

40th Session Of Seminars On Research In Energy Economics At Paris-
Sciences-Lettres

OPEC, Saudi Arabia, and the Shale Revolution:

Insights from Equilibrium Modelling and Oil Politics

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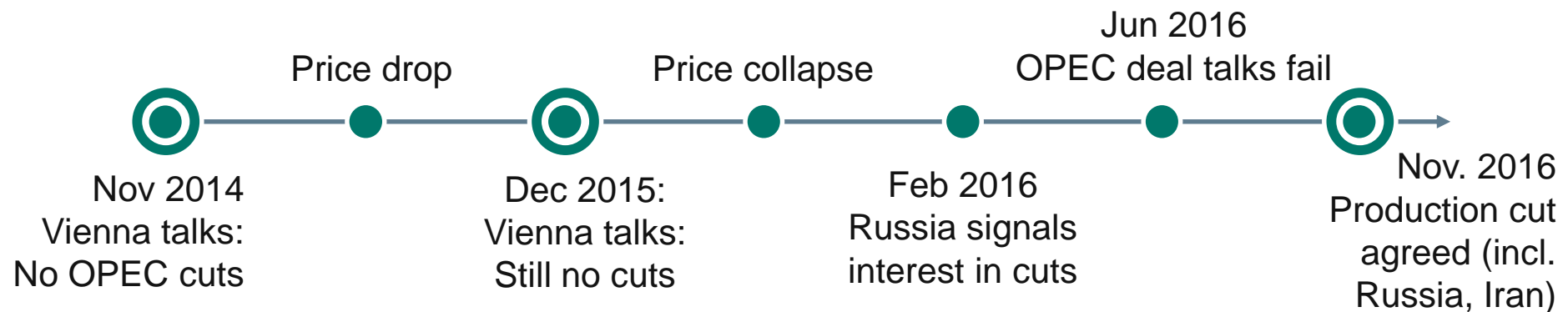
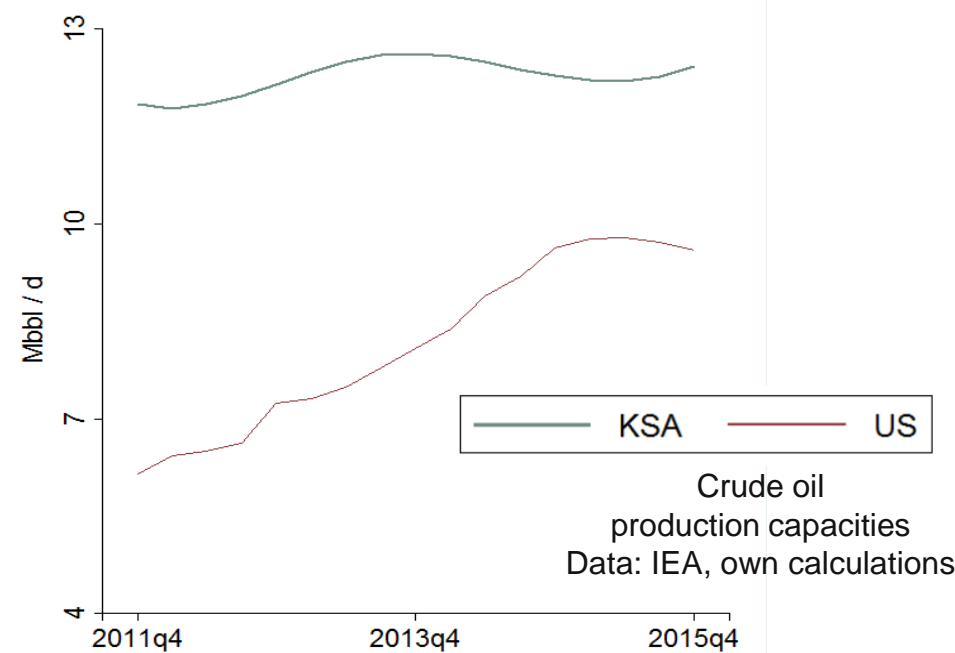
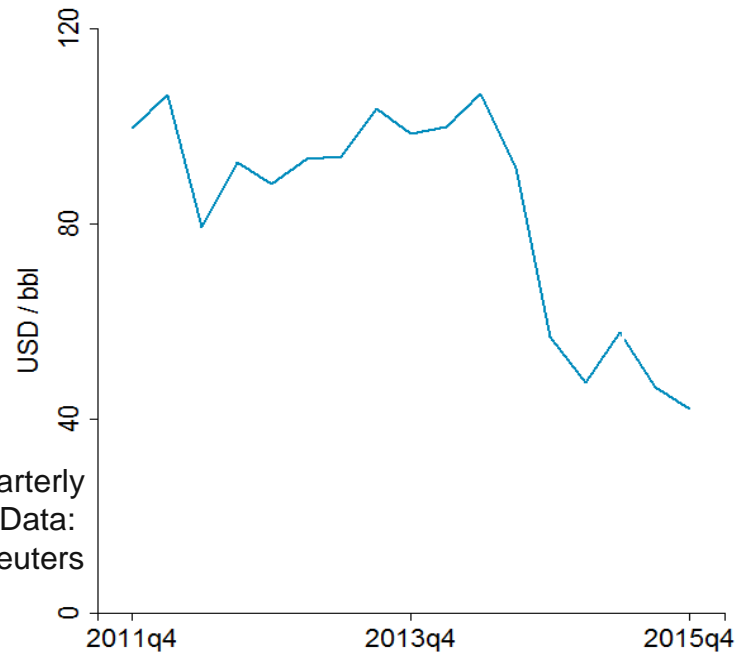
Outline

