

Intro to Complexity Science and Complexity Economics

Tom Wilkinson

A detailed landscape painting of rolling green hills. The hills are covered in vibrant green grass, with some areas showing darker green shadows. A thick layer of white mist or fog fills the valleys between the hills, creating a sense of depth and mystery. In the distance, a small cluster of buildings is visible through the mist. A faint rainbow is visible on the right side of the image, arching over the hills. The sky is a pale blue with soft white clouds. The overall mood is serene and contemplative.

Complexity is a set of tools for thinking about Science

We might think of Science as hill climbing in mist



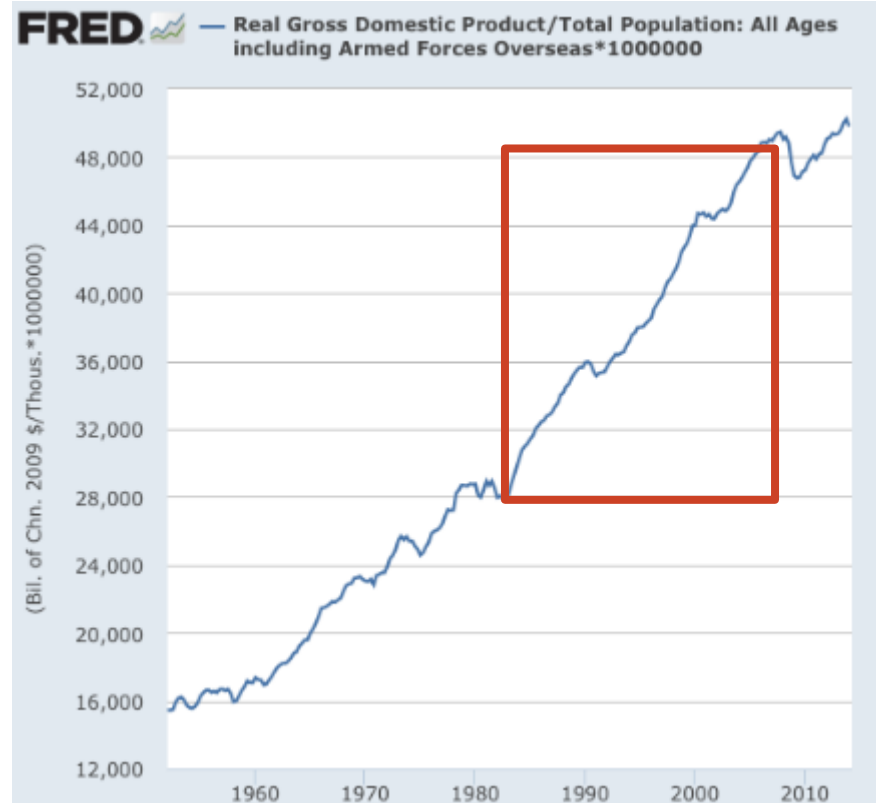
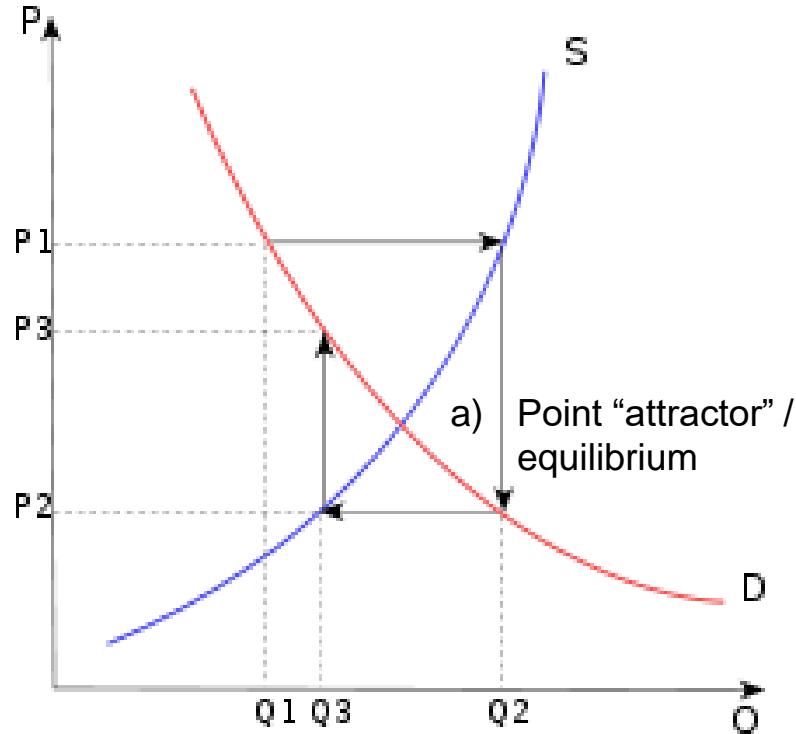
Economics compares qualities of life, through wealth



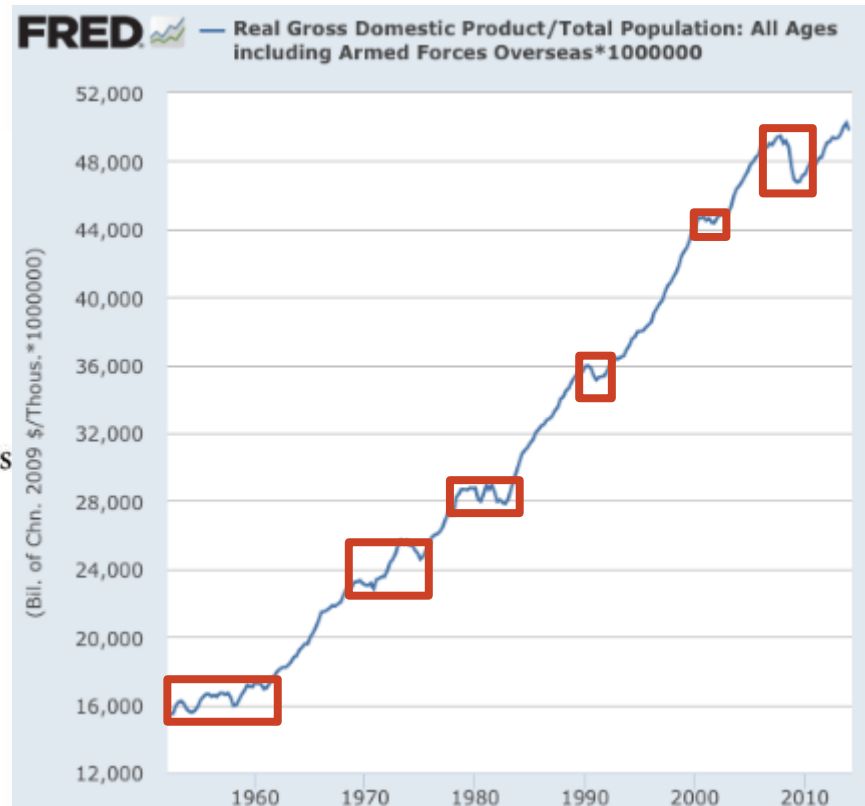
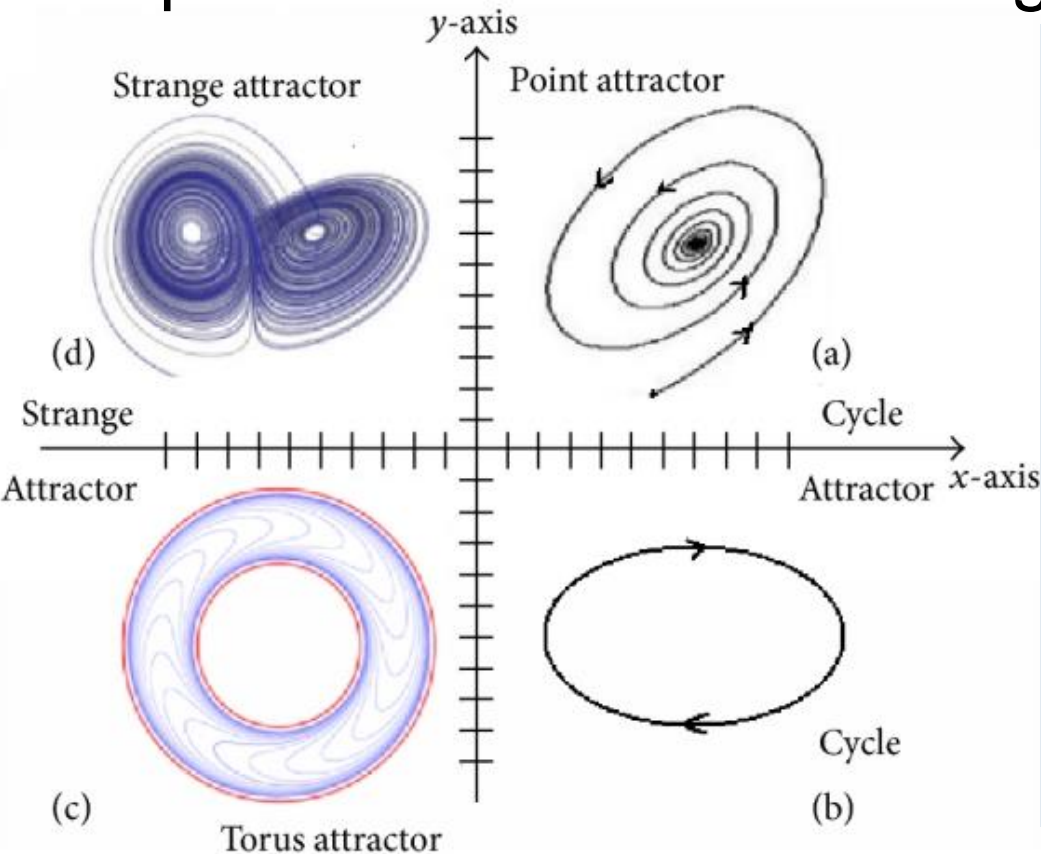
...it tries to separate long and short term wealth

