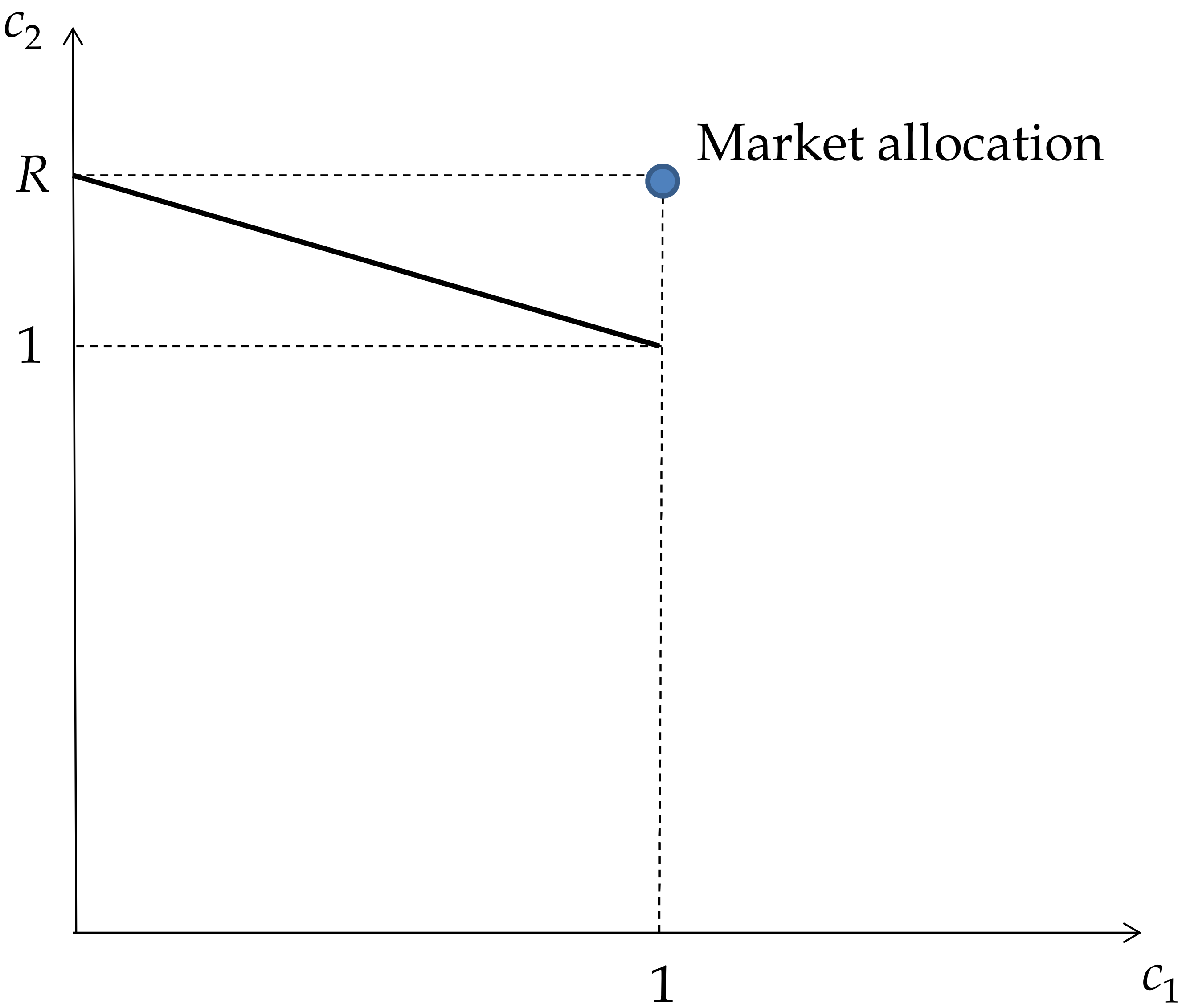
MARKET

- In equilibrium , with $P = 1$, the solution becomes

$$c_1 = x + Py = x + y = 1$$
$$c_2 = (x + \frac{y}{P})R = (x + y)R = R$$

The market allocation is a Pareto improvement if compared to the allocation under autarky

Market



Market

An asset market provides liquidity, as it allows an investor to convert her holdings of long assets in consumption at $t = 1$ at a price $P = 1 > L$

We could ask whether the amount of liquidity provided by the asset market is efficient, or if the market allocation could be somehow improved

Notice that this is an «incomplete market» economy, in that investors are not allowed to buy an insurance on their type at $t = 0$

Setting Up the Benchmark: Optimal Allocation

- To derive the first-best, suppose the problem is solved by a central planner (CP)
- Since there is no aggregate uncertainty, CP knows that there will be θ «early» and (1 - θ) «late» consumers
- CP will choose an asset allocation such that no consumption is given to impatient consumers in t = 2, and no consumption to patient consumers in t = 1

SETTING UP THE BENCHMARK: OPTIMAL ALLOCATION

- The social planner problem is

$$\max_{c_1,c_2} U = \theta U(c_1) + (1-\theta)U(c_2)$$

$$\text{s.t.} \qquad \theta c_1 = y$$

$$(1-\theta)c_2 = xR$$

- The two budget constraints can be combined to obtained a unique intertemporal budget constraint

$$\theta c_1 + \frac{1-\theta}{R} c_2 = 1$$

- The first order condition of the optimal allocation is

$$U'(c_1) = RU'(c_2)$$

OPTIMAL ALLOCATION (CONT'D)

- Given that $R > 1$ and $U''(.) < 0$

$$c^*_1 < c^*_2$$

- Given that $\frac{\partial c U'(c)}{\partial c} < 0$, the market allocation $(1, R)$ does not obey the FOC of the optimal allocation problem

$$U'(1) > R \cdot U'(R)$$

- That is (liquidity is valuable to consumers)

$$1 < c^*_1 < c^*_2 > R$$

OPTIMAL ALLOCATION (CONT'D)

- The optimal allocation has higher consumption for «early» consumers and lower consumption for «late» consumers than the market allocation
- That is, the optimal allocation calls for more liquidation of investment projects in $t = 1$ than is provided by the competitive equilibrium
- What is needed is a mechanism whereby consumers can coordinate and insure against the risk they are hit by a liquidity shock and have to liquidate their investment
- A financial intermediary – a bank – can help consumers to do this

