Converging Crises

Gail Tverberg - Age of Limits – May 25, 2014

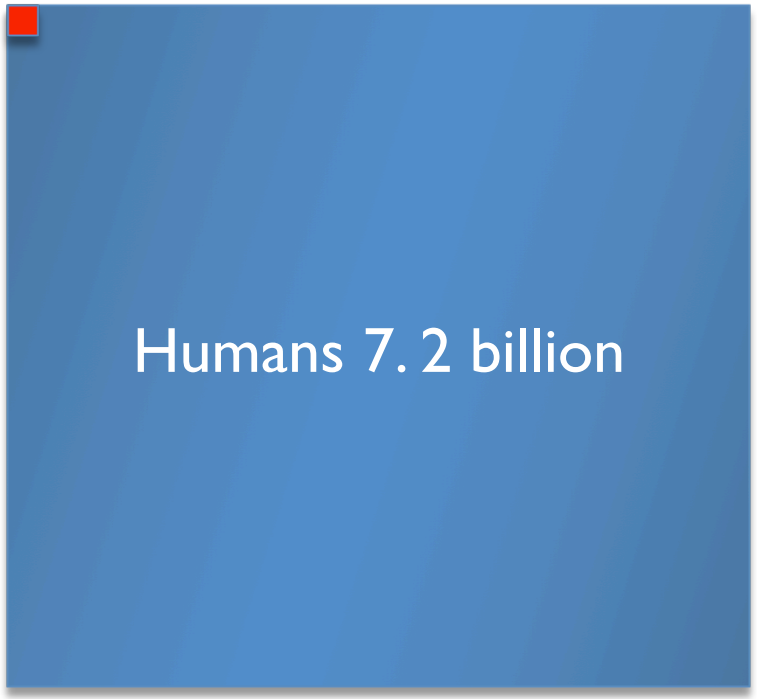
Many crises converging

1. Population Issues
2. Resource Depletion
3. Environmental Degradation
4. Debt; Viability of Financial System
5. Government Funding Issues
6. Jobs Availability
7. Electrical Grid Problems
8. Geopolitical: Fighting Over Resources Again

1. Population Issues

- Human population huge compared to our "relatives"

Chimps < 300,000 today
Max based on range, density < 3 million



Max chimp population - McEvedy and Jones, *Atlas of World Population History*, p. 13.

How did our population get to be so large?

- *All* species have more offspring than needed to replace parents

Source: http://www.publicdomainpictures.net/view-image.php?image=195

- Humans have done better than others in keeping deaths down.

Reason #1 for Population Growth

- Control of fire > 1 million years ago
- Our bodies are now adapted to cooked food
- Range is greater with fire

Source: http://www.publicdomainpictures.net/view-image.php?image=1161&picture=fire

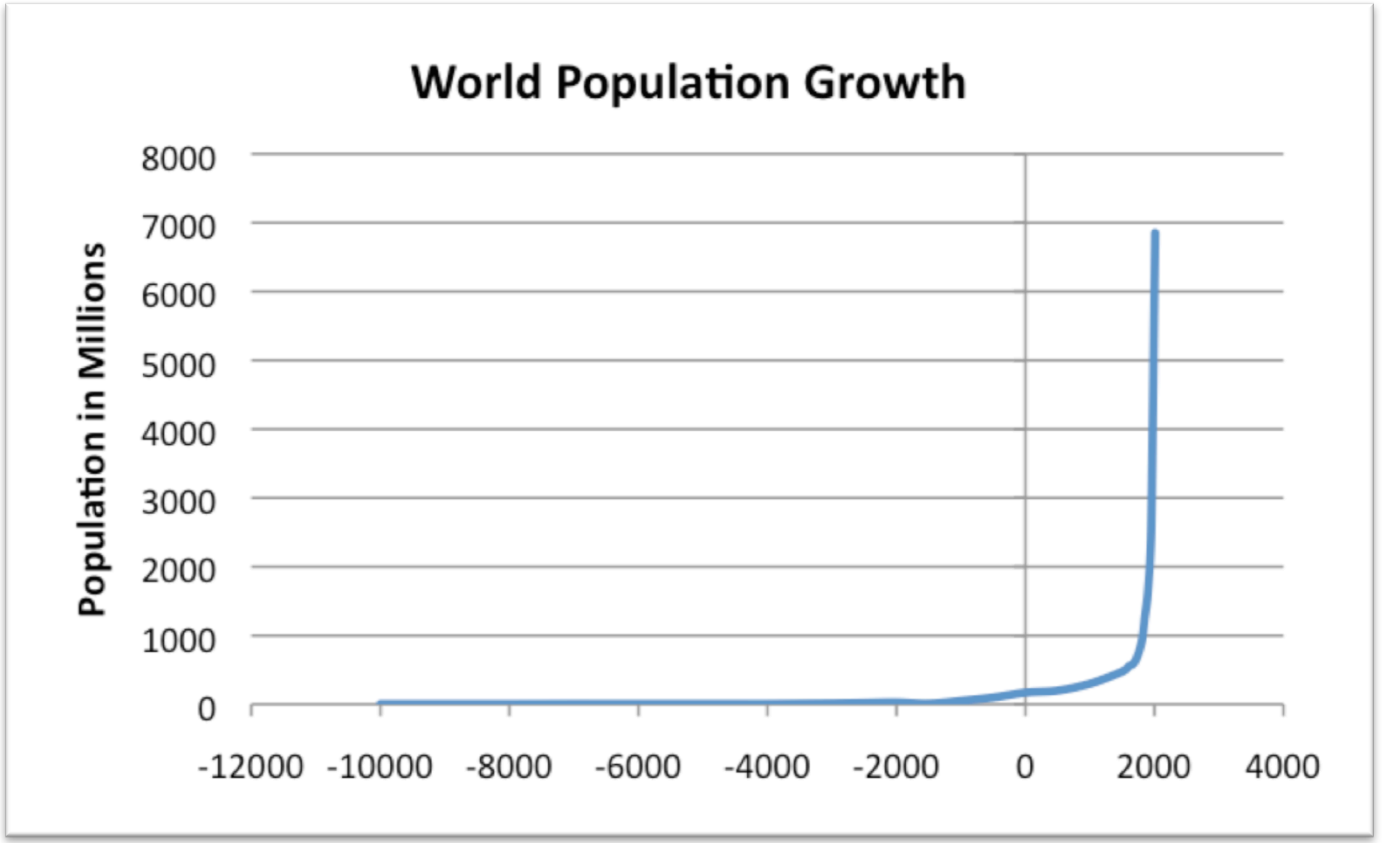
Reason #2 for Population Growth

- Agriculture ~ 10,000 Years Ago

Source: http://www.ars.usda.gov/is/graphics/photos/dec05/k5051-8.htm

Reason #3 for Population Growth

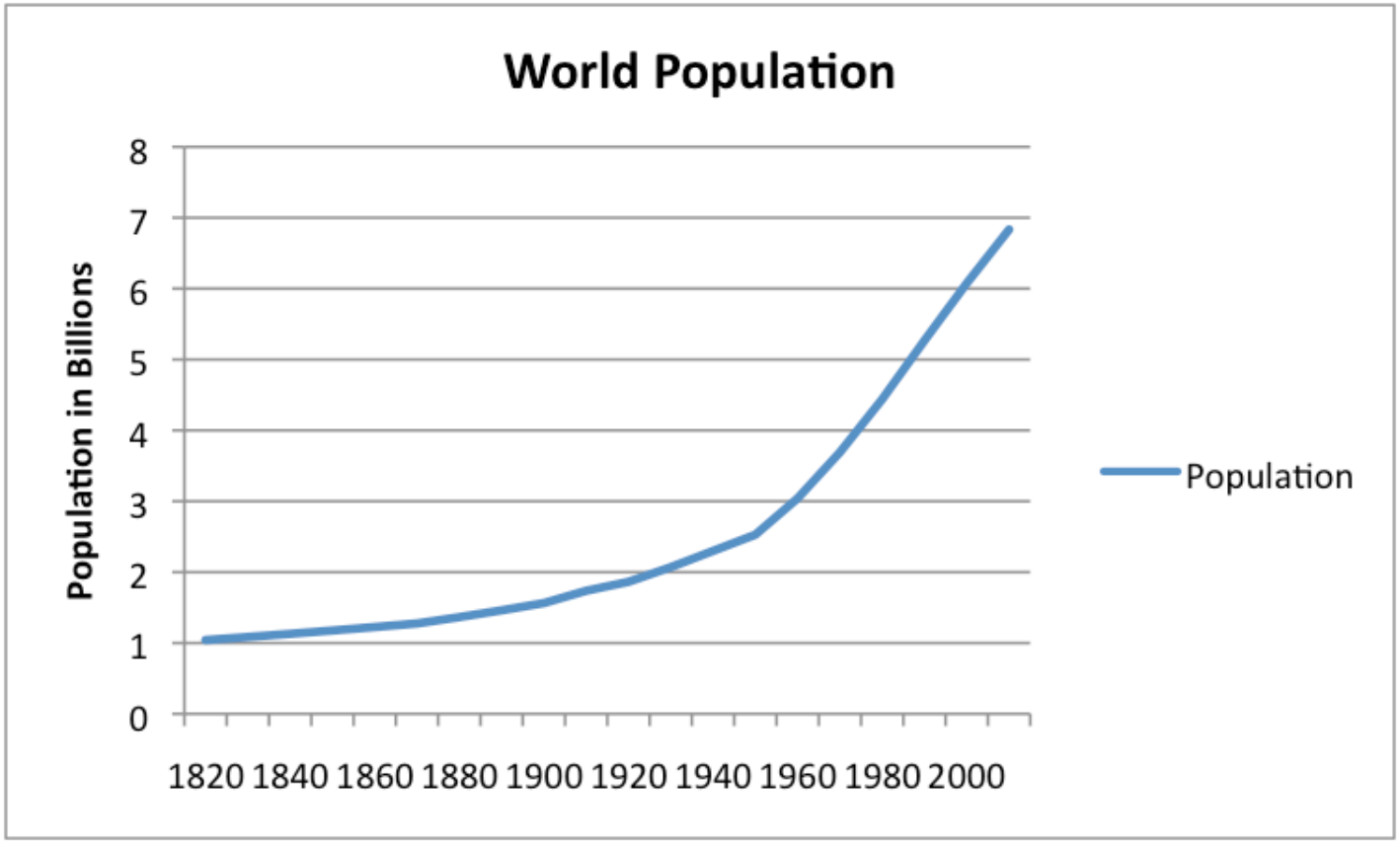
- Coal ~ 200 years ago



Source: US Census Bureau

Reason #4 for Population Growth

- Oil ~ 1945 on



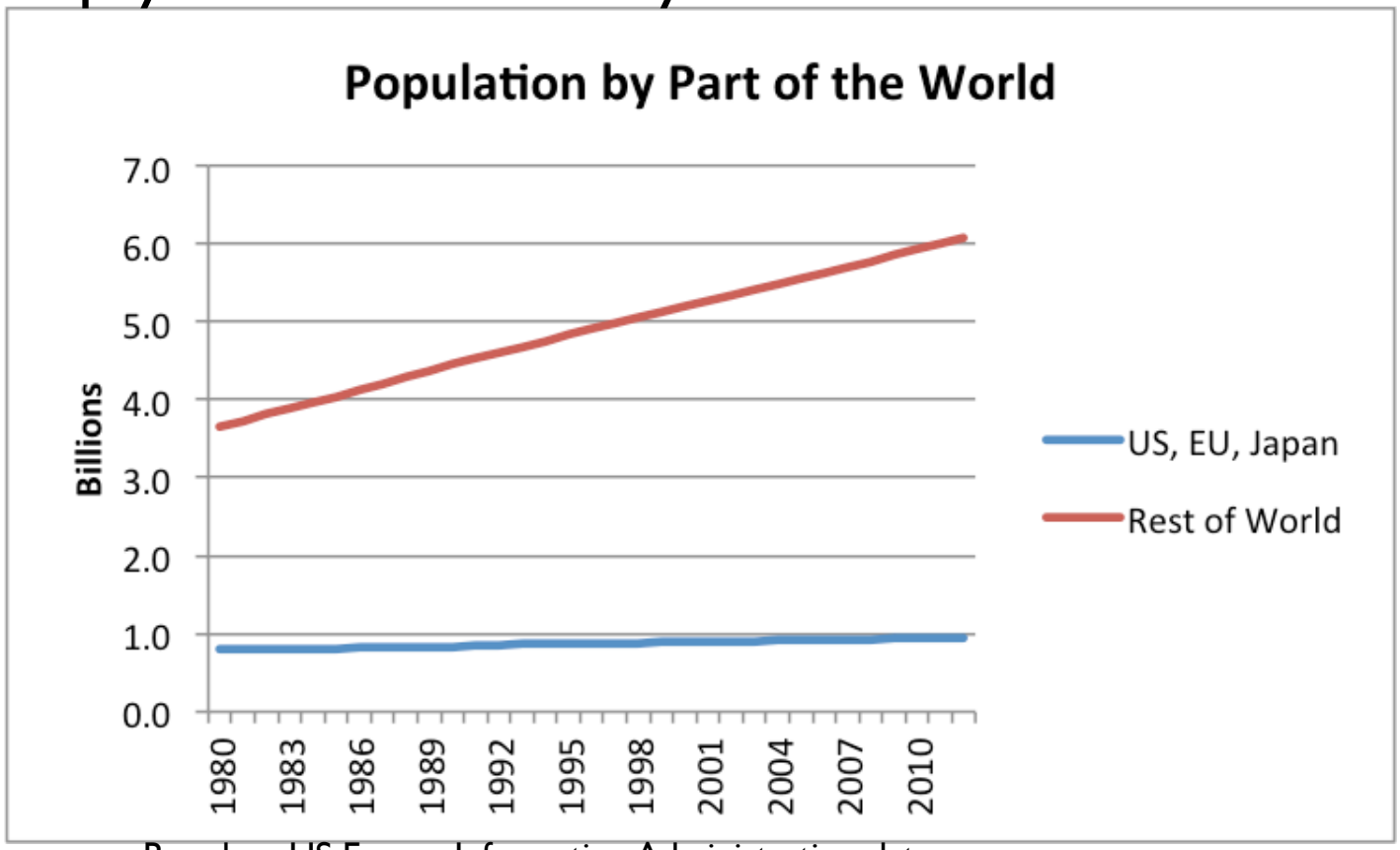
Based on Agnus Maddison estimates www.ggdc.net/MADDISON/oriindex.htm

Growing population – A problem!

