Les Houches – 10 mars 2016

GROWTH, PRODUCTIVITY AND OIL HISTORY
The Gordon knot

Michel Lepetit

Neo-physiocrats “smart grid”

The Shift Project Vice-President, *low carbon leading think tank*

Global Warning CEO, *Energy climate and finance strategy*

SFTE Spokesman, *Juncker Plan N°1 Energy Efficiency Investment program*

Riskergy Spokesman, *Forward-looking credit rating for sovereign risks taking into account energy*

LIED Research fellow, *Laboratoire interdisciplinaire des énergies de demain*

Beyond Ratings Co-founder, *Energy & Climate Risks matters for sovereign debts*

CEC-R-CEC 173 Spokesman, *Bank club on regulation and climate risks*

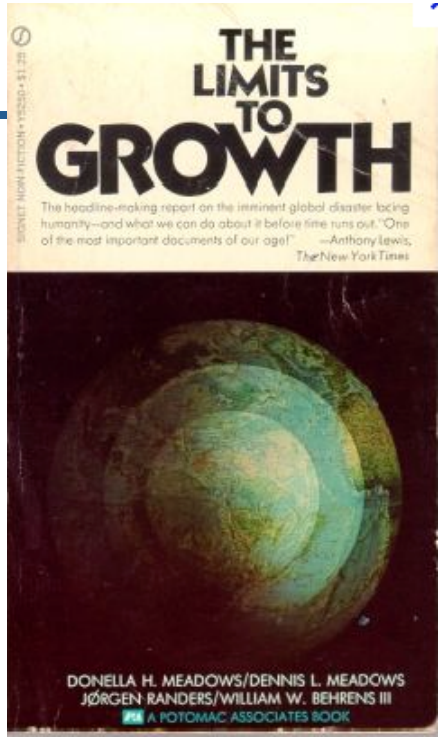
ASPO France member

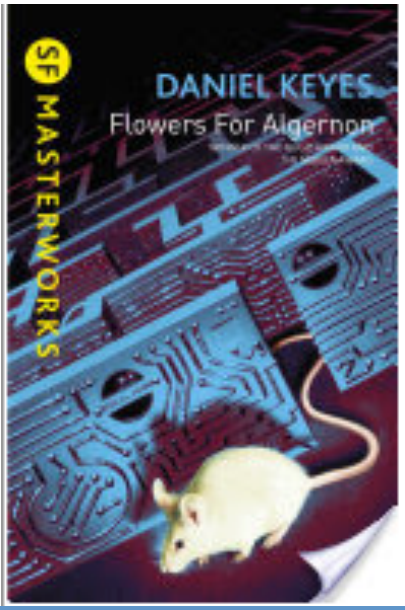
Academic Chair in economics Energy & Prosperity, 26/04 event : *Secular Stagnation and Energy*

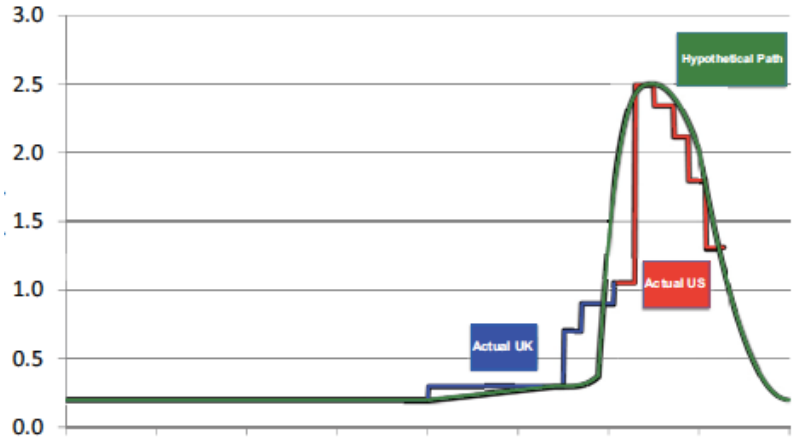
We are Charlie ?

- **Daniel Keyes in the Sixties**
- **Rise & fall :** 60QI × 3 then ÷ 3
- **S&F best seller :** Technology & science …

  & society from inside



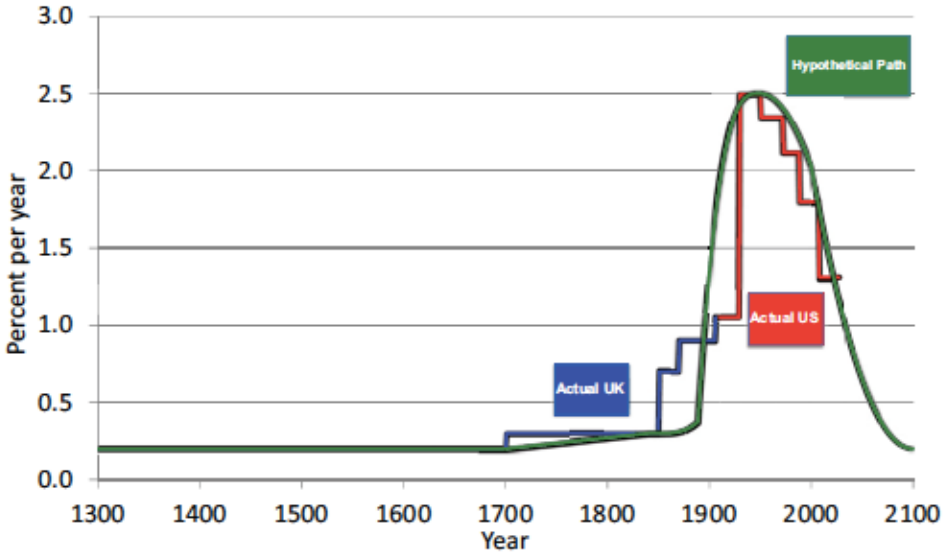




Flowers for humanity ?

- **SECULAR STAGNATION** global debate among economists
- **Robert J. GORDON** worldwide famous work on productivity
  - *Energy & Crude oil*
  - *World view*
  - *1951-2015 time span*
  - *Money*
  - *History and data*

Figure 2 Growth in real GDP per capita, 1300-2100, with actual and hypothetical paths



Gordon 2012 CEPR

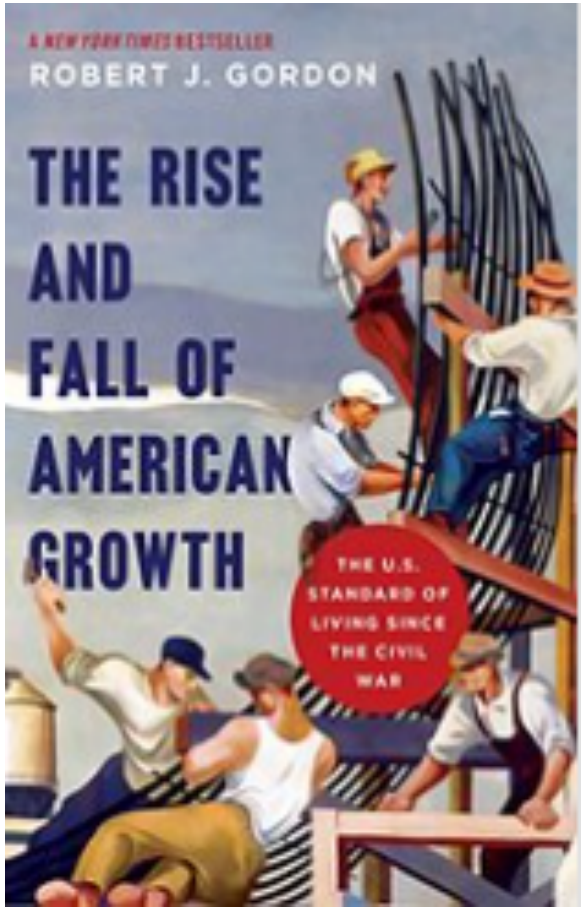
Presentation road map

- (I) Analysis of Gordon's ***Rise and Fall of American growth***
  - Rise & fall pattern
  - Focus on the Great Transition : 1973-1982
  - Great inventions and the GPT concept (General Purpose Technology)

- (II) Explaining the key role of energy :
  - The 1970s crisis historical analysis (a priori and a posteriori)
  - Money does exist : Financial symptomsof the crisis

R&FAG (784p) : A masterwork with three key assumptions

- Rise and Fall U.S. pattern
  - 1870-1970
  - Then secular stagnation
- The role of progress
  - The solowian view : K, L and TFP
  - Innovations and technology
- The 1970s as pivotal years
  - No new key innovations since



The 1970s

Table 1.

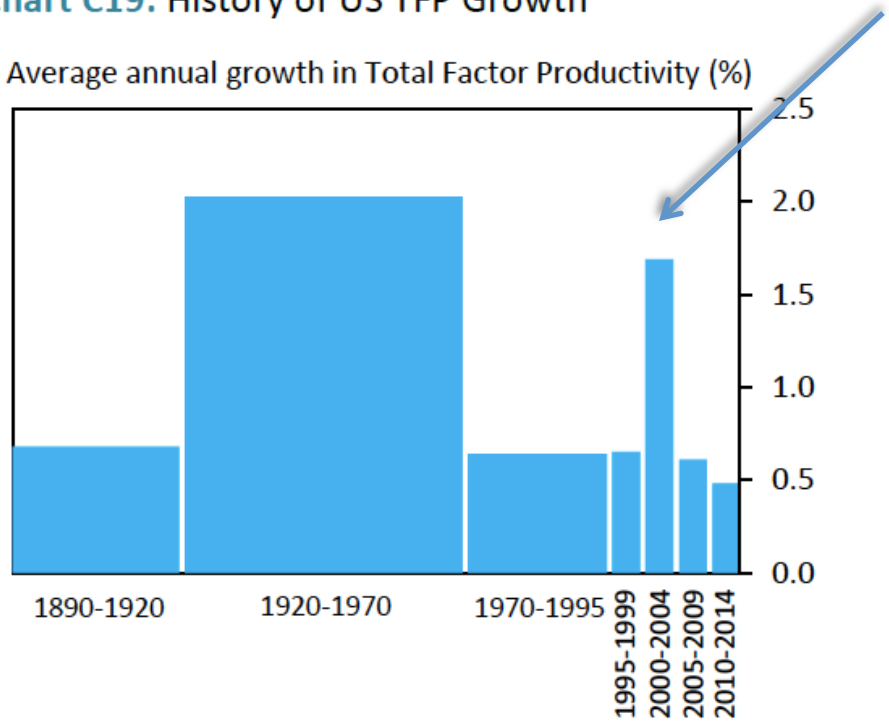
Growth Rates of Variables in the Output Identity Across Specific Intervals

Interval	Output	Labor Productivity	Hours Ratio ("Bridge Term")	Hours per Employee	Employment Rate	Labor Force Participation Rate	Working Age Population
1950:Q2 - 1972:Q1	3.89	2.62	0.06	-0.27	-0.01	0.08	1.40
1972:Q1 - 1996:Q1	3.03	1.42	-0.27	0.03	0.01	0.41	1.42
1996:Q1 - 2004:Q1	3.42	2.45	-0.12	-0.06	-0.02	-0.09	1.26
2004:Q1 - 2014:Q2	1.57	1.17	0.05	-0.14	-0.06	-0.49	1.04

Gordon

Good old days of TFP

Chart C19: History of US TFP Growth



Source: Gordon (2014)

