Could making banks hold only liquid assets induce bank runs?

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Agenda

• Contextualization
• Model: assumptions (vs Diamond-Dybvig)
• Banks (unified and separated system)
• Welfare maximization problem
• Results
• Take-aways
Contextualization

• Glass-Steagall Act (Banking Act of 1933)

“To provide for the safer and more effective use of the assets of banks, to regulate interbank control, to prevent the undue diversion of funds into speculative operations [...] .”

• Repeal of Glass-Steagall Act (1999)
Is Glass-Steagall’s repeal to blame?

- Paul Volcker (March 2009)

  "Maybe we ought to have a **two-tier financial system.**"

  "This institutions should not be taking extraordinary risks in the market place represented by hedge funds, equity funds, large-scale proprietary trading. Those things would put their basic functions in jeopardy"

- Could making banks hold only liquid assets induce bank runs? (PS, April 2010)
Model

• 3 periods: \( T = 0 \quad T = 1 \quad T = 2 \)
• Continuum of consumers: \([0; 1]\)
• Single good (costless storage)
• Each endowed with \( y \) in \( T = 0 \)
Model

• In $T = 0$ each consumer is identical
• In $T = 1$ they discover their type (patient or impatient)
• Private information
• Sequential service constraint
• Until now, same assumptions as in Diamond and Dybvig (1983)
Model

• $\alpha$: probability of being impatient
• $\alpha$ is a random variable with density $f$
• Support: $[0, \bar{\alpha}]$ where $\bar{\alpha} < 1$
• $\bar{\alpha}$: maximum proportion of impatient consumers
What is the difference?

Diamond-Dybvig

Peck-Shell

$\downarrow$

Intrinsic uncertainty
The utility functions

\[ U_I(C^1_i, C^2_i) = \begin{cases} 
\bar{u} + u(C^1_i + C^2_i - 1) & \text{if } C^1_i \geq 1 \\
\beta \bar{u} + u(C^1_i + C^2_i - 1) & \text{if } C^1_i < 1 
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]
The utility functions

\[ U_I(C^1_I, C^2_I) = \begin{cases} 
\bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I \geq 1 \\
\beta \bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I < 1 
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]

\[ C^1_I: \text{ consumption available to an impatient in } T = 1 \]
The utility functions

\[ U_I(C^1_I, C^2_I) = \begin{cases} 
\bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I \geq 1 \\
\beta \bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I < 1
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]

\( C^1_P \): consumption available to a patient in \( T = 1 \)
The utility functions

\[ U_I(C^1_I, C^2_I) = \begin{cases} 
\bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I \geq 1 \\
\beta \bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I < 1 
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]

\( C^2_I \): consumption available to an impatient in \( T = 2 \)
The utility functions

\[ U_I(C_I^1, C_I^2) = \begin{cases} 
\bar{u} + u(C_I^1 + C_I^2 - 1) & \text{if } C_I^1 \geq 1 \\
\beta \bar{u} + u(C_I^1 + C_I^2 - 1) & \text{if } C_I^1 < 1 
\end{cases} \]

\[ U_P(C_P^1, C_P^2) = \bar{u} + u(C_P^1 + C_P^2 - 1) \]

\( C_P^2 \): consumption available to a patient in \( T = 2 \)
The utility functions

\[ U_I(C^1_I, C^2_I) = \begin{cases} 
\bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I \geq 1 \\
\beta \bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I < 1 
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]

\( \bar{u} \) : incremental utility of:

- 1 unit of consumption in \( T = 1 \) for an impatient
- 1 unit of consumption in \( T = 2 \) for a patient
The utility functions

\[ U_I(C^1_I, C^2_I) = \begin{cases} 
\bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I \geq 1 \\
\beta \bar{u} + u(C^1_I + C^2_I - 1) & \text{if } C^1_I < 1 
\end{cases} \]

\[ U_P(C^1_P, C^2_P) = \bar{u} + u(C^1_P + C^2_P - 1) \]

\( \beta \bar{u} \): incremental utility of 1 unit of consumption in
\( T = 2 \) for an impatient
The utility functions

\[ u(C^1 + C^2 - 1): \text{utility from "left-over" consumption} \]
The utility functions

\[ u(x) = C_1^1 + C_1^2 - 1 \]

\[ C^1 + C^2 - 1 \]
The utility functions

\[ u(x) = u(C_1^1 + C_2^2 - 1) \]

\[ u(\bar{u}) \]

\[ \beta \bar{u} \]
The utility functions

\[ \tilde{u} + u(C_1^1 + C_2^1 - 1) \]

\[ \beta \tilde{u} + u(C_1^2 + C_2^2 - 1) \]

\[ u(C_1^1 + C_2^2 - 1) \]
One more assumption

Constant-return-to-scale technologies

- $i$: illiquid (higher-yield technology)
- $l$: liquid (lower-yield technology)

\[ 1 < R_l < R_i \]

\[
\begin{array}{c|c|c|c}
T: & 0 & 1 & 2 \\
\hline
i: & -1 & & R_i \\
\hline
l: & -1 & 1 & R_l \\
\end{array}
\]
Recap (What’s new?)

