

Agent-based models and their consequences for macroeconomic analysis

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Agent-based models: building blocks

1. Heterogeneous agents, interacting via price and non-price variables
2. Bounded rationality
3. Disequilibrium analysis

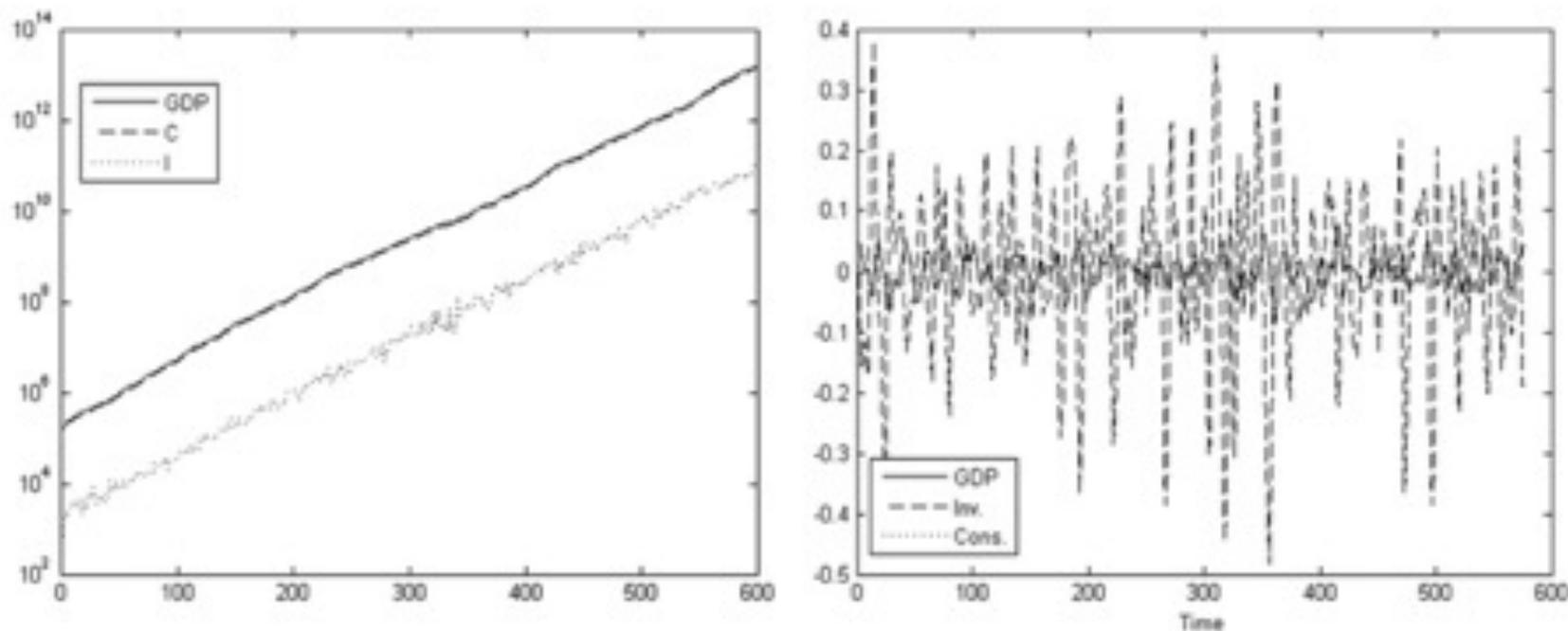
Bottom-up approach and emergent properties

- Macroeconomic phenomena are explained as ***emergent properties*** of the interaction of heterogeneous agents
- One starts with simple behavioural rules (the primitives of the model) and then studies whether the interaction of heterogeneous agents is able to generate the macroeconomic phenomenon under study (or not).
- **Generative approach**. Lack of isomorphism between aggregate dynamics and the hypotheses concerning single agents (contrast with reductionism).

Consequences for macroeconomic analysis

1. Endogenous business cycles

- Business cycles in ABMs are “endogenous”. The model switches from phases of expansions to recessions as a result of agents’ interactions (no need for aggregate shocks) – See e.g. K+S model Dosi et al (2010, 2013,2015)



Output, consumption and investment time series; left: logs; right: bandpass-filtered (6,32,12) series.

