Is the Macroeconomy Locally Unstable and Why should we care?

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Introduction

- In most macro-models, BC fluctuation arises as the response of shocks to an underlying stable system, that is, a system with a locally stable steady state (or stable balance growth path).
  - × This has lead to a search for 'enough' shocks to explain observed fluctuations
- Another possibility is that economy may be locally unstable, but not explosive. In such a case, part of fluctuations would arise as the result economic mechanisms which support cyclical behavior. Shocks in such a system would contribute to making the fluctuations irregular and un-predictable, but are not the only reason for fluctuations.
  - × This is the stochastic limit cycle view.

Introduction

- First question addressed in this paper: How can one evaluate from a reduced form perspective whether a system may be (1) locally unstable, and (2) possibly exhibit endogenous cyclical forces.
- Second question: Why should we care?

First question

- How to look for local instability?
- Let X_t be a cyclical measure of activity, example: hours worked or unemployment rate.
- Consider estimating an AR or ARMA process (assuming zero mean).

$$X_t = A(L)X_{t-1} + \epsilon_t$$

- If roots of $1 - A(L)$ are sufficiently outside of unit circle, we tend to take as evidence of local stability. If very close to 1, we worry about a unit root.

First question

- But what if process is of form

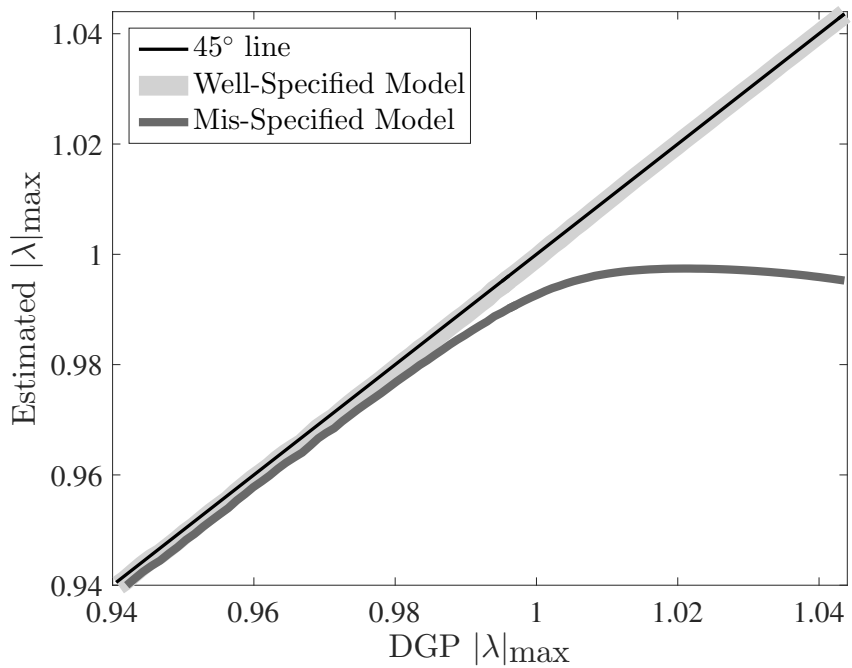
$$X_t = A(L)X_{t-1} + \alpha f(X_{t-1}) + \epsilon_t \qquad F(0) = 0$$

- where α may be very small.
- The omission of $\alpha f(X_{t-1})$ would not be very important if system is stable, but could lead to substantial bias if system is locally unstable (ie if roots of $1 - A(L)$ support instability.
- Consider AR(3) example with small cubed term

Illustration of Bias

- Example

Figure 1: Potential Pitfall in Assessing Local Stability with linear AR when The DGP is Nonlinear



Suggested approach

- Steps
  1. Look at how the addition of non-linear terms changes the local (near mean) evaluation of stability
  2. Examine for multiple steady states
  3. look at behavior of system when started out of steady state, with stochastic elements turned off
- based on estimating models of the form

