Learning From the Oil Cycle to Design the Future Economy

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November 12, 2020

Outline

Disagreements

(Graeber, 2013)

Secular Cycles

(Turchin and Nefedov, 2009)

1. Growth: happy!
2. Stagflation: decreasing wages, greater inequality, and discontent.
3. Crises: inter-elite competition, civil war.
4. Intercycle.

Basics

1. $Y \stackrel{\text{def}}{=}$ GWP
2. E energy production, $U \stackrel{\text{def}}{=} eE$, e efficiency.

Assumptions:

Ass1 $Y(U) \nearrow \implies Y(E) \nearrow$.

Ass2 The means of economic production are enabled by energy production.

$q \stackrel{\text{def}}{=}$ quantity of energy (including food) produced in some unit.

$p \stackrel{\text{def}}{=}$ average price per unit of energy. Definitions:

$$Y_E \stackrel{\text{def}}{=} pq \subset Y \tag{1}$$

$$Y_{E^{\complement}} \stackrel{\text{def}}{=} Y - Y_E \tag{2}$$

$$C \stackrel{\text{def}}{=} \frac{Y_E}{Y} = \frac{Y_E}{Y_E + Y_{E^{\complement}}} = pq/Y \tag{3}$$

$C =$ *cost share* or *energy intensity*.

Remark

1. All quantities are time dependent which we have omitted from the equations.
2. If energy is produced at a loss or subsidized, this means the the cost of production $c > Y_E = pq$ so that a quantity of money $X = c - pq \subset Y_{E^{\complement}}$ is used to produce energy.
3. It is immediate from the above that producing energy at a loss reduces the diversity of the economy.
4. Energy produced at a loss reduces its price because money from $Y_{E^{\complement}}$ a part of which would have been spent buying energy is instead spent producing energy.

The explicit price equation

Solving (3) for p we obtain

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$\alpha_g \approx 2/3$, $\alpha_s \approx 2.3$ (Illig and Schindler, 2017).

Dynamic production function equations

Solving (3) for Y:

$$Y = pq/C. \tag{5}$$

Taking the log and then the derivative with respect to q in (5) we obtain

$$\frac{\partial Y}{\partial q}/Y = \frac{\partial p}{\partial q}/p - \frac{\partial C}{\partial q}/C + 1/q. \tag{6}$$

Principles

P1 At constant salary, $C \searrow (\nearrow)$ living standards $\nearrow (\searrow)$.

P2 In (4), the effect of marketing is on C.

P3 When C is small (large), people use it inefficiently (efficiently) $\nearrow (\searrow)$ demand.

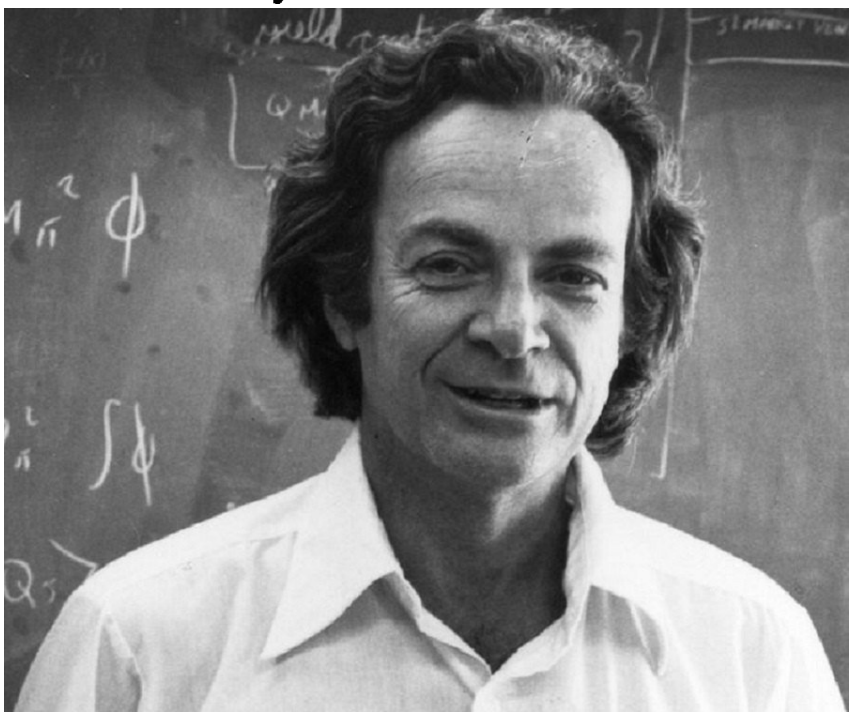
P4 If $C \searrow$ at constant salary, people tend to find more ways of using energy thus $\nearrow$ demand.

