Confidence Collapse in Macroeconomic Systems

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CNRS, Ecole polytechnique, Capital Fund Management

Integrative Economics - NAEC OECD

5-6 March 2020

Macroeconomic models

2 families of models

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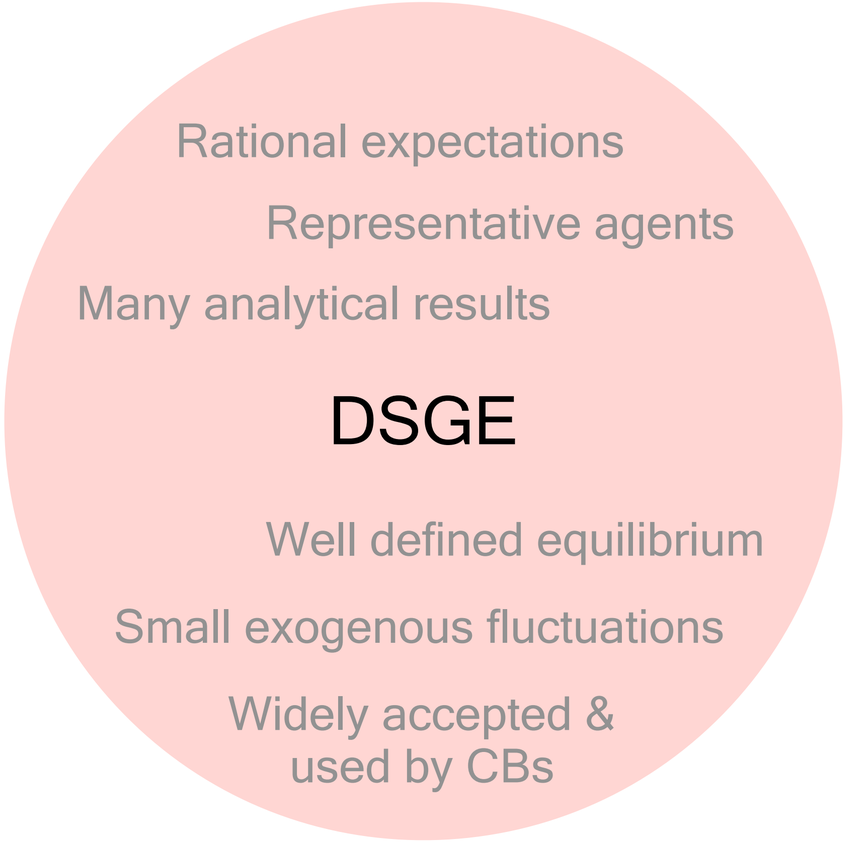
- Dynamic Stochastic General Equilibrium (DSGE)



Macroeconomic models

2 families of models

- Dynamic Stochastic General Equilibrium (DSGE)
- Agent Based Models (ABM)

Rational expectations

Representative agents

Many analytical results

DSGE

Well defined equilibrium

Small exogenous fluctuations

Widely accepted &
used by CBs

Zero-intelligence

Large heterogenous populations

Numerical simulations

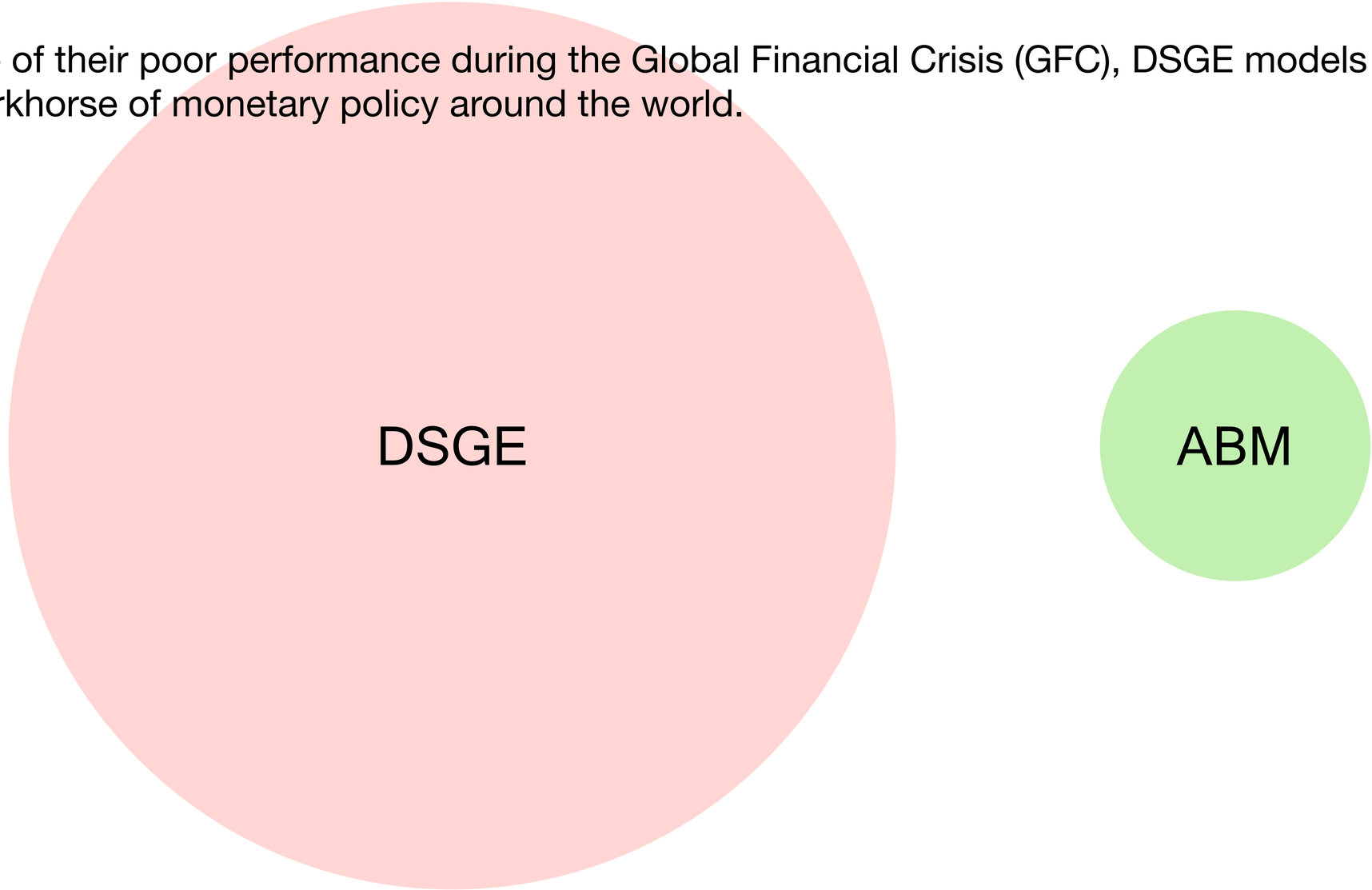
ABM

Out of equilibrium dynamics

Endogenous dynamics/chocs

Not taken seriously

In spite of their poor performance during the Global Financial Crisis (GFC), DSGE models still constitute the workhorse of monetary policy around the world.



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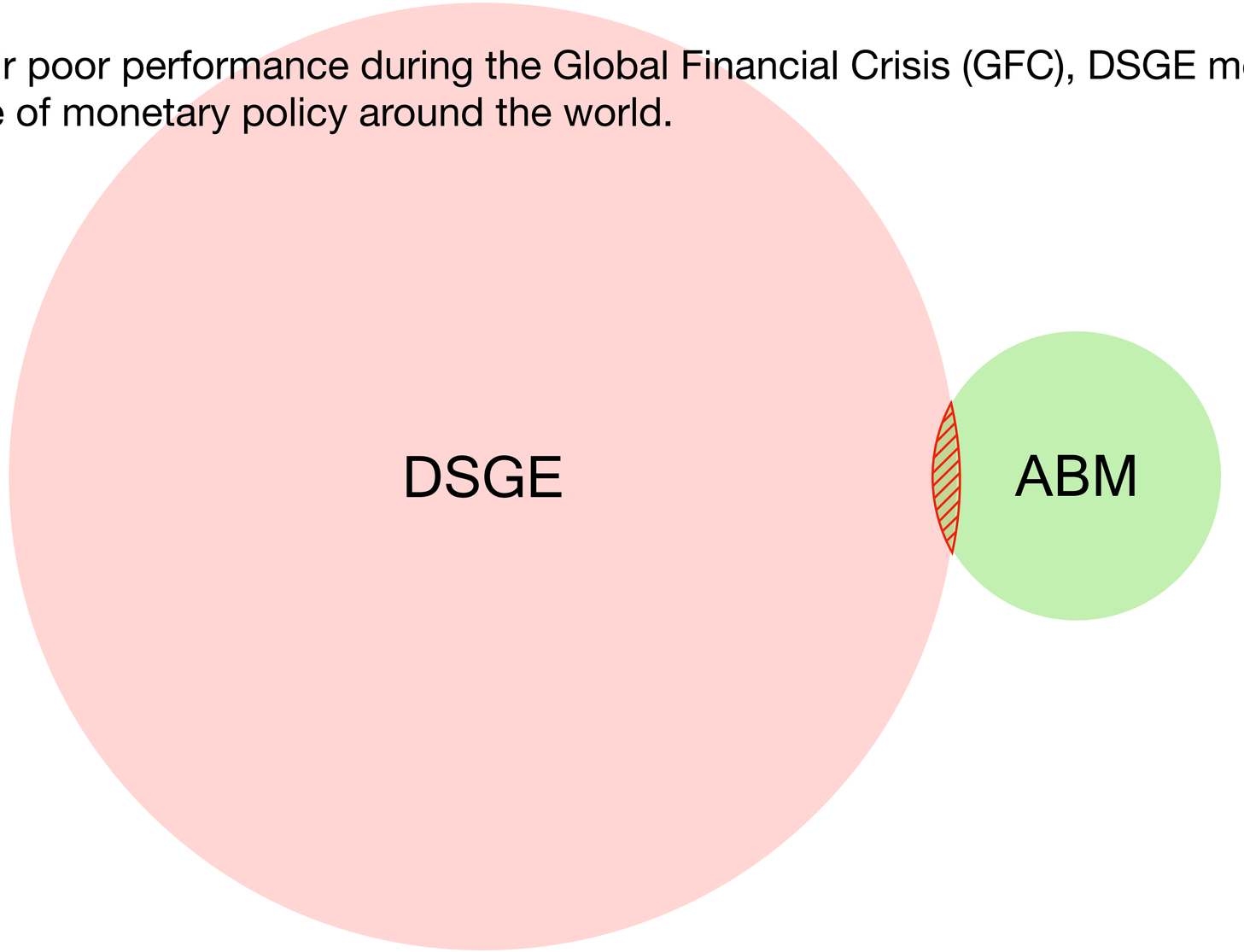


The DSGE Framework

Chocs on productivity

Firm

Max Profits

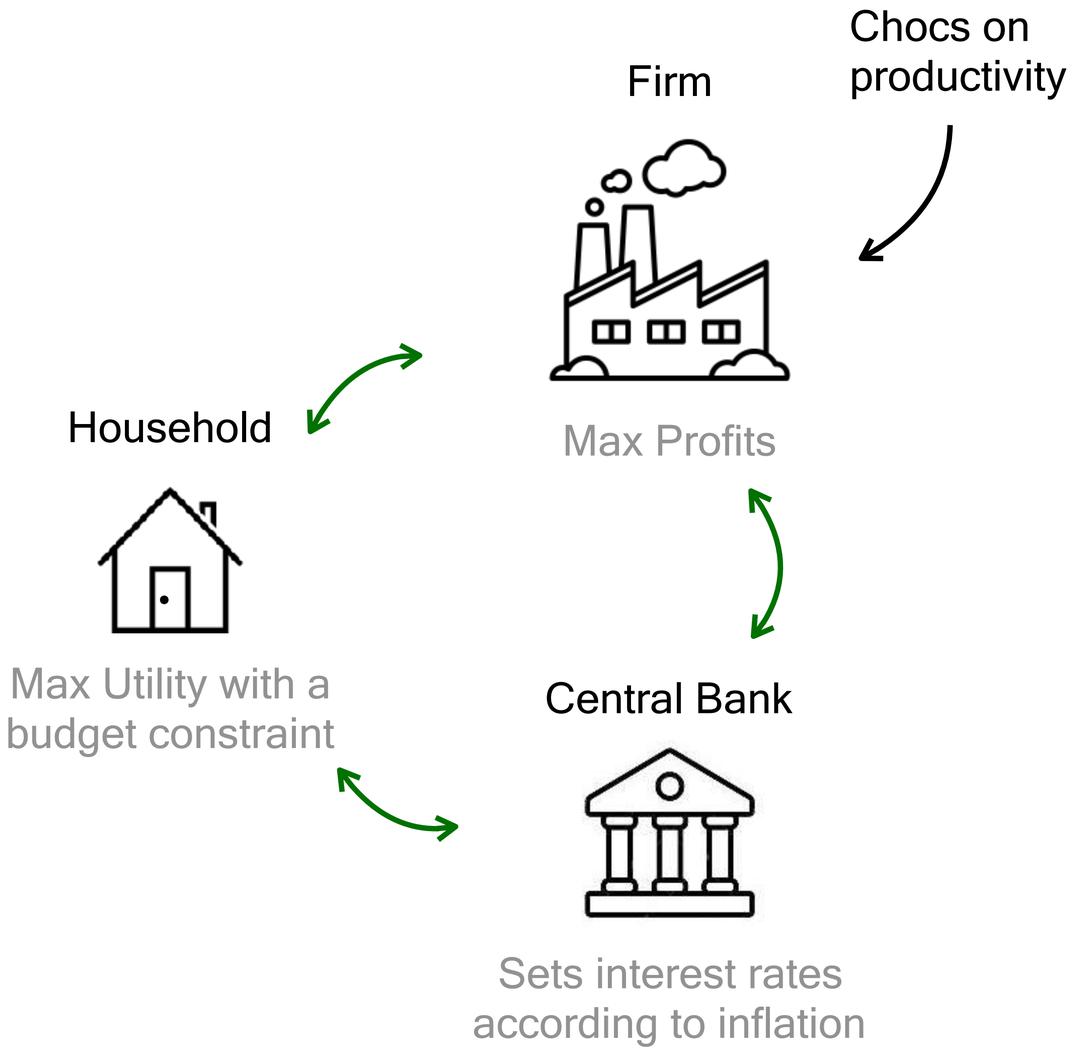
Household

Max Utility with a budget constraint

Central Bank

Sets interest rates according to inflation

The DSGE Framework



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- consumption
- production
- working hours
- wages
- inflation
- interest rates

