Overview of a Networked Economy

Gail Tverberg – Energy Economics and Analysis Modeling

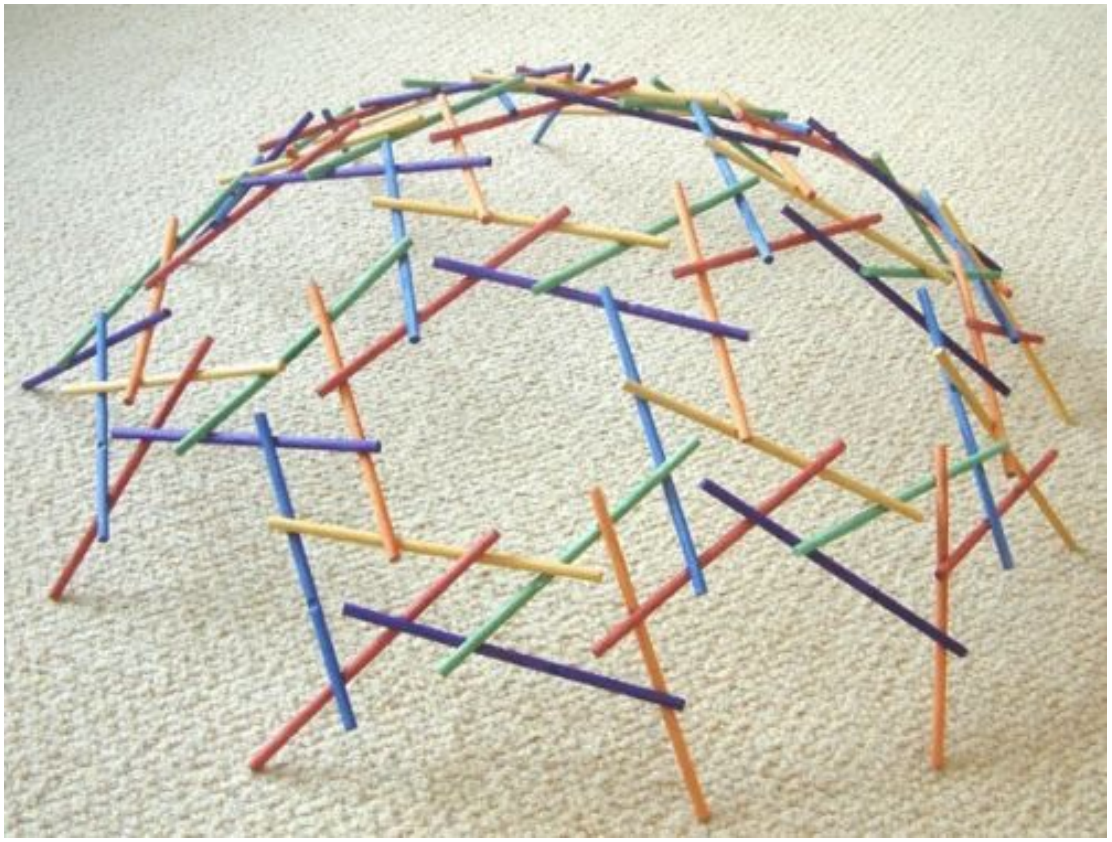
We are all familiar with how an economy works

- New businesses are added over time
  - Try to fill needs other businesses are not meeting
  - Look at government rules, customers available
    - Also availability of suppliers, workers
- People participate, both as workers and as consumers
  - Usually buy the low priced product
  - Can't buy more than they can afford
  - Want job that pays as much as possible
- Governments keep changing the rules
  - Also add roads, schools, trains
- Businesses and consumers adapt to changing situation
- A financial system ties things together

Does the previous slide agree with the way you think of an economy as working?

I imagine the economy as being like a child's toy – it gets built higher and higher

- Some sticks get taken out, and new ones added



Leonardo Sticks http://www.rinusroelofs.nl/structure/davinci-sticks/gallery/gallery-01.html

What happens when the Three Gorges Dam was built over the Yangtze River?

- What changes were made?
- How does the new electric power change lives?
- How does the loss of farmland change lives?
- How do the new homes change lives?
- Is it possible to "go backwards"?