FINANCIAL INTERMEDIATION

- The optimal allocation can be replicated if we introduce a competitive banking sector which offers the following deposit contract D

In exchange for 1 unit of good at time $t = 0$, the bank pays «on demand» c_1^B on deposits withdrawn at $t = 1$ and c_2^B on deposits withdrawn at $t = 2$

Bank balance sheet at $t = 0$

Assets	***Liabilities***
Short-run loans = y	Deposits = 1
Long-run loans = x	

FINANCIAL INTERMEDIATION (CONT'D)

- Competition among banks ensures that the deposit contract $D = (c_1^B, c_2^B)$ maximizes the ex-ante expected utility of the representative consumer

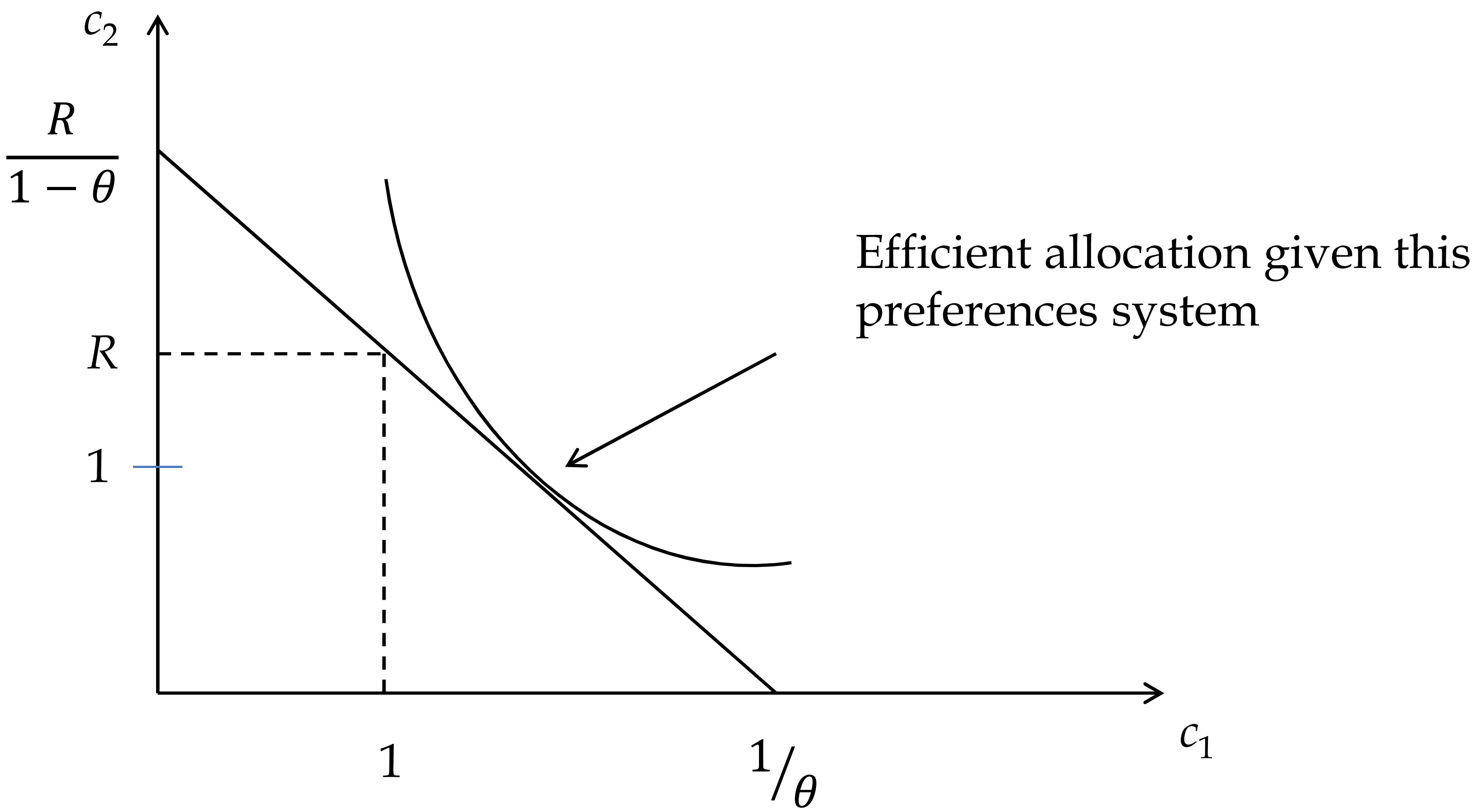
$$\theta U(c_1) + (1 - \theta) U(c_2)$$

- A bank faces the following uni-period budget constraints

$$\begin{array}{ll} t = 0 & x + y = 1 \\ t = 1 & \theta c_1^B = y \\ t = 2 & (1 - \theta)\, c_2^B = Rx \end{array}$$

FINANCIAL INTERMEDIATION (CONT'D)

- The market allocation belongs to the bank's feasible set.
- The whole feasible set is wider, however



Financial Intermediation (cont'd)

- The bank's problem is

$$\max_{x,y}\{\theta U(c_1) + (1-\theta)U(c_2)\}$$

$$\text{s.t.} \qquad \begin{aligned} & x + y = 1 \\ & \theta\, c_1 = y && \rightarrow \quad c_1 = \frac{y}{\theta} \\ & (1-\theta)c_2 = xR && \rightarrow \quad c_2 = \frac{xR}{1-\theta} \end{aligned}$$

- Substituting from the constraints in the maximand, the FOC is

$$U'({c_1}^B)\frac{\theta}{\theta} - RU'({c_2}^B)\frac{1-\theta}{1-\theta} = 0$$

FINANCIAL INTERMEDIATION (CONT'D)

- The banking allocation coincides with the optimal one

$$U'(c_1^B) = R\, U'(c_2^B)$$

Since $R > 1$ and U is concave, it follows that $c_1^B < c_2^B$.
The insurance against the liquidity risk is incomplete (the ex-post consumption is not equalized between «types»).
This implies that the allocation is ***incentive compatible***:
each depositor has the right incentive to report faithfully its «type» to the bank
The contract D^* and the asset allocation are a Nash equilibrium

