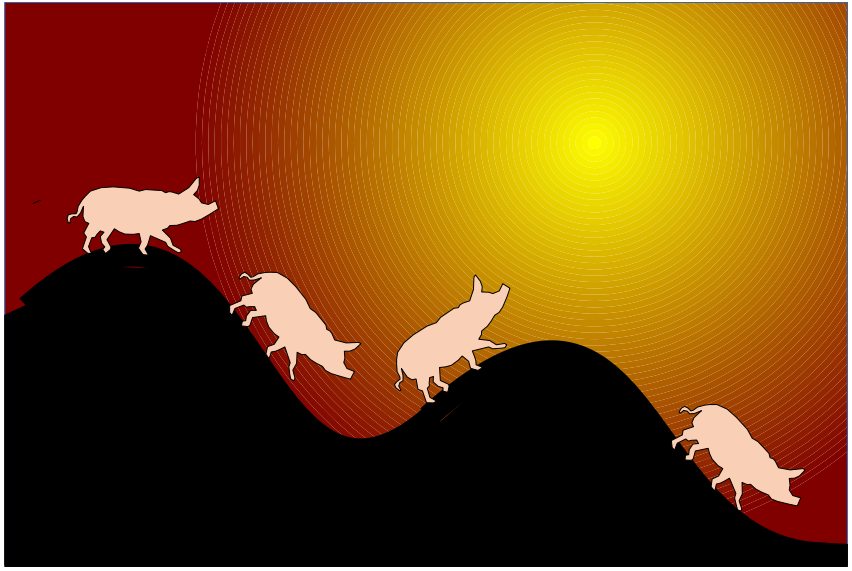
Why does the oil price not follow the ETP-Model ?

Berndt Warm

Version 1.03

14.07.2018



Abstract

Question: Why does the oil price not follow the ETP-Model ?

- We applied the theory of economists, that overproduction caused by fracking companies determines the oil price curve including the price crash of 2014.
- A fit of the WTI price curve to a sine function, representing a hog cycle, and a straight line, representing long time effects, has been done.
- The fit gives values for the undulating and the linear component.
- The linear component results in the same curve, which the HG has calculated for the maximum affordable price (MAP).
- The MAP curve is clearly identifiable and visible in the oil price trend.

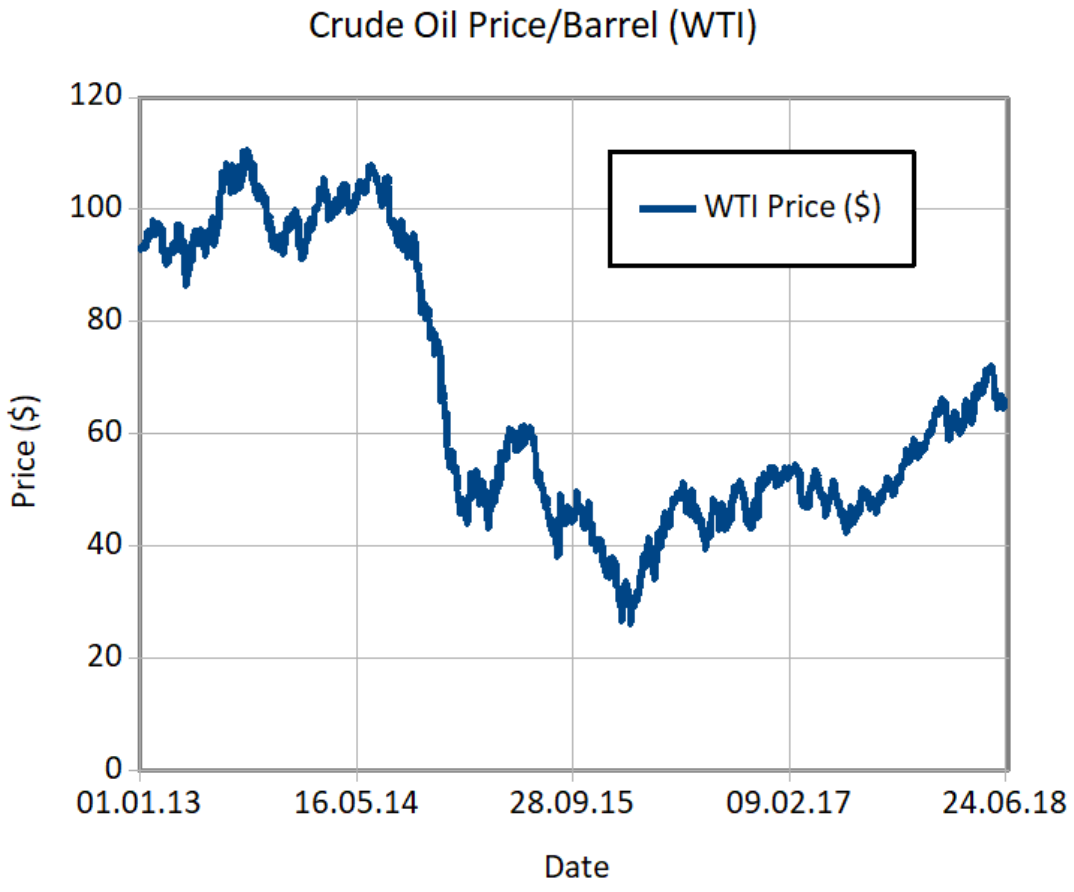
Answer: The long time oil price trend follows exactly the MAP, derived from the ETP model.

Introduction

Preface:

- The Hills-Group has developed an equation for the calculation of the energy required for oil production (see: The Hills Group, *„Depletion: A determination for the world's petroleum reserve“,* page 8, Eq #7)
- This ETP-equation predicts, that in the year 2029 the energy required will be as large as the useful exergy of oil
- The ETP-equation has been derived by using the second law of thermodynamics
- Out of the ETP-Equation, HG has developed a price prediction for Crude Oil.
- This prediction included a price decline for the oil price in 2012. The price decline happened, but in 2014.
- A simple look on the oil price diagram since 2013 reveals that the price prediction is faulty.
- 2013 has been the year oil production by fracking has got significant.
- The standard economic theory is, that the price crash 2014 has been caused by overproduction, caused by US fracking companies.

