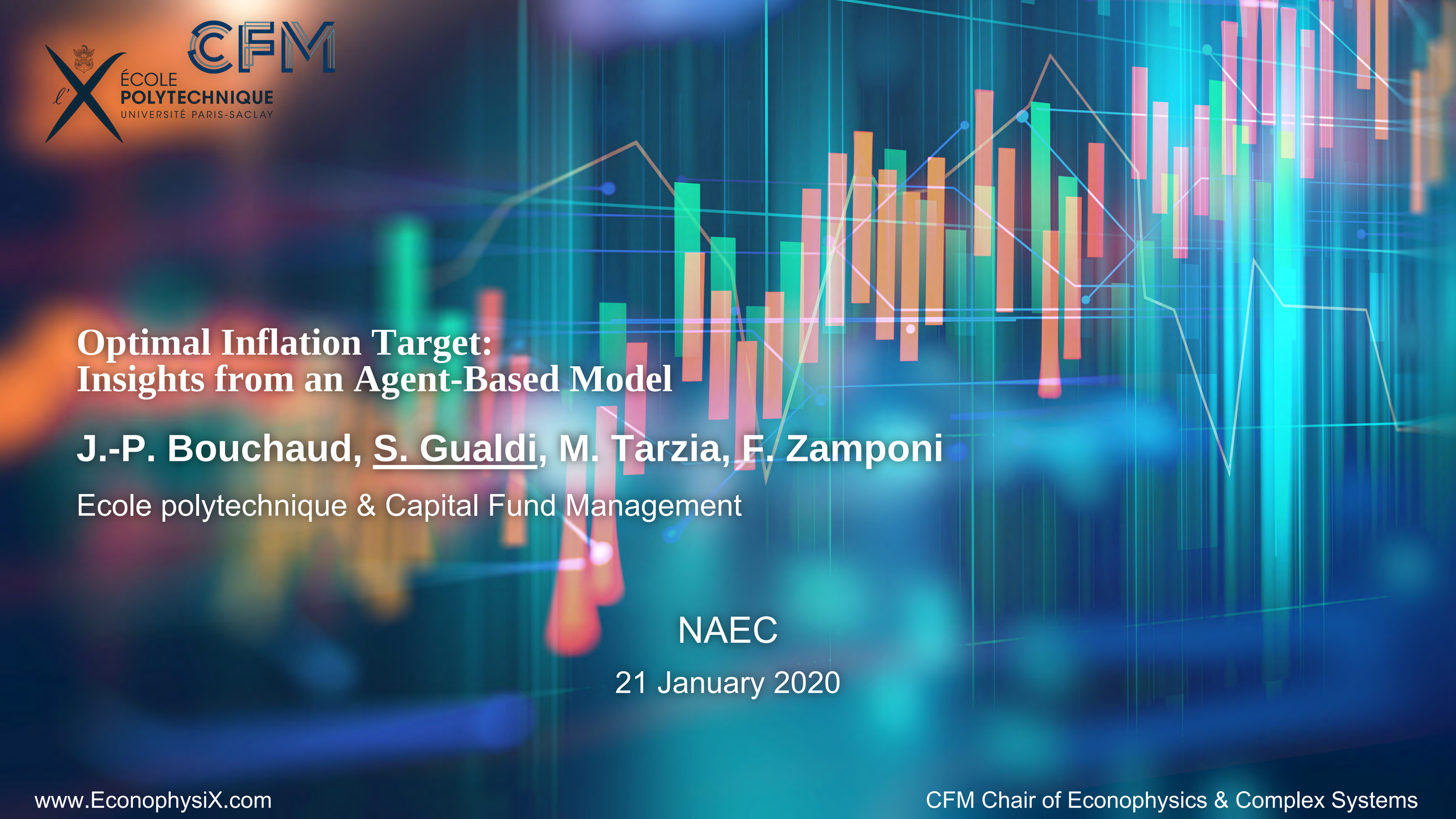

Optimal Inflation Target: Insights from an Agent-Based Model

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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 adress 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*