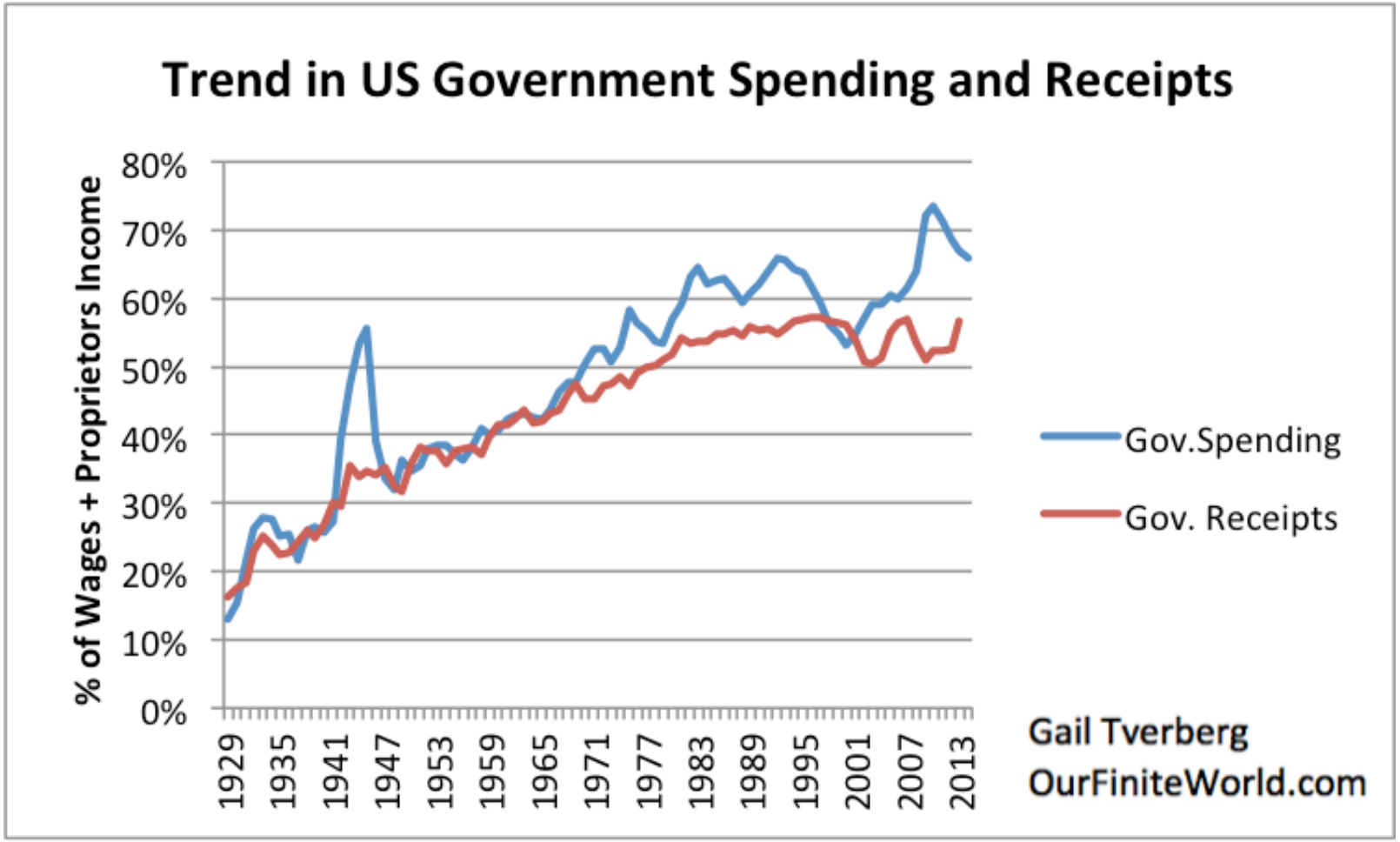
How about industrialization since 2001?

- How did it change lives?
- Does everyone know how to raise crops now?
- Are as many animals used in plowing available now as before?
- Could the system go backward, now, to a pre-industrialized state?

With the industrialization, what happens to the cost of government?

- Who pays for the new roads, bridges, train systems?
- Who pays for the food and housing of the elderly who now have their own apartments?
- How do schools change?
- How does healthcare change?
- How do tax levels change?
- Is it possible to go backward?