Choices

- Issues with the estimation of

$$X_t = A(L)X_{t-1} + F(X_{t-1}, X_{t-2}, \dots) + \epsilon_t$$

1. What is X_t
2. what $A(L)$
3. what to include in $F(\cdot)$

Choices

- Our way of addressing issues related to our theory based work (Beaudry, Galizia and Portier 2015).

$$X_t = A(L)X_{t-1} + F(X_{t-1}, X_{t-2}, \dots) + \epsilon_t$$

1. Focus first on labor market variables– hours worked– where low frequency movement removed.
2. Allow $A(L)X_{t-1} = a_1 X_{t-1} + a_2 X_{t-2} + a_3 \sum_{i=0}^{N} (1-\delta)^i X_{t-1-i}$
3. Take $F(\cdot)$ to be cubic function of elements above.

Results

- When allow for non-linear terms in estimation, evidence of local instability often arises.
- Multiple steady state equilibrium sometimes arise, but they do not tend to be attractive (our results do not support such models)
- When local instability present, out of steady state behavior suggests limit cycles (not explosion nor chaos)

Example of results

- Simplest model we estimate

$$X_t = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + a_3 \sum_{i=0}^{N} (1-\delta)^i X_{t-1-i} + a_4 X_{t-1}^3 + \epsilon_t$$

- we find that X_{t-1}^3 is significant and it changes the roots of the system from suggesting stability to indicating locally instability.
- Only on steady state
- starting out of steady state converges rather quickly to limit cycles

Local stability

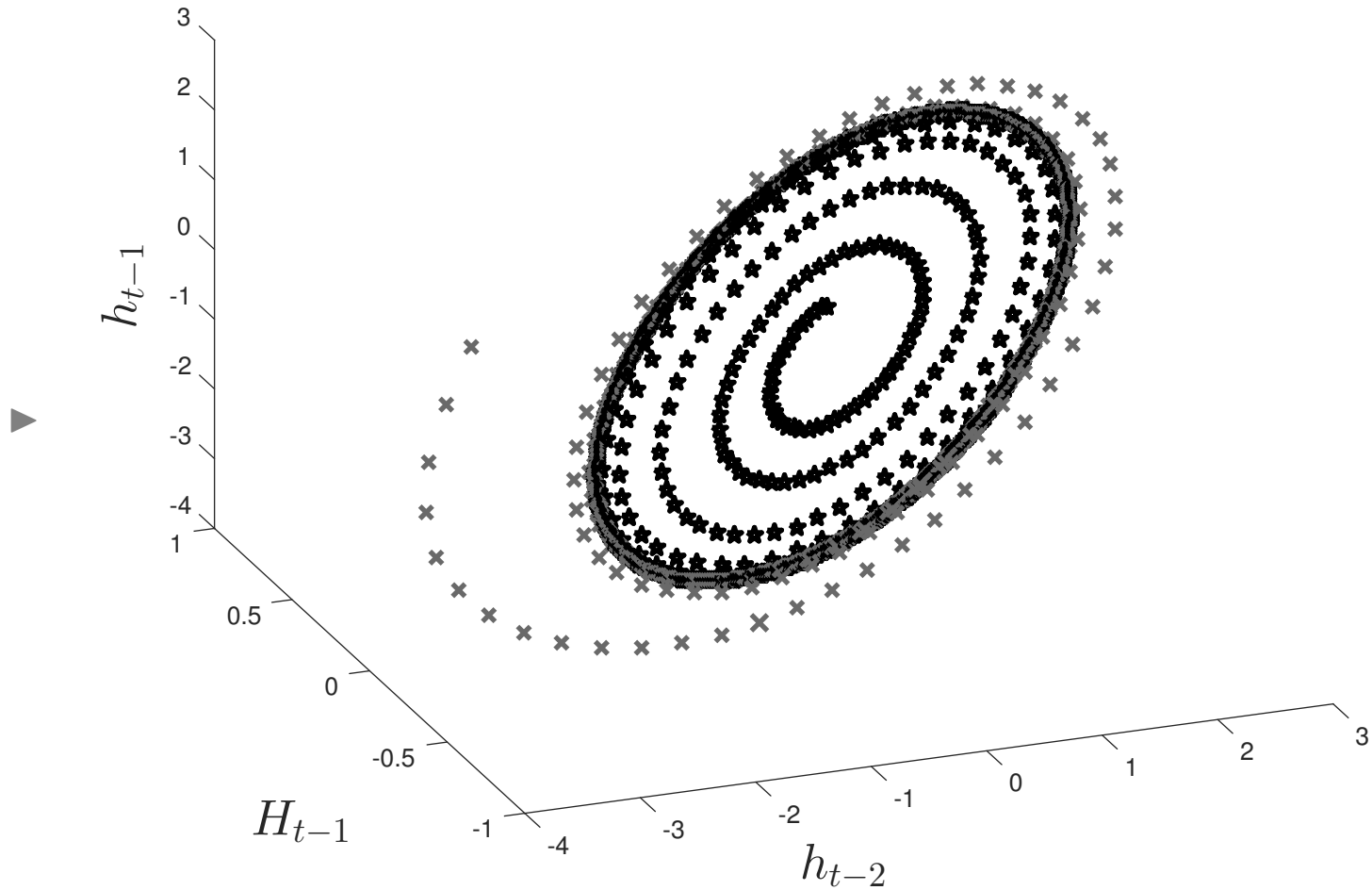
- $$\begin{aligned} h_t &= -0.00 + 1.42\ h_{t-1} - .48\ h_{t-2}, \\ h_t &= -0.01 + 1.31\ h_{t-1} - .34\ h_{t-2} - .25 \sum (1-\delta)^i h_{t-1-i}, \\ h_t &= -0.02 + 1.39\ h_{t-1} - .34\ h_{t-2} - .27 \sum (1-\delta)^i h_{t-1-i} - .01\ h_{t-1}^3. \end{aligned}$$