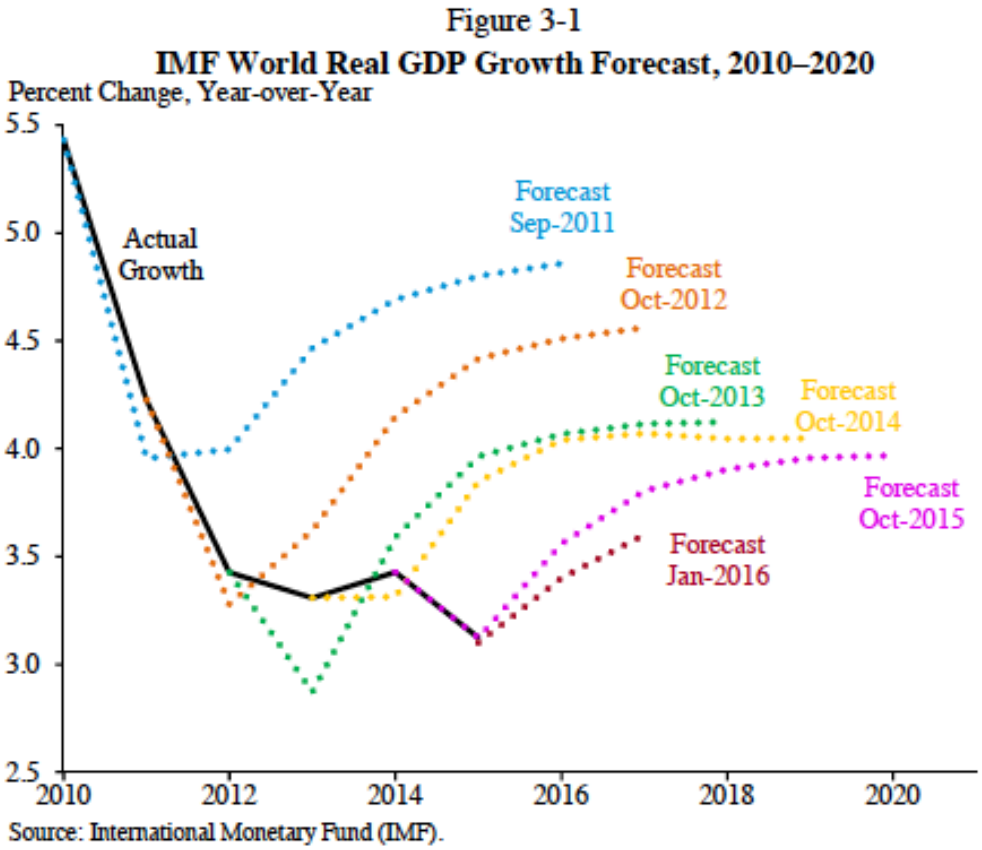
GORDON on ICT :

Option B is that you get everything invented in the past decade right up to Facebook, Twitter, and the iPad, but you have to give up running water and indoor toilets. You have to haul the water into your dwelling and carry out the waste. Even at 3am on a rainy night, your only toilet option is a wet and perhaps muddy walk to the outhouse.

Which option do you choose?

Gordon 2012 CEPR

ALPLBT macroeconomic model



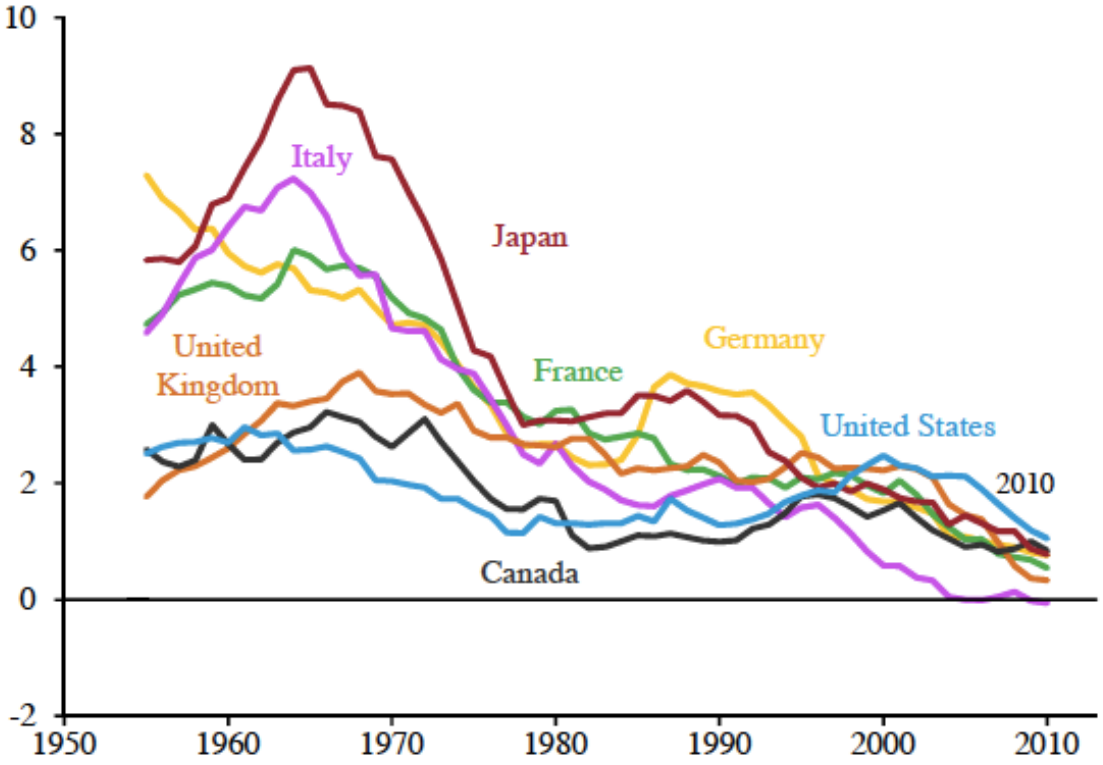
ALPLBT : Asymptotic Long-term Productivity Limit Back to Trend

Global warning …

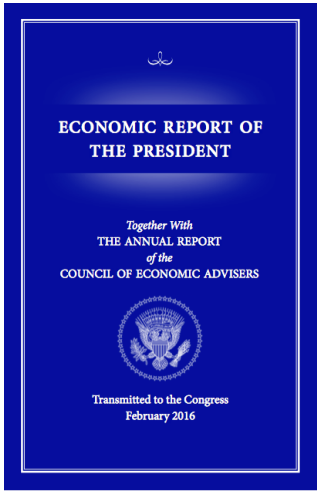
Figure 5-1

Labor Productivity Growth, 1955–2010

10-Year Centered Moving Average of Annual Percent Growth in Output per Hour



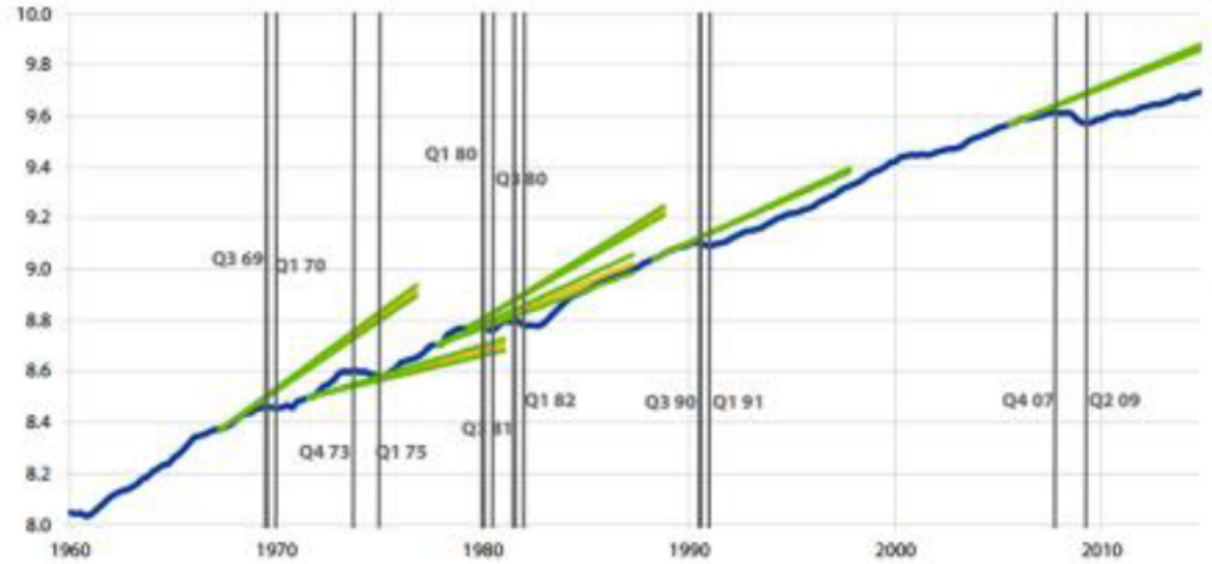
Source: Conference Board, Total Economy Database; CEA calculations.



Deceleration …

Hysteresis A Frequent Event

Evolution of log real GDP and extrapolated trends for the United States



Sources: Blanchard, Cerutti and Summers

China warning …

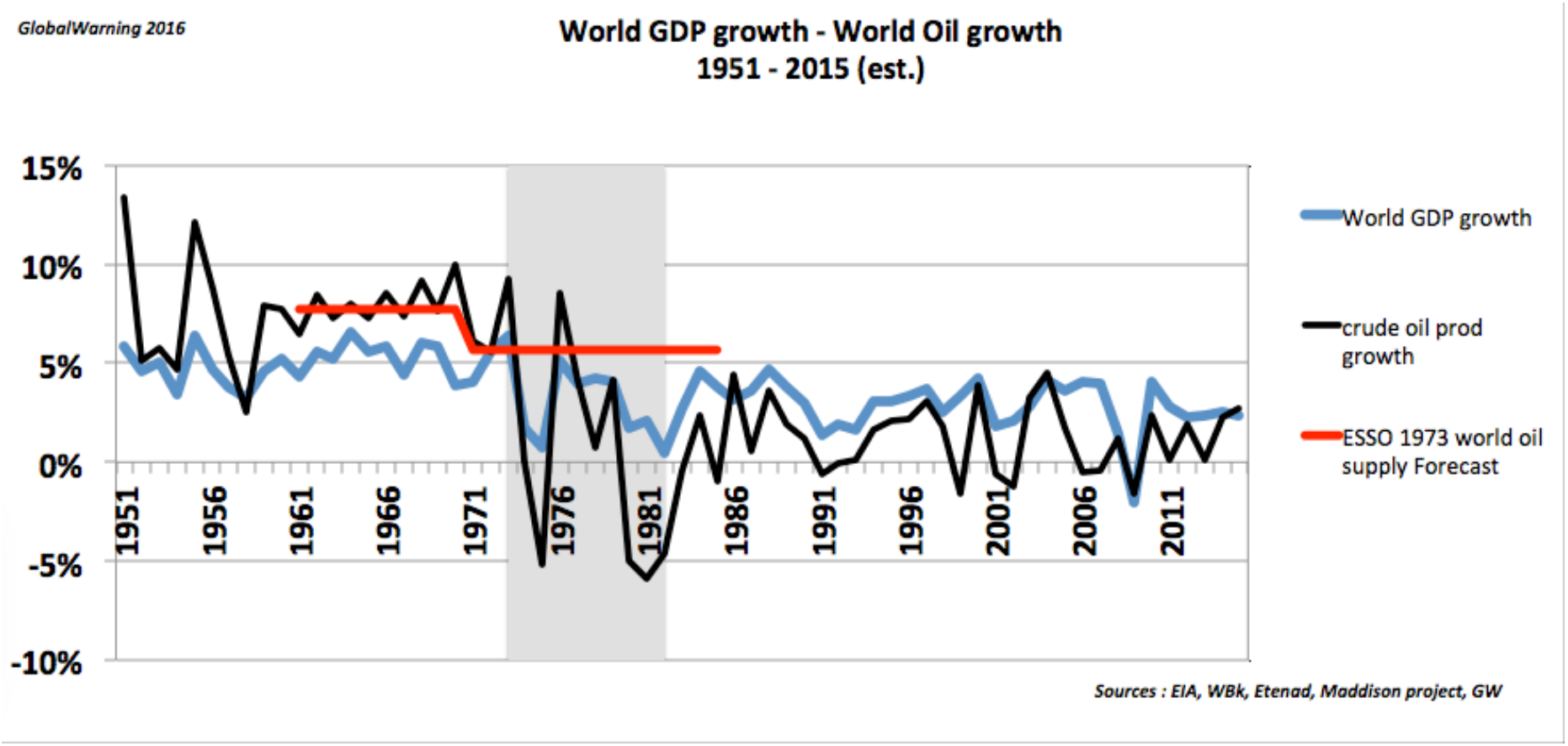
Note: Industrial electricity consumption is "secondary industry" consumption. Real GDP is year-to-year percent change.
Source: China National Bureau of Statistics; State Administration of Foreign Exchange; China Electricity Council; Haver Analytics.

