Advanced Macroeconomics I

ECON 525a - Fall 2009

Yale University

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Week 1

Syllabus and Schedule (subject to change)

- Foundations of Banks and Financial Contracts (3 weeks)
- Financial Frictions and Aggregate Fluctuations (1 week)
- Financial Crises - Bubbles and Panics (2 weeks)
- Regulation and Reputation in Financial Markets (1 week)

Modigliani-Miller

- Modigliani-Miller theorem (1958): Irrelevance of dividends and capital structure under following assumptions
  - Capital markets are perfectly competitive.
  - Individuals and firms borrow at the same rate.

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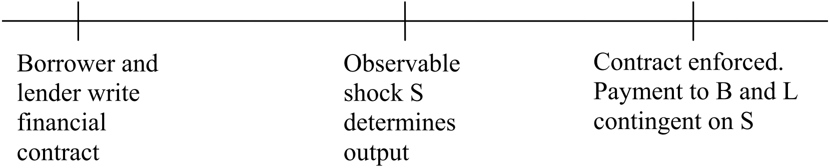
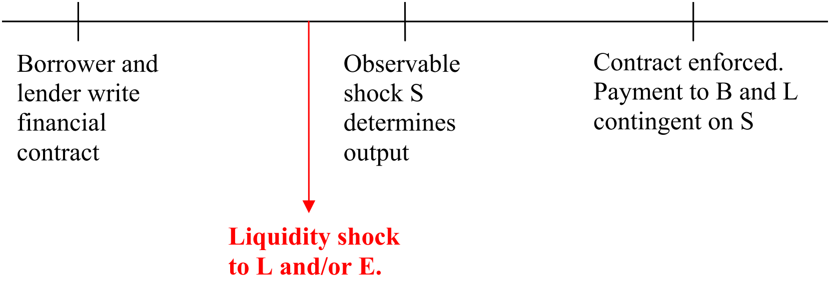
    - Capital markets are perfectly competitive.
    - Individuals and firms borrow at the same rate.
- Macro Implications
    - Asset ownership, wealth distribution and firm's capital structure DO NOT HAVE impact on investment and output.
- Financial intermediaries do not play any role.