Table 1: Some Statistics for the Different Models, Total Hours

	$AR(2)$	Linear	Minimal	Intermediate	Full
Max eig. modulus	0.86	0.96	1.01	1.01	{1.02,1.2,1.03}

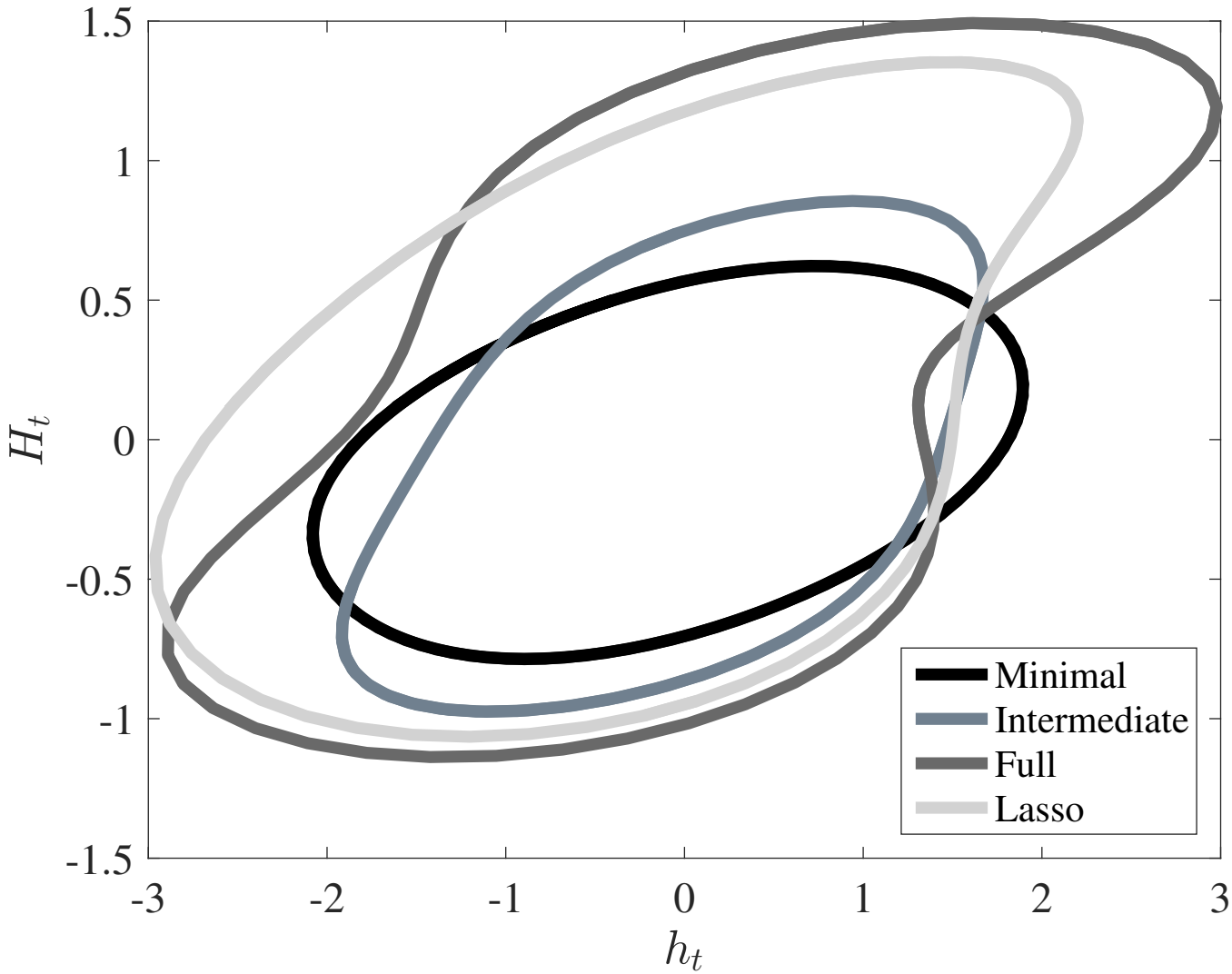
Phase diagram of estimated system

Figure 2: Convergence to the Limit Cycle in the Minimal Model, Total Hours



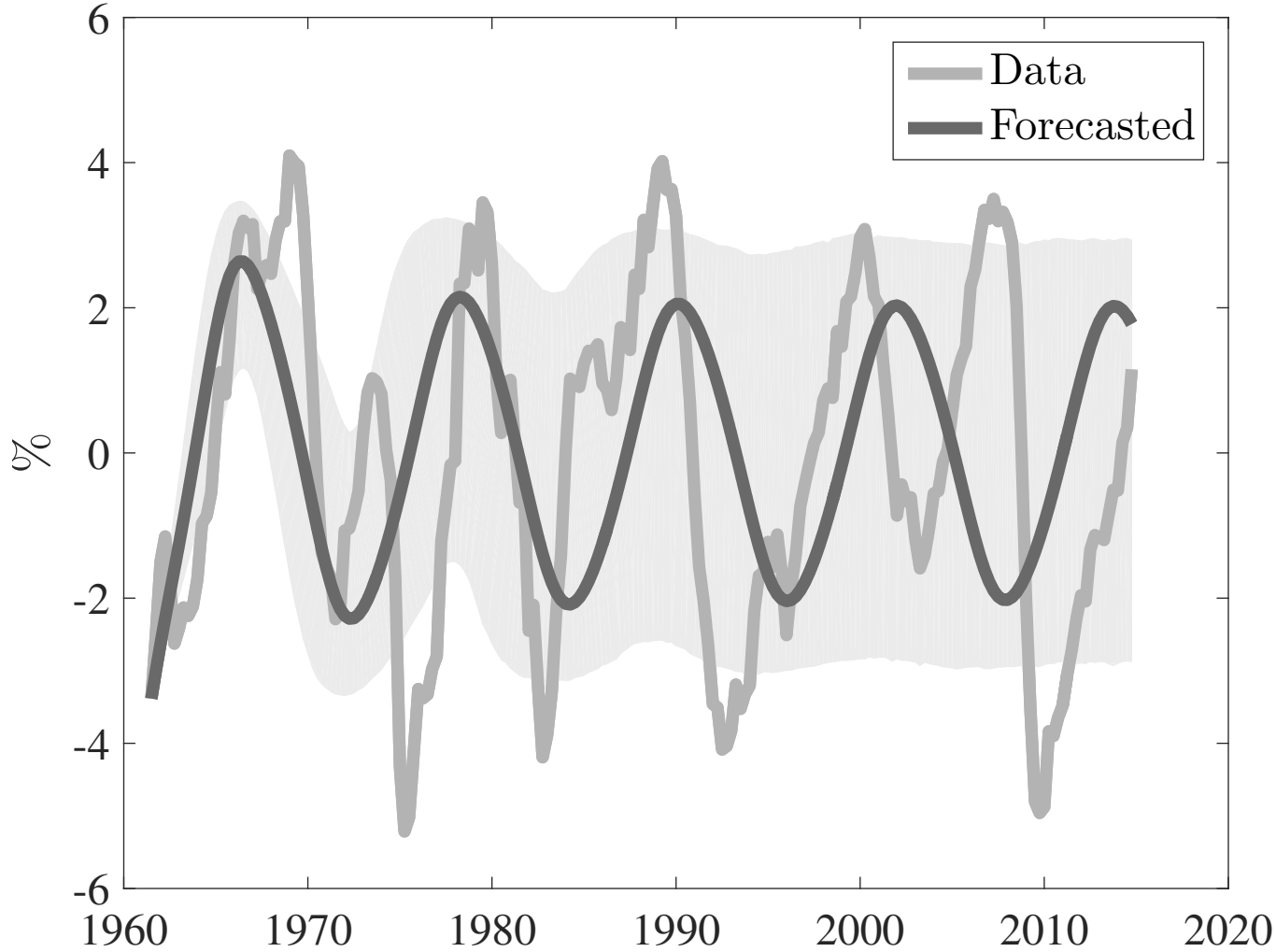
Different limit cycles

Figure 3: The Limit Cycle in the Four Models In (h_t, H_t)-space, Total Hours



