Uranium and Nuclear Power: Past, Present and Future

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Déjà vu All Over Again

- At end of WWII, US government wanted to encourage new uranium industry
- various incentives, including strong price signals
- that era ended in mid-1960s, whence nuclear power industry took root
- strong growth in uranium market followed, up to Three Mile Island incident (28 March, 1979)
  - conventional wisdom: TMI sealed Nuclear power's fate
    - no new Nuclear plant built from that date forward*
  - "beginning of the end" for Nuclear power?

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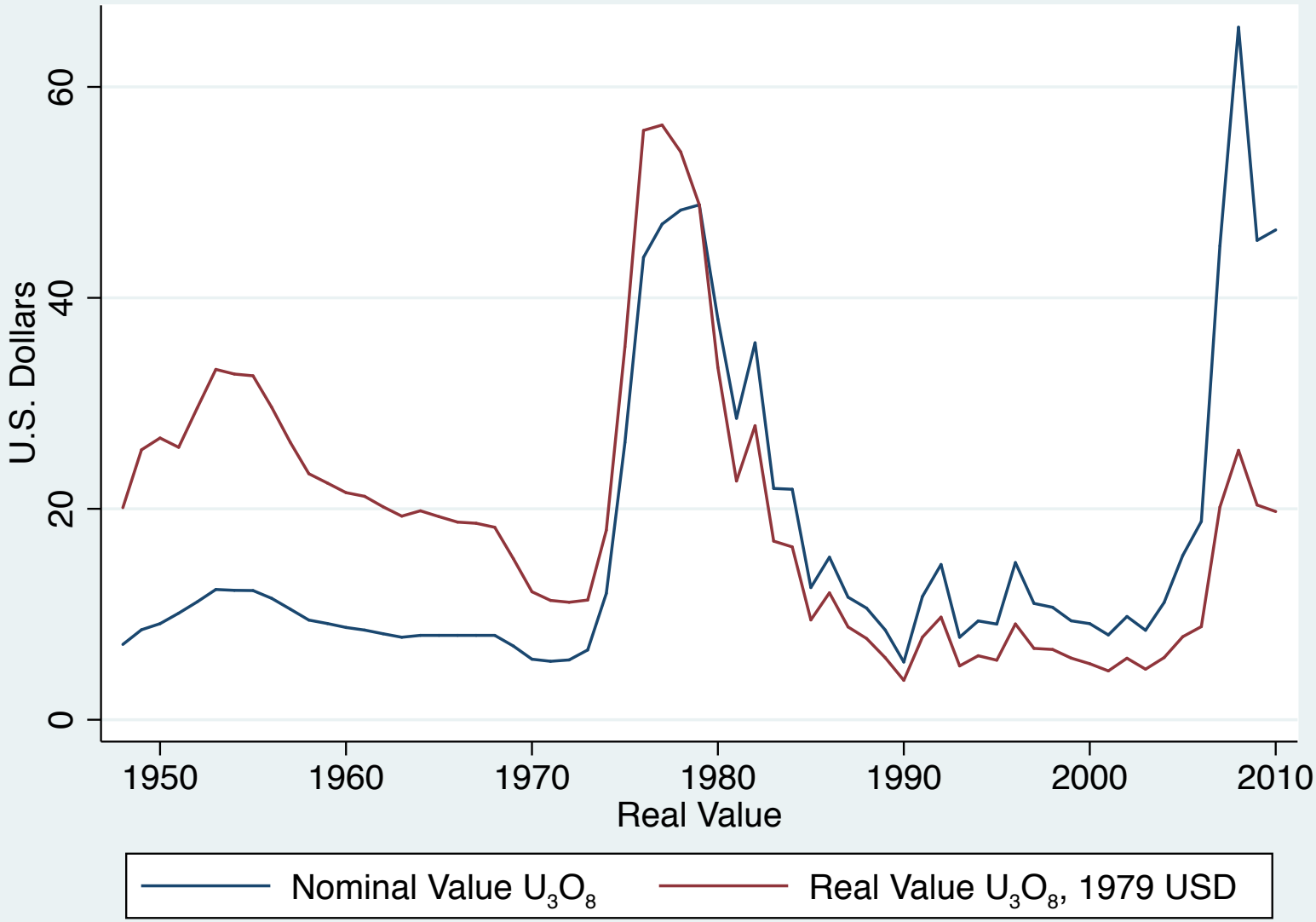
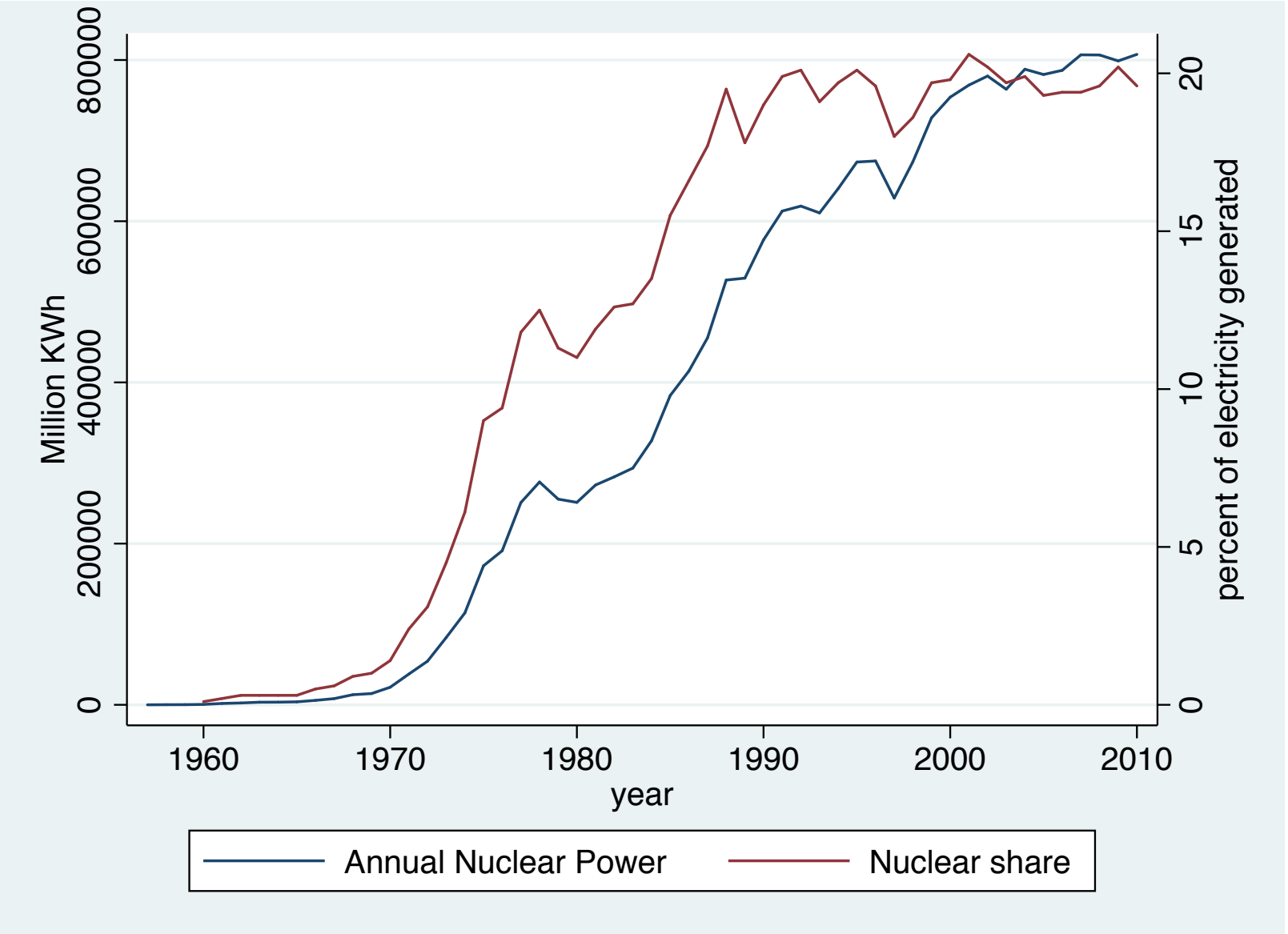
- fast-forward ... to 21st Century
- solid growth in nuclear energy
- until Fukushima Daiichi reactor meltdown, 11 March 2011
- "beginning of the end" for Nuclear power?