P5 At constant salary, if $C \nearrow$, people use energy more efficiently decreasing demand.

P6 In a growing economy sectors of the economy which grow faster than the economy contribute less to economic growth than sectors that grow slower than the economy.

Cost Share Theorem?

Richard Feynman



(Veblen, 1899; Graeber, 2018a; Ayres and Warr, 2009; Graeber, 2018b; Fix, 2020).

Permaculture design

1. Protect the earth.
2. Protect humans.
3. Share

A rational agent is a sociopath.

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Examples: toilets. Jenkins (2019); Országh (Országh), industrial agriculture (Wise, 2019).

Permaculture solutions

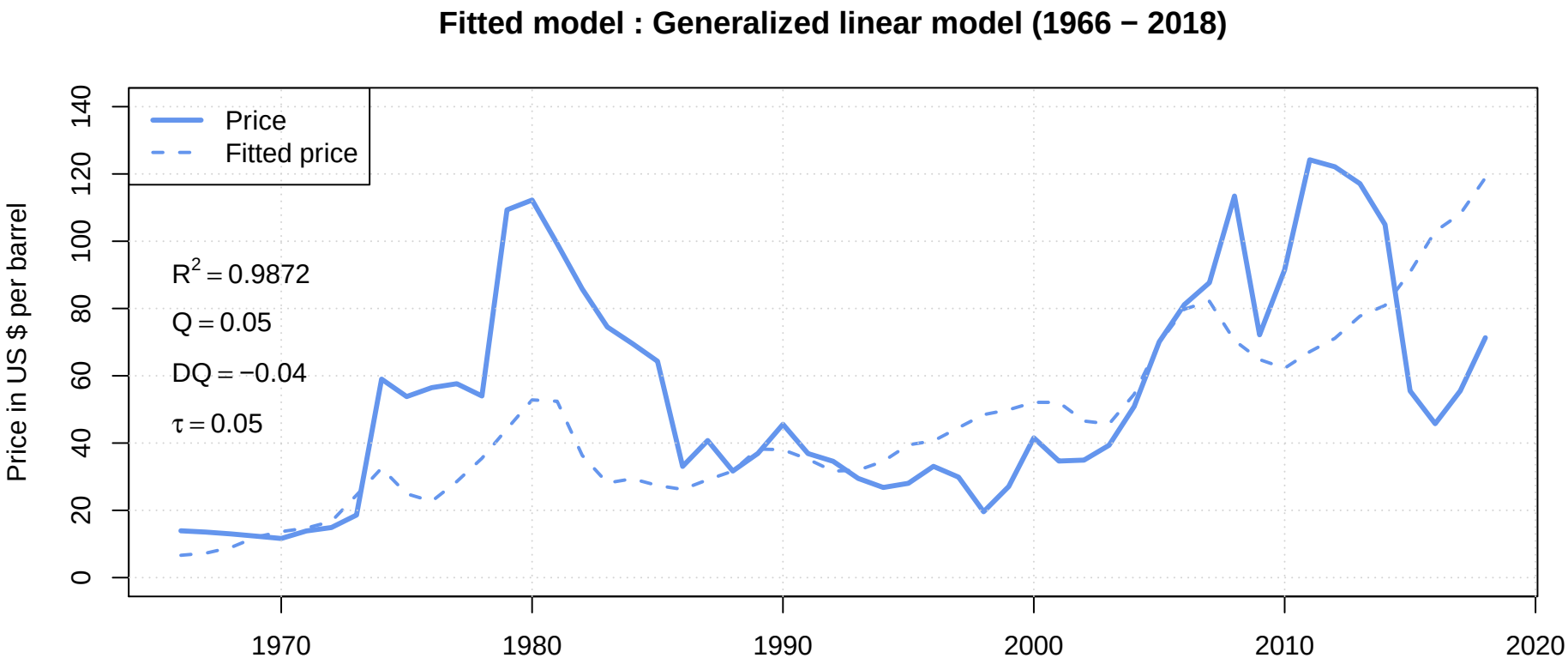
1. Permaculture encourages economic contraction through decreased energy use.
2. Because system science is used, fossil fuels are eschewed in permaculture design. From (4) it immediately follows that permaculture solutions decrease the price of fossil fuels because the cost share of fossil fuels are decreased.

