Putting the Cycle Back into Business Cycle Analysis

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Business Cycle Analysis and Modern Macroeconomics

Forces and mechanisms that drive economic fluctuations remain a debated subject.

Two theoretical approaches:

1. BCs are primarily driven by persistent exogenous shocks
2. BCs are mostly driven by forces internal to the economy which endogenously favor recurrent periods of boom and bust.

This paper argues that data favors the second theoretical approach.

Appeals of the First Approach

1. Empirical estimation of DSGE models support the existence and the persistence of exogenous driving forces to explain the data.

2. Since Granger (1966) and Sargent (1987), it has been argued that data are generally not supportive of strong internal boom-bust mechanisms.

This Paper

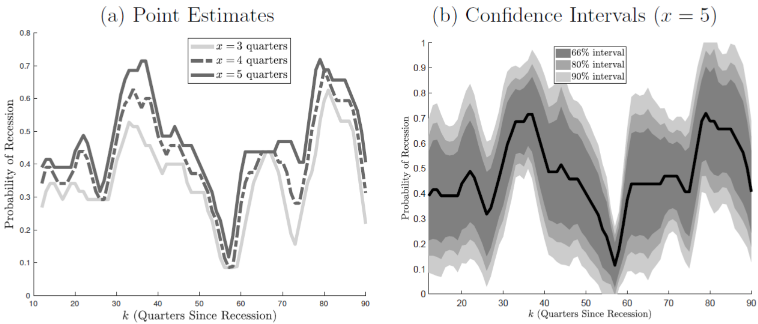
1. They examine spectral density properties of macro aggregates
   - a recurrent peak in several spectral densities at periodicities around 9 to 10 years

2. They analyze necessary features to theoretically reproduce peaks in the spectral densities
   - strategic complementaries across agents
   - accumulation of a stock with decreasing returns

3. They estimate a NK model where persistent shocks and endogenous cyclical mechanisms compete to explain data
   - estimation favors endogenous mechanisms to match empirical spectral density
   - estimation suggests the existence of stochastic limit cycles

Empirical Evidence (I)

Figure 1: Conditional Probability of Being in a Recession



Notes: Panel (a) displays the fraction of time the economy was in a recession within an x-quarter window around time $t + k$, conditional on being in a recession at time t, where x is allowed to vary between 3 and 5 quarters. Panel (b) shows confidence intervals for the $x = 5$ case. See Appendix B for the $x = 3$ and $x = 4$ cases, as well as for details of how these confidence intervals were constructed. The figure was constructed using NBER recession dates over the period 1946Q1-2017Q2.

Empirical Evidence (II)

Step 1 - Estimation of Z_t

Data

- X_t is log of Real GDP at time t
- $X_{t+k|t} = E[X_{t+k}|I_t]$ provided by SPF

Procedure

$$Z_t = (X_{t+4|t} - X_{t|t}) - (X_{t+4|t-1} - X_{t|t-1})$$

where

- $(X_{t+4|t} - X_{t|t})$ is expected growth rate of Real GDP conditional on information set up to time t
- $(X_{t+4|t-1} - X_{t|t-1})$ is expected growth rate of Real GDP conditional on information set up to time $t-1$
- Z_t is an innovation to the expectations of output growth rate

Step 1 - Estimation of $\tilde{Z}_t$

Problem. Z_t is correlated with current and future fundamentals such as fiscal policy, monetary policy, current and future TFP.

Solution. Estimate $\tilde{Z}_t$ as the residual of the following regression,

$$Z_t = C + \sum_{j=-J}^{H} \delta_j \Delta TFP_{t+j} + \gamma SS_t + \mu PC_{t-1} + \tilde{Z}_t$$

where

- C is a constant parameter
- ΔTFP_t is first difference of utility-adjusted total factor productivity at time t
- SS_t is a vector of structural shocks at time t possibly estimated via narrative approach
- PC_{t-1} is a vector of principal component at time $t-1$

Step 2 - Estimation of IRFs to $\tilde{Z}_t$

Define Y_t to be the BP-filtered log-transformation of an endogenous aggregate macroeconomic variable.

Using standard OLS techniques we estimate H regressions

$$Y_{t+h} = \Theta_h^Y \tilde{Z}_t + \epsilon_{t+h}$$

where $h = 1, 2, \ldots, H$ represent the forecast horizon.

$\Theta_1^Y,\ \Theta_2^Y,\ \ldots,\ \Theta_H^Y$ represent the path of the impulse response function of Y_t to a unit deviation of $\tilde{Z}_t$.