In the United States, government costs have risen sharply compared to wages



Based on data of the US Bureau of Economic Analysis.

Summary of a few characteristics of a networked economy

- Economy tends to grow over time, as energy is added
- Economy does not shrink back well
  - Model shows the economy as hollow for this reason
- Government tends to grow disproportionately to the economy as a whole

Such systems studied in recent years

- By systems analysts – Complex Adaptive Systems
  - System grows in complexity
  - Adapts to changing conditions

- By physicists – Dissipative Structures
  - Ilya Prigogine – Nobel Prize in 1977
    - Earliest work on such systems
  - Francois Roddier –Economy as Dissipative Structure
    - Thermodynamique de l'evolution
    - Published in 2012 in France

Dissipative structures

- Tend to form in thermodynamically "open" systems
- Receive energy from an outside source
  - Allows growth for a temporary period
  - System "self-organizes"
  - Permanent growth not possible in a finite system
- For example, all plants and animals are dissipative structures
  - Grow, eventually die
  - Receive energy from the sun, food
- Hurricanes are also dissipative structures
  - Receive energy from hot sea water, sun

Economy as a dissipative stucture

- Receives energy from many sources
  - Human energy
  - Animals used by humans
  - Burning wood and "biomass"
  - Fossil fuels
  - Nuclear electricity
  - Hydroelectricity
  - Other so-called "renewables"
- Grows and self-organizes, almost like a living being
- History shows that many economies have collapsed

Several scientists have studied economies that have failed

- *The Collapse of Complex Societies, 1988*
  - By Joseph Tainter, Archeologist
  - Emphasized the need for increasing complexity as society grew
  - Also the role of diminishing returns

- More notable: *Secular Cycles*, 2009
  - Lead author Peter Turchin, evolutionary biologist
  - New science of "Cliodynamics"
  - Studied details of eight agricultural civilizations that collapsed
  - Looked at precisely what happened
    - How growth occurred: wages, prices, debt, reason for downfall
    - Based on detailed original records
  - Goal: Determine why history takes place as it does

Findings of *Secular Cycles*

- Population typically found a new agricultural resource
  - Cleared land for farming
  - Or began using irrigation
  - Current situation: World began using fossil fuels about 1800

- **Stage 1: Growth Stage** (often 100+ years)
- Population below the *carrying capacity of* the newly available resource
  - Plenty of room to add population
  - Population grew rapidly
    - Wages tended to rise
    - Plenty of resources for everyone

Findings of *Secular Cycles* (Continued)

- **Stage 2: Stagflation** (often 50 to 60 years)
- Population approaches the carrying capacity of the land with the new resource
  - Population growth slows
  - Wages start becoming a problem
    - Not enough resources for new workers to make a good wage
    - Nobles still receive high wage
    - Increasing economic inequality
  - Increasing prices of commodities
  - Increasing peasant indebtedness
  - Urbanization increasing
  - Tax burdens heavy

