



Fracking, Cracking and the mass balance of small cracker products

Amsterdam, January 2017

@RobertPeels



Content

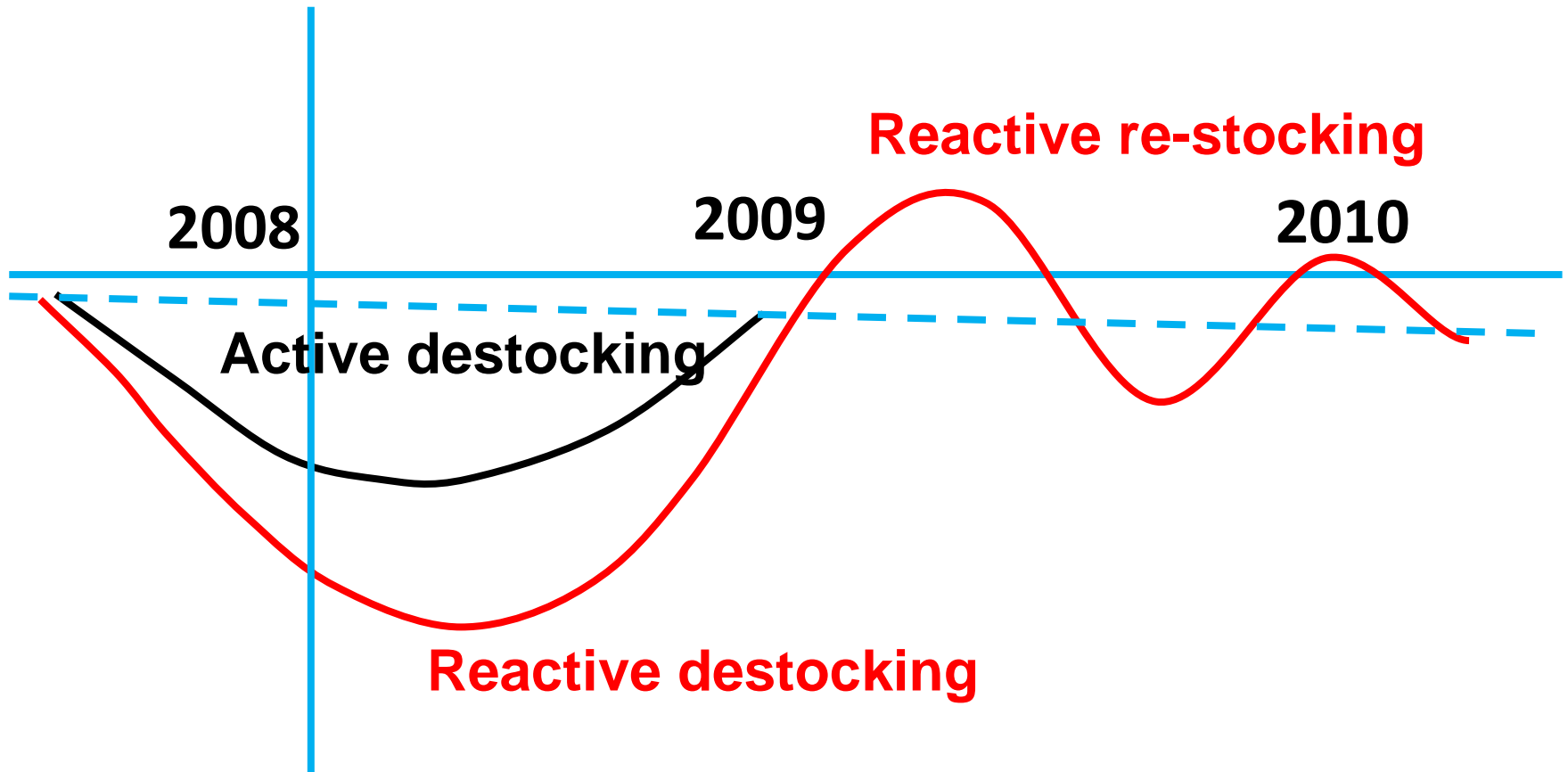
- Fracking
- Cracking
- Mass balance
- Pricing
- Volatility