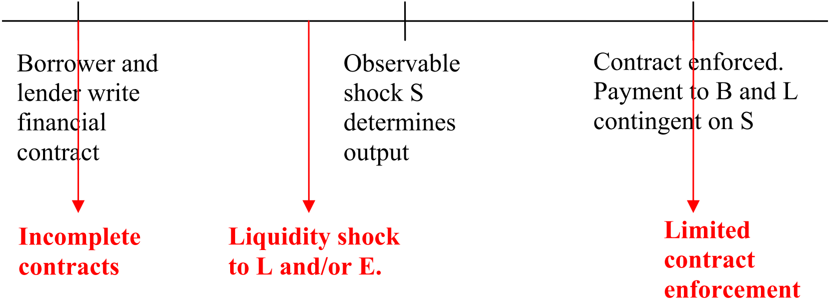
Modigliani-Miller



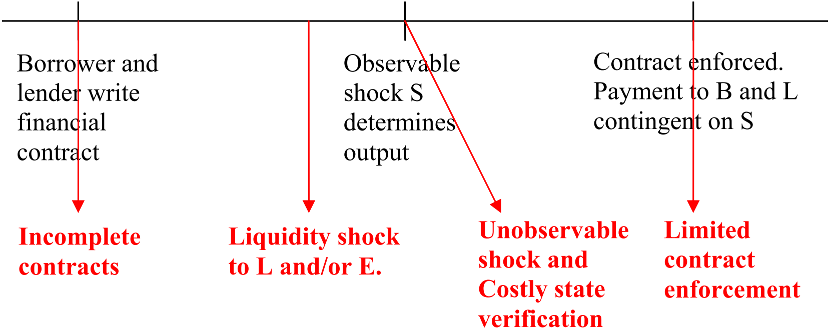
Liquidity Provision



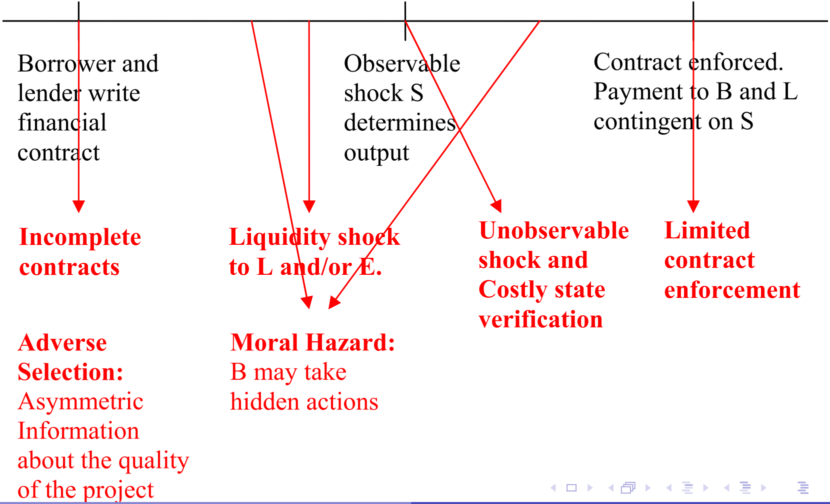
Incomplete Contracts and Commitment



Costly State Verification



Information Asymmetries



Macro Implications

- External Finance Premium.
  - Wedge between internal returns to project and external pledgable returns.
- Credit Constraints.
  - Not all NPV projects are financed.
  - Projects may not be financed up to efficient scale.
  - Credit rationing.

Open Questions

- How important are these frictions?
- Which friction is more important?
- Is there something governments can do to mitigate the macro effects of these frictions?
- Are financial frictions relevant for development?
- Are financial crises inevitable?
- Real impact of financial crises?

What is liquidity?

- Option to turn your investment into cash right now if you need.

What is liquidity?

- Option to turn your investment into cash right now if you need.
- Condition: The price at which you can turn the asset into cash is known in advance and does not vary much with how many other people are trying to do the same at the same time.

Main ideas

- Banks transform illiquid assets into liquid liabilities.
- Banks can improve on a competitive market by providing better risk sharing among people with different liquidity needs.
- Key: Asymmetric information about those needs.
- Bank runs: Undesirable equilibrium with real economic consequences (termination of productive investments).
- Contracts that may prevent bank runs:
    - Suspension of convertibility.
    - Deposit insurance (works even with aggregate uncertainty).
    - Lender of last resort.

Model

- Single homogeneous good. Endowments and technology

T=0	T=1	T=2
-1	1	0
-1	0	$R > 1$

- The agent may want to consume at $T = 1$ or $T = 2$, not both.
- $Pr(type\ T = 1) = t$ at $T = 0$.
- Assumptions
  - The type is unknown at $T = 0$ (idiosyncratic risk).
  - At $T = 1$ the agent privately observes his type (uninsurable risk).
  - t is known (NO aggregate risk).

Competitive markets

- $U(c_1, c_2; \Theta) = tln(c_1) + (1-t)\rho ln(c_2)$ where $1 \geq \rho > \frac{1}{R}$ (discounting does not overturn the gains from technology maturity)
- Economy-wide resource constraint for unit mass of agents:

$$1 = tc_1 + (1-t)\frac{c_2}{R}$$

- In competitive markets, the solution is autarky: $c_1^1 = 1$, $c_2^1 = 0$ and $c_1^2 = 0$, $c_2^2 = R$
- This is because no agent store goods from period 1 to 2.

Social optimum

- The society can do it better since there is the risk of becoming an early consumer and not taking advantage of production.
- The planner maximizes $U(c_1, c_2; \Theta)$ s.t. resource constraint.
- After some boring algebra

$$c_1^{1^*} = \frac{1}{t + (1-t)\rho} > 1$$

$$c_2^{2^*} = \frac{R}{(1-t) + \frac{t}{\rho}} < R$$

where also $c_2^{2^*} > c_1^{1^*}$, since $\rho R > 1$

Social optimum

- Benefit of liquidity: Turn the agent's wealth into readily-spendable in the event the agent discovers he or she needs it.