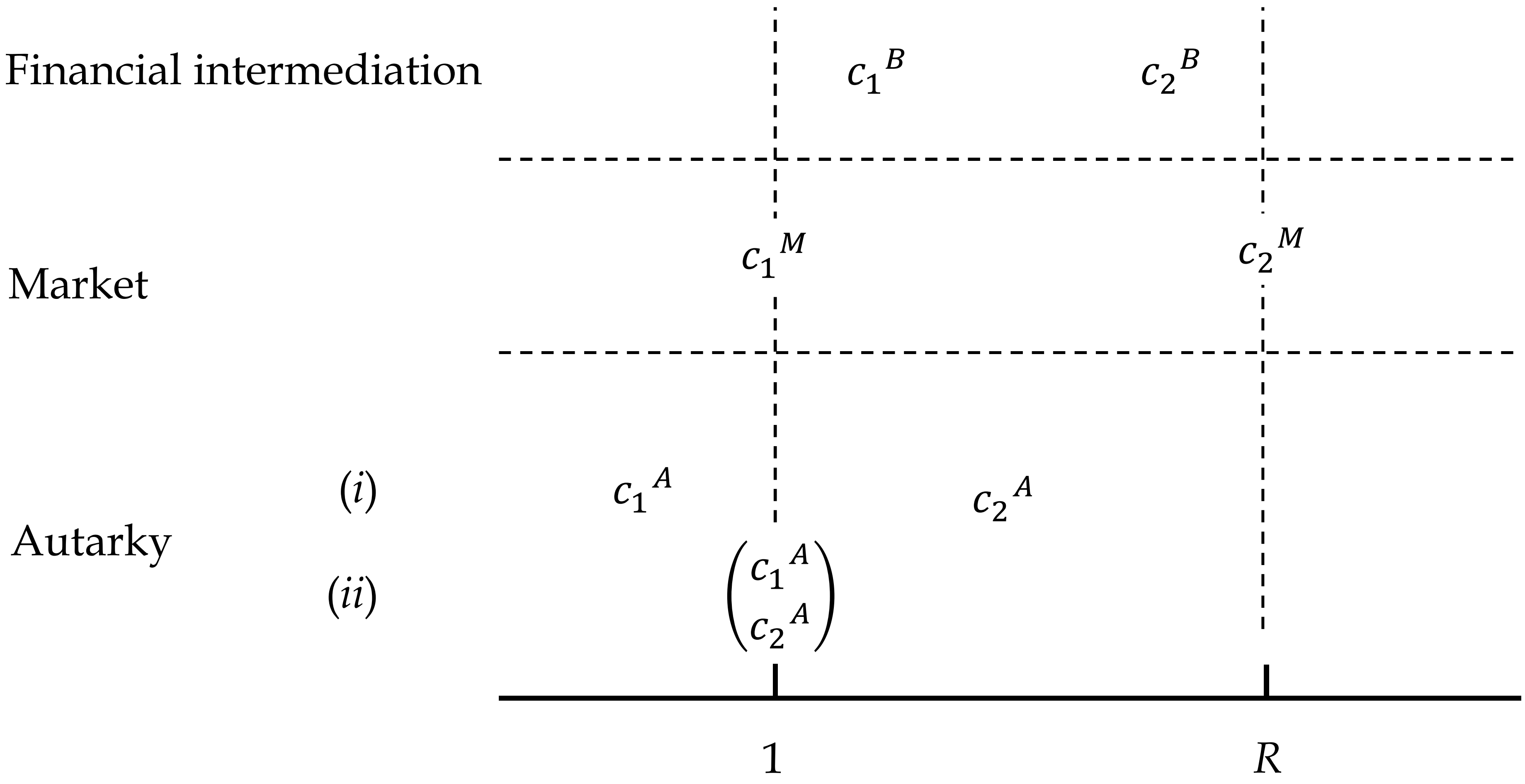
FINANCIAL INTERMEDIATION (CONT'D)

- The bank is involved in a typical asset-liability management problem
- Since it knows that to fraction θ it must pay c_1^B, it can honour its committment if it invests in the liquid asset a fraction $y^* = \theta c_1^B$
- The remaining funds ($1 - \theta c_1^B$) can be invested in the long asset, obtaining a return $R(1 - \theta c_1^B)$ that can be distributed amongst the fraction ($1 - \theta$) of depositors who did not withdraw in $t = 1$

$$(c_1{}^B)^* = \frac{y*}{\theta}$$

$$(c_2{}^B)^* = \frac{(1 - \theta(c_1{}^B)^*)}{1 - \theta}$$

SUMMARY


Financial intermediation
$c_1{}^B$
$c_2{}^B$
Market
$c_1{}^M$
$c_2{}^M$
Autarky
(i)
$c_1{}^A$
$c_2{}^A$
(ii)
$\begin{pmatrix} c_1{}^A \\ c_2{}^A \end{pmatrix}$
1
R

BANK RUNS

- The game has a second (bad) Nash equilibrium
- If depositors believe that only early consumers withdraw in $t = 1$, the bank can satisfy both early and late depositors by exploiting the law of large numbers
- If depositors hold different beliefs, however, the bank can be forced to bankruptcy

BANK RUNS (CONT'D)

- Recall that the optimal deposit contract $D = (c_1^B, c_2^B)$ implies an obligation to pay $c_1^B > 1$ to a consumer withdrawing in $t = 1$ and $c_2^B > R$ to a consumer withdrawing in $t = 2$
- If ***ALL*** consumers want to withdrawn in $t = 1$, the total amount the bank can pay back is

$$Lx + y < x + y < c_1^B$$

- If this occurs the bank is insolvent, given that it can pay back just a fraction of what it promised (by means of a contractual obligation) to its depositors
- Since all assets must be liquidated in $t = 1$, nothing remains in $t = 2$ for an inattentive latecomer depositor

BANK RUNS (CONT'D)

- A bank run emerges as a coordination failure among «late» consumers

		$\neq i$	
		Run	No Run
i	Run	$Lx + y,\ Lx + y$	$c_1,\ c_2$
	No Run	$0,\ Lx + y$	$c_1,\ c_2$