<u>rational expectations</u>

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*

<u>expectations from past data</u>

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 $\eta_{\pm}$

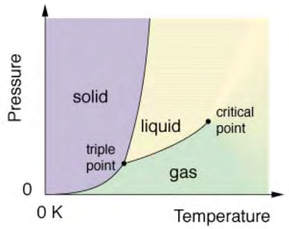
Model dynamics:

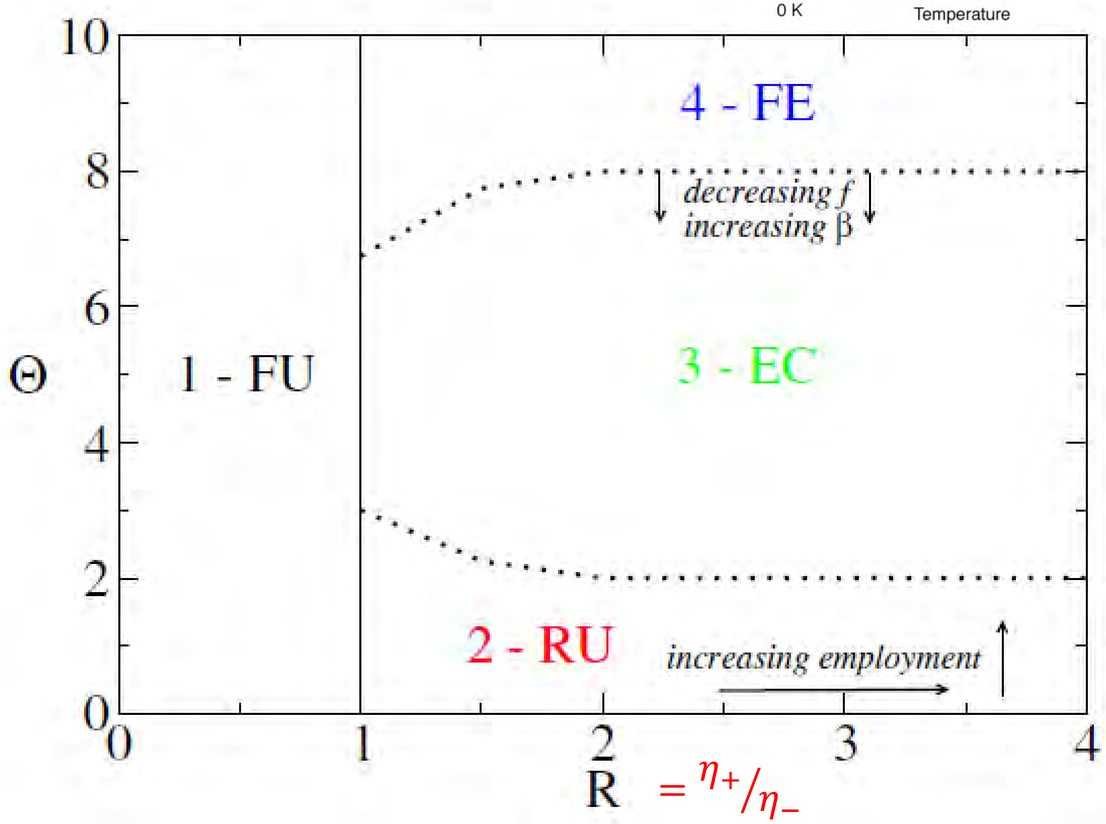
- Households have a nominal demand $D_t = C_B(S_t + W_t)$
- Firms adapt prices and quantities to meet demand
- Production increase / decrease is adaptive and asymetric ($\eta_{\pm} < 1$)
- Bankruptcy costs are absorbed by households and firms