    P7 Permaculture solutions are generally deflationary a fortiori with respect to fossil fuels.

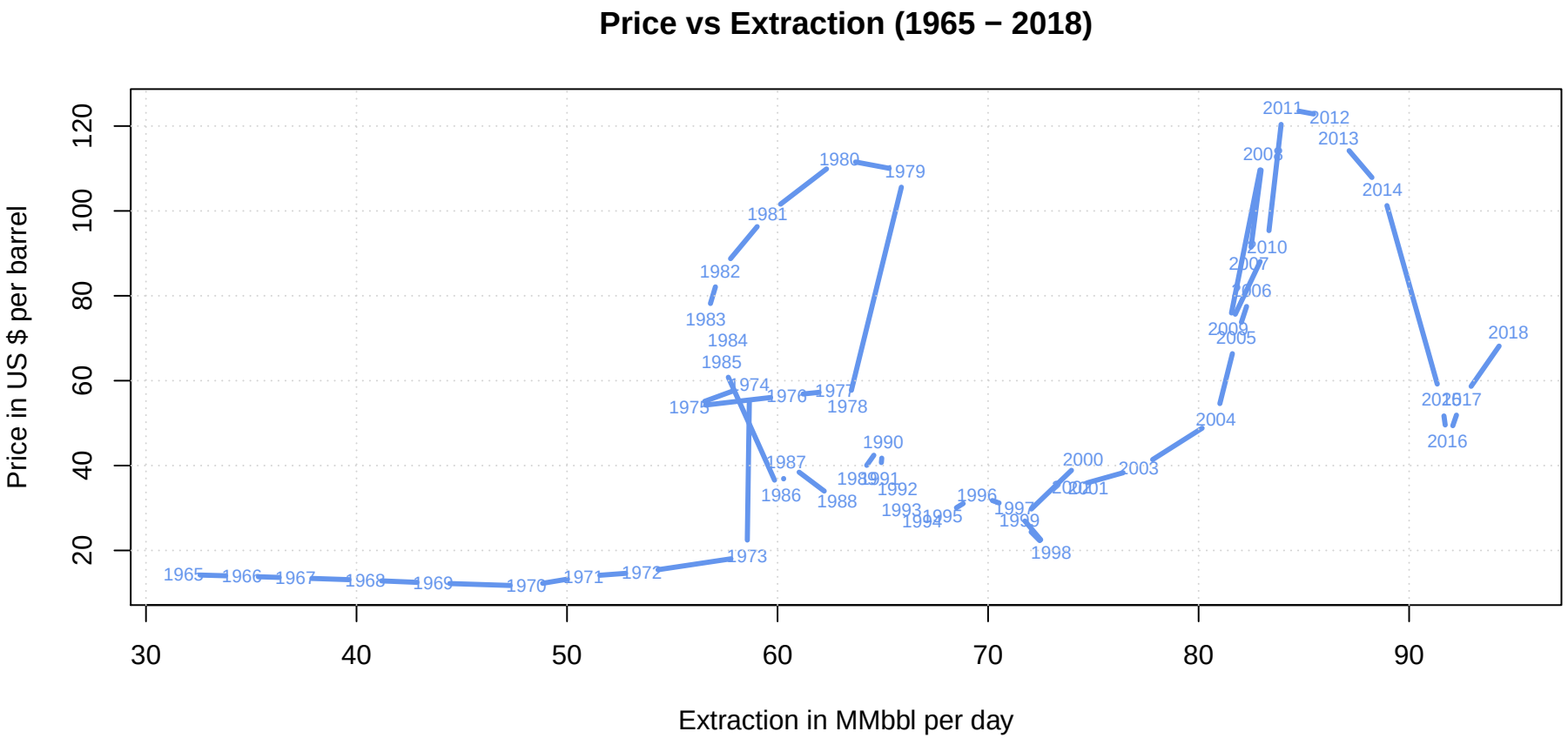
An empirical study of oil prices

$p_t = C_t Y_t / q_t$.
$\tau_t \stackrel{\text{def}}{=}$ US federal funds rate.
$Y_t = Y(q_{t-1}, \tau_t)$.
$\nabla Q_t \stackrel{\text{def}}{=} Q_t - Q_{t-1}$.
$P_t = \exp(a\tau_t + b\, Q_t + c\, \nabla Q_t + \epsilon_t)$.