Decentralization

- Competitive "bank" liquidity providers intermediaries that set the following interest rates:

$$r_1 = c_1^{1^*} = \frac{1}{t + (1-t)\rho} > 1$$

$$r_2 = \frac{c_2^{2^*}}{c_1^{1^*}} = \rho R > 1$$

This implies $R_2 = r_1 r_2 = c_2^{2^*}$

The good equilibrium: Social optimum

- Assume a sequential withdrawal rule:

$$V_1(f_j, r_1) = \begin{cases} r_1 & \text{if} \quad f_j < \frac{1}{r_1} \\ 0 & \text{if} \quad f_j \geq \frac{1}{r_1} \end{cases}$$

$$V_2(f, r_1) = \begin{cases} \frac{(1-r_1 f)R}{(1-f)} & \text{if} \quad f < \frac{1}{r_1} \\ 0 & \text{if} \quad f \geq \frac{1}{r_1} \end{cases}$$

- The optimal situation is feasible and an equilibrium
  - If $f = t$ and $r_1 = c_1^{1^*}$, then $tr_1 < 1$ (feasible)
  - If $f = t$, $V_2(t, c_1^{1^*}) = c_2^{2^*} > c_1^{1^*}$ (types 2 withdraw at $T = 2$)

The bad equilibrium: Bank runs

- There is another equilibrium, characterized by "bank runs".
- What creates the gains from liquidity ($r_1 > 1$), is also what creates the possibility of runs.

The bad equilibrium: Bank runs

- There is another equilibrium, characterized by "bank runs".
- What creates the gains from liquidity ($r_1 > 1$), is also what creates the possibility of runs.
- This is a very bad equilibrium because types 2 agents end up loosing the opportunity of consuming R.
- The good equilibrium is better than autarky.
- The bad equilibrium is worst than autarky.

Suspension of convertibility

- Eliminates bank runs **ONLY when t is known**.
- It eliminates incentives to type 2 agents to withdraw at $T = 1$

$$V_1(f_j, r_1) = \begin{cases} r_1 & if \quad f_j < \hat{f} \\ 0 & if \quad f_j \geq \hat{f} \end{cases}$$

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such that $\hat{f} \in [t, \frac{R-r_1}{r_1(R-1)}]$

- Optimal risk sharing is a unique NE in dominant strategies.

Suspension of convertibility

- **When** t **is unknown** (for example, following a stochastic process), the unconstrained optimum is not achievable.
- With sequential withdrawing, there is a distortion of the consumption of type 2 agents that comes from market clearing.
- Even when first best is not achievable, the result is better than without suspension.

Deposit Insurance

- **This works even when t is unknown.**
- Key: The government should tax ending $T = 1$, after observing f.
- Then, if withdrawn at $T = 1$ is f, set taxes such that the people who withdrew get $c_1^{1*}(f)$.

$$\hat{V}_1(f) = \begin{cases} c_1^{1*}(f) & if \quad f \leq \bar{t} \\ 1 & if \quad f > \bar{t} \end{cases}$$

- Implemented by the following proportional taxes

$$\tau(f) = \begin{cases} 1 - \frac{c_1^{1*}(f)}{r_1} & if \quad f \leq \bar{t} \\ 1 - \frac{1}{r_1} & if \quad f > \bar{t} \end{cases}$$

Deposit Insurance

- Taxes are plowed back into banks, to pay withdraws at $T = 2$. Then

$$\hat{V}_2(f) = \begin{cases} c_2^{2*}(f) = \frac{(1-c_1^{1*}(f)f)R}{(1-f)} > c_1^{1*}(f) & \textit{if} \quad f \leq \bar{t} \\ \frac{(1-f)R}{(1-f)} = R > 1 & \textit{if} \quad f > \bar{t} \end{cases}$$

- Then unique dominant strategy equilibrium is $f = t$ (the realization of $\widetilde{t}$), which delivers the unconstrained social optimum.

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- **CHICKEN MODEL!!!**

Final remarks - Not an aggregate story!

- Financial crises occur when depositors at many or all of the banks in a region or country attempt to withdraw their funds simultaneously.
- However this is not a story of contagion!

Final remarks - What fuels bank runs?

- Bank runs are self-fulfilling in nature.
- Are they random events or natural results of business cycles?
- Calomiris and Gorton (91) and Lindgren et al. (96) found there is no support for the "sunspots" view of bank runs.
- They also found evidence deposit insurance and lender of last resort are in fact effective in avoiding bank runs.

Final remarks - What fuels bank runs?