Preliminary analysis of *Rise & Fall*

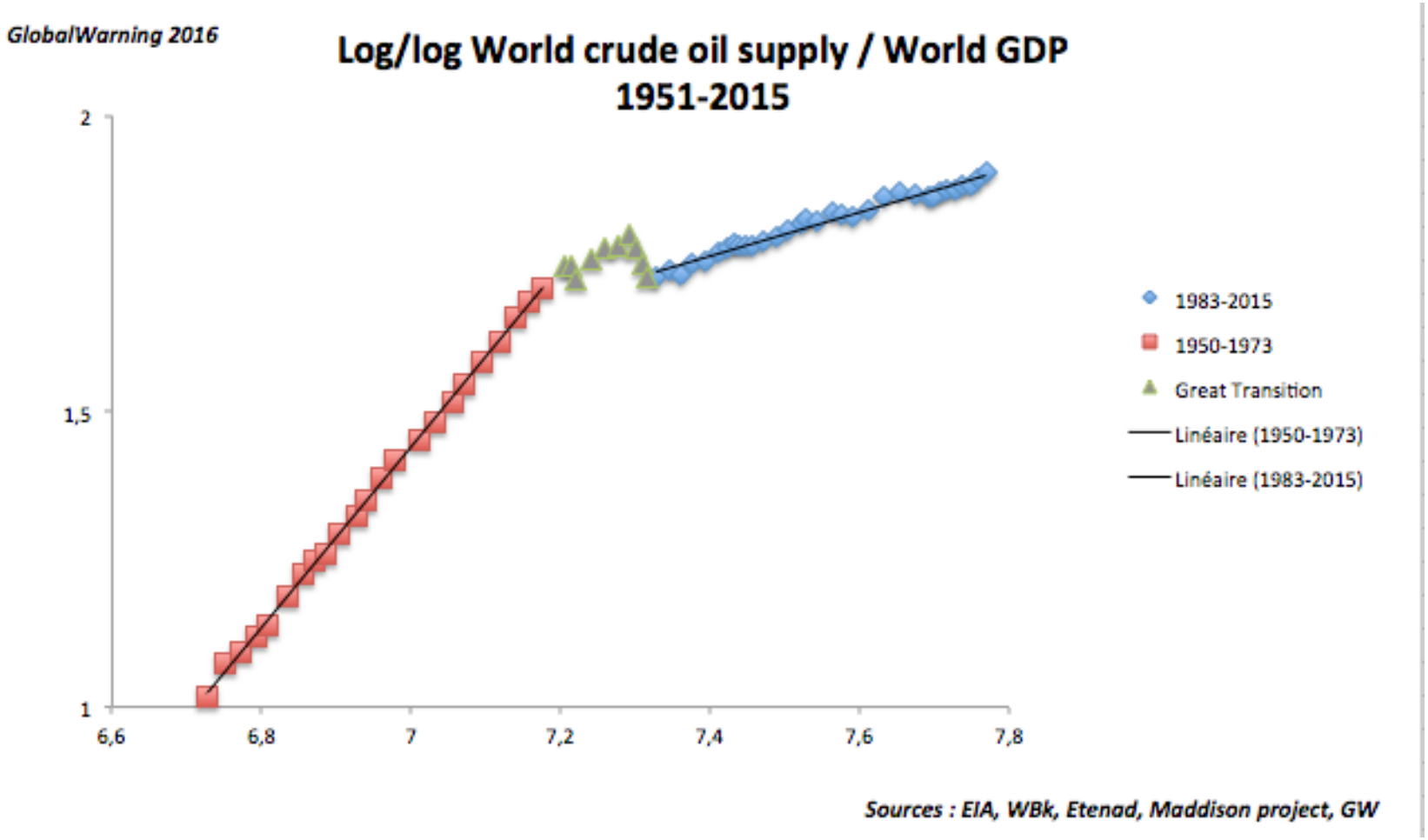
- A world without energy => crude oil
- A world without money => currency & credit
- A world without RoW => World
- A past without events => History of the 1970s

Rise and fall

per year	1951-1973	1982-2015
World GDP Growth	4,9%	3,2%
World oil supply Growth	7,6%	1,2%



1973 and 1982 : THE GREAT TRANSITION



INVENTIONS AND GPT … & JM Jancovici

*The two most important inventions of the late nineteenth century were **electric** light and **power** and the **internal combustion engine**, and these are often described as 'general purpose technology' (GPT) that can lead to the creation of many subinventions.*

*Subinventions made possible by **electricity** as a GPT are such fundamental drivers of productivity as elevators; electric hand and machine tools; electric streetcars, elevated trains, and underground subways; the whole host of consumer appliances (…).*

*A similar list of subinventions made possible by the **internal combustion engine** as a GPT includes the car, truck, bus, and taxi; supermarkets; suburbs; and all the aspects of personal travel, including motels and roadside restaurants, as well as air travel.*

LESLIE WHITE -

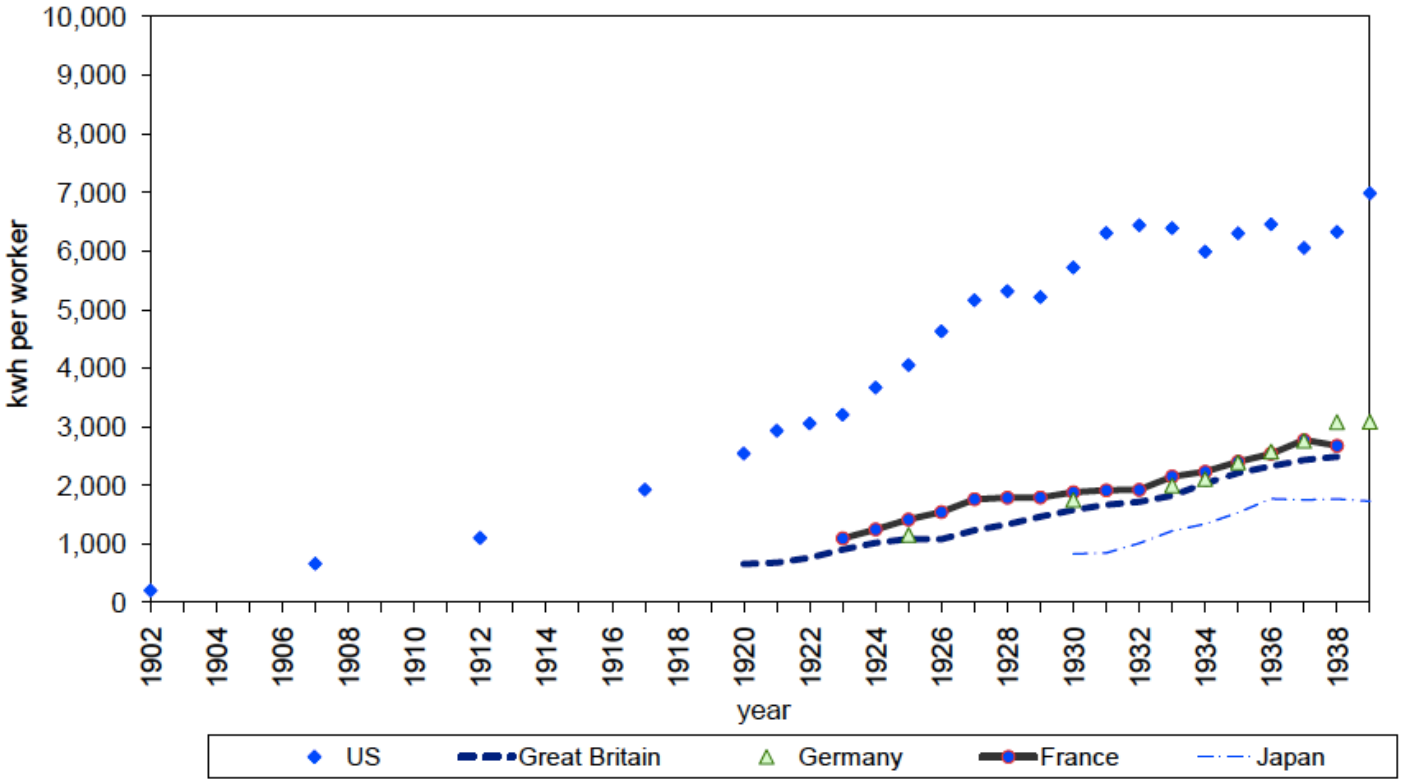
This leaves us, then, three factors to be considered in any cultural situation:
(1) the amount of energy per capita per unit of time harnessed and put to work within the culture,
(2) the technological means with which this energy is expended, and
(3) the human need-serving product that accrues from the expenditure of energy.

We may express the relationship between these factors in the following simple formula: ***E x T = P****, in which E represents the amount of* ***energy*** *expended per capita per unit of time, T the* ***technological*** *means of its expenditure, and P the magnitude of the* ***product*** *per unit of time.*

