

SYSTEMIC COLLAPSE

INSIGHTS FROM INTERACTING AGENT BASED MODELS

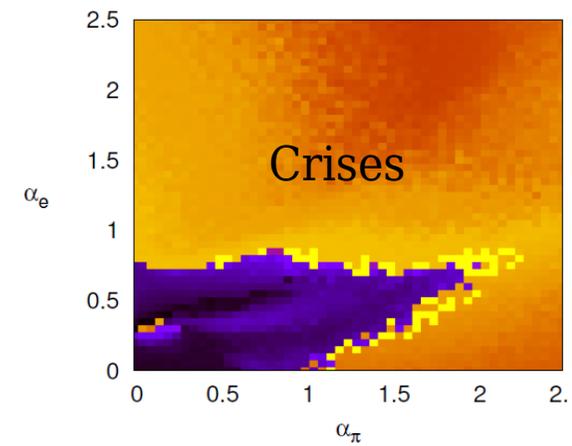
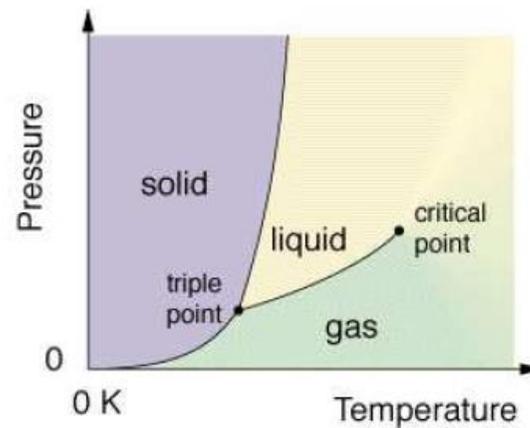
J.-Ph. Bouchaud (CFM/ENS)



Emergent behaviour

- The Economy is a complex system, with a large number of interacting units, of different kinds (firms, households) and (very) different sizes
- The main point in Economics is precisely about organization, cooperation and coordination of these different micro-units
- Such coordination can breakdown leading to systemic crises
- Treating all units as a unique representative firm/household throws the baby with the bathwater

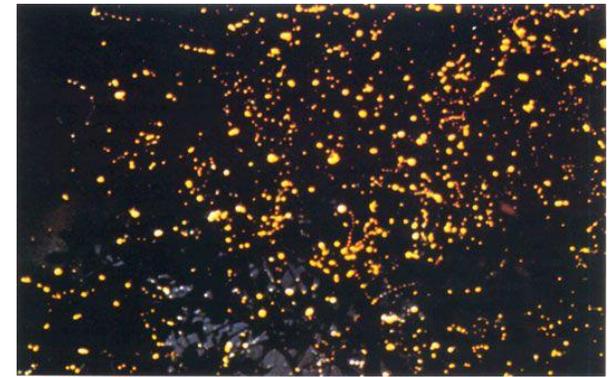
Radical Complexity



- Understanding these emergent properties is difficult: genuine *surprises* can appear when aggregating interacting micro-units
- Slightly different micro rules/micro parameters can lead to very different macro-states: this is the idea of “phase transitions”
- Sudden discontinuities (aka crises) can appear when a parameter is only slightly changed.
- Because of heterogeneities and non-linearities, these emerging surprises are hard, if not impossible to imagine or anticipate, even aided with the best mathematical apparatus. We need numerical simulations, aka “*telescopes for the mind*”

₃(M. Buchanan)

Experimenting *in silico*



Fireflies flashing in unison

- Agent Based Models allow experiments “in silico” leading to scenarios that would be nearly impossible to imagine
- (Think for example of the spontaneous synchronization of fireflies. It took nearly 70 years to come up with an explanation!)
- ABMs allow to train our minds to grasp these collective phenomena and to understand how they come about
- An intellectual exercise of genuine value: if we are not able to make sense of an emergent phenomenon within a world in which we set all the rules, how can we expect to be successful in the real world?

