Efficient Financial Crises

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Introduction

- Banks and Financial Institutions rely heavily on short-term debt to finance their assets
- Implies exposure to bank runs or rollover risk
- Bank runs play important role in understanding Great Depression, perhaps most recent financial crisis
- Why do banks find fragile capital structure optimal?

Fragility of Bank Capital Structure in Data

- Largest 0.1% of banks finance between 40 and 60% of assets with uninsured short-term liabilities
    - Largest 0.1% of banks now hold 50% of total bank assets (up from 20% in 1992)
- For comparison, largest 0.1% of non-financial firms finance up to 20% of assets with short-term debt
    - Only account for 15% of total non-financial firm assets

This Paper

- Develop theory of optimal capital structure of banks
- Show optimal capital structure of banks is fragile
  - there are states in which bank is inefficiently liquidated (bank runs)
- Show short-term debt is critical for fragility
- Analyze implications of theory for portfolio choices of banks

Key Contributions

- Short-term debt with many small lenders introduces a coordination problem which makes debt-roll over difficult
  - Coordination problem resembles problem of public good provision

- In moral hazard framework with fixed asset portfolio, depositors and banker will optimally choose to use short-term debt
  - Short-term debt allows depositors to commit to bank runs
  - Commitment to bank runs beneficial for resolving moral hazard

- Optimal capital structure features bank runs in equilibrium

Other Findings

- Endogenize asset portfolio decisions in model with multiple banks
  - With independent banks and bank returns, short-term debt may not commit depositors to bank runs
    - Short-term debt not sufficient to resolve commitment problem
  - Commitment problem can be resolved with correlated bank returns
- Optimal financial system features crises
- Planner subject to same constraints cannot improve outcomes $\Rightarrow$ Efficiency of crises

Related Literature

- Bank runs: Diamond and Dybvig (1983)
- Bank Runs as Disciplining Device: Calomiris and Kahn (1991), Diamond and Rajan (2001)
- Lender Coordination Problems: Bolton and Scharfstein (1990), Brunnermeier and Oehmke (2013)
- Many others on optimal capital structure, crises

Outline

- Example: When debt roll-over resembles a public good problem
- Benchmark Model: Single Bank, Many Depositors, and limited commitment
  - Optimal contracts resemble short-term debt
  - Optimal contracts feature ex-post debt-rollover problems
- Extension: Model with Multiple Banks
  - With limited commitment, correlated and risky returns across banks is optimal
- Policy Implications

Simple Example: When Debt Rollover Resembles a Public Good Problem

Environment of Simple Example

- Time: t = 1,2
- N Depositors' each owed I/N in period 1
- Preferences:
  - Depositors: $c_1 + v_i c_2$ with $c_t \geq 0$
  - v_i is an i.i.d. with $G_i(v_i)$ and support $[\underline{v}, \overline{v}]$
  - v_i is private information
  - $v = (v_1, \ldots, v_N)$
- Debt-Rollover:
  - Requires I resources in period 1
  - Delivers Y units of output in period 2

The Game Between Depositors

- Each depositor has a right to claim resources I/N in period 1
- A mechanism specifying payments to depositors in period 1 and 2 is proposed
- If each depositor (knowing v_i) agrees to waive their right, project is continued
- If any depositor refuses, project is discontinued

Rollover and Depositors' Discount Factors

- Consider designing general (direct) mechanisms $(p_1^i(v), p_2^i(v), x(v))$ which respect:
  - Private information of Depositors
  - Participation constraints of depositors
  - Raise I resources
- Will compare full information and private information outcomes

Full Information Outcomes

- When depositors' discount factors are observable, rollover dominates no-rollover if and only if there exist payments $p_2^i(v)$ such that

$$v_i p_2^i(v_i, v_{-i}) \geq I/N$$

where $\sum_i p_2^i(v_i, v_{-i}) \leq Y$

- Implies rollover is efficient if

$$I \frac{1}{N} \sum_i \frac{1}{v_i} \leq Y$$

Lemma

If $IE[1/v_i] < Y$ then as $N \to \infty$, the probability rollover is ex-post efficient tends to 1.