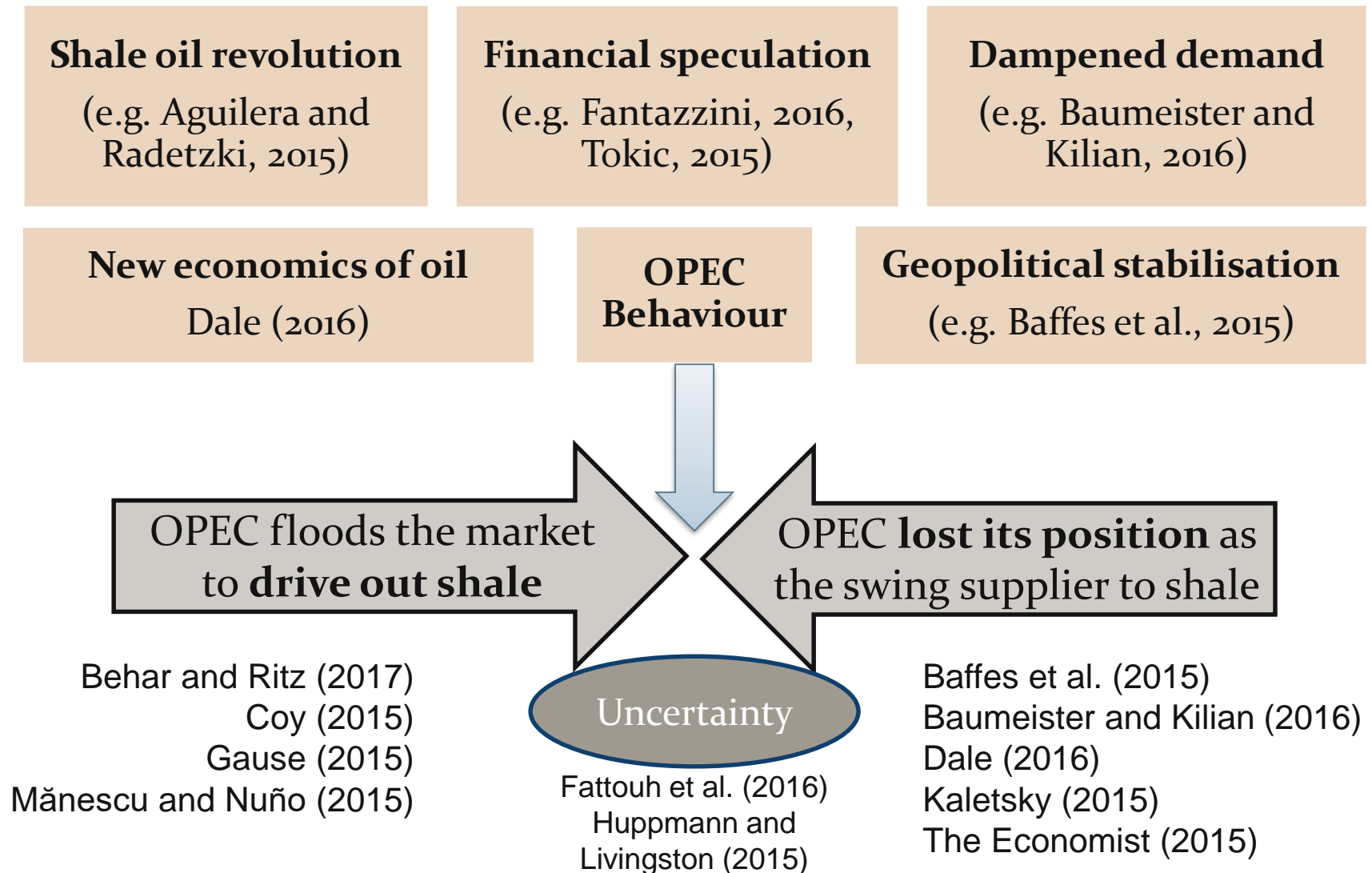
- 2014 – 2016: **Oil price crash**, following US shale growth and an **OPEC decision not to cut production**
- Previous literature: No consensus on **OPEC's intention**
 - *OPEC defeat, OPEC attack, or OPEC experiment?*
- **Bathtub model** to examine if static competition can explain price developments consistently over time
- **Qualitative discussion** about oil politics of OPEC and Saudi Arabia in particular
- Conclusions:
 - OPEC decision most likely an **attempt to drive out shale** and to **test for shale elasticity**
 - Shale oil might have altered competition permanently, but **OPEC is still an important player**