Transitional dynamics

Figure 4: Forecasted Path as of 1961Q3 with the Minimal Model, Total Hours

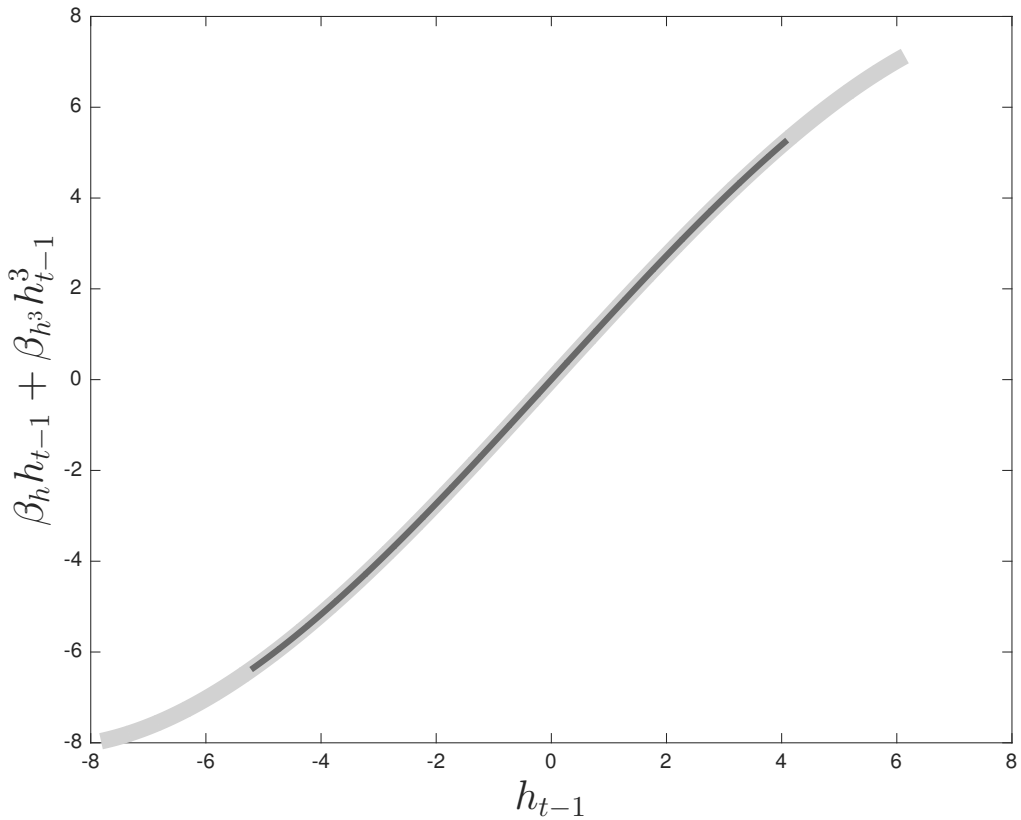


Extent of non-linearity

- Non-linearities are necessary for the emergence of limit cycles.
- However, these non-linearities may be very small
- In fact, the potential bias in evaluating the stability is worse when non-linearity is small
- If the system exploding locally as slow speed, need little non-linearity to maintain globally stability.