Flostock

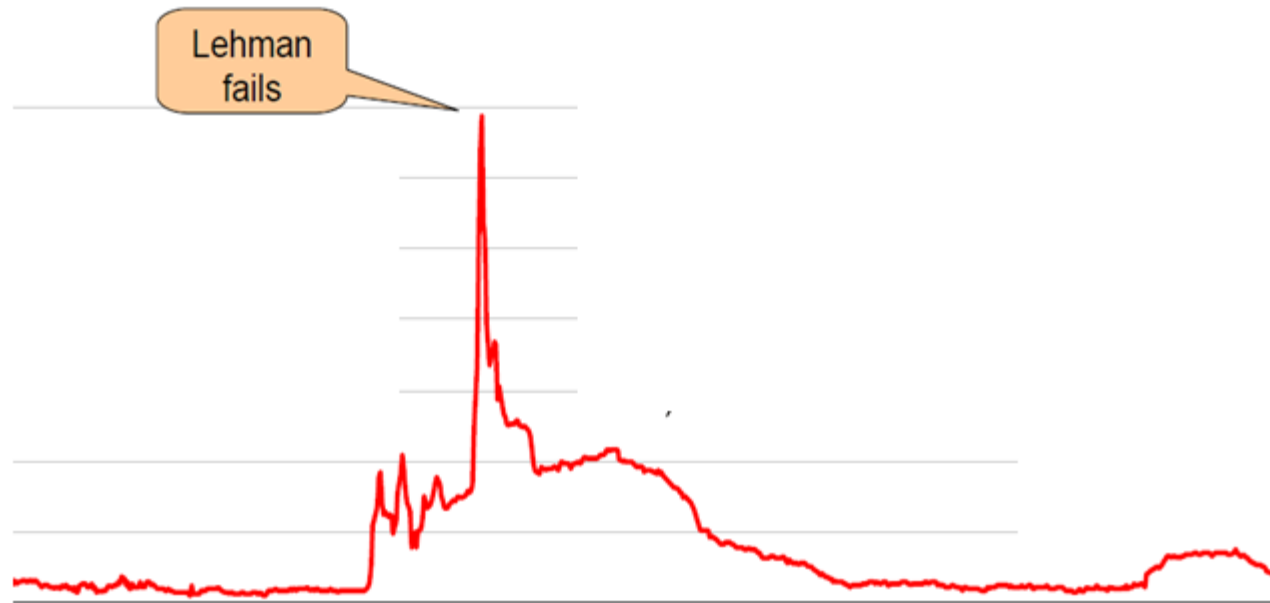


Lehman Wave was caused by Active & Reactive destocking



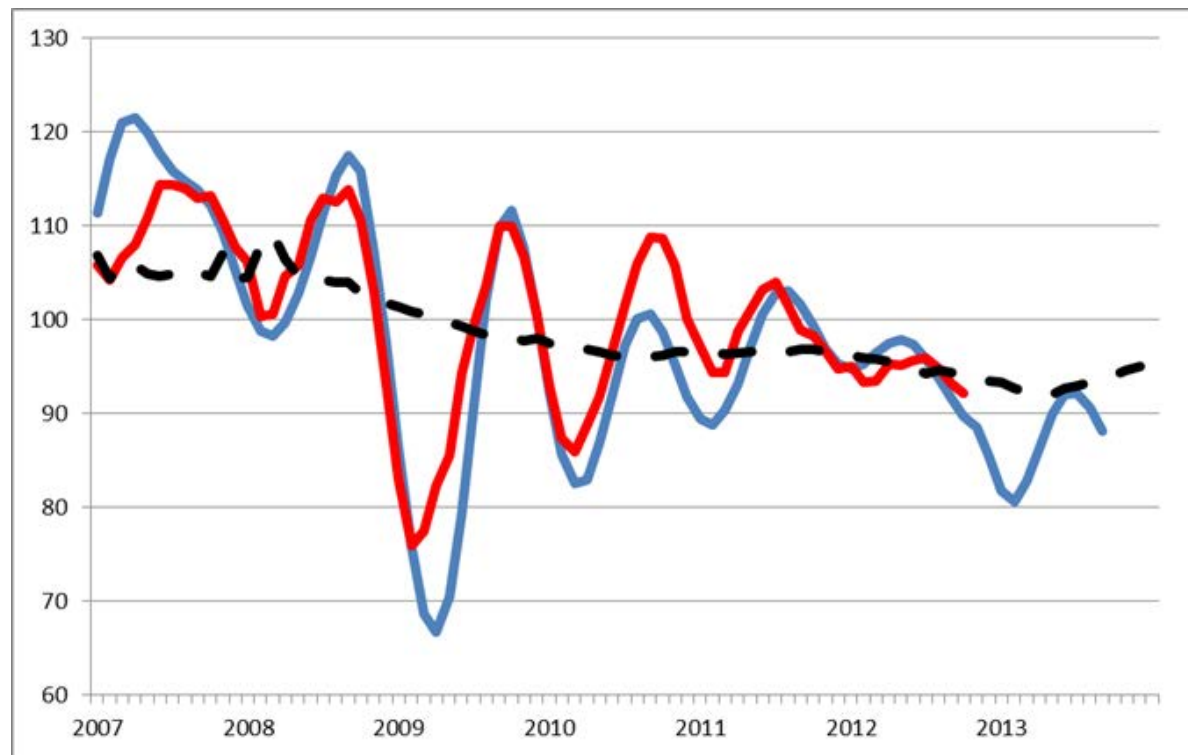


LIBOR 2003 - 2010



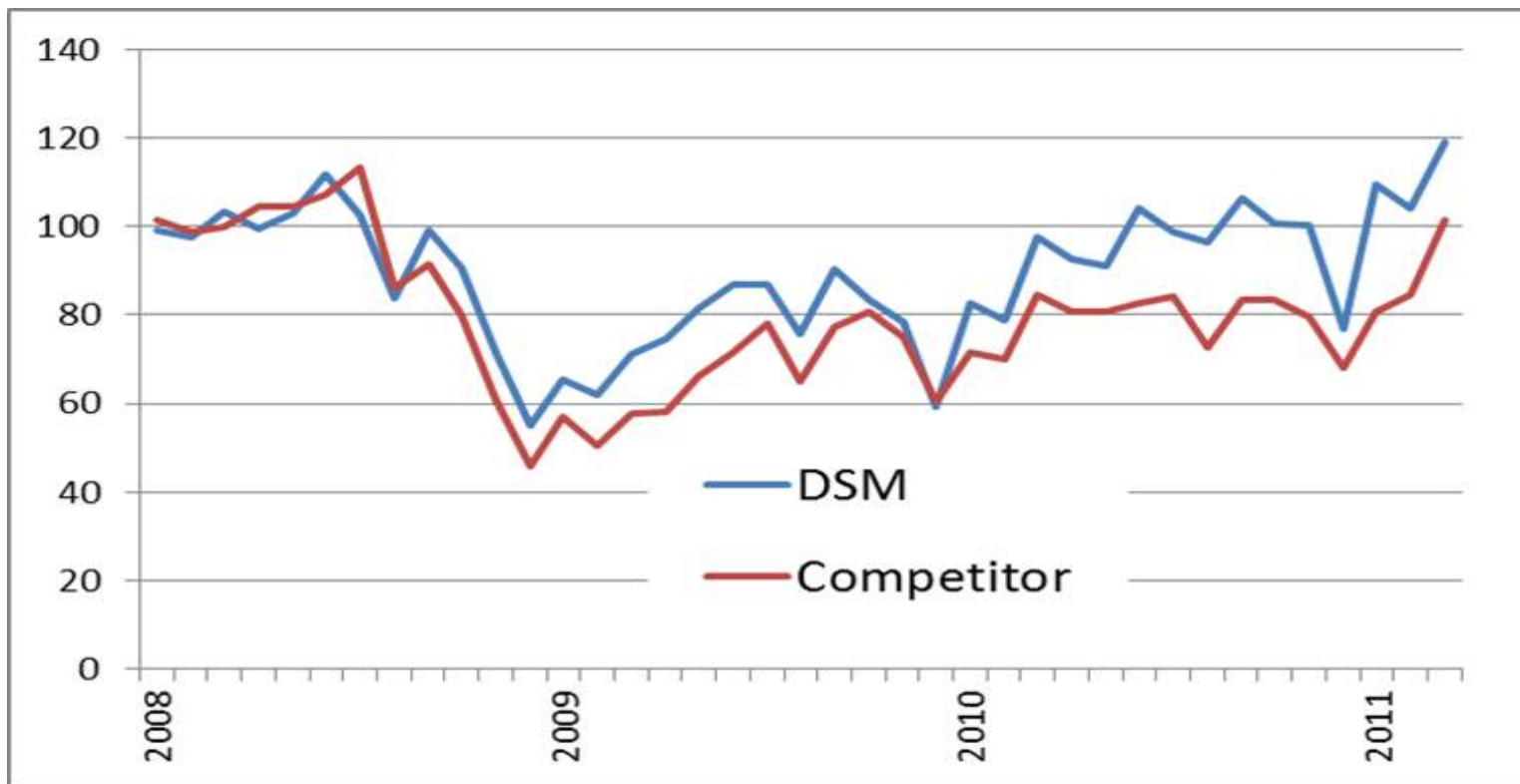


Model was $> 94\%$ accurate,
30 months into the future





DSM unit achieved 15% extra MS and
250 M€ extra turnover.



The Flostock insights are being picked up:

Part of curriculum at MIT, Wharton
and at least 6 European Universities.

First PhD, in Eindhoven;
2nd coming



Universiteit Utrecht

Called best practice by McKinsey



Described in the FT and
ICIS Chemical News

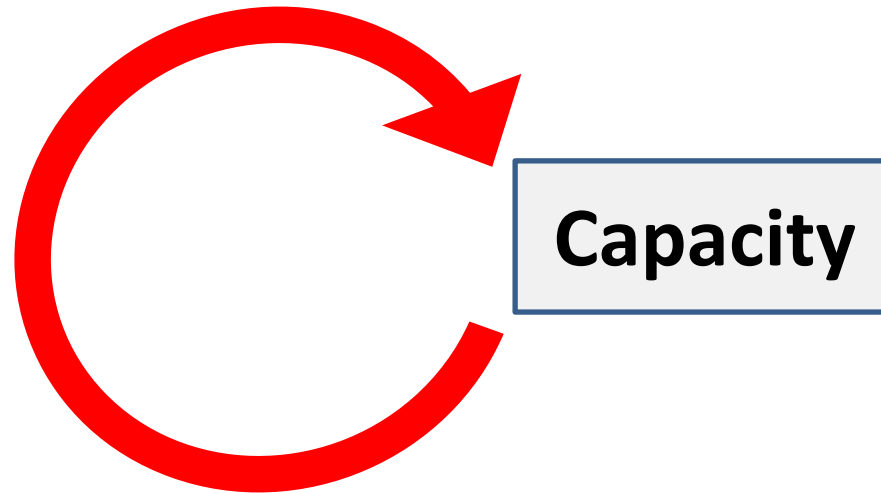


14-3-2017

First scientific article published;
several in preparation.