Generalized model



Supply and demand overrated



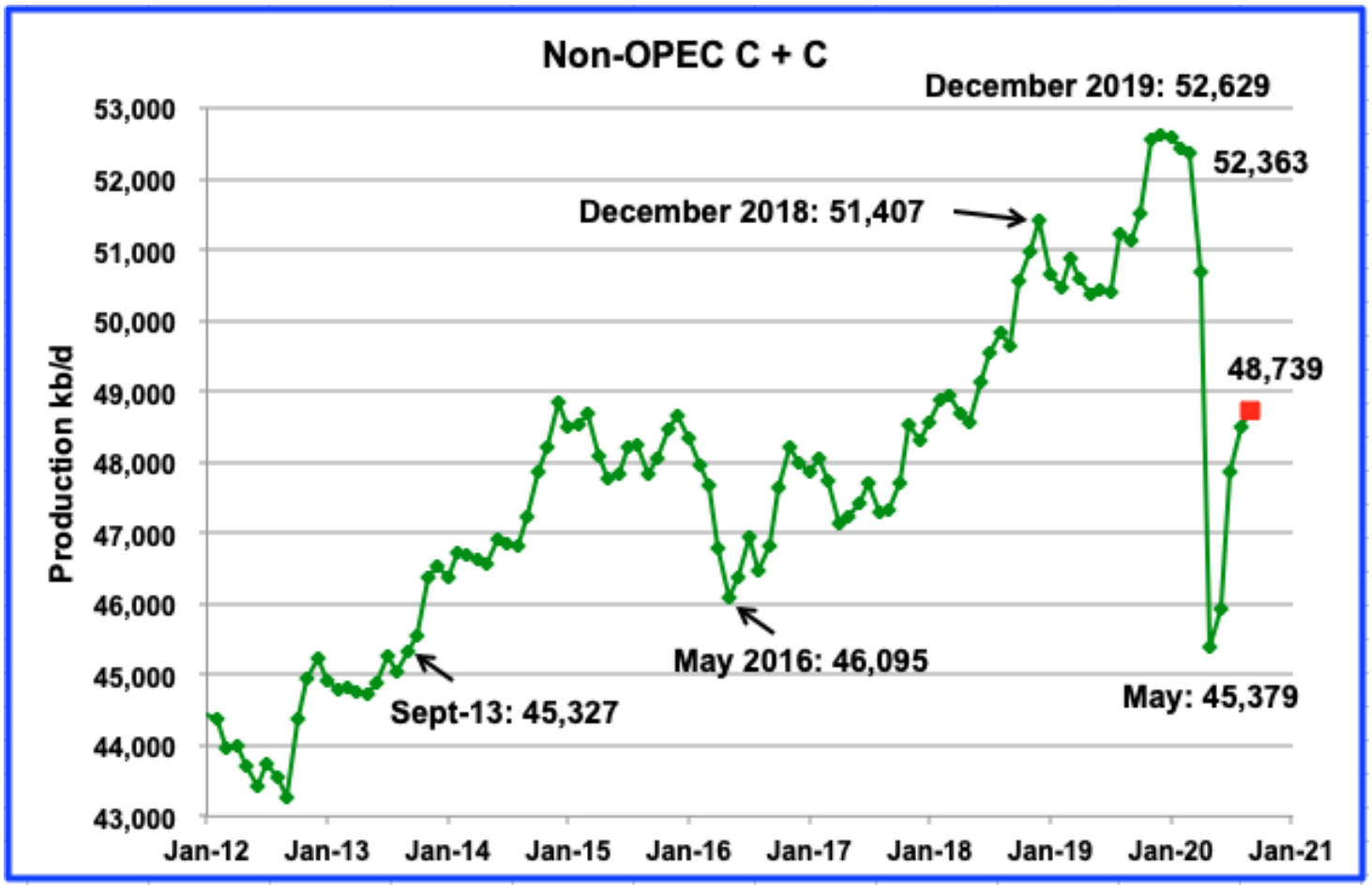
Supply and demand in oil

1. Actors
   - Finance: Capex + LOE.
   - Working interest (marketing!).
   - Mineral rights owner.