Is current macroeconomics broke?
Why fix it?

Rational equilibrium, convenient during Moderation



Equilibrium needn't be boring, just like real growth





SMD => “Aggregate Demand” is essentially Animism

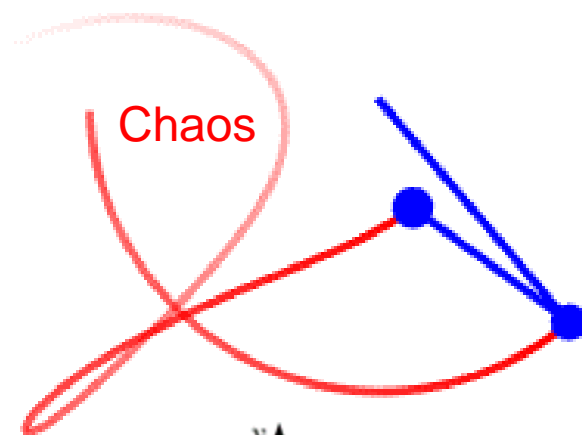
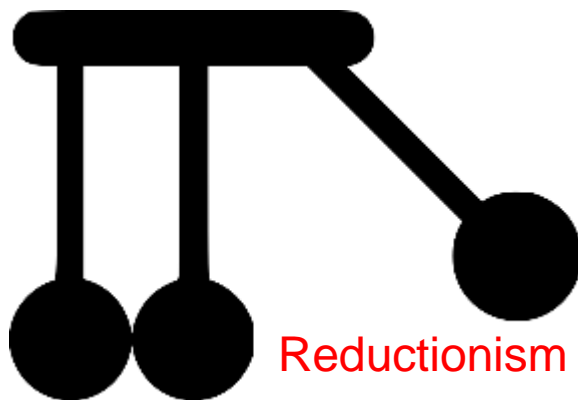
Macro-

Organised

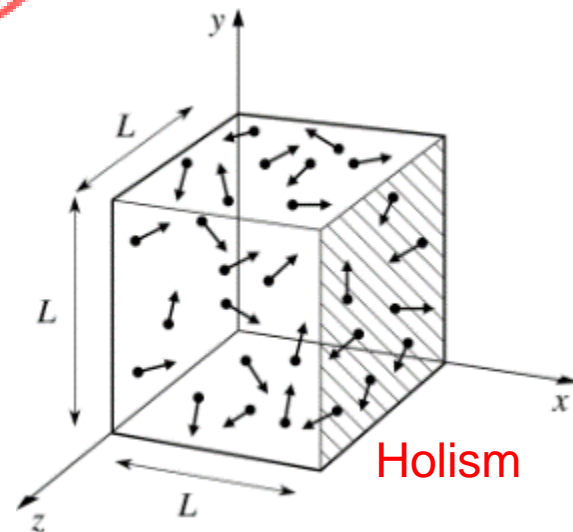
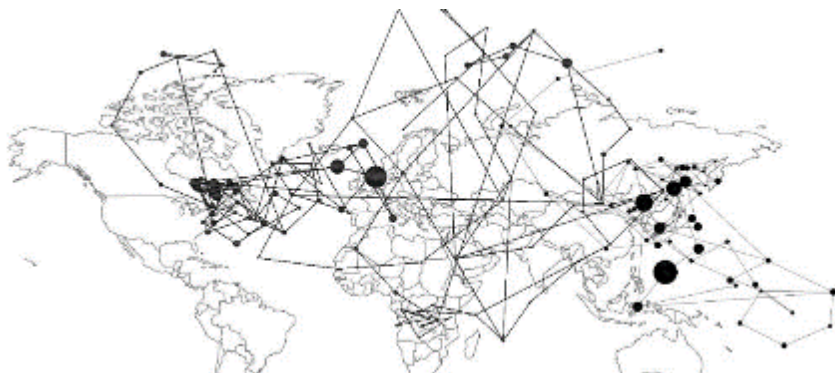
Disorganised

