Liquidity Coinsurance, Moral Hazard and Financial Contagion

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Motivations

• The objective is twofold: - Model contagion as an endogenous phenomenon with rational forward looking agents; - Contagion as a rare phenomenon in inter-bank deposit markets.

• Contagion is usually modelled as un unexpected shock (or an unforeseen contingency) able to create a chain reaction.

• Rochet-Tirole (1996), Allen-Gale (2000), Dasgupta (2000) consider contagion arising from inter-bank deposits that provide liquidity insurance to bank. However, a recent series of empirical papers suggest that the inter-bank linkage channel may not have so much "bite" as theoretical literature has assumed so far.

Results

- We study how the moral hazard problem affects the possibility of liquidity coinsurance among regions. We model an economy with two regions characterized by negatively correlated liquidity needs, and exposed to moral hazard problems.

- The insurance provided by the inter-bank deposit market has to be traded off against the costs of the possible imprudent investment made by the other region.

- Contagion is rare because banks do not enter the inter-bank deposit market when it is not properly convenient. Contrary to previous models, contagion is not negatively correlated with the degree of the inter-bank connections. We offer a counter-example, where contagion is bigger when cross-holding of inter-bank deposits is larger.

Related Literature (I)

- The paper is closely related to the banking literature that generally relies on exogenous unexpected shock that causes a crisis to spill over to other institutions. Financial links, which are desirable ex-ante, can have direct negative payoff effects on the linked institution.

- Allen and Gale (2000) rely on an unexpected aggregate liquidity shock; Aghion, Bolton and Dewatripoint (2000) consider a systemic liquidity shock; Freixas, Parigi and Rochet (2000) model a bank's solvency shock.

- Allen and Gale (2000) and Freixas, Parigi and Rochet (2000) find that the degree of inter-bank connections enhance the resiliency of the banking system.

Related Literature (II)

- Models based either on fundamental factors, or the behaviour of the investors, also rely on the appearance of unforeseen contingencies (which imply incomplete markets).

- Radelet and Sachs (1998) rely on a global fundamental shock (such as terms of trade or commodity prices).

- Contagion could be due to investors' liquidity constraints (Kodres and Pristsker, 2002), or wealth effect (Kyle and Xiong, 2001), or the use of portfolio management rules (Schinasi and Smith, 1999).

- All of them either imply the presence of contingencies that agents are unable to insure against with, or which they are unable to forecast properly, or imply no optimizing agents (choosing dominated portfolios).

The Model (I)

There are three dates $t = 0, 1, 2$. There is a single good and each consumer has initial endowment (1, 0, 0).

There are two types of assets: a *short* asset and a *long* asset. One unit of the short asset at date t produces one unit at date t+1. One unit of the long asset at date 0 produces $R>1$ units at date 2. However, with probability *p*, is available another illiquid asset (*gambling* asset). One unit of the gambling asset at date 0 produces λR units at date 2 (with $\lambda>1$) with probability η, and a return 0 with prob. $1-\eta$. We assume that $\eta \lambda R<R$.

There are two regions (A and B) with a continuum of ex-ante identical banks and consumers, which have Diamond-Dybvig preferences. The fraction of early consumers in each region is random $0<\omega^i<1$. The realization of liquidity preference shock is state-dependent.

The Model (II)

	A	B
S1	ω_H	ω_L
S2	ω_L	ω_H

Consumers learn their type in t=1. A class of agents called *investors*, with risk-neutral preferences, is considered to model bank capital. They are endowed with [e(0), e(1), e(2)] = (e, 0, 0) units of the consumption good. In t=0 investors can either consume or buy bank's shares. In the second case, they are entitled to get dividends d(t). Their preferences are given by Rd(0)+d(1)+d(2). They obtain utility Re if consuming in t=0. If they buy shares for e(0) then d(0)=e-e(0), and their utility is R[e-e(0)]+d(1)+d(2). Therefore, their participation constraint is d(1)+d(2)>Re(0).

Optimal Risk-Sharing

Optimal risk-sharing can be characterized by the solution of the planner's problem. Let the average fraction of early consumers defined as $\gamma \equiv \frac{\omega_H + \omega_L}{2}$. Let y, x and z be the per capita amounts invested in the short, long and gambling assets, respectively. The problem is :

Max $\gamma u(c_1) + (1-\gamma)u(c_2)$

Subject to the following three feasibility constraints:

$$x + y \leq 1; \gamma c_1 \leq y; (1-\gamma)c_2 \leq Rx.$$

The optimal solution y* satisfies the FOC: $u'(c_1^*) = \mathrm{R}u'(c_2^*)$

The first-best incentive-efficient allocation δ* is:

$$c_1^* = \frac{y^*}{\gamma}; x^* = 1 - y^* = 1 - \gamma c_1^*; c_2^* = \frac{R(1-\gamma c_1^*)}{1-\gamma}$$

Decentralized Economies in Autarky

The first-best can be achieved only if the two regions pool their resources, in order to eliminate aggregate uncertainty. What allocation is attained in autarky, when there is liquidity uncertainty and (possibly) moral hazard?

Banks offer contingent contracts [y, x, c , c , c , c].