2. Boom bust cycles (Auzanneau, 2016).
   - Cartels
   - TRRC
   - OPEC
3. Unprofitable oil

(Mullainathan and Shafir, 2013)

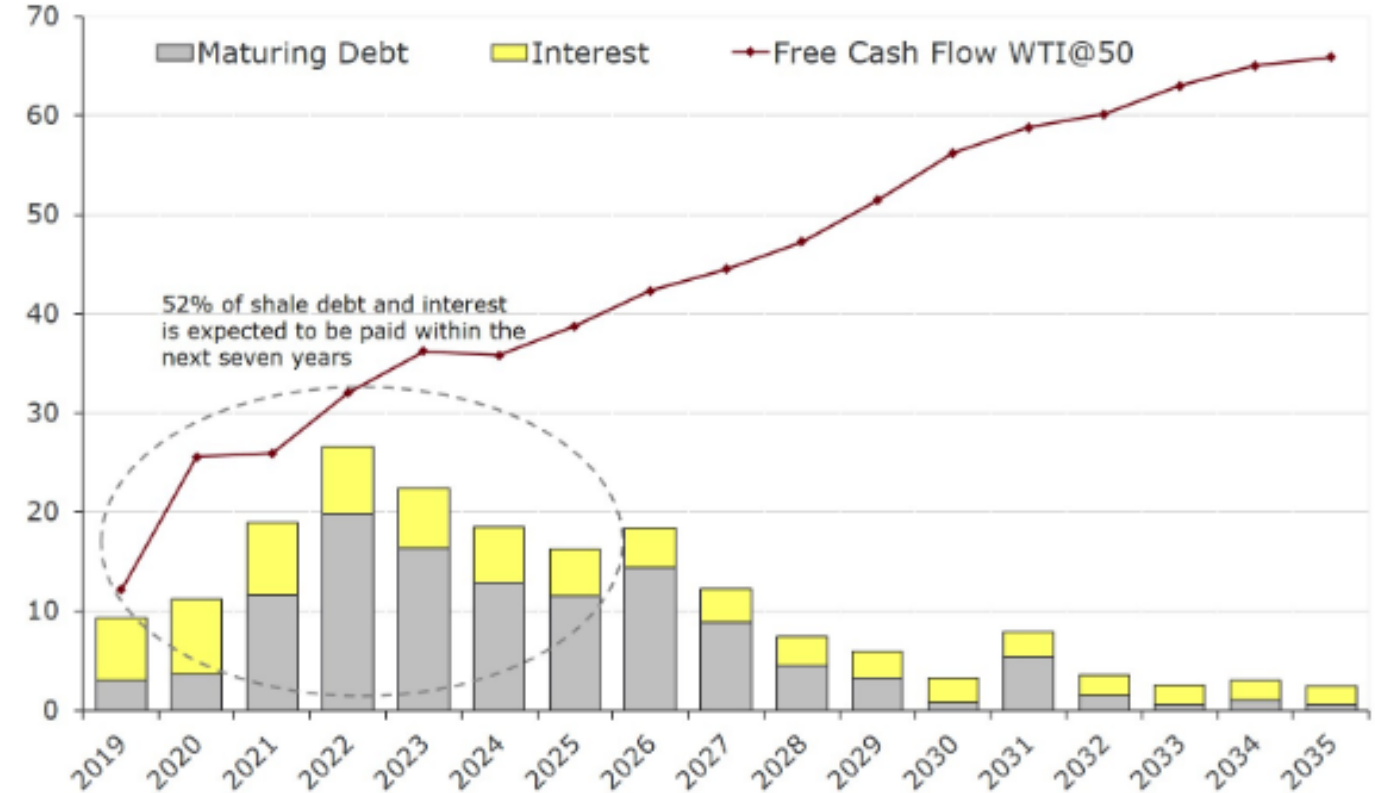
- Bankruptcies LTO since 2015: 248, $175 billion (Staff, 2020).
- high margin first.