"Energy and the evolution of culture"
American Anthropologist, 1945

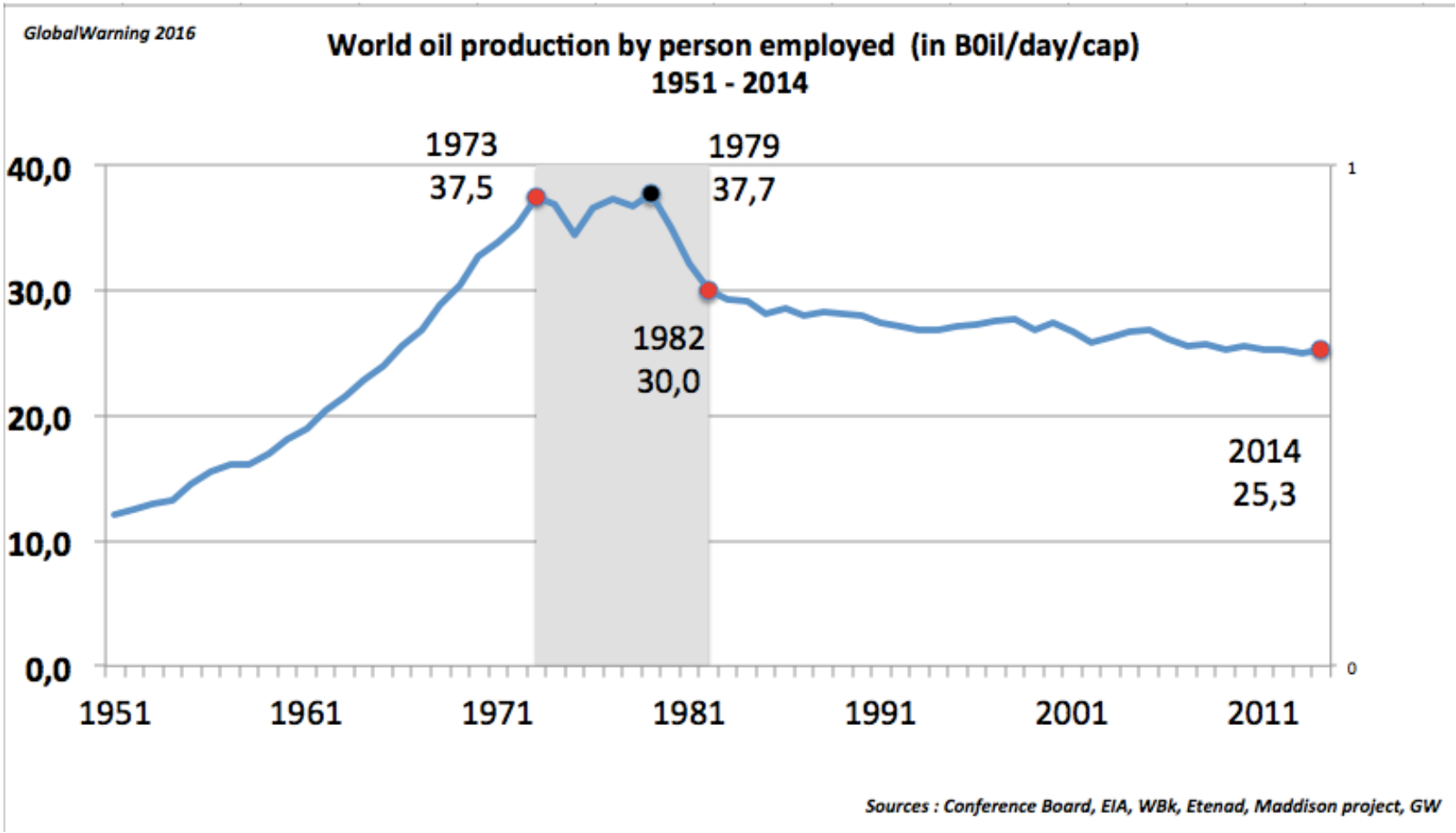
Can GPT explain economic growth ?

Figure 2. Consumption of electricity per employee in the manufacturing sector

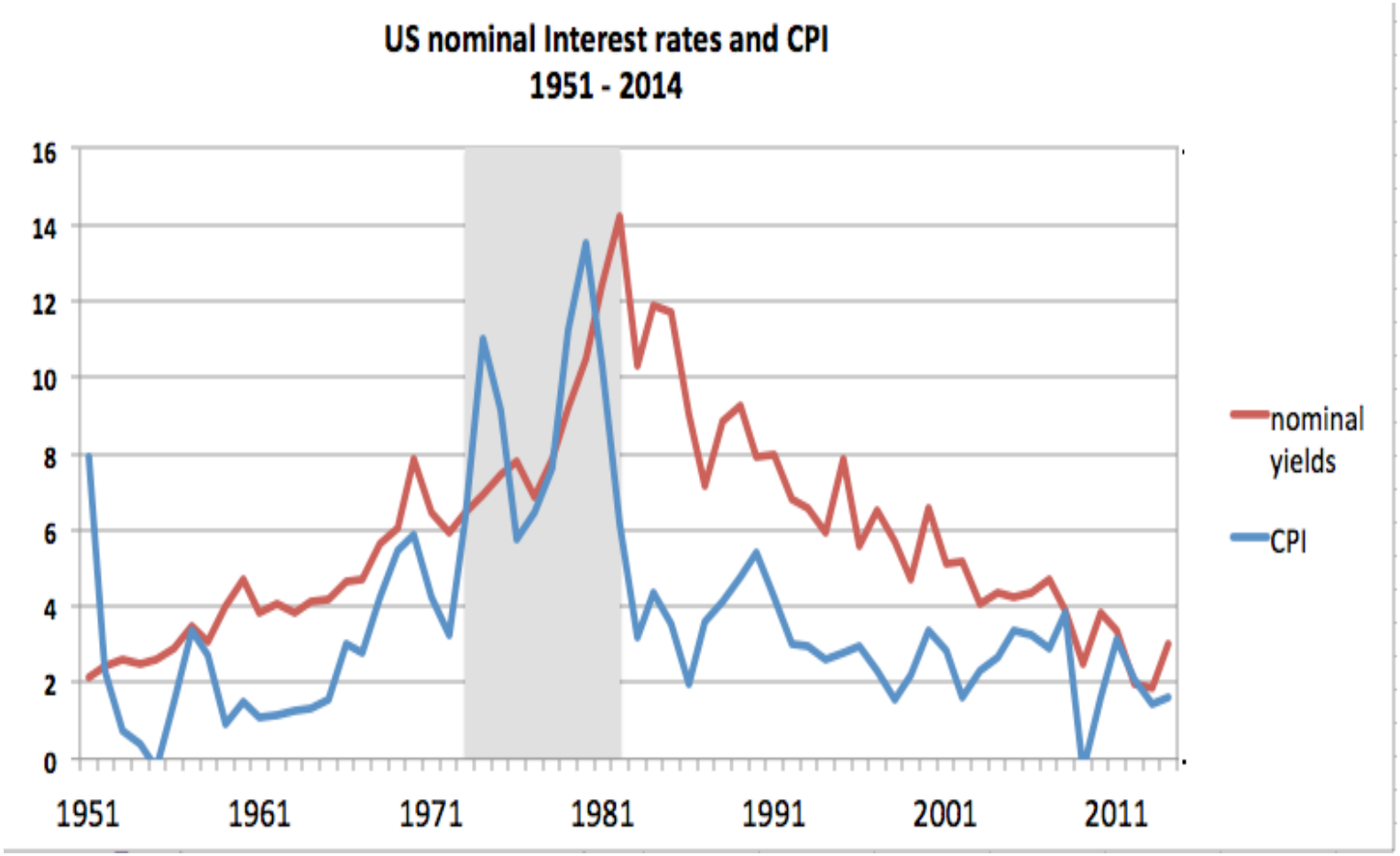


Ristuccia and Solomu 2014

RISE AND FALL : Labour productivity ? ICE with less OIL ?



Toward the ZLB, long time before 2008 …

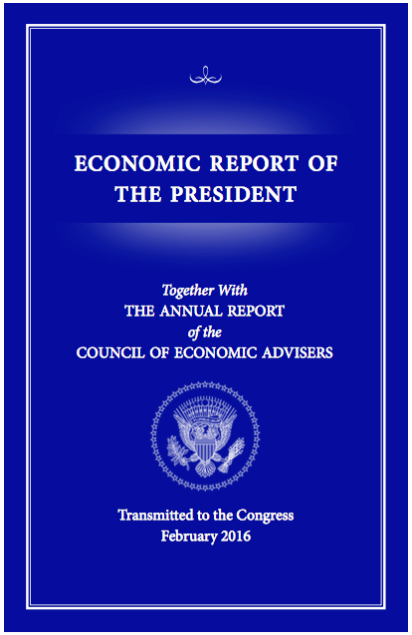


Deflation of inflation

Global inflation in 2015 is on pace to be at its lowest rate since 2009, and barring 2009, its lowest rate since at least 1980.

Out of the 20 G-20 economies, 8 (including 6 of the 7 G-7 countries) had four-quarter inflation rates below 1 percent in the third quarter of 2015, and three of them with rates below zero.

All of the world's major advanced economies had rates below their target



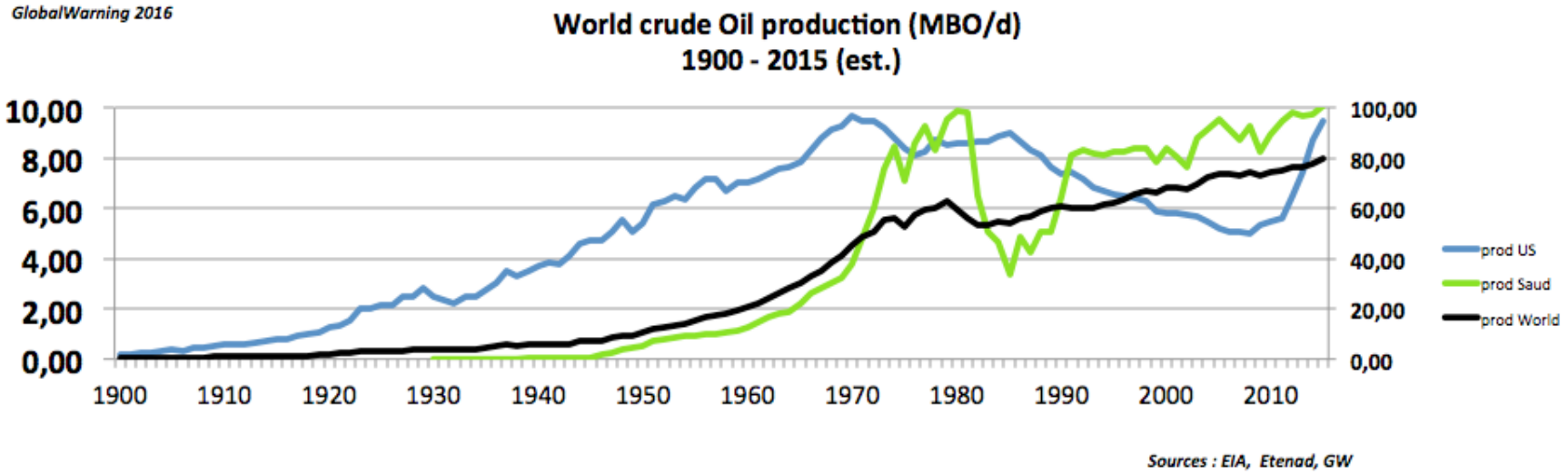
HISTORY & energy-GDP causation : the POGW theory

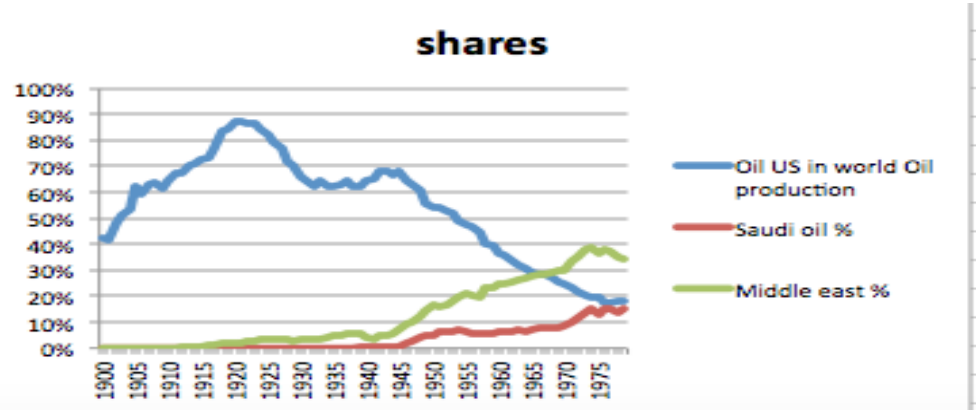
- The 1970s crisis : the unsustainable *(Cure)* 1950s &1960s
  - Unsustainable for Saudi
  - Unsustainable for the World : Esso forecast
  - Unsustainable for US : the end of Bretton Woods