Introduction: a (very) simple ABM

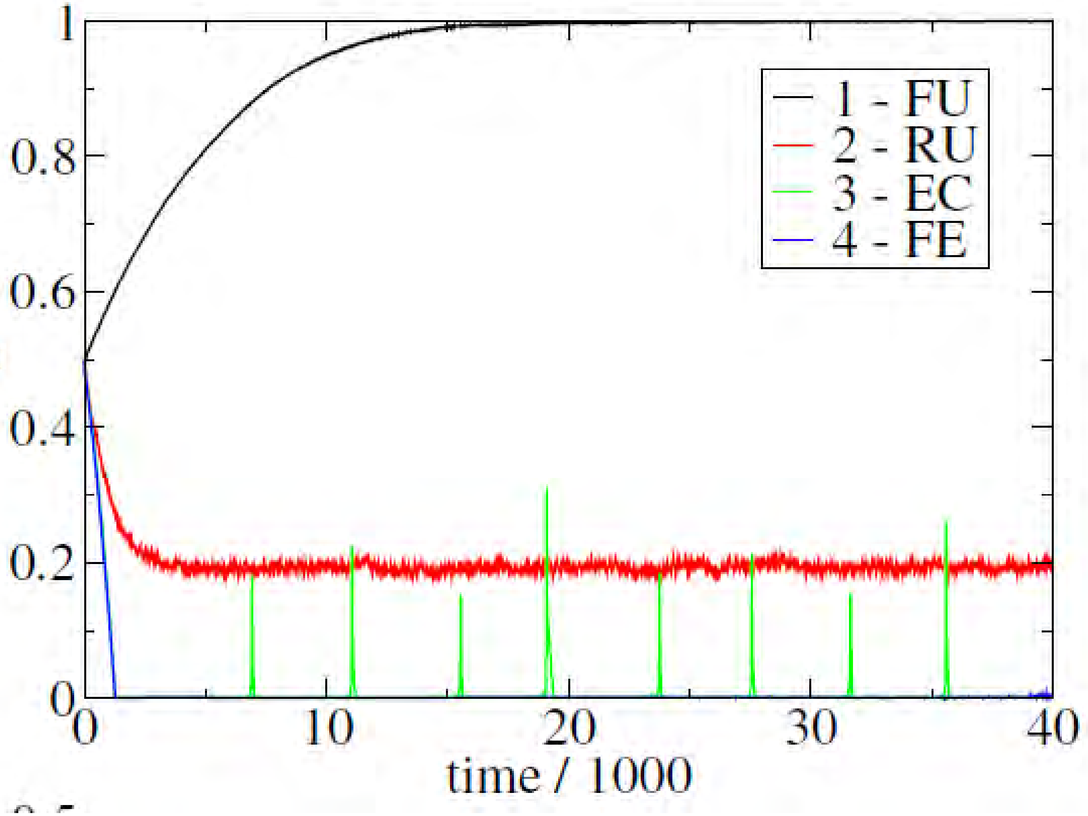
Several parameters but only few matters!

