Bank runs, Deposit Insurance and Liquidity

Douglas W. Diamond and Philip H. Dybvig, 1983

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Authors

- *Douglas Diamond:*
- Born 1953
- University of Chicago
- Best known for research on financial crisis & bank runs

- *Philip Dybvig:*
- Born 1955
- Yale University and WashU
- Research on banking, financial institutions and governance

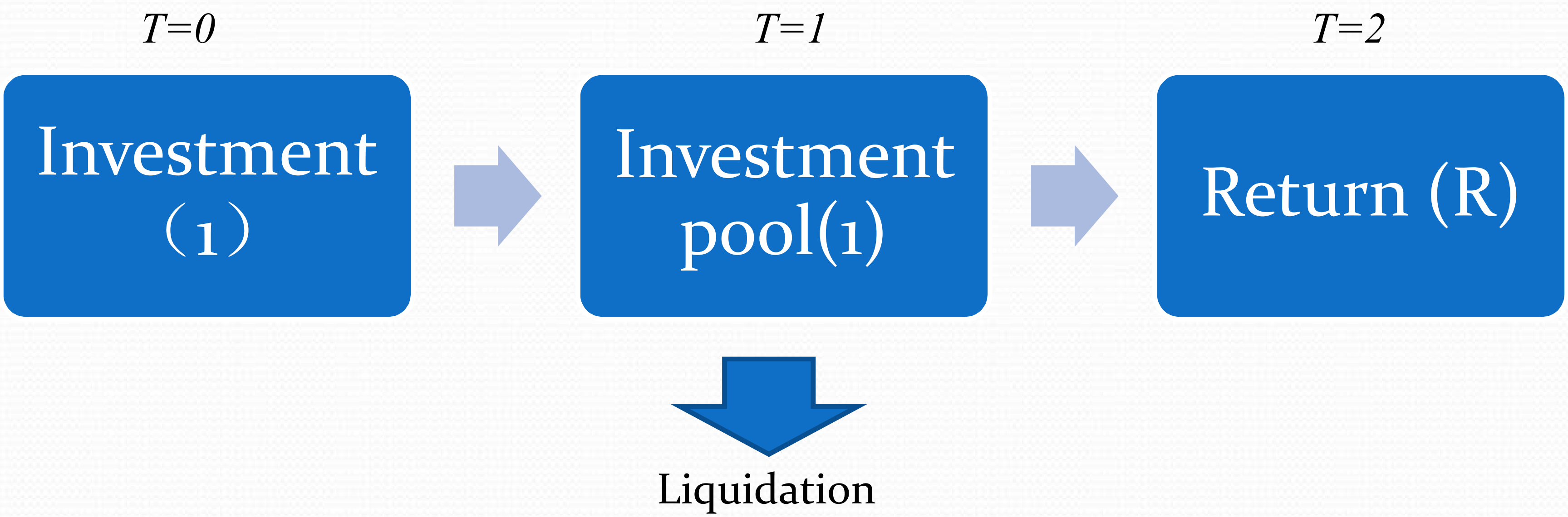
Contents

- 1. The basic structure of Diamond-Dybvig model on demand deposits
- 2. Optimal insurance contract and risk sharing
- 3. Equilibrium decisions and bank run
- 4. Banks' measures: suspension of convertibility
- 5. Government measures: deposit insurance
- 6. Why run-like behavior still exists
- 7. My opinion and potential research

DD model: Basic elements(Prescott, 2010)

- Long-term investments that are more productive than short-term investments
- A random need for liquidity on the part of an individual
- Private information about an individual's need for liquidity

DD model: Structure



$T=0$	$T=1$	T
-1	$\begin{cases} 0 \\ 1 \end{cases}$	

DD model: Utility

- Two types of agents:
- Type 1: Short term investors (forced liquidation)
- Type 2: Long term investors (care about total consumption)
- Proportion of type 1 is predetermined, but randomly chosen at T=1