- Less farmland per person
- Less wood per person (cooking, heating, making metals)
- Less readily accessible fresh water per person
- More resource extraction required
- Sixth mass extinction – other species

Can't easily stop population growth

- Contraception expensive
- Who pays for all the elderly?

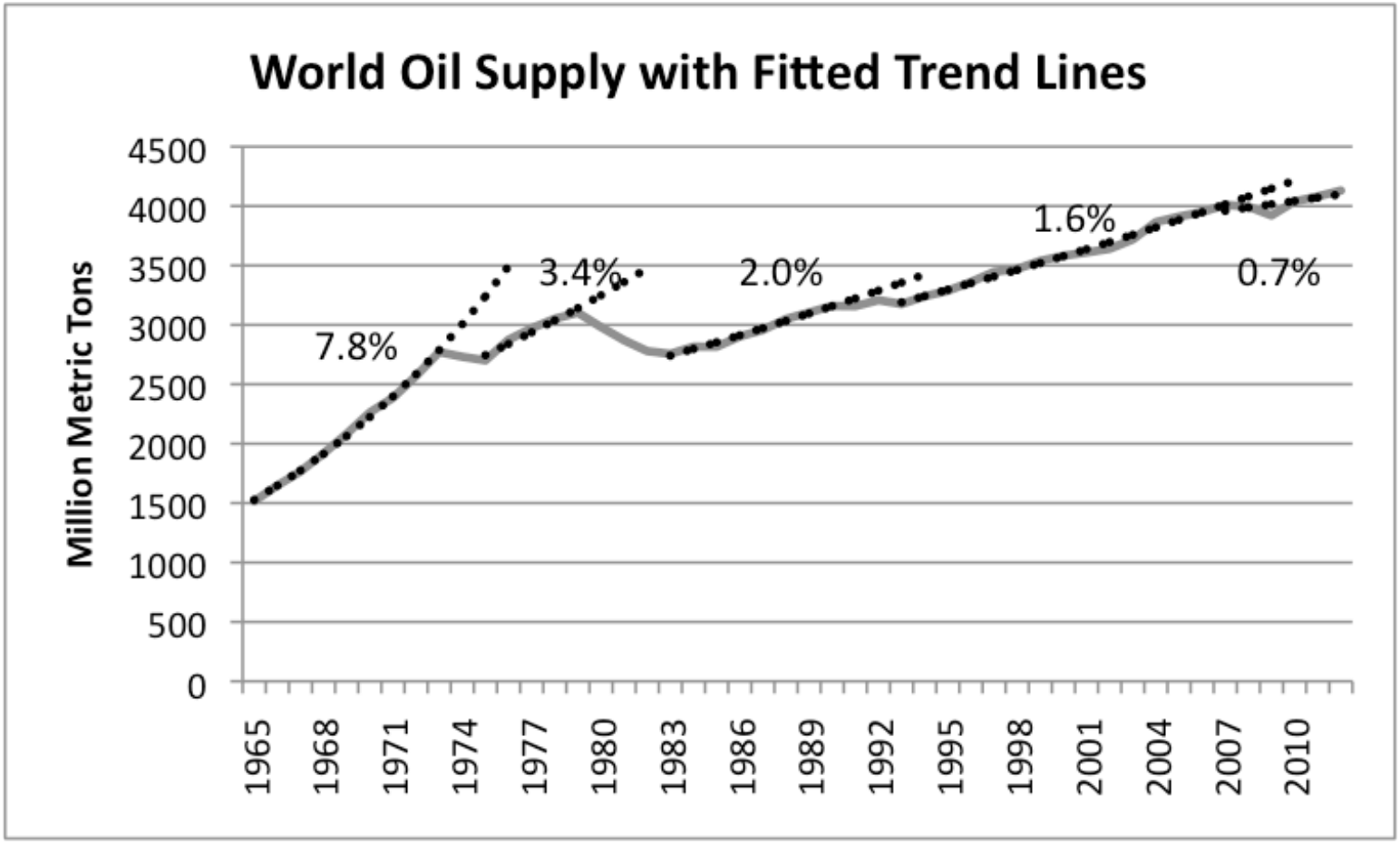


Based on US Energy Information Administration data.

2. Resource Depletion

- Problems in many areas:
  - Fresh water
  - Soil erosion
  - Fish
  - Pollinators
  - Deforestation
  - Minerals of many kinds
    - Gold, copper, platinum, phosphorous, etc.
  - Oil

Amount of oil extracted has been flat recently



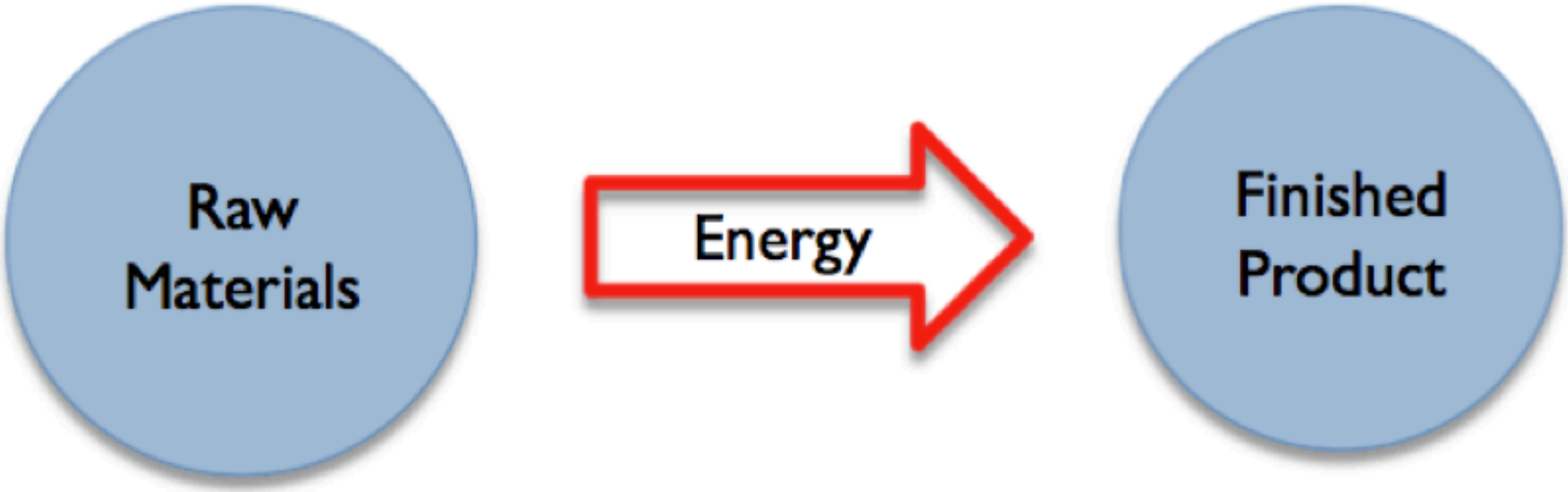
Based on BP 2013 Statistical Review of World Energy.

Shale oil

- Temporary growth in US oil
  - Little effect in world supply
- Estimates dropping
  - Monterey Shale estimate reduced by 96%!
  - Reduces total US resource amount by 60%
- Doubtful whether it is profitable

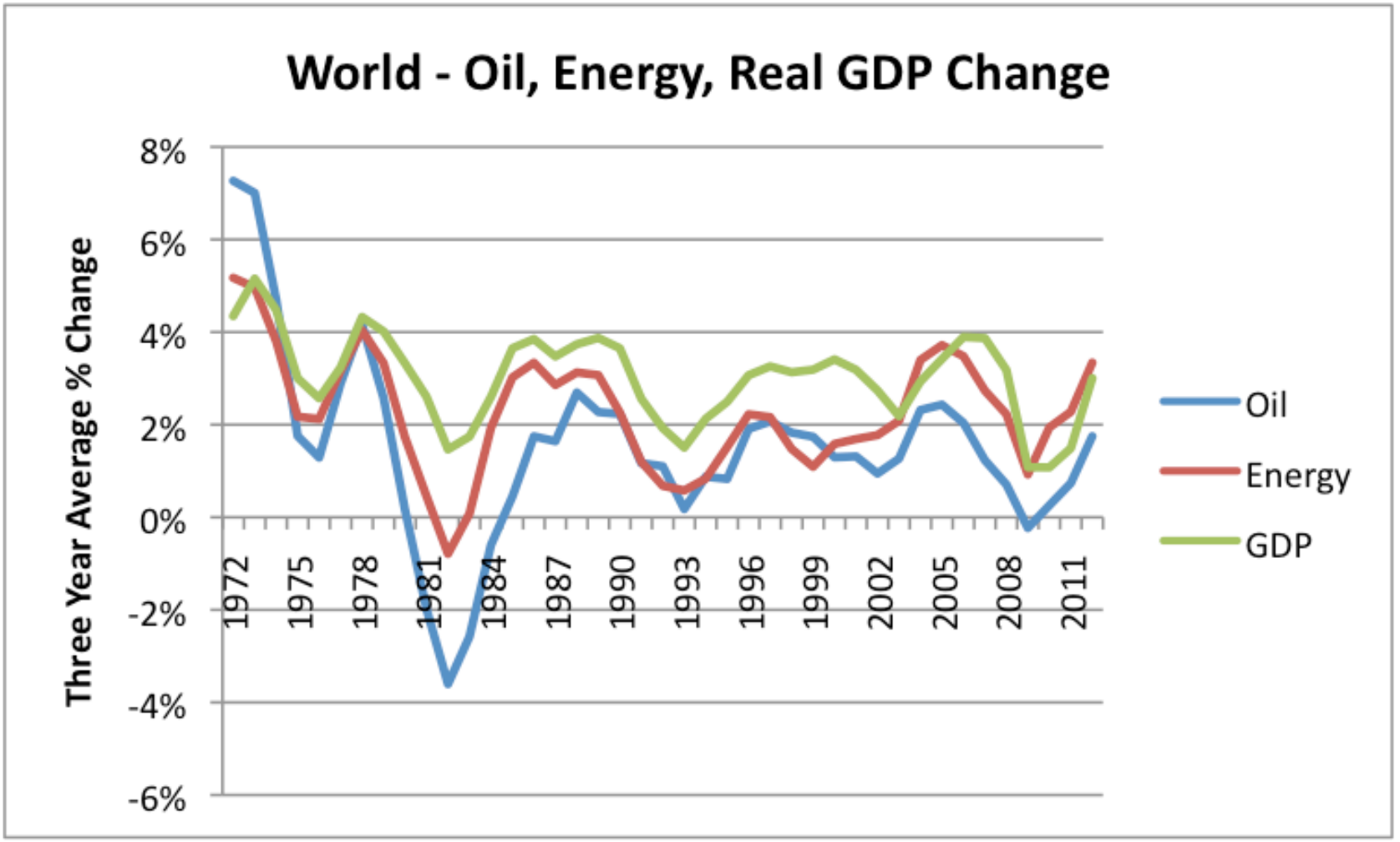
"Shale Drillers Feast on Junk Debt to Stay on Treadmill" –Bloomberg, Apr 30, 2014

