The Financial Accelerator under Learning and the Role of Monetary Policy

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Systematic effects of volatility shocks in industrial production: rapid drop, rebound and overshoots (see Bloom (2009))
Recent episode: negative real effects and large *swings* in confidence and financial variables.
Financial frictions help to explain the propagation of shocks (Carlstrom and Fuerst (1997); Bernanke et al (1999); Kiyotaki and Moore (1997))

Recent literature on learning highlights that shocks can be amplified through expectation formation

- Quasi-rational learning is able to match recurrent hyperinflation episodes (Marcet and Nicolini (2003))
- Propagation of shocks in New-Keynesian models is increased when learning in the expectation formation is included (Adam (2005), Milani (2007))
- Learning is able to generate large fluctuations in asset prices beyond fundamentals (Adam, Marcet and Nicolini (2009))
How MP should react to asset prices in the presence of financial frictions?

- A1: Even in the presence of bubbles there is little or no gains from targeting asset prices. Better to focus on the inflationary/deflationary consequences of asset prices (Bernanke and Gertler (1999, 2001), Gilchrist and Leahy (2002), Iacoviello (2005), Faia and Monacelli (2007), Gilchrist and Saito (2008)). **One limitation of these studies: bubbles in asset prices are exogenous**

- A2: MP should have an active role in the detection and prevention of “misalignments” in asset markets (Cecchetti et al (2000), Borio and Lowe (2002), Tetlow and von zur Muehlen (2003))

Learning and monetary policy

- MP should have a tighter control on inflation (Orphanides and Williams (2008) among others)
Two questions addressed

- Question I: Can the presence of learning magnify the effects of financial frictions in the economy?

- Question II: How monetary policy should be adjusted to stabilize the downturn of the economy in this type of situations?
What we do in this work

- We consider a closed economy model with financial frictions and nominal rigidities as in Bernanke, Gertler and Gilchrist (1999) (BGG).
- We extend the model to include small departures from Rational Expectations (RE) assuming agents form expectation through adaptive learning ⇒ asset price bubbles arise endogenously as result of the interaction between expectation formation and prices.
- We analyze a sequence of detrimental shocks that generate a transitory fall in productivity growth.
- We assess the performance of alternative Taylor-type rules.
Main results

- The combination of the financial accelerator mechanism and adaptive learning approach significatively magnifies the downturn of an economy hit by a sequence of adverse shocks.
- This amplification effect can be increased (in a non-linear way) with the size of the shocks and the level of financial fragility of the economy (measured by the leverage ratio of capital producers).
- Although a monetary policy that reacts to asset prices can stabilize the real economy, a tighter control of inflation can do a good job in stabilizing output and asset prices as well.
Model Economy

- Closed economy model with price and wage rigidities (see e.g. Christiano et al, 2007)
- Financial accelerator: Due to a costly state verification problem, financial intermediaries charge an external finance premium:

\[ i_{k,t} = i_t + \chi_k (qr_t + k_{t-1} - n_t) \]  

(1)

- Net worth evolution:

\[ n_t = n_{t-1} - z_t + \frac{K}{N} \left( \frac{r_k}{R_K} r_k + \frac{1 - \delta}{R_K} qr_t - qr_{t-1} \right) - \left( \frac{K}{N} - 1 \right) (i_{k,t-1} - \pi_t) \]  

(2)

where \( \left( \frac{K}{N} - 1 \right) \) is the leverage ratio of entrepreneurs.

- Taylor type rule:

\[ i_t = \varphi_i i_{t-1} + (1 - \varphi_i) [\varphi_\pi \pi_t + \varphi_y \Delta y_t] \]  

(3)

- Productivity growth fluctuations:

\[ z_t = \rho_z z_{t-1} + \varepsilon_{z,t} \]  

(4)
Introducing Adaptive Learning

- Equilibrium condition of the model:
  \[ F_{t}E_{t}x_{t+1} + Gx_{t} + Hx_{t-1} + D\varepsilon_{z,t} = 0 \]  \hspace{1cm} (5)