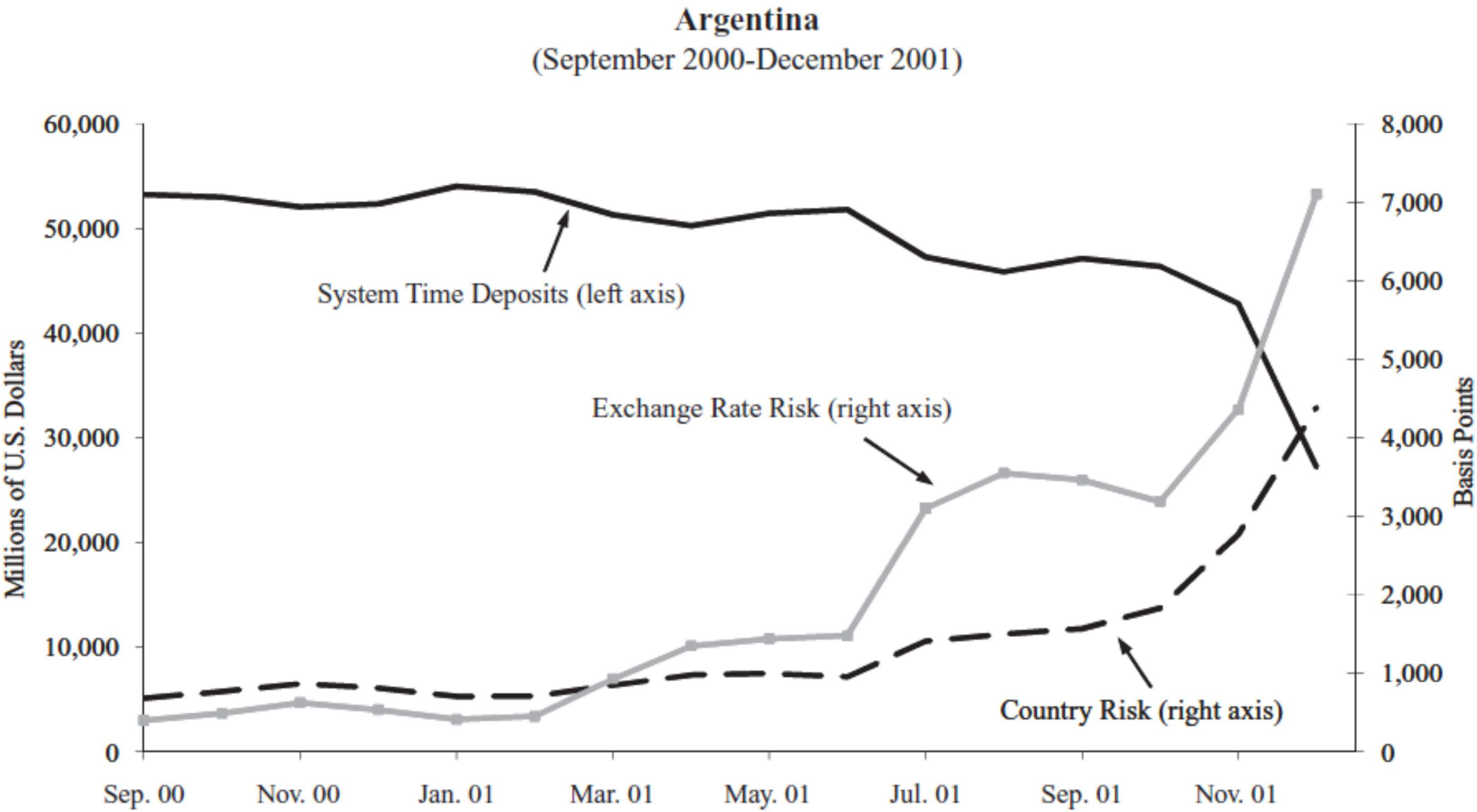
- If $0 < Lx + y < c_1 < c_2$, this game has two Nash equilibria: (Run, Run) and (No Run, No Run)

BANK RUNS (CONT'D)

- Remark #1
  - Bank runs are equilibrium phenomena
    1) If everybody «runs», for each depositor it is optimal to run
    2) If nobody «runs», it is optimal not to run as well