Efficient Rollover with Private Information

- When depositors' discount factors are unobservable, incentive compatibility requires

$$\int_{v_{-i}} \left[x(v_i, v_{-i}) v_i p_2^i(v_i, v_{-i}) + (1 - x(v_i, v_{-i})) \frac{I}{N} \right] dG_{-i}(v_{-i})$$
$$\geq \int_{v_{-i}} \left[x(\hat{v}_i, v_{-i}) v_i p_2^i(\hat{v}_i, v_{-i}) + (1 - x(\hat{v}_i, v_{-i})) \frac{I}{N} \right] dG_{-i}(v_{-i})$$

- Participation requires

$$\int_{v_{-i}} \left[x(v_i, v_{-i}) v_i p_2^i(v_i, v_{-i}) + (1 - x(v_i, v_{-i})) \frac{I}{N} \right] dG_{-i}(v_{-i}) \geq \frac{I}{N}$$

- Resources (in ex-ante terms)

$$\int_v x(v) \left[Y - \sum_i p_2^i(v) \right] dG(v) \geq 0$$

Efficient Rollover with Private Information

- Can show: a rollover rule, $x(v)$ is implementable if and only if $x(v)$ is increasing and

$$\int_v x(v) \left[Y - \frac{I}{N} \sum_i \left[\frac{1 - G_i(v_i)}{v_i^2 g_i(v_i)} + \frac{1}{v_i} \right] \right] dG(v) \geq 0.$$

Lemma

If discount factors are such that $\underline{v}Y < I$ *and* $(1 - G_i(v_i))/(v_i^2 g_i(v_i))$ *is decreasing, then* $x(v) \to 0$ *as* $N \to \infty$

- For large N, difficult to construct mechanisms which get all depositors to agree to waive rights

- Similar to standard results from public goods literature (Rob (1989) and Mailath and Postlewaite (1990))

Efficient Rollover with Private Information

- Reason difficult to construct rollover contracts
  - Most impatient type requires more than pro-rata share to participate
  - Implies rollover contract must subsidize impatient types in favor of patient types
  - Implies patient types have incentives to under-report discount factor:
    - Benefit: receive larger share of future returns
    - Cost: lower probability of roll-over
  - Costs tend to 0 as $N \to \infty$, Benefits do not
- For large N, not rolling over debt is ex-post inefficient and resembles runs or panics
- Next, show depositors endogenously choose capital structure with these outcomes

Benchmark Model with Single Bank and Many Depositors

Model Ingredients

- Standard repeated moral hazard environment (Holmstrom (1979))
  - Banker must be provided incentives to exert effort
  - Effort affects distribution of future returns
- Depositors experience private discount factor shocks (Diamond and Dybvig (1983))
  - Depositors must be provided incentives to report discount factor truthfully
- Limited enforcement of contracts

Environment

- Agents: N depositors, 1 banker
- Time: t = 0,1,2
- Depositors' Endowments: identical, $(\frac{I}{N}, 0, 0)$
- Preferences:
  - Banker: $c_0 + c_1 + \beta c_2$
  - Depositors: $c_0 + c_1 + v_i c_2$
  - v_i is i.i.d., distribution $G_i(v_i)$, support $[\underline{v}, \overline{v}]$ and $\beta < \underline{v}$
  - v_i is private information, $v = (v_1, \ldots, v_N)$
  - $c_t \geq 0$

Investment Technology

- Investment in period $t = 0, 1$ requires I goods and banker's effort, $e \in \{\pi_l, \pi_h\}$ with cost $\bar{q} = q(\pi_h), 0 = q(\pi_l)$

- Output:
  - Period 1:
    - Output: $I + y_1$

$$y_1 = \begin{cases} y_h & \text{w/ prob } e_0 \\ 0 & \text{w/ prob } 1 - e_0 \end{cases}$$

    - Continuation requires I re-invested and effort e_1

  - Period 2 (if continued)
    - Output: $I + \rho y_1 + z_2$

$$z_2 = \begin{cases} y_h & \text{w/ prob } e_1 \\ 0 & \text{w/ prob } 1 - e_1 \end{cases}$$