An ABM/DSGE Hybrid

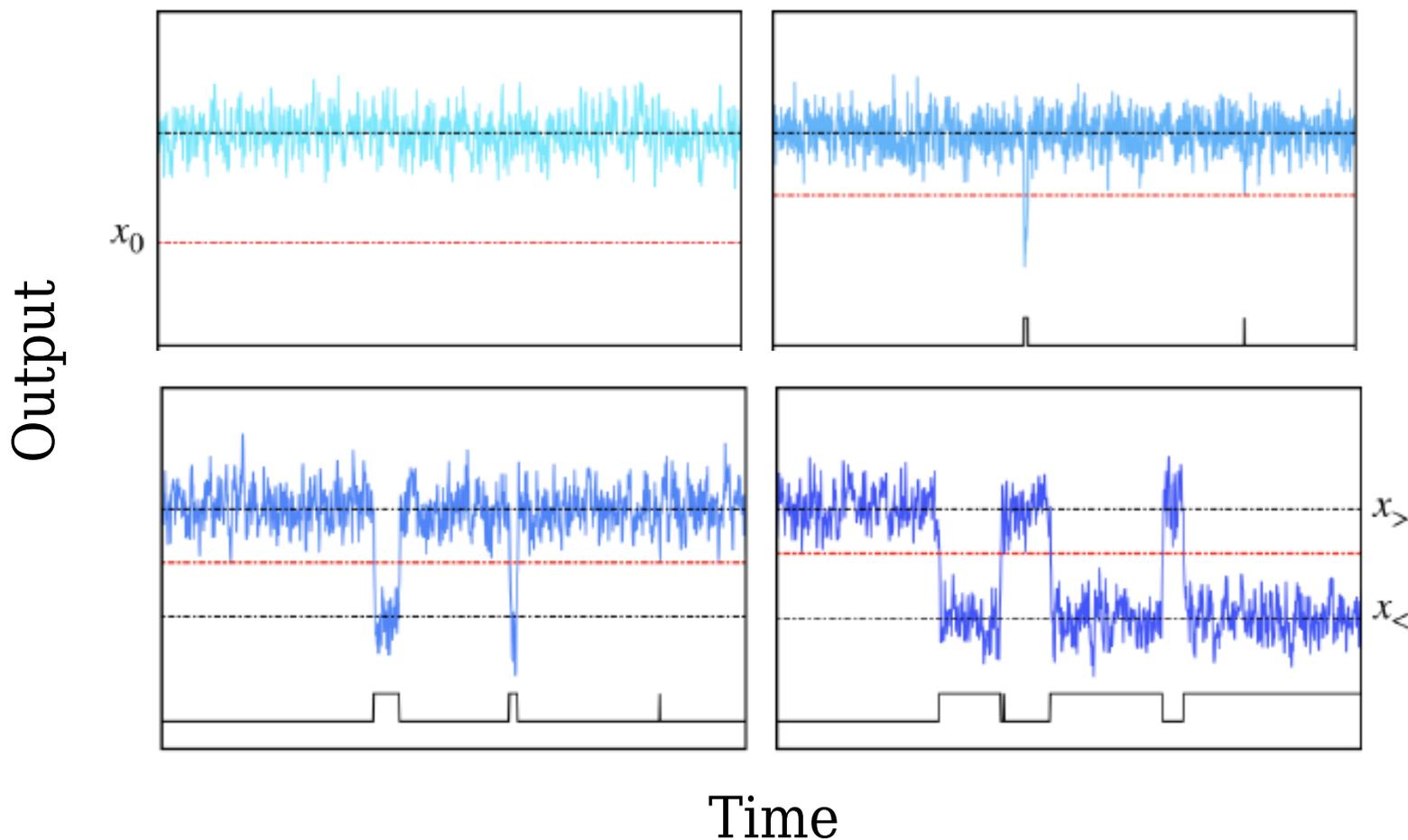
- However, ABM are still far from accepted in academic circles
- For all its shortcomings, DSGE is still the preferred framework, even by luminaries in the field*
- Can we somehow weld together the two approaches?
- An attempt: DSGE with heterogeneous agents, each with a consumption utility that depends on the average consumption level of others (herding)
- If others consume less, confidence is reduced and investment/consumption may collapse

*₅DSGEs make the right basic strategic choices and the current flaws can be addressed (Blanchard)

An ABM/DSGE Hybrid

(F. Morelli, M. Benzaquen, M. Tarzia, J.P. B.)

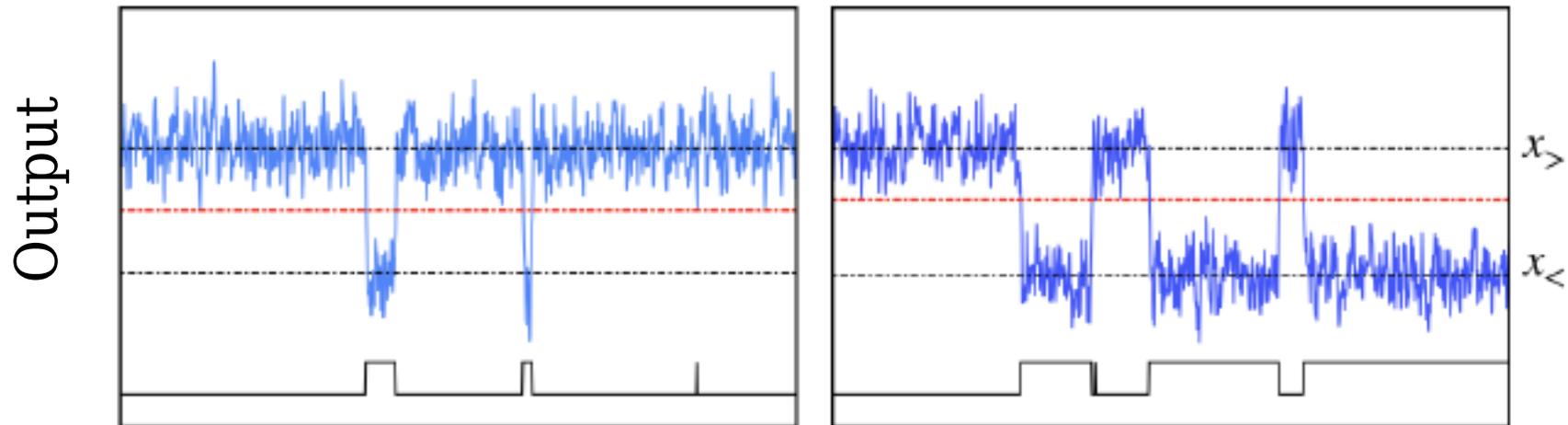
This confidence feedback loop can generate crises in such a DSGE framework!



An ABM/DSGE Hybrid

(F. Morelli, M. Benzaquen, M. Tarzia, J.P. B.)

- In the model, the probability of a crash is an « unknown known »
- The model suggests that confidence, and loss thereof, can be a driving force for crises and that narratives can play an important role (Bernanke - Tooze - Shiller)



- Interactions can lead to collective instabilities → « endogenous volatility », « small shocks, large business cycles » and unexpected crises, often disproportionate with real causes