EIA via Ovi


Non-OPEC C + C
December 2019: 52,629
52,363
December 2018: 51,407
48,739
May 2016: 46,095
May: 45,379
Sept-13: 45,327
Production kb/d
53,000
52,000
51,000
50,000
49,000
48,000
47,000
46,000
45,000
44,000
43,000
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21

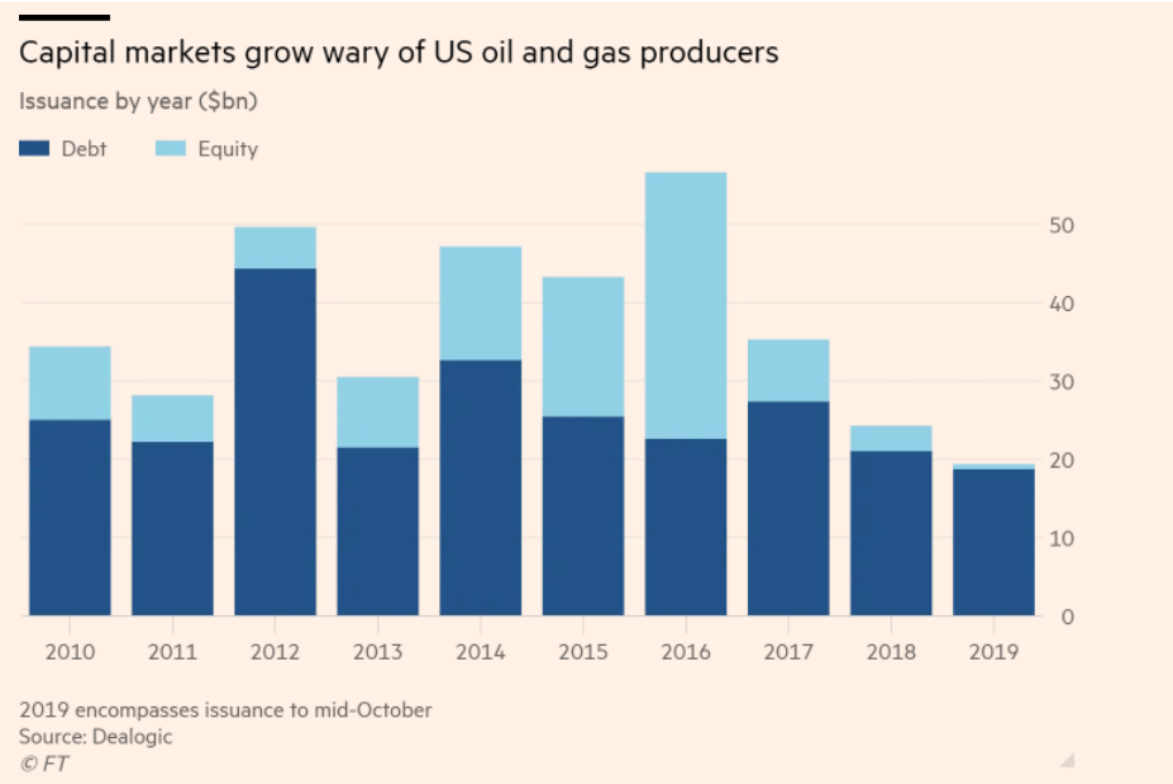
Marketing (Rystad 2019-03)

Figure 2: Obligations schedule for 33 US shale oil producers
Billion USD



Source: Rystad Energy UCube, E&P company reporting

Investor mistakes (via FT)



Energy: lowest returning sector 2010- end 2019 (Staff, 2019).