Need energy of the right kind for economic growth

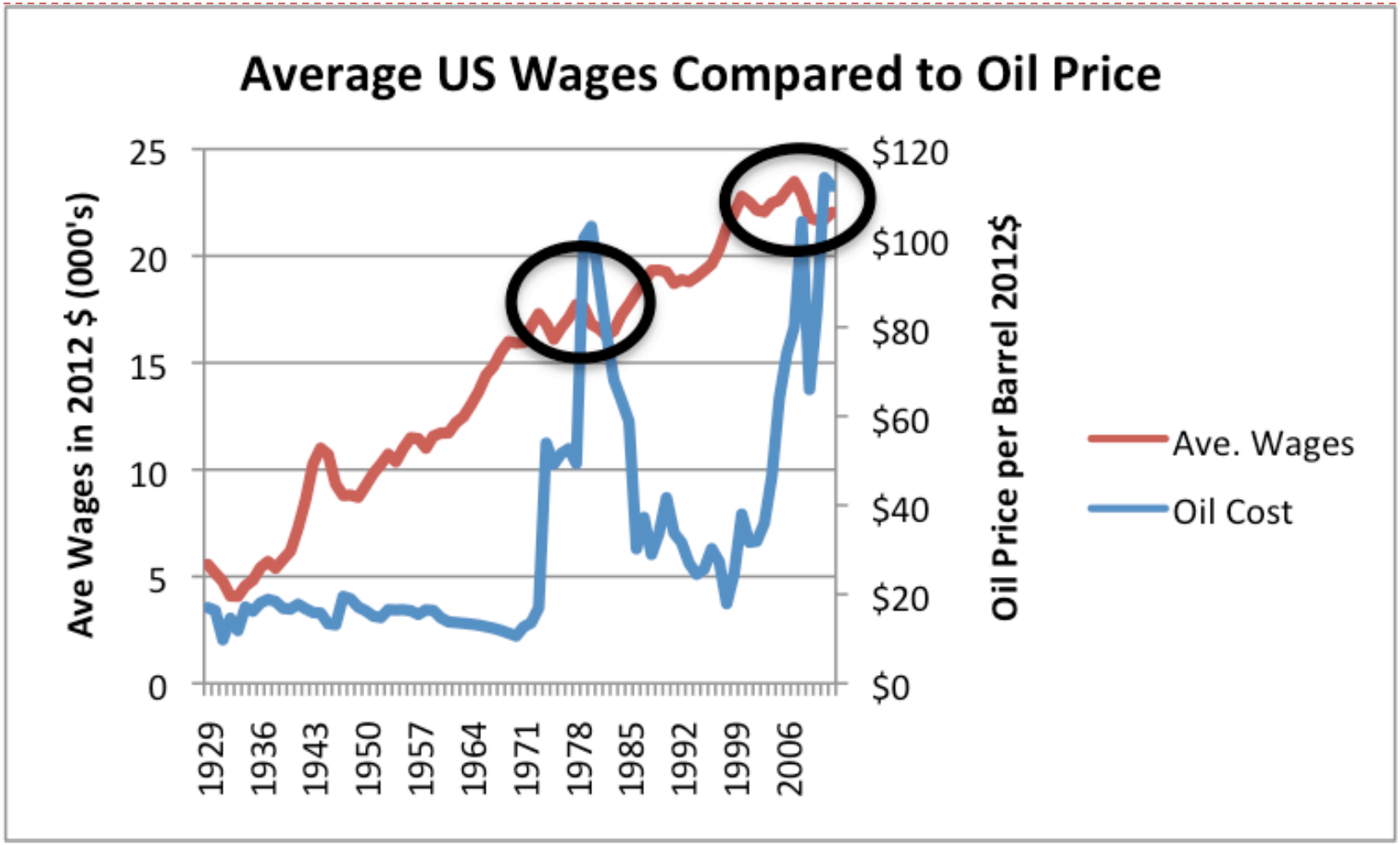


Based on BP 2013 Statistical Review of World Energy and USDA compilation of World Real GDP.

Economy grows as oil supply grows

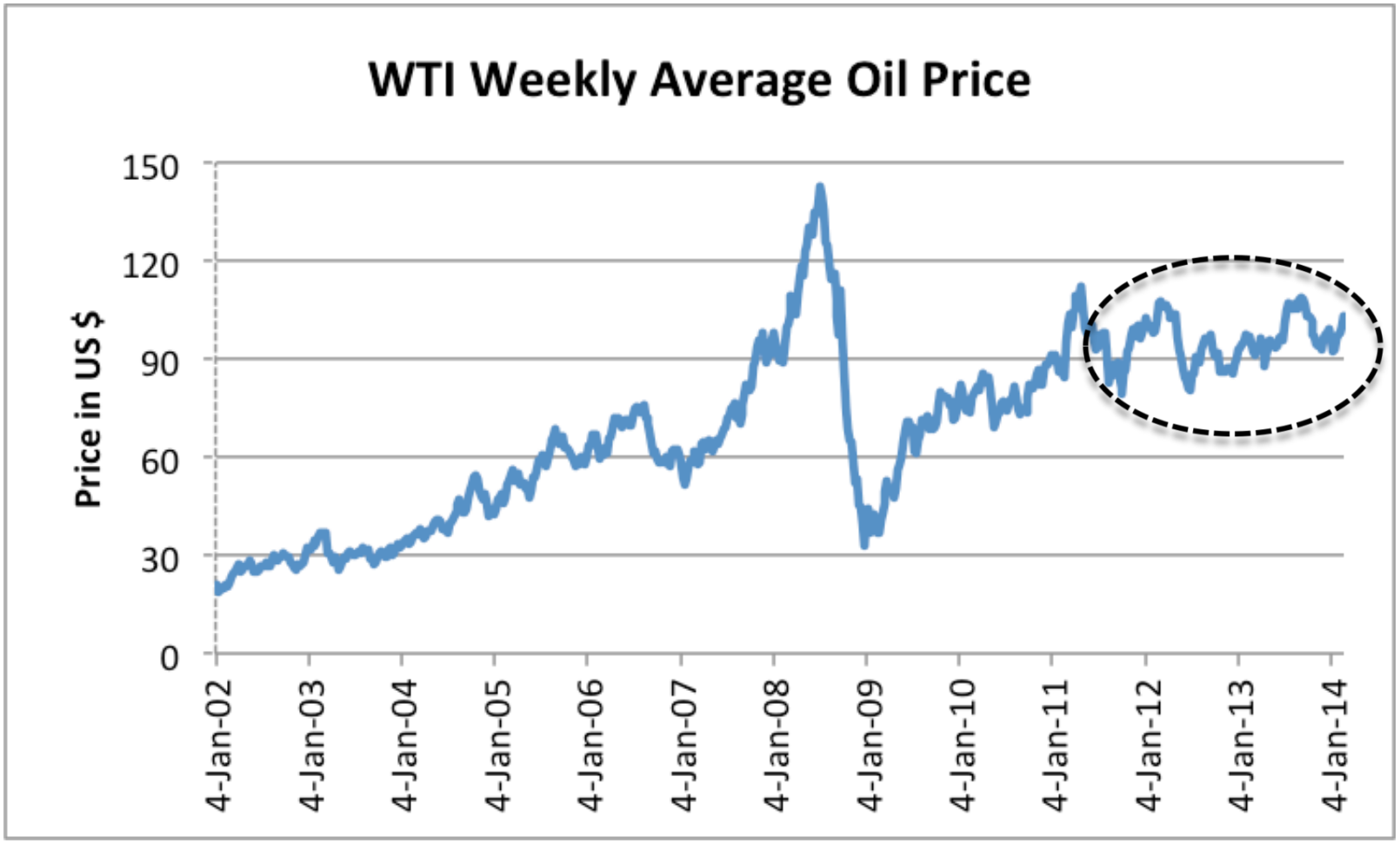


High oil prices lead to low wage growth



Source: Average wages are total US Wages from Bureau of Labor Statistics Table 2.1 adjusted to 2012 using CPI Urban, divided by *total* US population. Oil prices are from BP's 2013 Statistical Review of World Energy.

Right now, oil prices don't seem very high



Source: Based on US Energy Information Administration data.

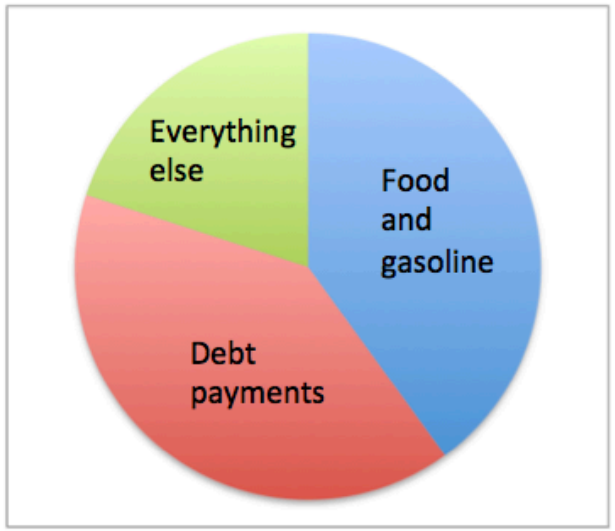
Oil prices are not high enough for oil producers

- Need to borrow to pay dividends
- Some companies may hit credit limit
- Some companies cutting back on new drilling
  - Shell oil, most majors
- Concern: "Quit and go home"

If oil prices rise, they become too high for consumer

Low oil price budget

High oil price budget



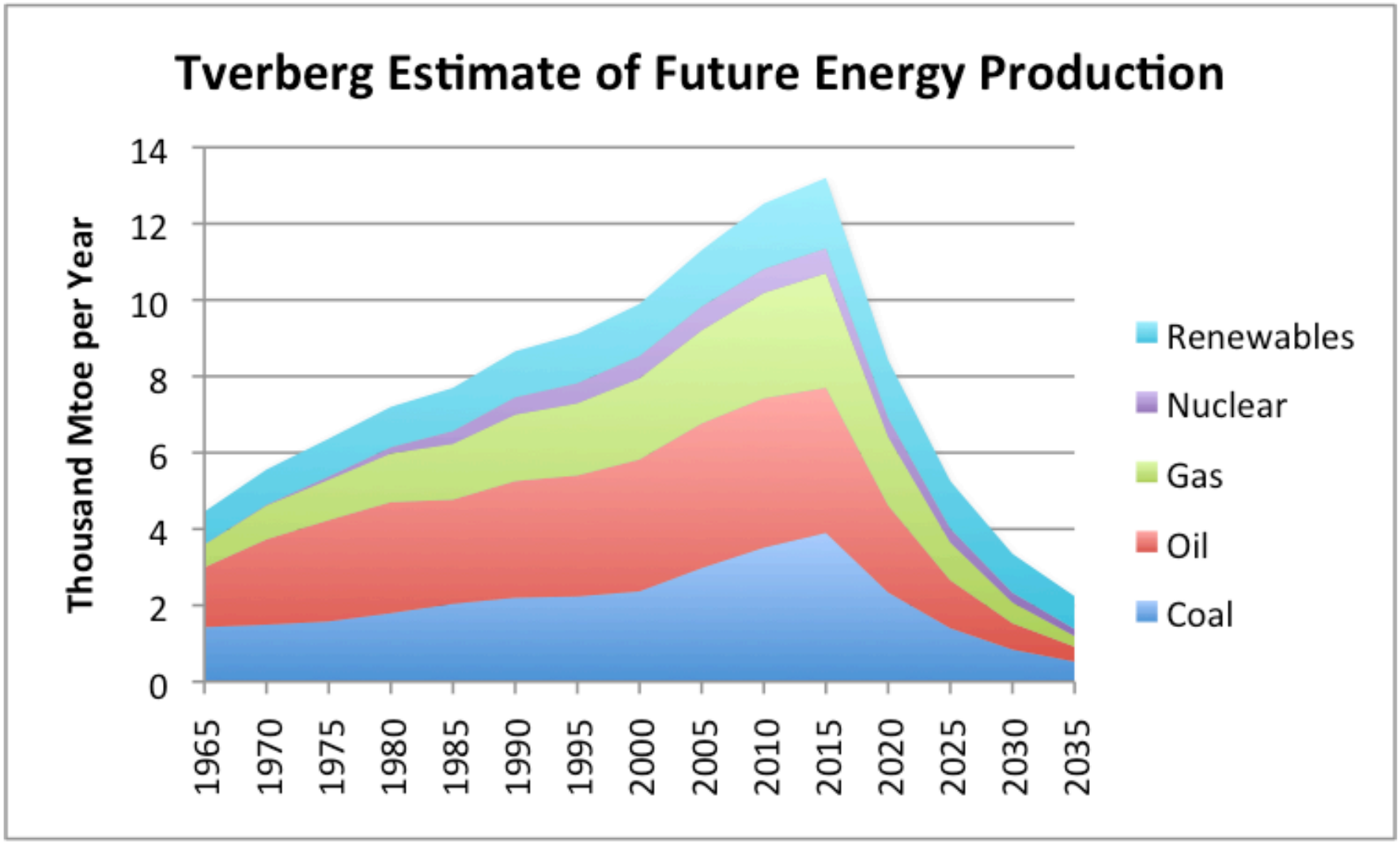
- Recession follows
  - Job layoffs

- Economist James Hamilton has shown that oil price spikes associated with 10 out of 11 recent US recessions!