phase diagram of the model



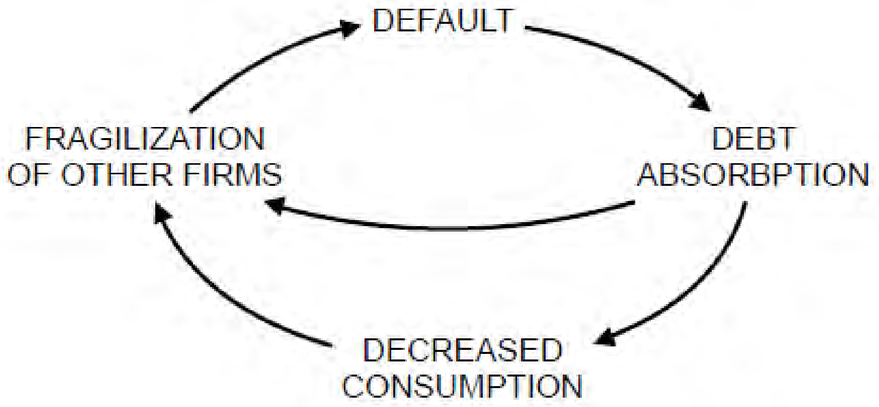


example time-series

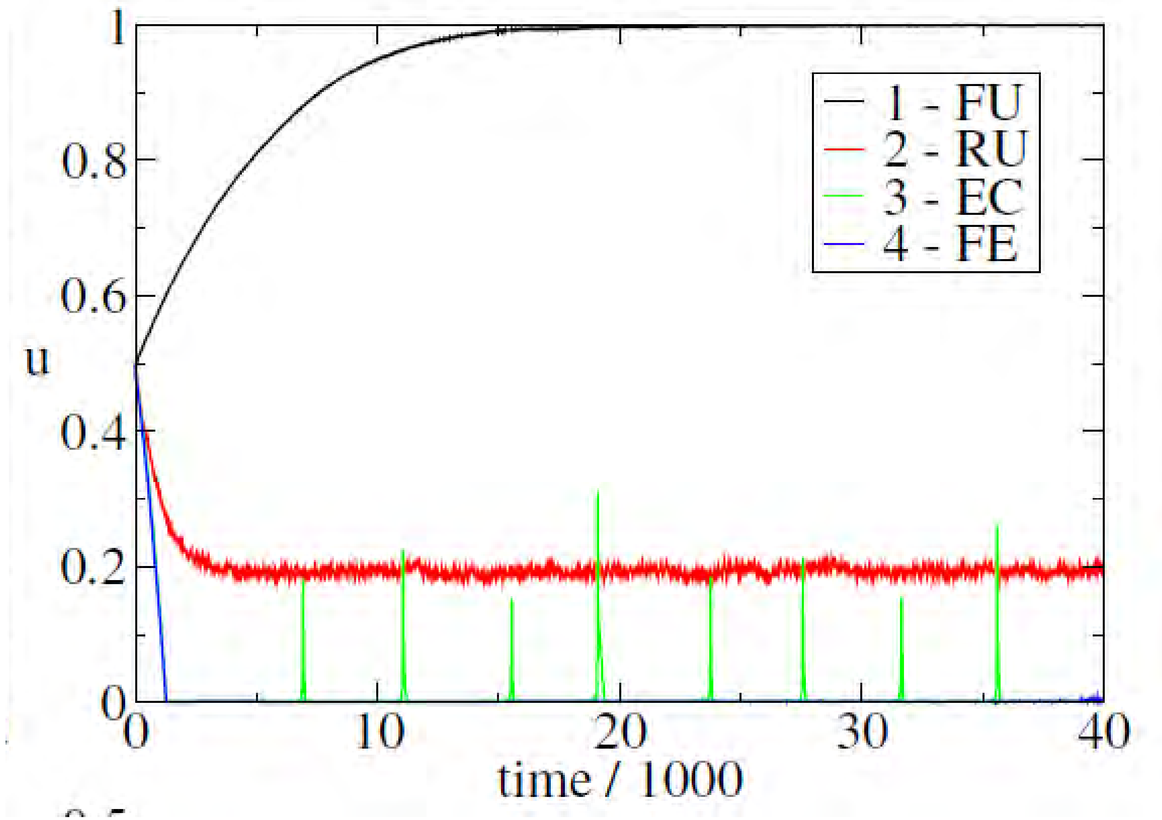


Introduction: a (very) simple ABM

The complexity of this toy model is mainly due to **feedback loops**
–> there is actually **very little heterogeneity**



example time-series



Generalizations and policy experiments

Central Bank:

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

Private Banks:

- Set interest rates ρ_t^l, ρ_t^d on loans and deposit (no profits including bankruptcy costs)

