Financial Integration and Liquidity Crises

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“changes in the structure of financial markets have enhanced their ability to handle risk in normal times”

–Larry Summers

Financial Times, December 26, 2006
“some of the same innovations that contribute to risk spreading in normal times can become sources of instability following shocks to the system.”

–Larry Summers

Financial Times, December 26, 2006
Motivation: US Bank
Motivation: Euro area
Motivation: Germany
Two Forces

opportunities to borrow

opportunities to lend

increases incentive

decreases incentive
Goals

• understand how integration affects liquidity risk

• understand how integration affects the banks’ investment decisions and response to equilibrium liquidity

• provide a possible theoretical explanation to the financial crisis
Building Blocks

• risk-sharing model among (competitive) banks in different regions

• two-region version of Diamond & Dybvig (1983)

• similar to Allen & Gale (2000) “Financial Contagion”
  
  • except we allow for fully state-contingent deposit contracts
Setting

two regions: A & B [ex-ante identical]

• three dates: $t = 0, 1, 2,$

• single consumption good [numeraire]

• continuum of consumers [ex-ante identical]

• endowment of one unit at $t = 0$
Timing

$t = 0$

per region

Contract

Endowment

Investment

*TBD
Consumers

• consumer utility function
  \[ u(\bullet) \in C^1 \]
  \[ u'(\bullet) \geq 0 \quad \lim_{c \to 0} u'(\bullet) = \infty \]
  \[ u''(\bullet) < 0 \]

• preference shock
  \[ \theta \in \{0, 1\} \]
  \[ \theta = 1 \quad \text{“early”} \]
  \[ \theta = 0 \quad \text{“late”} \]

• expected utility function
  \[ E\left[ \theta u(c_1) + (1 - \theta)u(c_2) \right] \]
Bank Technology

*perfectly elastic supply*

\[ t = 0 \quad t = 1 \quad t = 2 \]

**Short**

\[ [1] \rightarrow 1 \]

\[ 1 \rightarrow [1] \rightarrow 1 \]

**Long**

\[ [1] \rightarrow R \]

\[ R > 1 \]
Timing

Liquidity Shock → Preference Shock → World States

$t = 1$ per region
Shocks

regional liquidity shock

• fraction of regional population
• realized \([t = 1]\) & publicly observed

agent preference shock

• randomly assigned
• privately observed

\[ \omega^i = \{\omega_L, \omega_H\} \quad \theta = 1 \quad \text{fraction of consumers} \]
Shocks

regional liquidity shock

• magnitude

• probability of shock value

• expected value of regional shock

\[ \omega_H > \omega_L \]

\[ \Pr(\omega_L) = \Pr(\omega_H) = \frac{1}{2} \]

\[ \omega_M \equiv \mathbb{E} \left[ \omega^i \right] = \frac{\omega_H + \omega_L}{2} \]
States

- allows for various degrees of correlation between regional shocks
- four state of the world
  \[ S \in \mathcal{S} = \{HH,LH,HL,LL\} \]
- assume probability, \( p \), for mixed shocks \( p \in (0,1] \)

<table>
<thead>
<tr>
<th>State</th>
<th>A</th>
<th>B</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH</td>
<td>( \omega_H )</td>
<td>( \omega_H )</td>
<td>( (1 - p) / 2 )</td>
</tr>
<tr>
<td>LH</td>
<td>( \omega_L )</td>
<td>( \omega_H )</td>
<td>( p / 2 )</td>
</tr>
<tr>
<td>HL</td>
<td>( \omega_H )</td>
<td>( \omega_L )</td>
<td>( p / 2 )</td>
</tr>
<tr>
<td>LL</td>
<td>( \omega_L )</td>
<td>( \omega_L )</td>
<td>( (1 - p) / 2 )</td>
</tr>
</tbody>
</table>
Contracts

• fully state-contingent
• utility maximizing for consumer
  • Diamond & Dybvig (run equilibrium)
• investment liquidity decision

liquid asset = y

illiquid asset = (1-y)

