

Production networks, nominal rigidities, and the propagation of shocks

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- A quantitative, empirical paper on the sources of shocks driving business cycles.
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- A quantitative, empirical paper on the sources of shocks driving business cycles.
- **How do realistic forms of heterogeneity– related to multisectoral economy– alter the impact of shocks?**
- Carvalho (2006) says **heterogeneity in price stickiness** increases real impact of money shocks
 - How is this affected by intermediate inputs in the production function?
 - How is this affected by *heterogeneity* in input/output structure?
- Gabaix (2011) says **heterogeneity in sector size** may imply aggregate fluctuations from sector-specific shocks
 - How is this affected by price stickiness?
 - How is this affected by *heterogeneity* in price stickiness?

Model ingredients and data sources

- Standard **New Keynesian DSGE** framework, with some heterogeneity built in...
- **Calvo price stickiness** (but flexible wages)
 - Allow for *sectoral heterogeneity* in stickiness
 - Map to PPI data: **sectoral frequency of price adjustment**

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 - Map to **input/output tables**
- Shocks to Taylor rule
- Sector-specific productivity shocks

Table: Theoretical results: impact of heterogeneity

<i>Homogeneous stickiness</i>	<i>Heterogeneous stickiness</i>	<i>Heterogeneous stickiness</i>
<i>Heterogeneous I/O links</i>	<i>Homogeneous I/O links</i>	<i>Heterogeneous I/O links</i>
<i>Effects of monetary shocks</i>		
Prop. 1	Prop. 4	Prop. 6
<i>Effects of sector-specific technology shocks</i>		
Prop. 2	Prop. 5	Prop. 7
Prop. 3		

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Prop. 1	Prop. 4	Prop. 6
(Basu, '95)	(Carvalho, '06?)	
<i>Effects of sector-specific technology shocks</i>		
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(Gabaix, '11)		
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(Acemoglu et al, '12)		

Suppose prices are equally sticky in all sectors. Then...

Money shocks:

- **Prop. 1. Higher share of intermediate inputs** in production implies **greater monetary nonneutrality**. (Basu '95)
 - But *heterogeneity* in input use is irrelevant for nonneutrality.

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Sectoral productivity shocks:

- **Prop. 2.** Suppose all sectors use inputs in same proportions. Then slowly-decaying **power law in sector size** implies **LLN fails**: sectoral shocks have aggregate effects. (Gabaix, '11)
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- **Prop. 3.** Suppose **sectoral importance** in the I/O matrix obeys a slowly-decaying **power law**. Then **LLN fails**: sectoral shocks have aggregate effects. (Acemoglu, Akcigit, Kerr '13)

Suppose input weights equal consumption shares for all sectors. Then...

Money shocks:

- **Prop. 4.** Greater **heterogeneity of price stickiness** across sectors has an **ambiguous effect monetary nonneutrality**.
 - So the sign of the effect is left for the calibration exercise...
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Sectoral productivity shocks:

- **Prop. 5.** **LLN is more likely to fail** if **larger sectors** tend to have **more flexible** prices.
 - But the multiplier of sectoral shocks on aggregate output is **decreased by heterogeneity** of price stickiness (???)

Suppose heterogeneity in stickiness and in input weights. Then...

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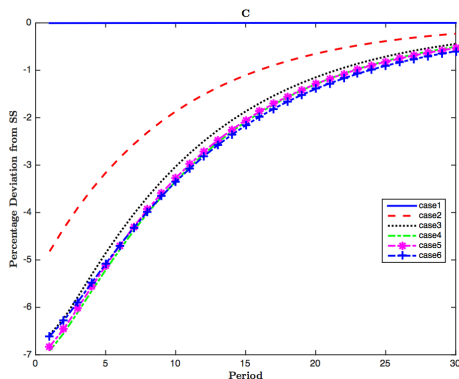
- **Prop. 6.** Generalizes Props. 1 and 4.
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Sectoral productivity shocks:

- **Prop. 7.** Generalizes Prop. 5: **LLN is more likely to fail if more important sectors** tend to have **more flexible** prices.

QUANTITATIVE RESULTS

Output response to money shock



This figure plots the impulse response function of consumption to a one-standard deviation monetary policy shock for a 58 sector model in the top panel and a 350 sector model in the bottom panel for different cases (see Table 2).

Main quantitative results:

- Heterogeneous stickiness amplifies nonneutrality (Case 2 \rightarrow 3)
- Heterogeneity of input linkages has little effect on nonneutrality

SOME COMMENTS

Nice job

- Disciplined exploration of complex quantitative modeling issues
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- Model structure closely matches data structure
- A concern about this class of models: **missing frictions?**
 - *Only* prices are sticky.
 - Wages, labor allocation across firms and sectors, demand allocation across firms and sectors are all *flexible*.
 - Impulse responses and welfare analysis could be sensitive to frictions in those other adjustment margins too...

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- Are Props. 6-7 really propositions at this point, or just rough observations? Why does 6 seem to contradict 4?

What else to do with a sectoral sticky-price model?

- Model has implications for response to changes in input prices (propagation of stickiness through I/O relations)
- This can't be explored with data sources used in this paper
- Need matched data on prices of wholesalers/retailers or input suppliers/purchasers

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- What they actually show is that *sectoral inflation residuals* unexplained by aggregate shocks look like *permanent shocks* and *explain more than > 90%* of sectoral inflation variance
- Costain/Nakov '11 show that a model of intermittent price changes *without sectoral shocks* reproduces the MMW09 evidence on sectoral inflation residuals almost perfectly, if the (finite) number of products per sector obeys a power law
- Why? The *sectoral inflation residual* is just **random variation which firms adjust when**
- We used a state-dependent pricing model, but the same argument should work in a Calvo model!

THANKS FOR YOUR ATTENTION!