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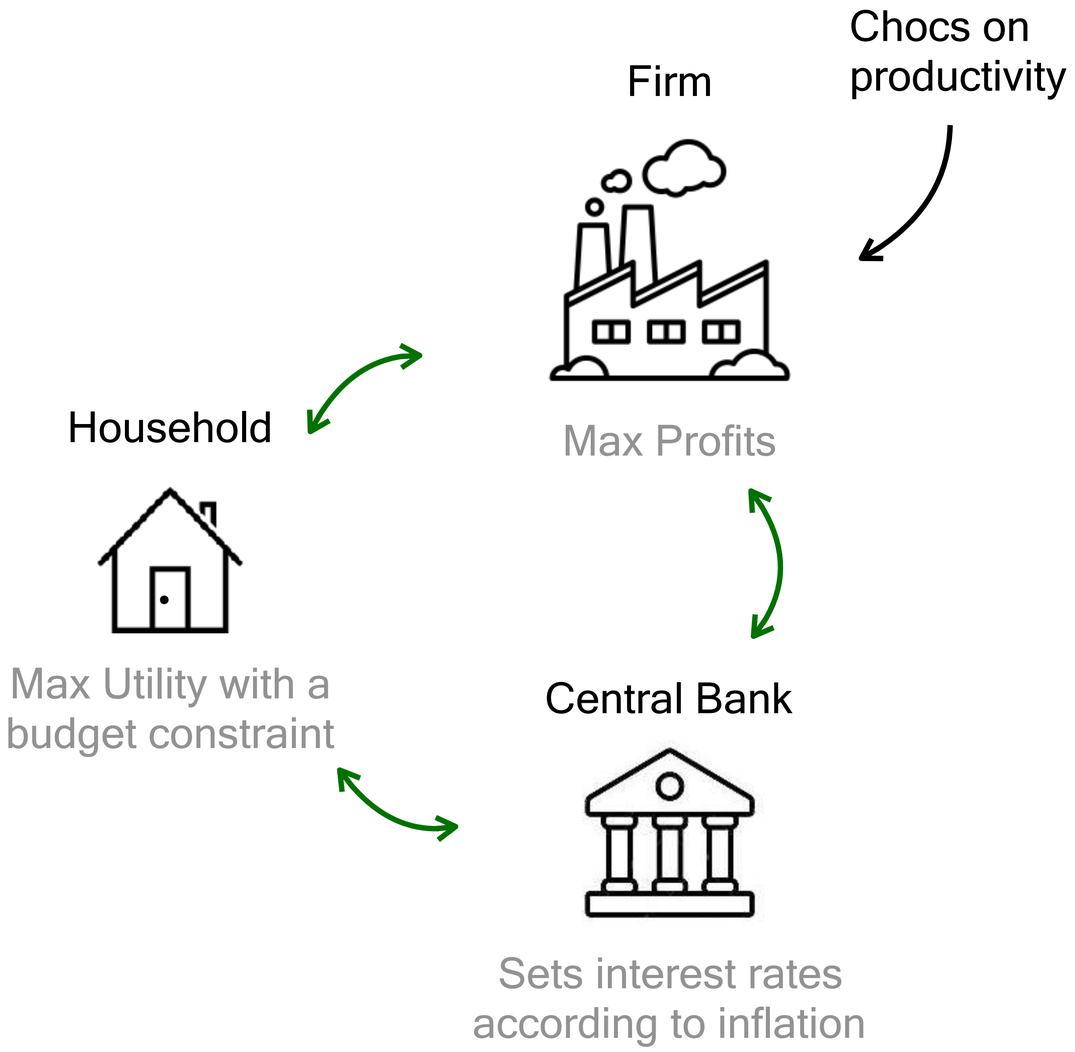

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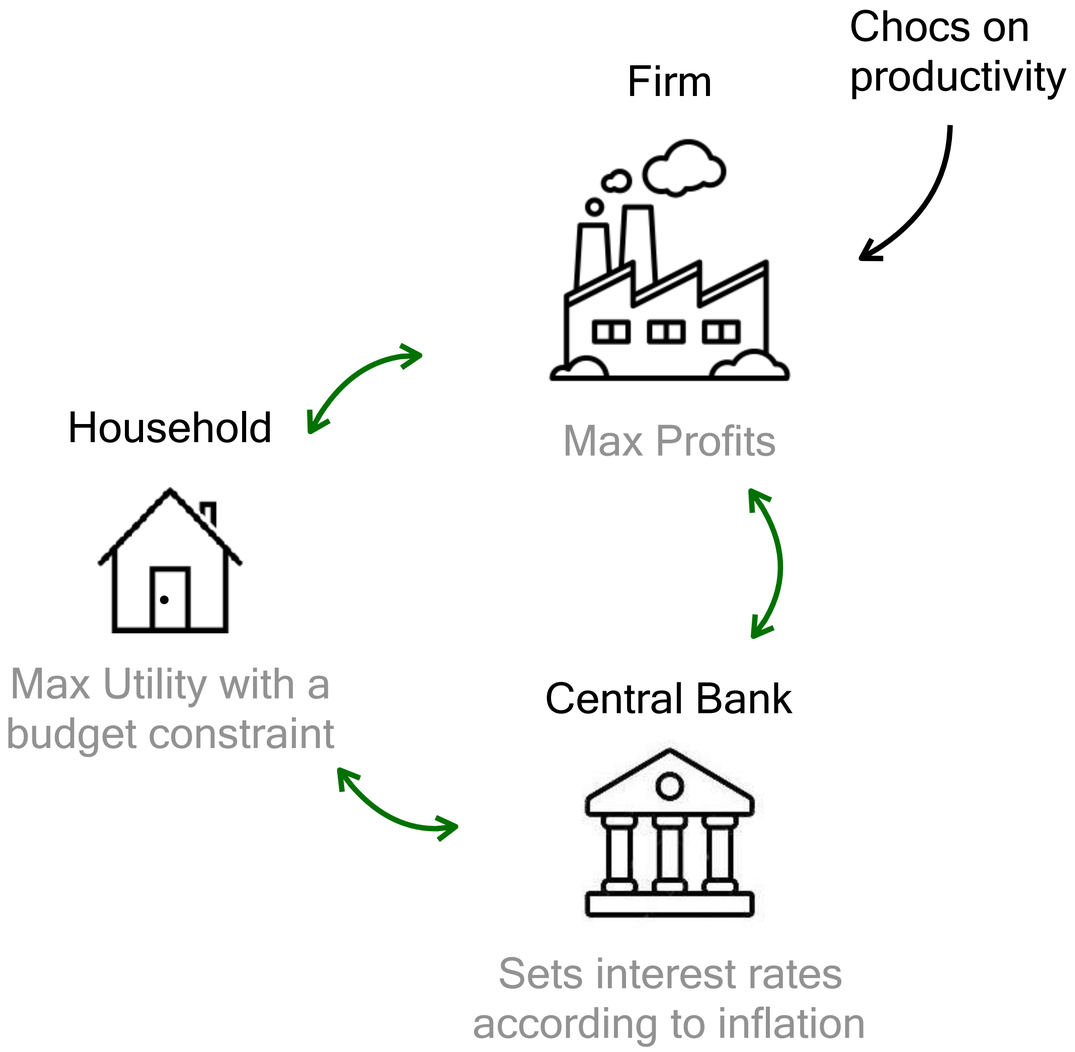

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with the assumption that Markets will clear
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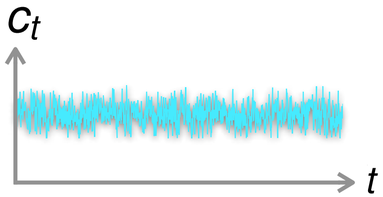
= an (quite unrealistic) analytically solvable world,

exogenous (gaussian) fluctuations around a well defined equilibrium



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- In one time step, simultaneously…

  The household maximises its utility, knowing the firm’s strategy,

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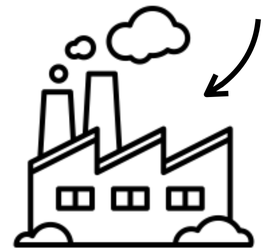
Shocks on productivity



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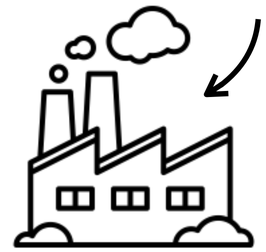

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↖ you are throwing the baby out with the bath water (no crises by construction)…

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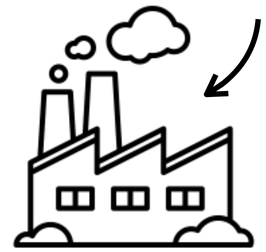

DSGE models are (…) over-simplified, they have to become less imperialistic and accept to share the scene with other approaches to modelisation.

O. Blanchard

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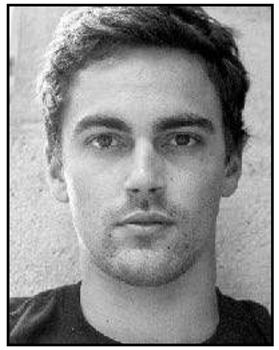

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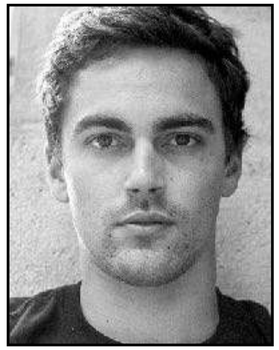

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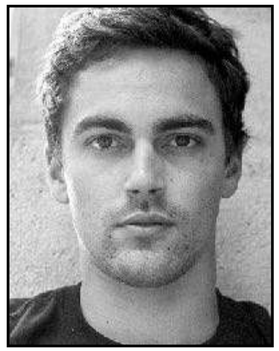

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→ Multi-household DSGE with feedback of past aggregate consumption on the sentiment of individual households.