Micro-

Simple

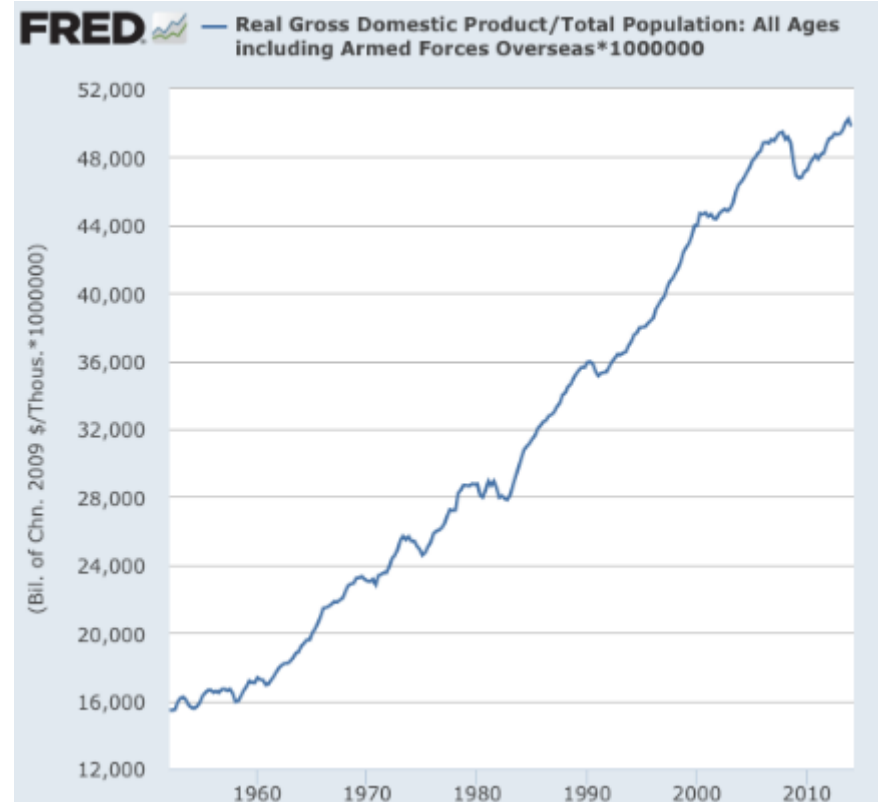
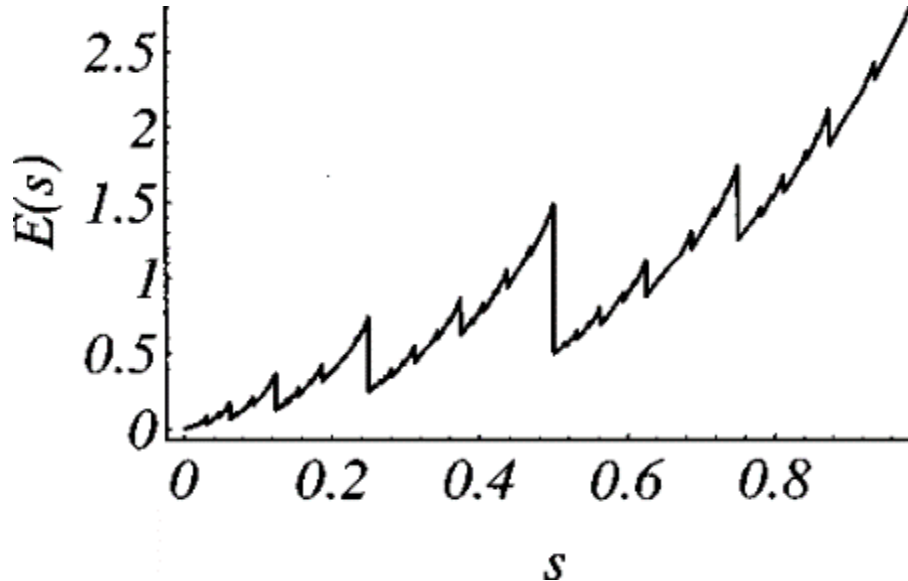


Complex

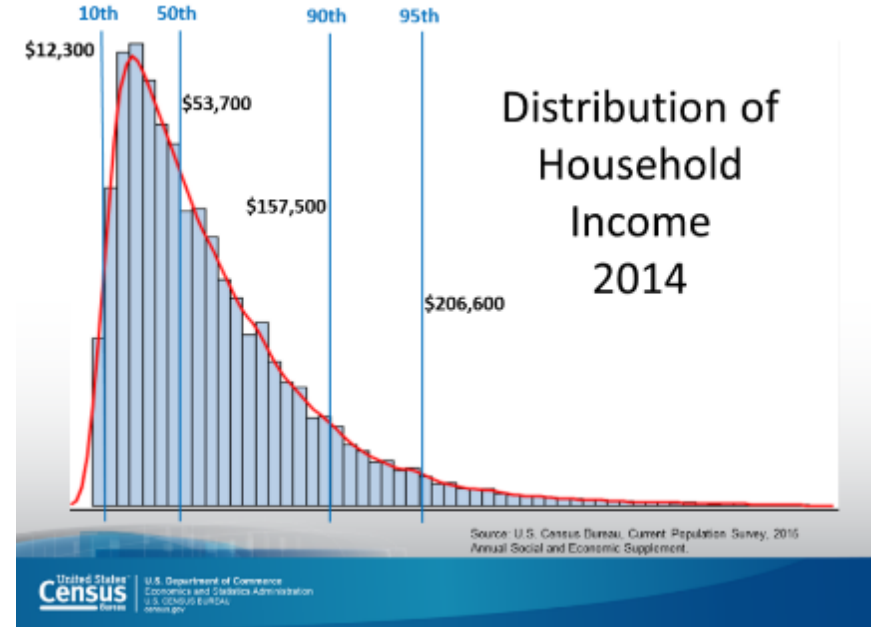
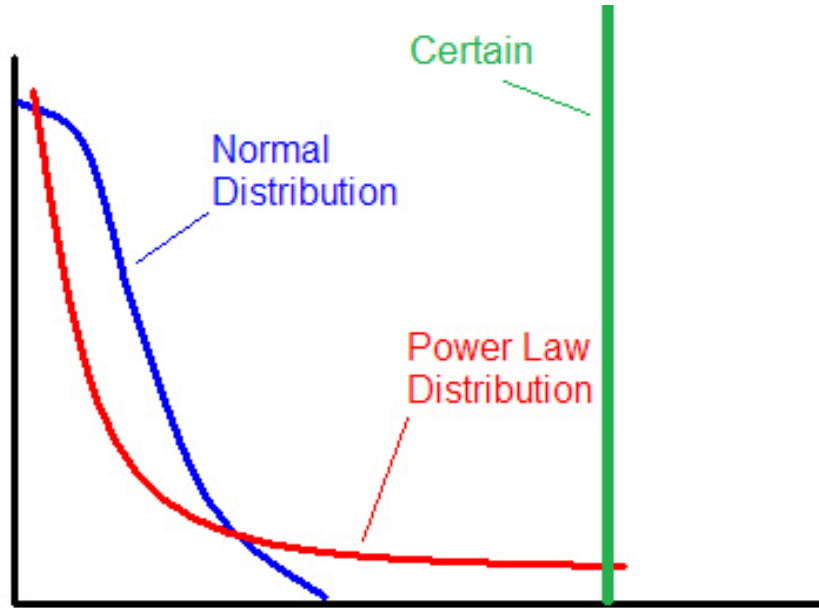


What systems look like real GDP? Complex systems?

A Complex “Sand Pile” model
([Physical Review E](#)):

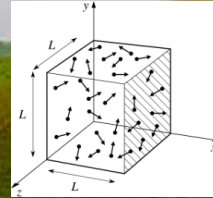


What systems look like income? Complex systems?