- A posteriori constraint proof: the 2013-2013 GFC episode

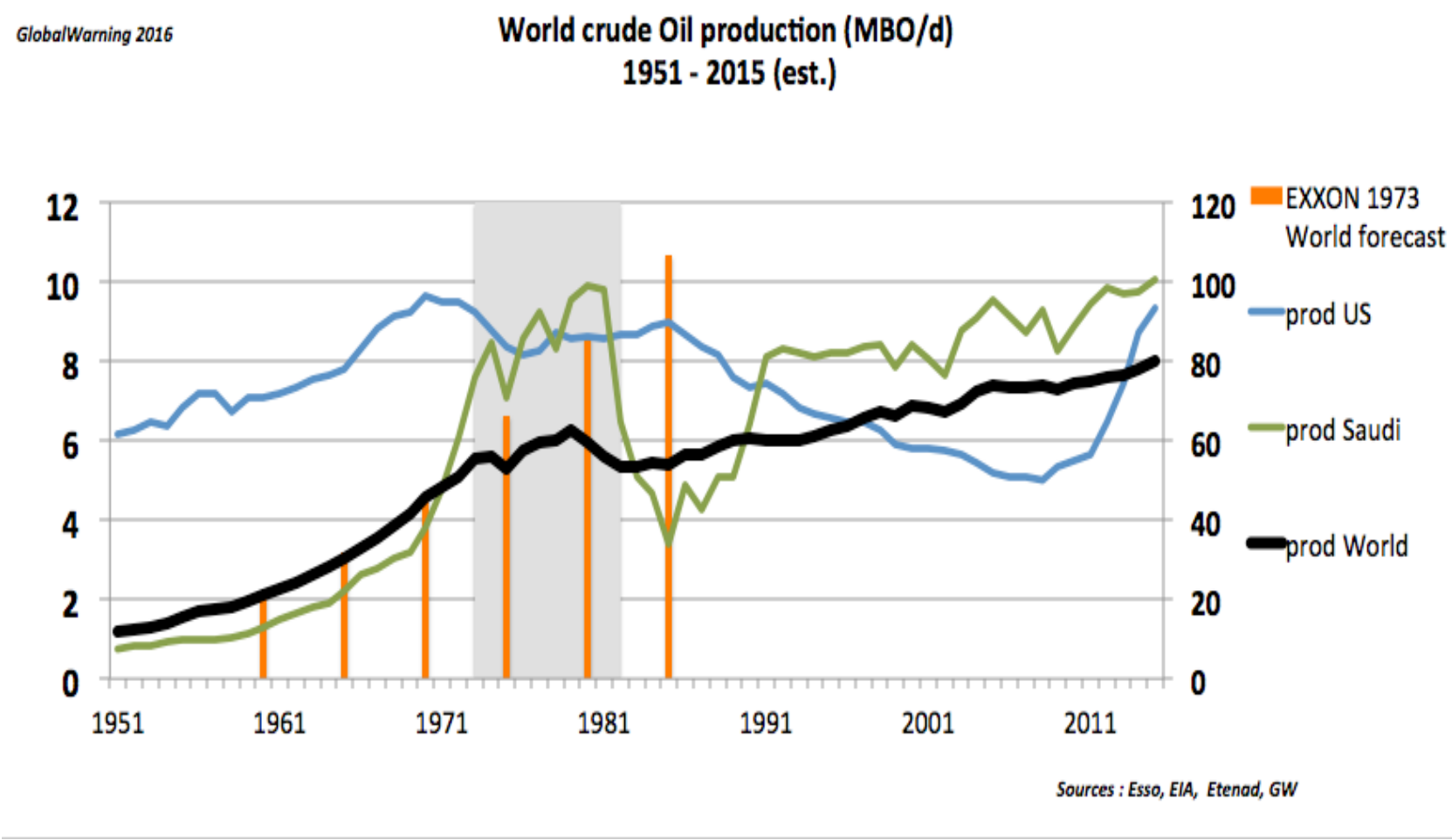
- History of finance

Unsustainable for Saudi : secular nation ?



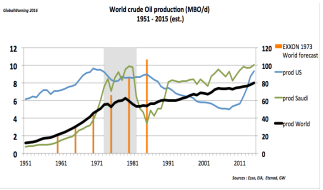


Unsustainable for the world : Kippur war as a pretext

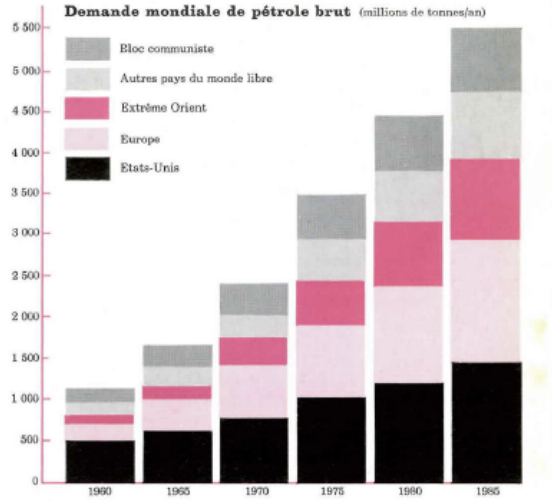


PÉTROLE PROGRÈS revue trimestrielle printemps 1973 95

“If something cannot go on forever, it will stop.” Herb Stein

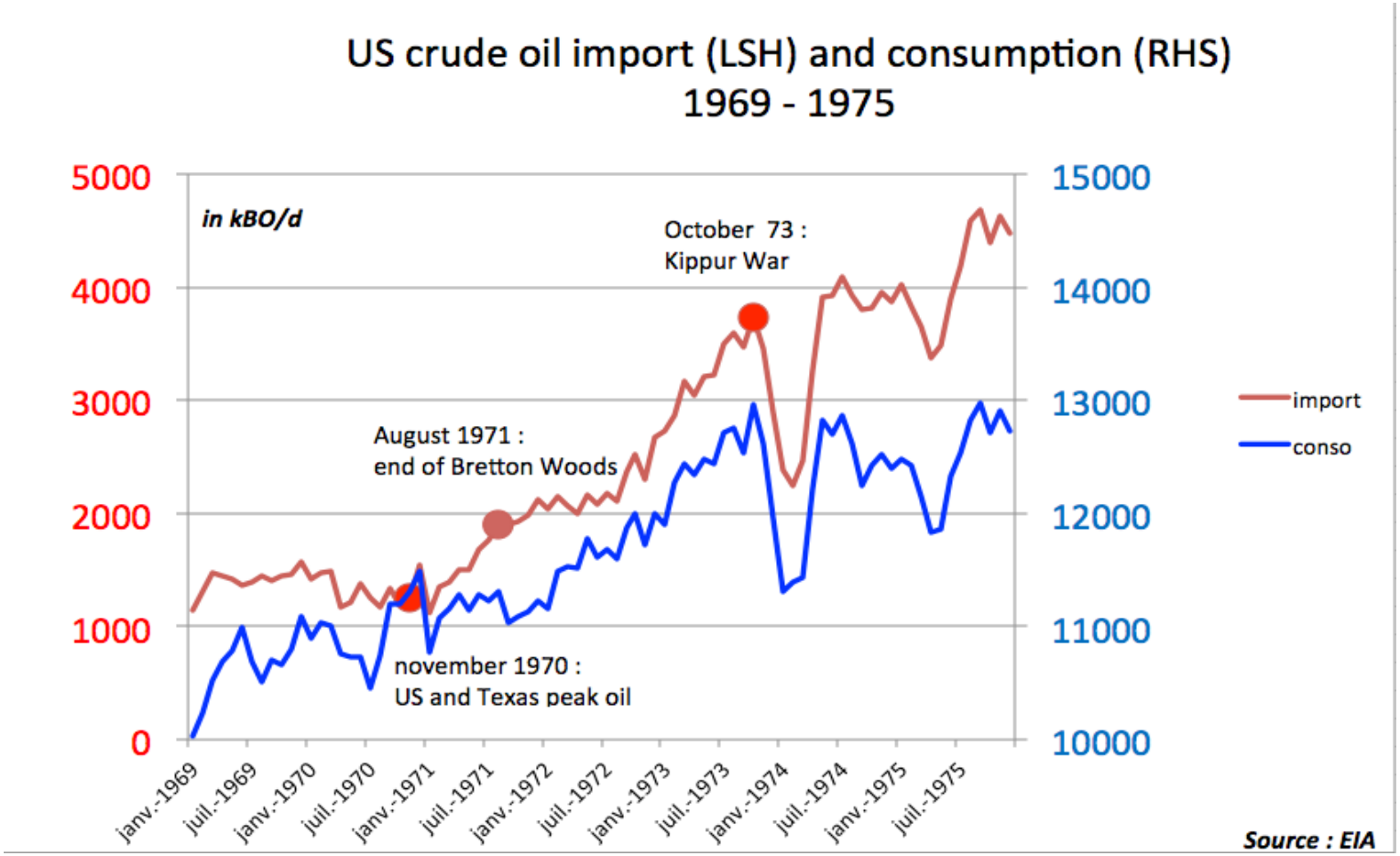


PERSPECTIVES MONDIALES DE L'ÉNERGIE



Si l'on essaie d'extrapoler ces perspectives pétrolières jusqu'en l'an 2000, les dimensions du problème deviennent alors véritablement vertigineuses. En supposant que la demande augmente annuellement entre 1985 et 2000 à la même cadence que durant les 15 années précédentes (1970-1985), la consommation en 2000 atteindra plus de 10 milliards de tonnes par an. Dans le cas où la production atteindrait un tel niveau, les quantités cumulées produites seraient voisines ou dépasseraient même l'ensemble des réserves récupérables telles qu'on les évalue aujourd'hui. On voit ainsi combien

Unsustainable for United States



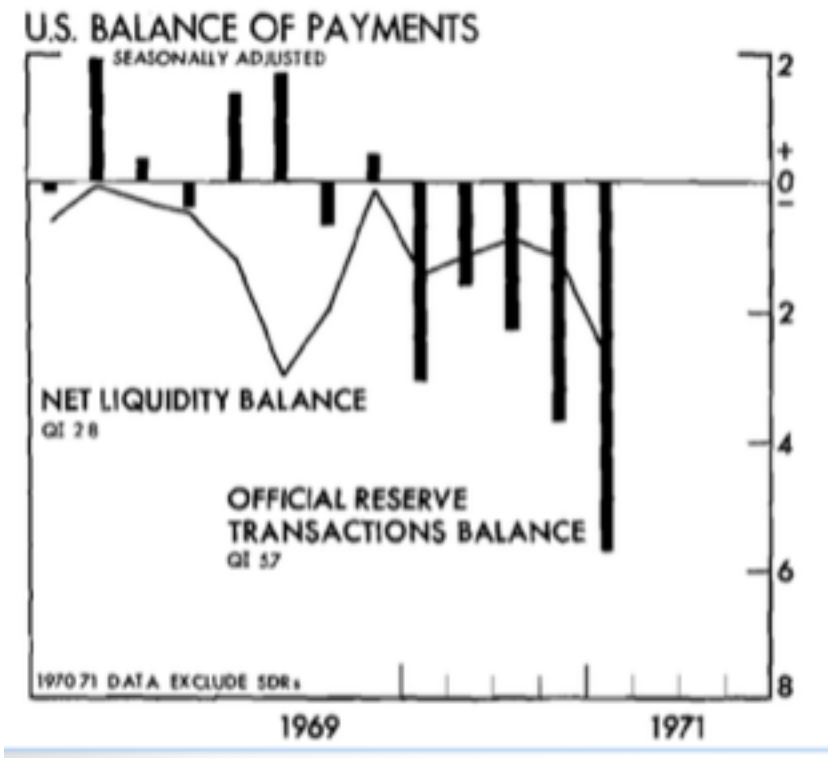
Oil price : from 1,21$/B (1970) to 10,97$/B(1974)

Unsustainable for United States

IV-C-1 7/20/71

U.S. AND INTERNATIONAL ECONOMIC DEVELOPMENTS

BILLIONS OF DOLLARS



RICHARD NIXON

XXXVII *President of the United States: 1969-1974*

195 - Special Message to the Congress on Energy Resources.