Morelli et al (2019), ArXiv:1907.07425

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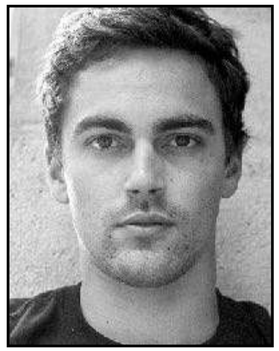

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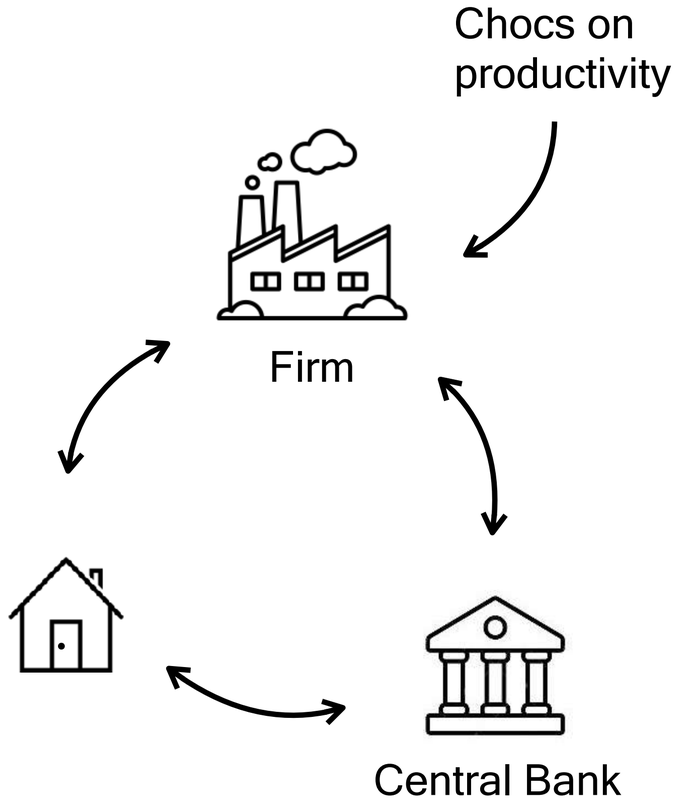

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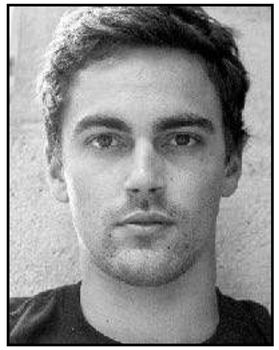

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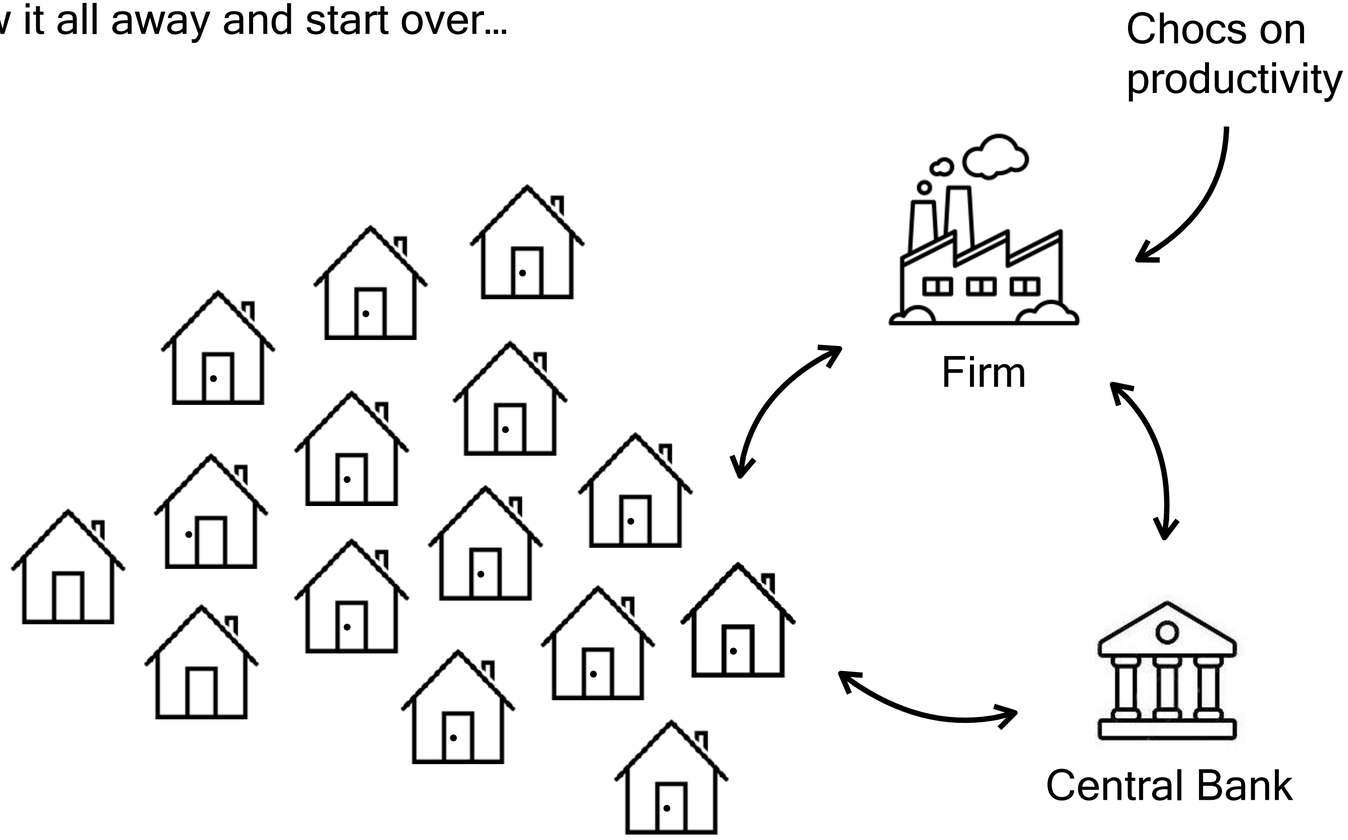

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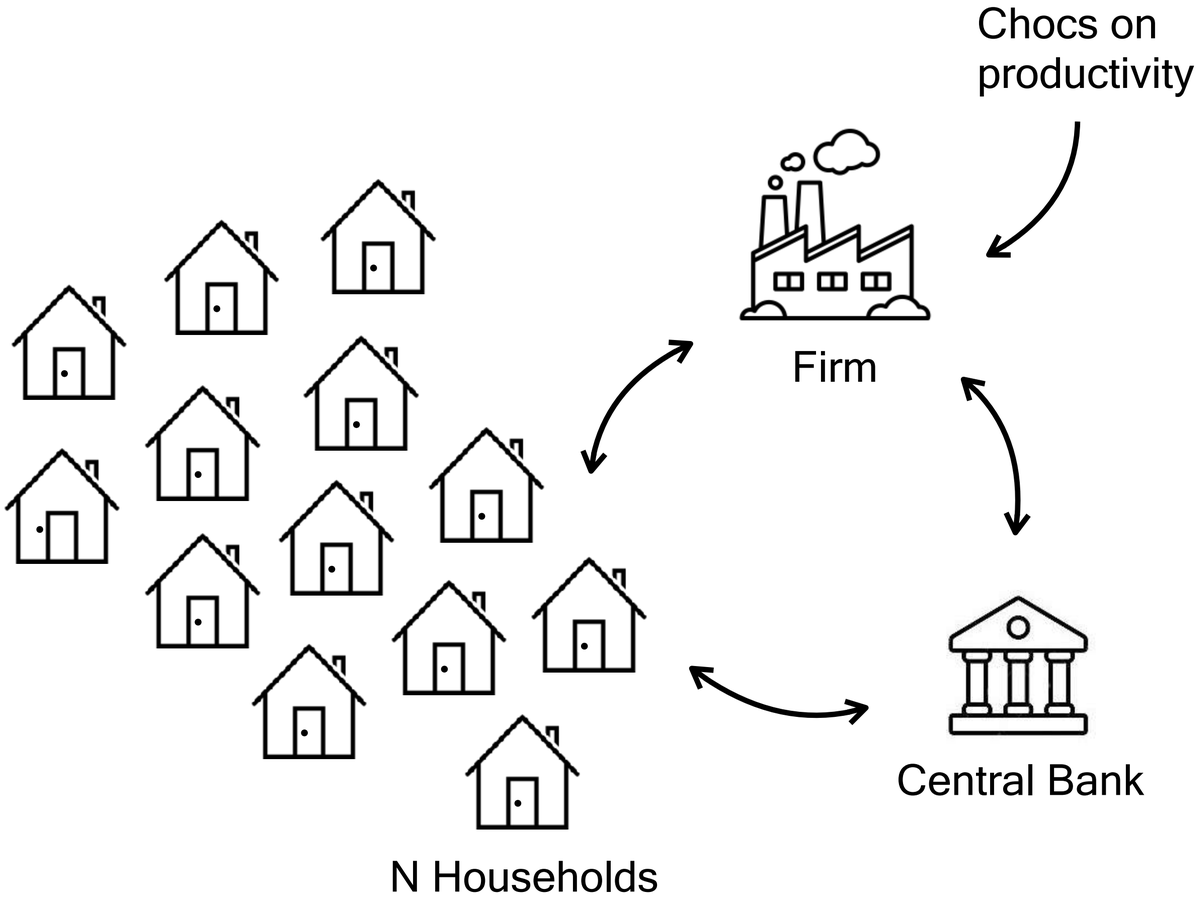
Utility of Household *i*

consumption

$$U_t^i = \log(c_t^i) - \frac{\gamma}{2}(n_t^i)^2$$

labour



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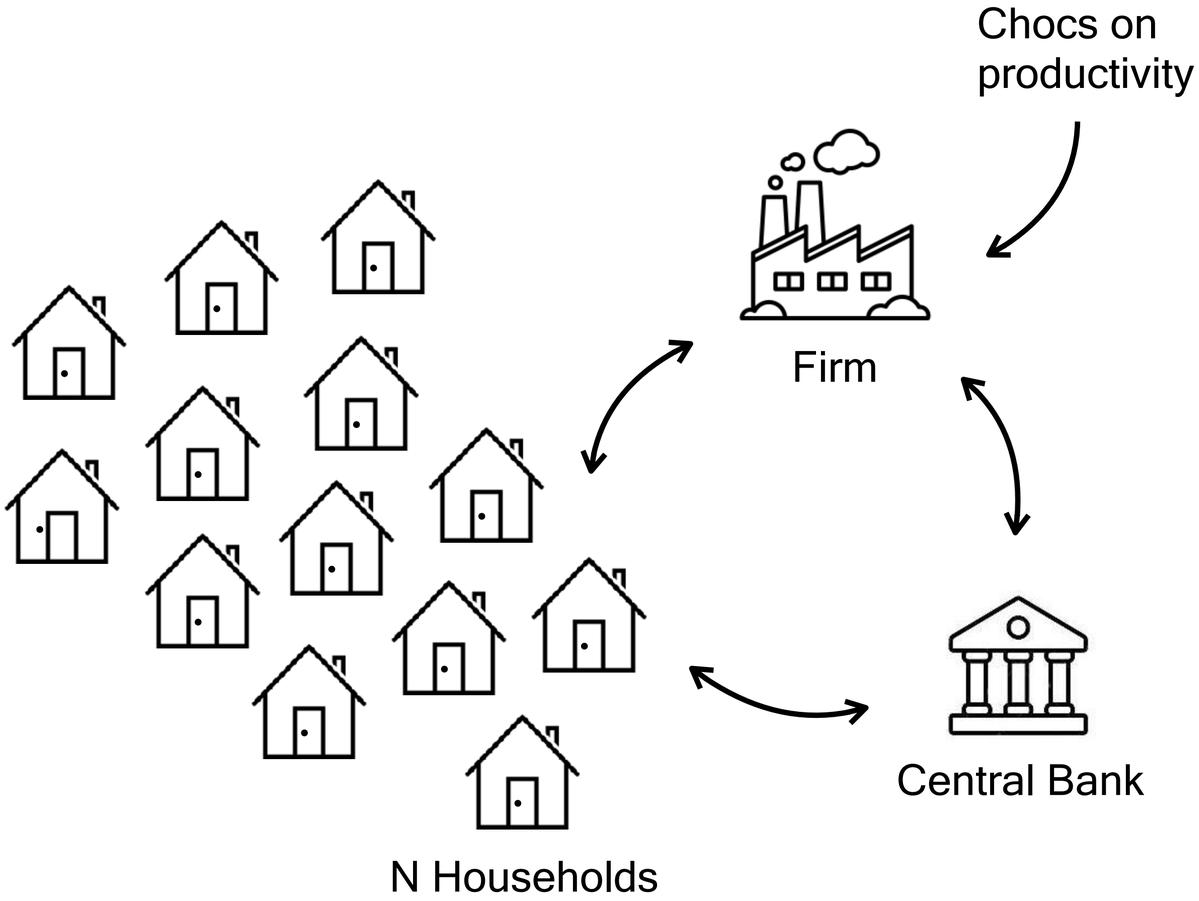