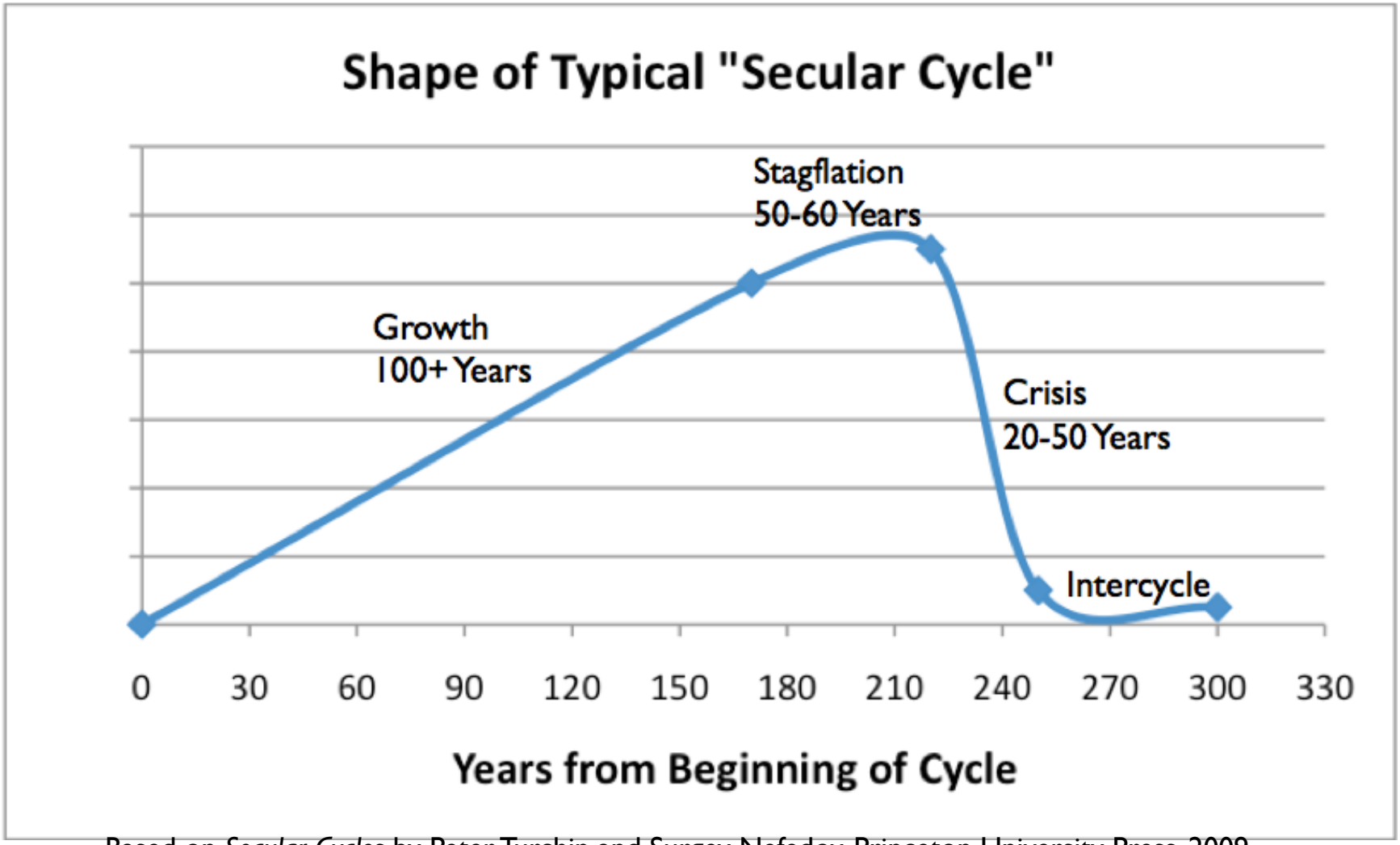
Danger of drop in oil production

- No oil price works
  - Low for producer
  - High for consumer
- Also debt connection – to be discussed later
- Combination likely to lead to steep drop off
  - Brings in all types of fuels simultaneously

Historical based on BP 2013 Statistical Review of World Energy, adjusted to IEA groupings.

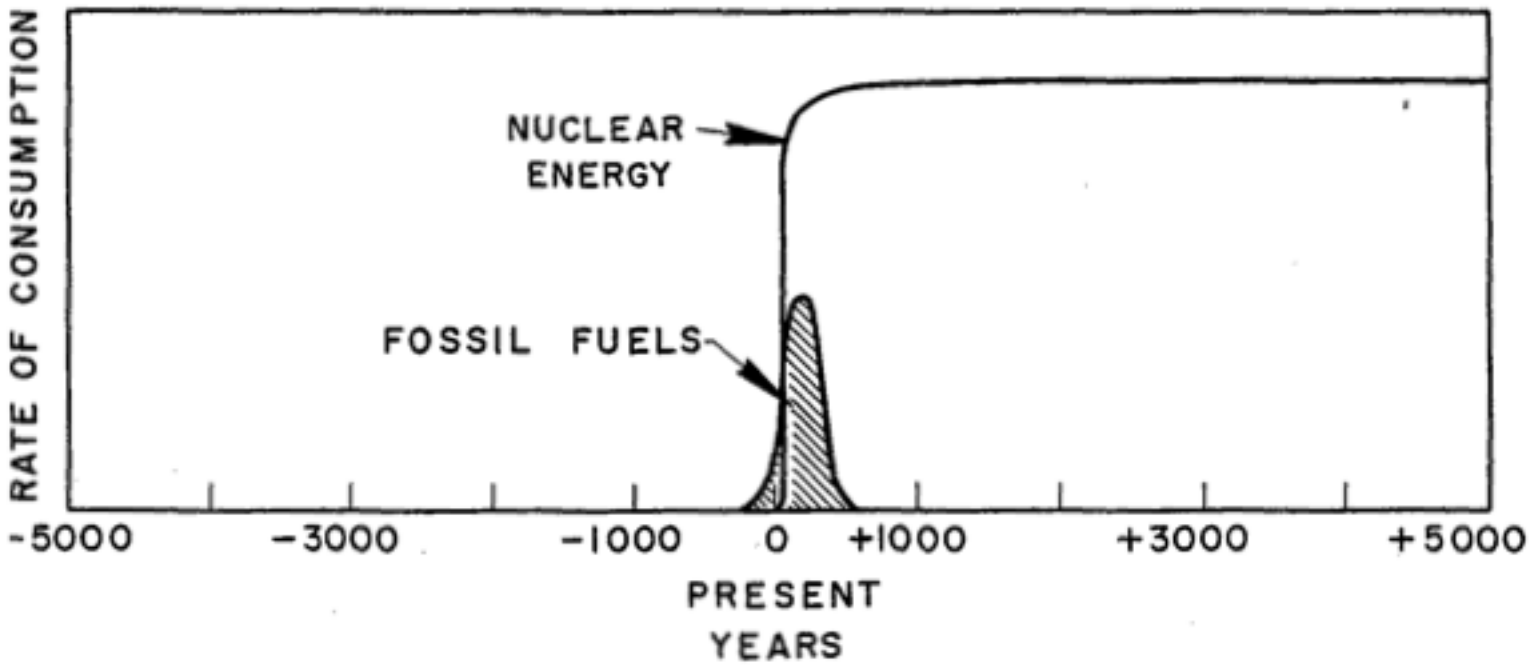

Tverberg Estimate of Future Energy Production
Thousand Mtoe per Year
14
12
10
8
6
4
2
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
Renewables
Nuclear
Gas
Oil
Coal

Shape of curve roughly in line with past collapses



Based on *Secular Cycles* by Peter Turchin and Surgey Nefedov, Princeton University Press, 2009.

Hubbert curve based on a very different scenario



gure 30 – Relative magnitudes of possible fossil-fuel and nuclear-
ergy consumption seen in time perspective of minus to plus 5000 years.

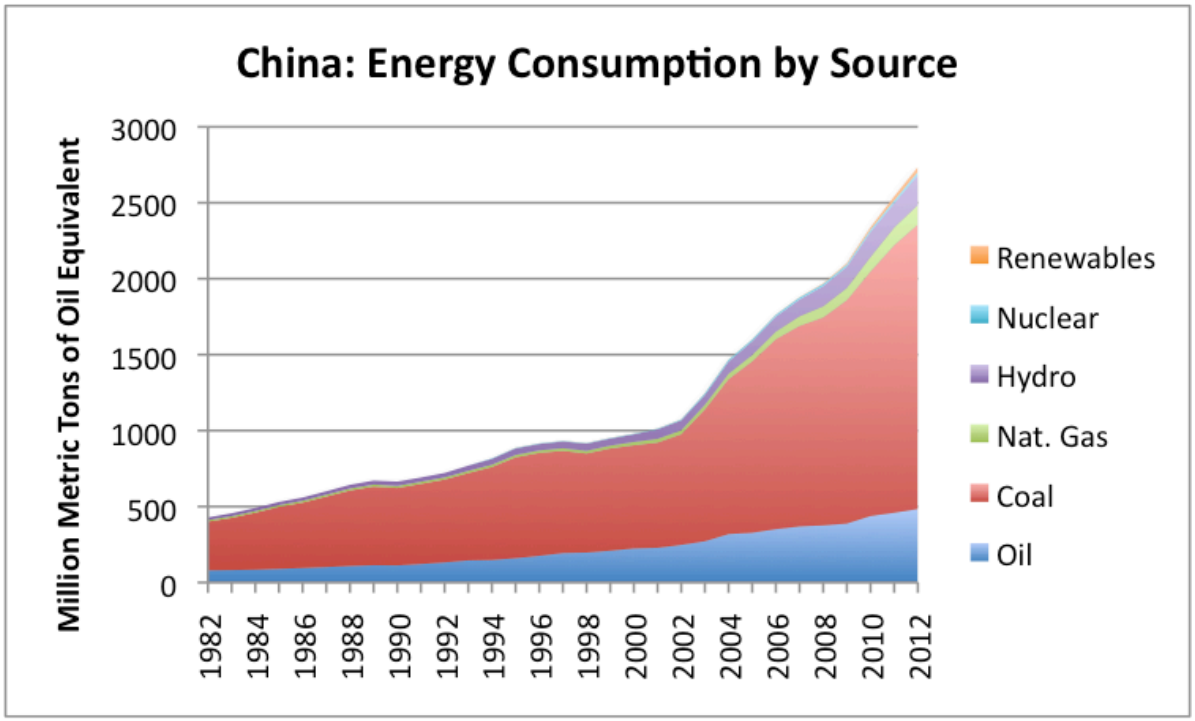
Source: M. King Hubbert, "Nuclear Energy and the Fossil Fuels," 1956, available at http://www.hubbertpeak.com/hubbert/1956/1956.pdf

3. Environmental Degradation

- Air pollution
  - Burning wood, coal, animal dung, etc.
- Soil degradation – salinity, loss of minerals, loss of carbon
- Ocean acidification
- Harm from extraction
  - Fracking for oil and gas harm aquifer
  - Oil spill harm
- Fossil fuel use in medicine, pesticides => unintended harm
- Climate change

