Speed of Financial Contagion and Optimal Timing for Intervention

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When Is It Optimal to Bailout the Financial System?

Difficult to distinguish between **fundamental** and **self-fulfilling** crises ▶ Distinction matters for the **decision to intervene** during a systemic crisis ▶ Distinction also matters for the **timing of intervention** during a systemic crisis

Financial Crises and Contagion

Self-fulfilling Beliefs or Panic ✓
- Can avert a bad equilibrium
- Eliminate early asset liquidation cost

→ Immediate Intervention is optimal

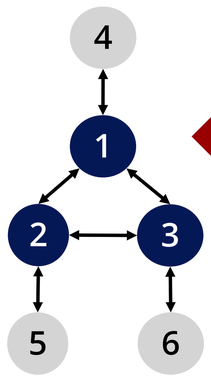
Fundamentals ✗
- Delays a necessary adjustment
- Distorts market discipline and prices

→ Immediate Intervention is **suboptimal**

Too Early
- **Unnecessary**: Uncertainty about whether or not the crisis is systemic
- **Not appropriately designed:** Uncertainty about the nature of the crisis
- **Confirm market fears:** May trigger a confidence crisis

Too Late
- **'Miss' the crisis:** Ineffective in resolving and containing crisis/contagion
- **Incur substantial costs:** Greater severity and duration

Optimal Timing Depends on Two Trade-offs



1 **Speed of Contagion**
- Resilience of Nodes
- Maturity of Liabilities

2 **Intervention**
- Benefit
- Cost

Model: Optimal Timing of Systemic Bailouts

Normal State — *All nodes able to meet obligations (no defaults)* $\vec{k_t} \leq \vec{e_t}$

Cascade State — *Some nodes unable to meet obligations (defaults)* $\vec{k_t} \geq \vec{e_t}$

Environment
- Regulator and $n = 6$ Banks
- Each node has welfare: $\vec{w}$
- Maturity of Liabilities (Stochastic): $\vec{k_t}$
- Resilience of Nodes (Deterministic): $\vec{e_t}$

Speed of Contagion
# of Default Nodes/Period

Intervention
- Cost: Shortfall: $\vec{k_t} - \vec{e_t}$
- Benefit: Welfare: $\vec{w}$

Optimal Stopping Problem

$$V_t(k,e) = max\{\overbrace{\sum_{i\in D} w - \sum_{i\in D}(k-e)}^{bailout}, \overbrace{0 + \delta\mathbb{E}[V_{t+1}(k',e')]}^{no\ bailout}\}$$

$$V_{T+1}(k,e) = 0$$

1. Horizon: $T = 5$
2. Discount: $\delta = 0.96$
3. Decision: $x_t = \{bailout, no\ bailout\}$
4. Reward in each state (k,e)
5. Joint Probability Transition Matrix

Assumptions
- **Untargeted Bailout:** Regulator must bailout all nodes in default
- **No Obligations Deferral:** Liabilities cannot be deferred to future periods
- **No Recurrent Obligations:** Each node cannot owe the same node more than once
- **Next Period Payment Clearing:** Payments owed in each period are cleared next period
- **Proportionality:** Claimant nodes are paid in proportion to amount owed

Findings Suggest ...

Speed of Contagion Identifies Optimal Time for Intervention ....

Timing of Intervention	Speed of Contagion: Fast ← Defaults per Period 5	4	3	2	Slow 1
Immediate t=1	15 (100%)	492 (100%)	4,247 (98%)	9,114 (92.4%)	4,395 (53.2%)
Wait until t=2			6 (0.1%)	40 (0.4%)	80 (1.0%)
Wait until t=3			11 (0.3%)	94 (1.0%)	227 (2.7%)
Wait until t=4			29 (0.7%)	295 (3.0%)	964 (11.7%)
Wait until t=5			16 (0.4%)	216 (2.2%)	1,618 (19.6%)

... and Faster Contagion Necessitates More Immediate Intervention

Timing of Intervention	Speed of Contagion: Fast ← Defaults per Period 5	4	3	2	Slow 1
Immediate t=1	15 (100%)	492 (100%)	4,317 (100%)	9,859 (99.9%)	4,242 (51.4%)
Wait until t=2				4 (0.04%)	30 (0.4%)
Wait until t=3				4 (0.04%)	73 (0.9%)
Wait until t=4					1,380 (16.7%)
Wait until t=5					2,531 (30.7%)

Too-Interconnected-to-Fail Effect: Optimal to Bailout Core Nodes Earlier....

# of Defaulted Core Nodes \ # of Defaulted Periphery Nodes	3	2	1	
3	0 (0.0%)	6 (0.03%)	168 (0.9%)	1,080 (5.7%)
2	9 (0.05%)	261 (1.4%)	2,187 (11.6%)	6,690 (35.4%)
1	63 (0.3%)	1,107 (5.8%)	4,652 (24.6%)	8,966 (47.4%)
	189 (1.0%)	2,348 (12.4%)	8,105 (42.8%)	

Likelihood of Immediate Intervention

... Even When Expensive

Cost of Intervention

# of Defaulted Core Nodes	High	Medium	Low
3	92 (0.5%)	790 (4.2%)	198 (1.0%)
2	144 (0.8%)	3,708 (19.6%)	2,838 (15.0%)
1		2,634 (13.9%)	6,332 (33.5%)

# of Defaulted Periphery Nodes	High	Medium	Low
3		189 (1.0%)	
2	36 (0.2%)	1,338 (7.1%)	974 (5.1%)
1	120 (0.6%)	3,288 (17.4%)	4,697 (24.8%)

... and Even When Core Nodes Contribute Less Welfare to the Financial System