NBER Cycle Peak-Trough	Panic Date	Percentage Δ (Currency/Deposit)	Percentage Δ Pig Iron
Oct. 1873-Mar. 1879	Sep. 1873	14.53	−51.0
Mar. 1882-May 1885	Jun. 1884	8.80	−14.0
Mar. 1887-Apr. 1888	No panic	3.00	−9.0
Jul. 1890-May 1891	Nov. 1890	9.00	−34.0
Jan. 1893-Jun. 1894	May 1893	16.00	−29.0
Dec. 1895-Jun. 1897	Oct. 1896	14.30	−4.0
Jun. 1899-Dec. 1900	No panic	2.78	−6.7
Sep. 1902-Aug. 1904	No panic	−4.13	−8.7
May 1907-Jun. 1908	Oct. 1907	11.45	−46.5
Jan. 1910-Jan. 1912	No panic	−2.64	−21.7

Final remarks - Moral Hazard!

- In the presence of portfolio choices, both deposit insurance and bailouts may introduce distortions through moral hazard.
- Question: Combination of tools to prevent bank runs and maintain potential punishments to bank managers.

Final remarks - Extensions and Critics

- This paper has been extended to currency crises and firms liquidity crises and has also been applied in designing bankruptcy laws.

- Green and Lin (00) show bank runs equilibrium is just an artifact of the simple contracting assumption, not being robust to a mechanism design approach.
- Jacklin study the existence of secondary markets.

Final remarks - Some questions

- Why do people deposit in the first place?
  - In fact, they only deposit if the "bank run" probability is low.

- Why does an intermediary appear in the first place?
  - A monopolist could profit while achieving the first best.

Final remarks - Some (killing) questions

- How about issuing equity to decentralize?
  - Optimum without banks...and without bank runs.
- What if ex post trading is allowed?
  - NO EQUILIBRIUM.

In next lectures

- Conditions for financial crises to be optimal (Allen and Gale).
- A unique equilibrium robust to imperfect information about relevant fundamentals (Morris and Shin).

Preview

- Here firms demand liquidity (advance financing), not consumers.
- Moral hazard: firms should induce managers to work by paying them a share. Since lenders cannot claim the total value of the firm, there are problems of liquidity demand.
- Since firms can sell to outsiders only a fraction of their expected returns, there are problems of liquidity supply.
- Four ways a firm can satisfy its liquidity needs.
    - Issuing claims on its own productive assets.
    - Holding claims on other firms.
    - Holding government-issued claims.
    - Using a credit line.

Preview

- **NO aggregate uncertainty**: Financial intermediaries achieve efficiency and the private sector is self-sufficient to finance its needs.
- **Aggregate uncertainty**: The government should issue securities to achieve efficiency since the private sector is not self-sufficient to finance its needs. Inter-temporal insurance by state contingent bonds.

Moral hazard leads to underinvestment

- Before going to H&T, let me show the effects of Moral Hazard.
  - Entrepreneur (E) and lender (L) are risk neutral.
  - E has no wealth, L is deep pocket.
  - E are scarce (they have all the bargaining power).
  - E has a project that costs I and pays RI with probability p and 0 otherwise.
  - $p \in \{p_L, p_H\}$ depending on E's unobservable efforts.
  - Assume $p_H RI \geq I \geq (p_L R + B)I$. E should work!!!
  - Contract specifies: Loan and Investment (I) and repayment (P).

Moral hazard leads to underinvestment

- E maximizes $E(\pi) = p_H(RI - P)$ subject to,

  IC: $p_H(RI - P) \geq p_L(RI - P) + BI$

  PC: $p_H P \geq I$

- IC binds: Given I, for the manager to work, the payment to L cannot be higher than

$$P \leq \left[R - \frac{B}{p_H - p_L}\right] I$$

Moral hazard leads to underinvestment

- Subject to the maximum pledgable return that guarantees no cheating is $p_H\left[R-\frac{B}{p_H-p_L}\right]I$, the lender lends only if the following condition is fulfilled

$$p_H\left[R-\frac{B}{p_H-p_L}\right]\geq 1$$

- A project is self-financing if

$$R>\hat{R}=\frac{1}{p_H}+\frac{p_H}{p_H-p_L}B$$

- A project is optimum to finance if

$$R>R^*=\frac{1}{p_H}$$

Moral hazard leads to underinvestment

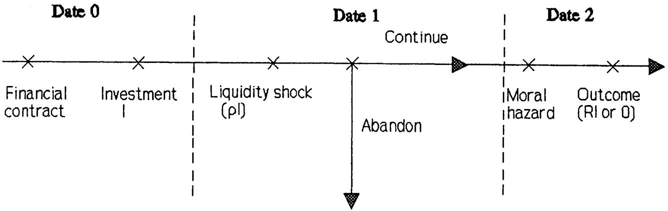
- There is a range of projects with returns $R \in [R^*, \hat{R})$ that would be optimal to finance, but are not. This is because moral hazard creates a wedge that translates into underinvestment.
- What creates firms' demand for liquidity is the combination between the uncertainty about future cash needs and moral hazard.