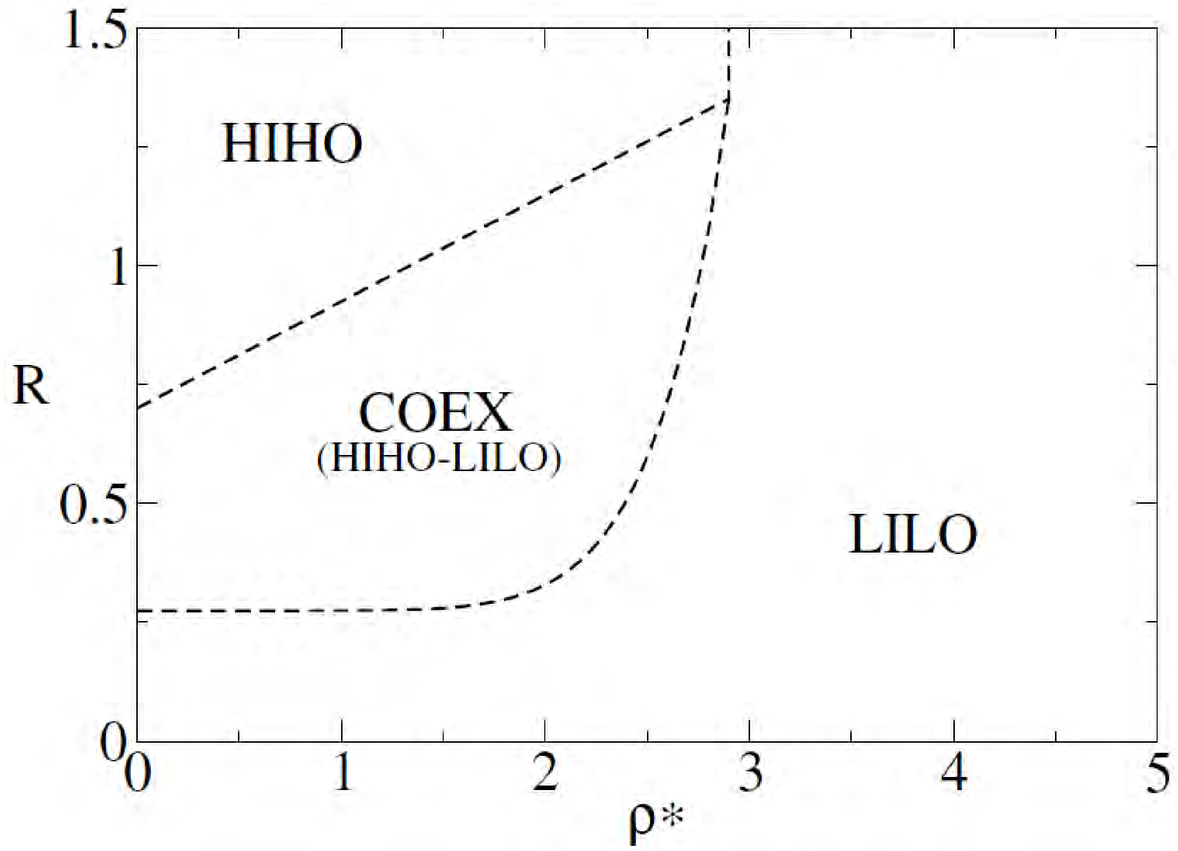
Expectations:

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

Feedbacks:

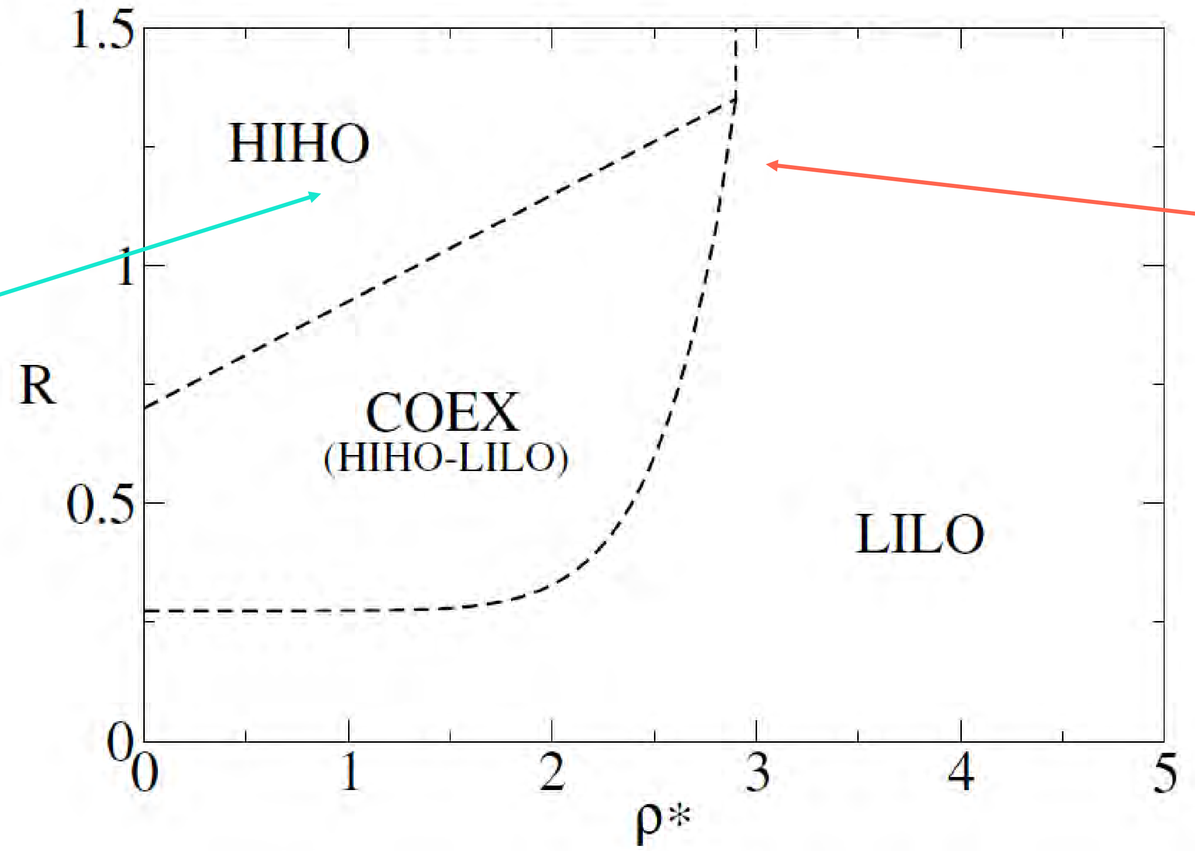
- Households consumption is coupled to the real interest rate on deposits $\widehat{\pi_t} - \rho_t^d$
- Inflation expectations are anticipated in price / wage updates
- Wage and production updates are coupled to firms financial fragility (coupling strength increasing with $\rho_t^l - \widehat{\pi_t}$)

Generalizations and policy experiments (native state)