- Non linearity we find is minor

Extent of non-linearity

Figure 5: Nonlinearities in the Minimal Model, Total Hours



Robustness

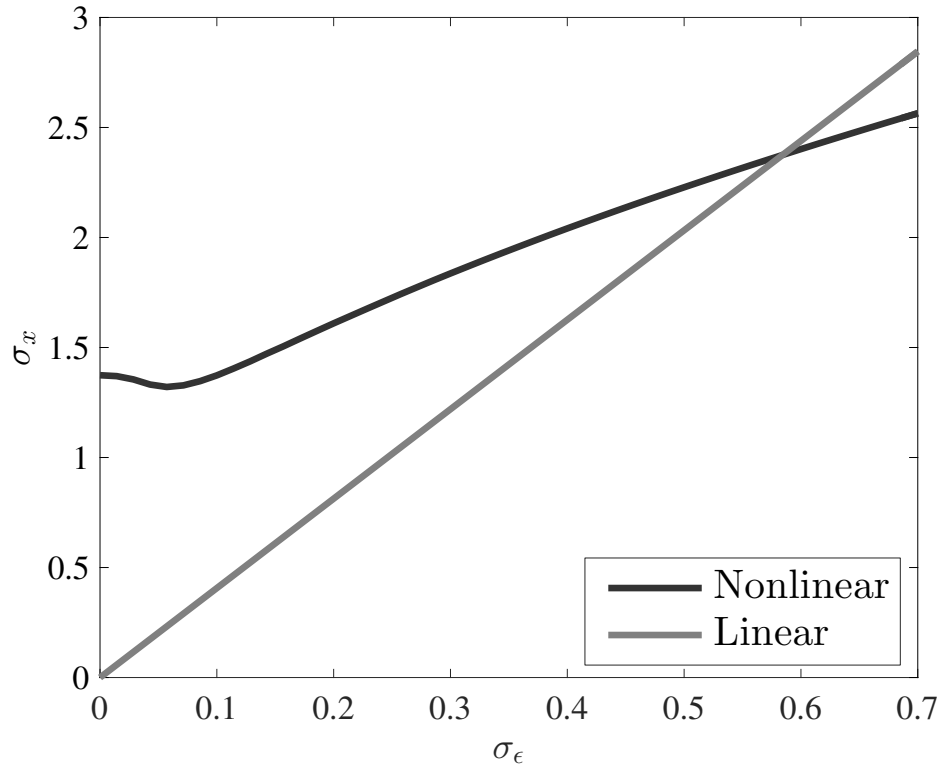
- Findings of local instability and LC are not knife edge, but not ubiquitous
- Monte Carlo suggest method may have low power
- evidence from other countries mixed
- evidence from quantity variables weaker, but could be expected.

Why should we care?

- Effects of stabilization policy may be quite different is stochastic limit cycle environment
- Example: can ask how volatility of system would change is the variance of shocks could be reduce(recognize pitfalls)
    1. Reduced variance of shocks may not reduce variance of outcome
    2. Variance of outcome may be much less sensitive to variance of shock
    3. Effect may mainly be to change the frequency of cycles.