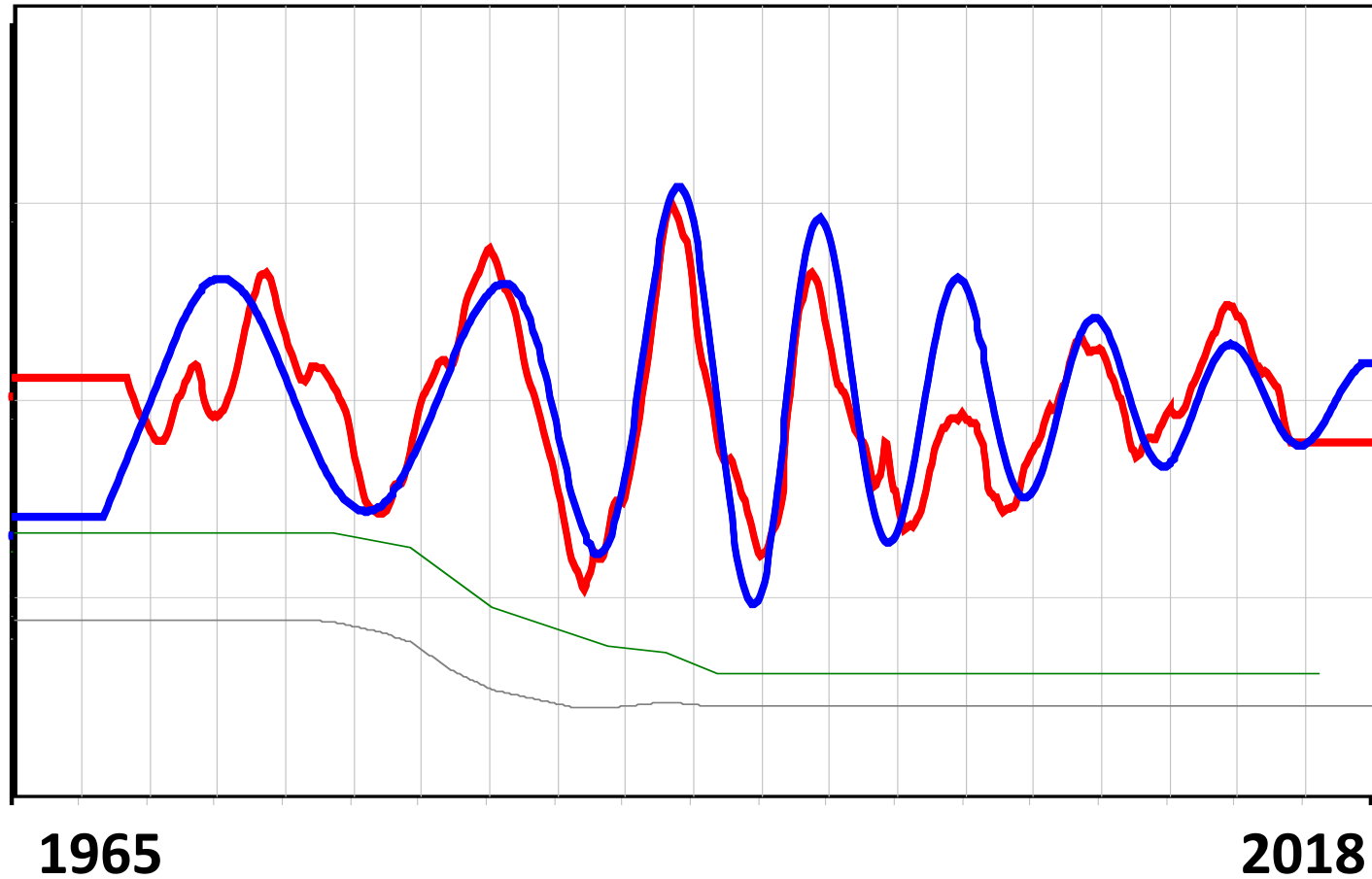
Modeling Pork Cycles



- In case of Capex with long leadtime.
- Several publications with TU/e in progress
- Applied in Housing, Food, Semi-conductors, Chemistry, Agro.



