Money and Modern Bank Runs

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Traditional vs. "Modern" Banking

Does Money Effect Bank Run Theory?

	"Real World"	Theory
Traditional Banking	"It's a Wonderful Life" ▪ Currency withdrawn from banking system	Diamond-Dybvig ▪ Demand deposits paid in goods
	Depletion from banks ⇒ Bank Runs	
Introduce: "Modern" Banking	"Wheelbarrow Lending" ▪ Wire transfers ▪ Same day electronic payment systems	▪ Clearinghouse model ▪ Deposits paid with inside money
	Interbank market lending ⇒ No Bank Runs	

Outline of Results

Results show how modern banking avoids traditional bank runs.

Bank Runs Model: Two innovations

I. Clearinghouse
   - ⇒ No panic "Redeposit Runs"
     - Due to interbank lending

II. Demand deposits paid in *money*
   - ⇒ No "Purchase Runs"
     - Monetary prices for goods adjust
     - Money as unit of account

Bank Run Literature

Models of interbank lending with goods:

- Bhattacharya and Gale (1987), Bhattacharya and Fulghieri (1994), Allen and Gale (2000a).

Models of interbank lending with money:

- Allen and Gale (1998, 2000b), Chang and Velasco (2000), Gale and Vives (2002), Freixas et al. (2000, 2003), Freixas and Holthausen (2001), Rochet and Vives (2002).
- Bank runs because money withdrawn from banks and economy.

Diamond and Rajan (2003b):

- Money in general equilibrium.
- Traditional currency withdrawal from banking system $\Rightarrow$ Bank runs.
- Heterogeneous asset shocks $\Rightarrow$ Bank runs.

Real Model Setup

- Three periods: $t = 0,1,2$.
- Consumers have total endowment of 1 good at $t=0$.
- Privately observed types at $t=1$:
  - λ early: $u(C_1)$.
  - $1-\lambda$ late: $u(C_2)$.
- Storage returns 1 over a period.
- Investment at $t=0$ returns:

  $R > 1$ at $t=2$

  —or— $r < 1$ at $t=1$ if liquidated.

Real Model Results

First Best: $\max_{C_1, C_2, \alpha}$ $\lambda u(C_1) + (1-\lambda)u(C_2)$

s.t.: feasibility constraints

$\alpha \leq 1$ is amount of goods invested.

FOCs: C_1^*, C_2^* and α^*.

- $\lambda C_1^* = 1-\alpha^*$
- $(1-\lambda)C_2^* = \alpha^* R$

Spot Market:

t=0: Consumers choose α to invest and store $1-\alpha$.

t=1: Early and late consumers trade.

$\Rightarrow$ Outcome: α, C_1=1, C_2=R generally not first best.

Lemma 1: ***Enforced storage of*** $1-\alpha*$
$\Rightarrow$ ***First best*** C_1^*, C_2^*.

Bank with Real Contracts (Diamond-Dybvig):