(2) $U(c_1, c_2; \theta) =$

$$\begin{cases} u(c_1) & \text{if } j \text{ is of type 1 in} \\ \rho u(c_1+c_2) & \text{if } j \text{ is of type 2 in} \end{cases}$$

where $1 \geq \rho > R^{-1}$ and $u : R_{++} \rightarrow R$ is twice con
differentiable, increasing, and strictly concave an
Inada conditions $u'(0) = \infty$ and $u'(\infty) = 0$. Als
sume that the relative risk-aversion coefficient -

DD model: Optimal insurance contract

c_k^i :consumption in period k of an agent who is of type i

(3) $c_1^{2*} = c_2^{1*} = 0$

(which says, those who can, delay consumption),

(which says, those who can, delay consumpti

(4) $u'(c_1^{1*}) = \rho R u'(c_2^{2*})$

(which says, marginal utility is in line with m
ductivity), and

(5) $tc_1^{1*} + [(1-t)c_2^{2*}/R] = 1$

DD model: example

$$Set\ u(c) = -\frac{1}{c}, u'(c) = \frac{1}{c^2}, R = 2, \rho \in (0.5,1]$$

t\rho	0.6	0.8	1
0.2	(1.57,1.72)	(1.42,1.79)	(1.31,1.85)
0.4	(1.37,1.50)	(1.28,1.62)	(1.21,1.32)
0.6	(1.22,1.34)	(1.17,1.48)	(1.13,1.60)
0.8	(1.10,1.20)	(1.08,1.37)	(1.06,1.50)

- c1*>1, c2*<R， c1*<c2*
- (Why ‘insurance’?)The optimal insurance ensures a larger return for Type 1 agents by diverting Type 2 returns
- The higher t, the lower return for both type agents (reduced investment)
- The higher rho, the higher return for Type 2 and lower return for Type 1(higher price for long-term earning)

DD model: Effect of return rate

$$Set\ u(c) = -\frac{1}{c}, u'(c) = \frac{1}{c^2}, t = 0.5, \rho = 0.6$$

R	c1	c2
2	1.29	1.42
3	1.19	1.6
4	1.12	1.74
5	1.07	1.86

- Higher return rate worsens the situation of Type 1 agents while benefits the Type 2
- Do NOT believe in the mercy of the lucky ones!

DD model: Interest and returns

- *r1: Per unit return for investors liquidating at T=1*
- *f: Total fraction of demand deposit withdrawn*
- *f j:Deposit withdrawn before agent j*
- *Sequential service constraint: t a bank's payoff to any agent can depend only on the agent's place in line and not on future information about agents later in line*

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

and

Equilibrium: Optimal/bank run

- Equilibrium: no one is motivated to change his/her strategy alone
- Only consider pure strategy equilibrium
- Optimal equilibrium: $r1=c1^*$; only type 1 liquidate at $T=1$
- Bank run equilibrium: everyone liquidate at $T=1$, only $1/r1$ of them get their $r1$ return
- Why dislike bank run?
- It offers mean return of 1 while adding risk