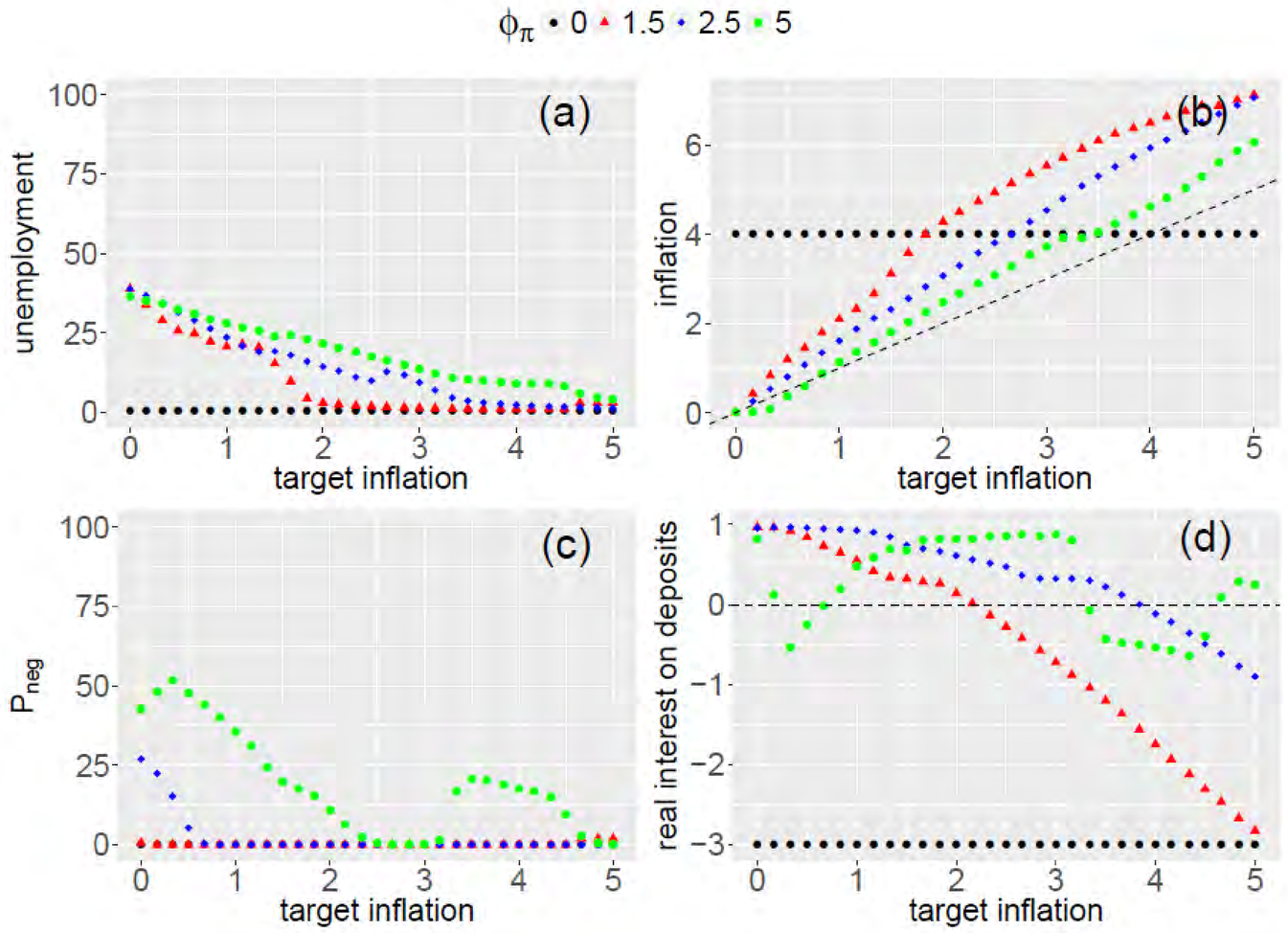
Generalizations and policy experiments (native state)