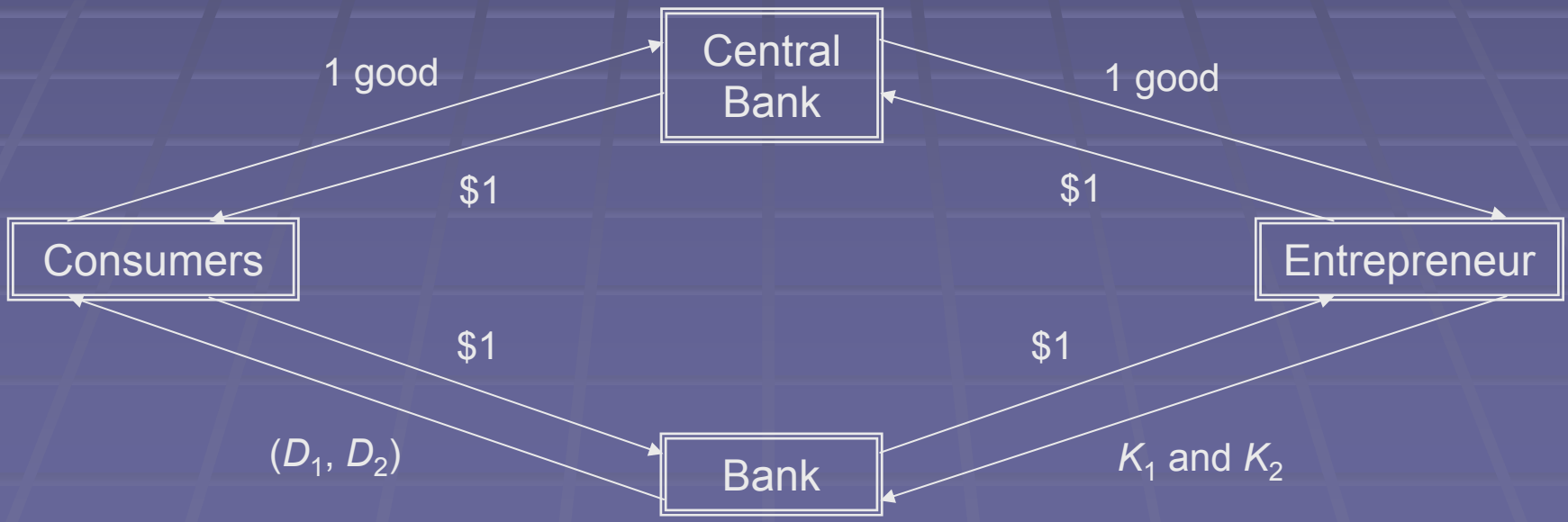
- Real demand deposits (C_1^*,C_2^*): Multiple equilibria.

Bank with Money and Nominal Contracts

Add to Diamond-Dybvig (real banking) model:

1. Entrepreneur: Store & invest goods to sell.
   - Bank ensures entrepreneur stores $1-\alpha^*$.
2. Money and nominal contracts.
   - t=0: Central Bank sets P_0=1.

Money Introduced at t=0



II. Single Bank: Money Deposits

Consumers:

t=1: $\lambda^p \geq \lambda$ withdraw D_1 and purchase goods.

t=2: $1-\lambda^p$ " D_2 " " "

- Bank run ≡ $\lambda^p > \lambda$ ("Purchase Run").

Prices: Market clearing condition

- $P_1 = \dfrac{\lambda^p D_1}{Q_1}$ $\qquad P_2 = \dfrac{(1-\lambda^p)D_2}{Q_2}$
- Entrepreneur sells Q_t goods at time t.

Assumptions

- Bank pays on t=1 to t=2 deposits competitive $D_{1,2} = \dfrac{D_2}{D_1}$
- CRRA ≥ 1 $\Rightarrow$ $D_{1,2} \leq R$
  - Bank provides insurance, not lottery ticket.
- Sequential-service constraint or pro-rata.

Results: No "Purchase Runs"

Step 1. Bank's choice of contracts.

Step 2. Entrepreneur's maximization problem and choice of Q_1 and Q_2.

Step 3. Late consumer's decision whether to run the bank.

Step 1. Bank

Bank:

- Chooses Contracts:

$$D_1 = C_1^*$$
$$D_2 = C_2^*$$

$$K_1 = \lambda D_1 \ (= 1-\alpha)$$
$$K_2 = (1-\lambda) D_2 \ (= \alpha R)$$

$$\alpha = \alpha^*.$$

Step 2. Entrepreneur

t=1:

- Chooses Q_1 goods to sell.
  - May liquidate investments or store good till t=2.
- Repays K_1 if possible.
- Excess revenues $(P_1 Q_1 - K_1)^+$ deposited for return $D_{1,2}$.

t=2:

- Chooses Q_2 goods to sell.
- Repays K_2 if possible.
- Consumes excess goods π_2.

Optimization:

$\max_{Q_1, Q_2}$ $[\pi_2 \mid \lambda^p]$

s.t. feasibility constraints.