Rapid rise in coal use in China => Pollution

- Occurred after China joined World Trade Organization in 2001



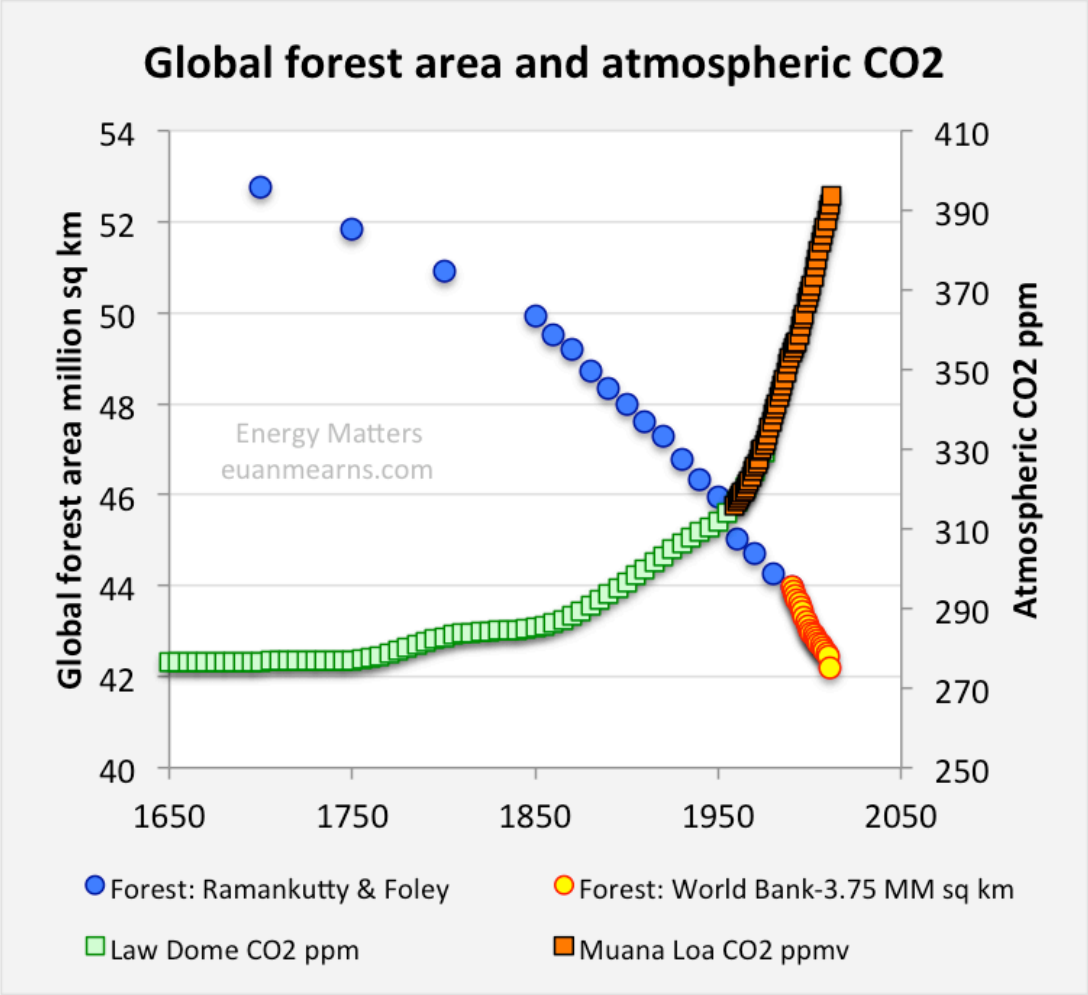
Source: Based on BP2013 Statistical Review of World Energy

- Now China cutting back because of pollution
  - Affects world economy

Climate change models: OK or not?

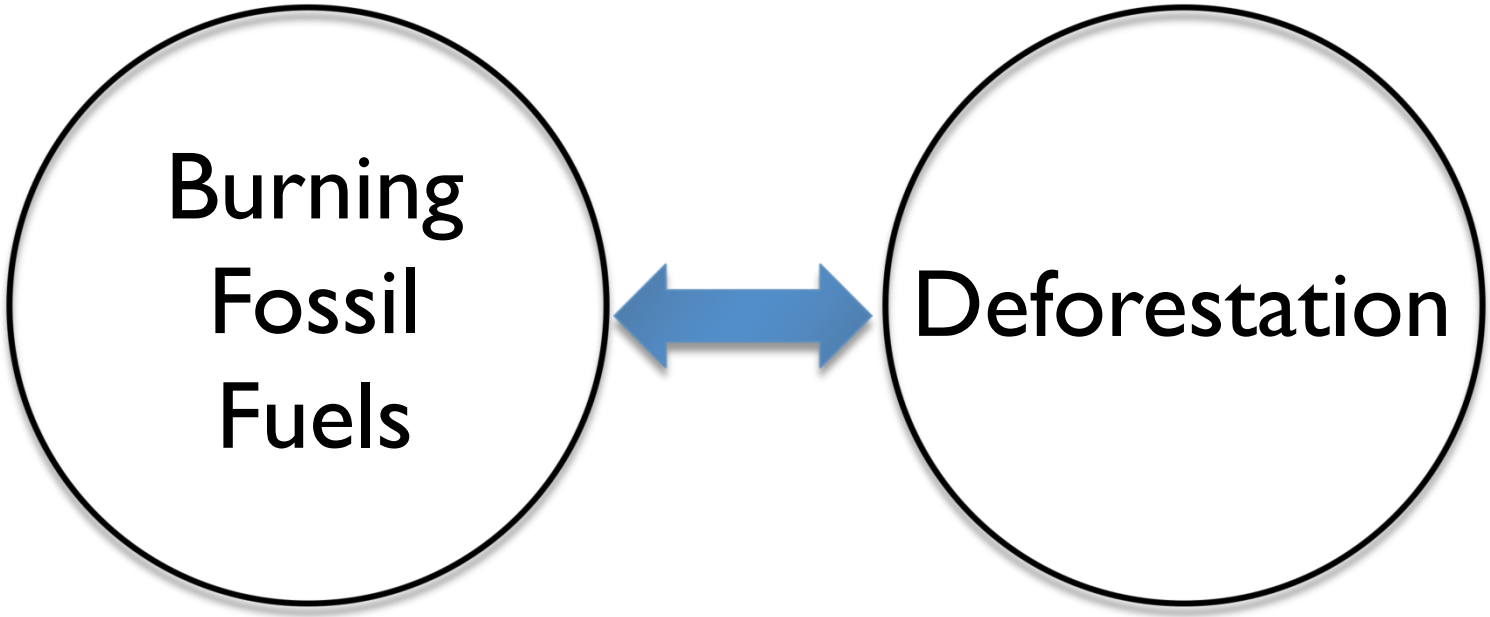
- 1. Hard to include everything relevant
  - Should deforestation impact be modeled?
  - How about changes in the sun?
- 2. Hard to use reasonable values for everything modeled
  - High end of fossil fuel emission range seems impossible
- 3. Climate is always changing
  - Hoping for a perfectly stable climate is unreasonable

Forest coverage has been shrinking with current policies, at same time CO_2 rising



Source: Chart by Euan Mearns of Energy Matters at euan.mearns.com

Which is worse?



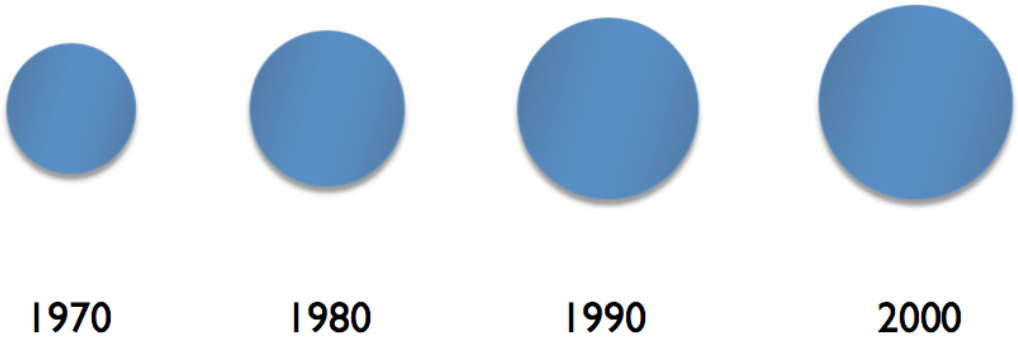
4. Financial System and Debt

- Financial system is like a computer operating system for the world
  - What gets made? What gets sold?
- Another analogy: Financial system is like the electric grid
  - Without it, everything stops
- International system is the issue
  - Problem is keeping everyone trusting each other
  - Debt is a big part of the system

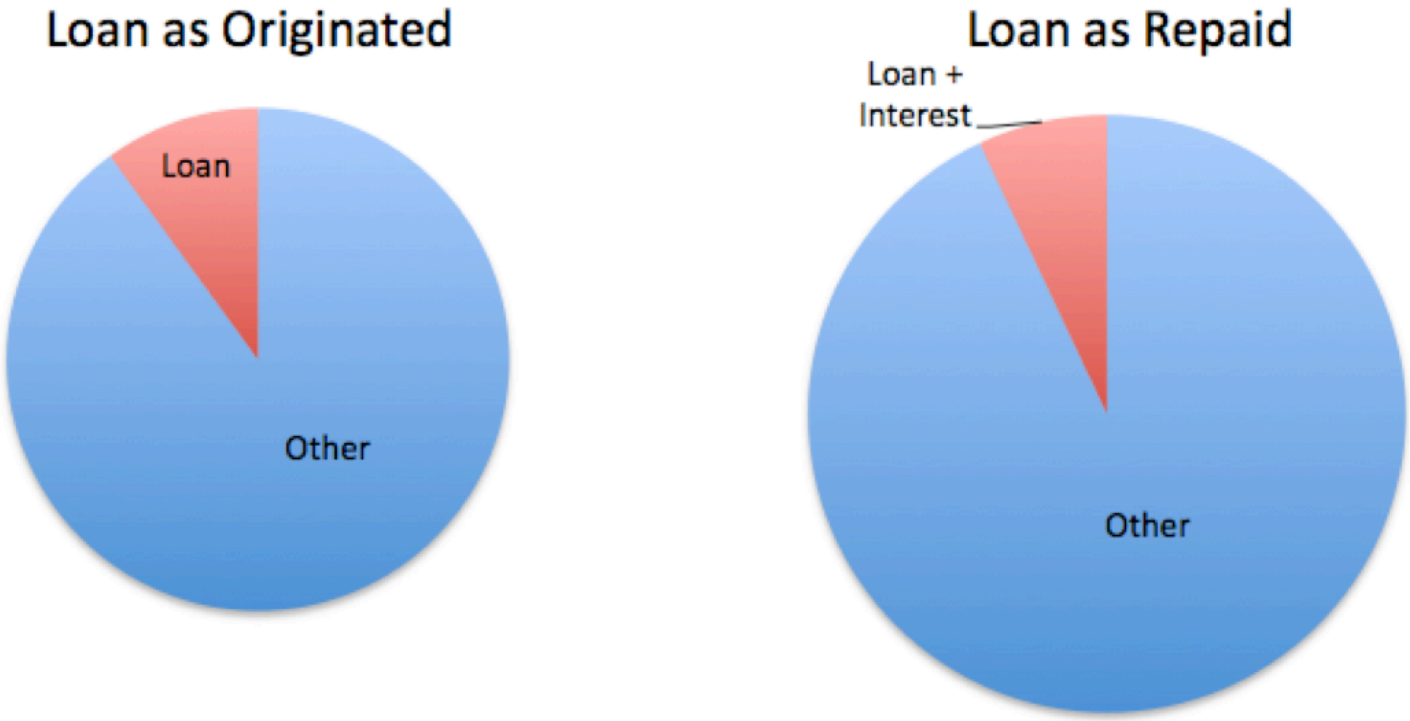
Adding debt makes the economic system "run faster"

- Consumer: Has $$ he never earned to spend
- Business: Can build new facilities, before profits are earned
- Governments: Spend money not yet collected in taxes