Equilibrium: example for bank run

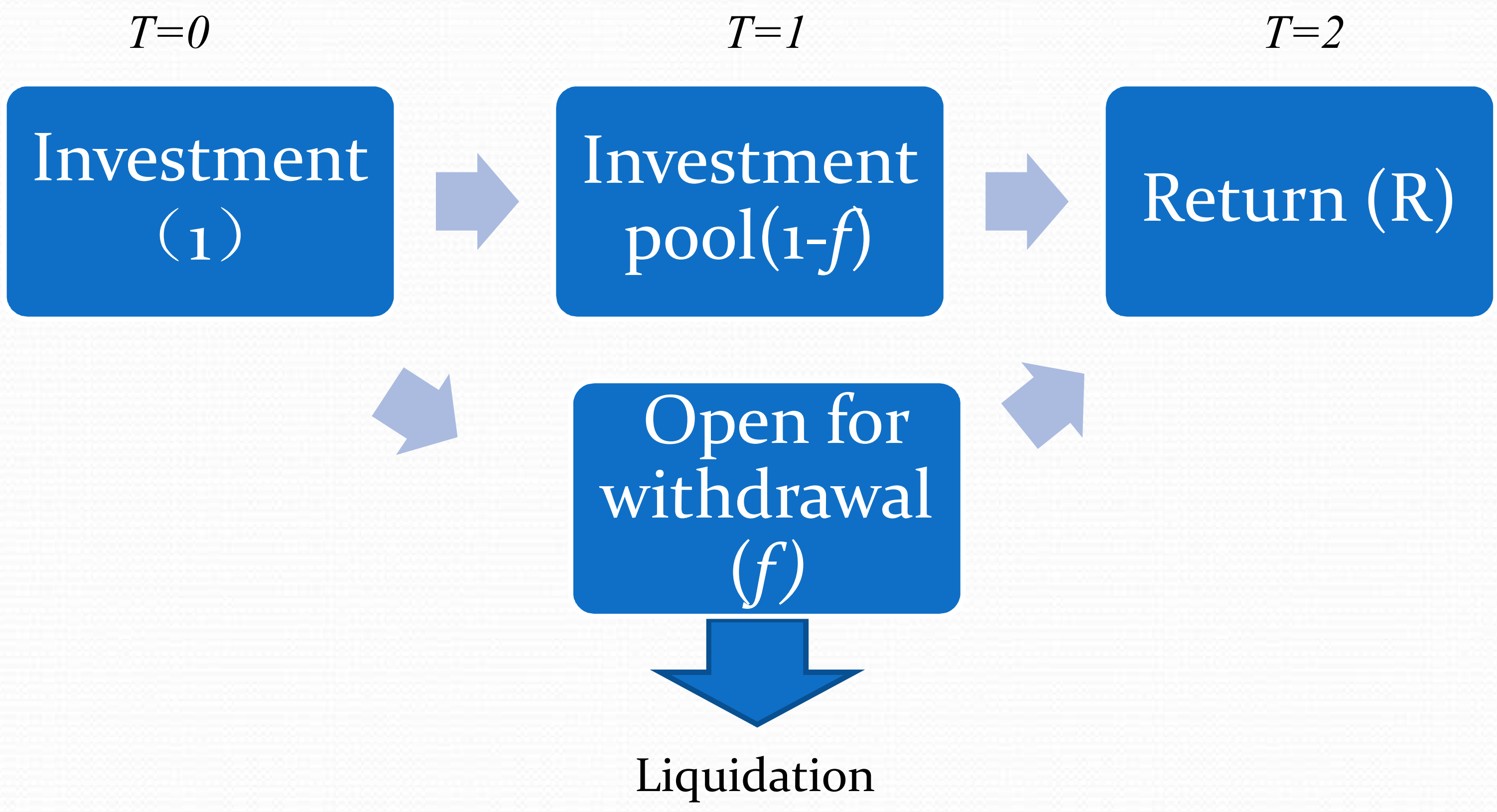
- Three agents, R=2, r1=1.5,t=1/3
- For Type 2 agents:

	Withdraw	Hold
Withdraw	(1,1)	(1.5,0)
Hold	(0,1.5)	(2,2)

The problem is that once agents have deposited, anything that causes them to anticipate a run will lead to a run

Suspension of convertibility: Structure

- The SC contract limits the total amount of investment open to liquidation at time 1



SC: Payoff and avoiding runs

Payoff:

$$(8) \qquad V_1(f_j, r_1) = \begin{cases} r_1 & \text{if } f_j \leq \hat{f} \\ 0 & \text{if } f_j > \hat{f} \end{cases}$$

