Unifying bank-run theories and (the trap of) financial integration

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Is financial integration a free lunch?

- Diamond Dybvig 1983: deposit-insurance feasible
- Wallace 1988: not without ad hoc assumptions
- Green Lin 2003: not needed with disclosure

This paper:

- Sequential service and financial integration
- Trade can reach new group of people
- But new group may face similar problem
- As new institutions/markets develop
- Final outcome can be a more fragile system

some bank-run results

- Fraction pN on average is impatient (type 0)
- Impatient consumes only at date-1, position i: $c_{i1}(\omega_1, ..., \omega_{i-1}, 0)$
- Patient: perfect substitution for date-2 consumption
- Type is private information
- Suppose the *forward-looking* property: for **all** i and **all** $\bar{\omega}^{i-1} \in \{0,1\}^{i-1}$

$$E\left[u\left(c_{i2}\left(\bar{\omega}^{i-1}, 1, \omega_{i+1}, ..., \omega_N\right)\right)\right] \geq u\left(c_{i1}\left(\bar{\omega}^{i-1}, 0\right)\right)$$

- Green Lin 2003, Andolfatto Nosal Wallace 2007: basic preferences with independent shocks

Liquidity versus disclosure

Theorem (Green Lin 2003)

If relative-risk aversion is everywhere greater than one and absolute risk-aversion is non–increasing then the direct mechanism with disclosure has truth-telling as its unique sequential equilibrium.

Example (Peck Shell 2003)

If $(N, p, R) = (2, \frac{1}{2}, 1.05)$, with utilities $v_0(\cdot) = -\frac{10}{c_1}$ and $v_1(\cdot) = -\frac{1}{c_1+c_2}$ then no-disclosure implements runs.

Liquidity versus disclosure

Theorem (BCM 2014)

If R is low, $v_0(\cdot) = u(c_1)$, $v_1(\cdot) = u(c_1 + c_2)$ and relative-risk aversion at $e = \frac{Y}{N}$ is $\delta > 1$ then no-disclosure implements runs if and only if

$$2p - 1 + (1 - p - \frac{p}{N}) \sum_{i=1}^{N} \frac{1}{i} > \frac{\delta}{\delta - 1}.$$

Disclosure revisited

Theorem

Disclosure implements runs in BCM economies if, and only if,

$$N > \frac{1 - p^N}{1 - p} \frac{1}{p^N + \frac{\delta - 1}{\delta}(1 - p)^2},$$

provided that M is large.

The new parameter

What is *M*? It is our way of...

- Mixing markets with SS
- Producing “simple contracts”
- Increasing liquidity: forward-looking unravels
- Bringing DD closer to macro/money models

The environment
Multiple queues

- $\tilde{\omega} = (\tilde{\omega}^{(1)}, \tilde{\omega}^{(2)}, ..., \tilde{\omega}^{(M)})$ with $\tilde{\omega}^{(j)} \in \Omega = \{0, 1\}^N$
- Independent shocks: $\Pr(\tilde{\omega}) = \prod_{j=1}^{M} P(\tilde{\omega}^{(j)})$, where for $\omega \in \Omega$, $P(\omega) = p^{N-|\omega|}(1-p)^{|\omega|}$.
- Each queue has size N and available date-1 endowment Y

- Savings in each queue must be nonnegative, grow at rate $R > 1$
- Queues can share date-2 goods
- SS: planner controls resources, transfer to position i is a function of information given by $n < i$ in the same queue only.
- Objective is average utility

Preliminary results
Symmetric allocations

- An allocation has $c_1^{(j)}$ function of $\tilde{\omega}^{(j)}$, but $c_2^{(j)}$ function of $\tilde{\omega}$.
- Symmetric allocations: $c_1^{(j)}$ same object as in the single-queue model, $x = (x_1, ..., x_N)$, $x_i : \{0, 1\}^i \to \mathbb{R}_+$.
- If $\omega \in \Omega$ then date-1 feasibility requires

$$\sum_{i=1}^{N} (1 - \omega_i) x \left(\omega^i\right) \leq Y. \tag{1}$$

Preliminary results
Equal treatment

- Upper bound on welfare:

$$E\left[\frac{1}{M}\sum_{k=1}^{M}\sum_{i=1}^{N}\left(1-\tilde{\omega}_i^{(k)}\right)u\left(x\left(\tilde{\omega}^{(k)i}\right)\right)+\right.$$
$$\left.\frac{|\tilde{\omega}|_M}{M}u\left(\frac{R}{|\tilde{\omega}|_M}\sum_{k=1}^{M}\left(Y-\sum_{i=1}^{N}\left(1-\tilde{\omega}_i^{(k)}\right)x\left(\tilde{\omega}^{(k)i}\right)\right)\right)\right],$$