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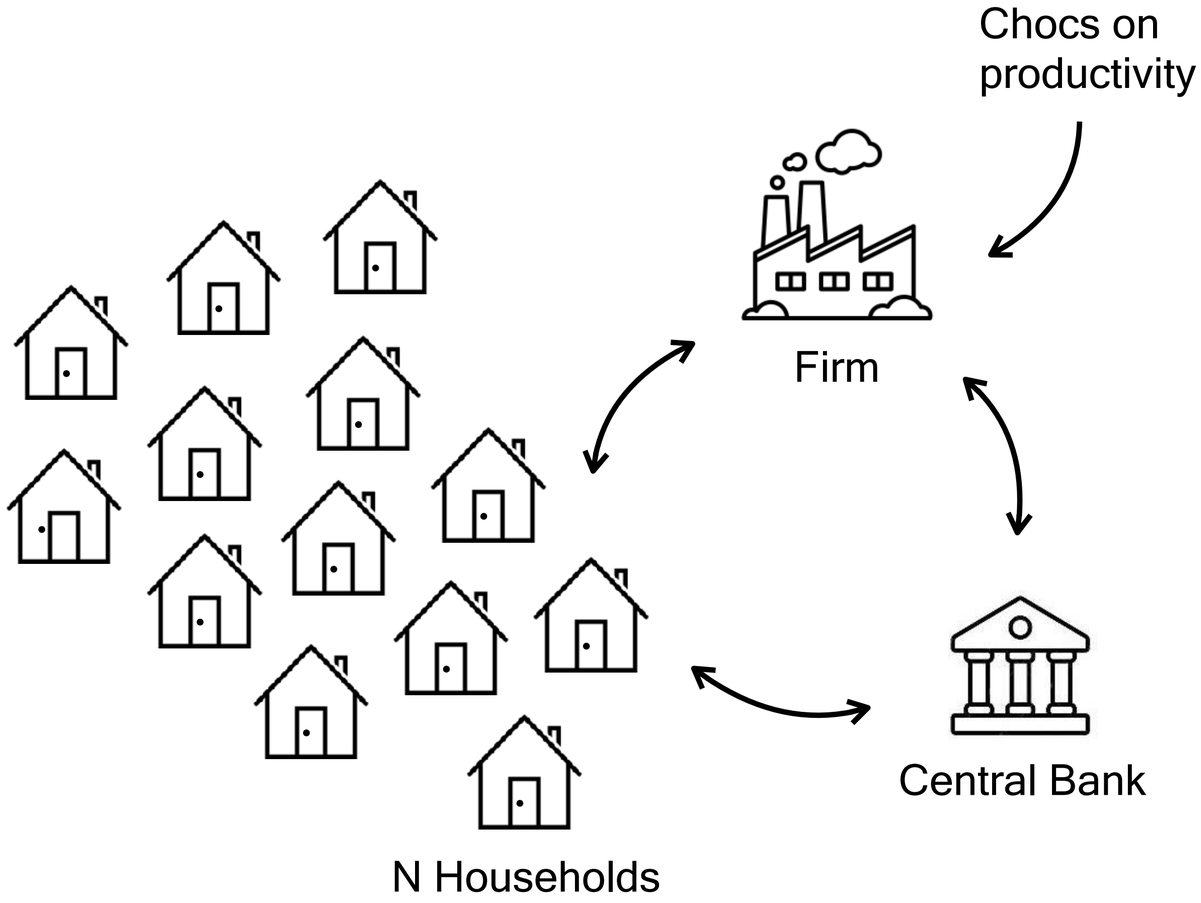

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increasing function

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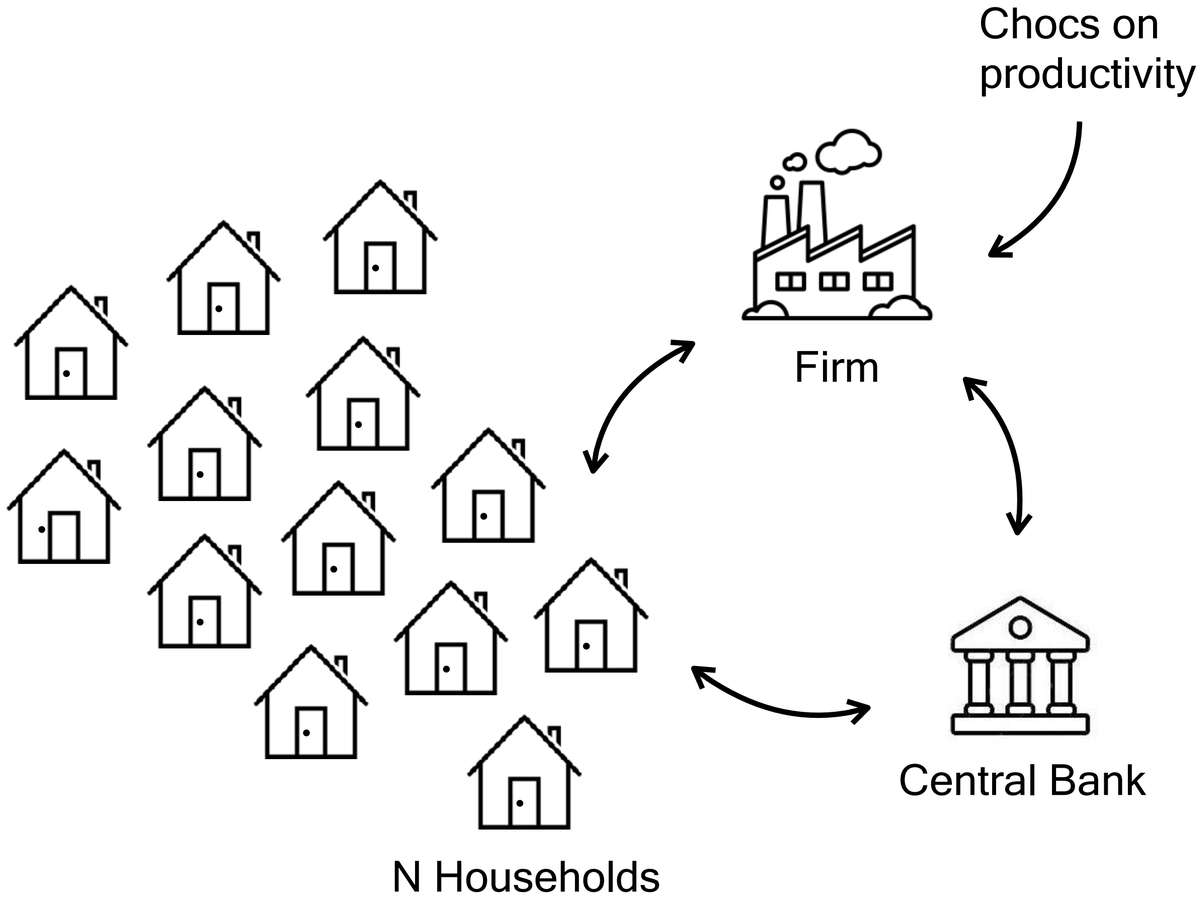
labour

influence of the past consumption of j on the confidence level of i



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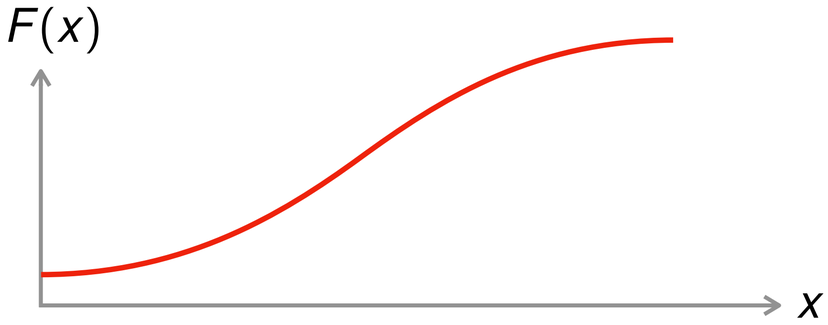

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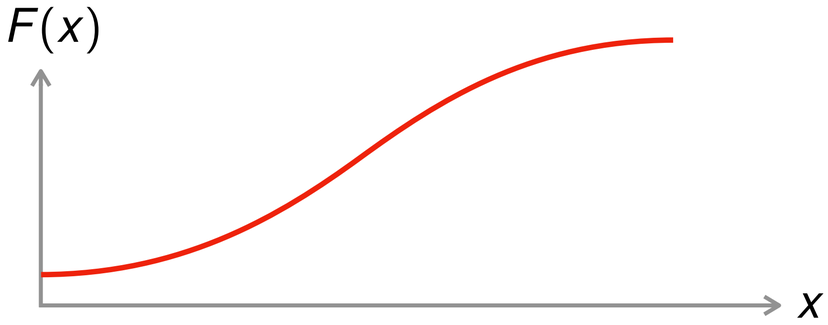

The sentiment of households at time t is a function of the past realised consumption of others, “animal spirits”.

If household i sees that other households have reduced their consumption, it interprets it as a sign that the economy may be degrading, which reduces its consumption propensity (and increases its precautionary savings).

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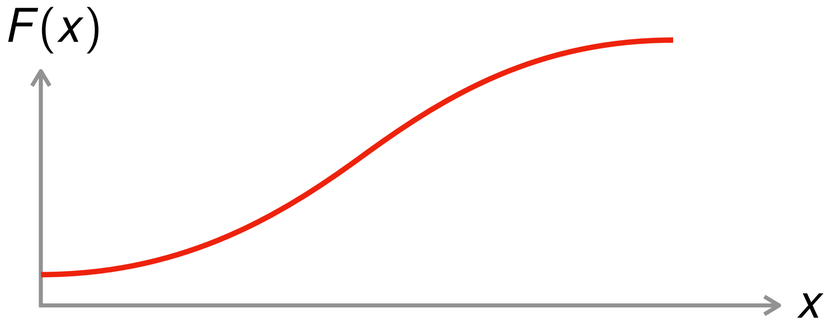

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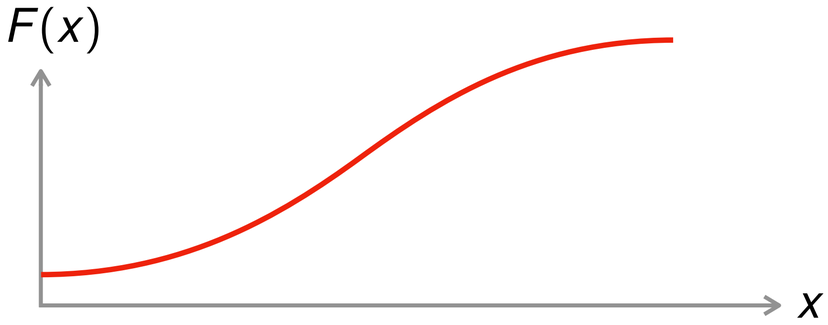

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Only the aggregate consumption matters, we neglect local network effects: $c_t^i = c_t \ \forall i$

Can we do anything?

A little bit of math, and you are left with a nice discrete time evolution equation for the consumption level:

$$c_t = e^{\xi_t} G(c_{t-1})$$

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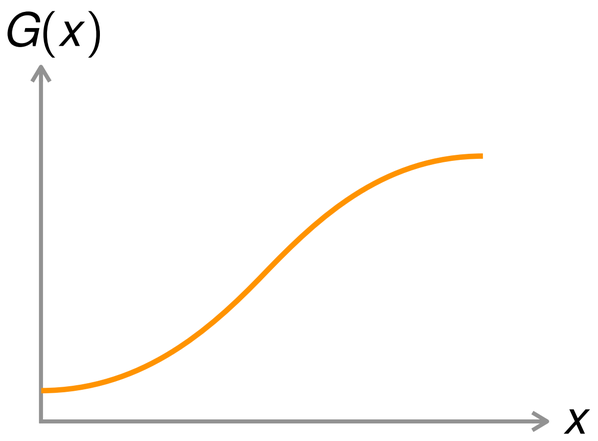

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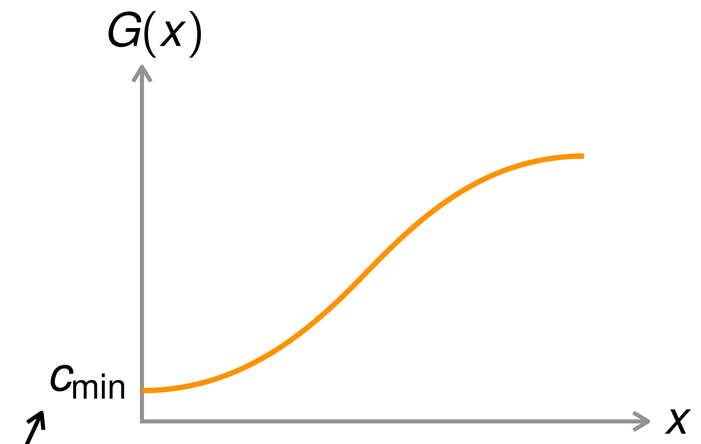

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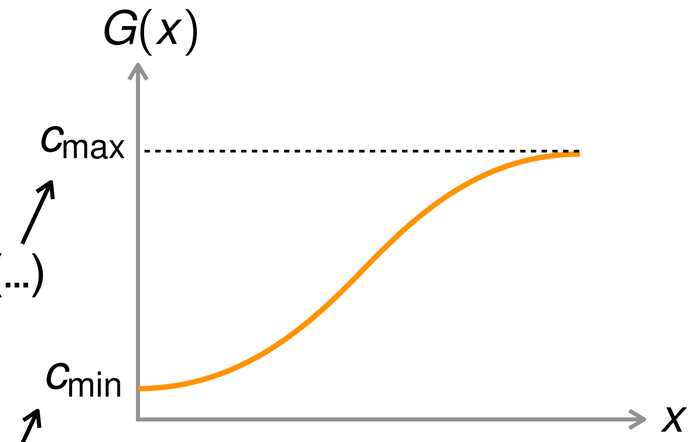

maximum level of goods (...)