    - $\rho > 0$

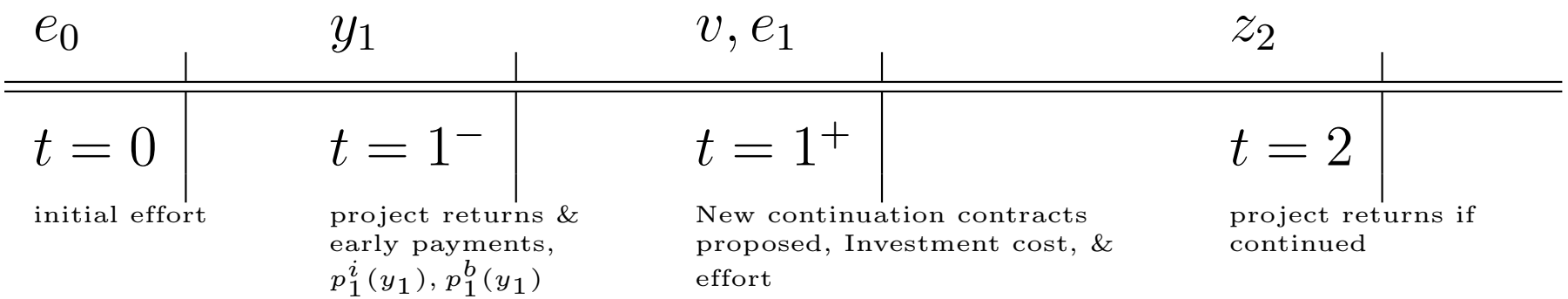
Investment Contracts

- Focus on direct mechanisms
- Investment contract specifies: banker's effort, transfers, continuation rule
  - Payments to depositors, p_t^i:

$$P^d = \left\{ \left(p_1^i(y_1), p_{1c}^i(y_1, v), p_{1n}^i(y_1, v), p_2^i(y_1, z_2, v) \right)_{i \in \{1,\ldots,N\}} \right\}$$

  - Payments to the banker, p_t^b: $P^b = \{p_1^b(y_1), p_2^b(y_1, z_2, v)\}$
  - Continuation rule: $x(y_1, v)$
  - Recommended effort: $e_0, e_1(y_1, v)$

Timing of Events



Constraints on Investment Contracts

- Resource Constraints
- Non-negativity constraints
- Banker's incentive constraints (to exert high effort)
- Depositors' incentive constraints (to report v_i truthfully)
- Depositors' participation constraints
- Enforcement constraints (to not re-negotiate the contract)

Constraints on Investment Contracts

- Resource Constraints

$$p_1^b(y_1) + \sum_{i=1}^{N} \left[p_1^i(y_1) + x(y_1, v) p_{1c}^i(y_1, v) + (1 - x(y_1, v)) p_{1n}^i(y_1, v) \right]$$
$$\leq I + y_1 - I x(y_1, v)$$
$$E_{e_1(y_1, v)} \sum_{i=1}^{N} p_2^i(y_1, z_2, v) \leq I + \rho y_1 + E_{e_1(y_1, v)} \left(z_2 - p_2^b(y_1, z_2, v) \right)$$

Constraints on Investment Contracts

- Banker's Incentives in period 1

$$\beta\left[\pi_h p_2^b(y_1, z_h, v) + (1-\pi_h)p_2^b(y_1, z_l, v)\right] - \bar{q} \geq \beta\left[\pi_l p_2^b(y_1, z_h, v) + (1-\pi_l)p_2^b(y_1, z_l, v)\right]$$

$$p_2^b(y_1, z_h, v) \geq \frac{\bar{q}}{\beta(\pi_h - \pi_l)} + p_2^b(y_1, z_l, v)$$

- Let $U_1(y_1, v) = x(y_1, v)\left[\beta E_{\pi_h} p_2^b(y_1, z_2, v) - \bar{q}\right]$

- Banker's incentives in period 0

$$p_1^b(y_h) + \int_v U_1(y_h, v)dG(v) \geq \frac{\bar{q}}{\pi_h - \pi_l} + p_1^b(y_l) + \int_v U_1(y_l, v)dG(v) \quad (1)$$