Patient consumption is constant in the limt

Proposition

The equal-treatment objective, as $M \to \infty$, converges to

$$\max_{(x,y)} E\left[\sum_{i=1}^{N}(1-\omega_i)u(x(\omega^i)) + N(1-p)u(y)\right]$$

$$\text{s.t. (1) and } y \leq \frac{R}{N(1-p)} E\left[Y - \sum_{i=1}^{N}(1-\omega_i)x(\omega^i)\right]$$

- Proof idea:
  - $N(1-p)u(y)$ is an upper bound on average date-2 utility
  - The limit solution x_∞ is feasible if M is finite

$$W_M(x_\infty) < W_M(x_M) < W_\infty(x_\infty)$$

  - By the strong law of large numbers $W_M(x_\infty) \to W_\infty(x_\infty)$ as $M \to \infty$

Limit consumption

Proposition

Simple contracts when $M = \infty$

- To fix ideas, consider a pairwise structure ($N = 2$). If $c_1 = x_1(0)$, $c_2 = x_2(0,0)$ and $\bar{c} = x_2(1,0)$ then the Lagrangian becomes

$$
\begin{aligned}
p^2(u(c_1) + u(c_2)) + p(1-p)(u(c_1) + u(y)) + \\
p(1-p)(u(y) + u(\bar{c})) + 2(1-p)^2 u(y) \\
+\mu(Y - c_1 - c_2) \\
+\lambda\Big[(1-p^2)RY - p(1-p)(Rc_1 + y) \\
-p(1-p)(R\bar{c} + y) - 2(1-p)^2 y\Big]
\end{aligned}
$$

Impatient consumption almost constant

Proposition

The objective for general N is

$$L = \hat{\phi}\hat{z} + \bar{\phi}\bar{z} + \sum_{i=1}^{N} \left(p^N \tilde{z}_i + \phi_i z_i \right) \tag{3}$$

where $z_i = u(c_i) - \lambda R c_i$, $\tilde{z}_i = u(c_i) - \mu c_i$, $\hat{z} = u(y) - \lambda y$, $\bar{z} = u(\bar{c}) - \lambda R \bar{c}$ *and the* ϕ*'s have a tractable form. In particular*

$$x_i(\omega^{i-1}, 0) = \begin{cases} c_i, & \text{if } \omega^{i-1} = 0; \\ \bar{c}, & \text{otherwise.} \end{cases}$$

Derivatives

Proposition

The derivative in R of the solution of the relaxed problem, at $R = 1$, has a closed form.

No loss of generality with relaxed problems

- IC without disclosure

$$u(y) \geq E\left[\frac{1}{N}\sum_{i=1}^{N} u\left(x_i\left(\omega^{i-1}, 0\right)\right)\right] \tag{4}$$

- IC with disclosure: for all i,

$$u(y) \geq E\left[u\left(x_i\left(\omega^{i-1}, 0\right)\right)\right] \tag{5}$$

Proposition

If M is high and R is low then the solution satisfies (IC), with or without disclosure.

Bank runs without disclosure

Proposition

If M is high and R is low then economies without disclosure are exposed to runs if and only if

$$N > \frac{1-p^N}{1-p} \frac{1+\frac{\delta-1}{\delta}}{p^N+\frac{\delta-1}{\delta}}$$

Bank runs with disclosure

- Fact: with disclosure, person N always tells the truth when people in other positions run.
  - Runs in positions $1, ..., N-1$ leave person N in 'autarky'
  - The Green-Lin argument holds: Best reply of person N is truth-telling

Proposition

With disclosure, a run that excludes position N is an equilibrium if and only if

$$N > \frac{1-p^N}{1-p} \frac{1}{p^N + \frac{\delta-1}{\delta}(1-p)^2}$$

Forward-looking breaks down

Proposition

There are cutoffs n_0 and n_1 such that runs excluding last two positions exist if and only if $n_0 < N < n_1$. In addition, if others at $N - 2$ play truth-telling off the equilibrium path, then the best reply of trader $N - 2$ is still to "run" for some parameters.