• implemented,
  1. aggregate shock S is observed
  2. consumers reveals preference shock

\[
\left\{ y, \left\{ c_t^S \right\} \right\}_{S; t=1,2}
\]

“early”
\( (c_1^S, 0) \)

“late”
\( (0, c_2^S) \)
Bank Autarky

- analogue of autarky in D & D economy
- bank only allowed to serve consumers in that region & no financial agreements with other banks
- other region liquidity shock becomes irrelevant
- problem: find optimal deposit contract only contingent on local liquidity shock
Bank Autarky: region A

\[ \begin{align*}
HH &= HL \\
LH &= LL
\end{align*} \quad \rightarrow \quad s = \{H,L\} \quad \rightarrow \quad \left\{ y, \{c_t^s\}_{s \in \{H,L\}; t=1,2} \right\}

\text{Problem:}

\[ \max_{y,\{c_t^s\}} \frac{1}{2} \left[ \omega_H u(c_1^H) + (1 - \omega_H) u(c_2^H) \right] + \frac{1}{2} \left[ \omega_L u(c_1^L) + (1 - \omega_L) u(c_2^L) \right] \]

\[ \text{s.t.} \quad \omega_s c_1^s \leq y, \quad \text{liquidity} \]

\[ s = L, H \]

\[ (1 - \omega_s) c_2^s \leq R(1 - y) + (y - \omega_s c_1^s), \quad \text{reserve} \]
Bank Autarky

**Proposition 1** The optimal allocation under autarky satisfies

\[ c_1^H < c_1^L \leq c_2^L < c_2^H. \]

No funds are rolled over between periods 1 and 2 in state H. If positive rollover occurs in state L then \( c_1^L = c_2^L \).

\[ (y - \omega_sc_1^K) > 0 \]
Financial Integration

• analogue of “smoothing effect” in D & D economy

• insure against regional liquidity shock by trading contingent credit lines with banks in other regions

• coinsurance in states HL & LH

• consider decentralized banking system
Financial Integration

- competitive banking sector
- state-contingent credit \((m_1, m_2) \in \mathbb{R}^2_+\)

**Problem:**

choose deposit contract and credit line to maximize utility of consumer in region
Financial Integration

\[
\max_{y, (c_t^s), (m_1, m_2)} p \left[ \frac{1}{2} \omega_H u(c_1^{HL}) + (1 - \omega_H) u(c_2^{HL}) \right] + \frac{1}{2} \omega_L u(c_1^{LH}) + (1 - \omega_L) u(c_2^{LH}) \right]
\]

\[
+ (1 - p) \left[ \frac{1}{2} \omega_H u(c_1^{HH}) + (1 - \omega_H) u(c_2^{HH}) \right] + \frac{1}{2} \omega_L u(c_1^{LL}) + (1 - \omega_L) u(c_2^{LL}) \right]
\]

\[
\omega_H c_1^{HL} \leq y + m_1, \quad (1 - \omega_H) c_2^{HL} \leq R(1 - y) + (y + m_1 - \omega_H c_1^{HL}) - m_2,
\]

\[
\omega_L c_1^{LH} \leq y - m_1, \quad (1 - \omega_L) c_2^{LH} \leq R(1 - y) + (y - m_1 - \omega_L c_1^{LH}) + m_2,
\]

\[
\omega_s c_1^{ss} \leq y, \quad (1 - \omega_s) c_2^{ss} \leq R(1 - y) + (y - \omega_s c_1^{ss}), s = H, L
\]

\[
\rightarrow \quad \text{borrow} \quad \text{LC & RC}
\]

\[
\rightarrow \quad \text{lend} \quad \text{LC & RC}
\]

\[
\rightarrow \quad \text{symmetric} \quad \text{LC & RC}
\]
by reducing aggregate uncertainty in “normal” states of the world, financial integration is in fact welfare increasing, but it also induces banks to reduce their liquid holdings, which in turn leads to an increase in the severity of a systematic crisis when it does occur.