Networks and Aggregate Fluxtuations

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Carlos’s Network Readers
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Network structure

:: What is the connection between the network structure of the economy and macro (GDP) fluctuations

:: Shocks are “idiosyncratic”

:: Systematic component comes from the “network structure”

:: What are the key elements to make the network bit “interesting”

:: All loosely (very!) on Acemoglu et. al. (2012; Econometrica)
:: There are sectors $s = \{0, 1, \ldots, S\}$
  :: Measure “gdp” with output of final sector $S$

:: Each sector has firms $n = \{1, \ldots, N\}$

:: Output of each firm
  :: $x_{s,n} \in \{0, 1\}$

  :: Depend on inputs from sector $s - 1$ for firms “linked to” firm $n$

:: Network of links is a lattice (on a torus)
NETWORK

Firms
n = 1 \cdots N

Sectors
S = 0

Final Goods

Final Goods - HERE
Production - Specific assumptions

:: Odds of producing depend on how many of your suppliers have output

\[ x_{s,n} = f \left( \{x_{s-1,n'}\}_{n' \in \mathcal{N}(n)}, \tilde{\epsilon}_{s,n} \right) \]

\[ = \begin{cases} 
1 & \text{prob } p = g \left( \{x_{s-1,n'}\}_{n' \in \mathcal{N}(n)} \right) \\
0 & \text{prob } 1 - p 
\end{cases} \]

:: \( g \) is a logistic function

\[ y_{s,n} = \sum_{n' \in \mathcal{N}(n)} \frac{x_{s-1,n'}}{C} \]

\[ g \left( y_{s,n} \right) = p_{\min} + (p_{\max} - p_{\min})(1 + \exp(-B(y_{s,n} - A)))^{-1} \]

:: For Sector 0, \( p = \bar{p} \)
Production Network - Specific assumptions

\[ y_{s,n} = \sum_{n' \in \mathcal{N}(n)} x_{s-1,n'}/C \text{ scaled to be } \in [0, 1] \]

- \( B \) controls the slope (Big B and you get a step function)
- \( A \) controls where the inflection is (where the step happens)
- \( p_{\text{min}} \) and \( p_{\text{max}} \) do the obvious thing
Network Size: 7

Percent of C in network that had $x_{s-1,n} = 1$

Probability $x_{s,n} = 1$
Production Network - Specific assumptions - Production Probs

Network Size: 8

Percent of C in network that had $x_{s-1,n} = 1$

Prob $x_s,n = 1$
Production Network - Specific assumptions - Production Probs

Network Size: 9

Prob $x_{s,n} = 1$ vs Percent of C in network that had $x_{s-1,n}=1$
Production Network - Specific assumptions - Production Probs

Network Size: 10

Percent of C in network that had $x_{s-1,n}=1$

Prob $x_{s,n} = 1$
Network Size: 11

Percent of C in network that had $x_{s-1,n}=1$

Probs $x_{s,n} = 1$
Network Size: 12

Percent of C in network that had $x_{s-1,n} = 1$

Probability $x_{s,n} = 1$
Production Network - Specific assumptions - Production Probs

Network Size: 13

Percent of C in network that had $x_{s-1,n} = 1$

$\text{Prob } x_{s,n} = 1$
Network Size: 14

Percent of C in network that had $x_{s-1,n}=1$

Probability of $x_{s,n} = 1$
Network Size: 15

Prob $x_{s,n} = 1$ vs Percent of C in network that had $x_{s-1,n}=1$
Examples!!

:: Think of $t$ as a “quarter”

:: $\epsilon_{s,n,t}$ iid (across: sector, firm, time)

:: Production over the quarter rolls from sector 0 to $S$

:: No inventory or persistence so periods are i.i.d

:: Look at:
  
  :: Simulation per $t$

  :: Unconditional distribution of “GDP” (or better “capacity utilization” since it is on 0 to 1) for final sector $S$
GDP of sector $S$: $C=10$
GDP of sector $S :: C=15$
GROWTH GDP of sector S :: C=9
Simulation

C=8; blue means x=1; yellow are good shocks; red are bad shocks; red and yellow stripes are the effect that period on output
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:: all for now