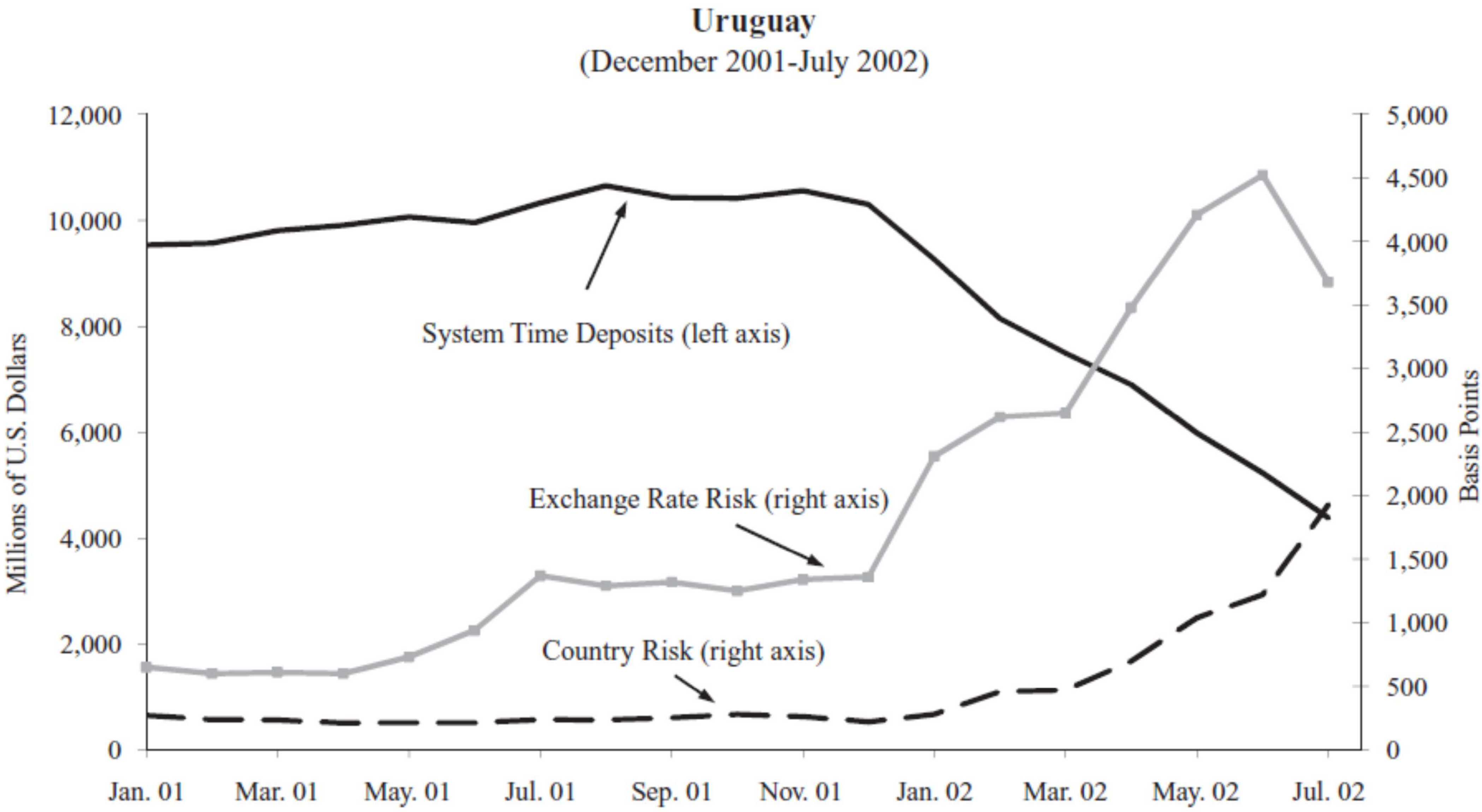
- Remark # 2
  - The good equilibrium is fragile (regardless of it being incentive-compatible). The system can jump to the bad one due to an exogenous adverse random signal (a profit warning or a run at another bank, etc.) not necessarily linked to the fundamentals of the bank under scrutiny.
  - It is fundamental to preserve trustworthyness

BANK RUNS – SOME EVIDENCE



Levy-Yeyati et al., 2010

BANK RUNS – SOME EVIDENCE



Levy-Yeyati et al., 2010

REMEDIES: SUSPENSION OF CONVERTIBILITY

- Suppose the bank is allowed to suspend payments in $t = 1$ before it liquidates all its resources
- In particular, suppose a suspension contract stipulates that the bank will pay out $c_1{}^*$ to a maximum proportion $\theta \leq \hat{f} \leq (c_1{}^*)^{-1}$ of consumers f wanting to withdraw in $t = 1$
- «Early» consumers will withdraw for sure, so that $f \geq \theta$
- If «late» consumers do not withdraw in $t = 1$, then $f = \theta$ and $(c_2)^* = \frac{(1-\theta(c_1)^*)}{1-\theta}$
- The suspension contract with $\hat{f} = \theta$ preserves the good Nash equilibrium
- But does it prevent the bad one?

SUSPENSION OF CONVERTIBILITY (CONT'D)

- What if a fraction $f > \theta$ decide to withdraw in $t = 1$?
- A late consumers withdrawing in $t = 1$ has a probability $\theta/f > 1$ to receive c_1^*, and a probability $(1 - \theta/f) > 0$ to receive nothing
- The expected return from the lottery is $(\theta/f)c_1^* + (1 - \theta/f) \times 0$
- A late consumer waiting till $t = 2$ will receive $(c_2)^* = \frac{(1-\theta(c_1)^*)}{1-\theta}$ with certainty
- The decision to run rests on whether it is better to take the chance in the period 1 lottery, or wait for the certain payment in period 2

SUSPENSION OF CONVERTIBILITY (CONT'D)

- The expected return from the period 1 lottery in decreasing in f
- The certain payment in period 2 is increasing in f
- If there is an incentive for «late» consumer to wait when $f = \theta$, such incentive is even stronger for $f > \theta$

A suspension contract depresses the maximum expected return in $t = 1$, and ensures that the resources of the bank are not depleted too early, so that there are sufficient resources available to provide the contractually committed return in $t = 2$. The bad Nash equilibrium is no longer supported

The bank run equilibrium is eliminated only if θ is known. When θ is unknown (for example, following a stochastic process), the unconstrained optimum is not achievable

