The economy as a human anthill

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Agent-based computational economics

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Business firms play the auctioneer's role

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Business firms play the auctioneer's role

Is a decentralized economy self-regulating?

The economy as a human anthill

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Business firms play the auctioneer's role

Is a decentralized economy self-regulating?

- The origins of monetary exchange
- The multiplier process
- Long-run costs of inflation
- Banks and economic crises

The emergence of monetary exchange

Howitt-Clower (*JEBO*, 2000)

Discrete time t (weeks)

n (10) goods, non-storeable

m (2160) agents,
each of some type (i, j) $i \neq j$

Each (i, j) agent
$\longrightarrow$ is endowed with 1 unit of i per week
$\longrightarrow$ can consume only good j

Symmetric distribution: b (25) agents of each type

Basic assumptions

Agents can trade only with “shops”

Some agents create shops

Others search for shops

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Long-term trading relationships with shops

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Some agents create shops

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Long-term trading relationships with shops

Each shop trades only 2 goods

An (i, j) shop s must post two offer prices:
p^s_{ij} = quantity of i per unit of j delivered to shop
p^s_{ji} = quantity of j per unit of i delivered to shop

An (i, j) agent can have a trading relationship with at most 2 shops at a time:
$\longrightarrow$ an outlet (employer) trading i and some k
$\longrightarrow$ a source (retail store) trading some k' and j

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  outlet o that trades (i, k) , source s that trades (k, j)
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- direct barter:
  outlet that trades (i, j)
  weekly consumption is p^o_{ji}
- no trade:
  weekly consumption is 0

Shop Technology and Pricing

Suppose the amounts y_j^s and y_i^s are delivered to shop

Overhead costs:
f_i units of good i and f_j units of good j

Operating surpluses:
$\pi_i^s = y_i^s - p_{ij}^s y_j^s - f_i$ units of i and
$\pi_j^s = y_j^s - p_{ji}^s y_i^s - f_j$ units of j

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Owner aspires to cover setup costs:

$\pi_i^{s,e} = C$ and $\pi_j^{s,e} = C$

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Price setting when owner expects $y_i^{s,e}, y_j^{s,e}$

$$p_{ij}^s = \left(\frac{y_i^{s,e} - f_i - C}{y_j^{s,e}} \right)^+ \text{ and } p_{ji}^s = \left(\frac{y_j^{s,e} - f_j - C}{y_i^{s,e}} \right)^+$$

The weekly routine

1. Entry (random innovations)
   initial $y_i^{s,e}, y_i^{s,e}$ random, $\leq X$ ("animal spirits")
   market research before entry is finalized

2. Search (direct and indirect)
   choose relationships to maximize weekly consumption

3. Trade

4. Exit
   with probability θ if $\pi_i^s < 0$ or $\pi_j^s < 0$

5. Update expectations and prices
   $\Delta y_i^{s,e} = \alpha \left(y_i^s - y_i^{s,e} \right)$ and $\Delta y_j^{s,e} = \alpha \left(y_j^s - y_j^{s,e} \right)$

Absorbing states (stationary equilibria)

State variables: owners, expectations, prices and relationships

Proposition: If $X < b$ and $max_i \{f_i\} + C < b$, absorbing states exist

Monetary equilibria, barter equilibria, other equilibria can exist

Proposition: Maximal total consumption is achieved in the least-cost monetary equilibrium

Simulation results

6,000 runs, each starting in autarky

Each run continues for 20,000 weeks or until monetary exchange emerges

Small enough animal spirits that absorbing states exist

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Each run continues for 20,000 weeks or until monetary exchange emerges

Small enough animal spirits that absorbing states exist

Results:

- Absorbing state was found unless fixed costs too high or too low
- The only absorbing states found were monetary

The multiplier process

Howitt (*JEIC* 2006)