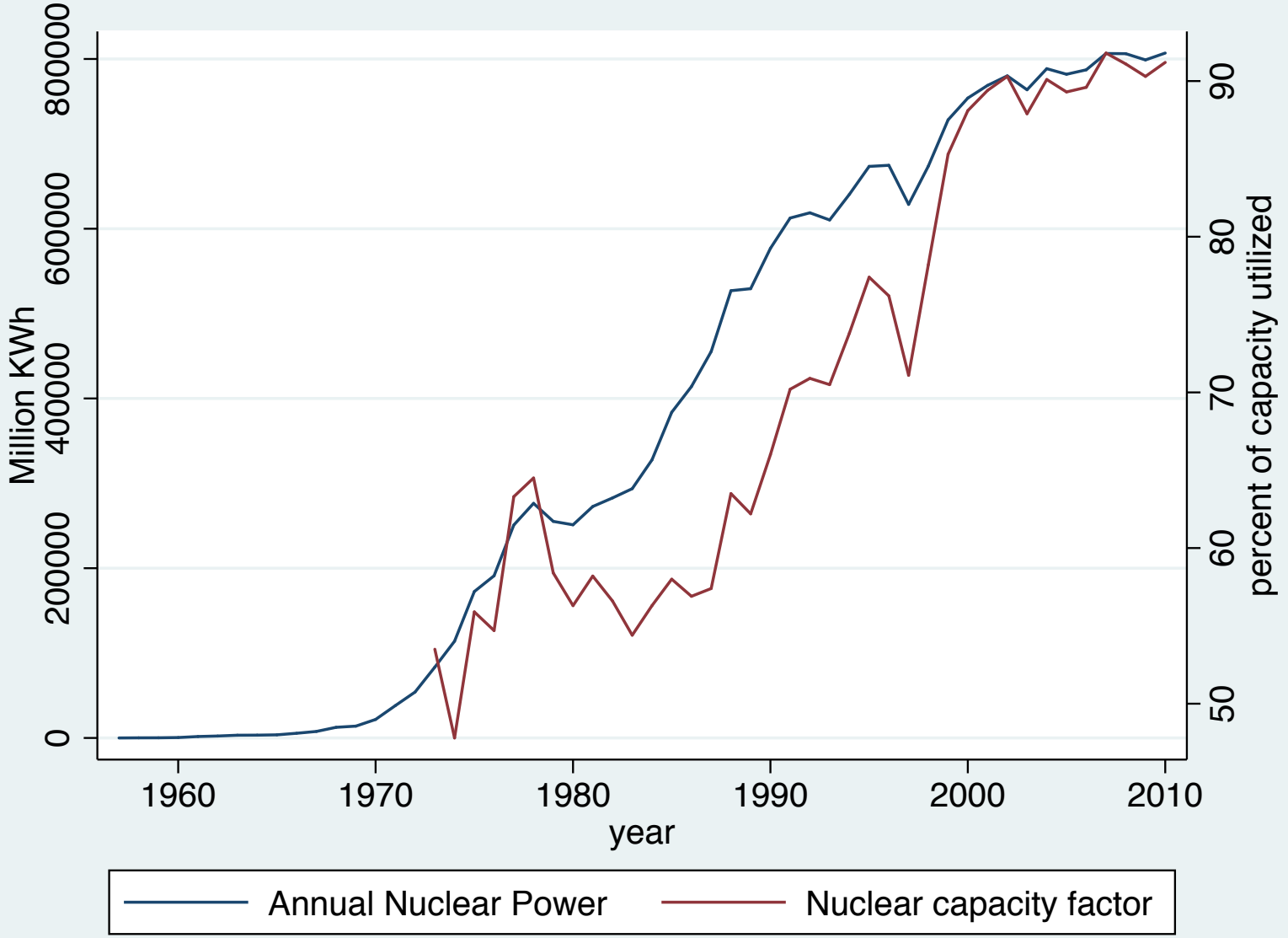
Time path: price of uranium



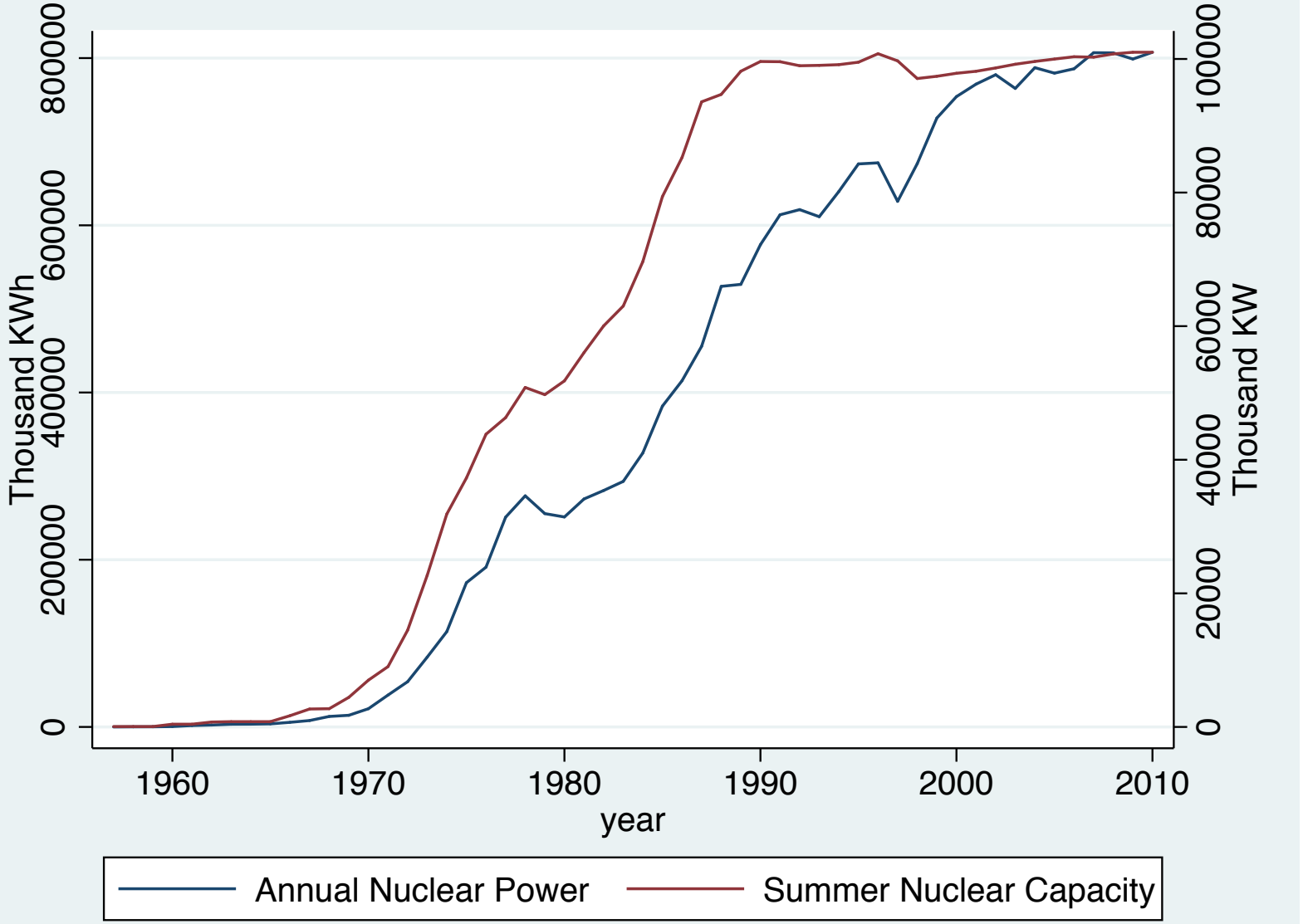