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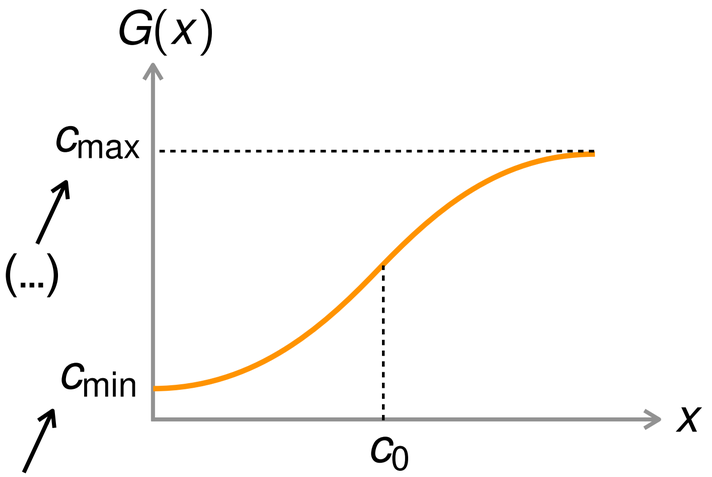

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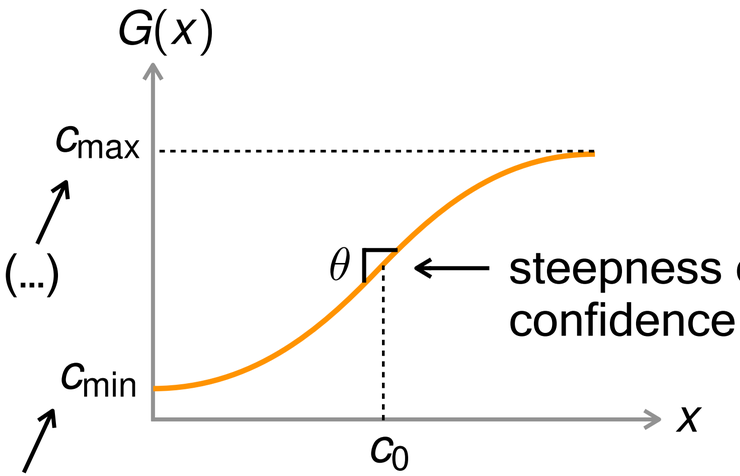

maximum level of goods (...)

steepness of the transition from low to high confidence (population heterogeneity)

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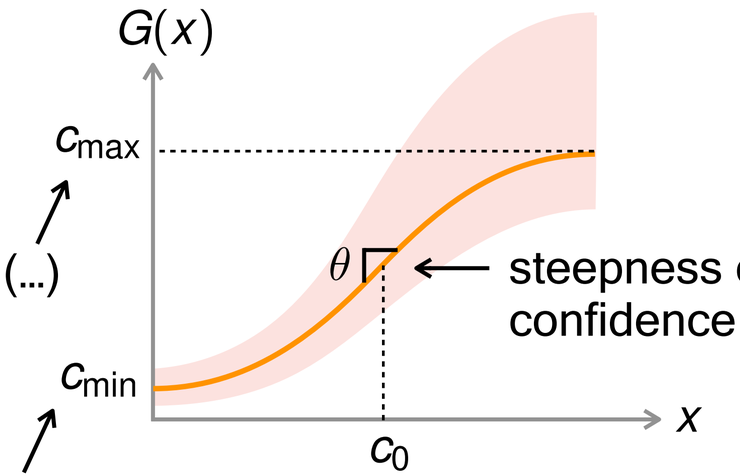


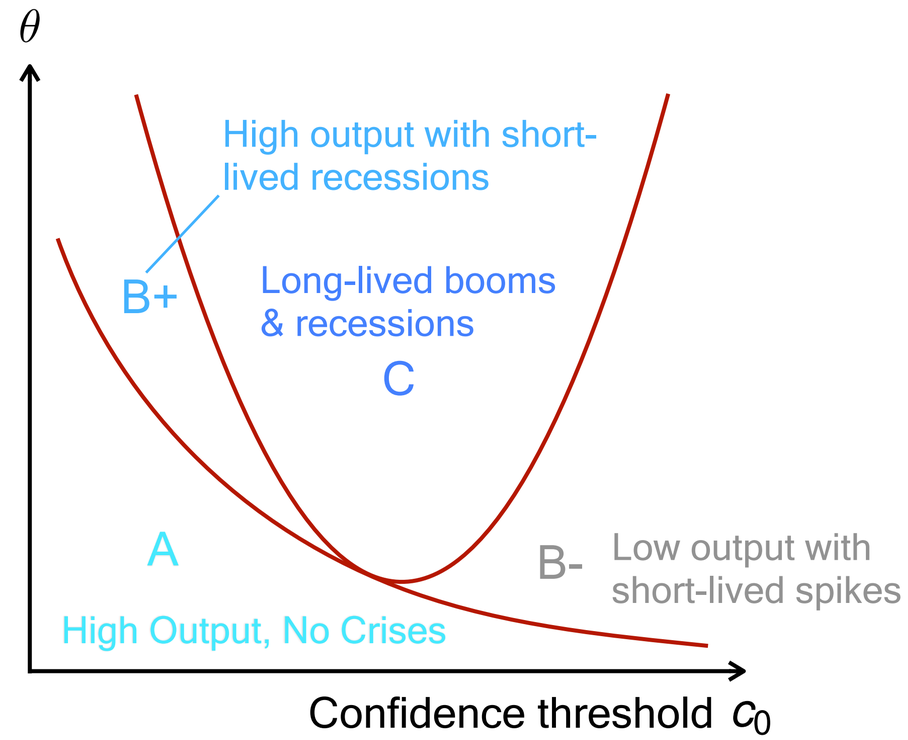
maximum level of goods (...)

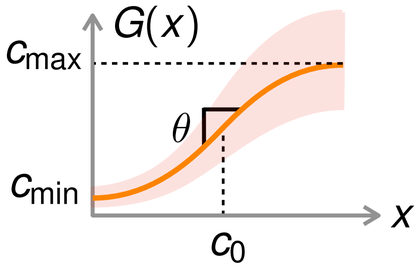
steepness of the transition from low to high confidence (population heterogeneity)

minimum level of goods that households will ever consume with average productivity ($\xi_t = 0$)

confidence threshold (the concavity of G changes, $c > c_0$ tends to favour a high confidence state and $c < c_0$ a low confidence state.

Phase diagram





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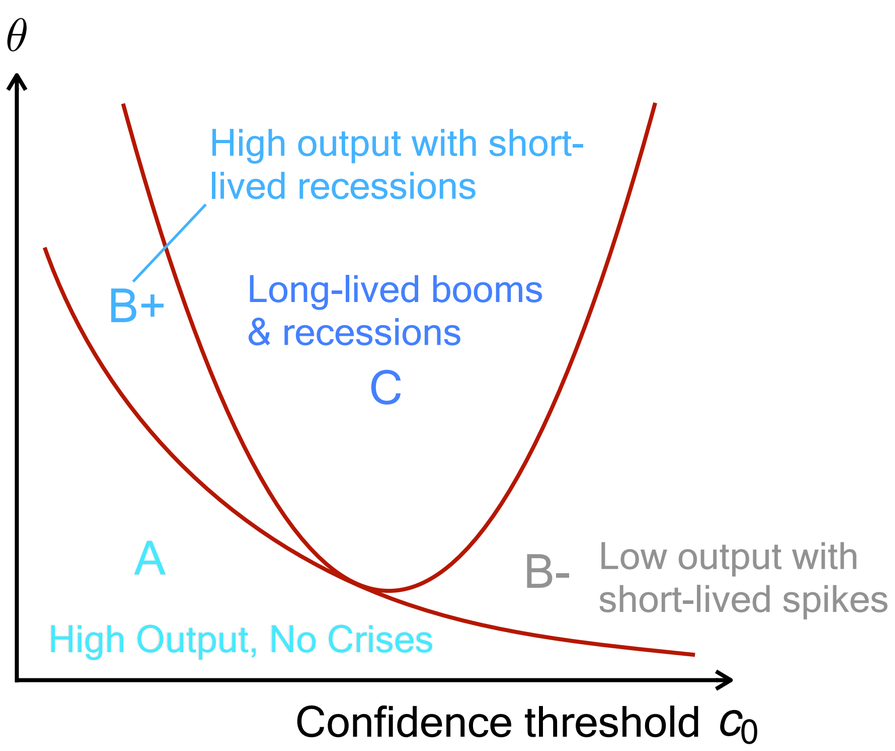

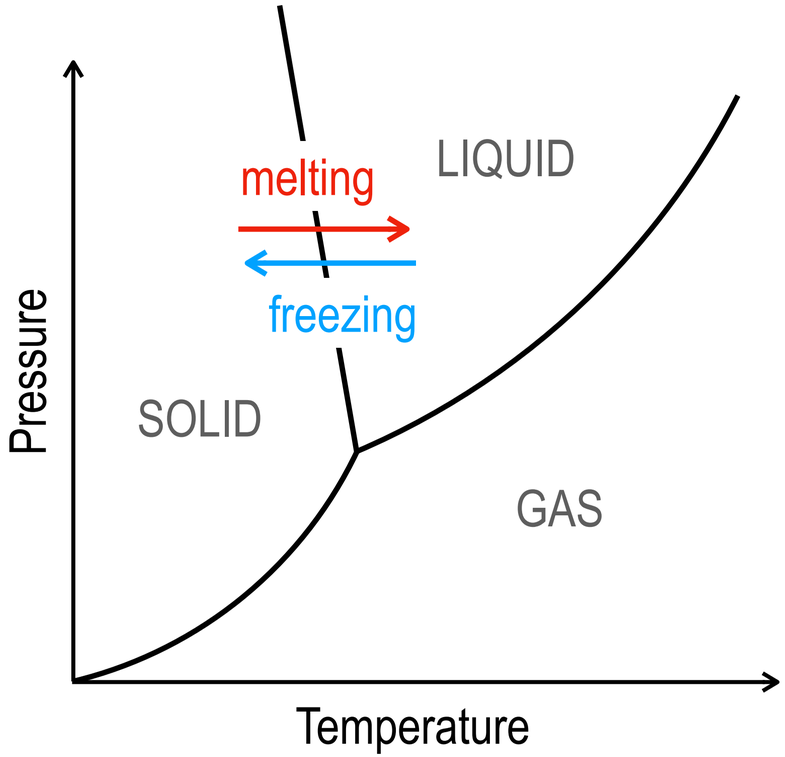

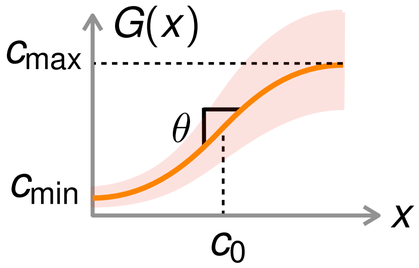

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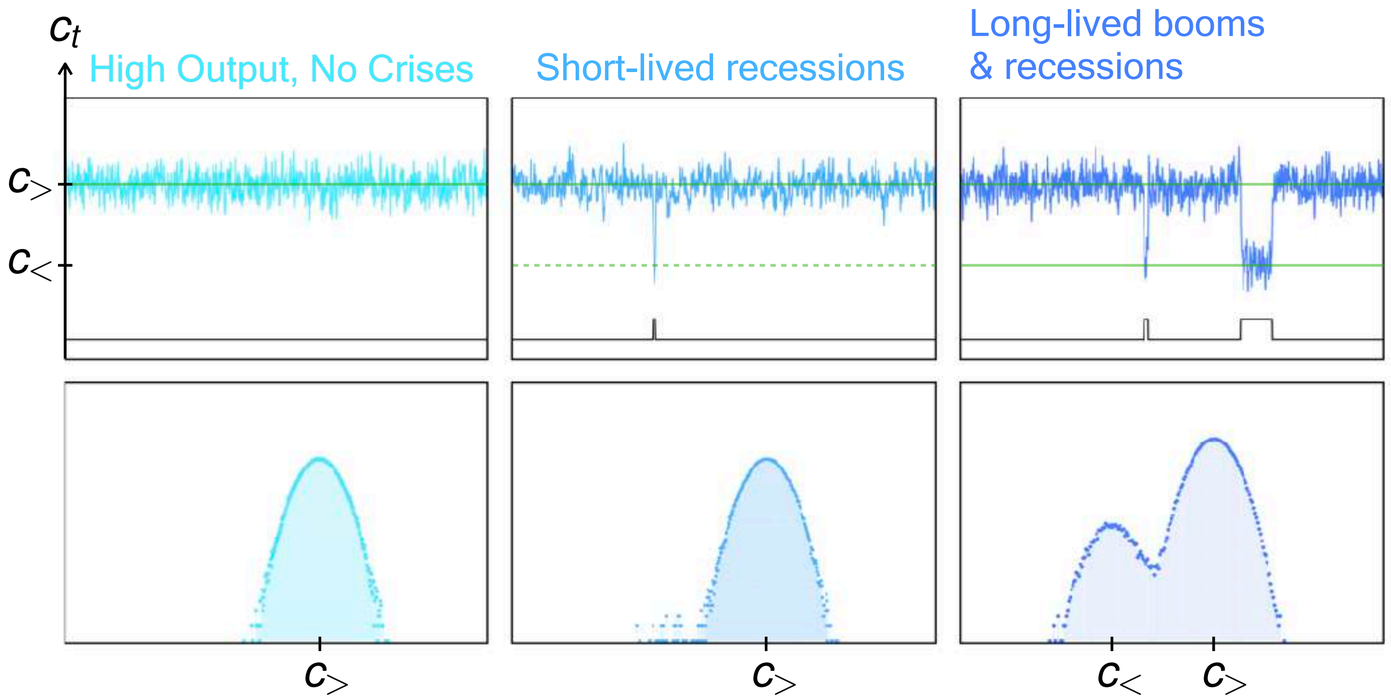