Consequences for macroeconomic analysis

2. Interactions between short- and long-run dynamics

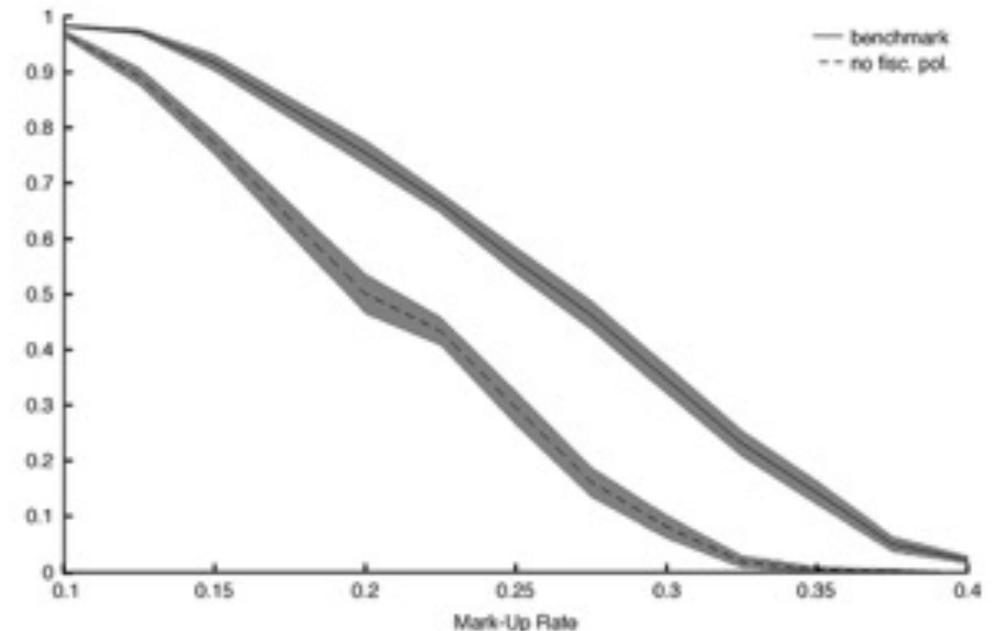
- ABMs go beyond the traditional dichotomy between short run and long-run. *Coordination issues do affect economic change.* See again Dosi et al (2010, 2013, 2015)

Politique budgétaire	Politique monétaire		
	TR_{π}	$TR_{\pi U}$	Spread
Pas de règle	1	1,019** (3,730)	0,994 (1,017)
PSC	0,527** (6,894)	1,014 (1,157)	0,794** (3,982)
TSCG	0,572** (6,499)	0,958 (1,296)	0,765** (4,863)
PSC _{dér.}	0,995 (0,876)	1,013** (2,572)	0,991* (1,665)
TSCG _{dér.}	0,992 (1,388)	1,021** (4,169)	0,997 (0,524)

* significatif à 10 % près ; ** significatif à 5 % près.

Interactions des politiques budgétaires et monétaires ; valeurs normalisées des taux de croissance moyens du PIB selon différentes conditions d'expérience ; valeur absolue de la statistique t (test de Student) de simulation de H_0 : « pas de différence entre la situation initiale et l'expérience » entre parenthèses ; *Politiques budgétaires* : pas de règle budgétaire (*pas de règle*) ; règle des 3 % de déficit (*PSC*) ; règle de réduction de la dette (*TSCG*) ; *PSC* avec clause dérogatoire (*PSC_{dér.}*) ; *TSCG* avec clause dérogatoire (*TSCG_{dér.}*). *Politiques monétaires* : règle de Taylor indexée sur la seule inflation (TR_{π}) ; règle de Taylor à mandat dual ($TR_{\pi U}$) ; Taylor indexée sur la seule inflation en présence ajustement des spreads obligataires (*spread*).

Source : Dosi et al. (2015).