Time path: Nuclear Power



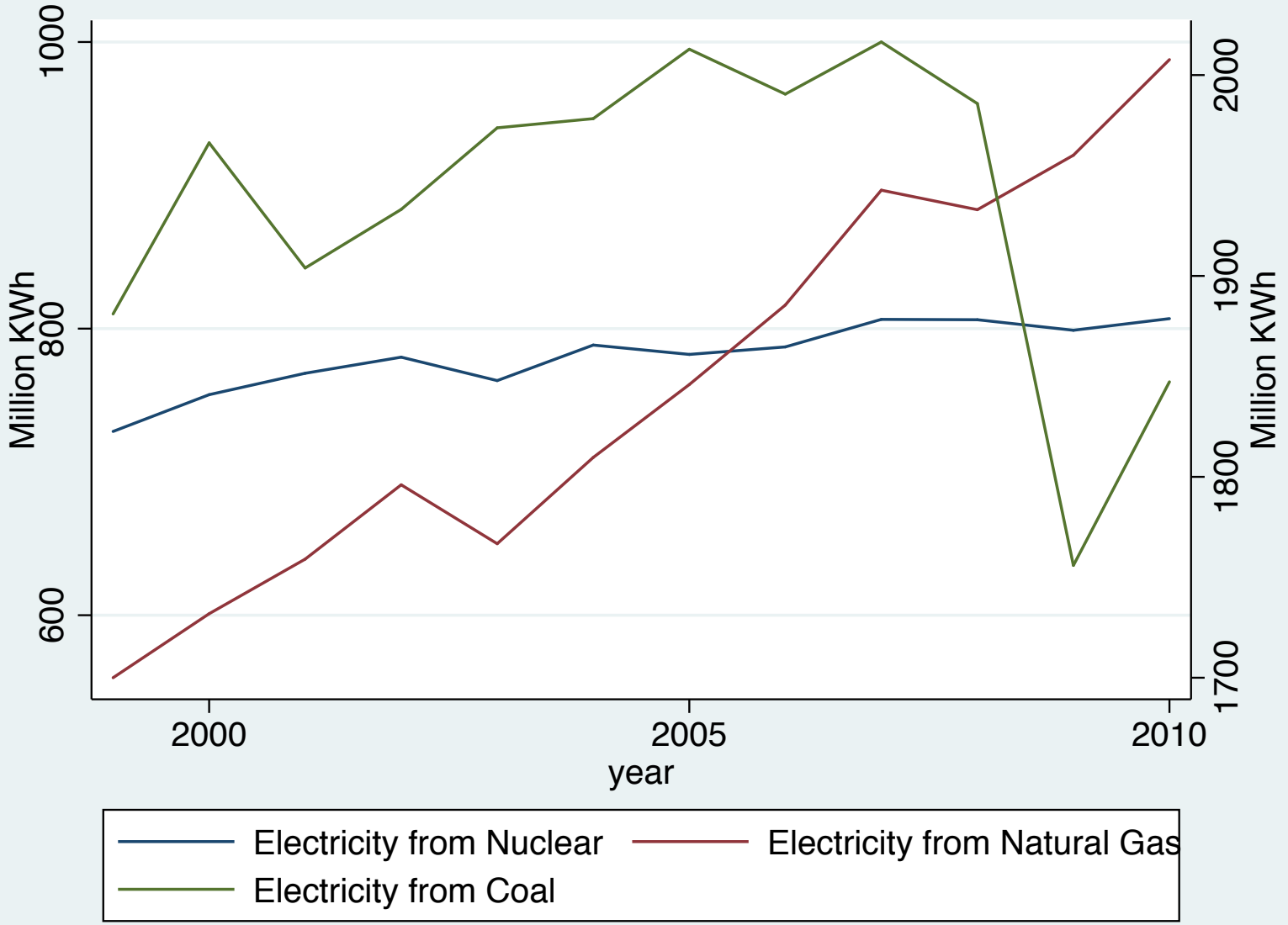
Time path: Nuclear Power, Capacity Utilization