Constraints on Investment Contracts

- Define $w(y_1, \hat{v}_i, v_i)$ as value of reporting $\hat{v}_i$ when true discount factor is v_i:

$$w_i(y_1, \hat{v}_i, v_i) = \int_{v_{-i}} x(y_1, \hat{v}_i, v_{-i}) \left(p^i_{1c}(y_1, \hat{v}_i, v_{-i}) + v_i p^i_2(y_1, \hat{v}_i, v_{-i}) \right) dG_{-i}(v_{-i}) + \int_{v_{-i}} (1 - x(y_1, \hat{v}_i, v_{-i}) p^i_{1n}(y_1, \hat{v}_i, v_{-i}) dG_{-i}(v_{-i}).$$

- Incentive and Participation Constraints:

$$w_i(y_1, v_i, v_i) \geq \max_{\hat{v}_i} w_i(y_1, \hat{v}_i, v_i)$$

$$\pi_h \int_{v_i} w_i(y_h, v_i, v_i) dG_i(v_i) + (1 - \pi_h) \int_{v_i} w_i(y_l, v_i, v_i) dG_i(v_i) \geq I/N$$

Nature of Limited Commitment Problem

- Allow depositors to construct new continuation contracts after $p_1^i(y_1)$ paid and v realized

- New continuation contracts must be *incentive feasible*
  - non-negativity of depositor's and banker's consumption
  - Depositors' incentive and participation constraints
  - Banker's incentive constraint
  - Resource constraints

Enforceable Contracts

- Contract is *enforceable* if no other continuation contract improves ex-ante welfare and is incentive feasible:

Improve Ex-ante welfare

$$\sum_i \int_v \left[\hat{x}(v)(\hat{p}^i_{1c}(v) + v_i \hat{p}^i_2(v)) + (1 - \hat{x}(v))\hat{p}^i_{1n}(v)\right] dG(v)$$

$$> \sum_i \int_v \left[x(y_1, v)(p^i_{1c}(y_1, v) + v_i p^i_2(y_1, v)) + (1 - x(y_1, v))p^i_{1n}(y_1, v)\right] dG(v)$$

Non-neg consumption

$$p^i_1(y_1) + \hat{x}(v)\hat{p}^i_{1c}(v) + (1 - \hat{x}(v))\hat{p}^i_{1n}(v) \geq 0$$

- Do not require pareto improvements

Benchmark Model: Characterizing Optimal Contracts and Bank Runs

Characterizing Optimal Contracts

- Outcomes under Full Commitment if moral hazard is severe
  - Liquidate project after low period 1 output
  - Continue project after high period 1 output
  - Many state-contingent plans implement optimum
  - Liquidation Outcomes resemble bank runs

- Outcomes under limited commitment mimic commitment outcomes
  - With full info of discount factors, cannot commit to liquidate
  - Short-term debt-like claims with private info needed
  - Long-term debt-like claims with private info do not work

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Incentive Benefits of Liquidation

- Recall banker's effort constraints

$$p_2^b(y_1, z_h, v) \geq \frac{\bar{q}}{\beta(\pi_h - \pi_l)} + p_2^b(y_1, z_l, v)$$

$$p_1^b(y_h) + \int_v U_1(y_h, v) dG(v) \geq \frac{\bar{q}}{\pi_h - \pi_l} + p_1^b(y_l) + \int_v U_1(y_l, v) dG(v)$$

- Moral hazard plus limited liability imply

$$U_1(y_l, v) = x(y_l, v) \frac{\pi_l \bar{q}}{\pi_h - \pi_l}$$

  or $U_1(y_l, v) > 0$ if $x(y_l, v) > 0$

- Implies banker earns rents if project is continued

- Liquidating after low output reduces $U_1(y_l, v)$, relaxes banker's period 0 incentive constraint

- Liquidating after low output potentially costly for depositors (forgone surplus)

Liquidation After Low Output

- Tradeoff involving reductions in $x(y_l, v)$:
  - Ex-ante benefit from reducing payment to banker, $p_1^b(y_h)$

$$\pi_h \underbrace{\frac{\pi_l \bar{q}}{\pi_h - \pi_l}}_{\text{banker's rent}}$$