Step 2. Entrepreneur (Cont'd)

- $P_1 = \dfrac{\lambda^p D_1}{Q_1}$ $\qquad$ $P_2 = \dfrac{(1-\lambda^p) D_2}{Q_2}$

Result: ***Entrepreneur never defaults.***

t=1: Revenues = $P_1 Q_1 = \lambda^p D_1 \geq \lambda D_1 = K_1$

t=2: Revenues = $P_2 Q_2 + (P_1 Q_1 - K_1) D_{1,2}$
$= (1-\lambda) D_2 = K_2$

Result: ***Entrepreneur provides optimal goods at t=1 and t=2.***

- FOCs $\Rightarrow$ Liquidation only if $P_1 > \dfrac{P_2}{D_{1,2}}$.
- Key: Bank enforces optimal storage at t=0.

Step 3. Late Consumers

Suppose there is a "Purchase Run": $\lambda^p > \lambda$

$\Rightarrow$ Requires: $\frac{D_1}{P_1} \geq \frac{D_2}{P_2} \Rightarrow P_1 \leq \frac{P_2}{D_{1,2}} < P_2$

$\Rightarrow$ No liquidation: $Q_1 = \lambda D_1 = 1-\alpha$

$\Rightarrow P_1 = \frac{\lambda^p D_1}{\lambda D_1} > 1, \quad P_2 = \frac{(1-\lambda^p)D_2}{(1-\lambda)D_2} < 1$

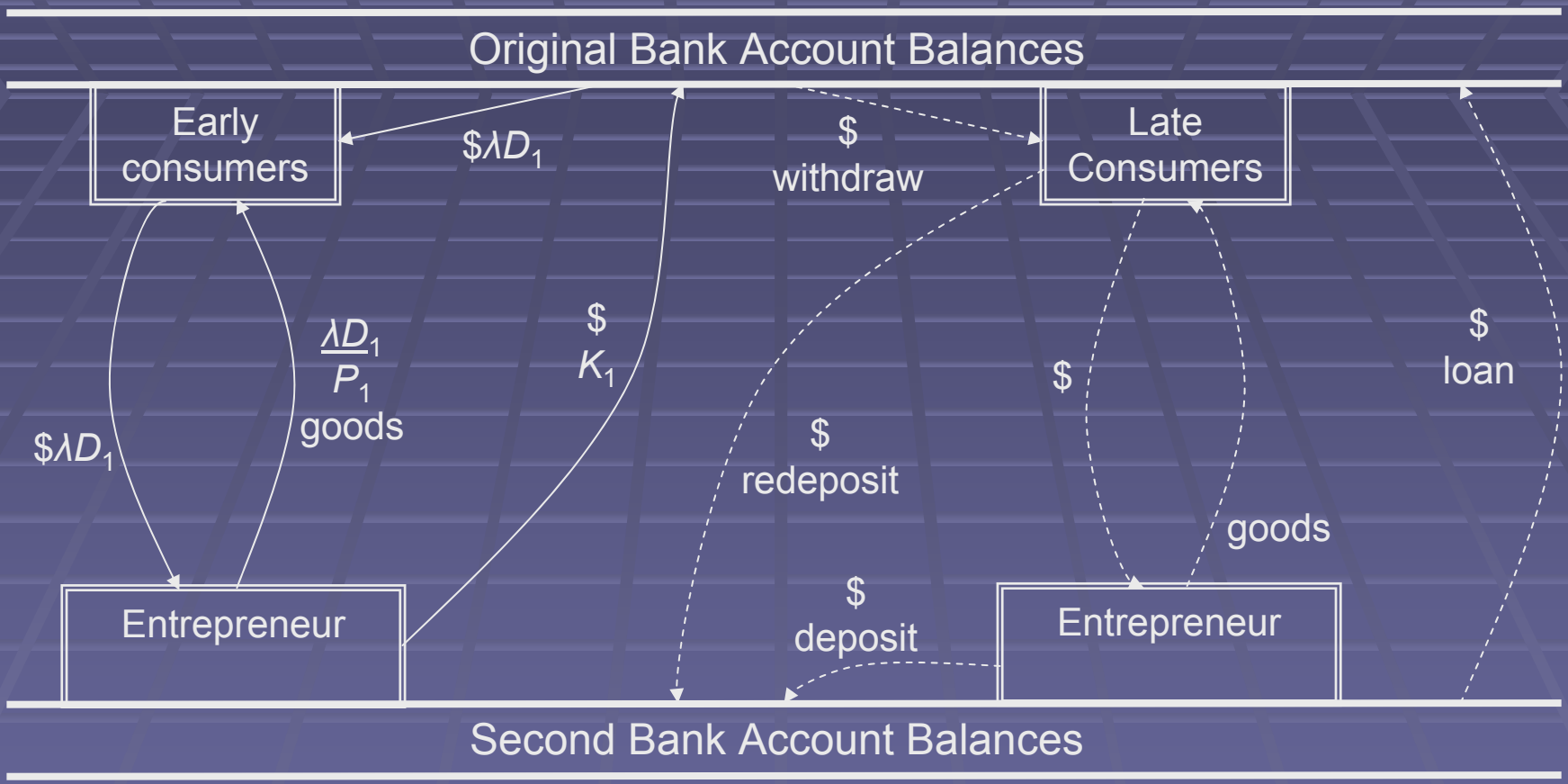
$\Rightarrow P_1 > P_2 \Rightarrow$ Contradiction