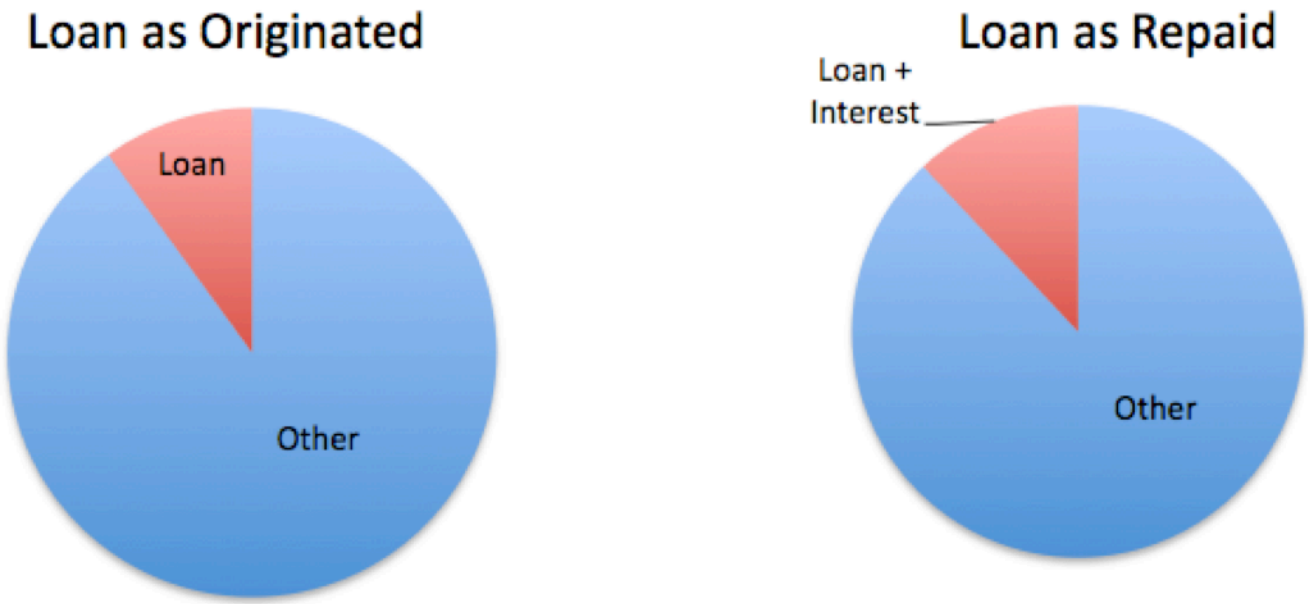
- Works if the economy is growing



Repaying loans is easy in a growing economy



Repaying loans is much more difficult in a shrinking – or flat - economy



Loans are essential to the system

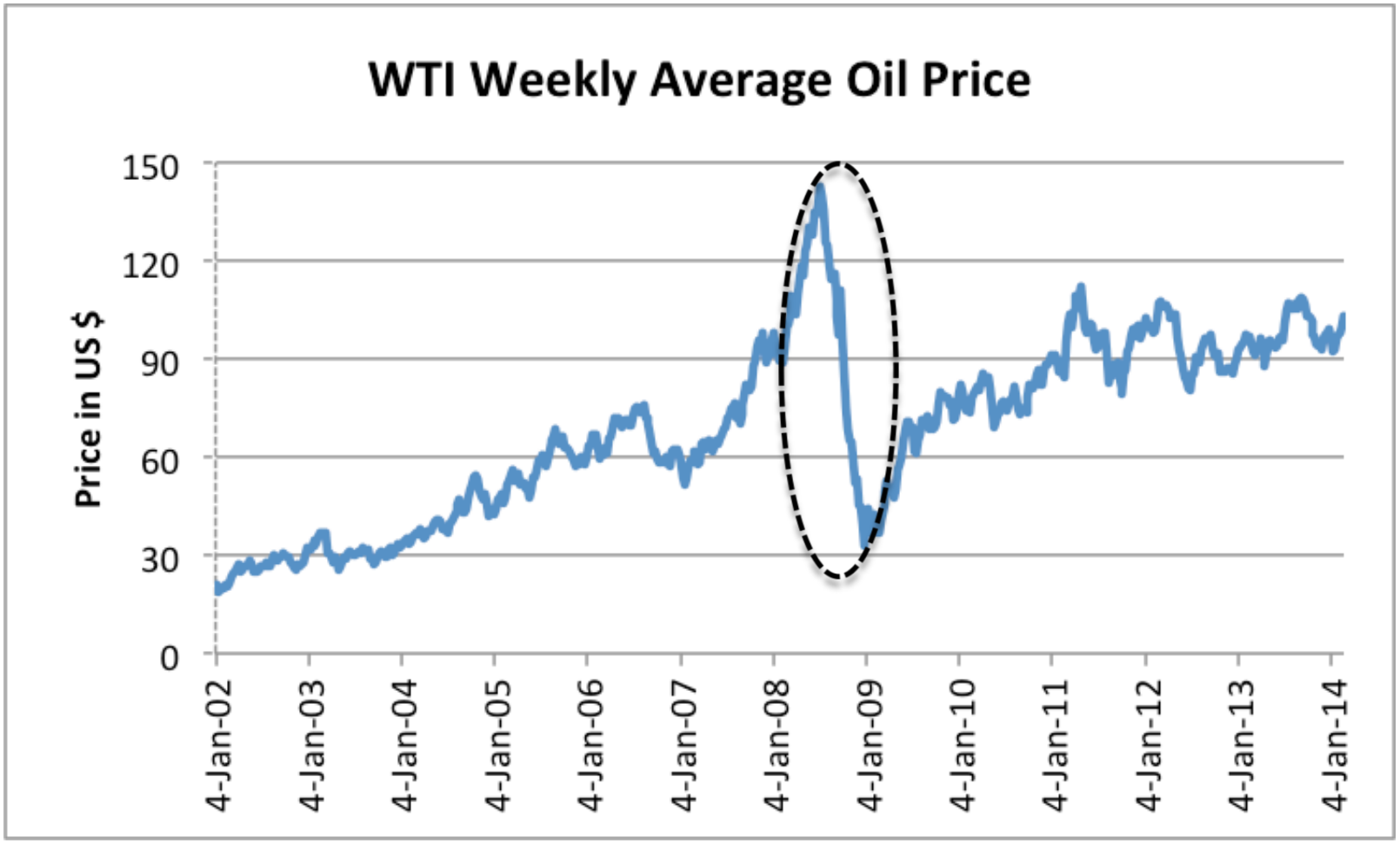
- Loans are promises
  - Hire a worker – use promise of pay
  - Buy something bigger than you can conveniently save up for
    - House
    - Factory
    - New car
  - International trade – promise payment will be "good" when merchandise ordered is shipped

- Danger is *loss of trust*
  - Too little chance of repayment

Loans have downsides

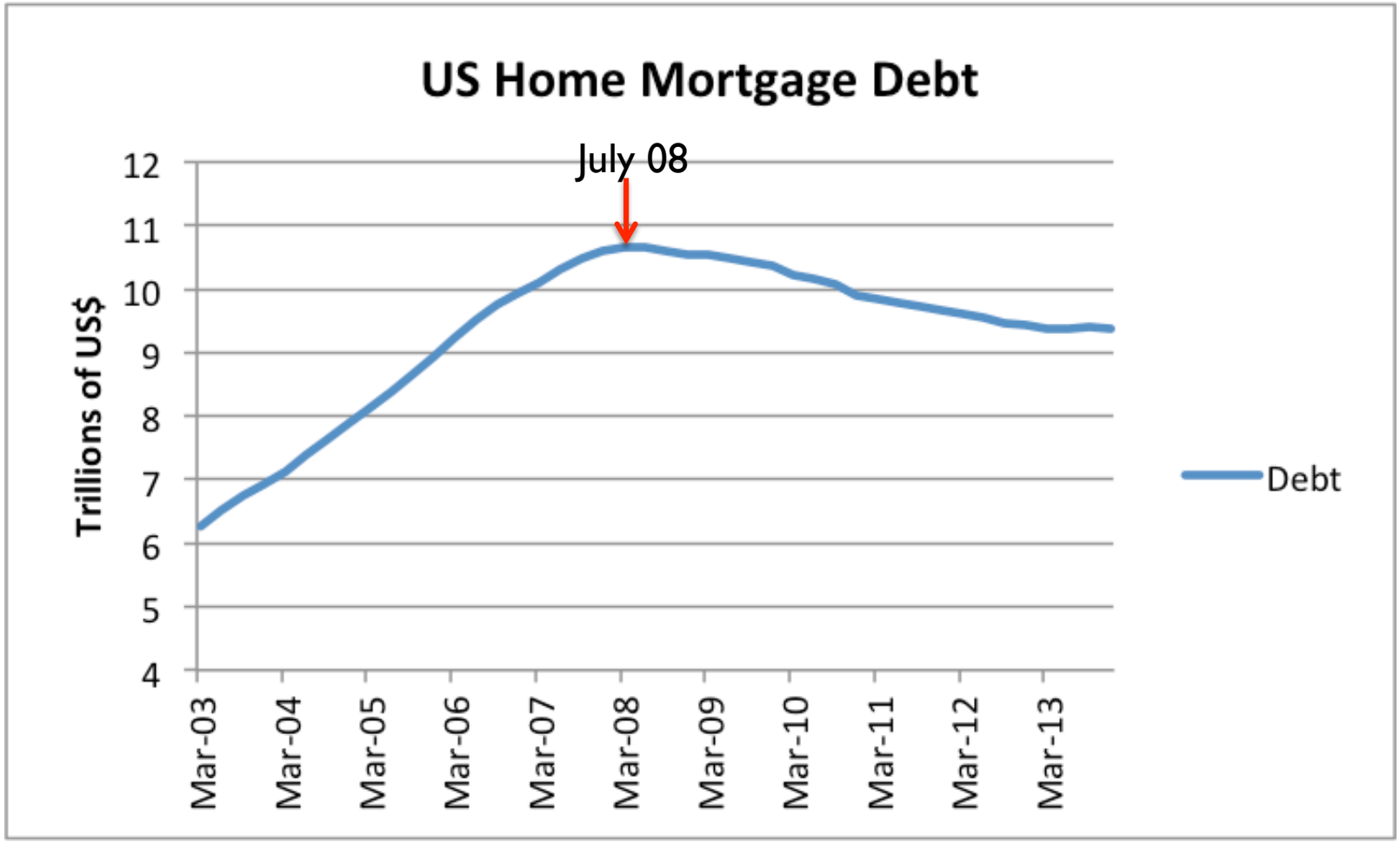
- Too much interest goes to "bank" (or "rentier")
  - => Growing income inequality
- If economy starts shrinking
  - Too many defaults
- Loss of loans => lower demand => low commodity prices
  - Can be huge problem
  - Oil companies stop extracting oil, if price too low

Big drop in oil prices was credit-related



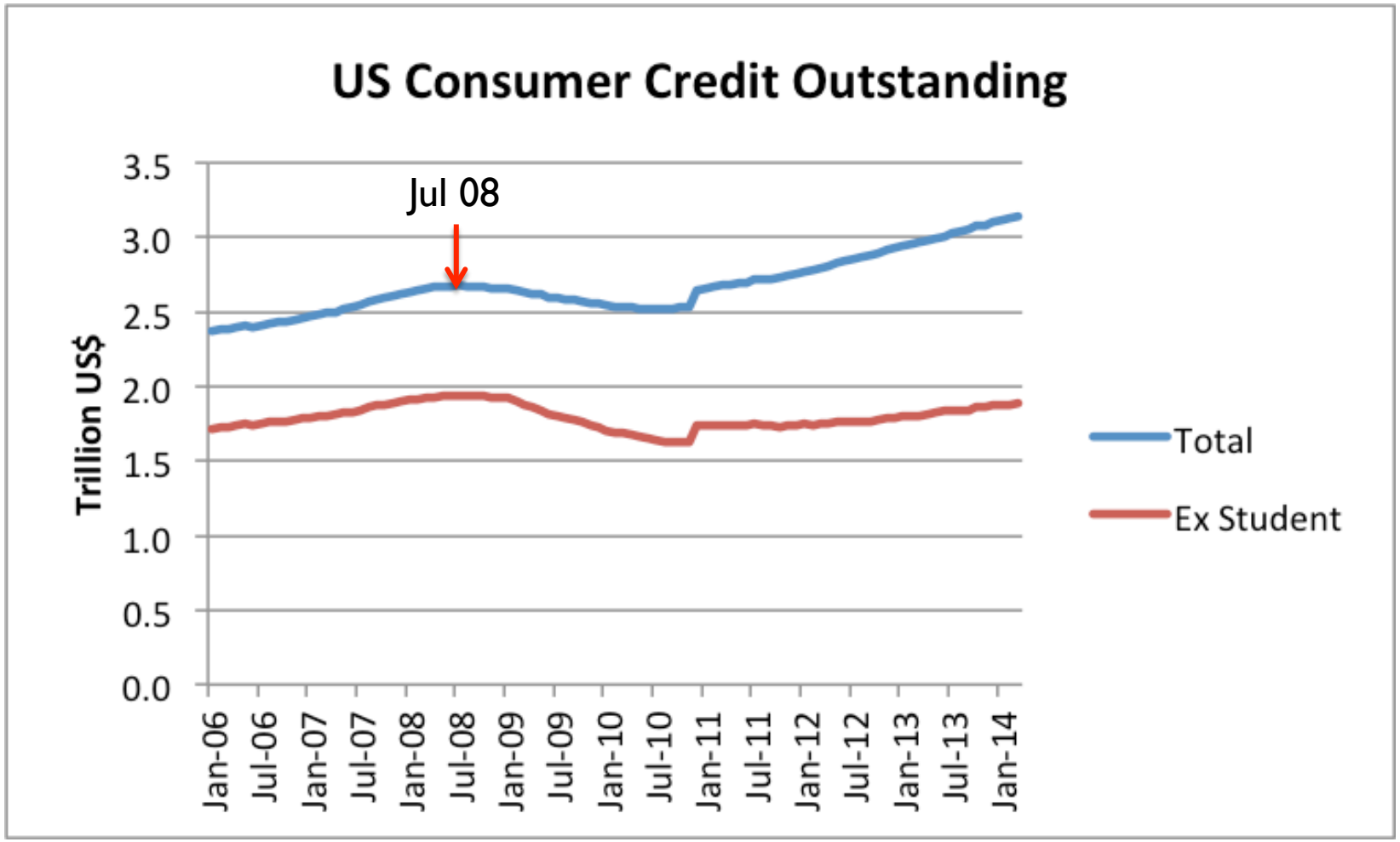
Source: Based on US Energy Information Administration data.