  - Ex-ante *maximal cost* from forgone surplus

$$(1-\pi_h) \underbrace{\left[-I + \bar{v}\left(I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}\right)\right]}_{\text{maximum } (\bar{v}) \text{ potential surplus}}$$

Lemma (Liquidate after Low Output)

The optimal contract satisfies $x(y_l, v) = 0$ *for all* v *if*

$$\frac{\pi_h \pi_l \bar{q}}{\pi_h - \pi_l} - (1-\pi_h)\left[-I + \bar{v}\left(I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}\right)\right] > 0$$

Continuation After High Output

- Increasing $x(y_h, v)$ reduces payment to banker and (potentially) increases surplus
  - Incentive benefit: $\beta \pi_h p_2^b(y_h, z_h, v) - \bar{q}$
  - Surplus benefit: $-I + \sum_i v_i p_2^i(v)$

- Surplus maximizing rule $x(y_h, v) = 1$ if and only if $\sum_i v_i p_2^i(y_h, v) + \beta \pi_h p_2^b(y_h, z_h, v) - I - \bar{q} \geq 0$

Lemma (Continute after High Output)

The optimal contract satisfies $x(y_h, v) = 1$ *for all* v *if*

$$\beta(I + \rho y_h + \pi_h z) \geq I + \bar{q}$$

- Assumption requires project to yield higher total surplus following high output under banker's discount factor than resource and effort cost

Optimal Contracts

- Have found optimal continuation rule
- Can solve for optimal payments
- Focusing on period 1 payments
  - Following low output, set $p_1^i(y_l) = I/N$ or $p_{1n}^i(y_l, v) = I/N$ (or any combination)
  - Following high output, depositors willing to pay I/N for pro-rata share if
$$I < \underline{v}\left[I + \rho y_h + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}\right]$$
(optimum more complicated typically)
- Optimum resembles short-term debt with liquidations, or long-term debt with bankruptcy, etc

Inefficient Liquidations

- Will say liquidations resemble bank runs if they are ex-post inefficient
- Ex-post inefficient if under full info, depositor welfare can be improved (ex-post) by continuing

Lemma (Ex-Post Inefficient Liquidations, Bank Runs)

If

$$IE\left[\frac{1}{v_i}\right] < \underbrace{I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}}_{\substack{\textit{Total Returns after low output} \\ \textit{net of banker's rents}}}$$

then the probability that liquidation resembles a bank run tends to 1 as $N \to \infty$.

Characterizing Optimal Contracts

- Outcomes under Full Commitment if moral hazard is severe
  - Liquidate project after low period 1 output
  - Continue project after high period 1 output
  - Many state-contingent plans implement optimum
  - Liquidation Outcomes resemble bank runs

- Outcomes under limited commitment mimic commitment outcomes
  - With full info of discount factors, cannot commit to liquidate
  - Short-term debt-like claims with private info needed
  - Long-term debt-like claims with private info do not work

Efficient Liquidations and Bank Runs

- If liquidations ex-post inefficient, for any long-term contract, depositors will re-negotiate (with high probability)

Proposition (Time Inconsistency)

If liquidations resemble banks runs, or,

$$IE\left[\frac{1}{v_i}\right] < I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)},$$

then under full information of discount factors as $N \to \infty$, no contract implements optimum with commitment. Equilibrium outcomes feature no liquidation.

- Proposition implies that if v_i is observable, optimal continuation rule is not enforceable for large N

Proposition (Sufficiency of Short-Term Debt)

Suppose $(1 - G_i(v_i))/(v_i^2 g_i(v_i))$ *is decreasing in* v_i *and*

$$\underline{v}\left[I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}\right] < I.$$

As $N \to \infty$*, the optimal continuation rule is enforceable if* $p_1^i(y_1) = I/N$*.*

- Main result: choosing high first period transfers when depositors' discount factors are unobservable introduces a "public goods" problem that resolves the time-inconsistency problem
- Enforcement constraint slack (in terms of welfare) but determines timing of payments