Oil Price Diagram

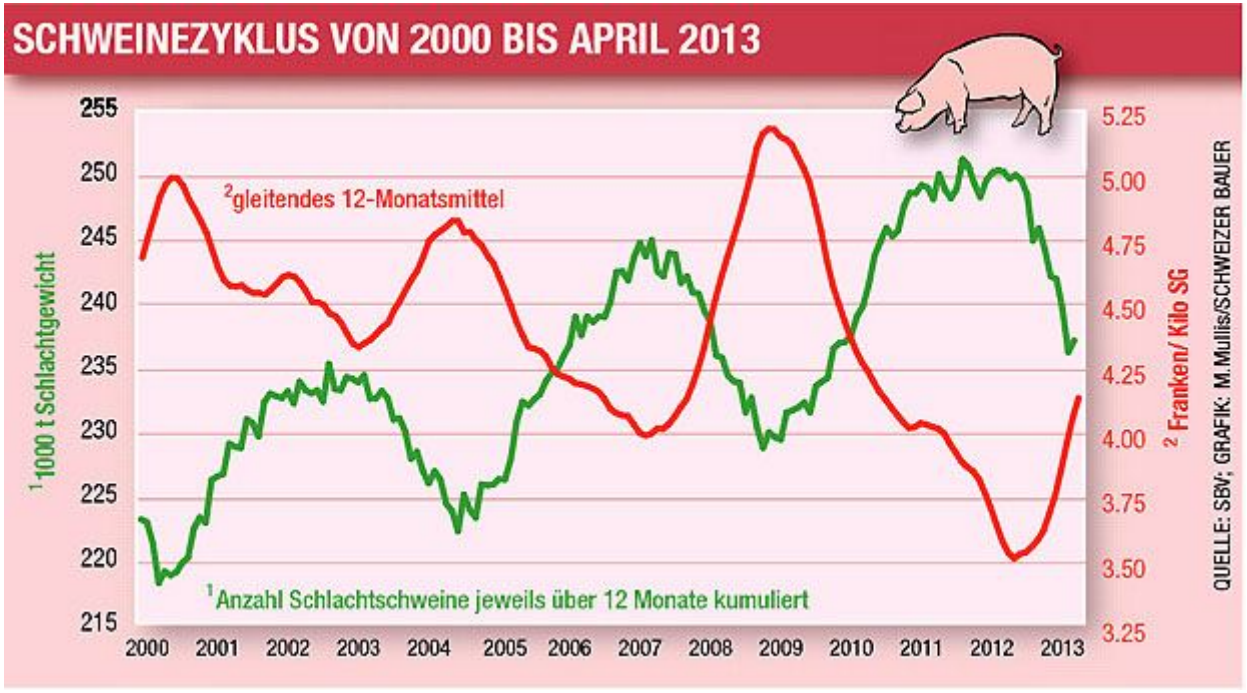


Details

- The price curve displays the price crash of 2014.
- Most analysts blame overproduction of oil for the crash, caused by fracking companies.
- They do not believe in other explanations for the oil price crash.
- They discuss very often the „hog cycle“, and believe, after leaving the „hog cycle“, prices will go up again.
- Fracking contributes only to ~5% of the total oil production, so it is difficult to believe that this can lead to ~60% oil price reduction, resulting in doubt for a simple overproduction explanation.

.

The Hog Cycle

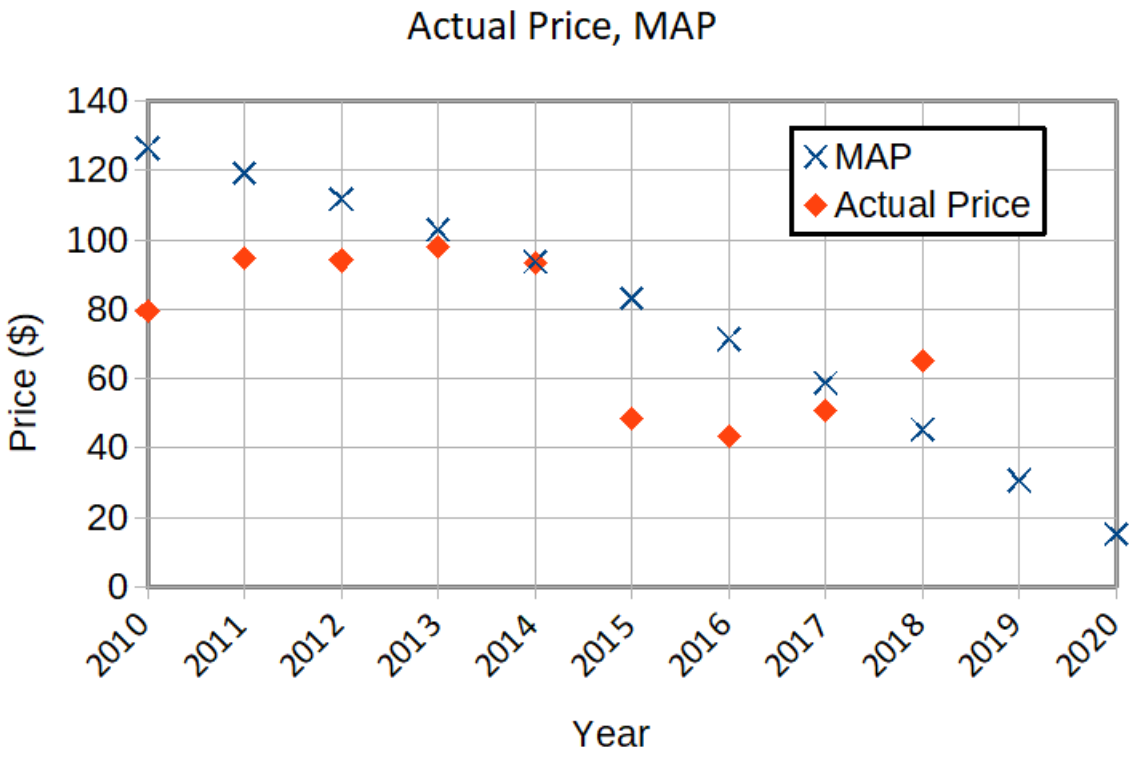


A supply increase of ~+10% corresponds price change of ~-25%

Hog Cycle

- The hog cycle is caused by demand and supply of cattle, visible in the price patterns of hogs.
- It needs about 18 months until a hog is ready for slaughter.
- The time from price peak to peak is about 3 lifecycles of a hog, that is 4-5 years.
- The hog cycle repeats and repeats.
- Economists believe, to escape the cycle, companies must be vertically integrated: hog raiser and butchers must be one company, allowing better adaption between supply and demand.
- The problem of applying the „hog cycle“ to oil prices is: **Undulating oil prices are not visible in price charts !**