- The bank run is avoided when a Type 2 agent refuse to withdraw even if ALL others choose to liquidate
- Therefore, we need

$$\frac{(1-\hat{f}r_1)R}{1-\hat{f}} > r_1$$

$$\hat{f} \in \{t, [(R-r_1)/r_1(R-$$

SC: Maximum promised return

- In $\hat{f} \in \{t, [(R - \bar{r}_1)/r_1(R-1)]\}$ the left constraint ensures that all Type 1s will receive the liquidation value, while the right constraint ensures that all Type 2s will receive return larger than r1 if waiting until T=2
- A maximum return exists for the suspension strategy to be feasible
- The maximum return is a increasing function of R and decreasing of t
- The increase speed shrinks as t rises

R\t	0.2	0.5	0.8
1.5	1.36	1.2	1.07
2	1.67	1.33	1.11
2.5	1.92	1.43	1.14
3	2.14	1.5	1.15

SC: Stochastic withdrawals

- t is stochastic
- Bank contracts (which must obey the sequential service constraint) cannot achieve optimal risk sharing when t is stochastic and has a non degenerate distribution

t\rho	0.6	0.8	1
0.2	(1.57,1.72)	(1.42,1.79)	(1.31,1.85)
0.4	(1.37,1.50)	(1.28,1.62)	(1.21,1.32)
0.6	(1.22,1.34)	(1.17,1.48)	(1.13,1.60)
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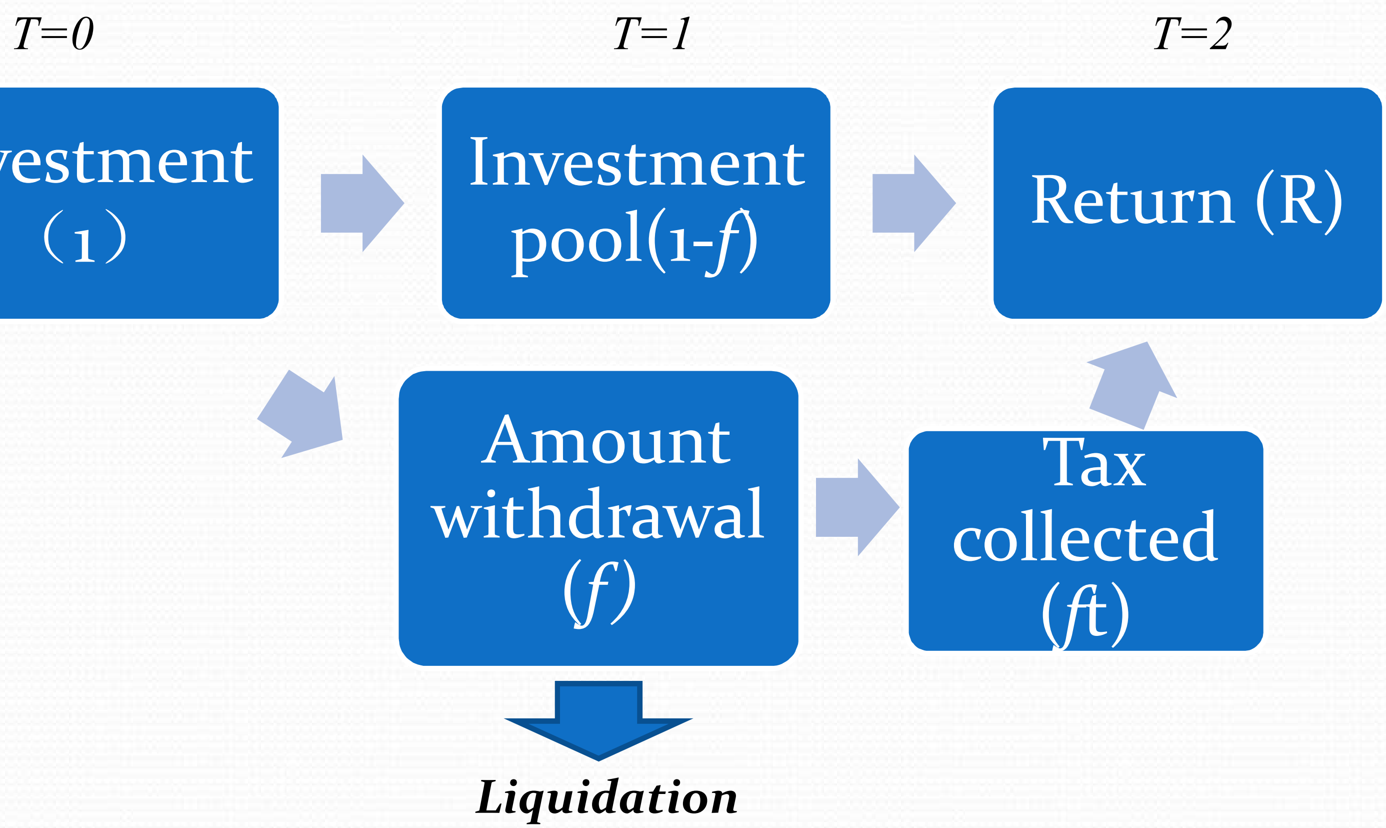
Deposit insurance: Structure