- $\alpha \sim f_\alpha(\alpha) \ast 1_{[0, \bar{\alpha}]}(\alpha)$

$$\bar{u}$$

- $U(x) = \text{or} + u(C^1 + C^2 - 1)$

$$\beta \bar{u}$$

- $i$ (illiquid) returns $R_i$ in $T = 2$
- $l$ (liquid) returns $R_l$ in $T = 2$
Banks

Separated system
(only $l$)

Unified system
(both $l$ and $i$)
Contract

\[ \begin{gathered}
\text{specifies } \\
\begin{aligned}
&\gamma \\
&c^1(z) \\
&c^2(\alpha_1) \\
&c^2_P(\alpha_1)
\end{aligned}
\end{gathered} \]

\( \gamma = \% \text{ of endowment in } l \)

\( c^1(z) = \text{withdrawal in } T = 1 \)

\( c^2(\alpha_1) = \text{withdrawal in } T = 2 \text{ if he also withdrew in } T = 1 \)

\( c^2_P(\alpha_1) = \text{withdrawal in } T = 2 \text{ if he did not withdraw in } T = 1 \)
Welfare

No entry costs

↓

Perfect competition

↓

Maximize utility
Welfare

Remarks:

• $c^1(z) = 1$  
  Maximum withdrawal in $T = 1$

• $\gamma y \leq \bar{\alpha} \cdot 1$  
  Maximum investment in $l$
Welfare

- $\alpha \leq \gamma y$  
  All impatient agents satisfied
Welfare

- $\alpha \leq \gamma y$  All impatient agents satisfied
- $\alpha > \gamma y$  Only $\gamma y$ impatient agents satisfied
Welfare

\[
W = \int^{\bar{y}}_{y} [\bar{u} + (1 - \alpha)u ((1 - \gamma)yR_i + c_p^2(\alpha) - 1) + \alpha u ((1 - \gamma)yR_i + c_i^2(\alpha))] f(\alpha) d\alpha + \\
+ \int_{y}^{\bar{a}} [(1 - \alpha + \gamma y)\bar{u} + (\alpha - \gamma y)\beta \bar{u} + (1 - \alpha)u ((1 - \gamma)yR_i + c_p^2(\alpha) - 1) + \\
+ (\alpha - \gamma y)u ((1 - \gamma)yR_i + c_p^2(\alpha) - 1) + \gamma y u ((1 - \gamma)yR_i + c_i^2(\alpha))] f(\alpha) d\alpha
\]
Welfare

Nobody is rationed

\[
\int_0^{\gamma y} \{\alpha [\bar{u} + u(C_I^T)] + (1 - \alpha)[\bar{u} + u(C_P^T)]\} f(\alpha) d\alpha
\]

\[\alpha[\bar{u} + u(C_I^T)] : \text{utility of all impatient agents}\]

\[(1 - \alpha)[\bar{u} + u(C_P^T)] : \text{utility of all patient agents}\]
Welfare

$(\alpha - \gamma y)$ are rationed

\[
\int_{\gamma y}^{\bar{\alpha}} \{ \gamma y[\bar{u} + u(C_I^T)] + (1 - \alpha)[\bar{u} + u(C_P^T)] + (\alpha - \gamma y)[\beta \bar{u} + u(C_P^T)] \} f(\alpha) d\alpha
\]

$\gamma y[\bar{u} + u(C_I^T)]$: utility of all satisfied impatient agents

$(1 - \alpha)[\bar{u} + u(C_P^T)]$: utility of all patient agents

$(\alpha - \gamma y)[\beta \bar{u} + u(C_P^T)]$: utility of all rationed impatient agents
Welfare

If it was discrete:

\[ W = W(\alpha_1)P(\alpha_1) + W(\alpha_2)P(\alpha_2) + \cdots \]

But it is continuous:

\[ W = \int_0^\alpha \{\ldots\} f(\alpha)d\alpha \]
Constraints

Resource constraint (only $l$)

\[ \alpha_1 c_l^2(\alpha_1) + (1 - \alpha_1)c_P^2(\alpha_1) = (\gamma y - \alpha_1)R_l \quad \alpha_1 \leq \gamma y \]

\[ \gamma yc_l^2(\alpha_1) + (1 - \gamma y)c_P^2(\alpha_1) = 0 \quad \alpha_1 > \gamma y \]
Constraints

Resource constraint (only $l$)

$$\alpha_1 c_l^2(\alpha_1) + (1 - \alpha_1) c_P^2(\alpha_1) = (\gamma y - \alpha_1)R_l$$

$$\alpha_1 \leq \gamma y$$

$$\gamma yc_l^2(\alpha_1) + (1 - \gamma y)c_P^2(\alpha_1) = 0$$

$$\alpha_1 > \gamma y$$

LHS: amount of withdrawals in $T = 2$

RHS: resources that can be withdrawn in $T = 2$
Constraints

Resource constraint (only $l$)

\[
\alpha_1 c_i^2(\alpha_1) + (1 - \alpha_1) c_P^2(\alpha_1) = (\gamma y - \alpha_1) R_i \quad \alpha_1 \leq \gamma y
\]

\[
\gamma y c_i^2(\alpha_1) + (1 - \gamma y) c_P^2(\alpha_1) = 0 \quad \alpha_1 > \gamma y
\]