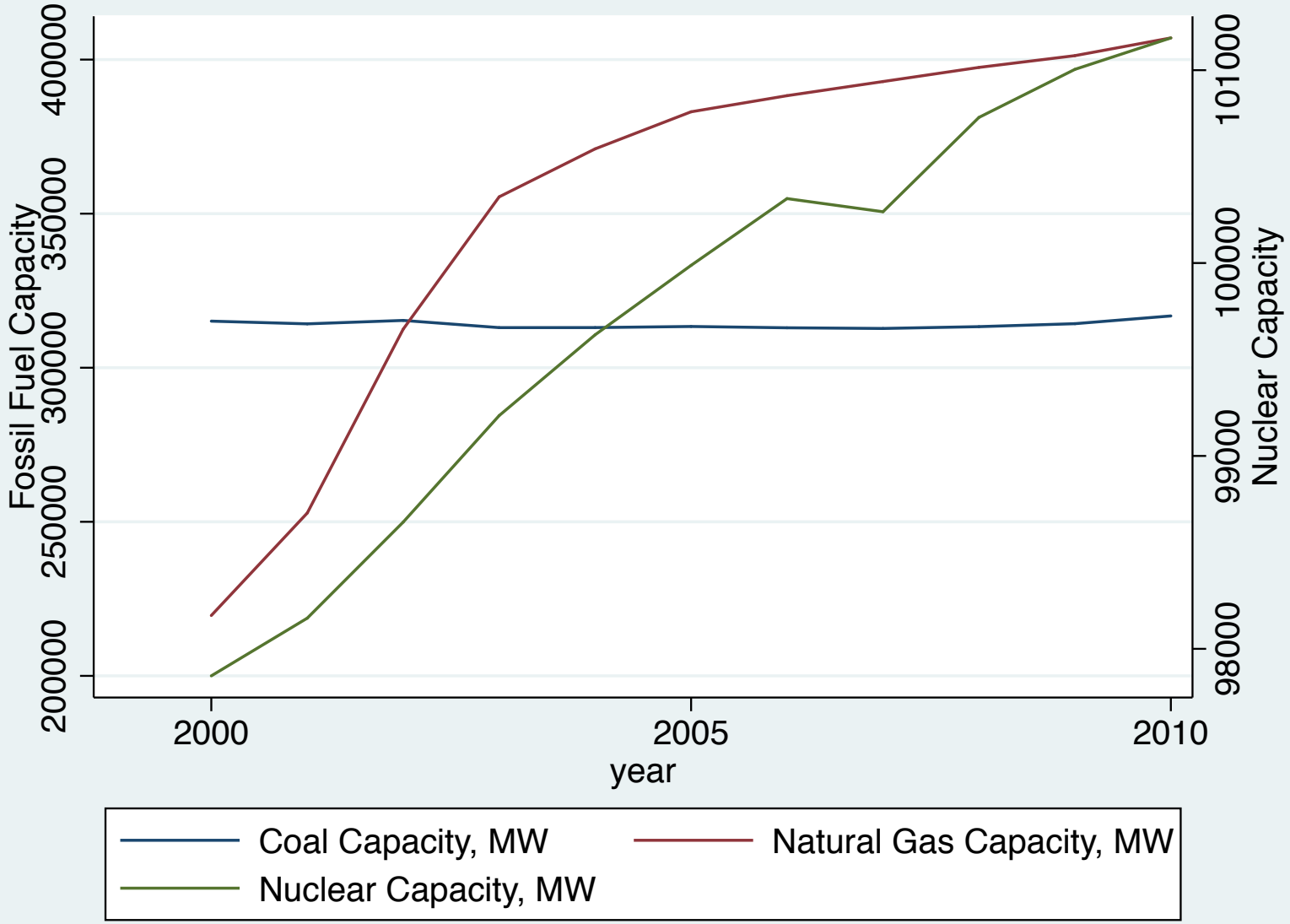
Time path: Nuclear Power, Summer Capacity



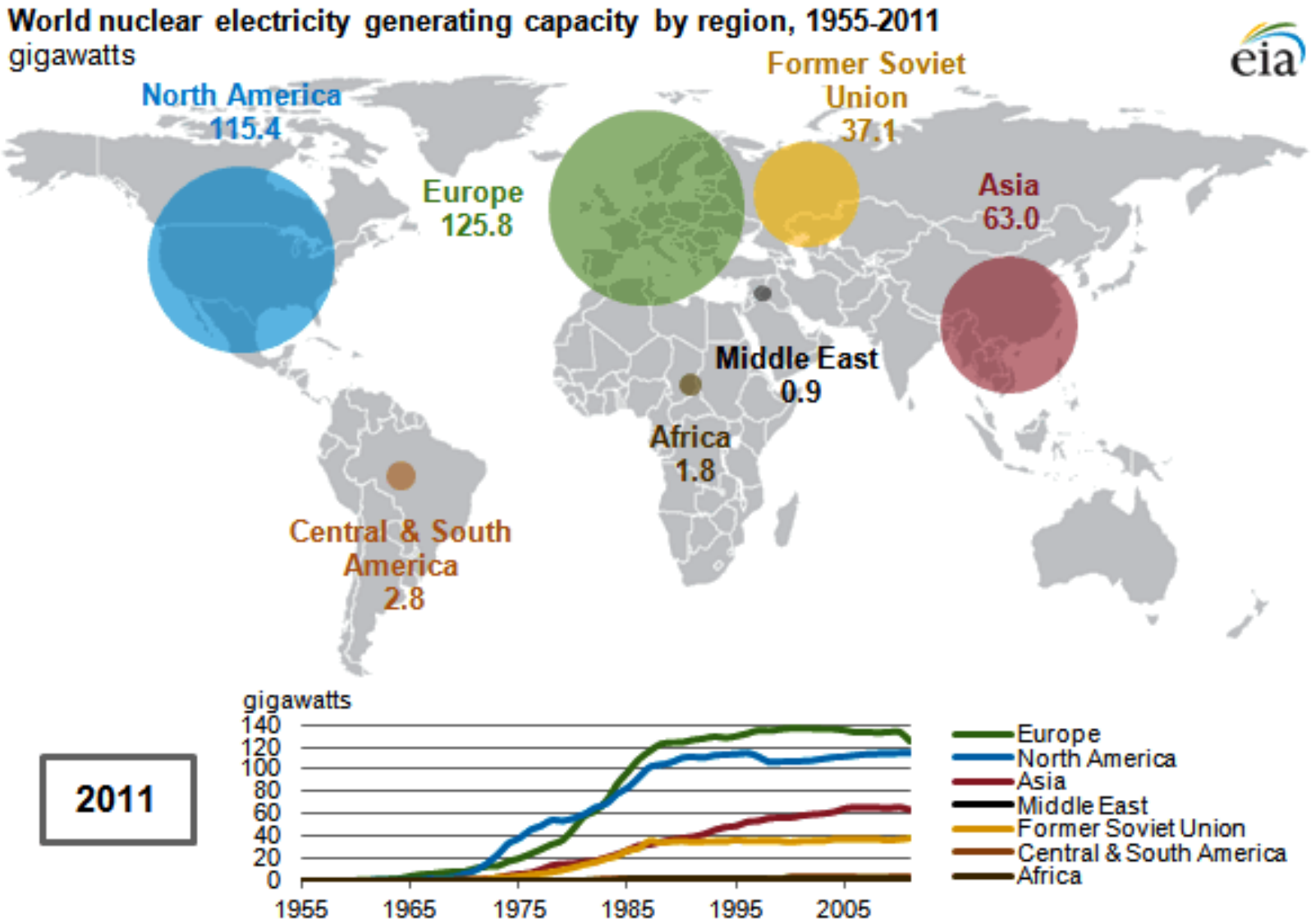
Time path: Electricity Production, Various Fuels