Example: Pork Cycle





Fracking



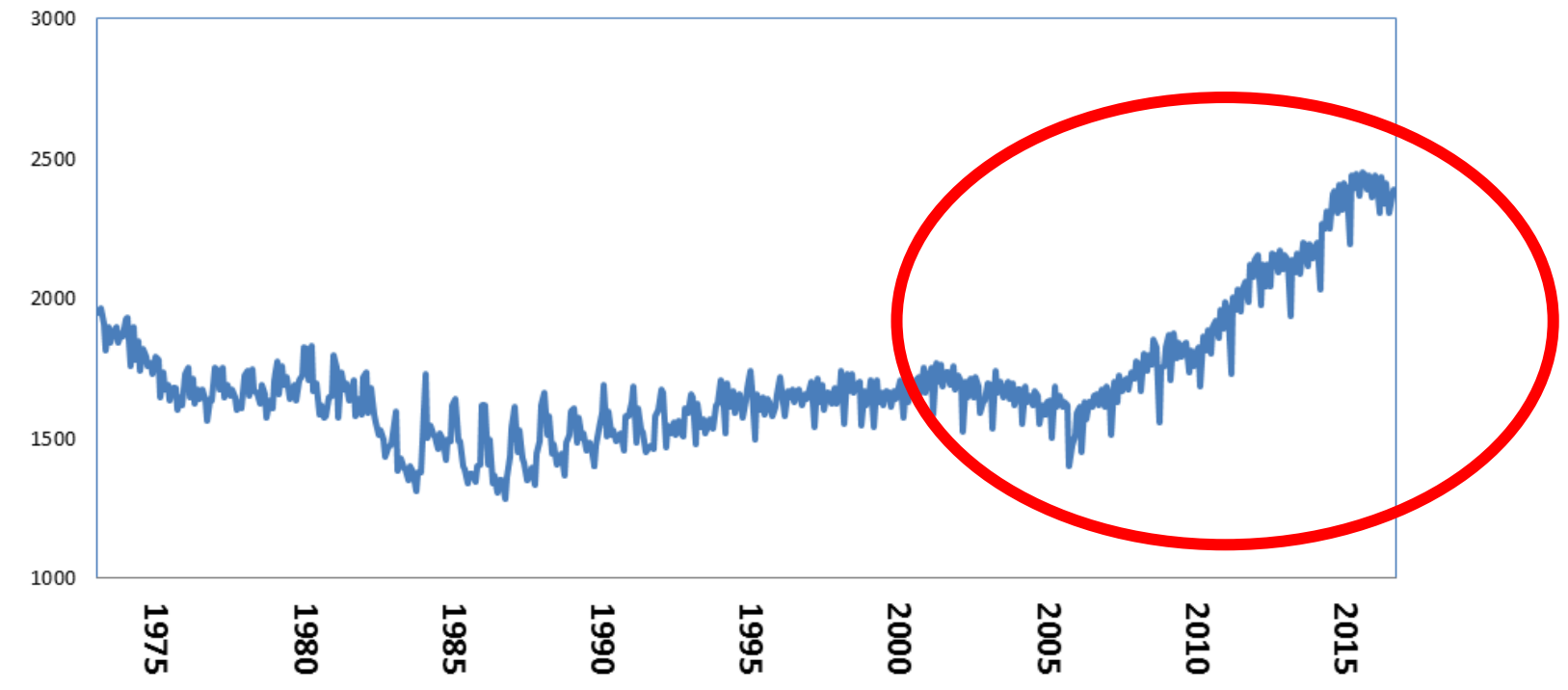
Fracking



Fracking & Horizontal drilling

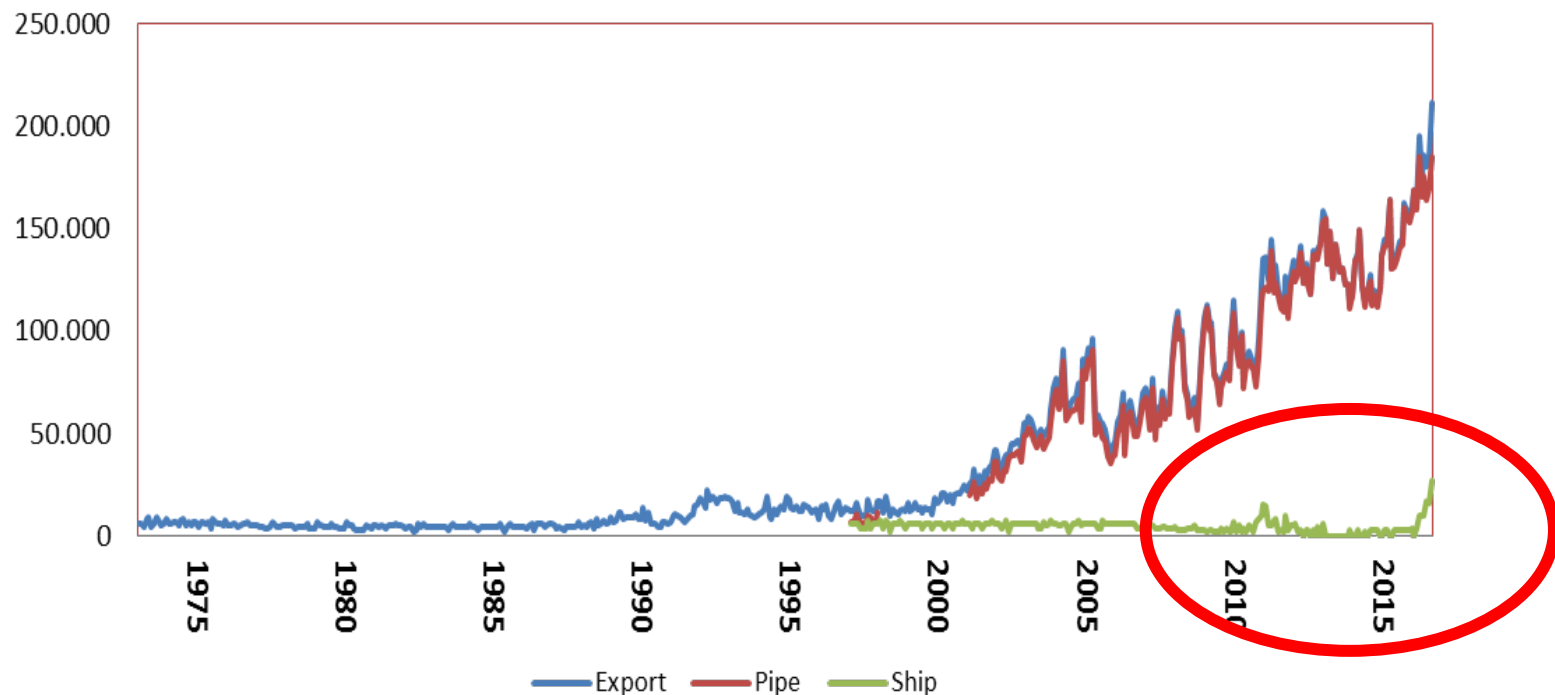


Fracking revolution in gas



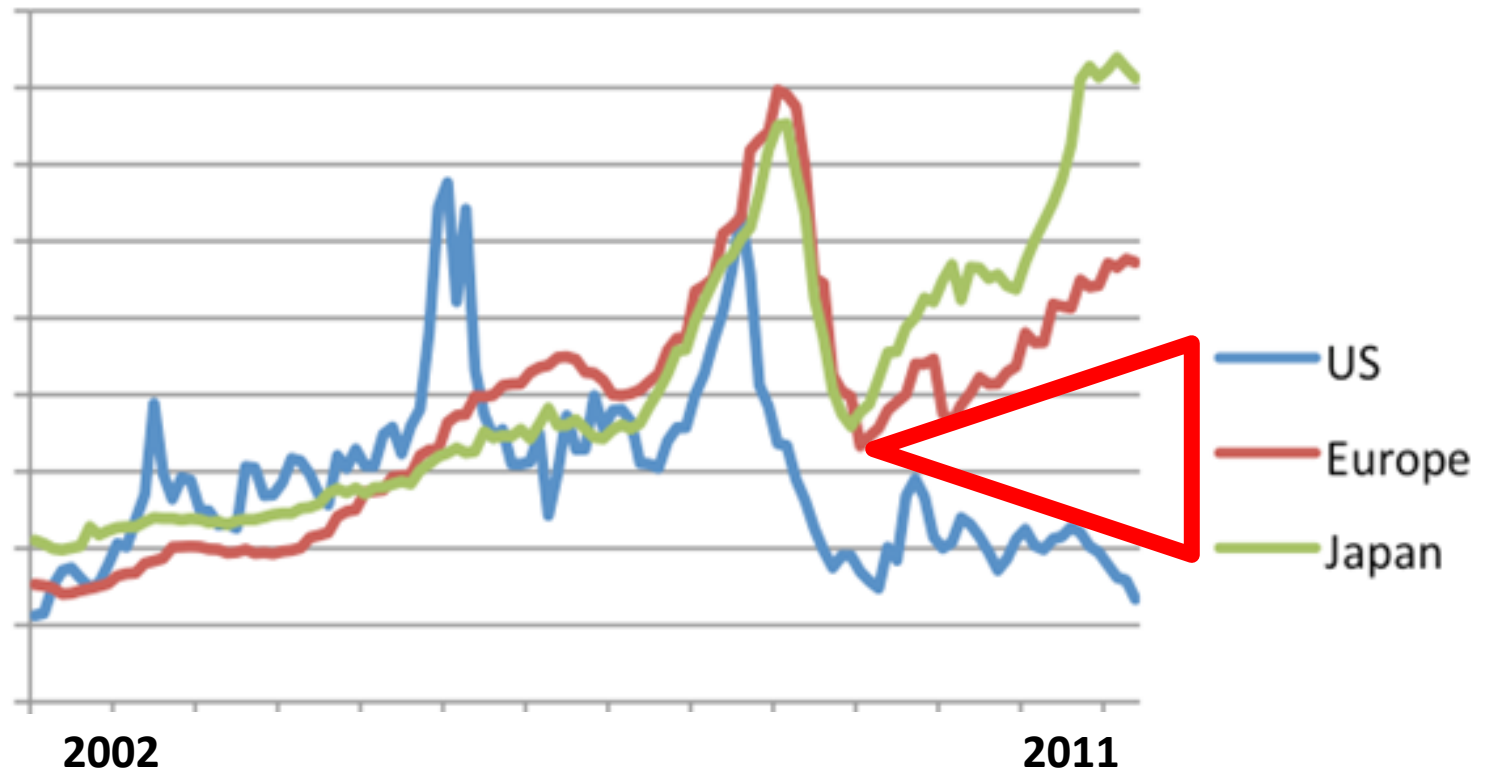


US has become a net gas exporter



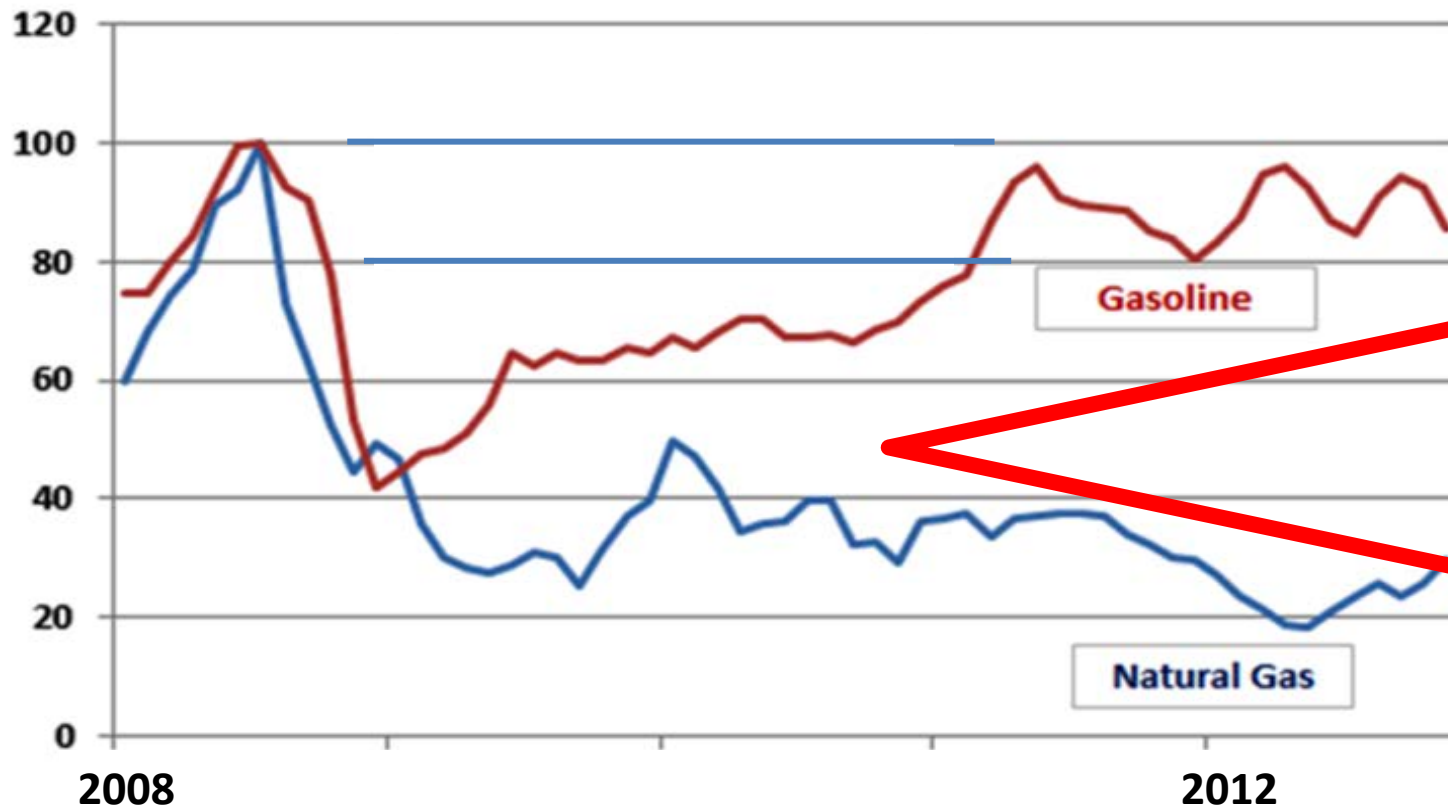


US Gas is independent from EU and JP





US Gas is independent from Oil



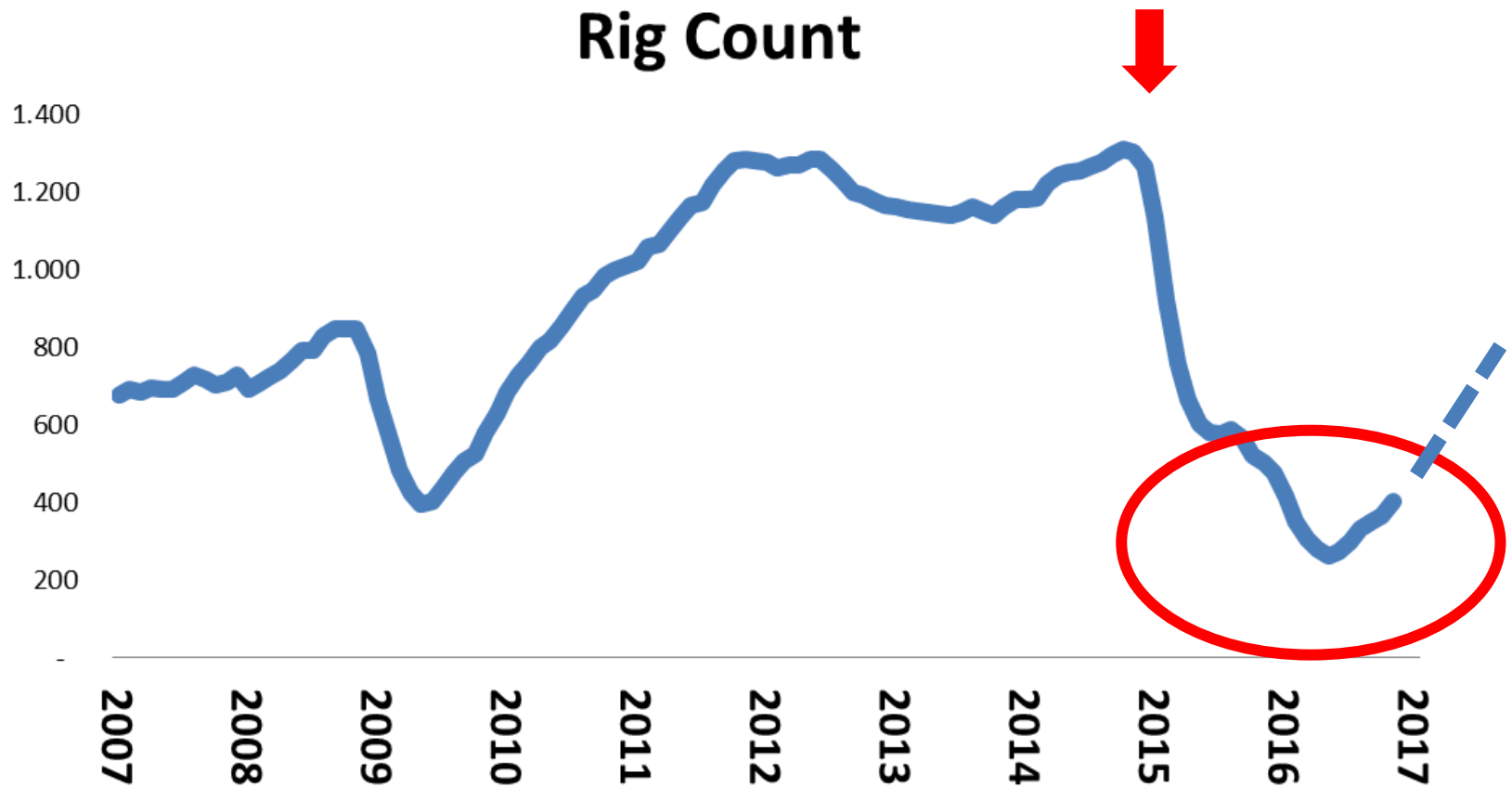


Two main effects of fracking

- Gas price declined versus Oil
- Gas price US declined versus EU



Fracking & OPEC





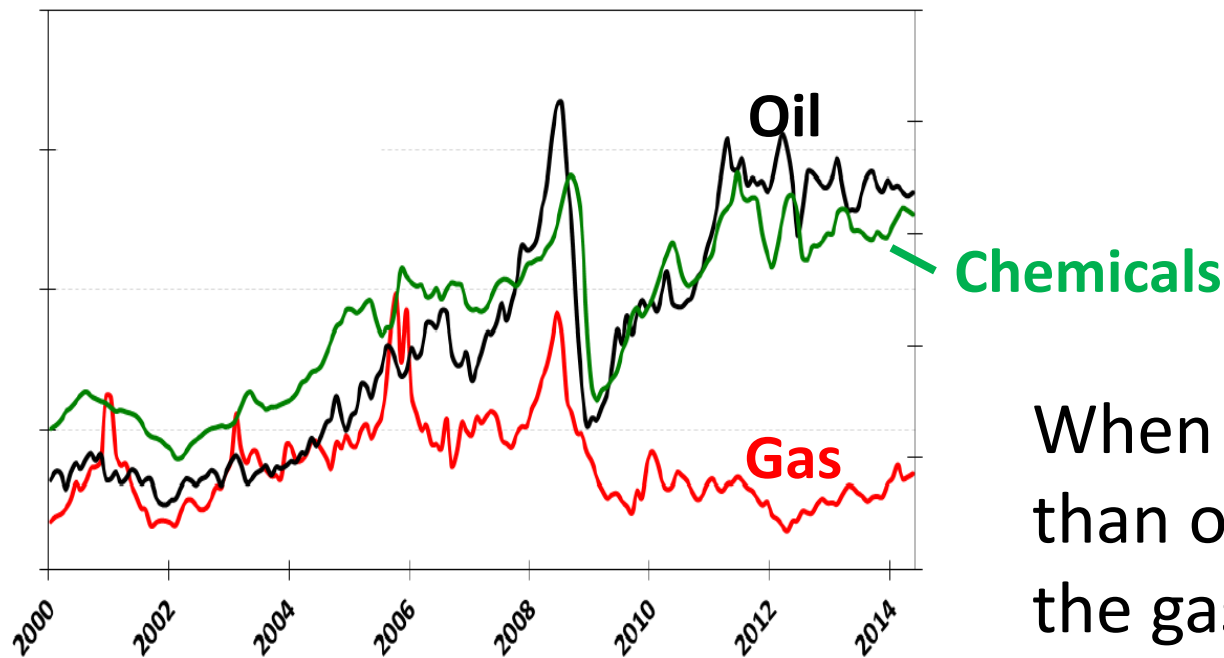
Cracking

Steam Crackers