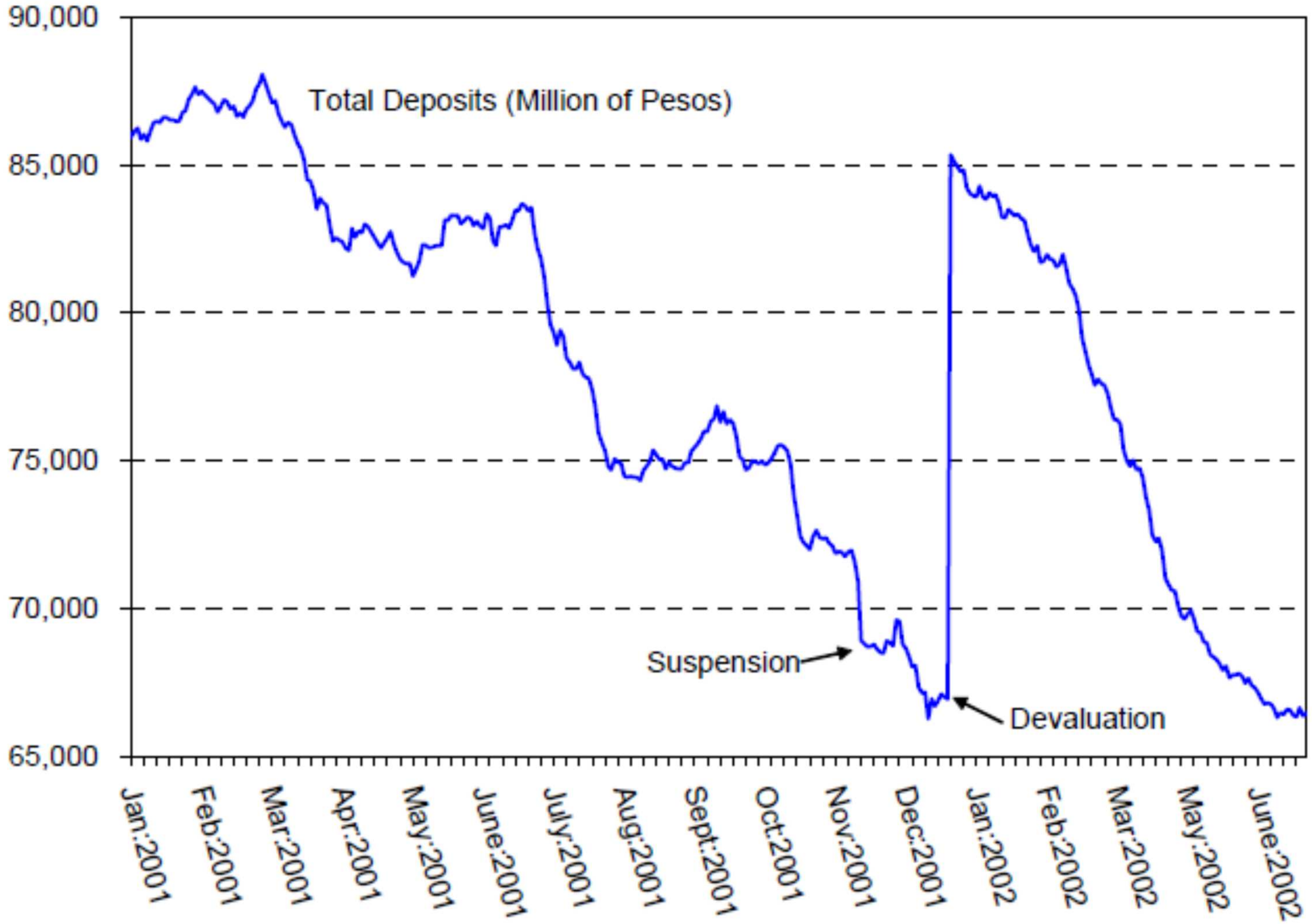
SUSPENSION OF CONVERTIBILITY (CONT'D)

- Ennis and Keister (2009) show that even a known θ is not sufficient to prevent a run, as soon as one admits the possibility that the policymaker cannot pre-commit to follow a certain course of action (i.e., imposing a suspension of convertibility) in response of a crisis
- Suppose a run started and reached the point where deposits have to be frozen
- In practice, it is impossible to know if the fraction $f = \theta$ is composed only of «early» consumers, or if a certain number of them are still waiting in queu.
- Suspending the convertibility of deposits would impose heavy costs on these individuals, who truly need access to their funds

SUSPENSION OF CONVERTIBILITY (CONT'D)

- An *ex-post* better policy would be to delay the freeze, or reschedule payments in a way that gives at least some funds to this depositors
- A banking authority that is unable to pre-commit to impose a complete-freezy «bank holiday» would not choose to do so once a run is underway
- Anticipating that the ex-post efficient response is permissive, and that more funds could be withdrawn even after a suspension has been officially declared, depositors are further incentivized to participate to the run
- The time-inconsistency of the optimal policy can generate self-fulfilling runs

SUSPENSION OF CONVERTIBILITY (CONT'D)



Evolution of deposits during the crisis in Argentina 2001-02

Ennis and Keister, 2009

Remedies: Deposit Insurance

- The government can provide an insurance to depositors by taxing withdrawal in $t = 1$
- The tax rate depends on the number of consumers trying to withdraw
- Let the pre-tax returns for depositors be c_1^* in $t = 1$, and $c_2^* = \frac{(1-\theta c_1^*)}{1-\theta}$ in $t = 2$
- The tax rate is
  - $\tau = 0$, if only «early» consumers withdraw
  - $\tau = 1 - (c_1^*)^{-1}$, if some «late» consumers withdraw

DEPOSIT INSURANCE (CONT'D)

- The «early» types obtain c_1* if only they withdraw, and $(1 - \tau)c_1^* = (1 – (1 + (c_1^*)^{-1}))c_1^* = 1$ if some «late» mates run
- «Early» consumers get at least their deposits back. Deposits are therefore insured, and there exists an incentive to deposit endowements with banks in $t = 0$

- What about «late» consumers?
- Let f be the fraction of total depositors which want to withdraw in $t = 1$
- If $f = \theta$, only the earlies withdraw, $\tau = 0$, and the good equilibrium is preserved

DEPOSIT INSURANCE (CONT'D)

- If $f > \theta$, the tax rate on withdrawal raises to $\tau = 1 - (c_1^*)^{-1}$, and «late» consumers have to trade off a return of 1 in $t = 1$ against a return $\frac{R(1-f)}{1-f} = R$ in $t = 2$
- Since $R > 1$, a «late» consumer has an incentive to wait and withdraw in $t = 2$

With a deposit insurance, waiting is a dominant strategy for «late» consumers for all f.

Remedies: Equity-Funded Intermediaries

- Jacklin (1987) shows that an intermediary financed by tradable equities (say, a Money Market Mutual Fund) can replicate the optimal social allocation - like a bank financed by non-tradable demand deposits - without the drawback of runs
- Let the MMMF collect funds (say, 1 unit of capital) by issuing dividend-paying equity shares with price 1 in $t = 0$
- The pay-out profile chosen by shareholders consists of a dividend d at $t = 1$, and a liquidating dividend of $R(1 - d)$ at $t = 2$
- Immediately after the dividend d is paid out, a competitive market in the ex-dividend shares opens
- Let q be the ex-dividend price of the share to be formed in the market

EQUITY-FUNDED INTERMEDIARIES (CONT'D)

- An early shareholders can consume in $t = 1$ the dividend d and the earning from selling ex-dividend the share, q

$$c_1 = d + q$$

- A late consumer can consume in $t = 2$ the liquidating dividend $R(1 - d)$ on the share she held from $t = 0$, plus the liquidating dividends on the shares she bought in $t = 1$ from an "early" mate by investing the received dividend d

$$c_2 = R\,(1 - d) + \frac{d}{q}\,R\,(1 - d)$$

EQUITY-FUNDED INTERMEDIARIES (CONT'D)