Numerical examples for finite M

Tabela: Runs (except at position N) with disclosure and $R = 1.05$: required minimum values of M

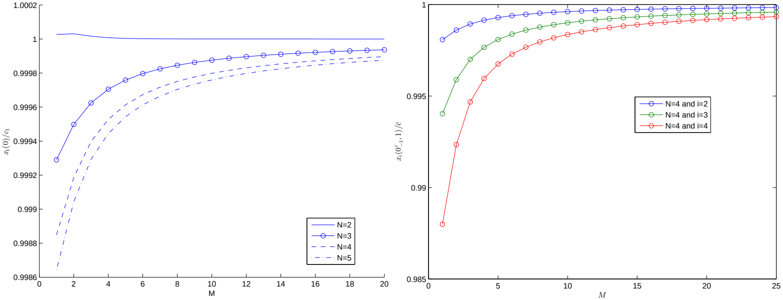
p	N	2	3	4	5
.1	$\delta = 2$	$(-)$	6	2	2
	$\delta = 5$	3	2	2	2
.2	$\delta = 2$	$(-)$	$(-)$	$(\pm)$	3
	$\delta = 5$	$(-)$	3	2	2

$(-)$: no runs for $M \leq 20$

$(+)$: satisfies run-condition for $M = \infty$

Examples with finite M

Figura: Convergence of x

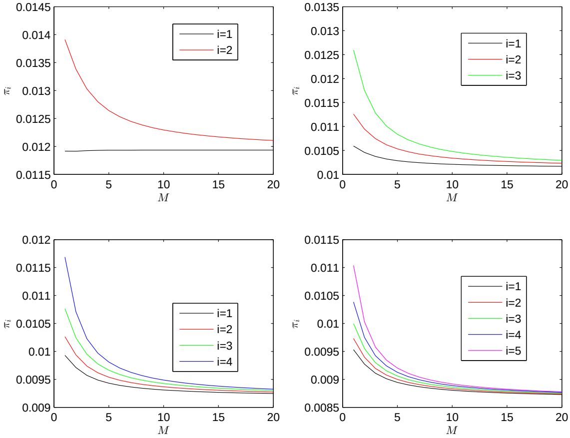


(a) Ratio of x_1 to c_1

(b) Ratio of $x_i(1, 0, ...)$ to $\bar{c}$

Examples with finite M

Figura: Satisfaction of IC with disclosure



Examples with finite M

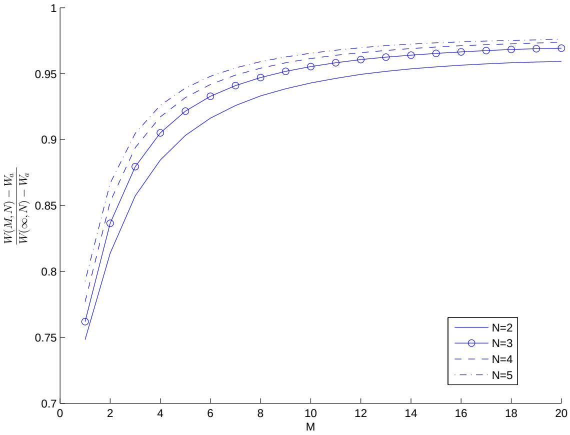


Figura: Convergence of welfare – ratio of $W(M,N)$ to $W(\infty,N)$

Conclusion

- Multiple-queue model tractable numerically and for low R/large M.
- If financial integration means borrowing/lending among groups with similar risks then it can become a trap.
- Contracts are simple and forward-looking property unravels, because SS not inconsistent with additional borrowing and lending
- Many DD views restored, except that ‘outside help’ is a free lunch.