Cascading shop failure in the Howitt-Clower model

The multiplier process

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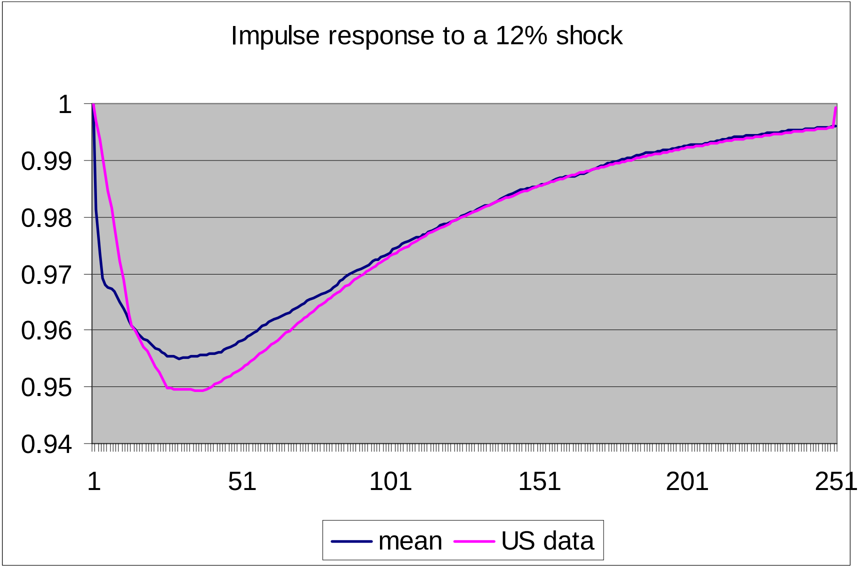
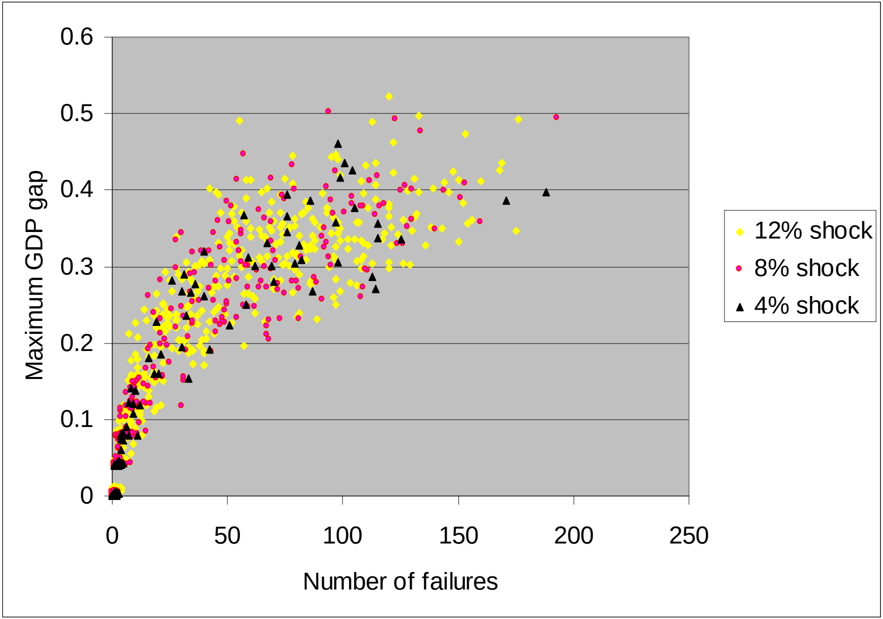
Cascading shop failure in the Howitt-Clower model

Suppose good 1 is established as money

Start in monetary equilibrium and apply reallocative shock


Impulse response to a 12% shock
1
0.99
0.98
0.97
0.96
0.95
0.94
1
51
101
151
201
251
mean
US data



0.6
0.5
0.4
0.3
0.2
0.1
0
Maximum GDP gap
0
50
100
150
200
250
Number of failures
12% shock
8% shock
4% shock

Costs of inflation

Ashraf-Howitt (2008 working paper, in progress)

Is macro performance better when trend inflation is lower?