June 4, 1971

To the Congress of the United States:

For most of our history, a plentiful supply of energy is something the American people have taken very much for granted. In the past twenty years alone, we have been able to double our consumption of energy without exhausting the supply. But the assumption that sufficient energy will always be readily available has been brought sharply into question within the last year. The brownouts that have affected some areas of our country, the possible shortages of fuel that were threatened last fall, the sharp increases in certain fuel prices and our growing awareness of the environmental consequences of energy production have all demonstrated that we cannot take our energy supply for granted any longer.

Unsustainable for United States

Richard Nixon

XXXVII *President of the United States: 1969-1974*

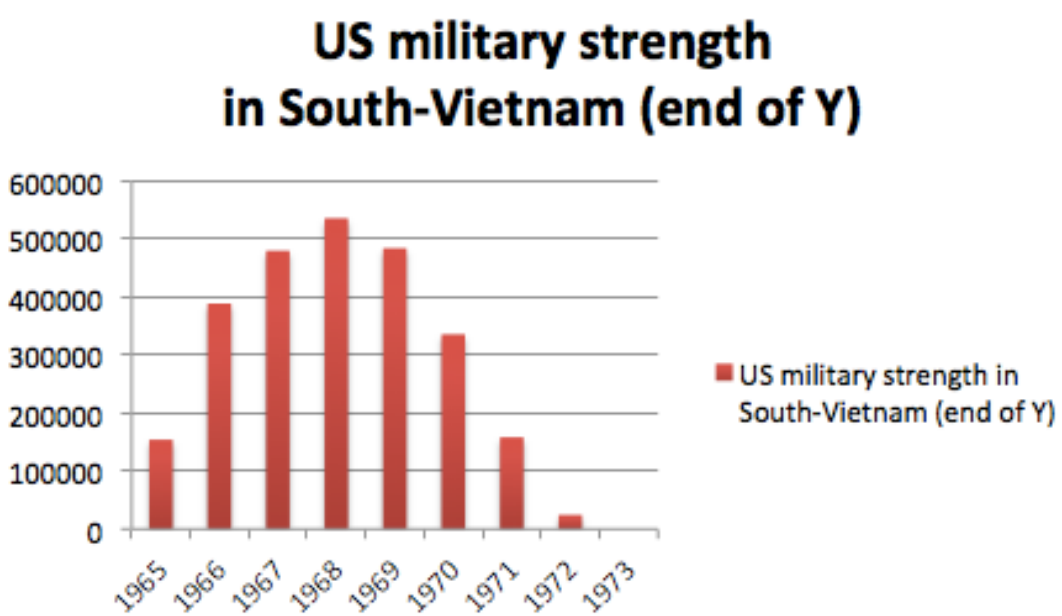
264 - Address to the Nation Outlining a New Economic Policy: "The Challenge of Peace."

August 15, 1971

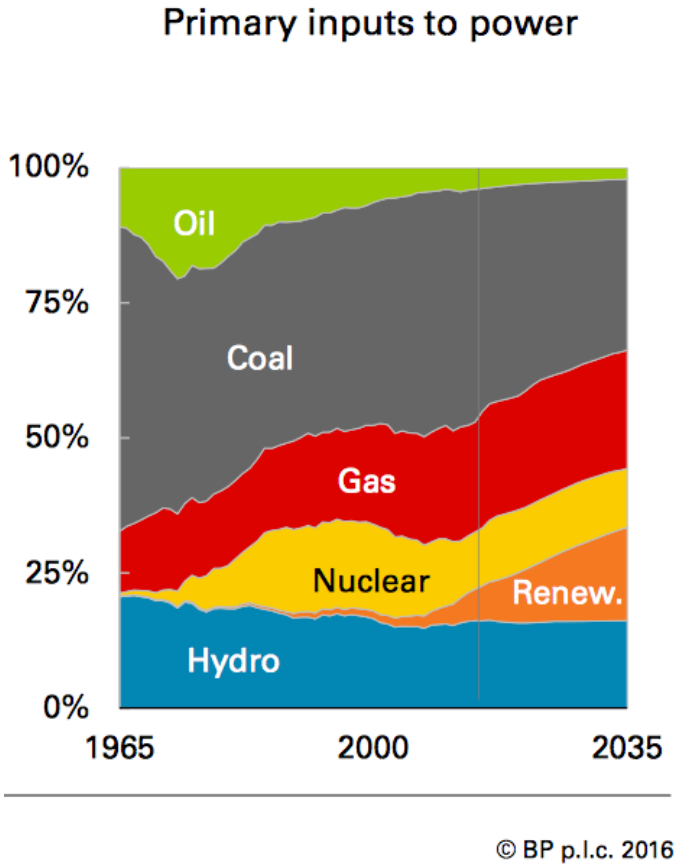
Good evening:

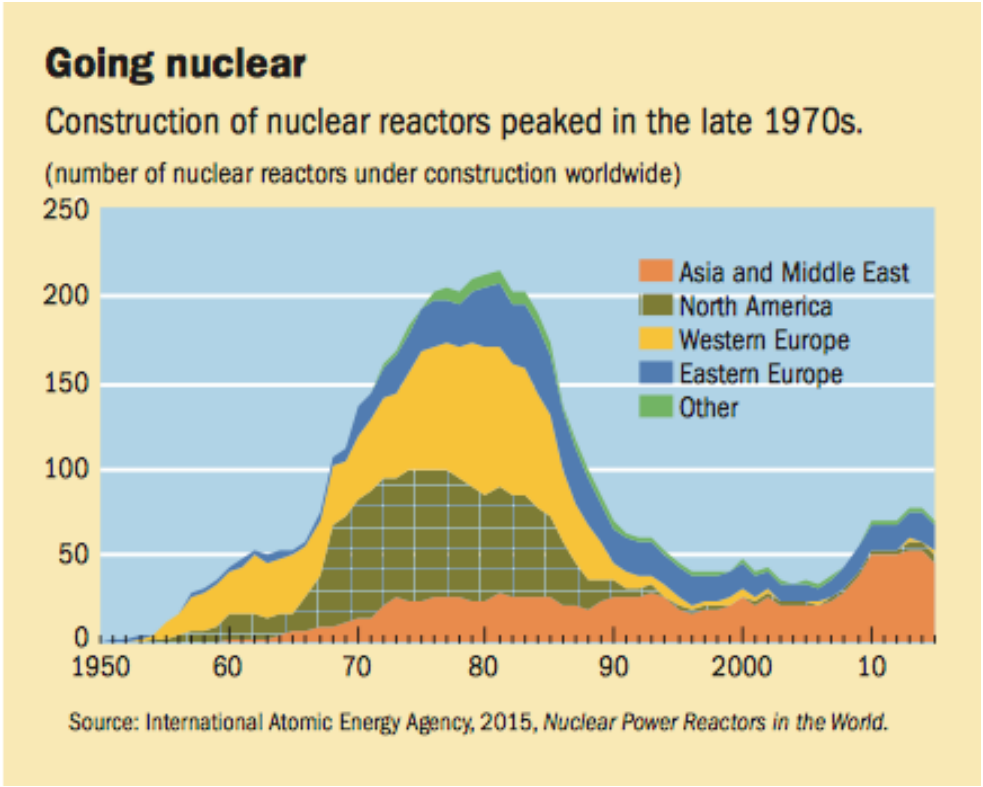
I have addressed the Nation a number of times over the past 2 years on the problems of ending a war. Because of the progress we have made toward achieving that goal, this Sunday evening is an appropriate time for us to turn our attention to the challenges of peace.

America today has the best opportunity in this century to achieve two of its greatest ideals: to bring about a full generation of peace, and to create a new prosperity without war.