Prices of chemicals follow Oil, not Gas.



Source: ICIS

When gas is cheaper than oil, the margin of the gas-based supply chain explodes.



New US Ethane Crackers (ICIS, 2014)

Company	Capacity	Downstream	Location	Start-up	Status
Chevron Phillips	1.5m tonnes	HDPE, LLDPE	Cedar Bayou, Texas	Mid-late 2017	Under construction

New US Ethane Crackers (Platts 2016)

Project	Location	Estimated Startup	Nameplate Capacity
Appalachian Resins (AR)	Salem Township, Ohio	2019	275
Axiall	Lake Charles, Louisiana	2019	1000
Badlands	North Dakota	2019	1500
Formosa Plastics	Point Comfort, Texas	2019	800
Total	Port Arthur, Texas	2019	1000
Ascent	Parkersburg, West Virginia	2020	1000
PTTGC	Ohio	2021	n/a
Shell	Monaca, Pennsylvania	2021	1400
Shintech	Louisiana	2021	500
Source: Platts, Platts Petrochemical Analytics		Total	7,475

Shintech	500,000 tonnes	NA	US Gulf Coast	NA	Feasibility, permit ting
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European Cracker closures

Company	Location	Capacity	Shutdown
Total	Antwerp, Belgium (NC1)	250,000 tonnes	2013
Versalis	Priolo, Italy (1 of 2 lines)	470,000 tonnes	Aug-Sep 2013
INEOS	Grangemouth, UK (G4)	320,000 tonnes	Q1 2014
Total	Carling, France	320,000 tonnes	H2 2015
Repsol	Puertollano, Spain	155,000 tonnes (reduction)	2015