- In equilibrium, q is such that the supply and demand of shares are equal

$$\underbrace{\theta q^*}_{\text{supply}} = \underbrace{(1 - \theta)\, d}_{\text{demand}}$$

That is

$$q^* = \frac{1-\theta}{\theta} d$$

- As we substitute the equilibrium price q^* into the budget constraints for early and late consumers we obtain

$$c_1 = \frac{d}{\theta} \qquad\qquad c_2 = \frac{R(1-d)}{1-\theta}$$

EQUITY-FUNDED INTERMEDIARIES (CONT'D)

- The final step consists in calculating the optimal dividend d^* chosen by shareholders
- This is obtained by maximizing the expected utility, subject to the budget constraints, with respect to d

$$\max_d U = \theta U(c_1) + (1-\theta)U(c_2)$$

$$\text{s.t.} \qquad c_1 = \frac{d}{\theta}$$

$$c_2 = \frac{R(1-d)}{1-\theta}$$

- The solution to this problem would be passed unanimously at the $t = 0$ shareholders meeting

EQUITY-FUNDED INTERMEDIARIES (CONT'D)

- Substituting from the constraints in the maximand, the FOC is

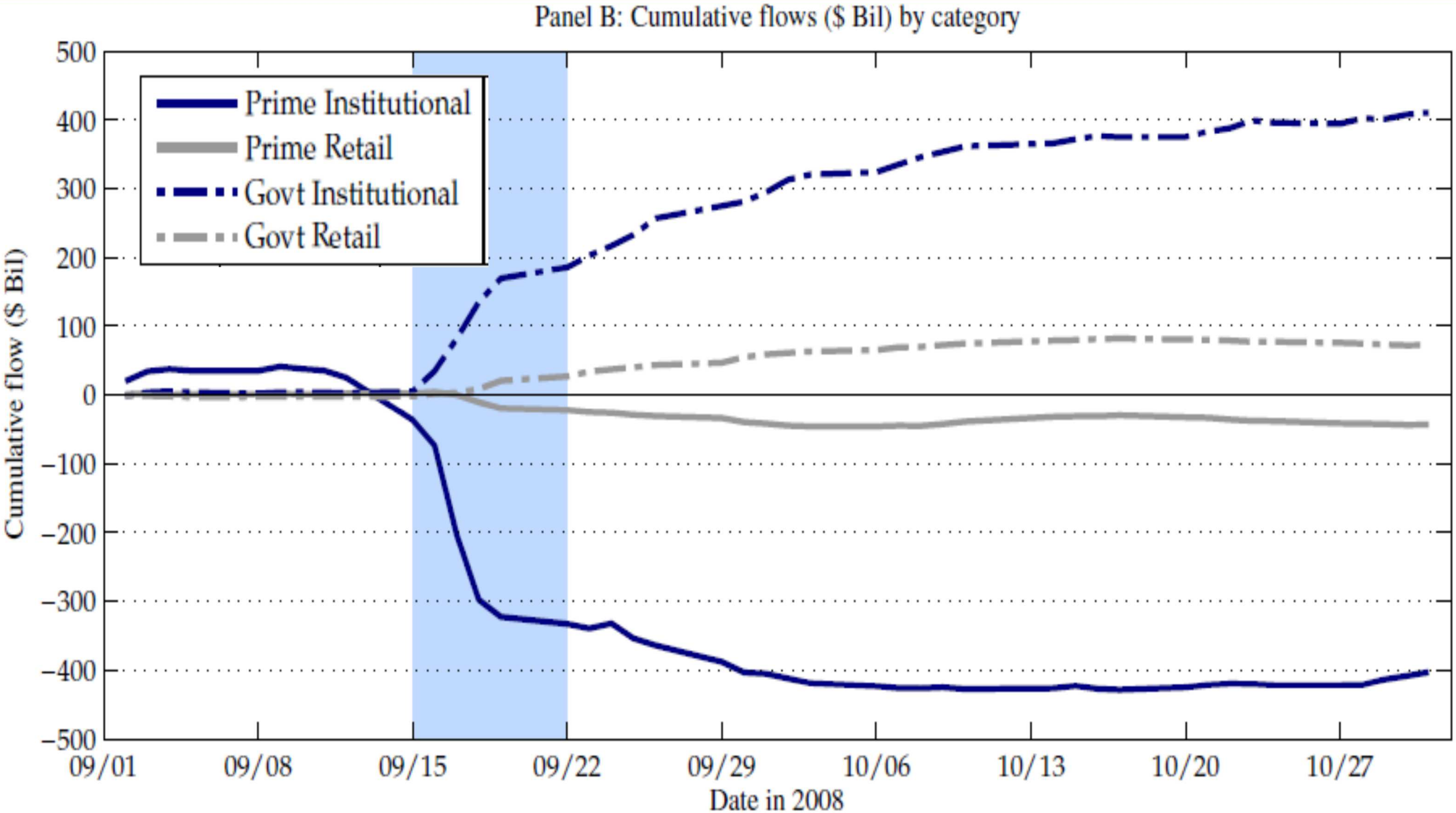
$$U'(c_1)\frac{\theta}{\theta} - RU'(c_2)\frac{1-\theta}{1-\theta} = 0$$

which is the same solution of the optimal allocation problem and of the banking allocation problem

$$U'(c_1) = RU'(c_2)$$
$$d^* = \theta c_1$$

This result is not general, however. It can be shown that with a more general (smooth) preference structure, demand deposits improve on competitive markets, even those with dividend-paying intermediaries

OPS, SOMETHING'S GOT WRONG!