Result: ***There is never a "Purchase Run"***

- $\lambda^p = \lambda$.

I. Clearinghouse

Transactions at t=1



Innovation:

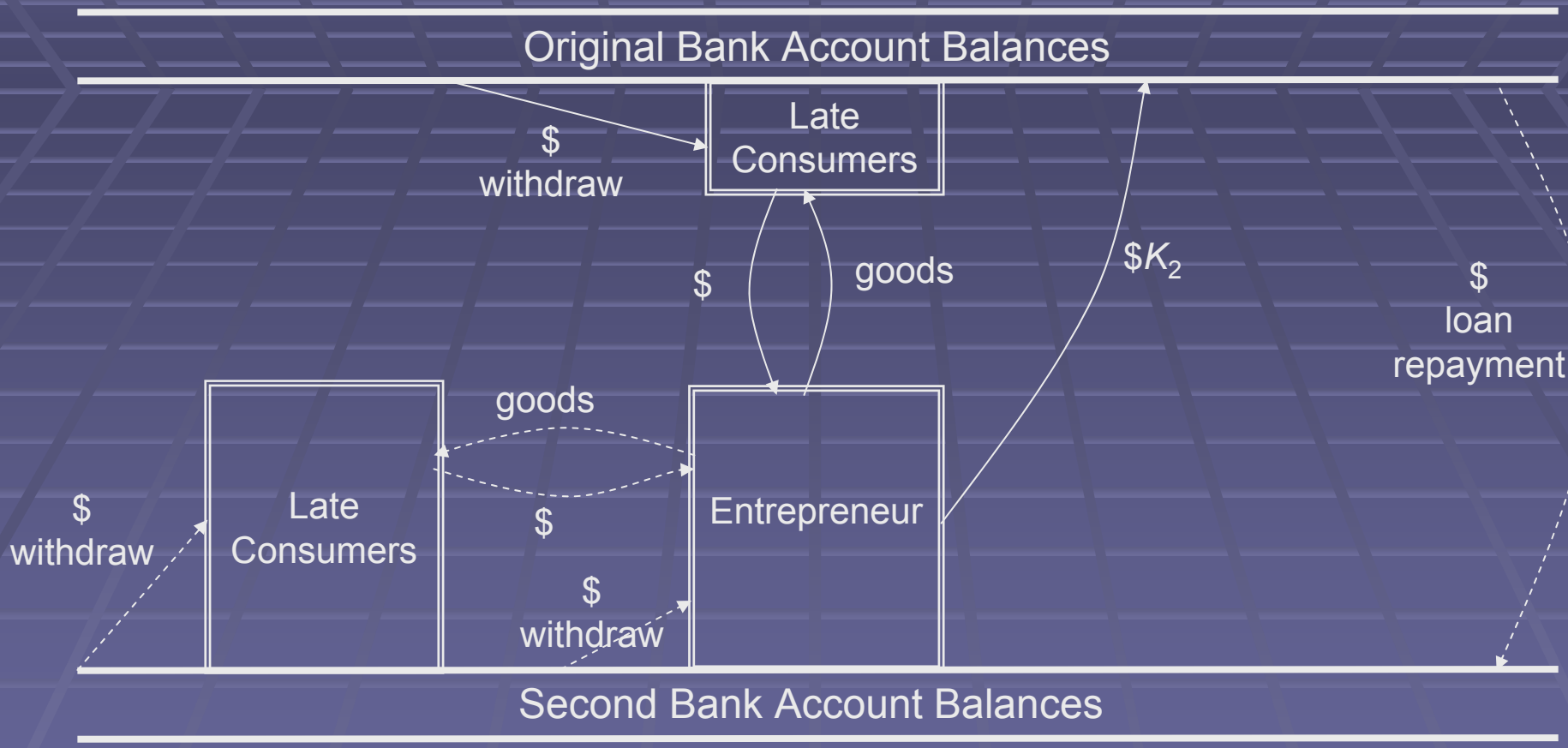
- Payment-in-the-Same-Period Constraint
- $\$Paid_t \leq \$Rec'd_t$ instead of $\$Paid_t \leq \$Rec'd_{t-1}$