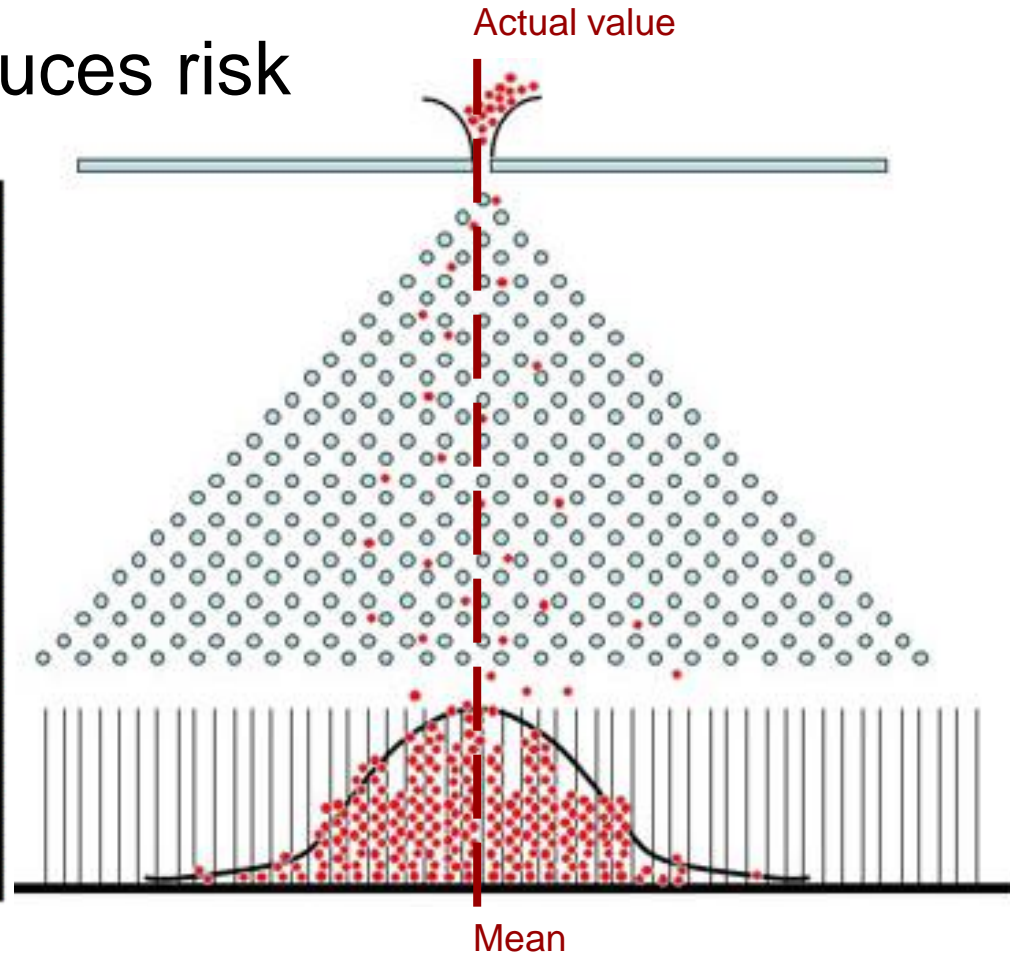
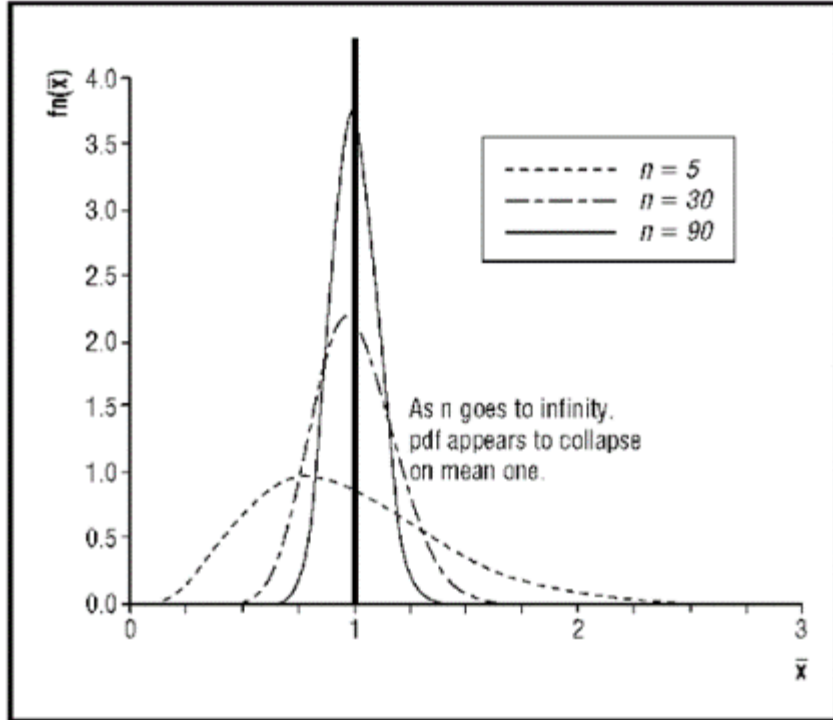
Power Law = “80:20” and “Black Swan Events”

Complexity Hill is higher than Holism Hill when describing macro AND micro together gets simpler

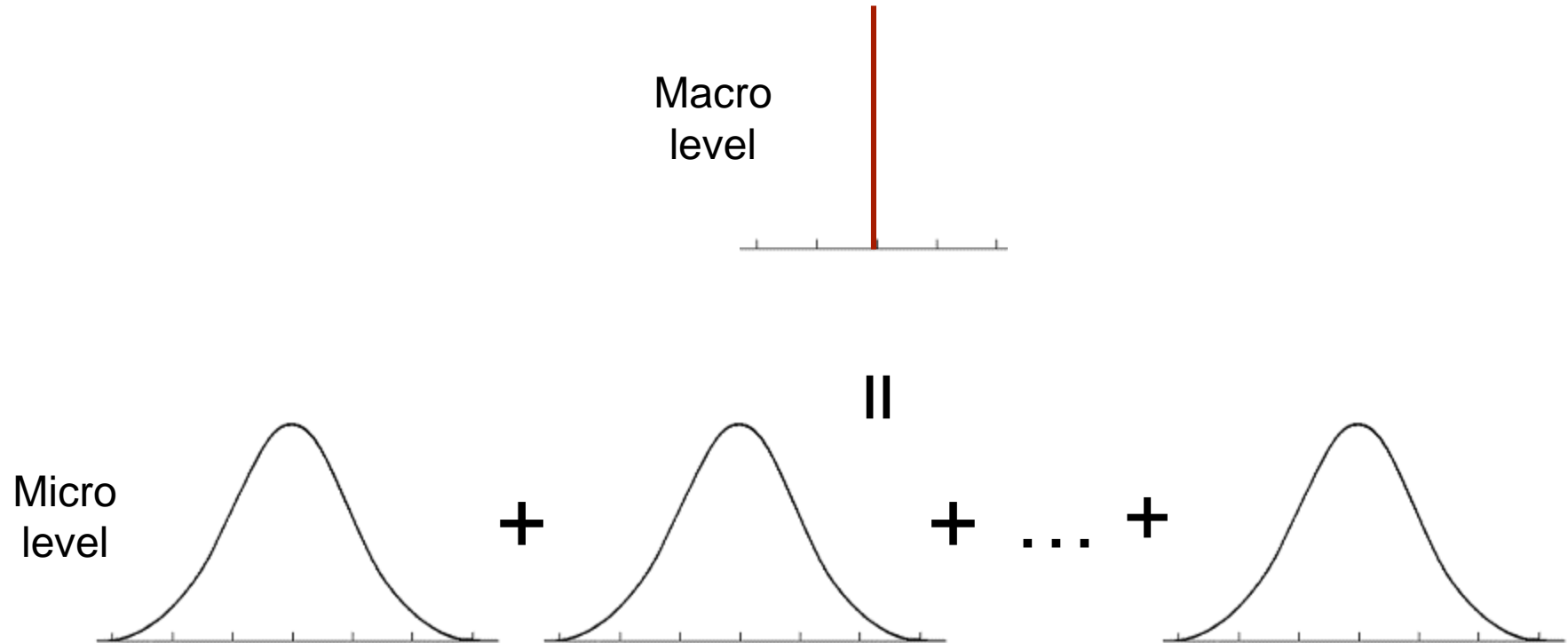


Why do complex systems have these characteristics?