How Short-Term Debt Replicates Commitment

- Suppose $p_1^i(y_l) = I/N$
- Look for re-negotiation contracts that feature continuation with positive probability
- Aggregate Resources:

$$p_1^b(y_l) + \sum_i p_1^i(y_l) + \sum_i \left[\hat{x}(v)\hat{p}_{1c}^i(v) + (1-\hat{x}(v))\hat{p}_{1n}^i(v)\right] \leq I - \hat{x}(v)I$$

$$\sum_i \left[\hat{x}(v)\hat{p}_{1c}^i(v) + (1-\hat{x}(v))\hat{p}_{1n}^i(v)\right] \leq -\hat{x}(v)I$$

- Limited Liability:

$$\underbrace{\frac{I}{N}}_{p_1^i(y_l)} + \hat{x}(v)\hat{p}_{1c}^i(v) + (1-\hat{x}(v))\hat{p}_{1n}^i(v) \geq 0$$

- Implies $\hat{p}_{1c}^i(v) = -I/N$

How Short-Term Debt Replicates Commitment

- Then, the participation constraint (to waive right to I/N) is

$$\frac{I}{N} + \int_{v_{-i}} \hat{x}(v_i, v_{-i}) \left[-\frac{I}{N} + v_i \hat{p}_2^i(v_i, v_{-i}) \right] dG_{-i}(v_{-i}) \geq \frac{I}{N}$$

- Re-negotiation faces exact public good problem as above
- Choosing $p_1^i(y_l) = I/N$ makes it difficult to get depositors to waive right
- Implies depositors can commit to liquidate after low output

Why Long-Term Debt Does Not Work

- Suppose $p_1^i(y_l) = 0$ but $p_{1n}^i(y_l, v) = I/N$
- Look for re-negotiation contracts that feature continuation with positive probability
- Aggregate Resources:

$$\sum_i \left[\hat{x}(v)\hat{p}_{1c}^i(v) + (1 - \hat{x}(v))\hat{p}_{1n}^i(v)\right] \leq I - \hat{x}(v)I$$

  Note: I still "in the bank"

- Limited Liability: $\hat{x}(v)\hat{p}_{1c}^i(v) + (1 - \hat{x}(v))\hat{p}_{1n}^i(v) \geq 0$
- Participation:

$$\int_{v_{-i}} \left[\hat{x}(v_i, v_{-i})\left(\hat{p}_{1c}^i(v_i, v_{-i}) + v_i\hat{p}_2^i(v_i, v_{-i})\right) + (1 - \hat{x}(v_i, v_{-i}))\hat{p}_{1n}^i(v_i, v_{-i})\right] dG_{-i}(v_{-i}) \geq 0$$

Why Long-Term Debt Does Not Work

- Can choose $\hat{x}(v) = 1, \hat{p}^i_{1c}(v) = \hat{p}^i_{1n}(v) = 0$ and $\hat{p}^i_2(v) = Y/N$ where

$$Y = I + \pi_h z_h - \frac{\pi_h \bar{q}}{\beta(\pi_h - \pi_l)}$$

- Clearly, this alternative contract is IC, feasible, and satisfies participation

- Status quo welfare $= I$

- Re-negotiated welfare $= \frac{Y}{N} \sum_i E[v_i]$

- Since $I < E[v_i]Y$, as $N \to \infty$, $\hat{x}(v) \to 1$ (such a re-negotiation is successful)

- Long-term debt (or equity) with bankruptcy does not work

Optimal Bank Maturity

- Constrained efficiency requires promising to re-pay entire principal ($\sum_i p_1^i(y_1) \geq I$)
- Contracts which do not promise to re-pay entire principal are worse
  - Such contracts do not commit depositors to liquidate the bank ex-post
- Contracts which do not promise to re-pay entire principal resemble long-term debt or equity
- In this sense, optimal for banks to use short-term debt over longer-term contracts
- In paper, show this in decentralized economy with explicit short, long-term debt contracts