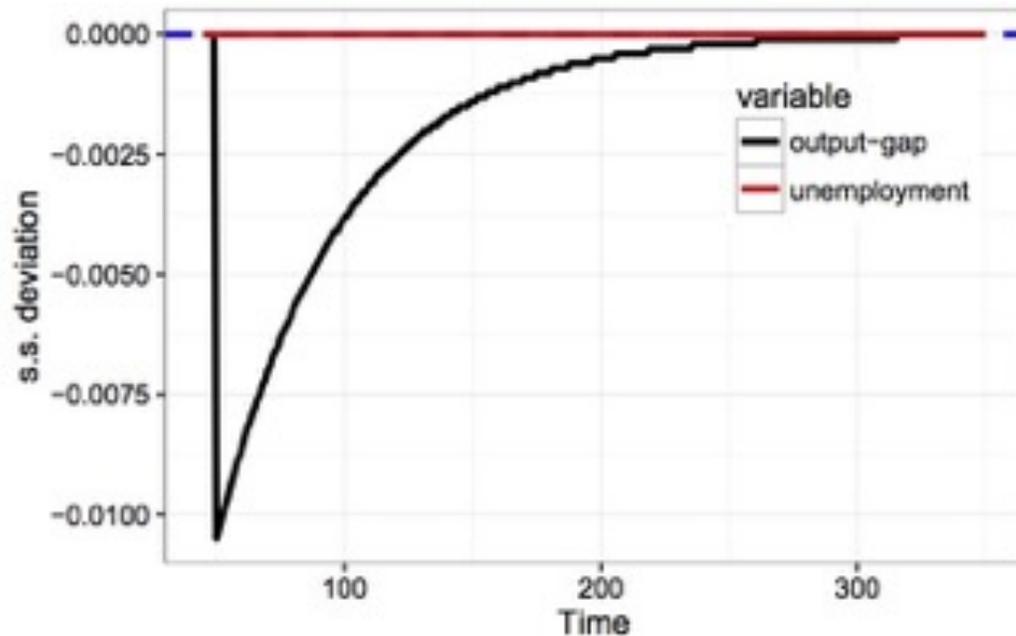


Frequency of full employment in the benchmark scenario (solid line) and in the scenario with zero fiscal policy (dashed line; 95% confidence bands in gray).