Amount of US mortgage loans outstanding dropped at same time



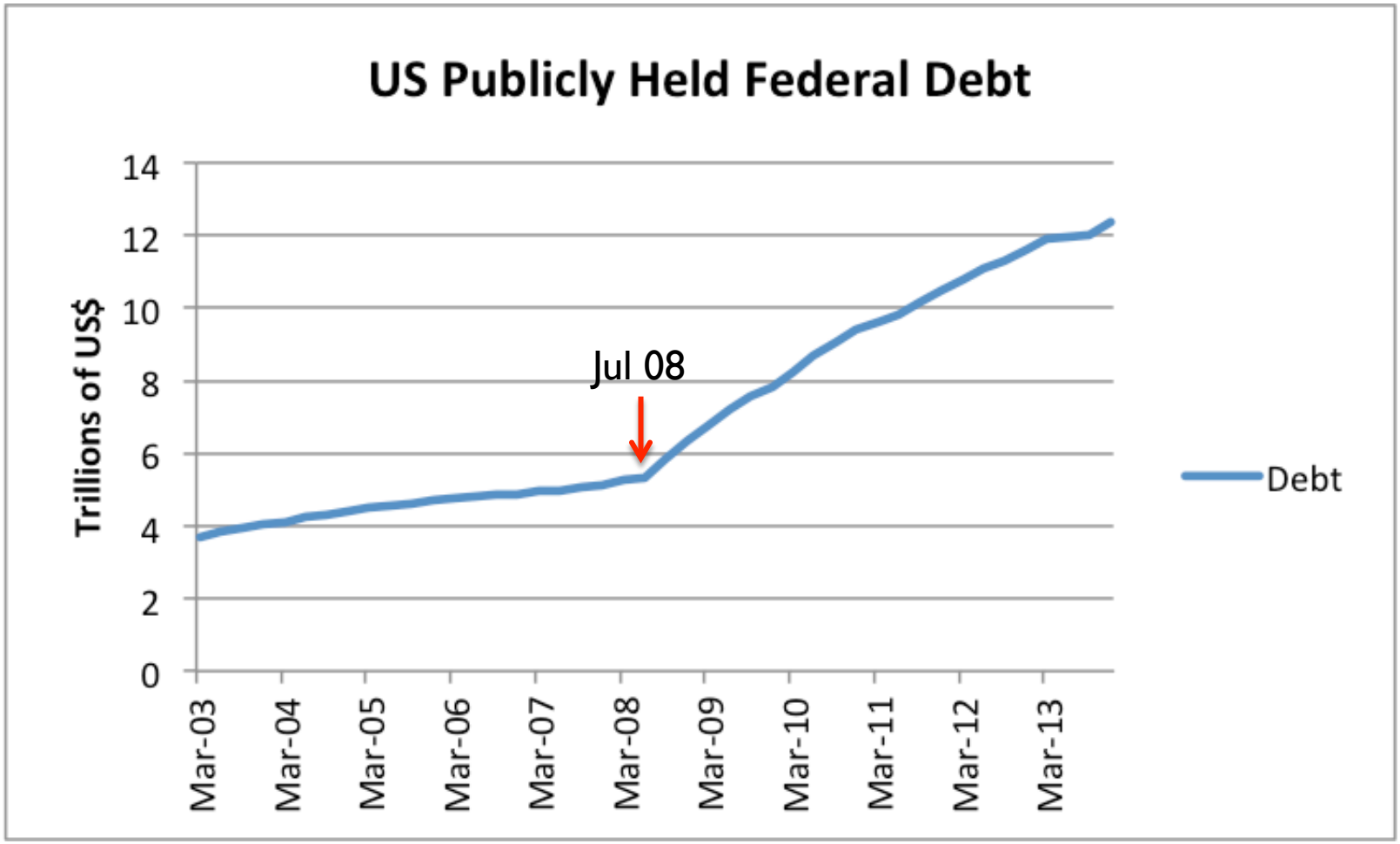
Source: Federal Reserve Z.1 Data

Amount of US consumer credit outstanding dropped



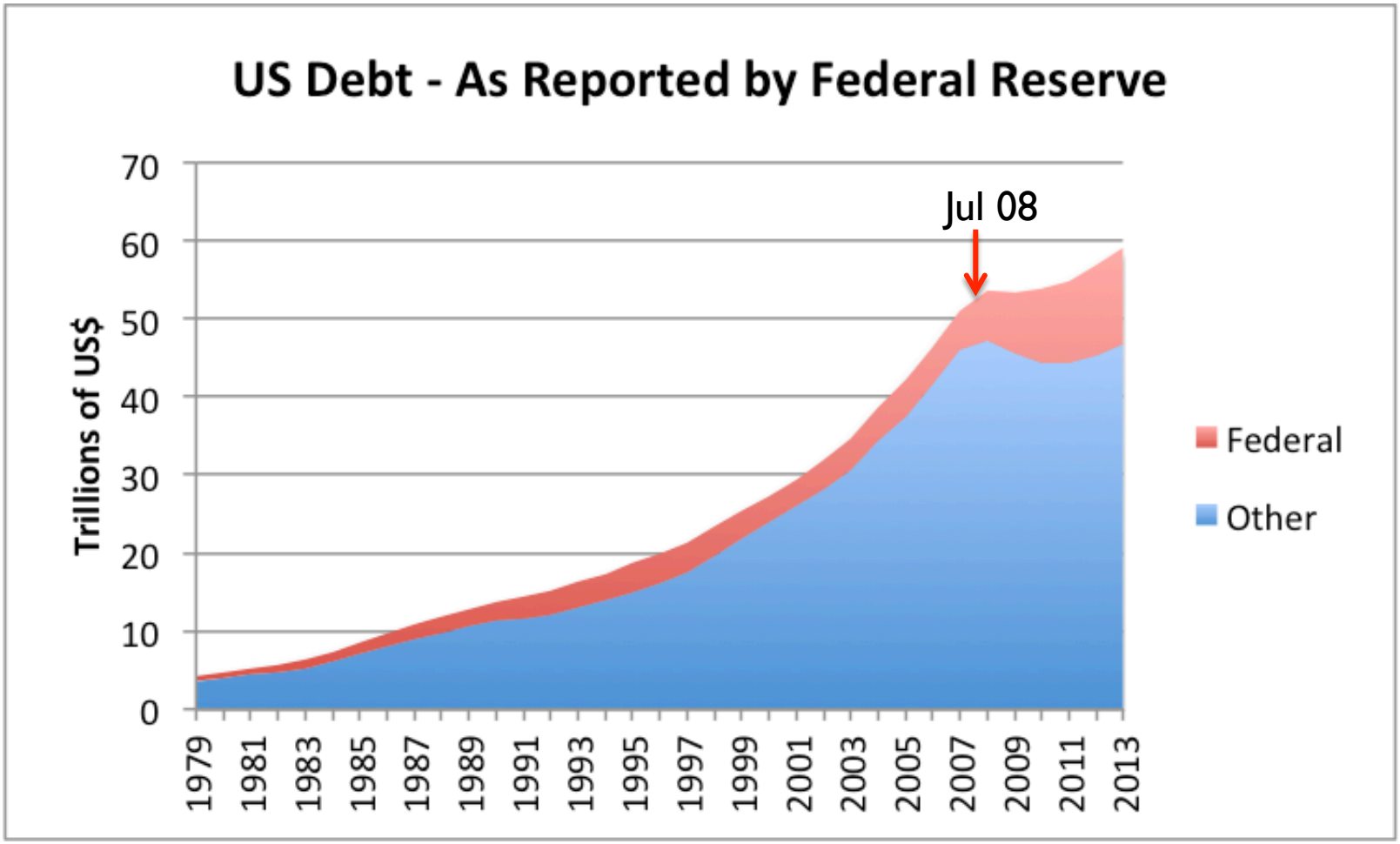
Based on Federal Reserve. (Student loan data estimated prior to Dec 08).

US Government debt suddenly soared



Source: Federal Reserve Z.1 Data.

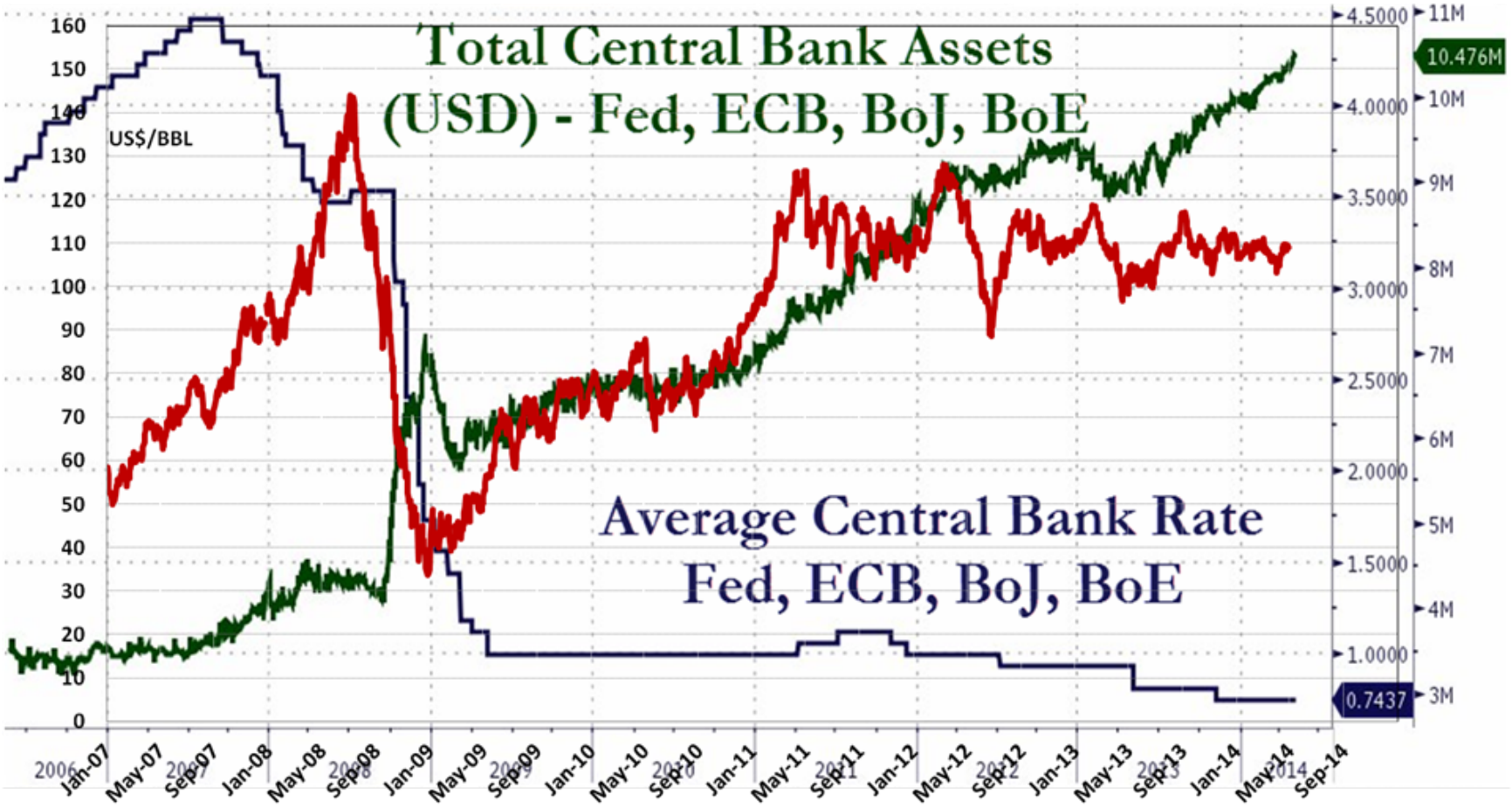
Even with Federal Government debt, total debt growth flattened



Debt System is in Serious Trouble

- Economy is not growing enough
  - Related to oil supply
- Reaching the point where it is impossible to keep non-government debt growing
  - Wages are too low
  - Young people can't afford expensive new homes, cars
- Have to keep interest rates low
  - Quantitative easing

Quantitative Easing has sort of worked



Overlay of oil prices on chart showing interest rates and central bank assets by Rune Likvern.

How long can current shenanigans last?