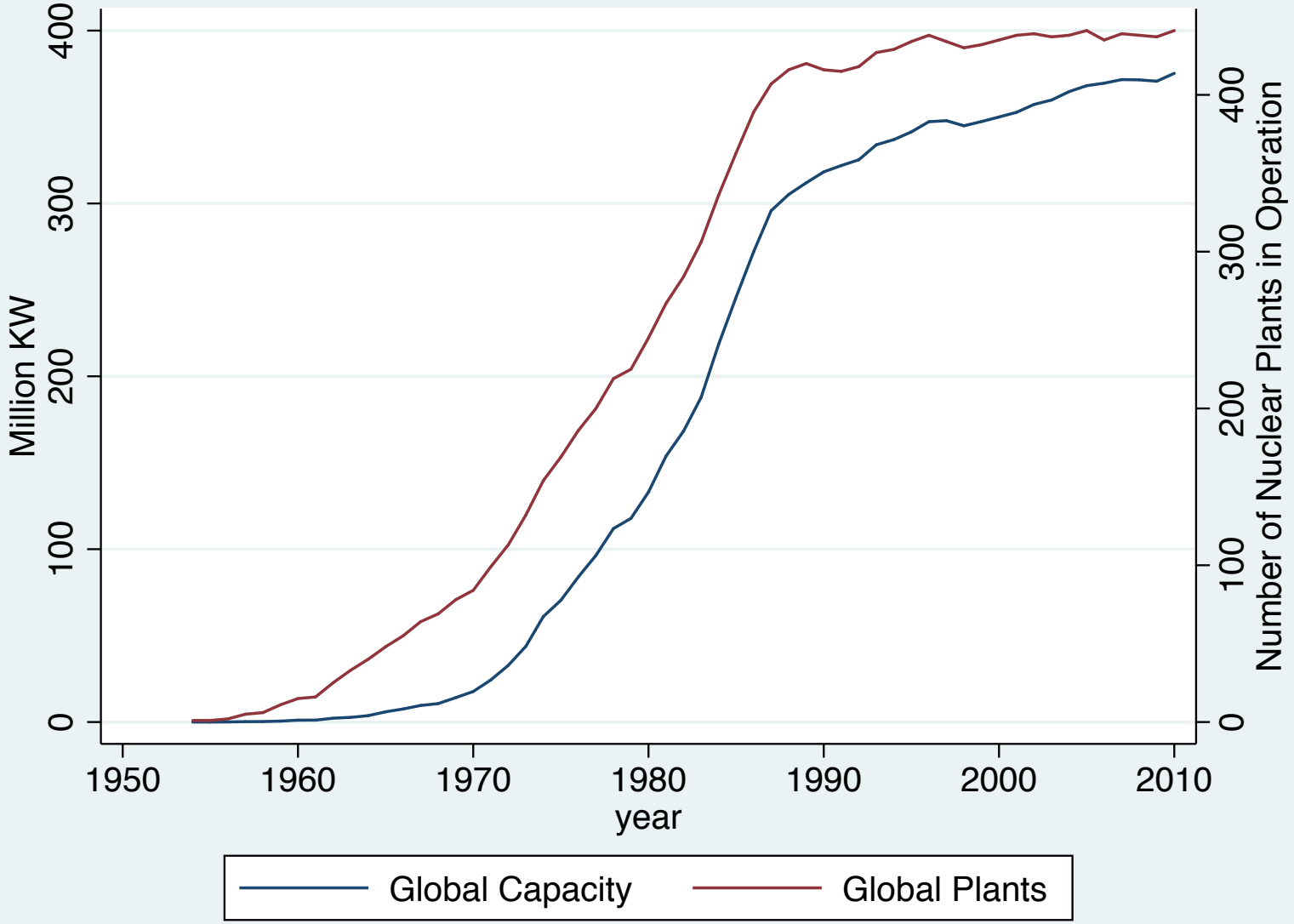
Time path: Various Fuels, Summer Power Capacity