Extended Model with Multiple Banks & Policy Implications

Crises vs. Individual Bank Failures

- Commitment to liquidate individual bank requires limited availability of external resources
- Show in environment with multiple banks, depositors and bankers also have incentives to choose investments that ensure limited availability of external resources
- Will consider two extreme examples:
  - Replica economy of above with 2 bankers, $2N$ depositors, fully independent
  - Economy with perfectly correlated, riskier returns
- Will show strict preference for correlated, risky return economy
  - Implies optimality of crises

Independent Replica Economies

- 2 bankers, $2N$ depositors
- Project returns and depositor discount factors drawn independently
- Immediate that optimal continuation rule under commitment is identical to one bank outcome $x(y_h, v) = 1$ and $x(y_l, v) = 0$ for both banks
- Ask, under limited commitment, can depositors enforce $x(y_l, v) = 0$?

Independent Replica Economies

- Answer:
  - If $y^1, y^2 = y_h, y_l$, then enforcement is possible
  - If $y^1, y^2 = y_l, y_l$, then enforcement is not possible

- Focus on case where both bank earn low returns

- Aggregate resources $2I$, aggregate welfare from status quo $= 2I$

- Construct re-negotiation contract with pro-rata shares:
  $\hat{p}^i_{1c}(v) = -I/N$ and $\hat{p}^i_2(v) = \frac{1}{N}(I + \pi_h z_h - \pi_h \bar{q}/(\beta(\pi_h - \pi_l)))$

- Do N most patient depositors want to undertake such a deviation?

Independent Replica Economies

- If depositor with *median* patience under G_i accepts, then for N large, N depositors will accept

- Implies exist incentive compatible continuation contracts which strictly improve depositor's welfare

- Consider incentives of a single banker
  - From ex-ante perspective, under low effort, with probability $(1-\pi_l)(1-\pi_h)$, both banks will realize $y_1 = y_l$
  - For N large, with probability $1/2$, $x(v) = 1$
  - Implies incentive constraint of banker given by

$$p_1^b(y_h) + \int_v U_1(y_h, v) dG(v) \geq \frac{\bar{q}}{\pi_h - \pi_l} + \frac{1}{2}(1-\pi_h)\frac{\pi_l \bar{q}}{\pi_h - \pi_l}$$

    which is strictly tighter than the commitment outcome

Correlated Return Economy

- Assume project returns are perfectly correlated and effort is leontief:

$$Pr\left[(y^1, y^2) \in \{(y_l, y_h), (y_h, y_l)\}\right] = 0$$

and

$$Pr\left[(y^1, y^2) = (y_h, y_h)\right] = \min\{e_0^1, e_0^2\}$$

and similarly in period 2

- Leontief implies no added advantage in terms of incentive provision in commitment outcome

- Also assume $y_1 = -I/2$ so that if $y^1, y^2 = y_l, y_l$, aggregate resources are I

- Increase y_h so that planner under commitment with $x(y_h, v) = 1$ and $x(y_l, v) = 0$ indifferent between independent projects and correlated, risky projects

Correlated Return Economy

- After high outcomes, continuation is feasible, optimal as before
- After low outcomes, each of $2N$ depositors need to finance a single bank operation
- If financed with short-term debt, exact same public goods problem implies no incentive feasible continuation contract has $x(y_l, v) > 0$ for either bank
- Implies commitment outcome enforceable

Efficiency of Financial Crises

Proposition (Efficient Crises)

If returns are perfectly correlated and sufficiently risky, then commitment outcomes are enforceable.

- Strict preference for aggregate crises (all banks earn low returns, all banks are liquidated)
- Suggests fragile banks should undertake riskier returns more correlated with aggregate outcomes than non-fragile banks
- Besides forgone profits, no additional external cost to crises

Policy Implications

- In absence of external costs, crises are efficient
- Optimal bank maturity responds to policies that distort moral hazard problem or income process of banks
- Implications for securitization and mortgage modification programs:
  - Securitization creates a disperse group of debtors
  - Inability to re-negotiate ex-post may be a feature of the system

Conclusion

- Developed model and conditions under which banks prefer fragile capital structure
- Along equilibrium path, bank runs occur
- Short-term debt allows small depositors to commit to ex-post inefficient runs
- Long-term debt/equity may not attain same level of commitment
- Limited commitment problems imply preference for correlated, risky outcomes in financial sector