- Rational expectation solution:
  \[ x_{t} = \Omega x_{t-1} + \Lambda \varepsilon_{z,t} \]  \hspace{1cm} (6)

- Adaptive learning (Marcet and Sargent (1989); Evans and Honkapohja (2001)):
  - Perceived Law of Motion (PLM):
    \[ E_{t}x_{t+1} = \tilde{\Omega}_{t-1} x_{t} + \tilde{\Xi}_{t-1} \varepsilon_{z,t} \]  \hspace{1cm} (7)
  - Actual Law of Motion (ALM) (replace (7) in (5)):
    \[ x_{t} = - \left( F_{t}\tilde{\Omega}_{t-1} + G \right)^{-1} \left( Hx_{t-1} + D + \tilde{\Xi}_{t-1} \varepsilon_{z,t} \right) \]  \hspace{1cm} (8)
  - Agents use recursive least square to update their beliefs:
    \[ \left[ \tilde{\Omega}_{t}, \tilde{\Xi}_{t} \right] = \left[ \tilde{\Omega}_{t-1}, \tilde{\Xi}_{t-1} \right] + \gamma \left( R_{t-1}^{-1} \left( x'_{t-1}, \varepsilon_{z,t-1} \right)' \right) \]  \hspace{1cm} (9)
Simulation

- Standard calibration following closely Christiano et al (2007)
- Financial accelerator parameters in line with BGG, Gilchrist and Saito (2008), Gilchrist (2004) \( K/N = 1.9, \chi_k = 0.065 \)
- Process for productivity growth: \( \rho_z = 0.80 \).
- Learning introduces additional parameters:
  - Gain parameter: \( \gamma = 0.025 \) [small deviation from RE]
  - The model economy starts at the RE equilibrium
- A sequence of three negative shocks in productivity growth hit the model economy
Amplification effects of the financial accelerator

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Amplification effects of adaptive learning

Introduction
Model
Simulations
The role of monetary policy
Conclusions

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Combination of financial accelerator and adaptive learning
Financial accelerator under learning: the role of expectations

- Expected level of output at t+4
- Expected Inflation at t+4
- Expected Interest Rate at t+4
- Expected Asset Price at t+4
- Expected level of net worth at t+4
- Expected external finance premium at t+4
Difference of responses between Learning and RE under different sizes of shocks

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Difference of responses between Learning and RE under different leverage ratios

- Level of output
- Inflation
- Interest Rate
- Asset Price
- Level of net worth
- External finance premium

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The role of monetary policy in stabilizing the economy

- What the monetary policy should do to alleviate the downturn?
- We assume that monetary authority has no superior information about fundamentals
- Alternative MP:

\[ i_t = \varphi_i i_{t-1} + (1 - \varphi_i) [\varphi_\pi \pi_t + \varphi_y \Delta y_t + \varphi_q qr_t + \varphi_{\Delta q} \Delta qr_t] \]  

Alternatives MP in order to minimize the average square path of fluctuations in inflation and output growth

- Rule $q$: Pick $\varphi_q$, fixing other parameters and $\varphi_{\Delta q} = 0$
- Rule $\Delta q$: Pick $\varphi_{\Delta q}$, fixing other parameters and $\varphi_q = 0$
- Rule $y$: Pick $\varphi_y$, fixing other parameters and $\varphi_q = \varphi_{\Delta q} = 0$
- Rule $\pi$: Pick $\varphi_{\pi}$, fixing other parameters and $\varphi_q = \varphi_{\Delta q} = 0$
Responses under alternative monetary policies

- Level of output
- Inflation
- Interest Rate
- Asset Price
- Level of net worth
- External finance premium
Conclusions

- Under small departures of rational expectation, financial accelerator mechanism may significantly increase economic fluctuations.
- This amplification can be increased in a non-linear way with the size of the shocks and the degree of financial fragility of the economy.
- In our model financial market bubbles arise endogenously and monetary policy has no superior information regarding the non-fundamental part of asset prices.
- A tighter control of inflation can do a good job in stabilizing output, inflation and asset prices.
- Targeting asset prices can reduce the fall in the real economy in the short term, but with an additional cost of increasing inflation at the medium term horizon.