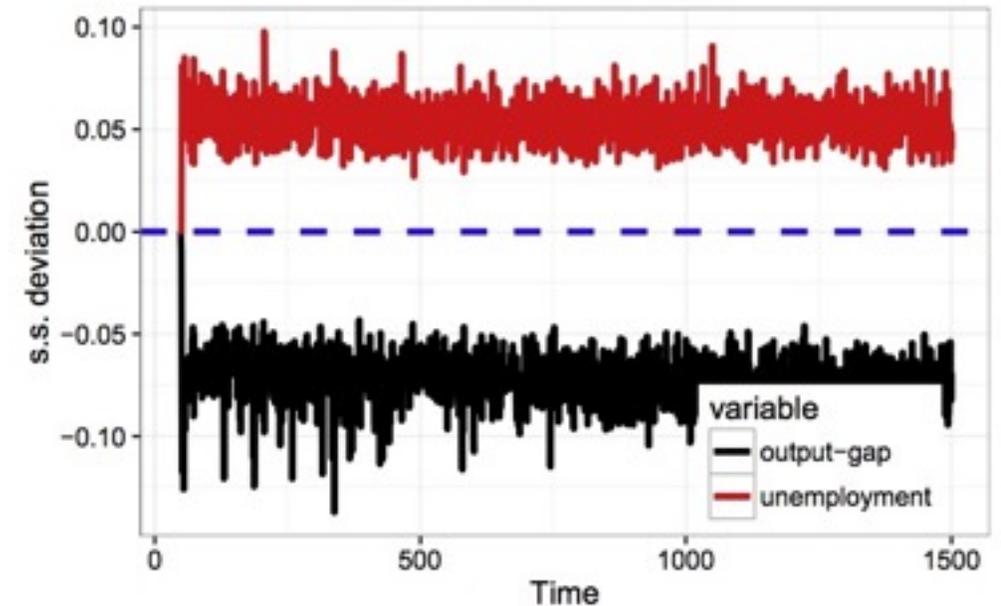
Consequences for macroeconomic analysis

3. Interaction structures, wage and price adjustments and full-employment

Centralized matching scenario



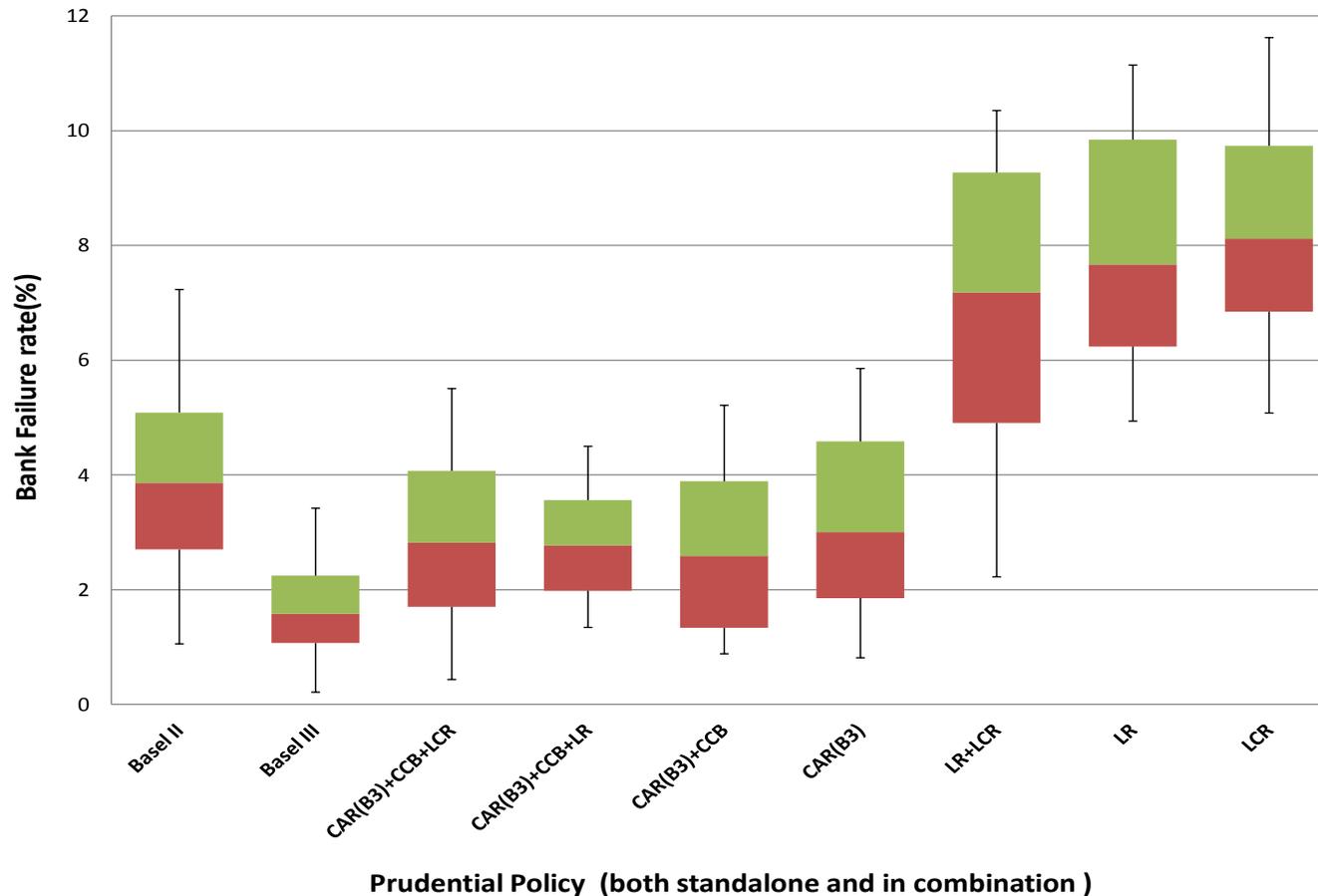
Decentralized matching scenario



- The type of interaction in the goods and labor markets determines whether wages and price adjustments promote the return to full employment or not (see Guerini, Roventini, Napoletano, 2017)

Consequences for macroeconomic analysis

4. Flexible tools for policy analysis



- Basel III has positive impact in a framework where banks' credit favors trade relationships and their recovery after a crisis (see Popoyan, Napoletano, Roventini, 2017)

Some critiques to agent-based models

1. The wilderness of bounded rationality and the ad-hoc critique
2. The issue of causality and the black-box critique
3. The Lucas critique
4. The lack of adequate validation with empirical data

Some References

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- Guerini, M., Napoletano, M., Roventini, A. (2018), No Man Is an Island : The Impact of Heterogeneity and Local Interactions on Macroeconomic Dynamics. *Economic Modelling* Volume 68, January, pp. 82-95.
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