1. Background: Developments and scientific discourse
2. A (*not-so*) simple model of the crude oil market
3. Qualitative discussion: Oil politics
4. Summary & Conclusion

Background:

Developments and scientific discourse







"[Ali al-Naimi's] biggest move was the latest one of defending Saudi market share, and abandoning the OPEC swing role."

Mohammad al-Sabban, June 2015

[...] It is not in the interest of OPEC producers to cut their production.

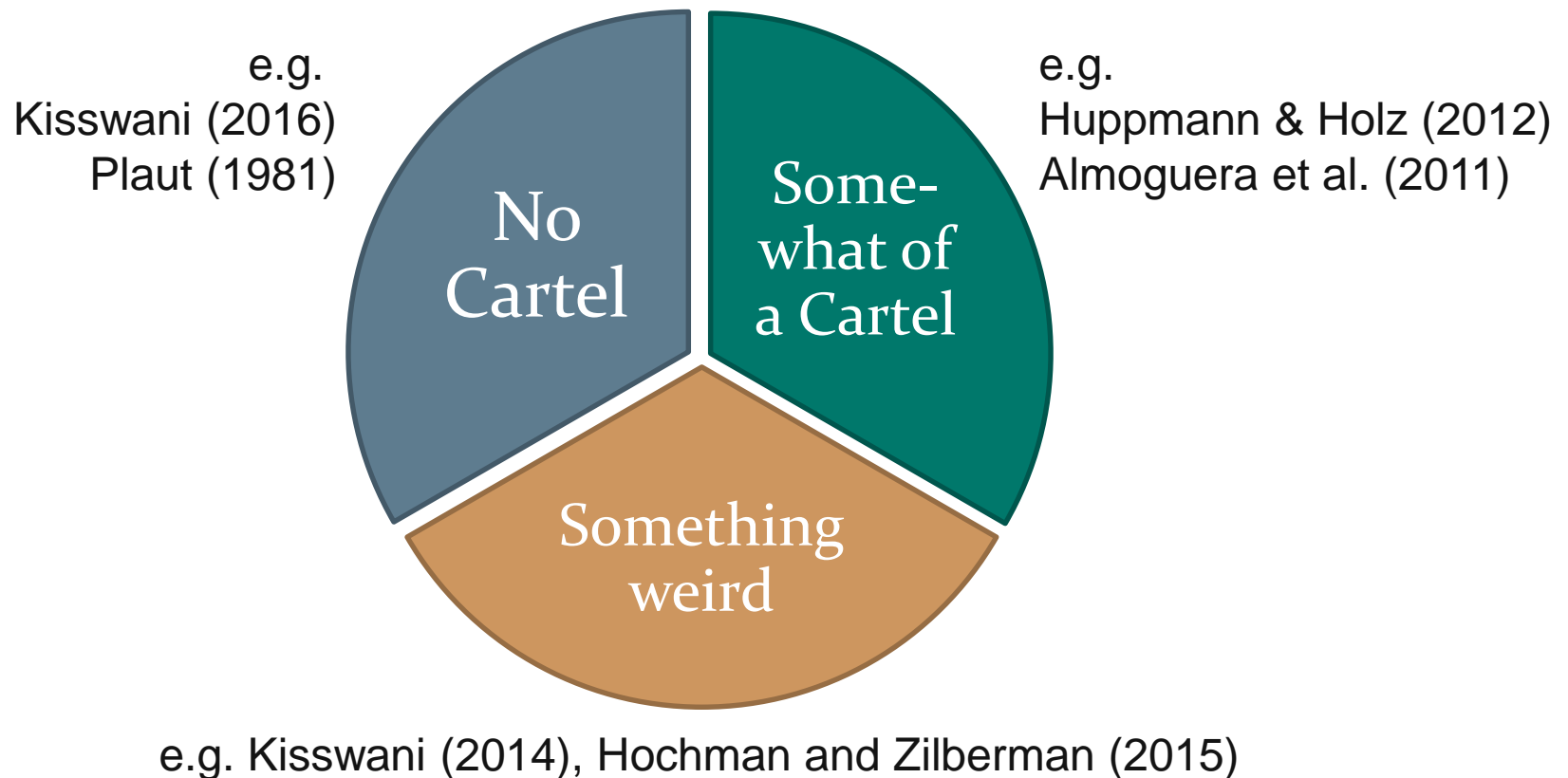
*[...] **Whether [the price] goes down to \$20/B, \$40/B, \$50/B, \$60/B, it is irrelevant.** [...] But if it goes down, others will be harmed greatly before we feel any pain.*

Ali al-Naimi, November 2014

**OPEC states:
We will flood the market
and defend our market
share!**

**Does history back
this decision?**

Is OPEC a cartel?



