Cascades along the Business Cycle

Massimo Ferrari

contact: m.ferrari897@gmail.com

Catholic University of Milan

Complexity Lab in Economics

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Modelling complex networks: real banking newtork v.s. *implied* DSGE banking networks

This paper models cascades (sequences) of contagion on financial markets. The default of one institution can create a «domino effect» involving its direct and indirect partners. The size and probability of such an event are endogenous and depend on how institution are connected. To generate a cascade model, therefore, it is necessary to model the interbank banking network (left) and integrate it into a state-of-the-art DSGE model (right).

A state-of-the-art DSGE model with frictions (Gertler & Karadi 2011)

The interbank network is incorporated into a standard DSGE model with frictions on real and financial frictions. Network measures describe the aggregate state of the financial system in each period.

A moment generating function approach to the modelization of networks

$p_k = Ak^{-\gamma}$

degree distribution

$$\begin{cases} \Omega_k = P\left(k < \frac{1}{\varphi}\right) \\ \varphi = \int_0^1 f(\varphi)\, d\varphi = 1 \end{cases}$$

probability of being vulnerable

$G_0(x) = \sum_{k=0}^{\infty} \Omega_k p_k x^k$

degree distribution of vulnerable vertices

$z = \sum_{k=0}^{\infty} p_k x^k$

average degree

$P_v = G_0(1)$

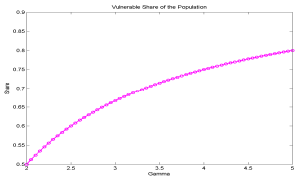
cascade probability

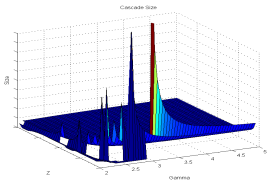
$z_v = G'_0(1)$

average degree of vulnerable vertices

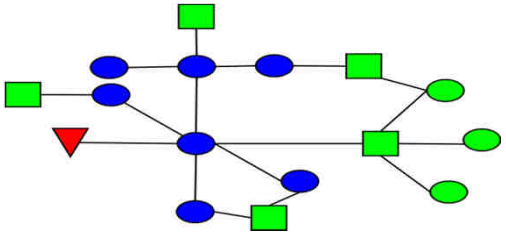
$\|n\| = P_v + \frac{(z_v)^2}{z - G''_0(1)}$

cascade size



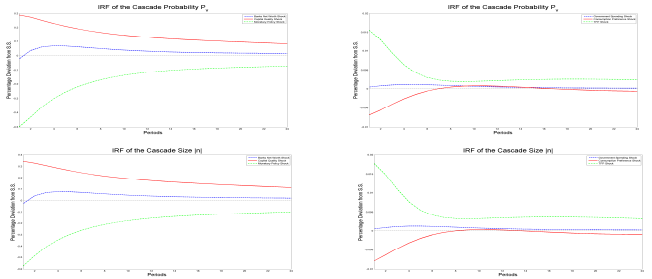


Intuition: a cascade in action

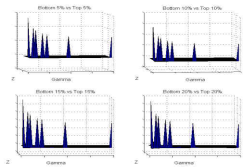


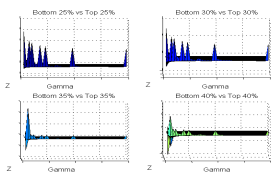
The red triangle is the initial seed (i.e. the institution starting the contagion), that moves exogenously from state 0 (no default) to state 1 (default). Circles are vulnerable nodes (i.e. nodes that move to state 1 if hit by a shock) and squares are resilient nodes (i.e. nodes that never move to state 1). Green nodes are in state 0 while blue nodes are in state 1. The cascade is composed by the initial seed and by all blue nodes.

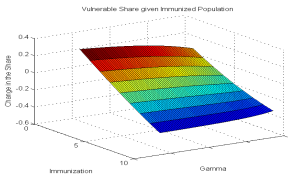
IRFs of probability and size of contagion after real and financial shocks



Active policies: immunization (i.e. supply funds to banks in distress) and leaning against the network (i.e. let the target rate respond to financial conditions)







k_{pv}	Int. Rate	TFP	Inflation	Gov. Spending	Preference	Cap. Quality	Banks' Net Worth
Cummulative change in the contagion probability P_v in differences from the baseline							
0.05	2.34	-0.07	0.15	0.00	0.04	-1.33	-0.11
0.10	2.91	-0.08	0.18	-0.01	0.04	-1.68	-0.20
0.15	3.18	-0.08	0.20	-0.01	0.04	-1.87	-0.29
0.20	3.34	-0.08	0.21	-0.01	0.04	-2.02	-0.41
0.25	3.45	-0.07	0.22	-0.01	0.03	-2.17	-0.55

Ratio between the variances of Y and π under a specific rule and the baseline

	Y	π	Y	π	Y	π	Y	π	Y	π	Y	π	Y	π
0.05	0.11	0.06	0.61	1.08	0.11	0.06	1.02	0.74	1.47	2.68	0.07	6.03	0.09	46.13
0.10	0.05	0.18	0.64	1.02	0.05	0.18	1.04	0.91	1.80	6.24	0.19	18.34	0.89	231.03
0.15	0.04	0.36	0.78	1.01	0.04	0.36	1.07	1.67	2.18	19.42	0.64	40.69	3.59	650.46
0.20	0.04	0.60	1.04	1.18	0.04	0.60	1.12	3.49	2.69	55.59	1.85	86.92	9.43	1509.48
0.25	0.06	1.00	1.51	1.76	0.06	1.00	1.18	7.61	3.49	151.39	4.97	196.47	22.26	3316.88

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Dipartimento di Economia e Finanza