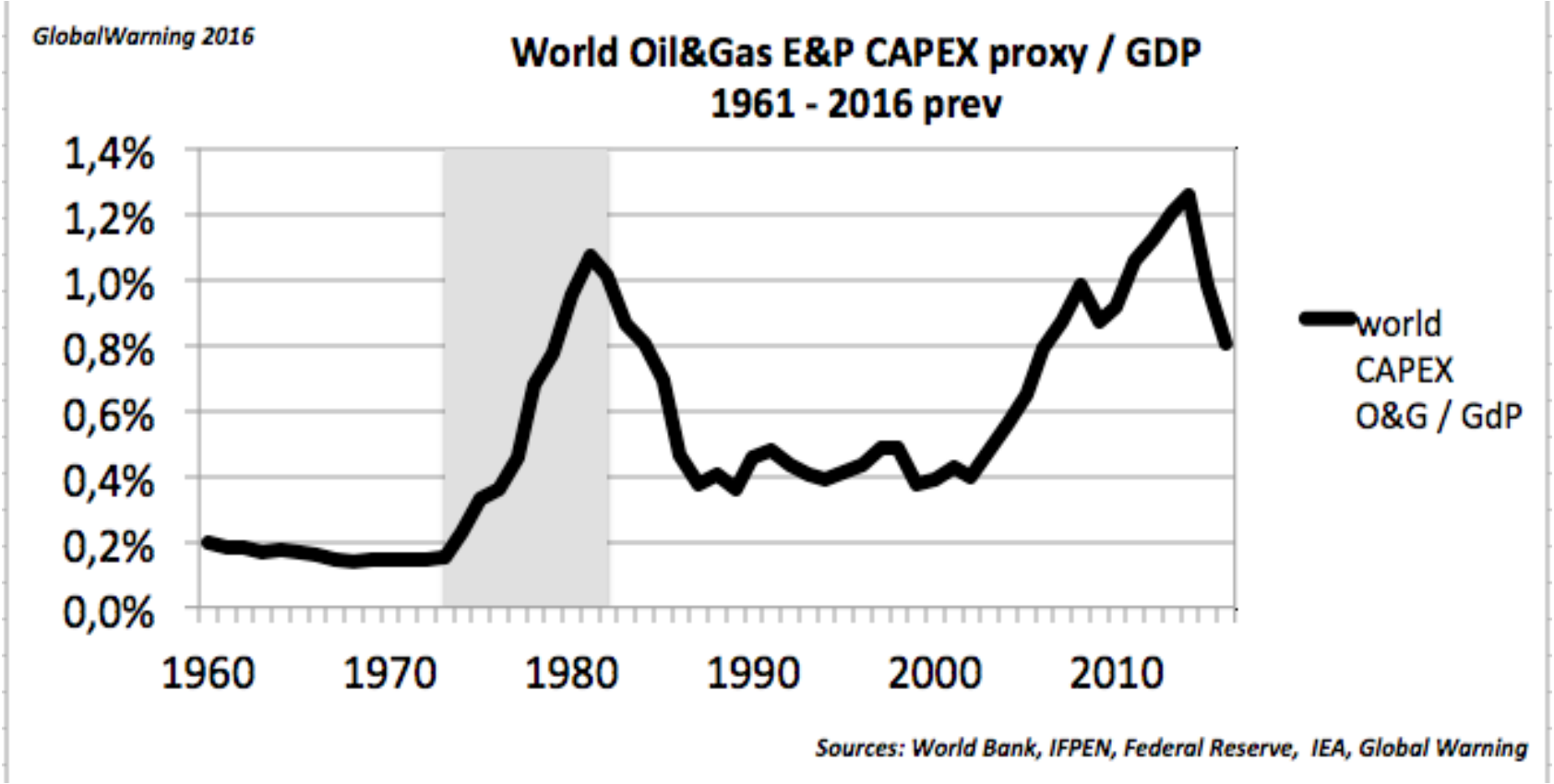


Price elasticity of oil is not what is used to be …

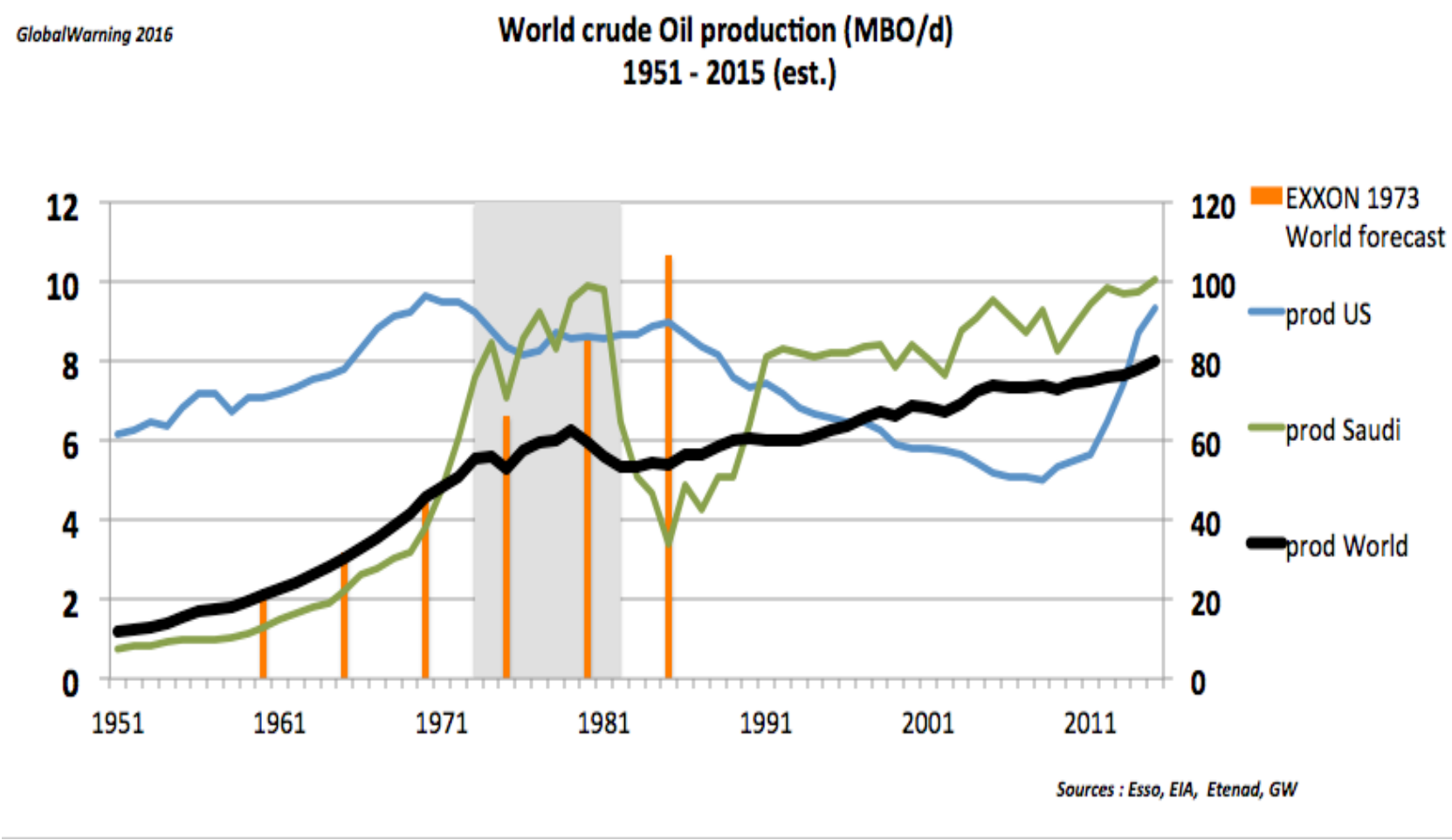




CAPEX : 2003-2013 Oil price signal … was not enough for 1973 …



A POSTERIORI ANALYSIS

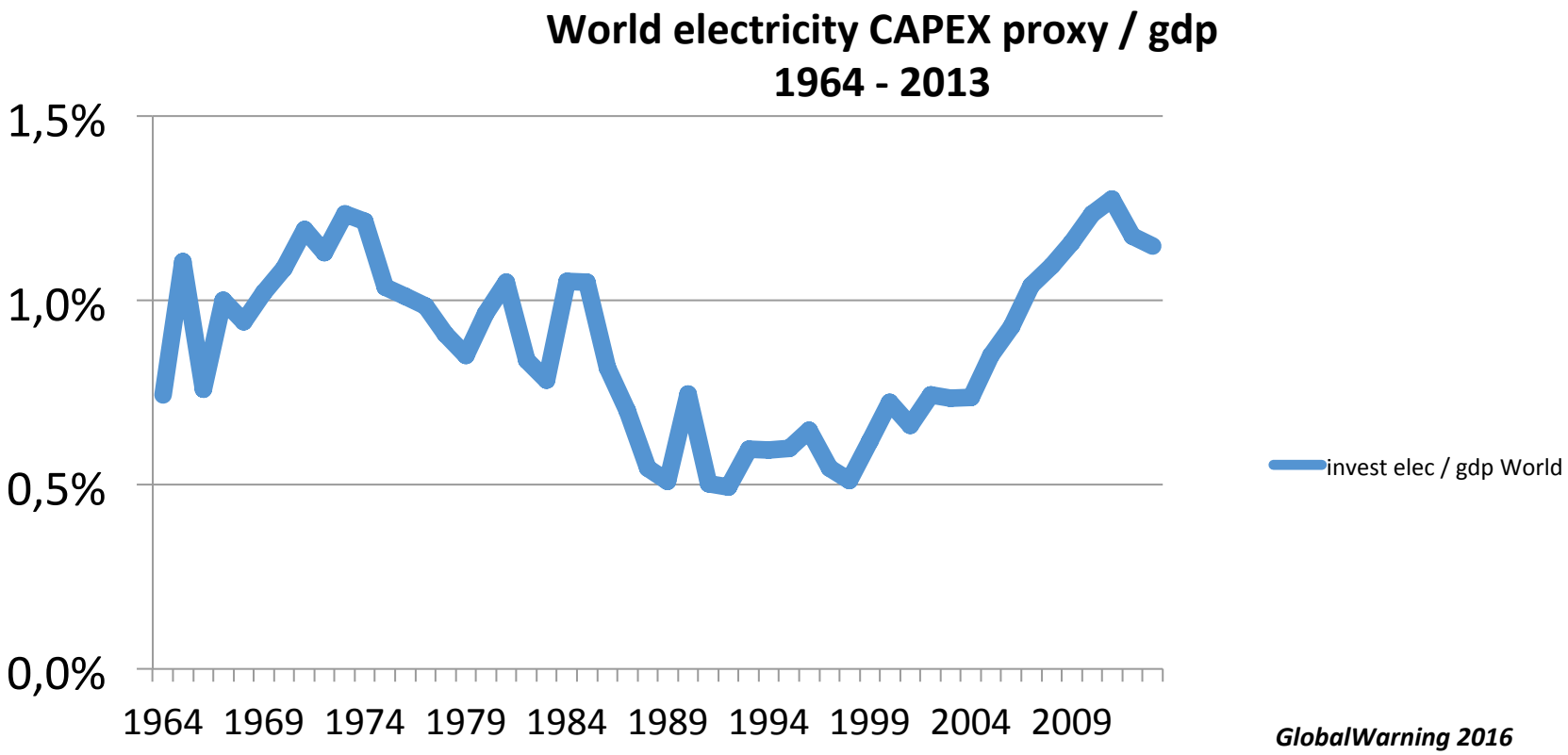


And world energy CAPEX ?

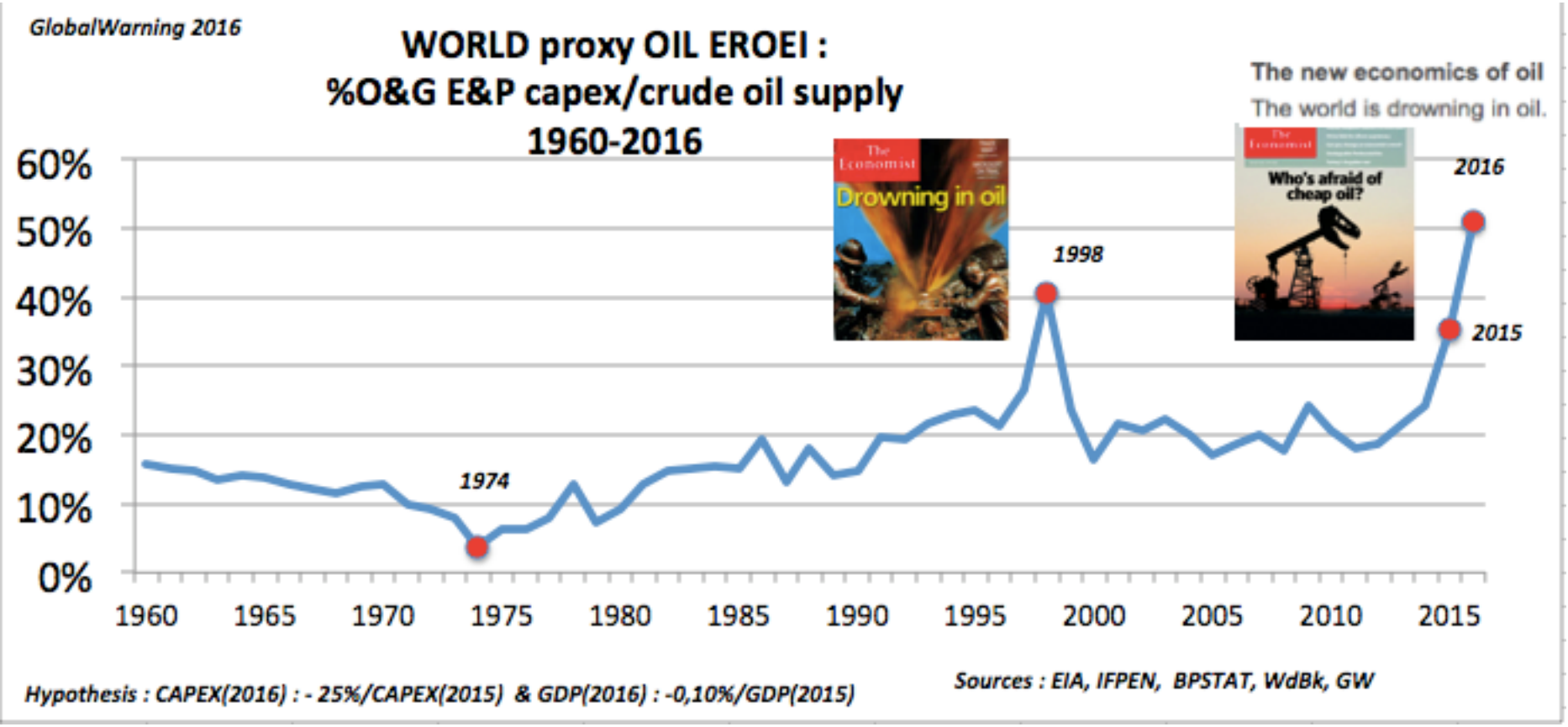
World

	Historical	Average annual investm... New Policies ...
	2000-13	2014-20	2021-25
Energy Supply *(billion, year-2012 US dollars)*			
Total	1 230	1 772	1 759
Oil	427	637	608
Upstream	320	510	509
Transport	54	50	42
Refining	52	77	57
Gas	252	357	388
Upstream	152	230	272
Transport	100	127	116
Coal	61	54	40
Mining	31	32	29
Transport	30	21	10
Power	479	713	712
Fossil fuels	106	120	117
Of which: Coal	55	68	66
Gas	46	49	49
Nuclear	8	46	56
Renewables	153	241	234
Of which: Bioenergy	17	22	23
Hydro	52	71	65
Wind	43	76	81
Solar PV	37	60	49
Transmission	48	84	80
Distribution	164	222	227
Biofuels	10	11	11