•Different from the suspension of convertibility, the deposit insurance allows the government to take adjustment actions AFTER the decisions of agents are made.

DI: Tax rate

- *τ: The tax rate*
- $\bar{t}$ *:The largest possible t*

- Our goal is to reach the optimal risk sharing in the demand deposit system

$$(10) \quad \tau(f) \begin{cases} 1 - [c_1^{1*}(f)/r_1] & \text{if} \\ 1 - r_1^{-1} & \text{if} \end{cases}$$

- It simply 'forces' the reply rate of return in period 1 to be c1*, and 'punishes' those who participate in a run

DI: Returns and equilibrium

$$(11) \quad \hat{V}_1(f) = \begin{cases} c_1^{1*}(f) & \text{if } f \le \bar{t} \\ 1 & \text{if } f > \bar{t}\,. \end{cases}$$

$$(12) \quad \hat{V}_2(f) =$$

$$\begin{cases} R\{1 - [c_1^{1*}(f)f\,]\}/(1-f) = c_2^{2*}(f) & \text{if } f \le \bar{t} \\ R(1-f)/(1-f) \qquad\qquad\quad = R & \text{if } f > \bar{t}\,. \end{cases}$$

- As c2*>c1*, no bank run will ever happen
- Therefore, the second situation never exists, and only the optimal equilibrium is feasible

$$(13) \quad \hat{V}_1(f = t) = c_1^{1*}(t)$$

and

$$(14) \quad \hat{V}_2(f = t) = [1 - tc_1^{1*}(t)]R/(1-t) = c_2^{2*}$$

DD model: Conclusions

- Two possible equilibriums exist in the Diamond-Dybvig bank model: the system optimal and the bank run
- Anything anticipating a run will lead to a run
- Suspension of convertibility(bank) can ensure the optimal risk-sharing when t is known ex ante
- Deposit insurance can ensure the optimal risk-sharing in stochastic t cases
- As long as the government can impose some tax to finance the insurance, no matter how distortionary, there will be no runs and the distorting tax need never be imposed

Why still crisis? (Prescott 2010)

Bank-like Arrangements
- Repo markets
- Money market mutual funds

Random Return
- Hard to determine the optimal strategy
- No fixed tax rate

Moral Hazard
- No complete information
- Risk of portfolios selected by manager

Conclusions

- Deposit insurance is a efficient tool to remove the possibility of bank runs and reach optimal risk sharing
- The deposit insurance is costless as long as it exists
- Several financial arrangements resemble banks and run-like behavior demonstrates that the Diamond-Dybvig model is still relevant
- It might be necessary to include new financial arrangements in the insurance system to prevent possible runs

My opinions and future research

- A framework of banking and deposit insurance system
- *WHAT IF*:
- The R is random/unknown?– risk, moral hazard and mechanism design (Myerson 1979)
- There exists several banks?
- Different risk aversion of agents exist while only the distribution is known?
- R is related to t?
- *IS THERE A METHOD*:
- That does not use personal tax rates?
- To avoid political criticism of ‘determining the interest rate’?

Thanks for listening!