The deposit contract specifies the amount invested in both the liquid (y) and the illiquid asset. However, depositors do not observe what *kind* of illiquid asset the bank is investing in (either x or z). Depositors cannot observe the extra return that the gambling asset eventually produces. When the return is λRx only the portion Rx is observable. The fraction $(\lambda-1)Rx$ can be appropriated by the bank (on-the-job perks, money diverted to personal accounts).

Autarky with Aggregate Uncertainty (I)

We start to analyze the form of the optimal contract in autarky without moral hazard problems. The allocation characterized only by aggregate uncertainty is given by the solution of the problem:

Max

subject to:

Autarky with Aggregate Uncertainty (II)

Let δ(e) = [y(e), x(e), c (e)] be the optimal allocation offered to consumers under autarky when the amount of capital is e, where s = H, L and t = 1, 2. We have the following result:

Proposition 1. *There is a level of capital e such that, for each e ≥ e the optimal allocation δ is the same and satisfies*

$$c \;< c \;\leq c \;= c\,.$$

For values of e < e the expected utility of the consumers is strictly increasing in e, and it is constant for e ≥ e.

The allocation δ(e) obviously gives a lower expected utility than the first-best allocation δ*. Define δ the contract offered when e ≥ e the optimal contract under autarky, no shortage of bank capital and no moral hazard.

Autarky with Moral Hazard (I)

So far banks are assumed to invest in the safe long-term asset x. This is clearly the case when bank capital is large with respect to the long-term investment. This is because, investors are reluctant to gamble with their own money.

Then, what is the minimum amount of bank capital needed to be sure that banks actually prefers the safe long-term asset to the gambling asset?

Proposition 2. *If the deposit contract offers a level of long-term investment x then the bank will invest in the safe asset only if the bank capital is $e \geq \xi x$.*

Where $\xi \equiv \dfrac{\eta(\lambda - 1)}{1 - \eta\lambda}$ is the lowest value of the ratio *e/x* such that the bank does not gamble. If $e < \xi x$ then is common knowledge the bank gambles whenever possible.

Autarky with Moral Hazard (II)

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Liquidity Coinsurance without Moral Hazard

When regions are characterized by uncertain liquidity needs and no moral hazard, the solution to get first-best allocation is represented by an interbank deposit market (IDM).

Proposition 3. *If there is no moral hazard and the two regions exchange an amount* $(\omega_H - \gamma)$ *of deposits at t=0, then the first-best allocation* δ^* *can be implemented by a decentralized banking system with standard deposit contracts.*

The region with high liquidity need withdraw the interbank deposits in t=1, while the other region waits until t=2.

The IDM makes bank capital indeterminate in both regions, however banks in one region cannot observe the kind of long term investment made by the banks in the other region.

Liquidity Coinsurance with Moral Hazard (I)

Consider the case where banks offer first-best contract δ^*. Assume bank in region A has incentive to gamble, while bank in region B behaves. Then:

- with probability $(1-p)+p\eta$ either the gambling asset does not appear or it is successful. In both cases depositors get first-best in both regions;

- with probability $p(1-\eta)$ the gambling asset appears and it fails. In t=2 region A is bankrupt and, if it had an high liquidity need in t=1, also region B will be bankrupt.

The allocation δ^* can be achieved if banks in both regions have no incentive to invest in the gambling asset.

Proposition 4. *If $e \geq \xi x^*$ then the first-best is attainable*.

Liquidity Coinsurance with Moral Hazard (II)

METTERE PAG. 16 (FINO ALLA METÁ)

PROPOSITION 5

Liquidity Coinsurance with Moral Hazard (III)

METTERE PAG. 16-17

PROPOSITION 6

Liquidity Coinsurance with Moral Hazard (IV)

When x < x*, and the optimal contract prevents moral hazard under autarky, then the opening of interbank markets leads to better liquidity coinsurance *and* a positive probability of bankruptcy whenever *p* is sufficiently low.

Proposition 7. *Assume x < x*, e [max{ξx , e }, ξx*) and p < p Then the two regions invest in the safe asset under autarky and in the gambling asset when interbank deposits are possible. Under the optimal allocation there is a strictly positive probability of bankruptcy and contagion.*

Since moral hazard is prevented, under autarky there is no bankruptcy and δ is selected. However, liquidity coinsurance makes long-term investment more valuable. Bank capital is not sufficient to prevent moral hazard, which is allowed given low *p*.

Multiple Regions

Considering multiple regions, we can see what structure of the interbank market is more conductive to contagion. Consider 4 regions, with the following liquidity needs.

	A	B	C	D
S1	ω_H	ω_L	ω_H	ω_L
S2	ω_L	ω_H	ω_L	ω_H

Two market structures are considered (Figure). Assume region A is exposed to moral hazard. Its bankruptcy occurs with probability $p(1-\eta)$, and contagion with probability $\frac{1}{2}p(1-\eta)[1-p(1-\eta)]$

In the less connected structure contagion affects only region D (region C does not withdraw from D). In the fully connected structure also region B is affected by region's A bankruptcy.

Conclusions and Extensions

We have shown how financial contagion may arise as an endogenous phenomenon, without relying on unexpected contingencies or exogenous shocks.

Financial contagion becomes a rare event in interbank deposit market since exposure to moral hazard affects the deposit contract offered by the regions. The possible outcomes of financial fragility are rationally taken into account.

Interbank Deposit Market: Different Structures