Question

- To what extent do financial contracts and intermediaries provide adequate amount of cash?

Model

- **Date 0**: E has endowment $A > 0$, all the bargaining power and needs funds for the project investment I. L has deep pockets.
- **Date 1**: E needs to reinvest ρI to continue. ρ is uncertain at $T = 0$ and known at $T = 1$ by everyone.
- **Date 2**: Moral hazard and outcome.



First Best

- Reinvest only if $\rho < \rho_1 \equiv p_H R$
- Assumption

$$\int max\left[p_H R - \rho, 0\right] f(\rho) d\rho - 1 > 0 > \int max\left[p_L R + B - \rho, 0\right] f(\rho) d\rho - 1$$

- The contract needs to implement high efforts. E should work!!!

Contract

- $Contract = \{I, \lambda(\rho), R_E(\rho)\}$, where
    - I is the initial investment (sunk cost at $T = 1$).
    - $\lambda(\rho)$ is the prob. of continuation contingent on ρ
    - $R_E(\rho)$ is what E keeps in case of success. ($R - R_E(\rho)$ goes to L)

Optimal Contract

- E solves

  max $U_E = I \int p_H R_E(\rho)\lambda(\rho)f(\rho)d\rho - A$

  subject to

  IC: $p_H R_E(\rho) \geq p_L R_E(\rho) + B, \qquad \text{for all } \rho$

  PC: $I \int \{p_H[R - R_E(\rho)] - \rho\} \lambda(\rho)f(\rho)d\rho \geq I - A$

- This problem is linear in I. E wants to have the highest possible I

Solution

- IC is binding, $\Rightarrow R_E(\rho) = \frac{B}{p_H - p_L}$
- This gives us the date 1 pledgeable unit return from investment,

$$\rho_0 \equiv p_H \left(R - \frac{B}{p_H - p_L} \right) < \rho_1$$

Solution

- Minimize the money investors have to contribute to continue. This is a cutoff rule.

$$\lambda(\rho) = \begin{cases} 1 & if \quad \rho \leq \hat{\rho} \\ 0 & if \quad \rho > \hat{\rho} \end{cases}$$

- Hence, the binding PC can be rewritten as (recall $\rho_1 = p_H R$)

$$I \int_0^{\hat{\rho}} p_H R_E(\rho) f(\rho) d\rho - A = \left[\int_0^{\hat{\rho}} [\rho_1 - \rho] f(\rho) d\rho - 1 \right] I$$

Solution

- Replacing the IC in the maximization problem

$$maxU_E(\hat{\rho}) = m(\hat{\rho})I$$

where

$$m(\hat{\rho}) = \int_0^{\hat{\rho}} [\rho_1 - \rho] f(\rho) d\rho - 1$$

- $m(\hat{\rho})$ **is the marginal net social return on investment.**

Solution

- We assumed

$$\int_0^{\rho_1} (\rho_1 - \rho) f(\rho) d\rho > 1$$

- Now assume self financing is ruled out,

$$\int_0^{\rho_0} (\rho_0 - \rho) f(\rho) d\rho < 1$$

which is consistent with a positive wedge $(\rho_1 - \rho_0) > 0$.

Solution

- From the PC (recall $\rho_0 = p_H[R - R_E(\rho)]$)

$$I \left[\int_0^{\hat{\rho}} (\rho_0 - \rho) f(\rho) d\rho \right] = I - A \Rightarrow I = k(\hat{\rho})A$$

where

$$k(\hat{\rho}) = \frac{1}{1 - F(\hat{\rho})\rho_0 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho}$$

- $k(\hat{\rho})$ **is the equity multiplier.**
- **Hence, the firm maximizes** $U_E(\hat{\rho}) = k(\hat{\rho}) m(\hat{\rho}) A$

Solution

- The firm maximizes $U_E(\hat{\rho}) = k(\hat{\rho})m(\hat{\rho})A$
- Which is the same, the firm chooses ρ^* to minimize

$$\frac{1 + \int_0^{\hat{\rho}} \rho f(\rho) d\rho}{F(\hat{\rho})}$$

  the expected unit cost of total expected investment.