Two main shifts in Cracking

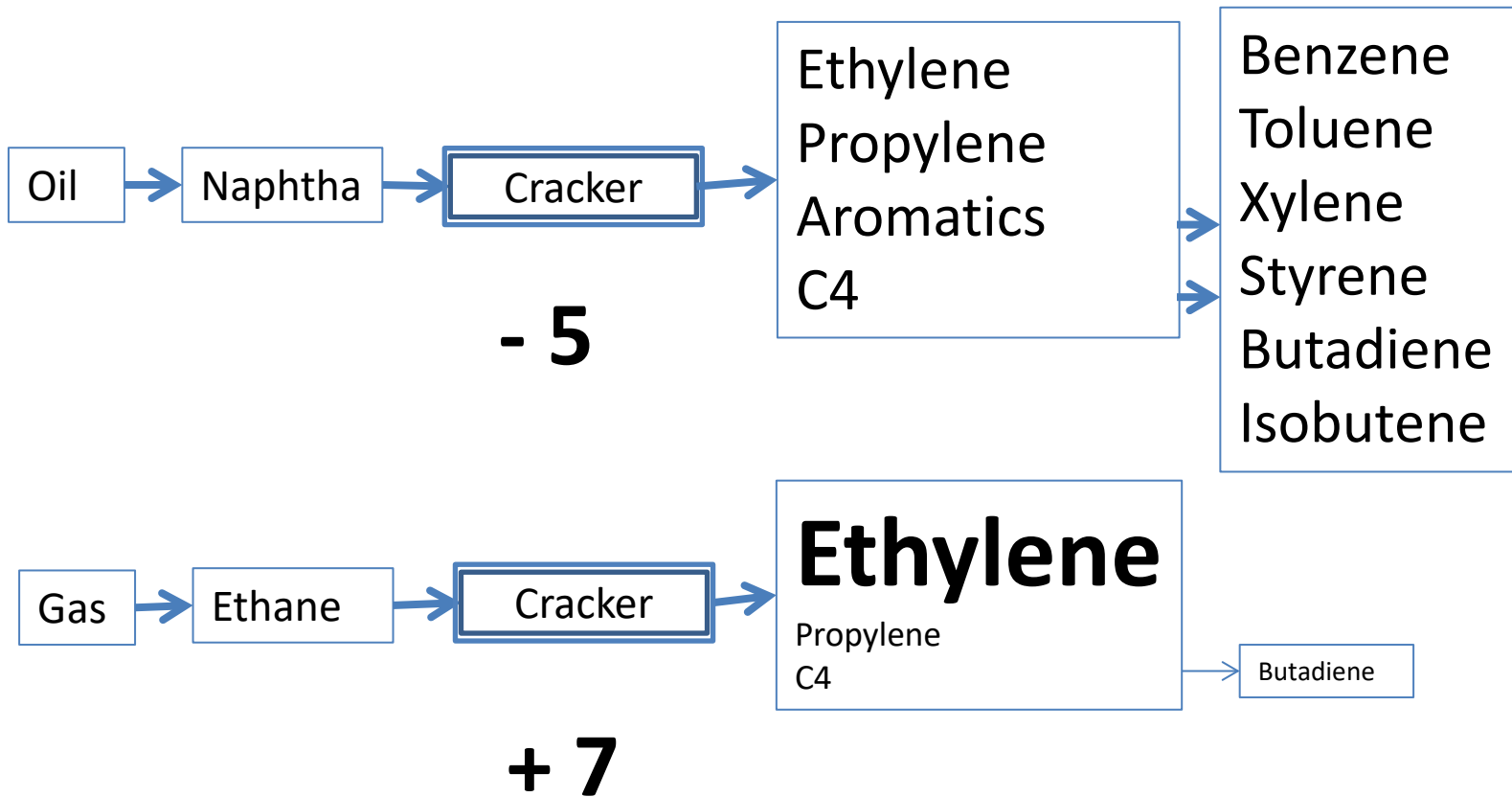
- From Naphtha to Gas
- From Europe to the US

US export of Gas/Ethane will reduce the shift from Europe to the US, but stimulate conversion from Naphtha to Gas.



Mass Balance

Flows





Natural gas composition*

- Methane 75% - fuel
- Ethane 16% - cracker
- Propane 5% - fuel
- Butane, Pentane and others 1%



On purpose production of Butadiene and Aromatics

- Several projects started.
- Most will be more expensive.



Pricing



By-product credits

- Naphtha crackers can stay open if by-products bring enough credits to compensate for the cost disadvantage.
- Cost advantage* Gas vs. Naphtha:
 - 7x in 2012 - 2013,
 - 3x in 2015 - 2016.
- The price of by-products will increase till the crackers are marginally competitive.

Non-Ethylene credits

	Ethane Cracker		Naphtha Cracker	
	Mt	B€**	Mt	B€
Feedstock	1	1,2	1	1,5
Other Cost		0,2		0,2
Sale Ethylene	1	1,4	0,95	1,3
Sale Byproduct	0	0	0,05	0,4
Profit		0,2		0

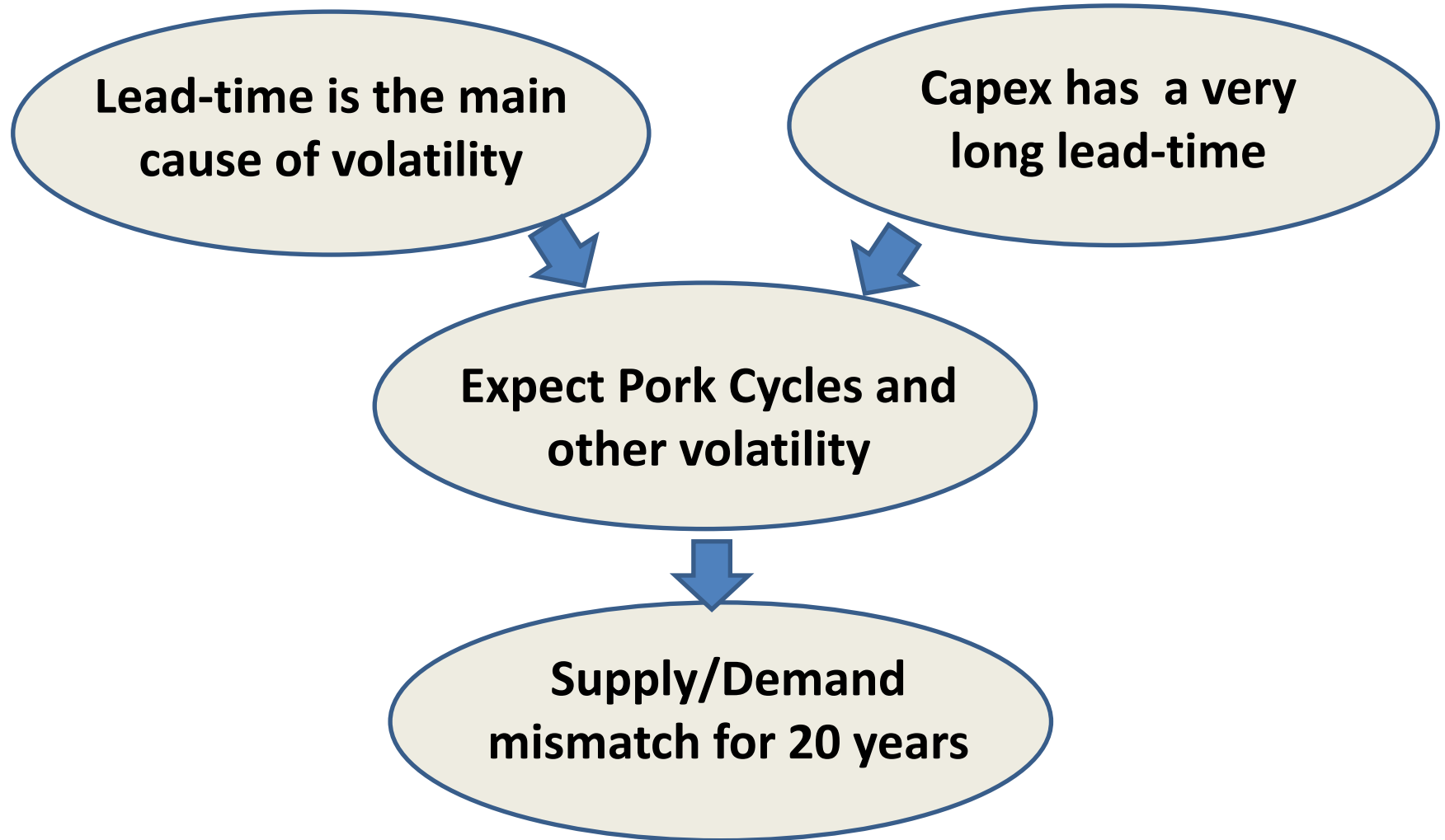
Byproduct = 5% \rightarrow Δ price = 20 x Δ Feedstock advantage