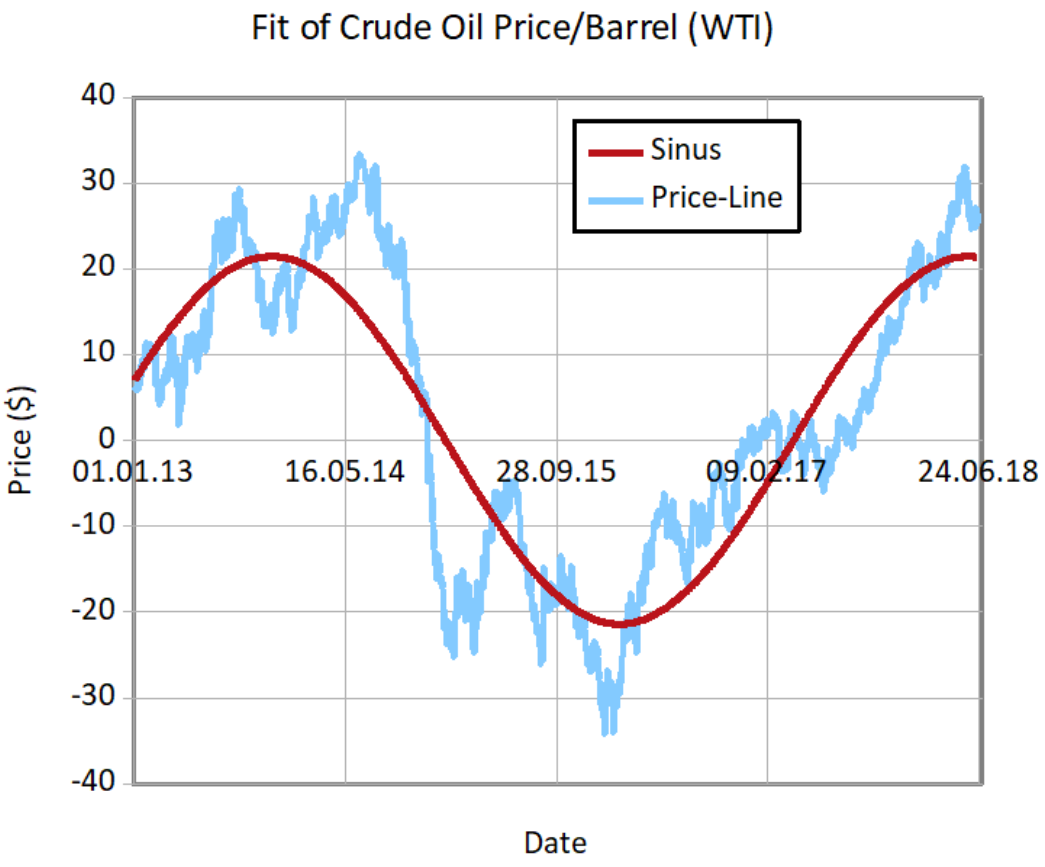
The HG Maximum Affordable Oil Price (MAP)



The Maximum Affordable Price

- The HG Model, set up in 2012, allows to calculate the MAP using the energy intensity curve for a barrel of crude oil.
- The MAP is the price the general economy is able to pay per barrel of oil.
- The HG Model predicted a price crash and a following yearly decline of the MAP price about 11 $.
- From 2013 to today the actual oil price should follow the MAP.
- The left diagram shows, that the actual price does not follow the predicted price.
- In 2015 and 2016 the actual price has been significantly lower, in first half of 2018 it is higher than the prediction.

Undulating pattern



Hog Cycle of Crude Oil

- An Observation:
- If MAP is subtracted from the actual oil price, an undulating pattern gets visible !
- It looks very much like a hog cycle.
- Thus it makes sense to disassemble the oil price in two components: An linear part and a hog cycle part.
- This applies the favorite model of economists !
- Numerical fit methods allow to attach dollar and time values to the components.

Fitting the Price Curve

The Assumptions for the Fit

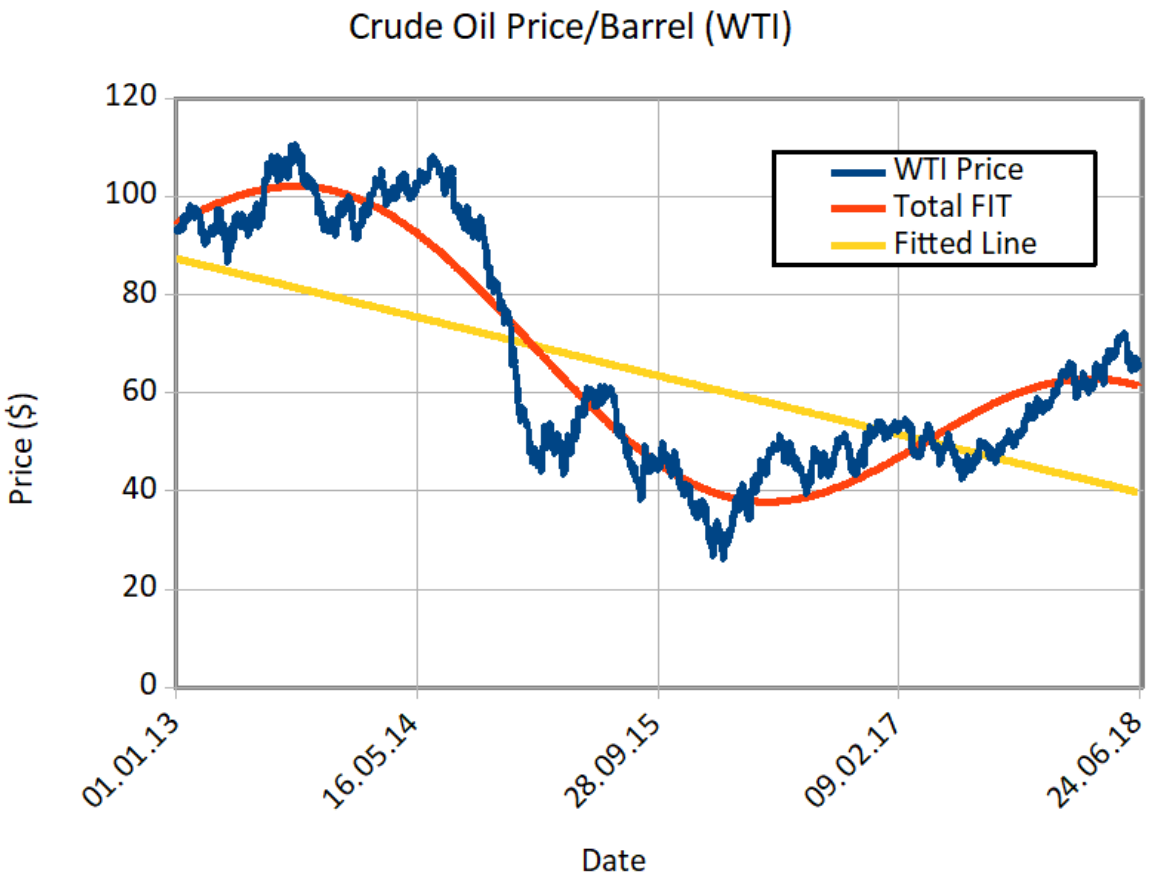
- Several methods exist, which fit a set of variables to a curve.
- Here the Damped Least Squares Method is used.
- The goal is to fit the price curve to:
- A straight line, corresponding the MAP, described by a starting value y0 and a slope m:

$$y1(day) = y0 + m * day$$

- A sine wave, corresponding the hog cycle, characterized by an amplitude a0, a period P and a phase alpha:

$$y2(day) = a0 * \sin\left(\frac{2 \cdot \pi \cdot day}{P} + \alpha\right)$$

The Fit Result



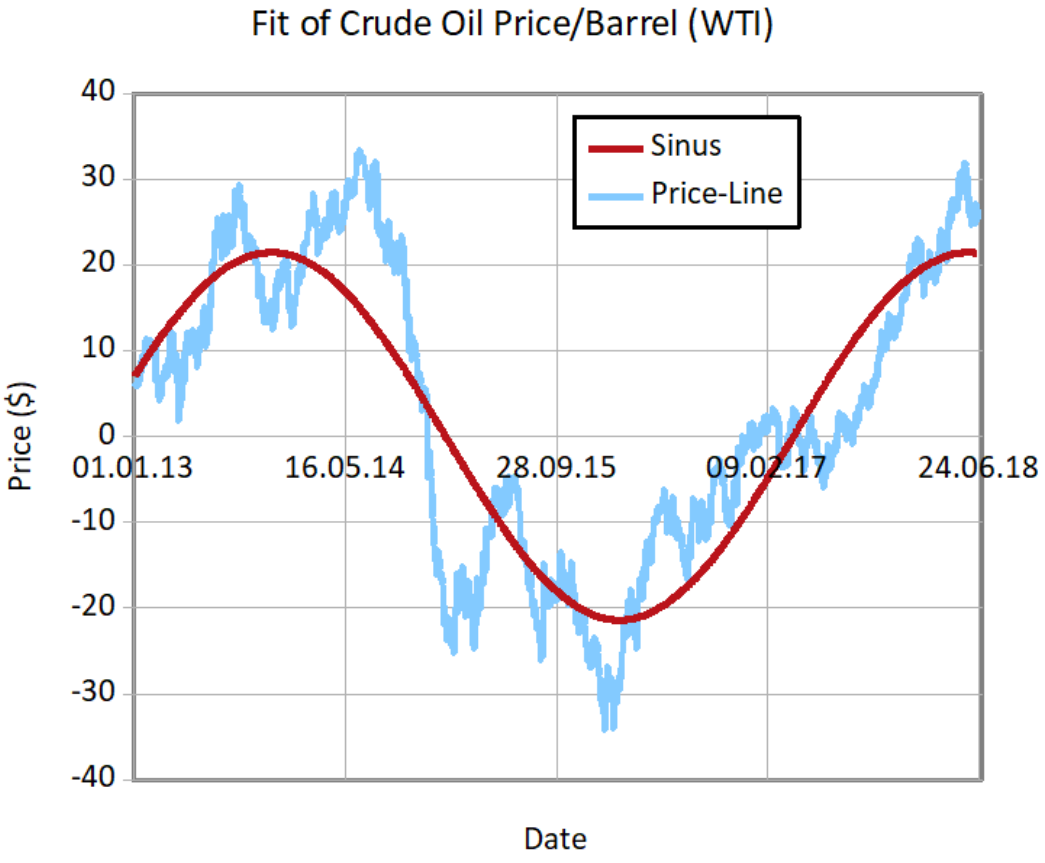
Best Fit Coefficients

- y0: 87.3 $
- m: -0.0238 $/day or -8.7 $/year
- a0: 21.4 $
- P: 1647 days, or 4.5 years
- α : 0.33

standard deviation: ±7.7$

- The visual impression of the total fit: it gives a reasonable result !

The Oscillating Curve

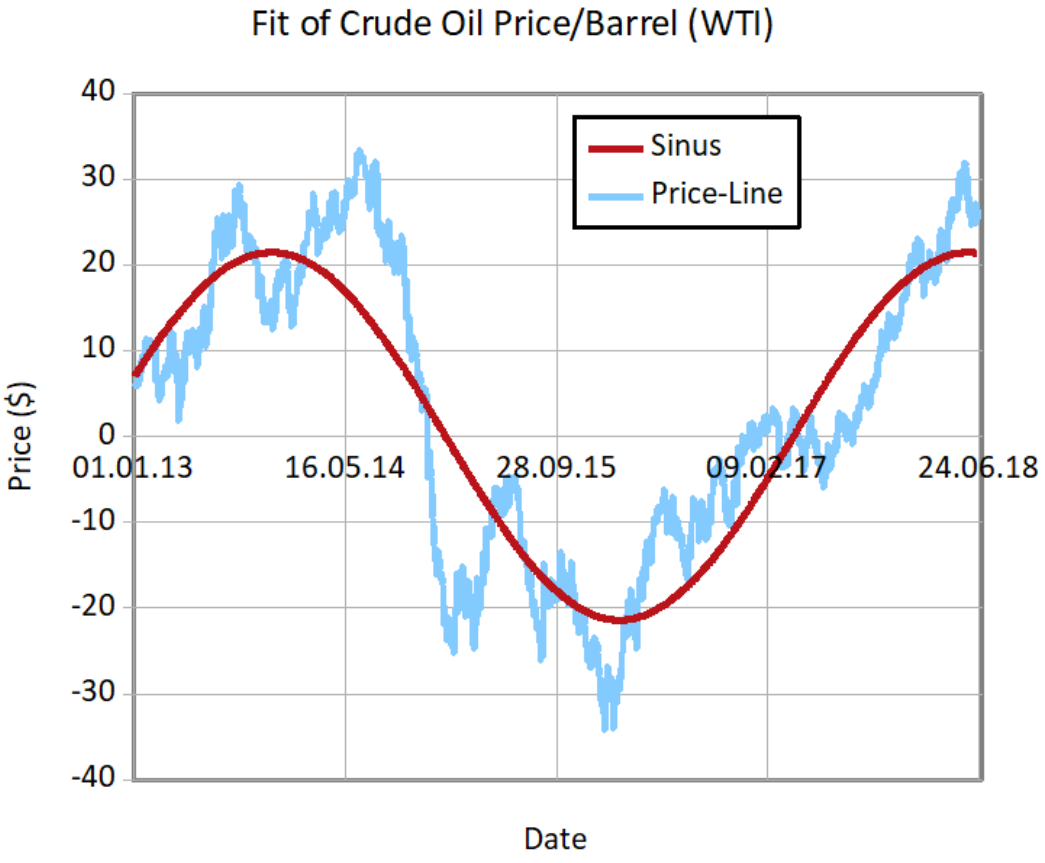


Supply Side

- About 2013 fracking begins to deliver a substantial part of US oil production.
- The Oscillation has started with an upward wave, allowing the fracking companies to expand.
- Fracking well production rates deplete in 12 months to about 30% [1], giving an explanation for a cycle time of ~4.5 years.
- Large Oil companies like BP, Total or Aramco (OPEC) are vertical integrated companies including refineries and distributors, in contrast to frackers.
- It is likely, that the emergence of fracking companies causes of a hog cycle variation of the oil price.