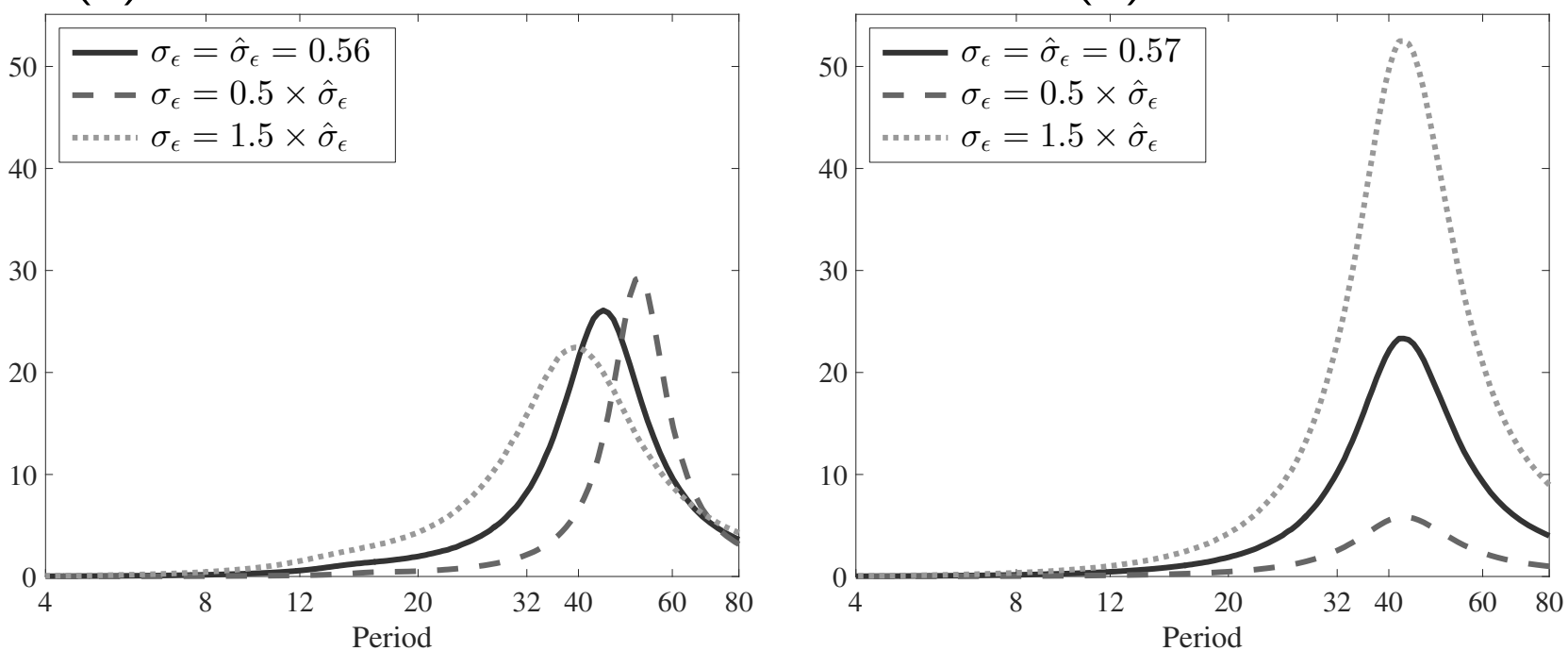
Relationship between outcome variance and shock variance

Figure 6: Relationship between σ_x and σ_ϵ



Effect on frequency

Figure 7: Spectrum of x



Conclusion

- In the business press, it is common to hear a narrative about business cycle which suggests that markets economies have a natural tendency to generate booms and busts
- In this paper, we have presented and explored a simple reduced form framework which can be used to try to detect whether such forces are present.
- Our main finding is that the data – especially US labor market data – provide 'intriguing' evidence is support of such a possibility.
- What may be behind such cyclical behavior? In our previous work, we suggest it may reflect a housing-durable cycle where precautionary behavior create incentives for agents to coordinate purchases. Obviously, more research is needed...