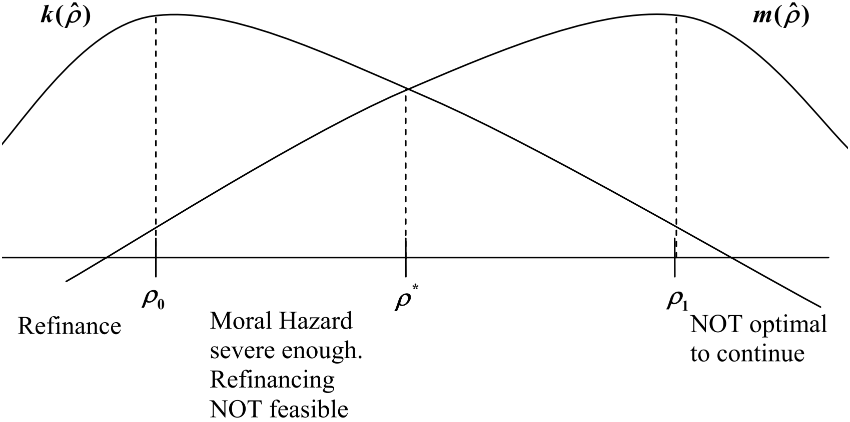
- Hence ρ^* satisfies

$$\int_0^{\rho^*} F(\rho) d\rho = 1$$

  and

$$U_E(\rho^*) = \frac{\rho_1 - \rho^*}{\rho^* - \rho_0} A$$

Solution


$k(\hat{\rho})$
$m(\hat{\rho})$
ρ_0
ρ^*
ρ_1
Refinance
Moral Hazard
severe enough.
Refinancing
NOT feasible
NOT optimal
to continue

Implementation of second best

- Investors do not want to inject more cash into the project if $\rho > \rho_0$.
- Possible solutions to implement ρ^*
  - **Irrevocable line of credit.** Give $I - A$ at $T = 0$ and a line of credit up to $\rho^* I$.
  - **Cash account.** Give $(1 + \rho^*)I$ at $T = 0$ with the covenant of keeping $\rho^* I$ in reserve for reinvestment. (equivalent to a liquidity ratio $\frac{\rho^*}{1+\rho^*}$).
- What if storage is not feasible? We need to replicate cash by financial contracts. This is, entrepreneurs hold financial claims against each other.

A Financial Market for Individual Claims

- Continuum of ex-ante identical E.
- ρ_i are i.i.d. across i. NO aggregate uncertainty.
- L are deep pockets. They cannot sell claims on future endowments. Only claims on firms can be made (backed up by marketable assets)
- Claim: $P at $T = 0 \Rightarrow (R - R_E)$ at $T = 2$ if success (share in the firm).
- Can the firm cover a potential shortfall by buying, at date 0, claims issued by other firms and selling these claims at date 1, when liquidity is needed?

A Financial Market for Individual Claims

- Not in general.
  - Lucky firms hold shares they do not need.
  - Unlucky firms cannot continue because the average share of the market portfolio offers insufficient liquidity.
- When the market fails, the second best can be implemented by an intermediary that pool liquidity needs (a mutual fund, for example)

Intermediation

- A conglomerate of firms (mutual fund) generate enough liquidity to implement the second best.

$$I\left[F(\rho^*)\rho_0 - \int_0^{\rho^*} \rho f(\rho) d\rho\right] = I - A > 0$$

Intermediation

- At $T = 0$ the intermediary signs a contract with investors on scale:
  - Overall operation I^* at $T = 0$
  - Total transfer at $T = 1$, $I^* \int_0^{\rho^*} \rho f(\rho) d\rho$
  - Total repayment at $T = 2$ to make outsiders break even
- At $T = 0$ the intermediary signs a contract with each entrepreneur, that specifies:
  - Investment I.
  - Continuation policy $\lambda(\rho)$
  - Payoff policy $R_E(\rho)$

  and guarantees a credit line for $T = 1$ up to ρ^*

Aggregate Uncertainty

- Assume shocks are not iid, but perfectly correlated (all firms have the same ρ).
- No role for pooling.
- We go back to the original situation.

Role for the government?

- Governments should issue bonds at $T = 0$ and force E to hold them.
- Bonds proceeds to investments.
- E sell and/or redeem bonds.
- Government taxes L's to finance repayment.
- **Government uses its taxation power to create storage opportunities**

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