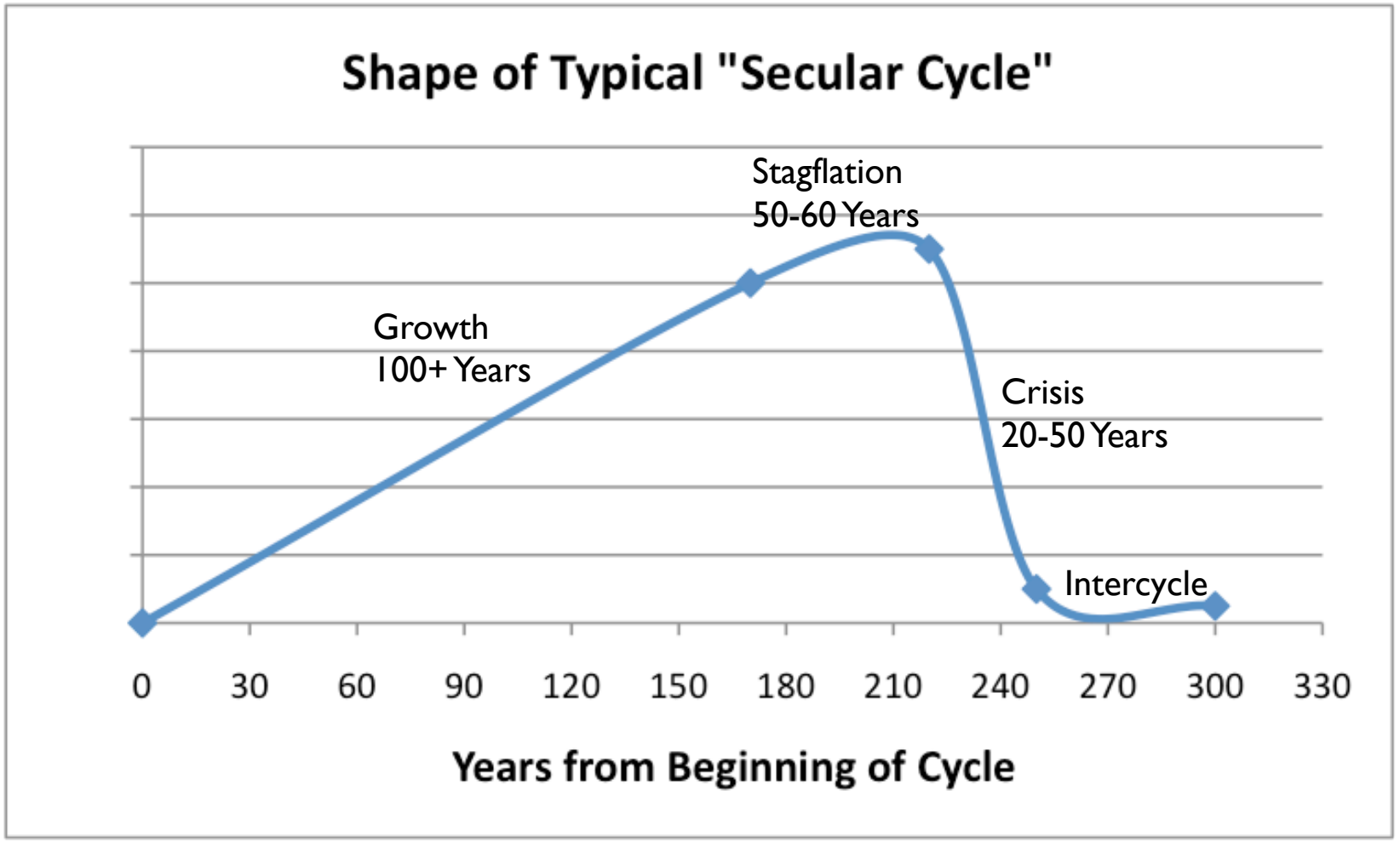
Findings of *Secular Cycles* (Continued)

- **Stage 3: Crisis Phase** (up to 50 years)
- Commodity prices high, very variable
- Sociopolitical instability
  - Tax system in a state of crisis
  - Can't collect enough taxes from impoverished peasants
  - May be civil war
- High concentration of land in hands of a few large owners
  - High economic inequality
- Impoverished common workers subject to epidemics
  - Not getting enough good food
- Population declines
- Popular movements for abolition of debts, land reform

Findings of *Secular Cycles* (Continued)

- **Stage 4: Intercycle** (can be very long)
- Population is low
- Government in state of disintegration or collapse
  - Periodic attempts to restore
- Abundant free land
  - By may not be secure enough to farm
  - Lack of government to protect against intruders
- Trade mostly local
  - Long distance networks interrupted
- Susceptible to invasions
- Handicrafts, artisanship declining

General Shape of Collapse in Non-Industrial Economies



Based on *Secular Cycles* by Peter Turchin and Sergey Nefedov.

What Peter Turchin is saying is

- Falling wages of the common worker, net of taxes, are likely to lead to collapse
  - Government can't collect enough tax dollars
  - Government likely to fail
  - Financial system, as part of government, may also disappear

Our civilization is different

- Secular Cycles studied agricultural societies
  - No electricity
  - No fossil fuels
- Our situation is likely different
  - Farmers, if they survived, could move elsewhere and farm
  - Today, how would a computer programmer survive?
    - If no computers or electricity available
    - And computer programmer didn't know how to farm
  - We are much more specialized
- World economy is now integrated
  - Hard for one part of the world to collapse and others continue

Can today's civilization avoid collapse?