[1] J.David Hughes, „Drill, Baby, Drill“, 2013, Post-Carbon-Institute

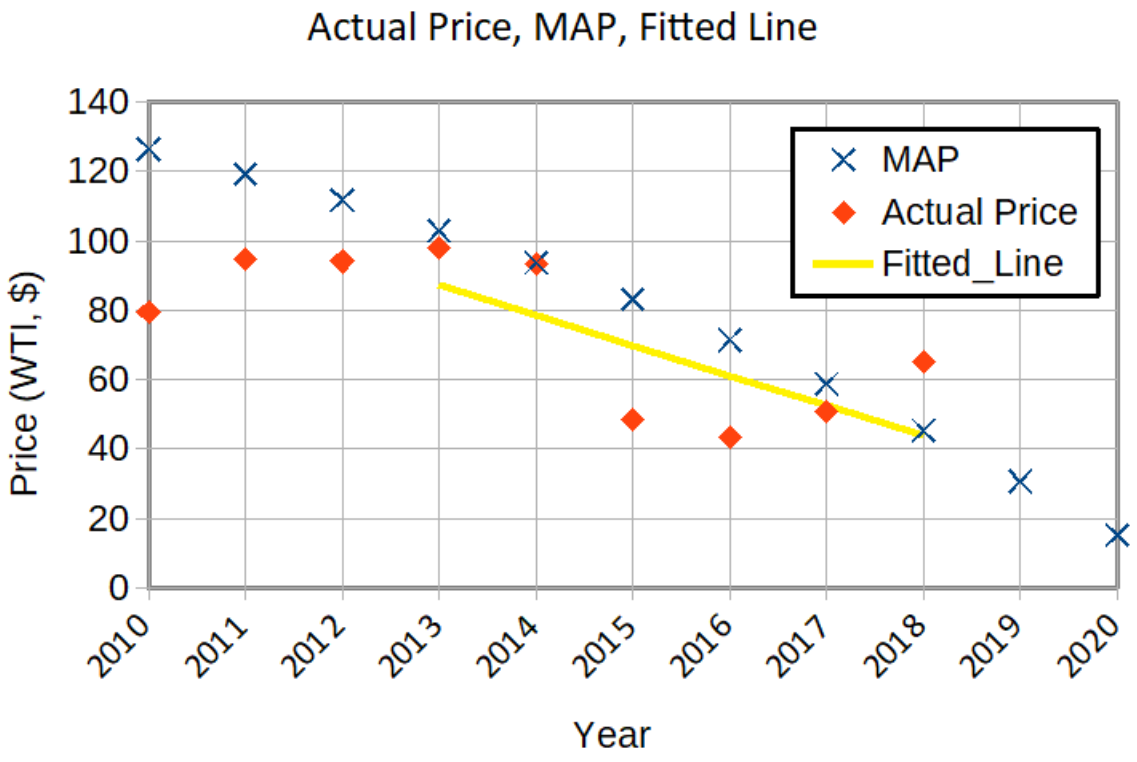
The Oscillating Curve



Demand Side

- The oscillation is not only an effect of the supply side, it happens on the demand side too.
- The duration of one wave is about 4.5 years.
- The undulating pattern begins to evolve in 2013 with the onset of fracking.
- Evidently, the global economy is be able to withstand prices higher than MAP for a short period.
- After the high price period a low price period has followed and must follow again.

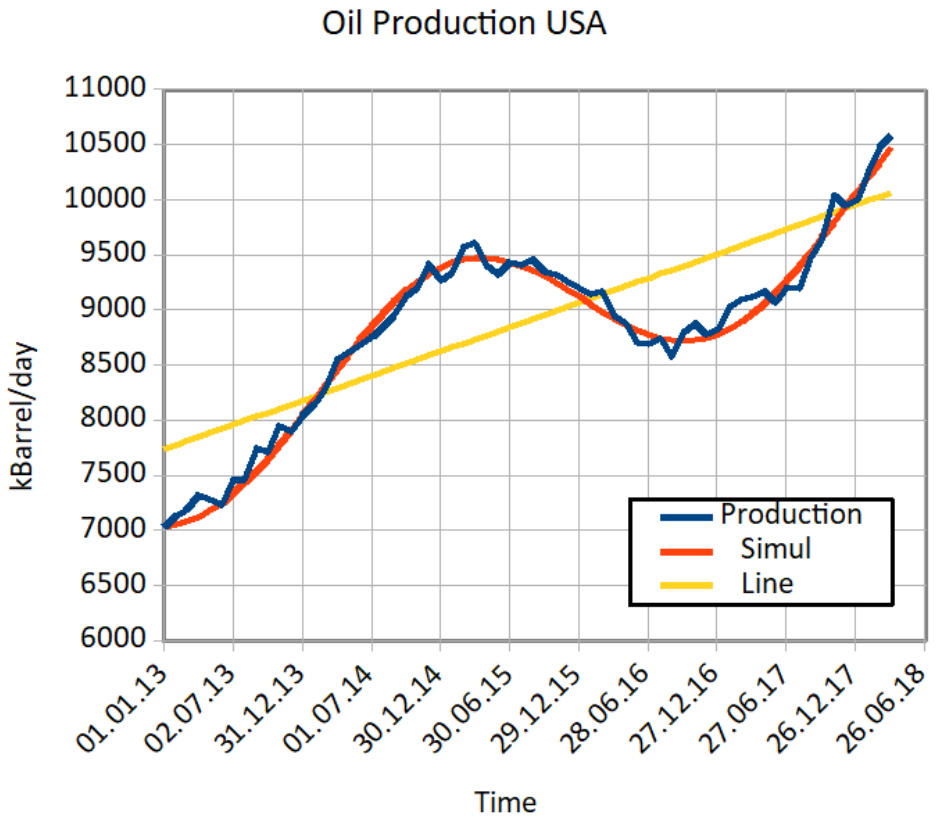
MAP and the Fit Result



The Fitted Line

- The price fit has a linear component, which gives nearly the same line as the MAP.
- The total price is oscillating about the linear component.
- This result is a very strong signal that the MAP is a real effect.
- This gives evidence for ETP and MAP.
- **If we analyze the oil price, using the economic model of overproduction by fracking, we get the MAP curve !**