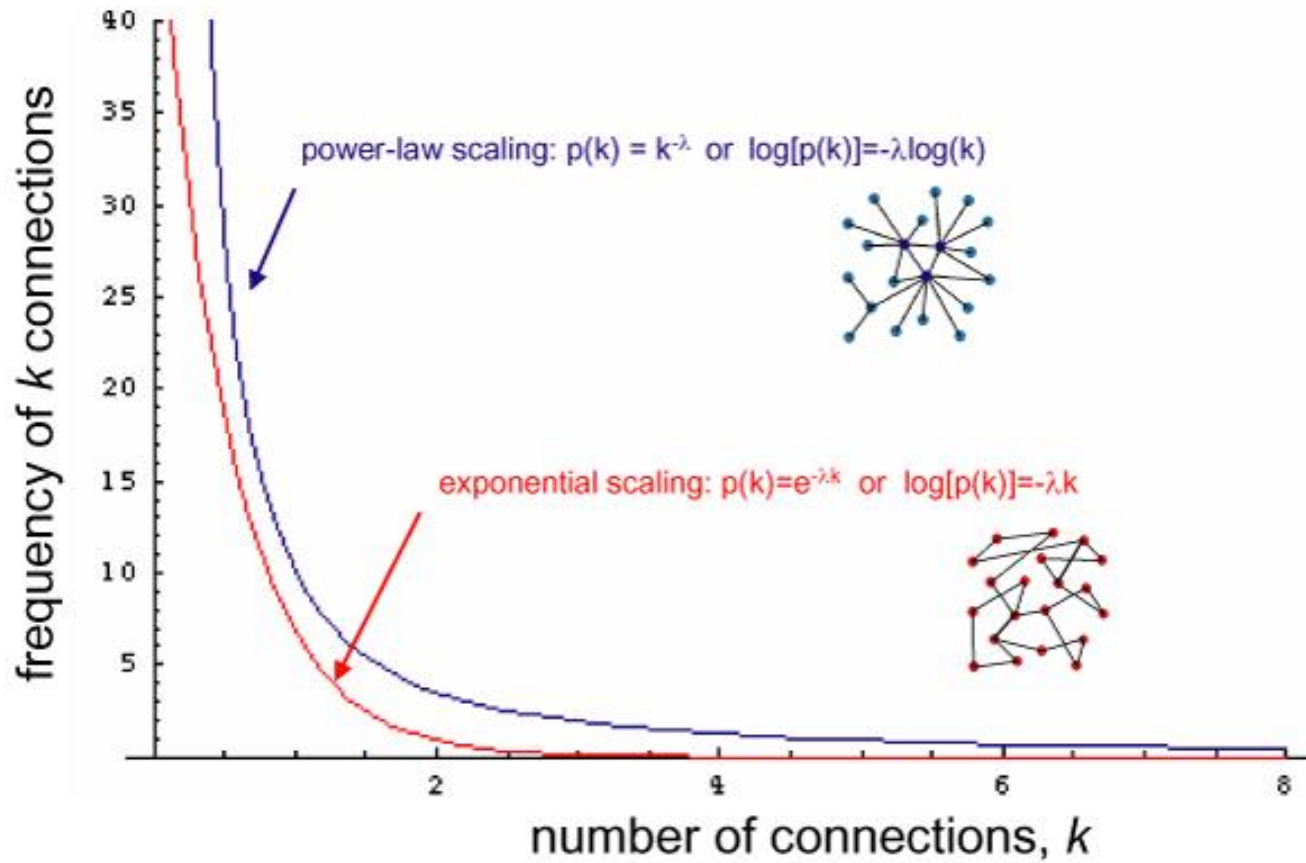
Aggregation usually reduces risk



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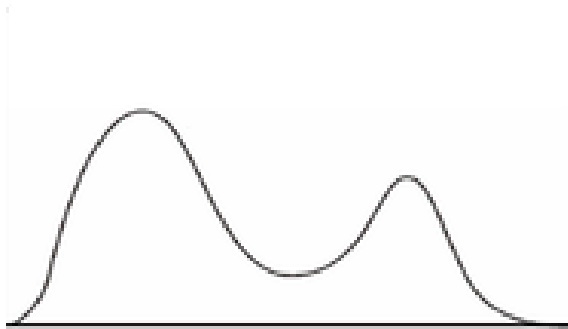


Aggregating networks of interactions *can* create risk



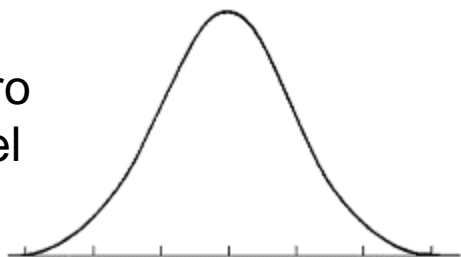
Emergence: “the whole is different from the sum of its parts”...

Macro
level

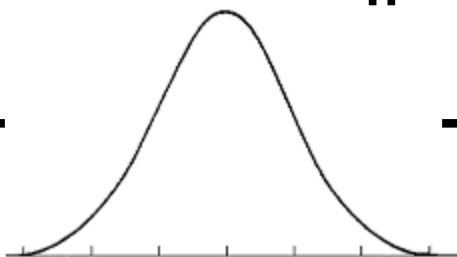


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Micro
level



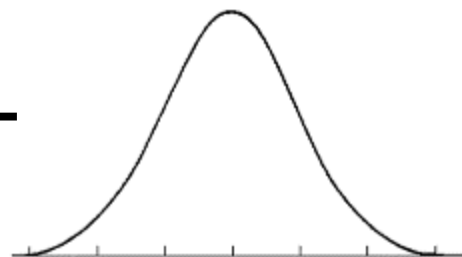
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Undriven simple systems are stable

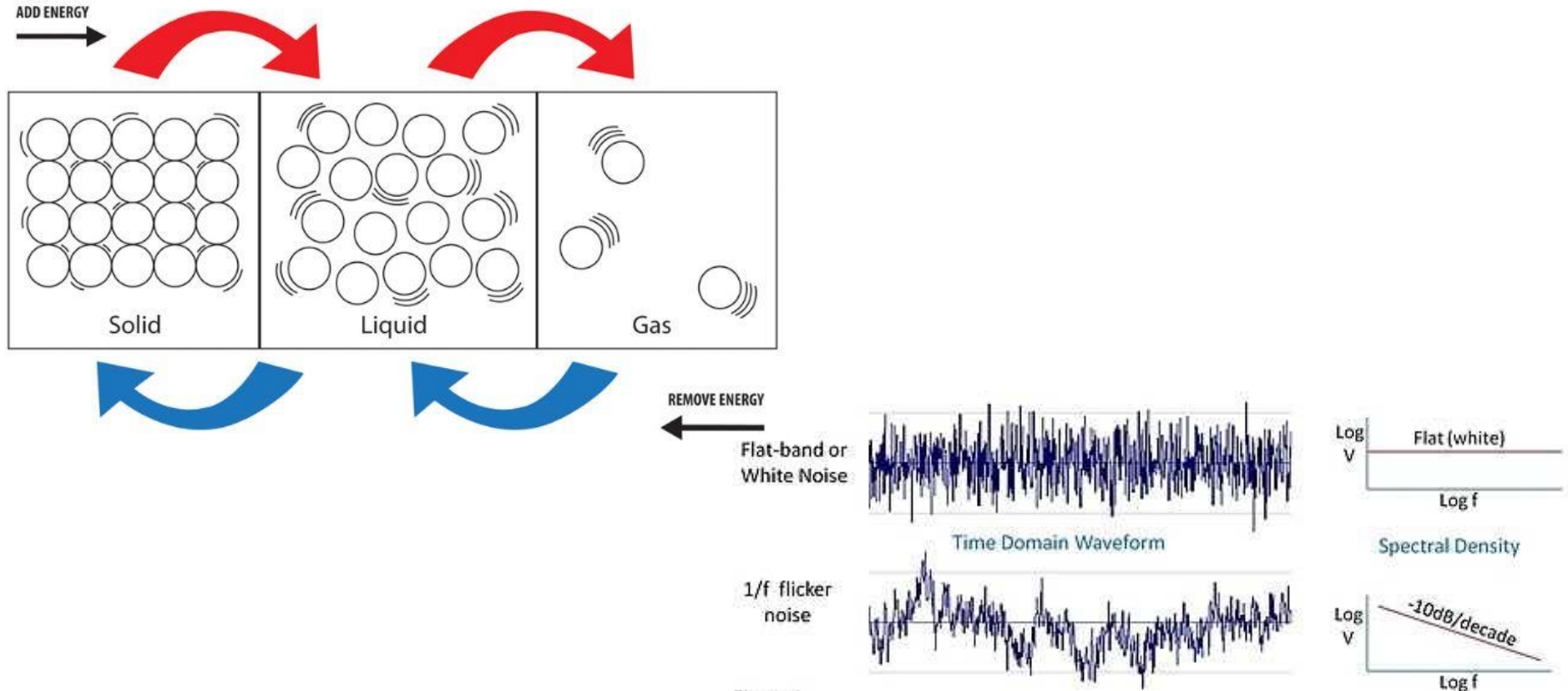


Figure 1.