And even worse: How to model that?

Fattouh and Mahadeva (2013): Changing OPEC objectives and behaviour over time make it **impossible to have a single model** explaining all OPEC history.

A (*not-so*) simple model of the crude oil market

**Perfect
Competition**

*Lower-end
benchmark*

Cournot

*Equal market
power*

Stackelberg:

KSA / United OPEC vs
Cournot / Fringe

Asymmetric market power

Bathtub market

- Homogeneous crude
- **Pool model:** Unified, **global demand** function
- **Relaxation:** quality adjustment

Present profit maximisation

- **No dynamic** strategic behaviour
- Full information and certainty

Golombek production costs

Linear demand

- From actual demand and fixed elasticity

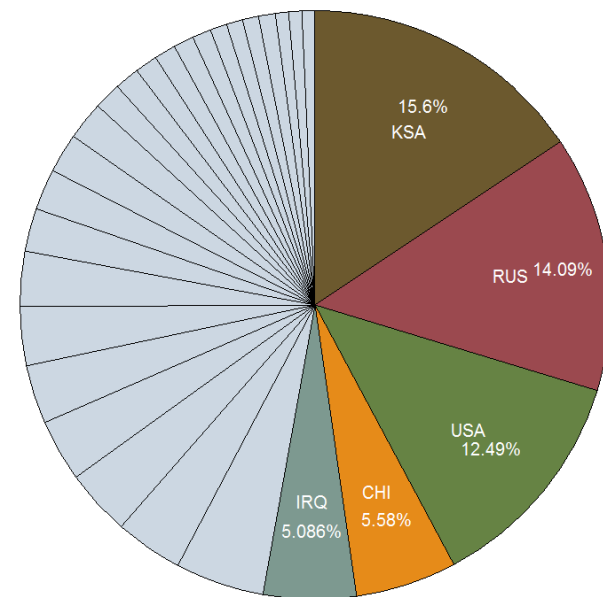
$$\max_{q_{it}} \{p_t(\cdot)q_{it} - C_{it}(q_{it}) \mid q_{-it}^s\} \quad \forall i, t$$