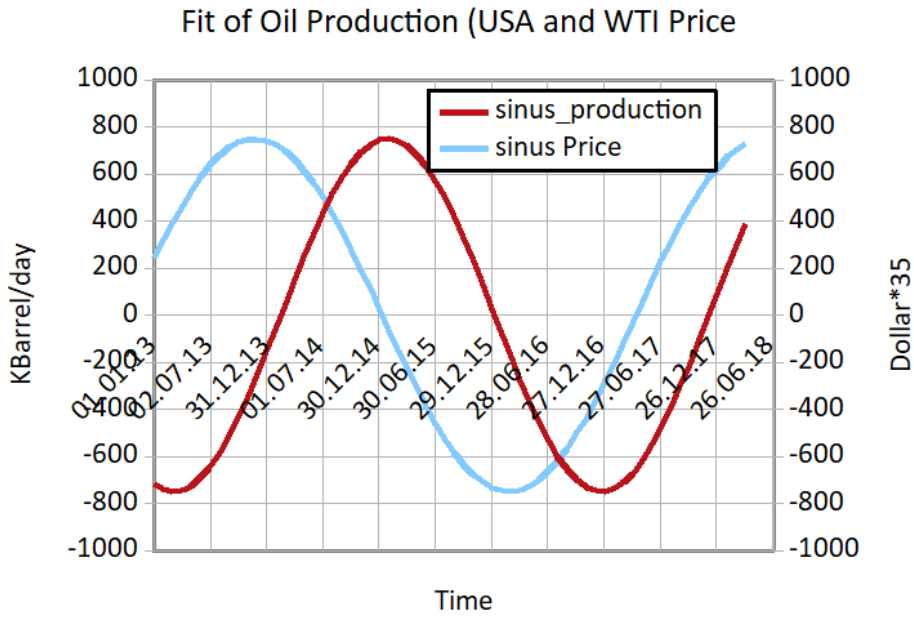
Another Oscillating Curve



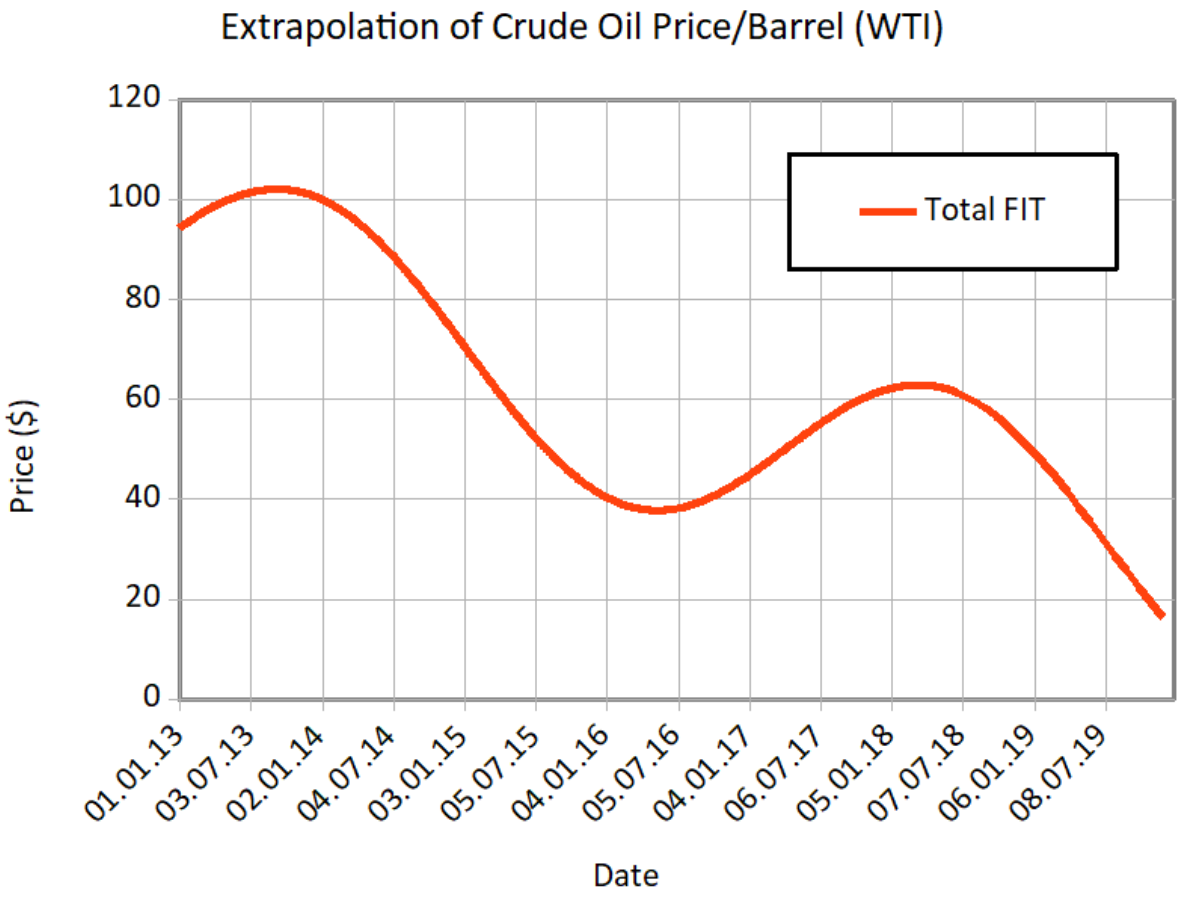
Source: http://www.jodidb.org/TableViewer/tableView.aspx?ReportId=93906

Fit of Oil Production USA

- A fit of the oil production with line and sine results in a similar structure as the fit for the price.
- The production curve has the same form as the price curve, but is about one year delayed.



Extrapolation of Fit



Extrapolation

- Because fracking companies are still independent and no vertical integration with refiners exist, the hog cycle will continue.
- The curve says, in summer 2018 the oil price reaches a temporary maximum.
- The price will fall in autumn 2018.
- In summer 2019 it will reach about 30$/barrel, which is considered as production costs for many oil fields.
- When the price falls below 30 $, oil fields will be shut down.
- The oil price will continue to fall all over 2019.
- Other influences: politics, cartels, bailouts, chaos, depletion etc. can lead to a very different development.