Evolving systems can keep returning to instability



Addition of
sand grains:
slope increases

→ Critical slope

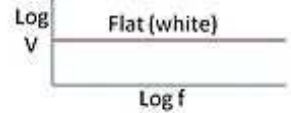
Avalanche
occurrence:
slope decreases
←

Flat-band or
White Noise



Time Domain Waveform

1/f flicker
noise



Spectral Density

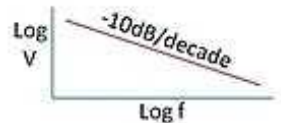
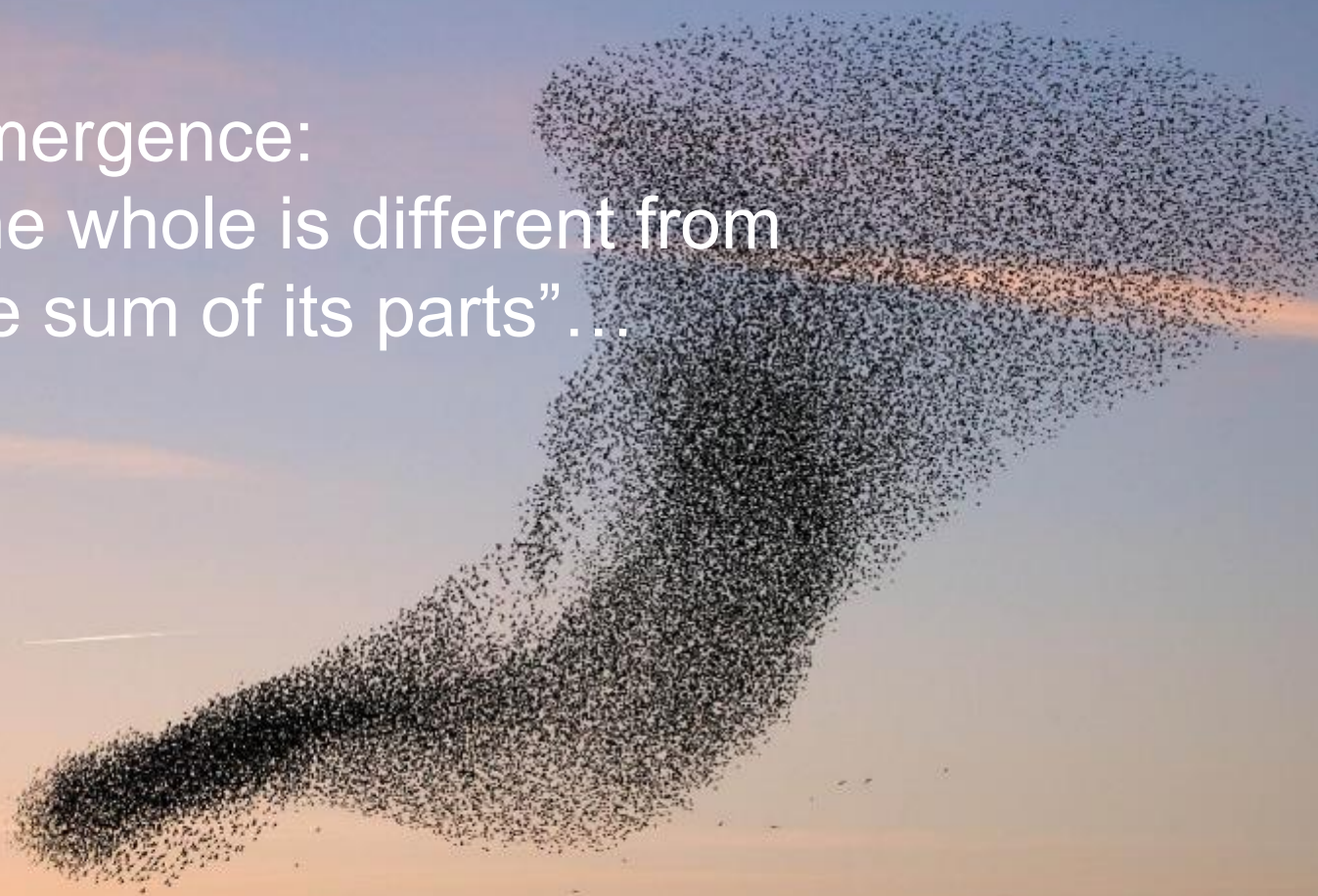
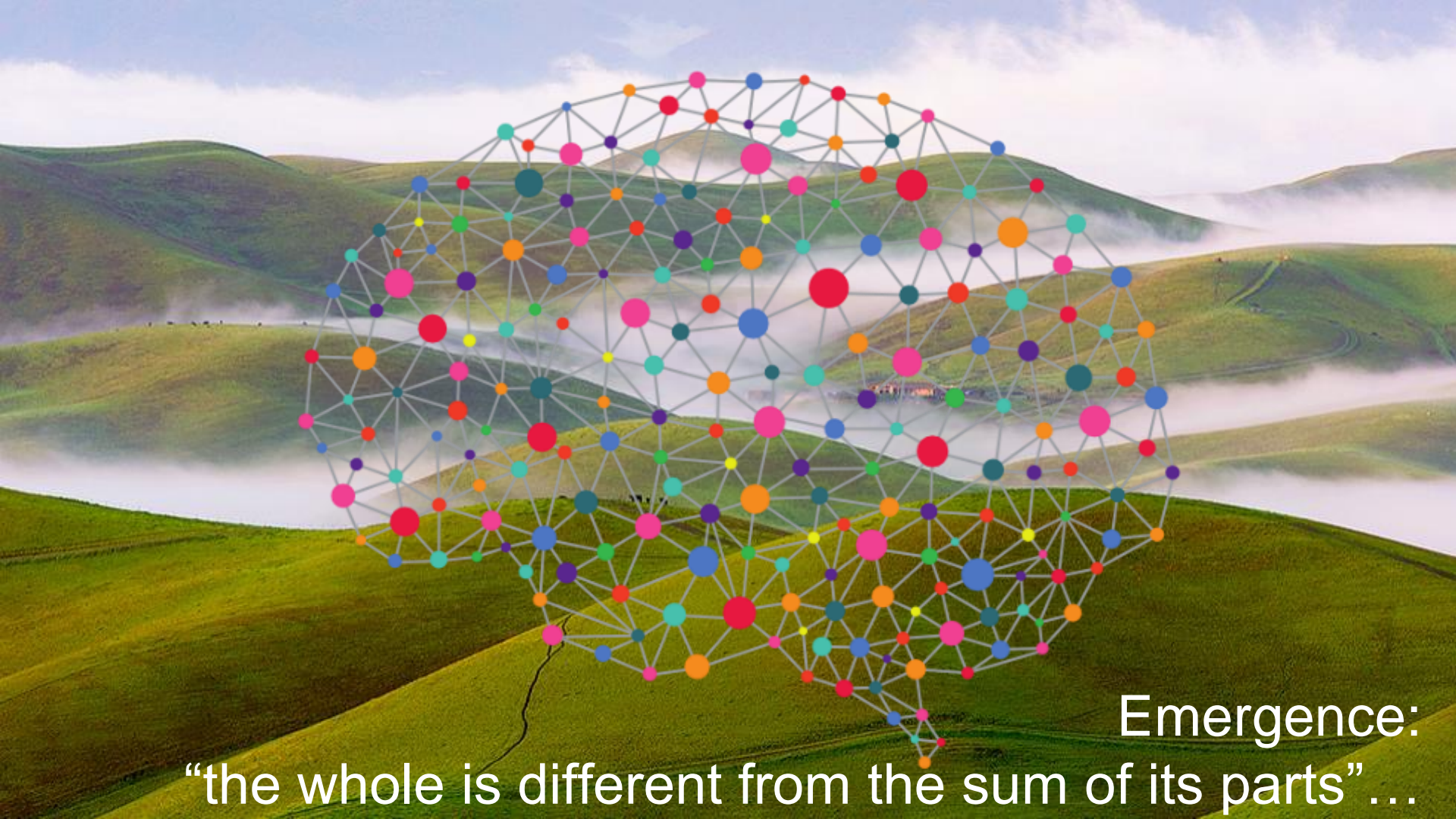