Off-equilibrium ≡ ⇢

Bank Run ≡ Late consumers withdraw at t=1

I. Clearinghouse

Transactions at t=2



- Money is a flow, not a stock

Off-equilibrium ≡ ⇢

Bank Run ≡
Late consumers withdraw at t=1

Assumptions

Second Bank makes Take-It-Or-Leave-It loan offer to Original.

Bank has special relationship ability to collect on its loans.

If Original Bank defaults:

- Calls in K_2 loan.
- Demand deposits senior to interbank loans.

Prices are analogous to those above.

Results: No "Redeposit Runs"

Step 1. Original Bank's budget constraint and choice of contracts.

Second Bank's interbank lending decision.

Step 2. Entrepreneur: Same choice as in "Purchase Runs."

Step 3. Late consumer's decision whether to run the bank.

Step 1. Banks

Original Bank chooses same contracts as above.

Second Bank lends fully at return $\frac{D_2}{D_1}$.

Original Bank: Budget Constraint holds for t=1 and t=2.

- All funds net owed by Original at t=1 are available to borrow from Second Bank.
- Original then owes one-period return $\frac{D_2}{D_1}$ to Second Bank instead of to late consumers who run.

Lemma 2: ***Original Bank does not default even if all consumers withdraw early.***

- Key: Second Bank (interbank market) lends efficiently.

Step 3. Late Consumers

Suppose there is a "Redeposit Run":

$\Rightarrow$ Requires either:

i. Original Bank is expected to default.

$\Rightarrow$ Contradiction

ii. $\dfrac{D_1 D_{1,2}}{P_2} > \dfrac{D_2}{P_2} \quad \Rightarrow \quad D_{1,2} > \dfrac{D_2}{D_1}$

$\Rightarrow$ Contradiction

Result: ***There is never a "Redeposit Run"***

Unique First Best Outcome

Consumption is uniquely determined:

- $C_1 = \frac{D_1}{P_1} = C_1^*$
- $C_2 = \frac{D_2}{P_2} = C_2^*$

Proposition 1: ***Unique equilibrium is the first best outcome with no bank runs.***

New Bank Run Mechanism

Breakdown in interbank lending $\Rightarrow$ Runs and Contagion

- Original Bank liquidation $\Rightarrow$ Deflation: $P_1 \downarrow$
  $\Rightarrow$ Sub-optimal risk sharing for all consumers.
  $\Rightarrow$ All banks lose liquidity.
  $\Rightarrow$ Monetary prices cause contagion.
- Lender of Last Resort

Conclusion

Model of Banking with Money:

1. Deposits paid in money
   $\Rightarrow$ No "purchase runs"

2. Clearinghouse payment system:
   - Interbank lending $\Rightarrow$ No "redeposit runs"

Lack of bank runs in U.S. post-Great Depression

- Flexible value of money
- Modern electronic clearinghouse