Conclusion

- The theory of economists, that overproduction caused by fracking companies determines the oil price curve, has been applied.
- A fit of the WTI price curve to a sine function, representing a hog cycle, and a straight line, has been done.
- The sine (undulating) component with a period of 4.5 years is part of the oil price.
- The linear component results in the same curve, which the HG has calculated for the maximum affordable price (MAP).
- The MAP curve has clearly been identified in the oil price trend.
- The oil price has developed in a more complex way than the HillsGroup ecpected in 2012, but their prediction is valid and visible as the slow-varying component of the oil price.
- The analysis is valid for the past, an extrapolation of the price fit curve results in an oil price crash in 2019.

Giving some Thoughts to the Result

Can this be real ? Is a fast crash probable ?

Reading proposals:

- Turchin & Nefedov : „Secular Cycles“
- Tainter: „The Collapse Of Complex Societies“
- ISO 14971 „Application of risk management to medical devices“
- ISO 31000 "Risk management – Guidelines"

Have your own thoughts.

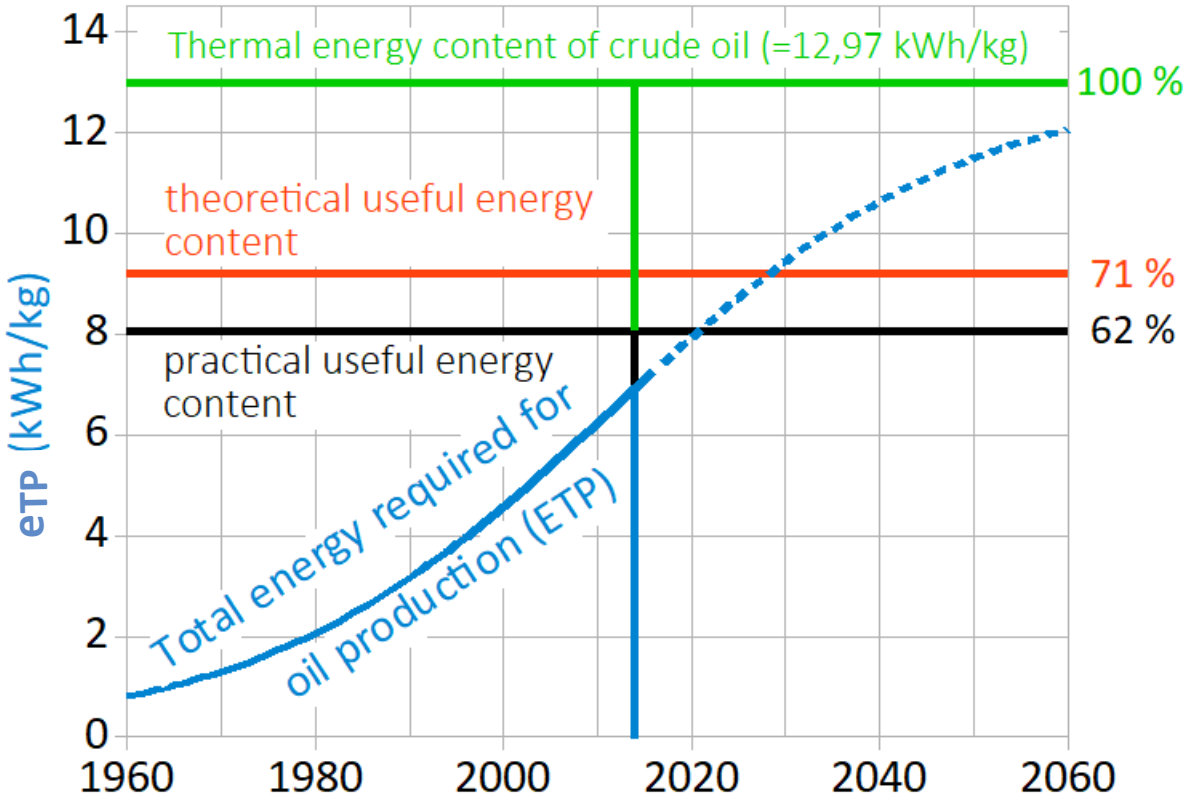
ETP - Modell

A law of physics tells us:

In some years oil production will hit a severe limit.
Physics laws can‘t get violated.