Bootstrapping Techniques

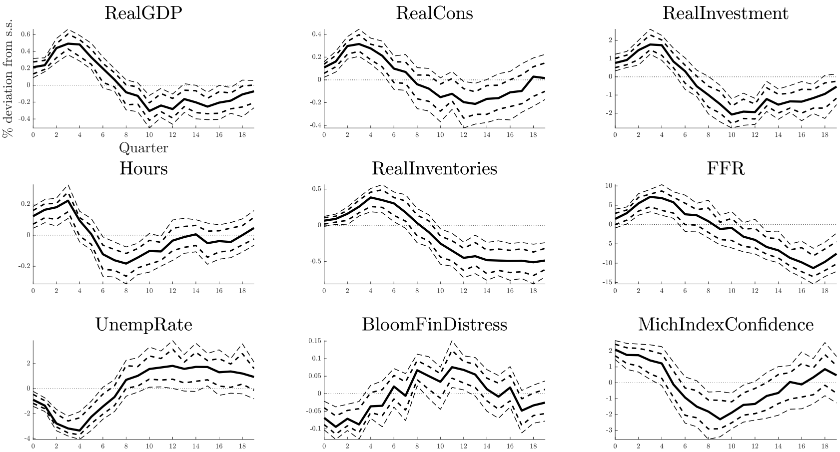
1. Consider the tuple $\Gamma_h^Y = \{Y_{t+h},\ T_t,\ \tilde{Z}_t,\ X_{t-1}\}$.

2. Divide Γ_h^Y over time t in smaller blocks and randomly reorder these blocks in order to form a new tuple $\Gamma_{h,Boot1}^Y$ of the same size of the previous one.

3. Estimate $\Theta_{h,Boot1}$ from $\Gamma_{h,Boot1}^Y$ using standards OLS techniques.

4. Redo (1)-(3) 2000 times and select confidence intervals.

Local Projection - Confidence Interval 68% and 90%



Testing the existence of cycles generated by structural shocks

Idea: given a structural shock a cycle emerges *iff* the shock induces a local peak in the spectral density.

Based on Canova (1996) and Beaudry Galizia Portier (2019) but applied conditioning on a shock
$\hookrightarrow$ Unlike them we compute the spectrum parametrically using truncated IRFs.

Under the null the shock generates a spectral density monotonically non decreasing in the periodicity
$\hookrightarrow$ H_0 : the IRF belongs to an AR(1) process with persistence of magnitude $\in [0, 1)$.

Implementation

1. Compute IRFs from data and bootstrap using Local Projections.
2. Compute the spectrum as
$$y_t = B(L)\epsilon_t \Rightarrow S_y(\omega) = B(e^{-i\omega})S_\epsilon(\omega)B(e^{i\omega})$$
Provided that the structural shock is a white noise,
$$S_y(\omega) = \frac{\sigma_\epsilon^2}{2\pi}B(e^{-i\omega})B(e^{i\omega})$$
3. Define D_1 as the average spectral density over some window around 25 quarters, and D_2 the average around 60 quarters. The test statistic is $D = D_1/D_2$.
4. $H_0 : D \leq 1$. Note that $D = 1$ under a white noise while it is smaller than one for an AR(1) with positive persistence.
5. Compute p-value using bootstrap.

Implications from findings

Results suggest a model where

- Sentiments are not correlated with TFP and policy shocks. Related, the model should not generate an invertibility issue.
- Sentiments generate boom-bust dynamics while fundamental shocks don't.
- Sentiments generate comovement in the real variables while they are non inflationary
- Sentiments explain only 12% of stock prices while they explain almost 40% of variations in real GDP

Model?

What are sentiment shocks?

- Preference shocks, expectational errors, self-fullfilling fluctuations

How do we obtain boom and bust dynamics after a shock?

- In a unique equilibrium framework with imperfect info resulting in overaccumulation due to expectational errors$\rightarrow$ What are the information assumptions that we can make?
- Steady state is a sink $\rightarrow$ all shocks would generate boom and bust(?) (Benhabib and Farmer 1994)
- Multiple steady states and equilibrium is (locally) unique $\rightarrow$ economy is temporarily in the proximity of the bad steady state after a shock (Boissay Collard and Smets 2016)

Questions raised

- What's the meaning of boom and bust? Look at this IRF, does it display a peak?
- Cycle emerges *iff* ... is a definition or a result? A definition
- Doesn't the spectral density converges to zero by construction? No, because (?)
- Related, shouldn't the truncation horizon affect mostly the estimation of the spectral density at longer periodicities? No, it's the opposite, because (?)
- Why you do not search or compute the global maximum? Ok that you answer by saying that you follow the literature
- Ok that model with self-fullfilling shocks gives you the wrong movements in response to tfp shocks
- Try my model with Gaetano, sentiments shoould give you boom and bust while permanent tfp shocks should give you the right dynamics.

Rayan's view is that we could write a model in the spirit of Chahrour and Gaballo where after sentiment shocks the bust emerges because agents realize they were wrong. This implies that agents'information set is smaller than econometrician's info set. That agents do not know aggregate variables is consistent with Chahrour and Ulbricht.

However, in CG agents learn from prices. But in our model prices decrease after the shock, which is not consistent with the idea of having an improvement in the local conditions, we need to think hard about how to get the right price movement.