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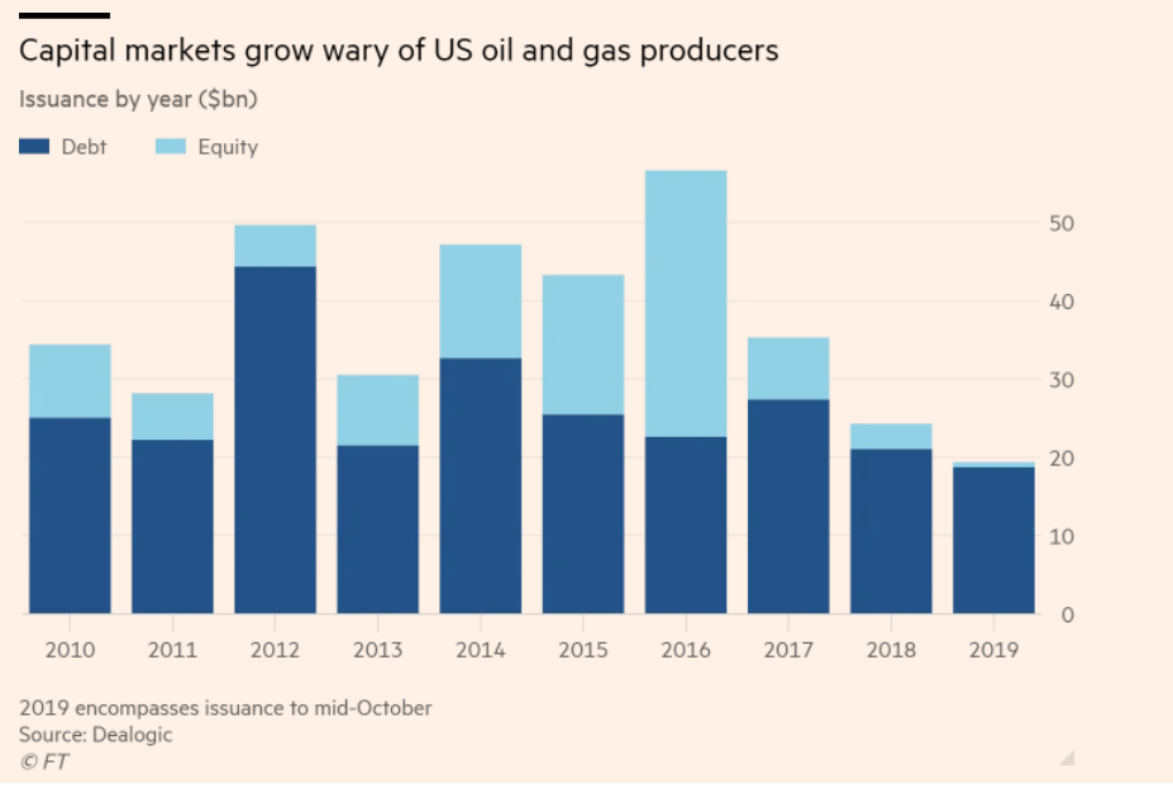

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Carbon taxes?

Pandemic

$$p = CKq^{\alpha-1}.$$

currently $\alpha < 1$. WEO 2016-2019 not enough investment will need LTO. WEO 2020 investment -1/3. Once oil becomes a constraint $\alpha > 1$. Empirical model an upper bound for prices $\implies$ 2018, 2019 peak.

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BP, Shell, Total, DNV-GL, the IEA and OPEC: peak demand.

End game

Financial failure. Extreme cases:

- Investors retreat: extraction ceases.
- Money creation from $Y_{E^{\complement}}$: until workers walk off because of low salaries.

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Examples:

1. 60,000 abandoned mines in Australia (Campbell et al., 2017).
2. Venezuela (Buitrago and Ulmer, 2018).
3. USA: 2.6 million unplugged abandoned wells (Schuwerk and Rogers, 2020).

Industrial agriculture

1. USSR (peak 1989).
2. North Korea: famine.
3. Cuba: special period (permaculture).

Money creation and religion

Greenspan put (Prins, 2018; Taibbi, 2020).
Long Chen: Finance as a service facilitating trust, connectivity, and financial services.

1. Rome.
2. Interest bearing debt: competition, accelerates economic trend.
3. Blockchain (and derivatives).
   - Proof of (useless) work: Bitcoin.
   - Proof of useful work.
     - Utility token: Filecoin, Fuelcoin, Golem.
   - Good behavior: Solarcoin, Mobicoin.
   - Equality (universal basic income): cooperation, June (Ğ1).

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