Fatih Birol: ***Leave oil before it leaves us***

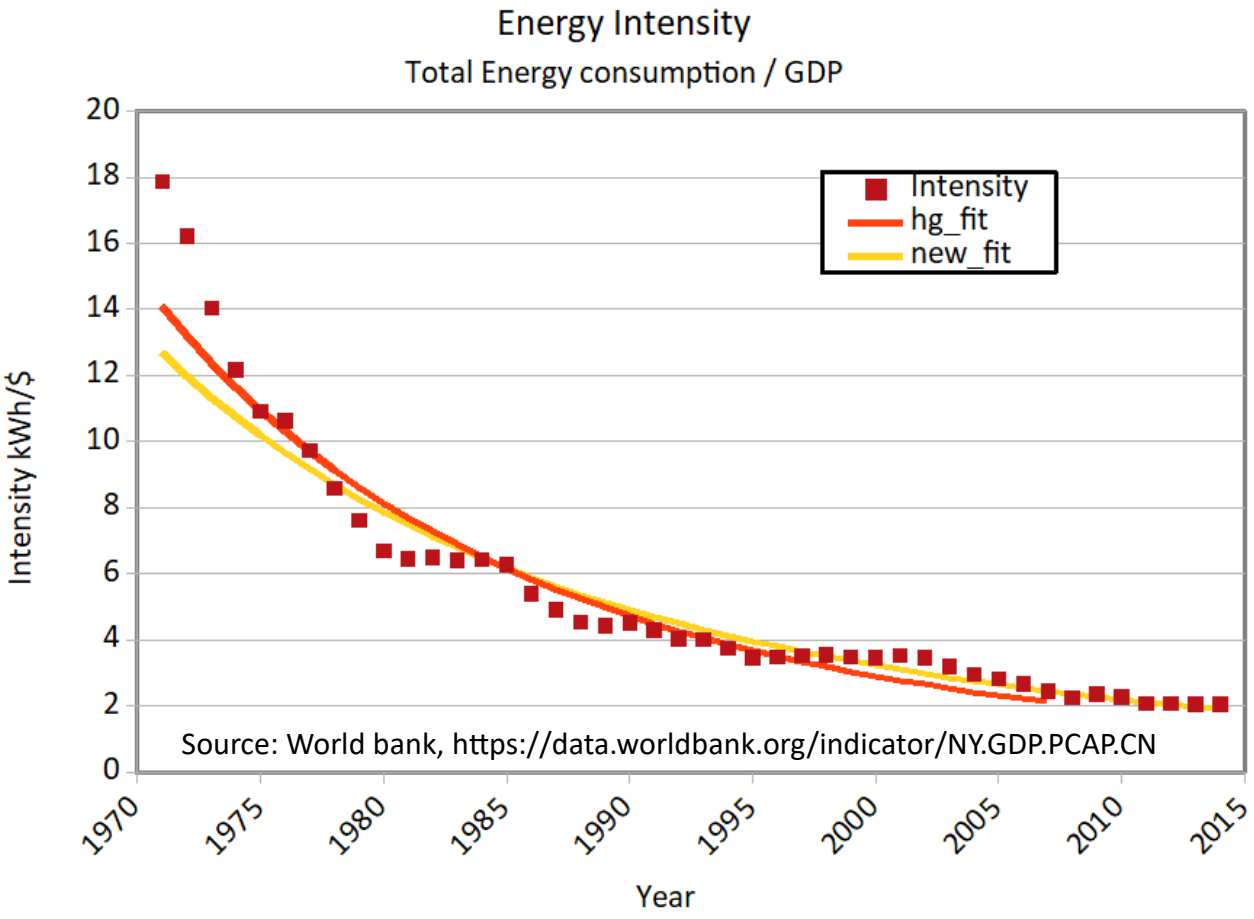
ETP-Model – Diagram



The ETP Diagram

- Thermodynamic calculations result in the ETP- curve.
- Because the calculation is physics based and sound, effects on the price of crude oil are expectable.

Not accepted Explanations for the current Oil Price Rise



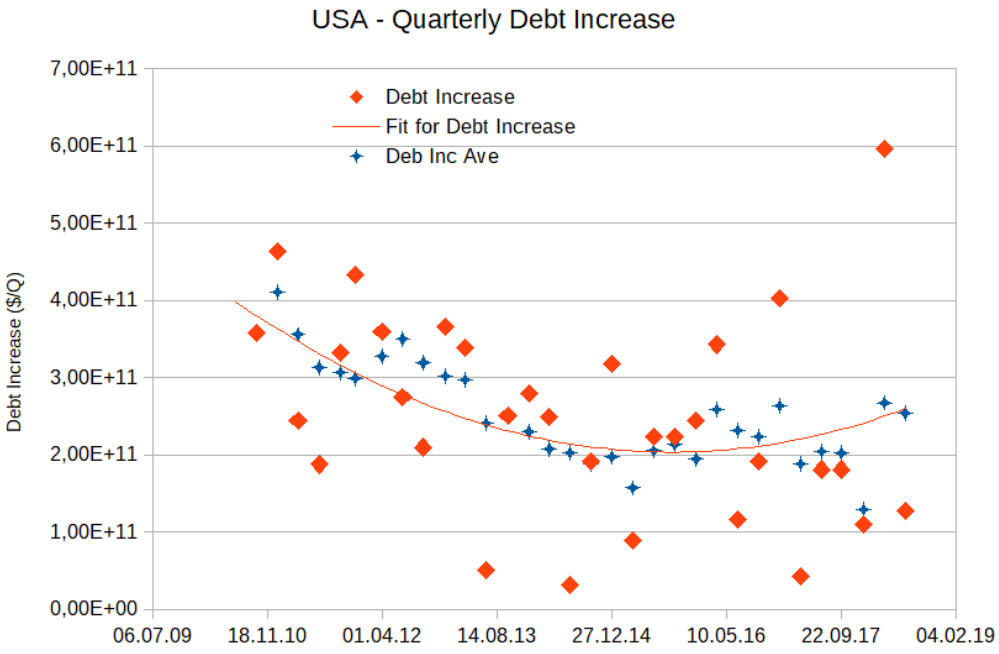
Change of Energy Intensity Curve

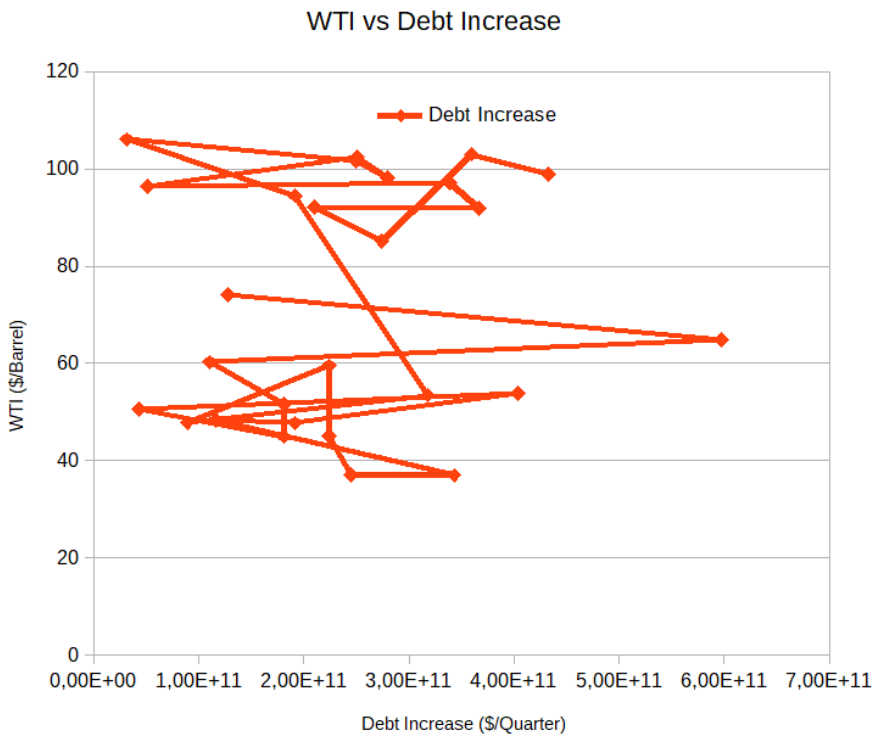
- It is improbable that the current rise of the oil price is caused by a changed energy intensity curve.

Not accepted Explanations for the current Oil Price Rise

Debt allows to spent more money on oil

• No correlation exists between US debt increase and the oil price (WTI).





Source: https://www.treasurydirect.gov/govt/reports/pd/pd_debttothepenny.htm

Not accepted Explanations for the current Oil Price Rise

All explanations neglecting the thermodynamic calculation of the energy (physics) to produce oil:

For example:

- **Money is used to produce oil.**
- **Only supply and demand determine the oil price.**
- **Only a fraction of the energy content of oil is necessary for its production.**
- **Cheap Energy is used for oil production (if conversion efficiency is not evaluated)**
- **Technology will save us.**