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Maybe inflation impedes market mechanisms
(Heymann-Leijonhufvud)

Higher inflation raises the incidence of cascading shop failures

Changes to the basic model

Durable goods (for shops)

Each household has two consumption goods

Fiat money - established convention

Staggered price setting

Government bonds - intertemporal consumption choice

Taylor rule and fiscal adjustments

Continual shocks and large animal spirits

Calibration to US economy

FIGURE 1: THE BASELINE EXPERIMENT

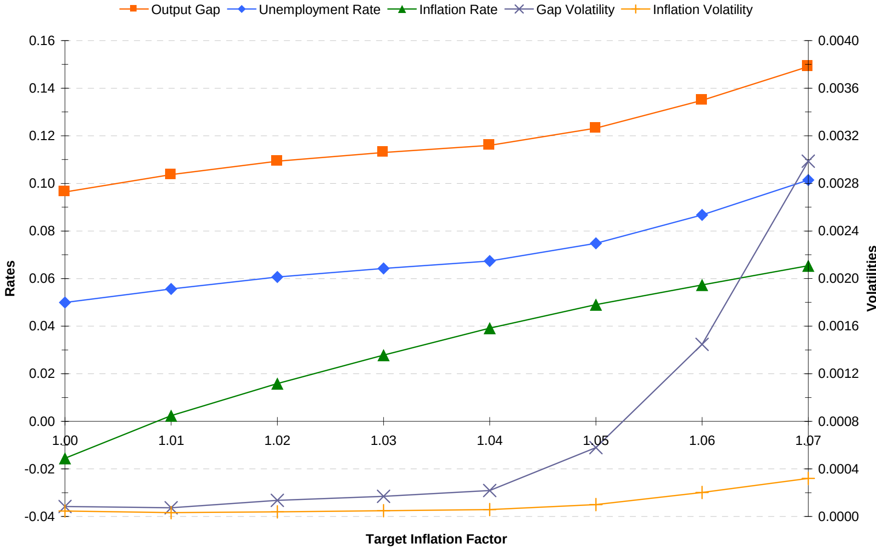
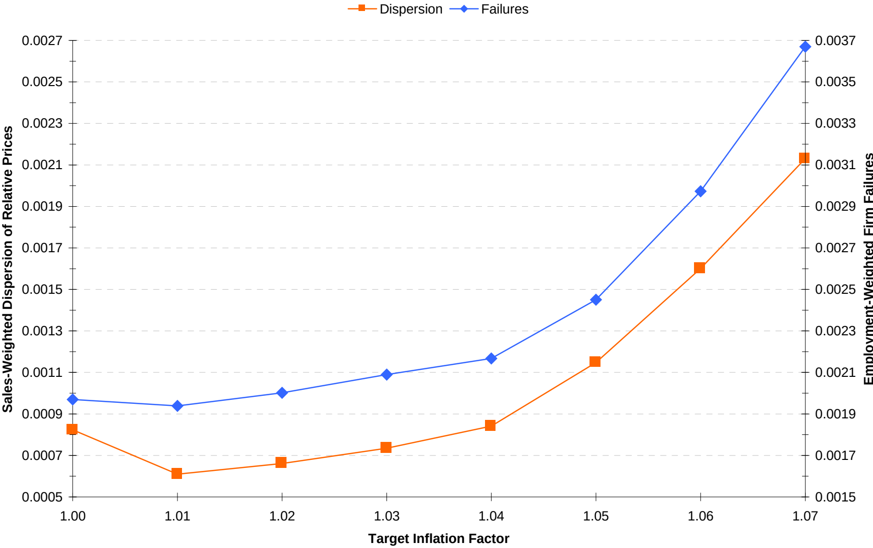


FIGURE 2: PRICE DISPERSION AND FIRM FAILURES IN THE BASELINE EXPERIMENT



Banks and economic crises

Ashraf, Gershman and Howitt (2009)