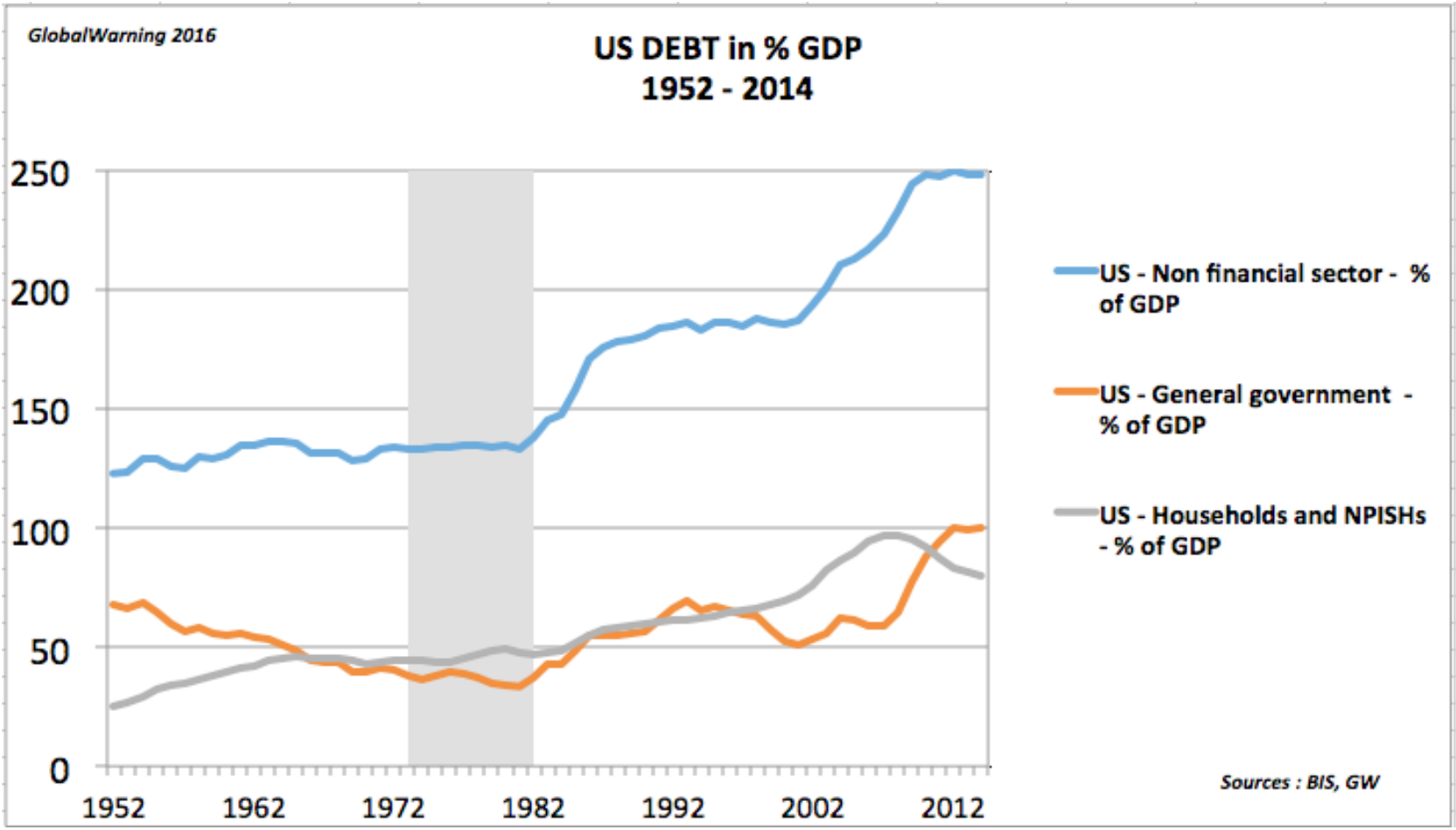
Proxy of electricity CAPEX ?



OIL EROI (proxy)



Easy money and “Summers time” : public & private money creation



THERE IS NO LIMIT => financial deregulation &the Great Transition

- End of Bretton Woods : 1971
- US deregulation 1982
- UK deregulation 1983
- France deregulation 1984

Anselme : « *Dieu est tel qu'on ne peut pas penser plus grand* »
Proslogion, Allocution sur l'existence de Dieu, 1077

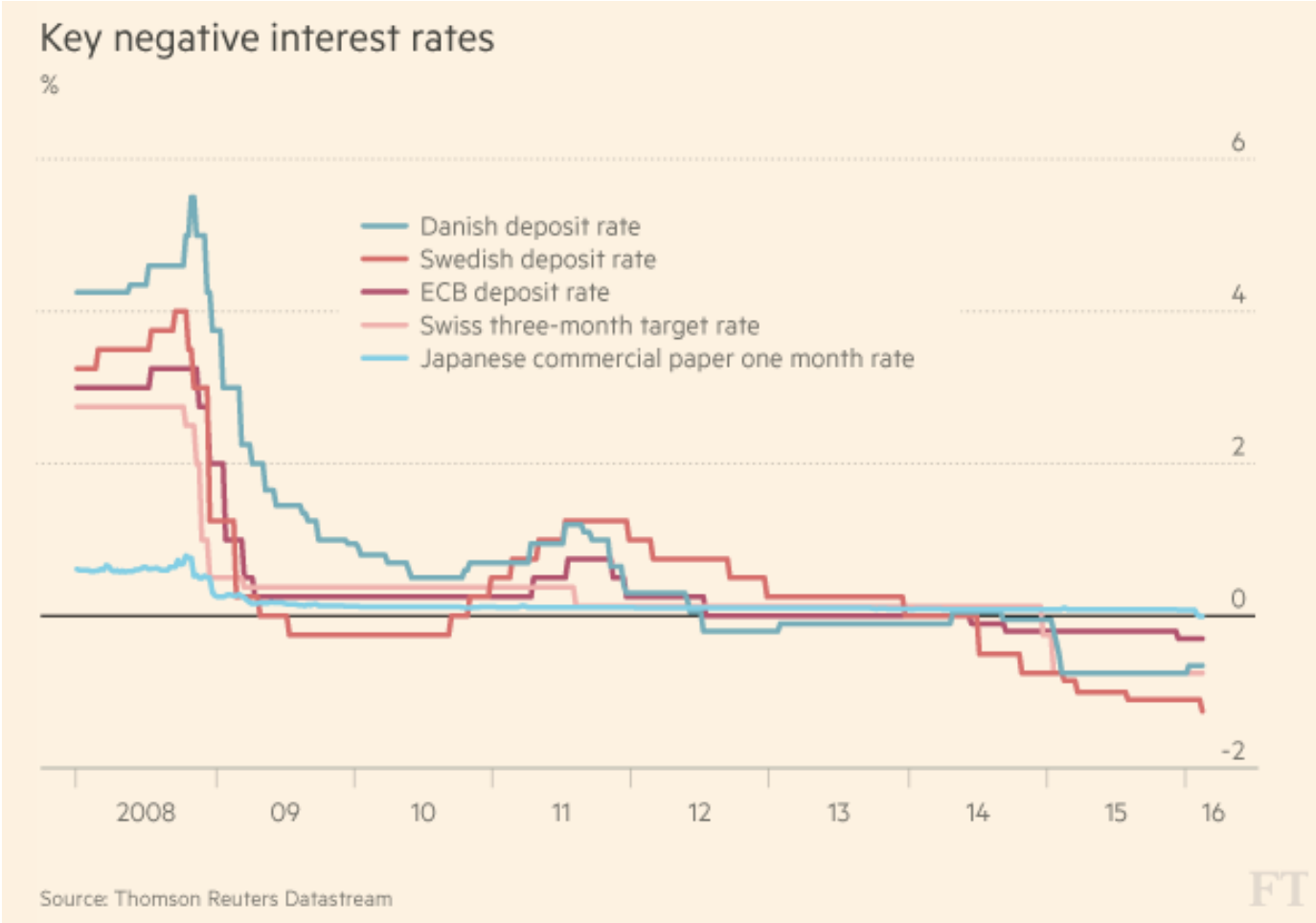
Draghi : « *There are no limits to how far we are willing to deploy our instruments within our mandate to achieve our objective of a rate of inflation which is below but close to 2%.* »
ECB, 2016

THROUGH THE ZLB ?

Figure 1: Spot Yields on 10 Year Bonds, G7 Excl. Italy, Quarterly: 1985 - 2013

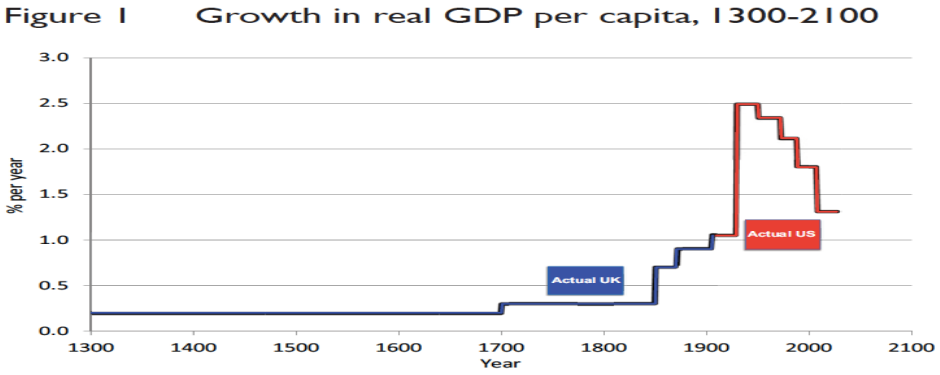
Source : Marvin King

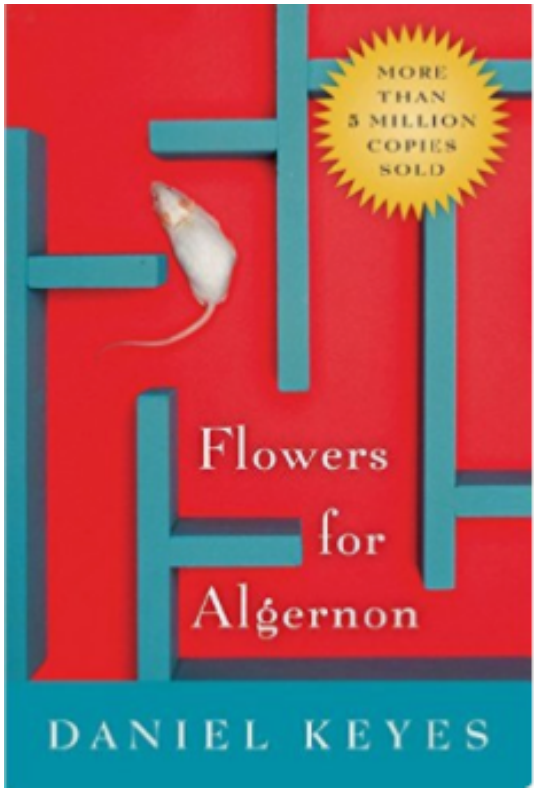
Negative thinking (FT 17/02/16)



We are Charlie ?

- **Economic history & the GPTs : hydro, wind, wood, peat & gun powder**
- **Macroeconomics (and the IPCC)**
- **The ZLB symptom**
- **Finance and the transition**





F.Braudel, R. Philippe, Soddy, Leslie White, Lynn White, Putnam, R.Ayres, Wrigley, Arnoux, Gordon, Jancovici, Clavier, D. Bourg, Giraud …

Thank you !

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