Figure 1.

Emergence:
“the whole is different from
the sum of its parts”...





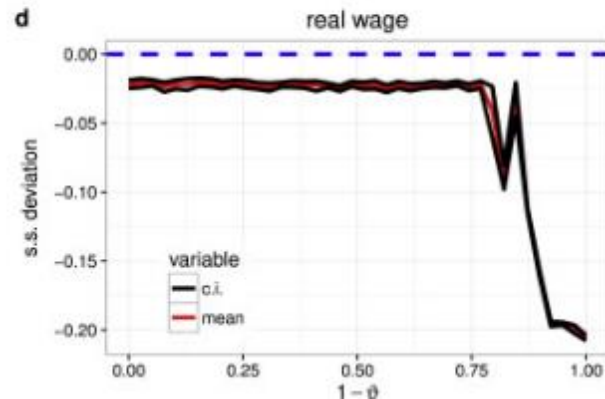
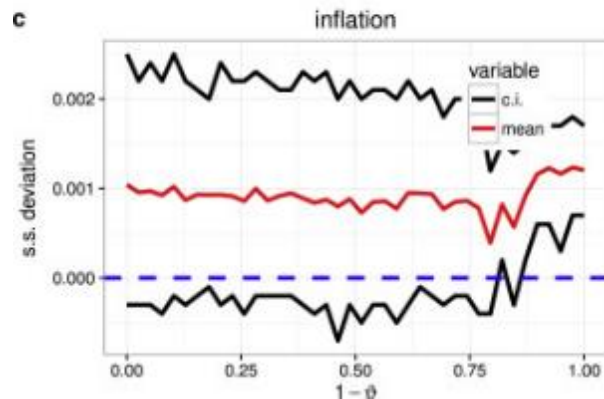
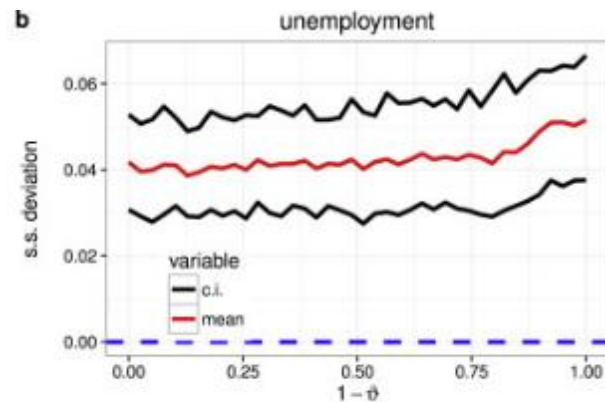
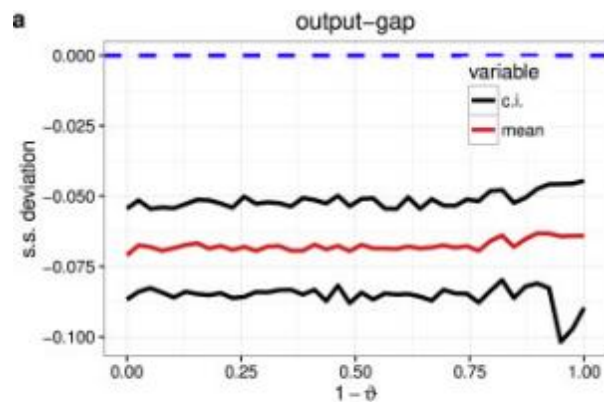
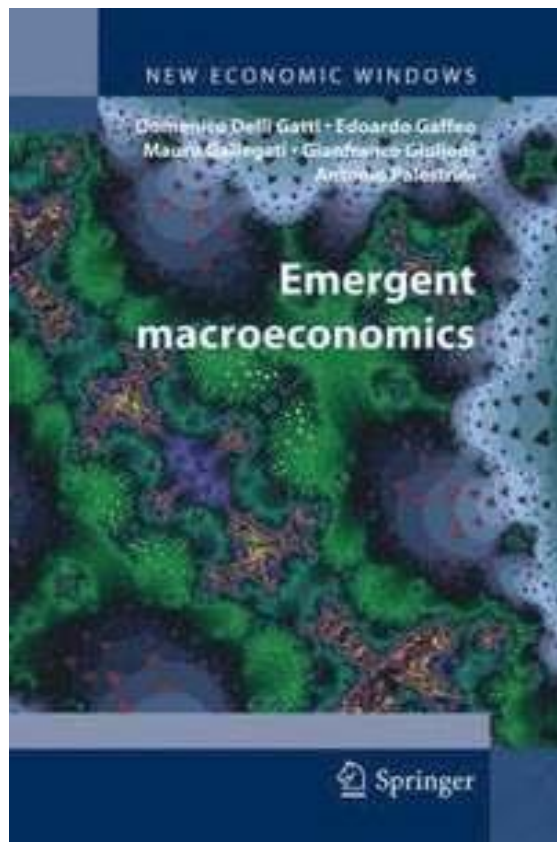
Emergence:
“the whole is different from the sum of its parts”...

How has complexity been used so far?

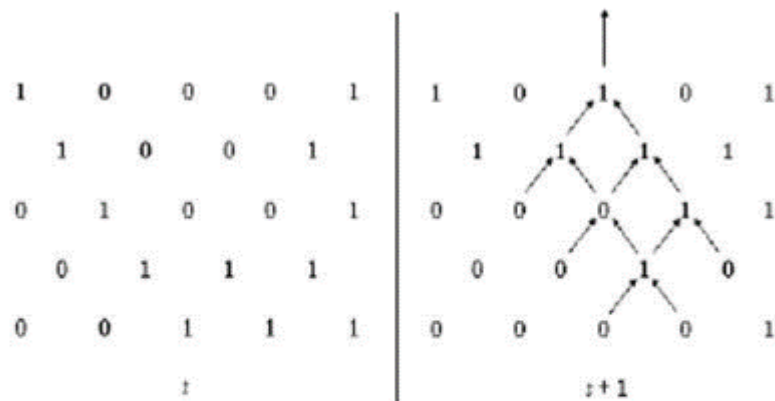
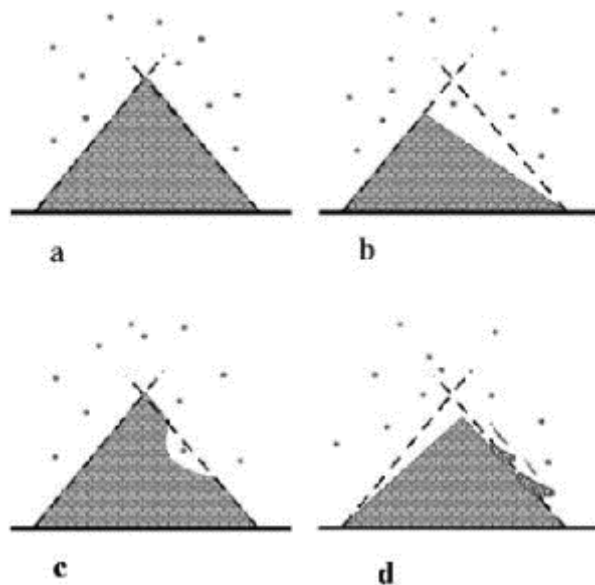
Financial and epidemiological contagion models



