What is the economy?

Metabolism of civilization

- Converts natural resources and human effort into goods and services
- Coordinates and amplifies the activities of an ecology of specialists
  - allows us to do remarkable things together that we could never do on our own
Physical supply chain of a laptop
Imagine google maps for the economy

- Flows of goods and services between firms
- Stocks and flows of capital
- Web of contracts
- Occupational capabilities
- Wealth and poverty
- Ownership
- Ecology of innovation
- Physical and environmental impacts
- Regulatory constraints

Geographically anchored literal verisimilitude
How much data do we need?

- Production network
  - 50M firms with billions of physical links
- Household network
  - 2B households, 3.3B workers, trillions of links to consumed products
- Web of contracts — trillions
- Ownership: a few own almost everything
How would this work using existing data?

Not too bad at level of entire world

But let’s zoom in …
We are very far from having a detailed map of the economy
But we do know it is highly heterogeneous, with persistent, fine-grained structure
Inflation

Source: New York Times
Technological change

• Technologies improve at very different rates

• The rates are highly persistent
Technological progress

Distribution of price annual growth rates

Number of industries

Average annual growth rate, in %

Food
Textile
Wood or related
Chemicals
Metals
Machinery
Transport
Electronics
Others

Electronic Computer
Semiconductor and Related Device
Computer Storage Device
Computer Terminal
Other Computer Peripheral Equipment

Thanks to Francois Lafond and Jangho Yang
Distribution of technological progress rates

30 domains reported in Triulzi, Alstott & Magee (2018)

Annual technical improvement rate

Frequency

-0.6
-0.4
-0.2
0.0

Optical telecom
Wireless telecom
MRI
Semiconductor info. storage
LED
Genome
Wind
Solar PV
Hybrid corn
Milling

30 domains reported in Triulzi, Alstott & Magee (2018)
Distributional forecast of solar PV assuming business as usual

Farmer and Lafond, 2016
• Technological change drives economic growth

• The economy rewires itself toward rapidly improving technologies
Ecology improves prediction
The U.S. and China

China

U.S.
Future industry price return vs. trophic level of industry

Real price return 1995-2009

Trophic level in 1995

regression
bin average

McNerney, Savoie, Caravelli and Farmer, 2018
More reasons to model the economy at fine scale
Emergent behavior

- Emergent behavior: Qualitatively different than that of individual components.
- Nonlinear behavior: Whole not equal to the sum of its parts
- Emergence depends on nonlinearity
- Must model at fine scale
Catch 22 of macro

• Economy is complex
• Economy evolves
  – limited aggregate data
  – only simple models can be estimated
• But economy is complex — Catch 22
Global microeconomics

- There is much more data at fine scales
- Use it to fit fine grained models
- Advantages
  - better statistical significance
  - takes advantage of heterogeneity
  - can predict more things (more tests)
  - can model emergence
  - endogenous dynamics
Economy is built from overlapping networks

Must understand linkages between the layers
Google map for the economy

- Flows of goods and services between firms
- Stocks and flows of capital
- Web of contracts
- Occupational capabilities
- Wealth and poverty
- Ownership
- Ecology of innovation
- Physical and environmental impacts
- Regulatory constraints

Geographically anchored
literal verisimilitude
Economics is not isolated

“Bad economics led to bad politics”

Need to couple economics to social science

- Preference formation
- Power
- Politics
- ....