- Low interest rates create problem for pension plans
- US currently discontinuing Quantitative Easing
  - But strange happenings in Belgium
- Rising interest rates will sink the economy
  - Oil prices will drop
- Concern is debt defaults
  - Also follow-on loss of confidence

Impact of "Loss of Trust" on loans

- First affected
  - Countries in trouble: Greece, Cyprus
  - Consumers with low credit scores
  - Marginal businesses
    - Like shale oil/gas drillers
    - Or small companies in oil drilling "chain"
- Eventually
  - Long-term loans in general
  - Countries without good trading record
  - All but the most local, shortest-term loans

5. Government funding issues

- Government is funded by the surpluses of an economy

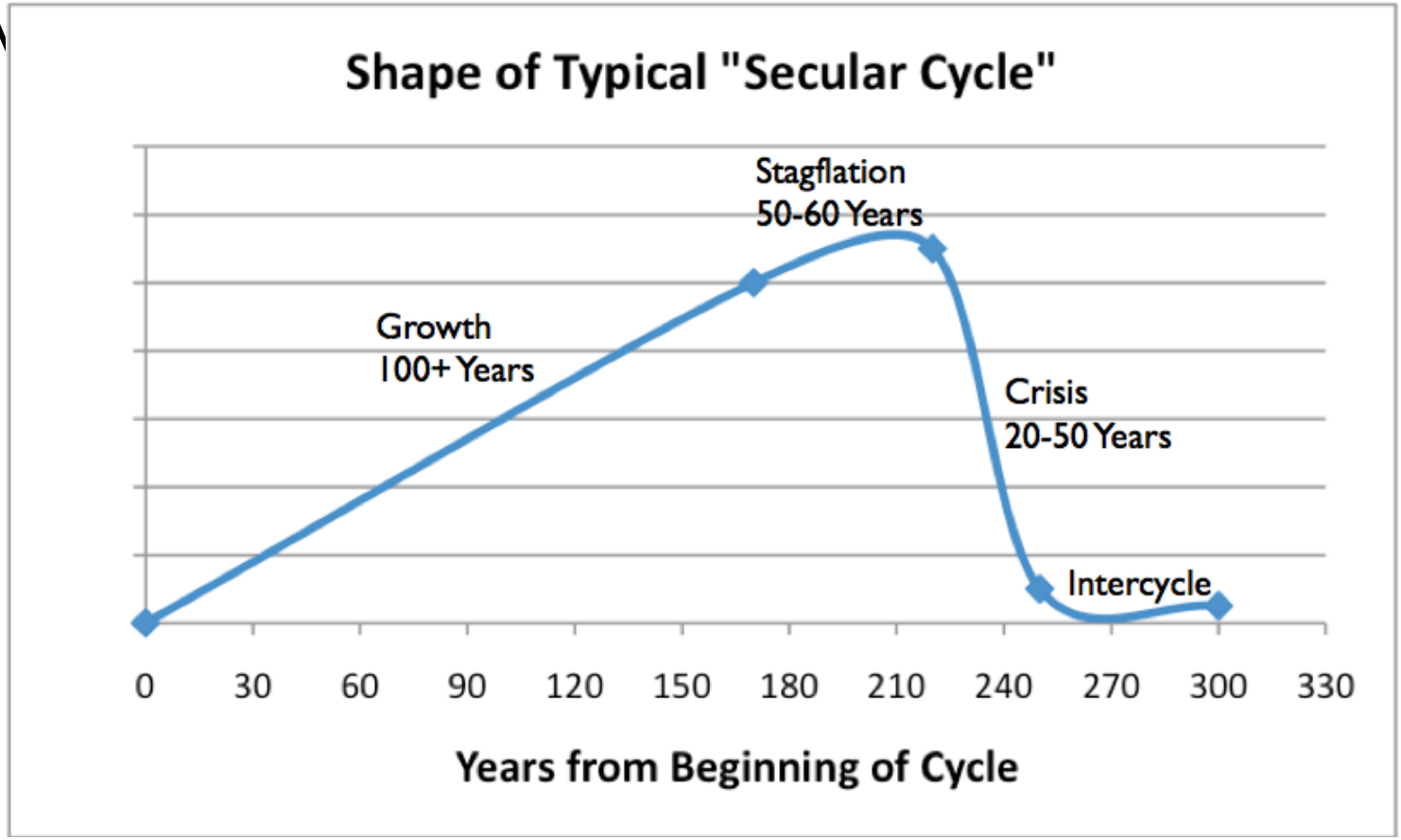
- Empires find it harder to maintain their armies
  - Can't afford the army; collapse back to smaller size
  - Example: Collapse of Former Soviet Union

- Poor societies can only afford kings, dictators
  - Few programs to benefit the poor; elderly

- Rich societies can afford democracy
  - Also programs to take care of the poor, elderly

Turchin and Nefedov: Government funding was often a factor in collapse

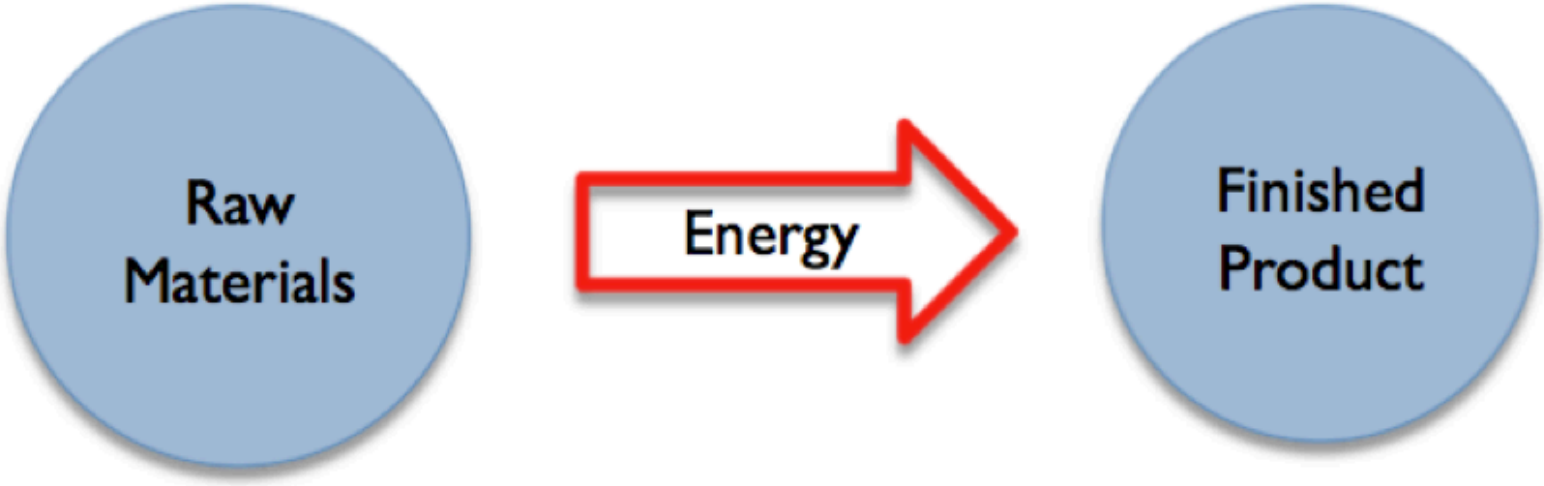
- Diminishing returns: Needed higher taxes; wages low



Based on *Secular Cycles* by Peter Turchin and Surgey Nefedov, Princeton University Press, 2009.

6. Jobs Availablity

- Energy transforms raw materials into finished goods



- Too little energy => disappearing jobs
- Still can dig in dirt with a stick
  - Example of job not requiring energy

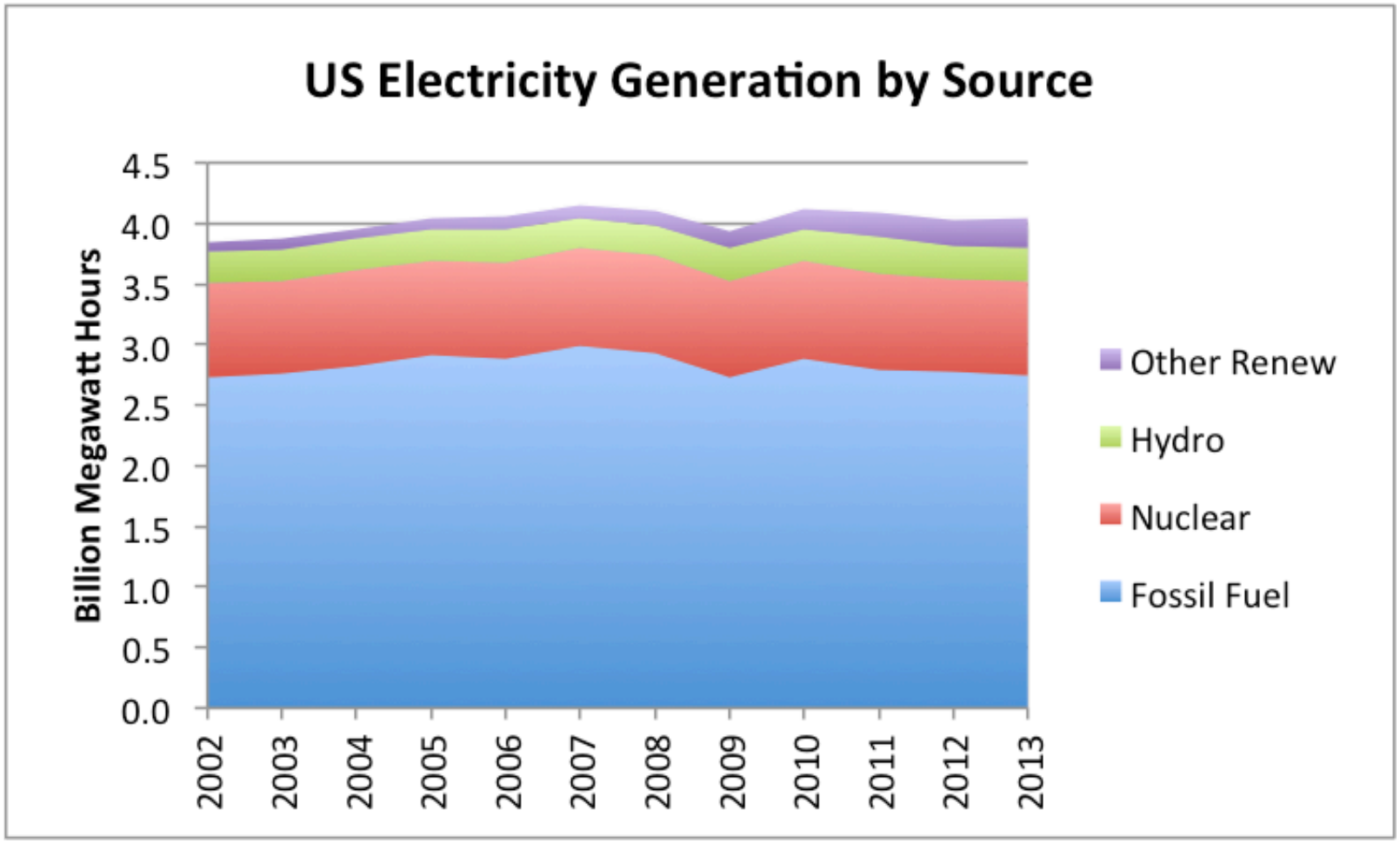
7. Electrical Grid Problems

- Myth: Electricity will save us if oil is a problem
- Reality (1): Electricity costs poised to rise
  - Add to our oil-based problems
- Reality (2): Electric grid likely to outlast oil by at most a few years
  - Too closely networked with rest of system

Why Electrical Grid Can't Last

- Electricity infrastructure – mostly very old
  - No company has economic incentive to upgrade it
- Oil is necessary to maintain electric grid
- Cutbacks on coal, nuclear likely to affect electric grid
- Natural gas is not ready for the role many would like
  - The US is still a natural gas importer

Electrical grid mix changes slowly



Source: US Energy Information Administration.

Electrical Grid Problems

- Adding intermittent renewables adds grid problems
  - Load balancing
  - Higher cost
  - Utilities in financial distress (Germany)

- Corollary: If you want electricity long-term,
  - Do it yourself
  - Do it off grid
  - Stockpile batteries; inverters

8. Geopolitical: Fighting over resources again

- Globalization
  - Works well as long as there is "enough"
- Doesn't work so well when there isn't enough
  - Fight for own benefit
- Examples:
  - Russia – Ukraine
  - China – Viet Nam

Russia – Ukraine Background

- Ukraine can't afford Russian natural gas
  - Russia can't afford customers who can't pay
  - Cutting off Ukraine is a necessity
- Russia has great power over Europe
  - Source of 30% of EU natural gas imports
  - No good source elsewhere
- Crimea has oil and gas reserves that would be helpful to Russia

Russia – Ukraine Recent

- Russia signed $400 billion gas deal with China
  - Undercuts US$ reserve currency
  - Less for Europe in long run
- US has an import advantage with the US dollar as reserve currency
  - If Russia (or Russia – China – Iran) can dislodge US as reserve currency, it will mean more oil for rest of the world
- Alliances may change
  - Germany may stick more closely with Russia
  - Bad for rest of EU-27

Solutions to Converging Crises

- 1. Limit family size
- 2. Look after the needs of your own family
  - Join forces with others with similar ideas
  - Can't solve the problems of the whole world
- 3. We need help from a Higher Power

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