Banks affect the macroeconomy via the market mechanism

Bank loans affect entry and exit of shops

Normally beneficial, but can amplify the multiplier process

More changes to the model

Fixed number of banks

Lend only to shops, with recourse, secured by inventories

Fixed spreads, maximal loan-to-value ratios

Banks also buy gov't bonds

Non bankowners hold money and deposits

Capital requirements, sanctions when capital inadequate

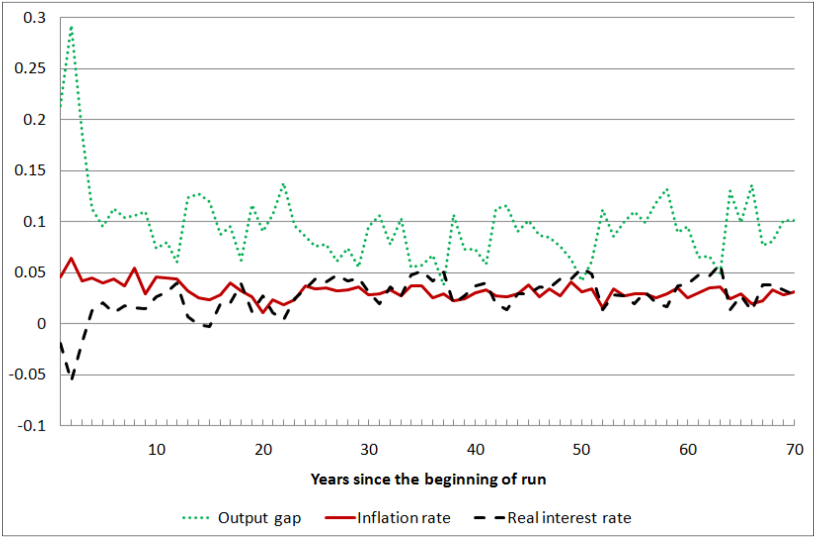


Figure 2: A normal run (rnseed=11)

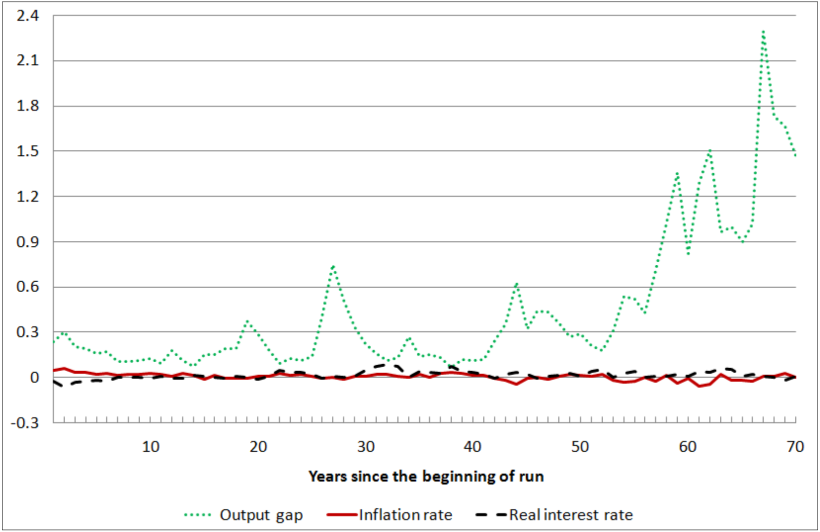


Figure 5: A collapse (rnseed=114)

	Medians		Worst deciles	
	Banks	None	Banks	None
Inflation	2.9	2.9	2.1	2.3
Output gap	7.6	8.4	22	17
Unemployment rate	6.1	6.7	15	12
Unemployment duration	11	12	17	16
Job loss rate	.59	.60	1.2	.94
Volatility of output gap	2.8	3.3	9.6	7.8
Volatility of inflation	.74	.92	1.4	1.4
Annual bank failure rate	.50	0	1.0	0
Fraction of banks in trouble	3.1	0	27	0