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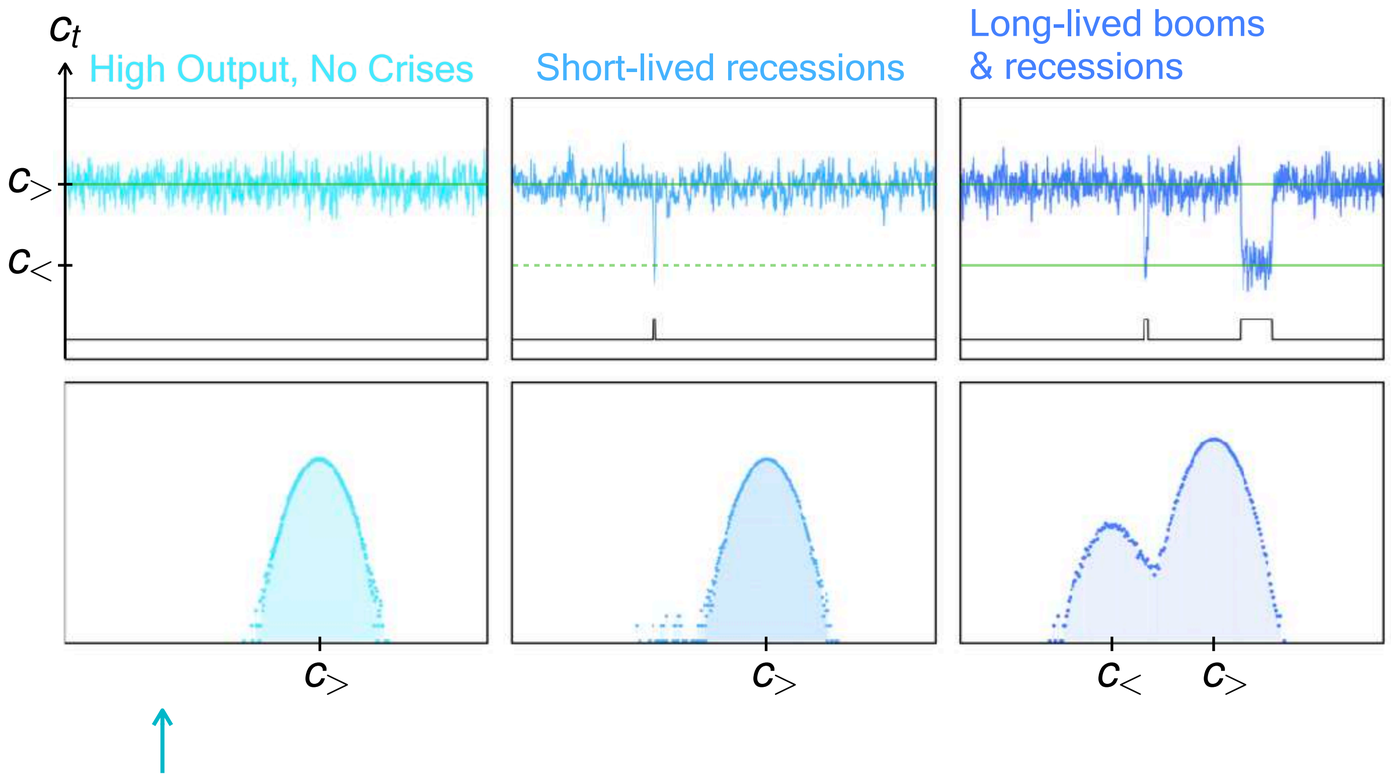
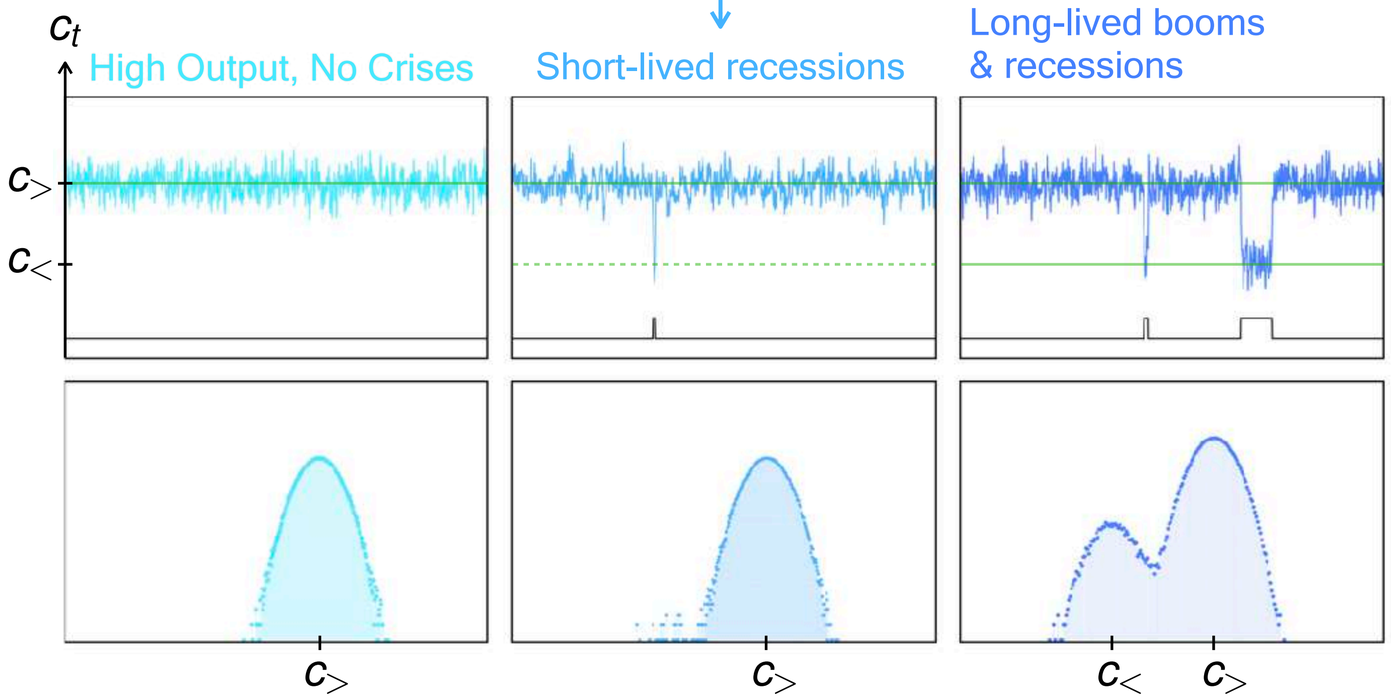


DSGE phenomenology

The feedback mechanism leads
to excess volatility

Phase diagram

A relatively mild drop of productivity can trigger large fluctuations of output (amplified by the self-referential “panic” effect).



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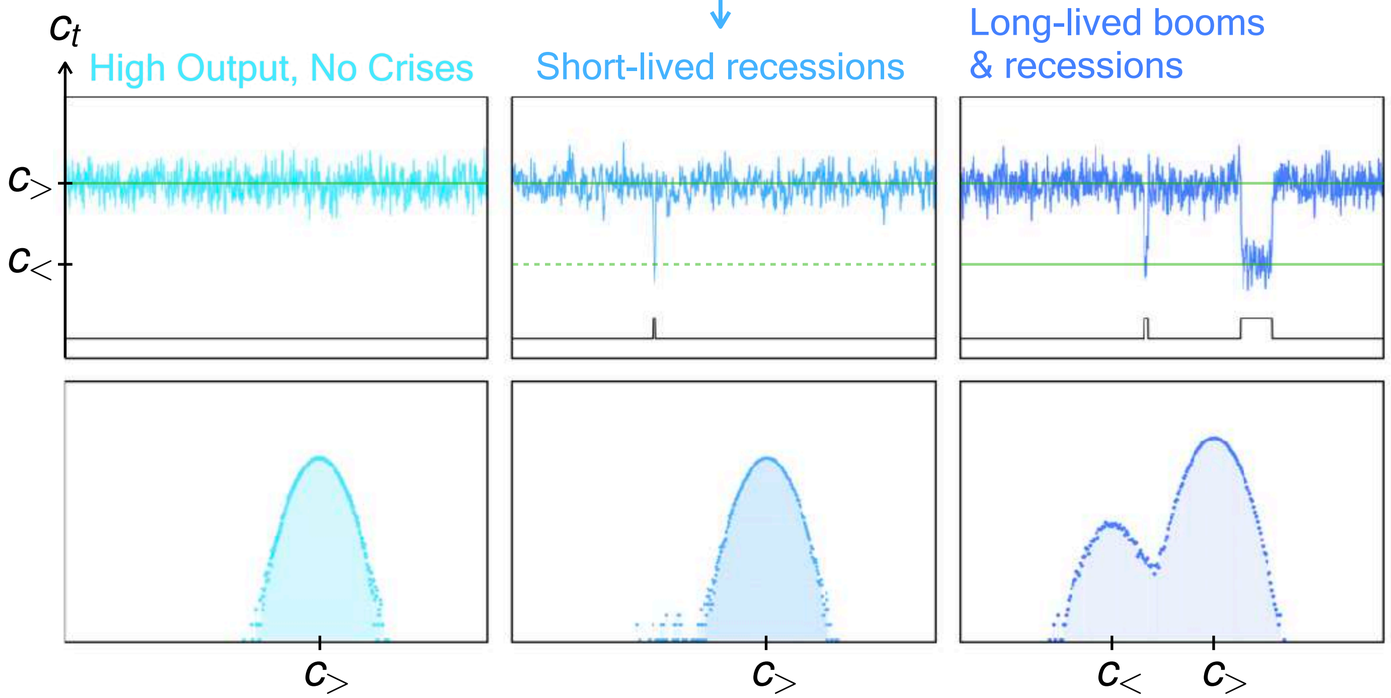


DSGE phenomenology

The feedback mechanism leads to excess volatility

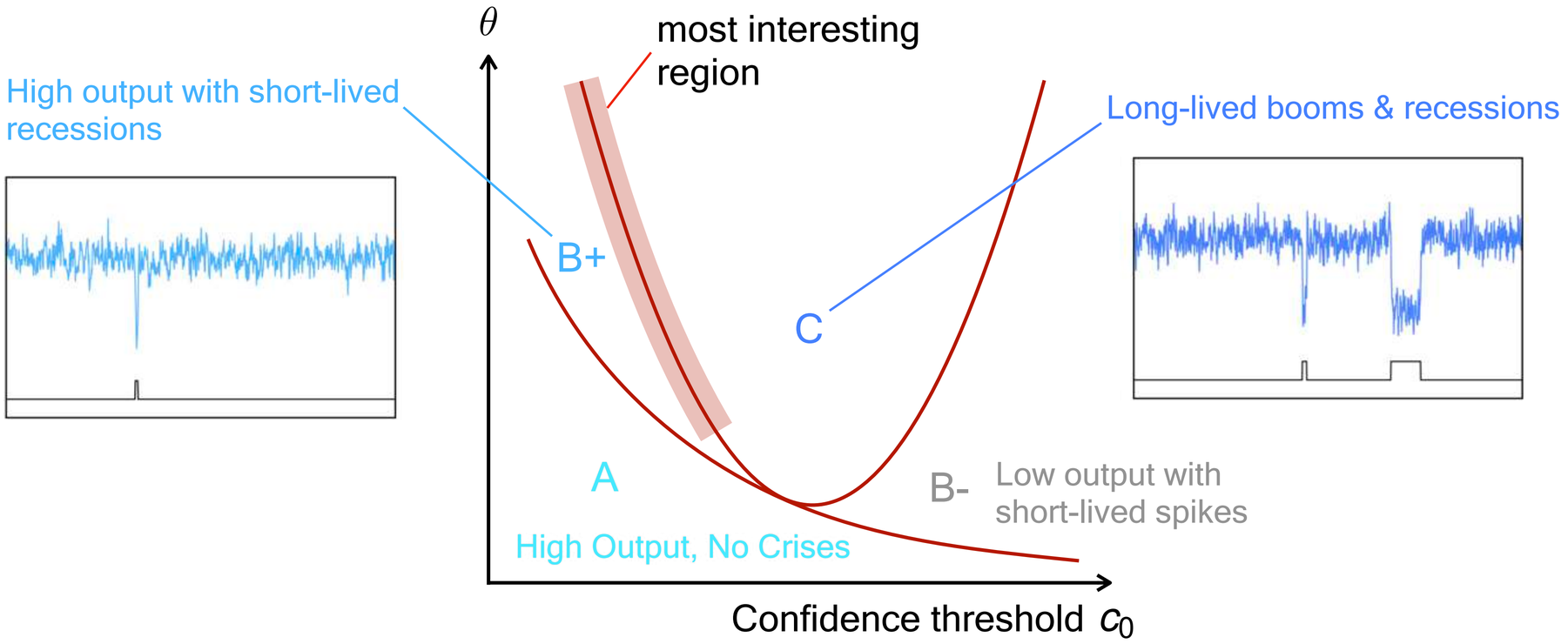
Two stable solutions. Any, however small, amount of productivity fluctuations can to induce transitions.