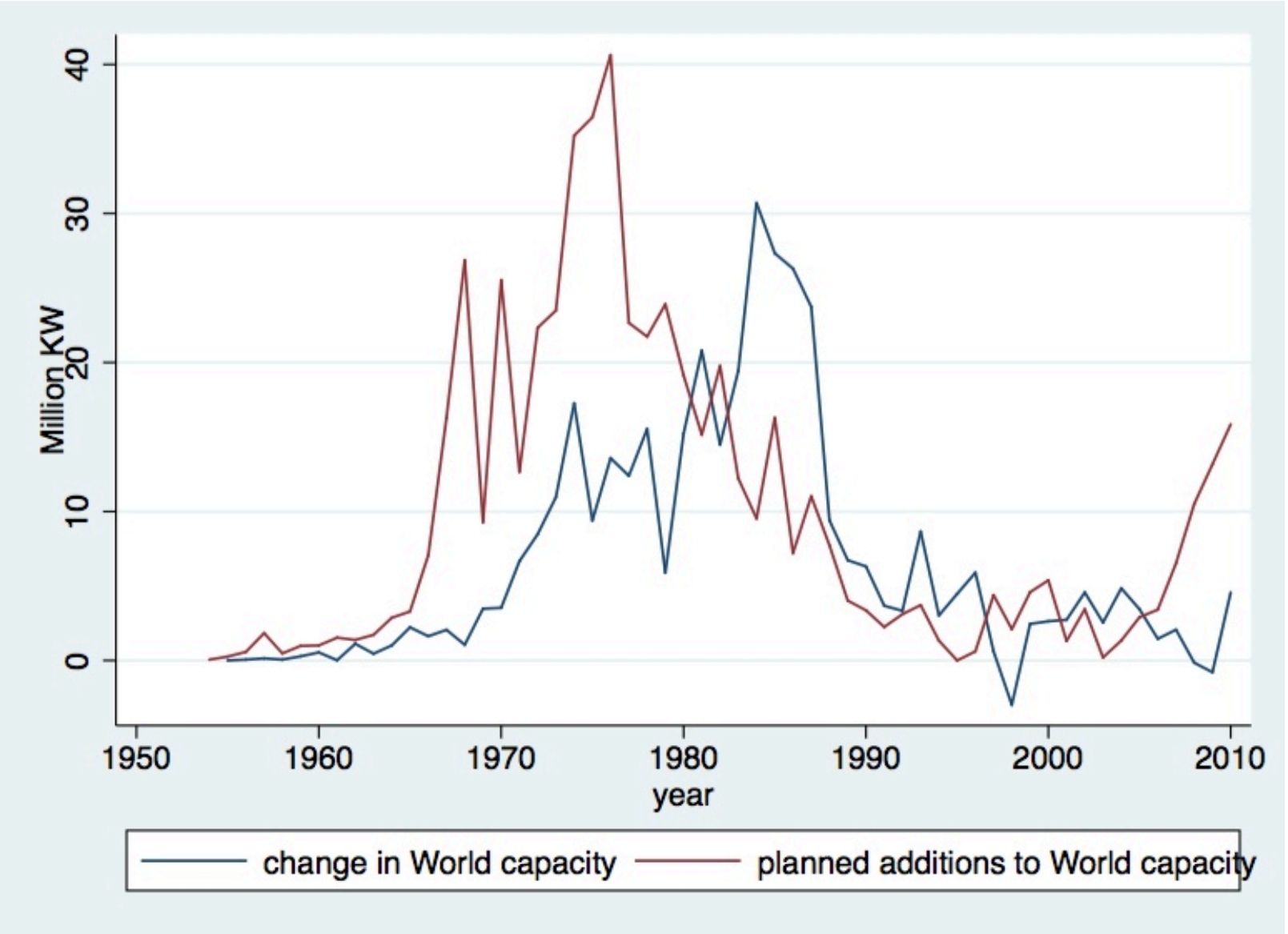
Nuclear Power: Global Role



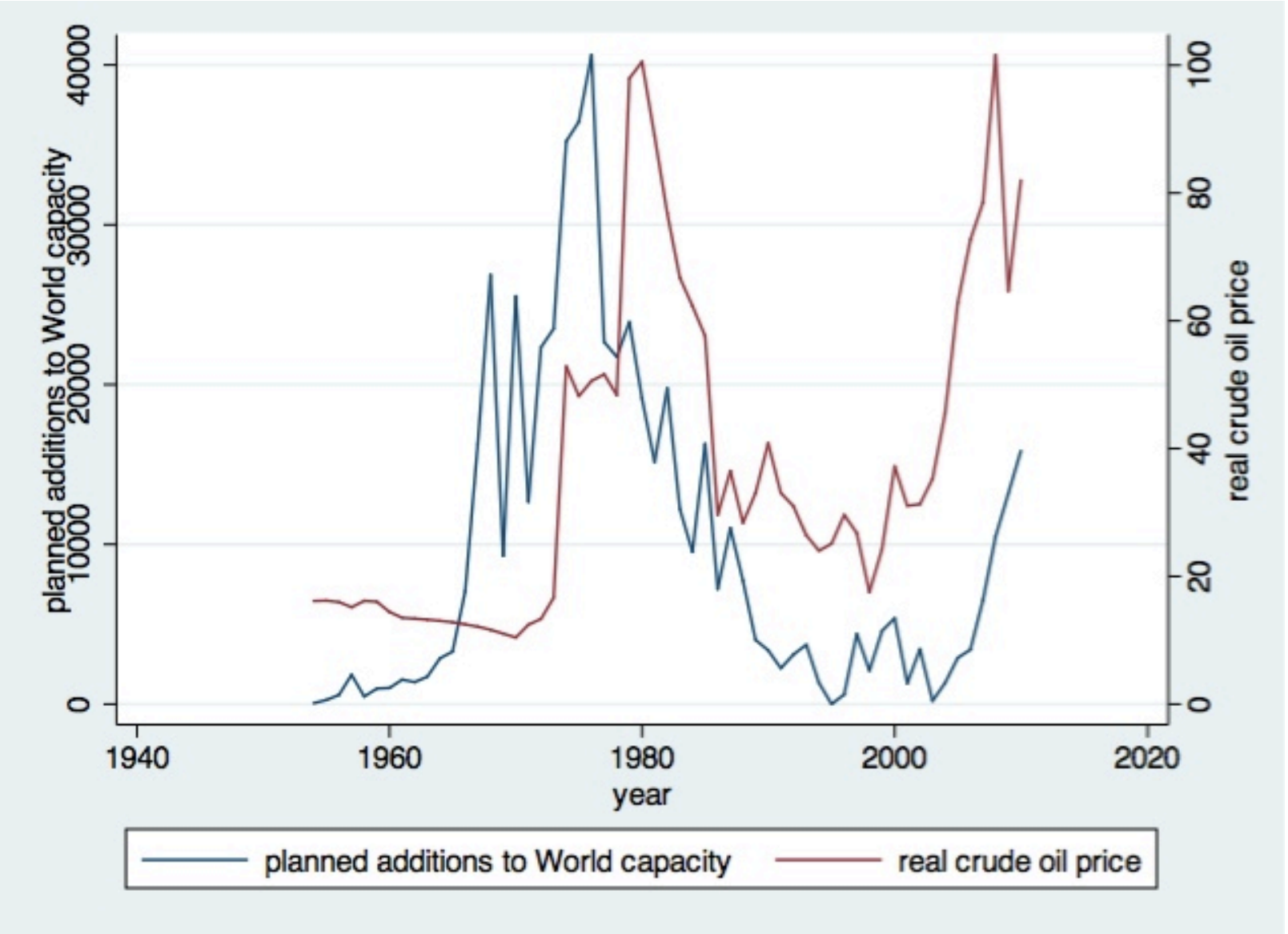
Time Path: Global Nuclear Capacity



Nuclear Power: Historical Global Expansion



Why Nuclear Expansion?



Carbon Policy and Nuclear Power

- 1.020 kg CO_2 per kWh for coal
- 0.515 kg CO_2 per kWh for natural gas
- plausible impact: pressure towards reduced use of both fuels as inputs into electricity
- then increased pressure for usage of Nuclear energy
  - In North America and Europe
  - also in FSU, BRIC countries
- induces increased demand for Uranium

Implications

- Coal is faltering
- Natural Gas is rising rapidly
- Nuclear continues steady growth, particularly if
  - oil prices continue to rise
  - meaningful carbon policy is enacted
- huge new deposits of Natural Gas apparently at hand
- what about Uranium?
  - likely push towards new exploration, new development

Optimal behavior: resource extracting firms

- privately optimal rate of extraction sets current rents equal to discounted future expected rents
- expectation depends on current beliefs
- but also manifest anticipated extraction next period
- in this way, current production is indirectly influenced by current exploration
  - if current exploration rises, this increases expected future finds, which in turn motivates larger production today

What do we know?

- privately optimal exploration balances current marginal exploration cost against future expected benefits
  - value of expected finds
  - (negative?) impact of current exploration on future find rate, which will adversely impact payoffs two periods hence
  - expected value of information
    - current exploration yields inform'n, changes future beliefs
    - this is true for other firms as well
    - possibility of public good aspect to information
    - also possibility of using information for speculative purposes
- evidence suggests speculation governed past exploration
- increases in D, associated sharp increases in production and exploration would seem to reinforce this conclusion
- similarity to first decade of 21^{st} century striking
- likely implication: over-exploration continues
  - on a global scale?

What can we learn from the past experience?

- strong price signals lead to over-exuberant exploration
- this excess exploration likely motivated by speculation
- excess exploration spills over into extraction levels, yielding social over-production
- attendant welfare losses from over-exploration, over-production
- can we draw useful insights from the record of solid prices in 1950s, strong run-up in prices in early 1970s to guide policy going forward?
- evidence suggests a role for (international) governmental intervention
  - tax on exploration?
  - (larger) severance tax on produced ore?