Volatility



Volatility-1 Capex





Volatility-2 Run-Aways

**These are capital
intense industries,
running at high
Utilization Rate.**

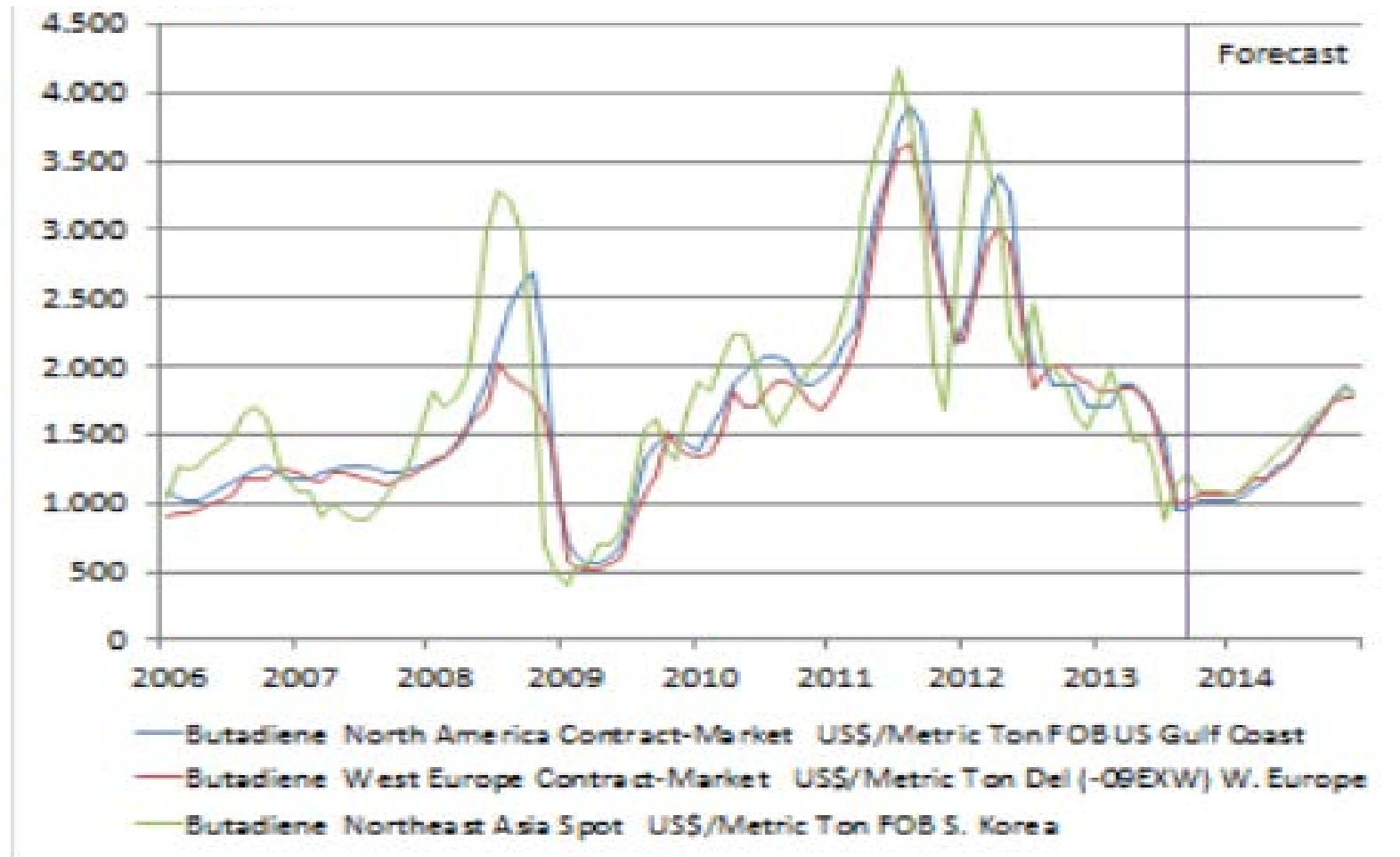


**Disruptions
immediately cause
shortages.**



**A shortage may
cause a price run-
away.**

Butadiene Run-aways





Volatility-3 Prices

- Dedicated production is expensive.
- Small byproducts need to provide big credits for naptha crackers.

Volatility-4 Oil



BBC News (World) ✓

@BBCWorld · 4h

Price of crude oil surges after
involved for first time

with Shale Oil*.



The Associated Press ✓ @AP · 6h

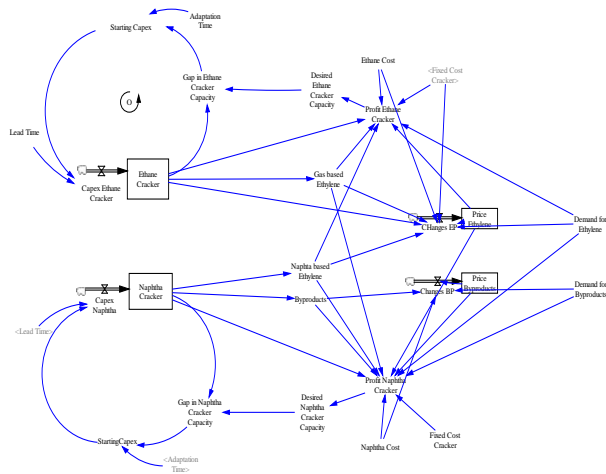
BREAKING: **OPEC** agrees to cut 1.2 million barrels a day from its output to 32.5 million barrels, effective January.



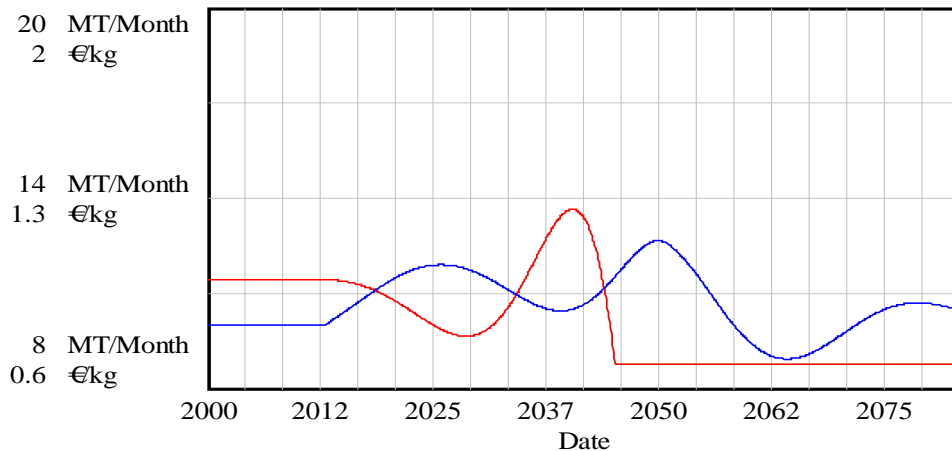
Reuters top
Why **OPEC** cuts may not boost oil

The falling cost of U.S. shale production

Model demo= eitje



Selected Variables



Ethane Cracker : test — MT/Month
Price Ethylene : test — €/kg

The huge scale, big capacities and long leadtimes are **exceptionally suitable** for modeling in system dynamics, once you know how to handle oscillations.



Conclusions

- Balancing by the ‘invisible hand of the free market’ will be messy.
- Byproducts will be shifting source and location. Price will be high and volatile.
- Forecasting is possible due to long lead-times and inert capacities. And will give strong advantage.



Worried about
volatility?

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