Cumulative change in assets under management for each category of USA MMMFs

Schmidt et al., 2014

JACKLIN '87 CRITIQUE

- Jacklin made a second relevant point: if a bank and a competitive market for the illiquid asset coexist, the financial market's ability to arbitrage the implicit cross-subsidy in favor or early consumers breaks down the insurance provided by the bank
- This undermines the theoretical justification for the presence of financial intermediaries as liquidity providers

Jacklin '87 Critique (cont'd)

- In $t = 0$ a bank offers a deposit contract (c_1^B, c_2^B) with $c_1^B > 1$ and $c_2^B < R$, and invests the funds it obtains in a portfolio of assets (x, y)
- If a «late» pretends to be an «early», she can
  - withdraw $c_1^B > 1$ in $t = 1$
  - use the amount obtained to buy Pc_1^B units of long asset, which in $t = 2$ will yield a per-unit return R
- Since in equilibrium $P = 1$, in $t = 2$ one gets

$$R\, c_1^B > R > c_2^B$$

JACKLIN '87 CRITIQUE (CONT'D)

- A «late» can obtain a higher level of consumption if she withdraws her deposits in $t = 1$ and re-invests them in the financial market, rather than waiting at the bank till $t = 2$
- A competitive financial market inhibits the provision of liquidity by the bank, which can not operate, so that the only feasible allocation is the one offered by the market $(1, R)$.

EX-ANTE HETEROGENEITY OF CONSUMERS

- Gorton and Pennacchi (1990) offers a solution to this theoretical difficulty
- Suppose financial markets are imperfect due to information asymmetry: some traders are informed, other are uninformed
- In a standard D&D setting, suppose the return on the illiquid asset is uncertain (random).
- If investors have different information and beliefs on the final outcome, the market price is not fully revealing
- If uninformed traders recognize that they are likely to loose money when trading with better-informed traders, a demand arises for liquid and safe securities like bank deposits

THE RATIONALE FOR REGULATING BANKS

- So far we have seen the public provision of deposit insurance is a necessary policy tool to prevent bank runs and limit the inherent fragility of intermediaries
- A public deposit insurance comes with a dark side, as it gives intermediaries incentives to take too risky positions in their balance sheets

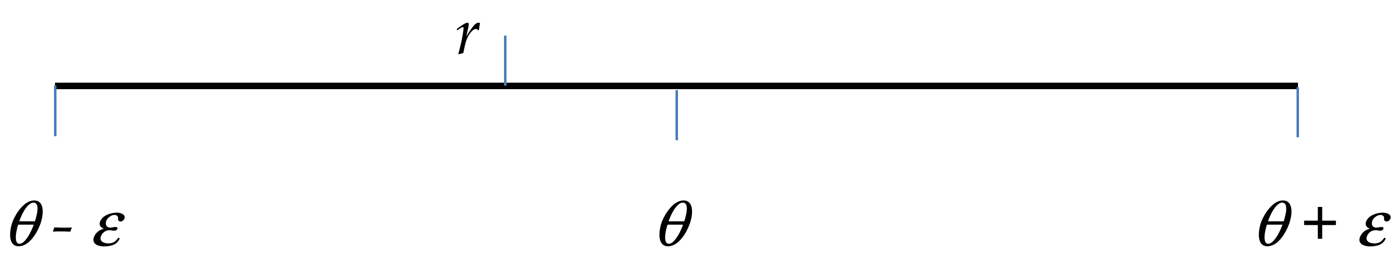
- Kareken and Wallace (1978)
  - if financial intermediaries do not bear the full consequences of their actions (because they are insured), profit maximizing portfolios will be too risky
  - a policymaker offering deposit insurance to preserve financial stability should also regulate the portfolio positions of intermediaries

KAREKEN – WALLACE '78

- Two-period model, $t = 1, 2$
- A representative consumer with an endowment $e = 1$ in $t = 1$
- A large number of banks which compete to invest on behalf of the consumer in $t = 1$, in order to return a pay-off in $t = 2$
- The consumer has preferences over portfolio allocations
- Banks compete to grab the client by offering a financial allocation in line with such preferences
- As we solve for the optimal portfolio structure of a consumer, the same allocation traslates to banks' balance sheets

Kareken – Wallace '78 (cont'd)

- Invest the endowment into a portfolio composed of two assets
  - $(1- \alpha)$ in a safe asset, with a certain return $r > 1$ in $t = 2$
  - α in a risky asset, which in $t = 2$ pays a random return uniformly distributed over the interval $(\theta - \varepsilon, \theta + \varepsilon)$. The expected return is θ and the variance is $\frac{\varepsilon^2}{3}$
- We assume that $\theta > r$ (the risky asset has an expected return higher than the safe asset), and that neither asset dominates



KAREKEN – WALLACE '78 (CONT'D)

- Expected return of the portfolio $E[R] = \alpha(\theta - r) + r$
- Variance of the portfolio $\sigma^2 = \alpha^2 \frac{\varepsilon^2}{3}$
- Mean-variance utility function

$$\max_{\alpha} E(R) - \frac{c}{2}\sigma^2$$

where $c > 0$ measures the degree of risk aversion

- The first order condition is

$$\theta - r - \frac{c}{3}\varepsilon^2\alpha = 0$$

i.e. $\alpha^* = \frac{(\theta - r)}{\varepsilon^2}\frac{3}{c} > 1$ for sufficiently high risk aversion (c)

KAREKEN – WALLACE ‘78 (CONT’D)

- Now introduce deposit insurance, so that the consumer is guaranteed a return of at least r whatever the state of the world
- The insurance will be invoked if the return in the risky asset turns out to be bad, $\theta - \varepsilon$. When this occurs, the insurance mechanism kicks in and the consumer receives r
- The expected return of the risky asset becomes $\alpha(\theta + \frac{\varepsilon}{2} - r) + r$
- The new optimal portfolio allocation reads

$$\alpha'^{*} = \frac{6}{c}\left[\frac{2(\theta - r) + \varepsilon}{\varepsilon^2}\right] > \frac{(\theta - r)}{\varepsilon^2}\frac{3}{c}$$

and it is upper contrained at 1 (corner solution)

KAREKEN – WALLACE '78 (CONT'D)

- The introduction of deposit insurance incentives banks to take riskier portofolio decisions in order to satisfy their clients' preferences
- The moral hazard emerges only if deposit insurance exists. Banks takes positions that do not admit bankruptcy in equilibrium if they face the full consequences of their actions
- Financial stability requires both deposit insurance ***and*** the regulation of the risk appetite of banks
- Basel II/III capital requirements can be seen as a response along these lines

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