Unemployment = 0%
Inflation = 4%

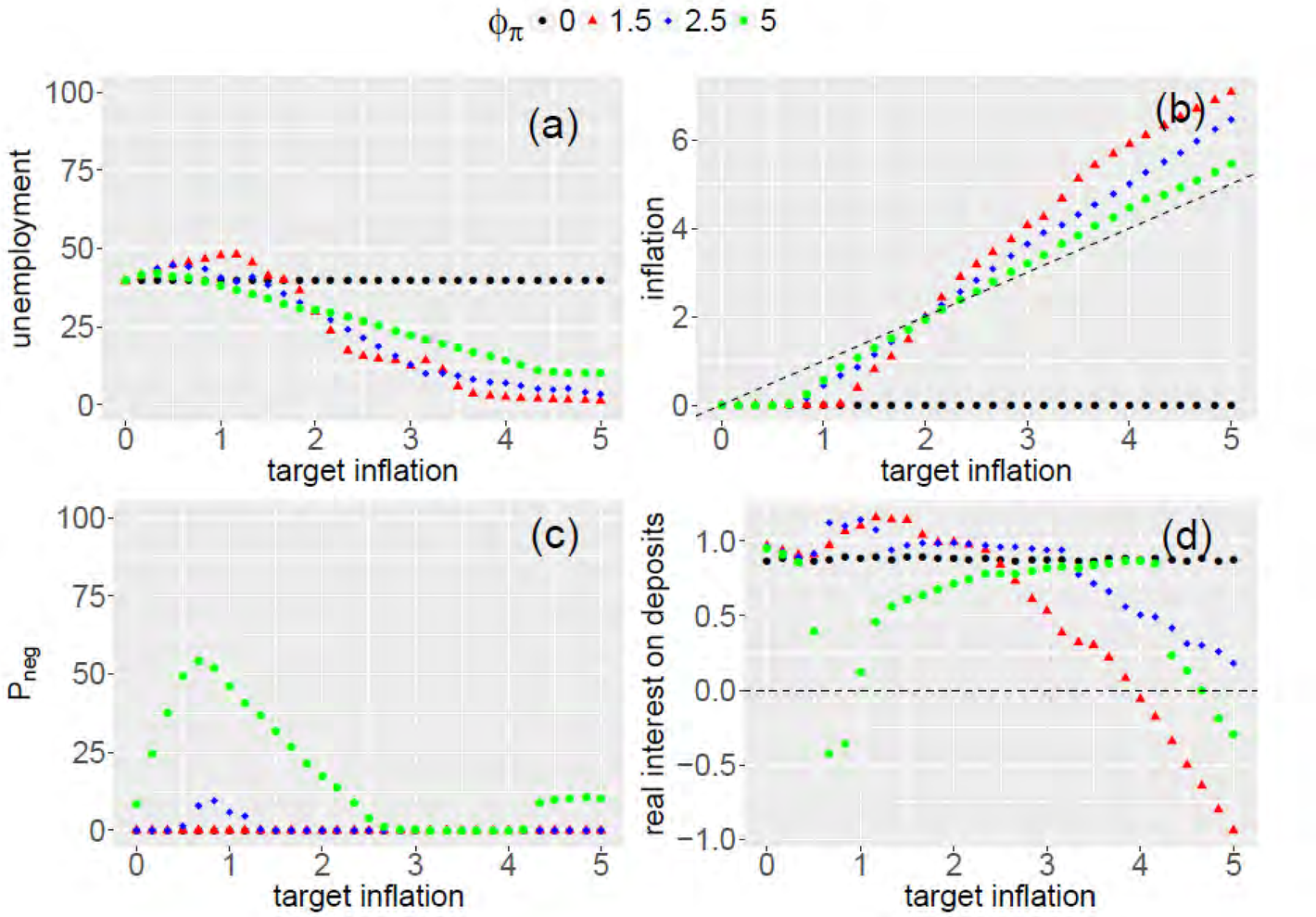


Unemployment = 39%
Inflation = 0%

Generalizations and policy experiments (from HIHO)



Generalizations and policy experiments (from LILO)



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*“
  S. Gualdi, M. Tarzia, F. Zamponi and J.-P. Bouchaud, JEDC 50, 29-61 (2015)
- "*Monetary Policy and Dark Corners in a stylized Agent-Based Model*“
  S. Gualdi, M. Tarzia, F. Zamponi and J.-P. Bouchaud, JEIC, 1-31 (2016)
- "*Optimal Inflation Target: Insights from an Agent-Based Model*“
  J.-P. Bouchaud, S. Gualdi, M. Tarzia and F. Zamponi, Economics: The Open-Access, Open-Assessment E-Journal, 12 (2018-15): 1–26
- "*Endogenous crisis waves: a stochastic model with synchronized collective behavior*“
  S. Gualdi, J.-P. Bouchaud, G. Cencetti, M. Tarzia and F. Zamponi, PRL 114 (8), 088701 (2015)