Optimal Inflation Target: Insights from an Agent-Based Model

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Introduction

• The Global Financial Crisis highlighted the limitations of standard tools used for policy making.
• One can indeed argue that current DSGE models are useful in normal times but become unreliable in critical times, which is when they are mostly needed...
• Is this just a matter of making better DSGE models?
• Is this a fundamental problem which requires a change in macro-economics modelling?
• In this talk we present a simple Agent-Based Model (ABM) and use it to address the question of inflation targeting by central banks.
• More in general, we try to highlight the main differences between ABMs and DSGE.
Introduction: why ABMs?

**DSGE**
Dynamic Stochastic General Equilibrium  
*rational agents / equilibrium models*

- + mathematically tractable  
- + well defined calibration procedures  
- + well understood  
- - micro = macro  
- - crisis only through large shocks  
- - difficult to generalize

**rational expectations**

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**ABM**
Agent based models  
*simple agents rules (bottom-up)*

- + micro != macro  
- + large fluctuations from small shocks  
- + versatile  
- - many assumptions / parameters  
- - black-boxes  
- - difficult to understand

**expectations from past data**
Introduction: a (very) simple ABM

**Single representative household:**
- Savings $S$
- Wage (constant) $W$
- Consumes a fixed fraction $C_B$ of $S$

**Set of $N$ firms:**
- Produce $Y_i$ (linear, employment $\propto$ production)
- Equity $E_i$ (excess cash or debt)
- Financial fragility $\Phi_i = -\frac{E_i}{W_i Y_i}$ (if $\Phi_i > \theta$ bankruptcy)
- Fixed propensities to hire / fire $\eta_{\pm}$

**Model dynamics:**
- Households have a nominal demand $D_t = C_B (S_t + W_t)$
- Firms adapt prices and quantities to meet demand
- Production increase / decrease is adaptive and asymmetric ($\eta_{\pm} < 1$)
- Bankruptcy costs are absorbed by households and firms
Introduction: a (very) simple ABM

Several parameters but only few matters!

phase diagram of the model

example time-series

$$R = \frac{\eta_+}{\eta_-}$$
Introduction: a (very) simple ABM

The complexity of this toy model is mainly due to **feedback loops**
→ there is actually **very little heterogeneity**
Central Bank:

- Baseline interest rate $\rho_0 = \rho^* + \phi_\pi (\pi_t - \pi^*)$ to target an inflation level $\pi^*$
- Native state if $\varphi_\pi = 0$

Private Banks:

- Set interest rates $\rho^l_t, \rho^d_t$ on loans and deposit (no profits including bankruptcy costs)

Expectations:

- $\bar{\pi}_t = \tau^R \pi_t + \tau^T \pi^*$

Feedbacks:

- Households consumption is coupled to the real interest rate on deposits $\bar{\pi}_t - \rho^d_t$
- Inflation expectations are anticipated in price / wage updates
- Wage and production updates are coupled to firms financial fragility (coupling strength increasing with $\rho^l_t - \bar{\pi}_t$)
Generalizations and policy experiments (native state)
Generalizations and policy experiments (native state)

Unemployment = 0%
Inflation = 4%

Unemployment = 39%
Inflation = 0%
Generalizations and policy experiments (from HIHO)
Generalizations and policy experiments (from \textsc{LILO})

![Graphs showing the relationship between unemployment, inflation, and real interest on deposits vs. target inflation.](image_url)
Conclusions

• Too low inflation targets are detrimental within this framework (persistent under-realization of inflation)
• The model emphasizes the benefits of inflation while neglecting costs (price dispersion for instance)
• Mark-0 is a barebone ABM, many important effects are missing (but can be easily introduced)
• The native state of the economy is itself an output of the model and affects the optimal policy
• In our opinion more research is needed and can offer complementary views on macro-economics
• ABMs complexity can be reduced, usually few parameters are actually important (qualitatively)
• Parallel research direction: start from simple DSGE models and relax some of the assumptions
Thanks!

- "Tipping points in macroeconomic Agent-Based models"

- "Monetary Policy and Dark Corners in a stylized Agent-Based Model"

- "Optimal Inflation Target: Insights from an Agent-Based Model"

- "Endogenous crisis waves: a stochastic model with synchronized collective behavior"