$\alpha_1 c_i^2(\alpha_1)$: withdrawals of impatient agents in $T = 2$

$(1 - \alpha_1) c_P^2(\alpha_1)$: withdrawals of patient agents in $T = 2$
Constraints

Resource constraint (only $l$)

\[ \alpha_1 c_i^2(\alpha_1) + (1 - \alpha_1)c_p^2(\alpha_1) = (\gamma y - \alpha_1)R_l \quad \alpha_1 \leq \gamma y \]

\[ \gamma yc_i^2(\alpha_1) + (1 - \gamma y)c_p^2(\alpha_1) = 0 \quad \alpha_1 > \gamma y \]

\[ \gamma yc_i^2(\alpha_1) \text{: withdrawals of satisfied impatient agents} \]
\[ \text{in } T = 2 \]

\[ (1 - \gamma y)c_p^2(\alpha_1) \text{: withdrawals in } T = 2 \text{ of who did not withdraw in } T = 1 \]
Constraints

Resource constraint (only $l$)

\[
\alpha_1 c_i^2(\alpha_1) + (1 - \alpha_1)c_P^2(\alpha_1) = (\gamma y - \alpha_1)R_l \quad \alpha_1 \leq \gamma y
\]

\[
\gamma yc_i^2(\alpha_1) + (1 - \gamma y)c_P^2(\alpha_1) = 0 \quad \alpha_1 > \gamma y
\]

$\gamma y$: total $l$ invested

$\alpha_1 \cdot 1$: total amount of withdrawals of impatient agents in $T = 1$

$R_l$: returns on asset $l$
Incentive compatibility constraint

\[ \int_{0}^{\bar{\alpha}} u(C_P^2) f_p(\alpha) d\alpha \geq \int_{0}^{\bar{\alpha}} u(C_I^2) f_p(\alpha) d\alpha \]
Constraints

Incentive compatibility constraint

\[
\int_0^{\bar{\alpha}} u(C_P^2) f_p(\alpha) d\alpha \geq \int_0^{\bar{\alpha}} u(C_I^2) f_p(\alpha) d\alpha
\]

\(u(C_P^2)\) = expected utility of a patient that does not withdraw in \(T = 1\)

\(u(C_I^2)\) = expected utility of a patient that withdraws in \(T = 1\)

\(f_p(\alpha)\) = density of \(\alpha\) from a patient consumer’s point of view
Maximization problem

$$\max \quad W$$

$$\gamma, c_i^2(\alpha_1), c_P^2(\alpha_1)$$

s.t. (ICC) and (RC)
THEOREM 3.1

A bank will never invest more than $\bar{\alpha}$ in $l$ and there is full consumption smoothing

i) $c_l^2(\alpha_1) = c_p^2(\alpha_1) - 1$

ii) Optimal contract $\iff \gamma y < \bar{\alpha}$
Results

PROOF

i) Maximizing W sub. only to the RC, we obtain:

\[ c_I^2(\alpha_1) = c_P^2(\alpha_1) - 1 \quad \iff \quad \text{Consumption Smoothing} \]

(i.e. \( C_P^{TOT} = C_I^{TOT} \))

Now,

\[
\begin{cases}
\text{RC} & \implies \text{ICC} \\
\text{C.S.} & \implies \text{ICC}
\end{cases}
\]
Results

PROOF

ii) Plugging RC and C.S. conditions in $W$

\[
\left( \frac{\partial W}{\partial \gamma} \right)_{\gamma=\overline{\alpha}/y} < 0
\]

Investing more than $\overline{\alpha}$ in $l$ is sub-optimal
Results

THEOREM 3.2

i) There exists an optimal contract for the unified bank, also socially optimal

ii) Assuming that a patient does not run if indifferent,

\[ C^T_{TOT} = C^T_{TOT} \implies \text{NO RUN} \]
Results

PROOF

i) Setting the RC and the C.S. to hold is sufficient for

\[
\max_{\gamma, c_I^2(\alpha_1), c_P^2(\alpha_1)} W \quad \text{to have a solution}
\]

ii) • Under the optimal contract \( C_P^{TOT} = C_I^{TOT} \)
• Patient agents are indifferent between running and not running

\[\implies \text{No run equilibrium}\]
Take-aways

• “The unified system optimally resolves the trade-off between liquidity and economic growth; in doing so it maximizes social welfare”

• “Our Analysis in its present state does not prove that imposing Glass-Steagall restrictions would be a mistake, although it does suggest that one should be skeptical about the purported stability benefits. Before using the model to offer policy advise, moral hazard should be included.”
Sources