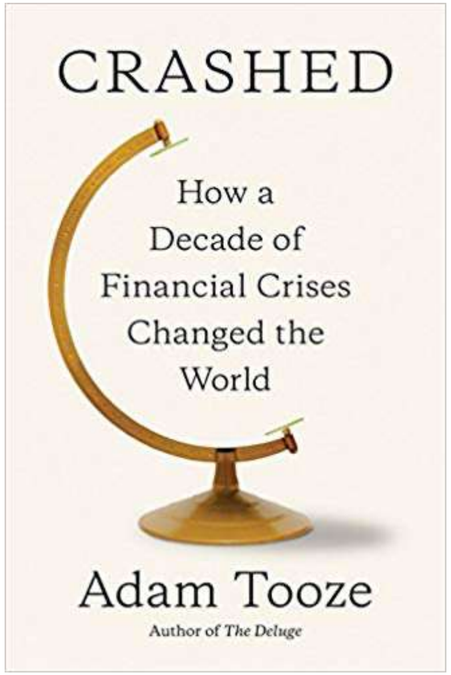
The economy can remain for a very long time in a high output state, until a self-fulfilling panic mechanism throws it in a crisis state where output is low.

Phase diagram

Although quite parsimonious, the model is rich enough to generate a variety of realistic dynamical behaviour, including short-lived downturns and more prolonged recessions

The 2008 GFC could correspond to a confidence collapse modelled by a sudden $c_> \to c_<$ transition





The time needed for such transitions to take place is however exponentially long

$$T \sim e^{W/\sigma^2}$$

W: activation barrier

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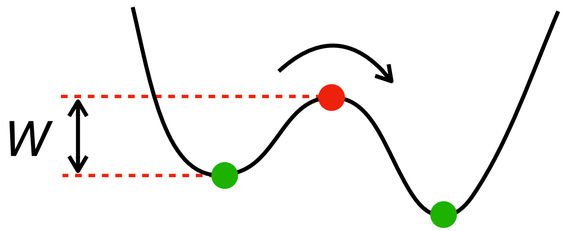
activation barrier

similar to Kramer's problem



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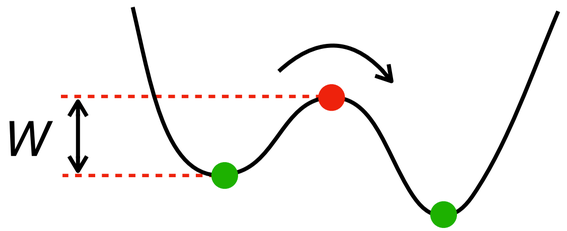

Clearly, any small uncertainty about the parameters of the model (i.e. c_0, $c_{\min}$, $c_{\max}$, θ) or for that matter the precise specification of the function $G(c)$, or any other feature neglected in the model, will affect the precise value of W.

The crisis probability is exponentially sensitive to the estimation error of the parameters of the model.

Unknown knowns

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Precisely as the famous butterfly effect (the exponential sensitivity on initial conditions) forbids any deterministic description of chaotic systems, the exponential dependence of the crisis rate means that this rate is, for all practical purposes, unknowable.

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⟶ “Unknown knowns” What may happen is known, but its probability is impossible to quantify.

De facto impossibility to price extreme risks

The model is usually closed by assuming a Taylor rule for the interest rate: $r_t = \Phi \pi_t - \log \beta$

inflation

fixes the amplitude of the response of the Central Bank to inflation

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Monetary policy and Narratives

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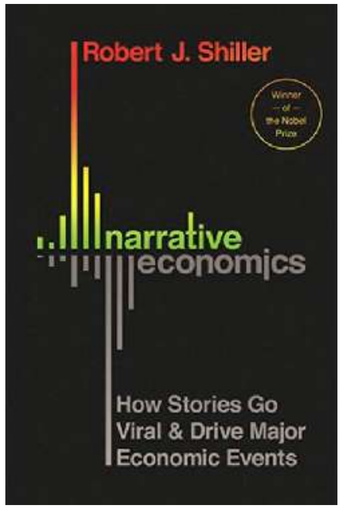
Another important aspect of our model is that it suggests alternative, behavioural tools for monetary policy, in particular in crisis time.

Beyond adjusting interest rates and money supply, policy makers can use Narratives to restore trust.



"What people say about the economy can set off a recession"

Robert J. Shiller, Sept. 12, 2019

Trust is parameterised in our model by the threshold c_0.

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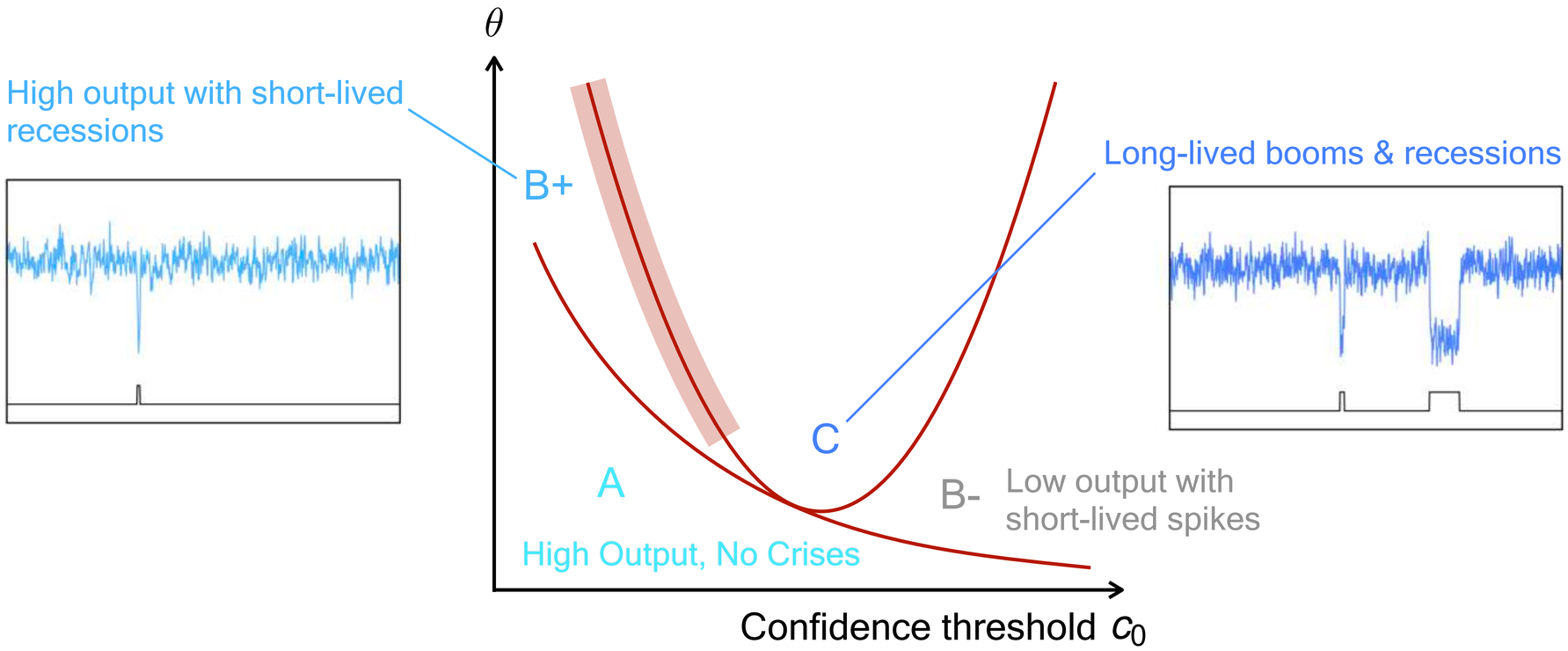
If the economy lies in the neighbourhood of the C/B+ phase boundary, a mild decrease of c_0, engineered by the Central Bank, can help putting back the system on an even keel.



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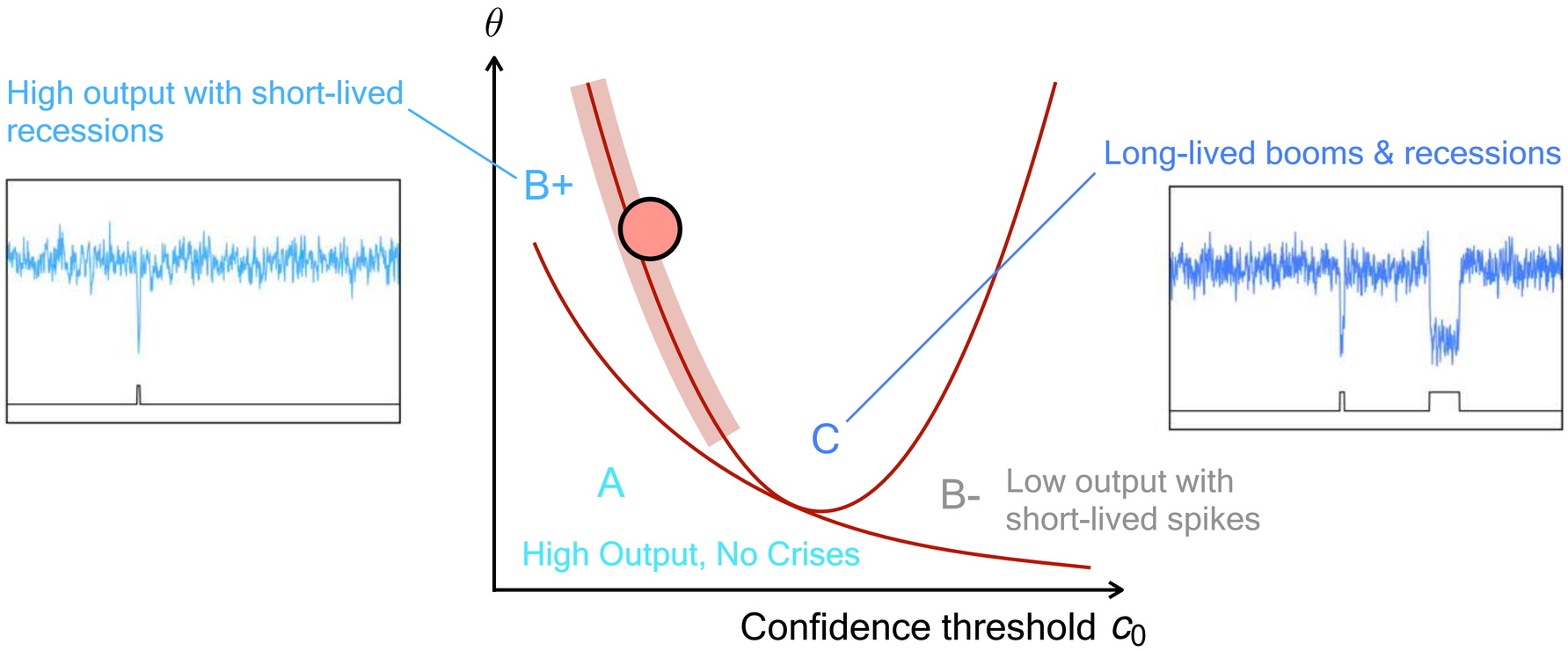