Macroeconomic “puzzles” Agent Based Models



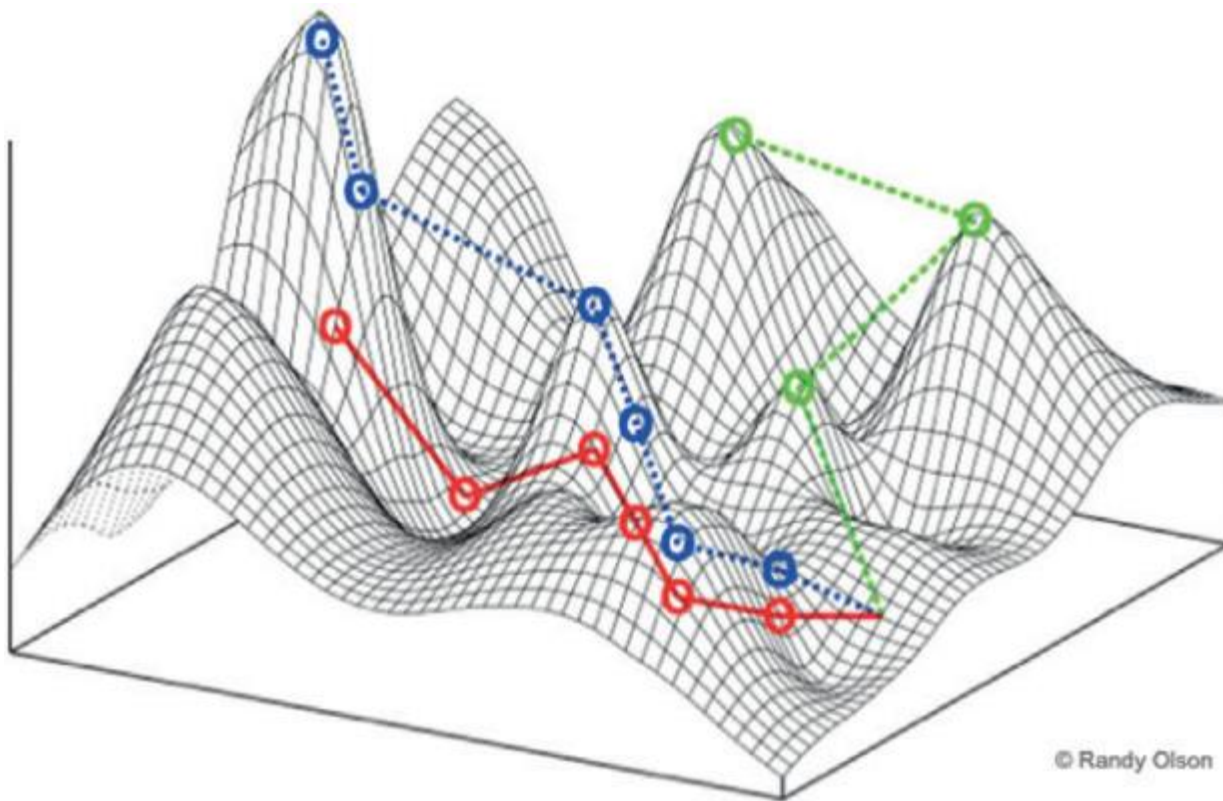
Boom and bust



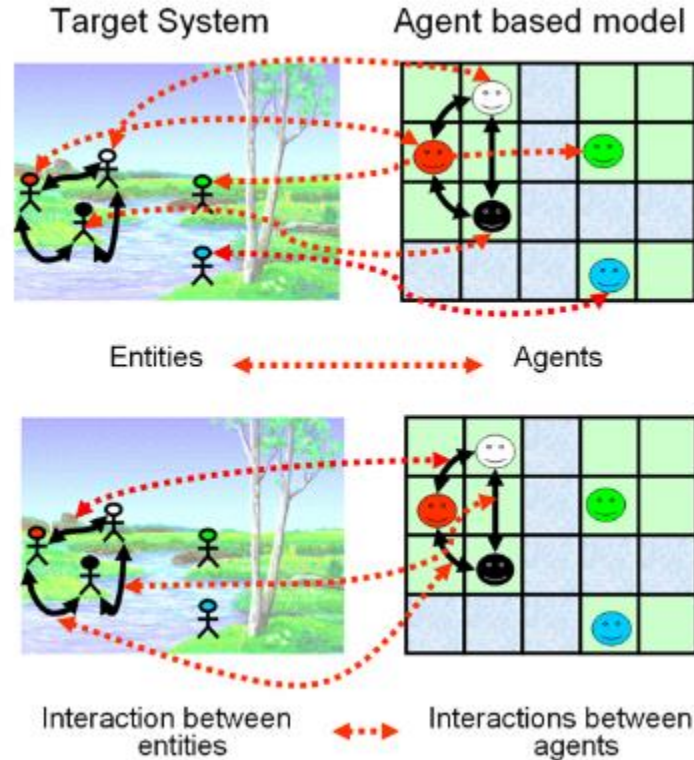
Example of a production avalanche in the BCSW model caused by the production of one final good at $t + 1$ that leads to the total production of 22 units.

Bak, Chen, Scheinkman, Woodford, "Aggregate fluctuations from independent sectoral shocks: self-organized criticality in a model of production and inventory dynamics."

Evolution of political parties



Genocide norms emerging through ABM

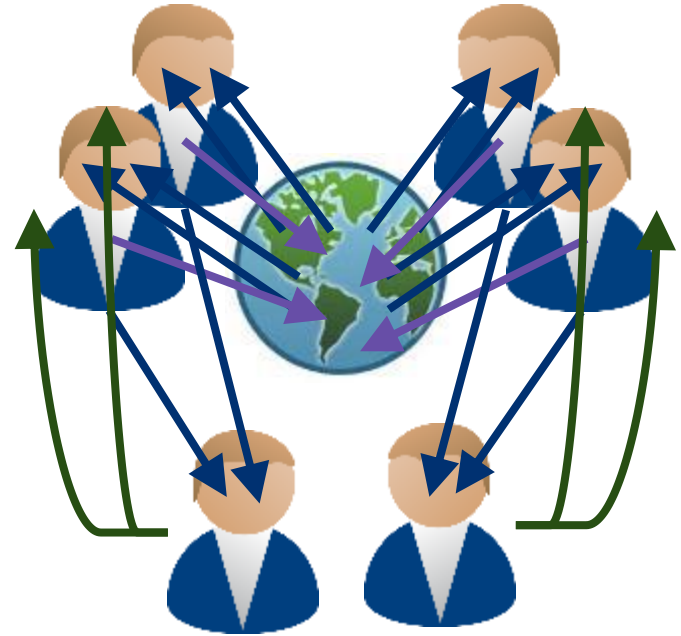


How could it be used?

System Stewardship instead of specific regulation



Command



Stewardship



vs



Can we build a hillwalking machine?