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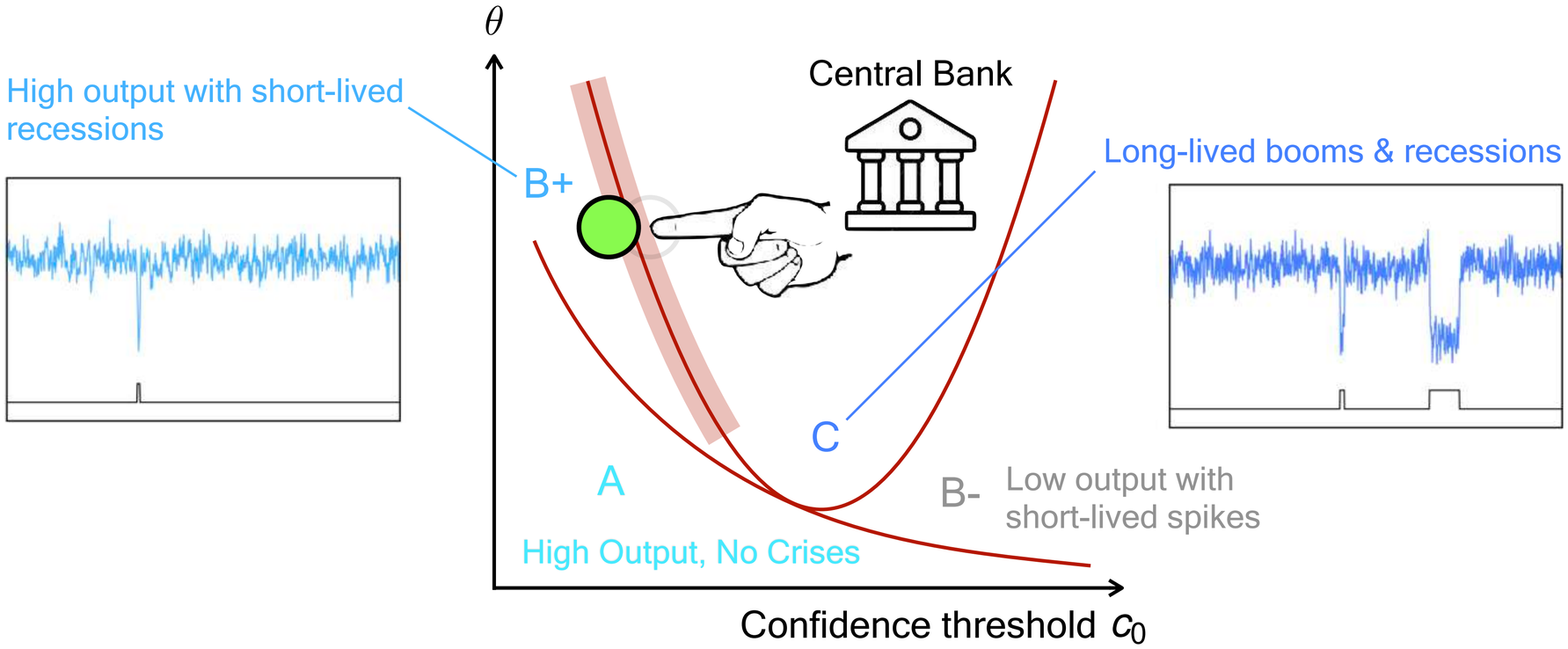

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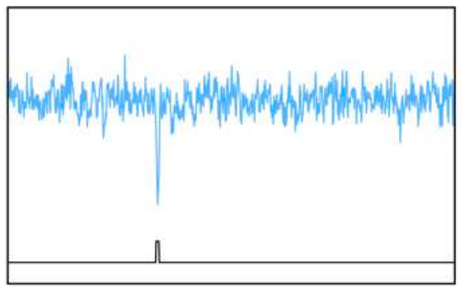

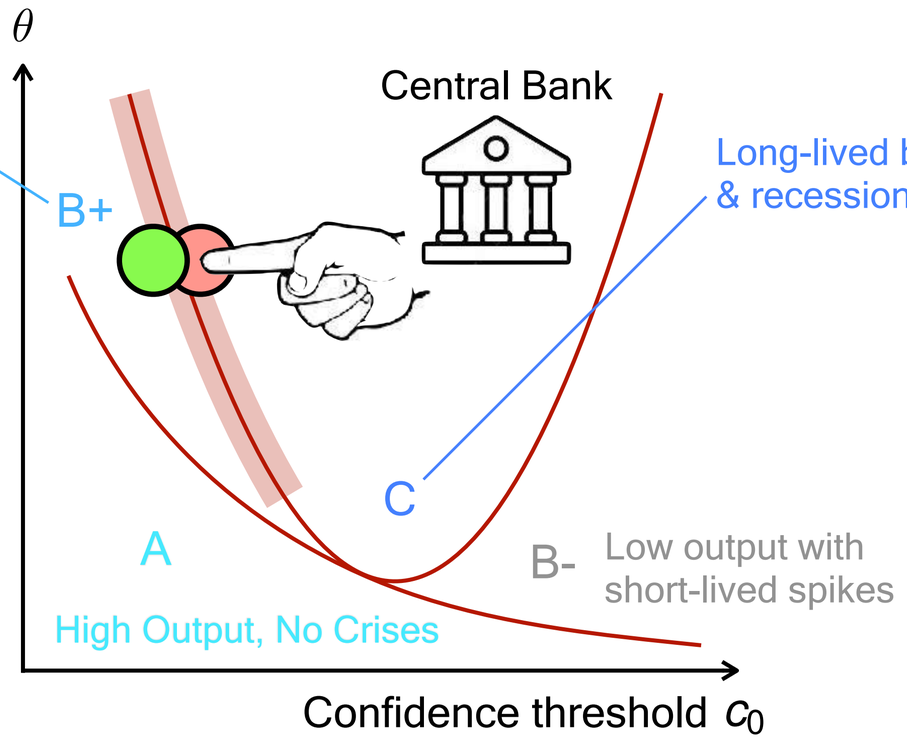

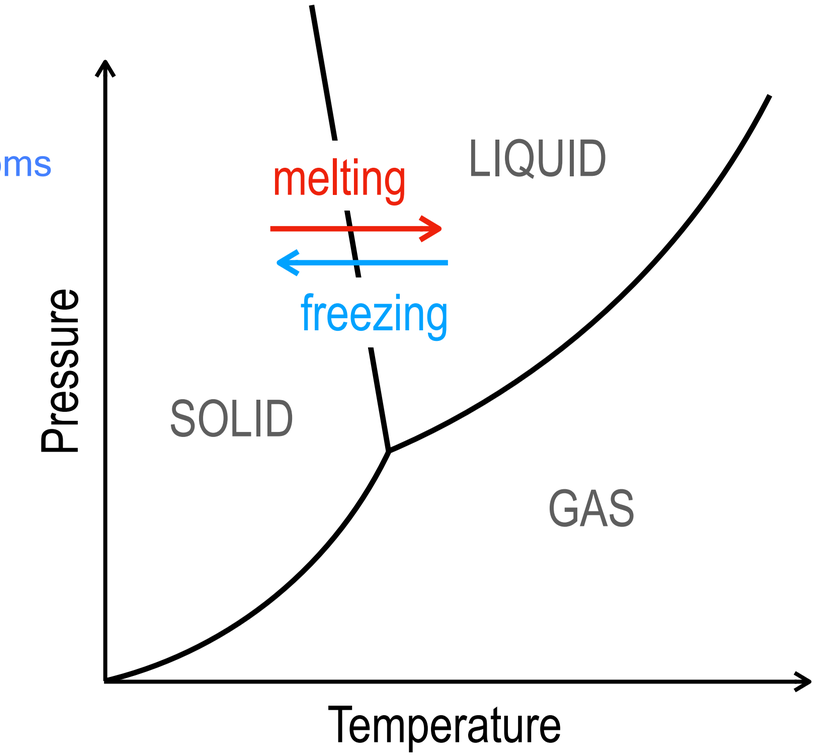

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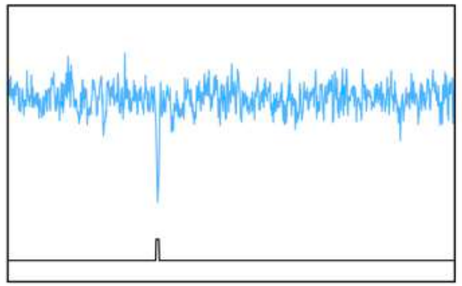

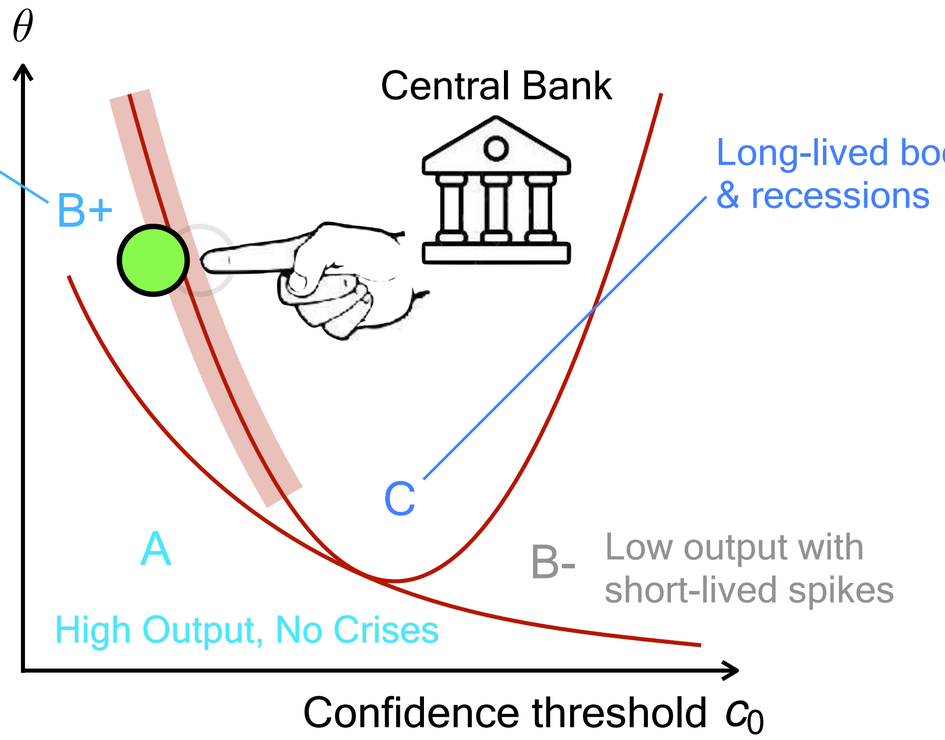

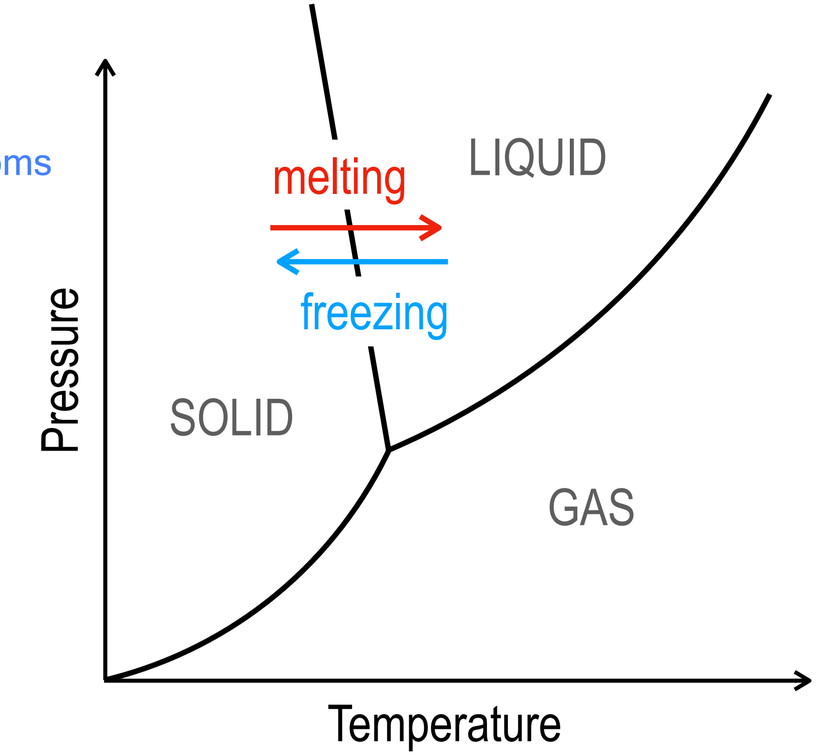

Thank you!

“The only thing we have to fear is fear itself”

Franklin Roosevelt, inaugural 1933 address