An extension of Huppmann (2013)

t : 2011 Q4 – 2015 Q4, quarterly

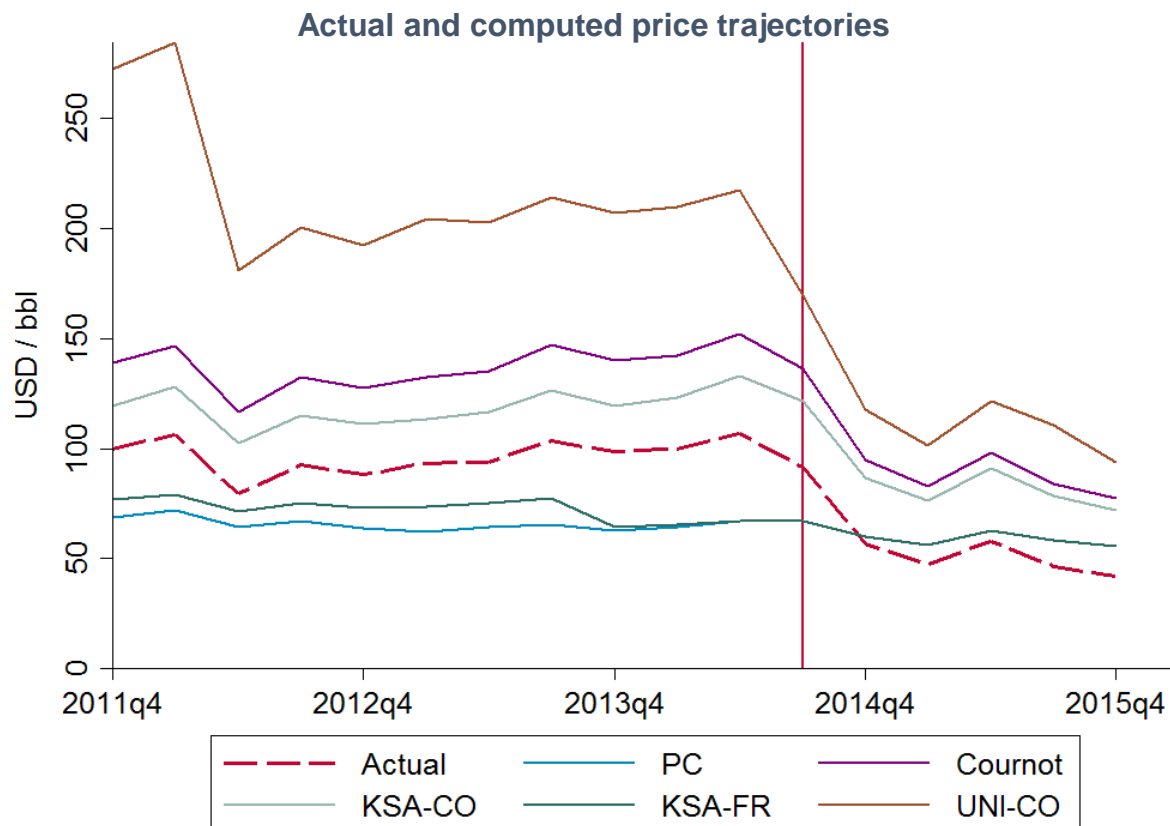
Type	Source
Supply	IEA (29 suppliers with 94.4% of global supply)
Capacities	OPEC: IEA , non-OPEC: 97%-of-output rule and IEA (e.g. Behar & Ritz, 2017)
Production costs	DIW data set (e.g. Langer et al, 2016)
Oil quality adjustment	Calculations based on US Dept. of Energy, EIA, Oil & Gas Journal
Demand elasticity	Survey-based: Javan & Zahran (2015), Caldara et al. (2016)

Setup	Formulation	Solver
Cournot, Perfect Comp.	MCP	PATH
Stackelberg	MPEC → MINLP	Bonmin, Couenne



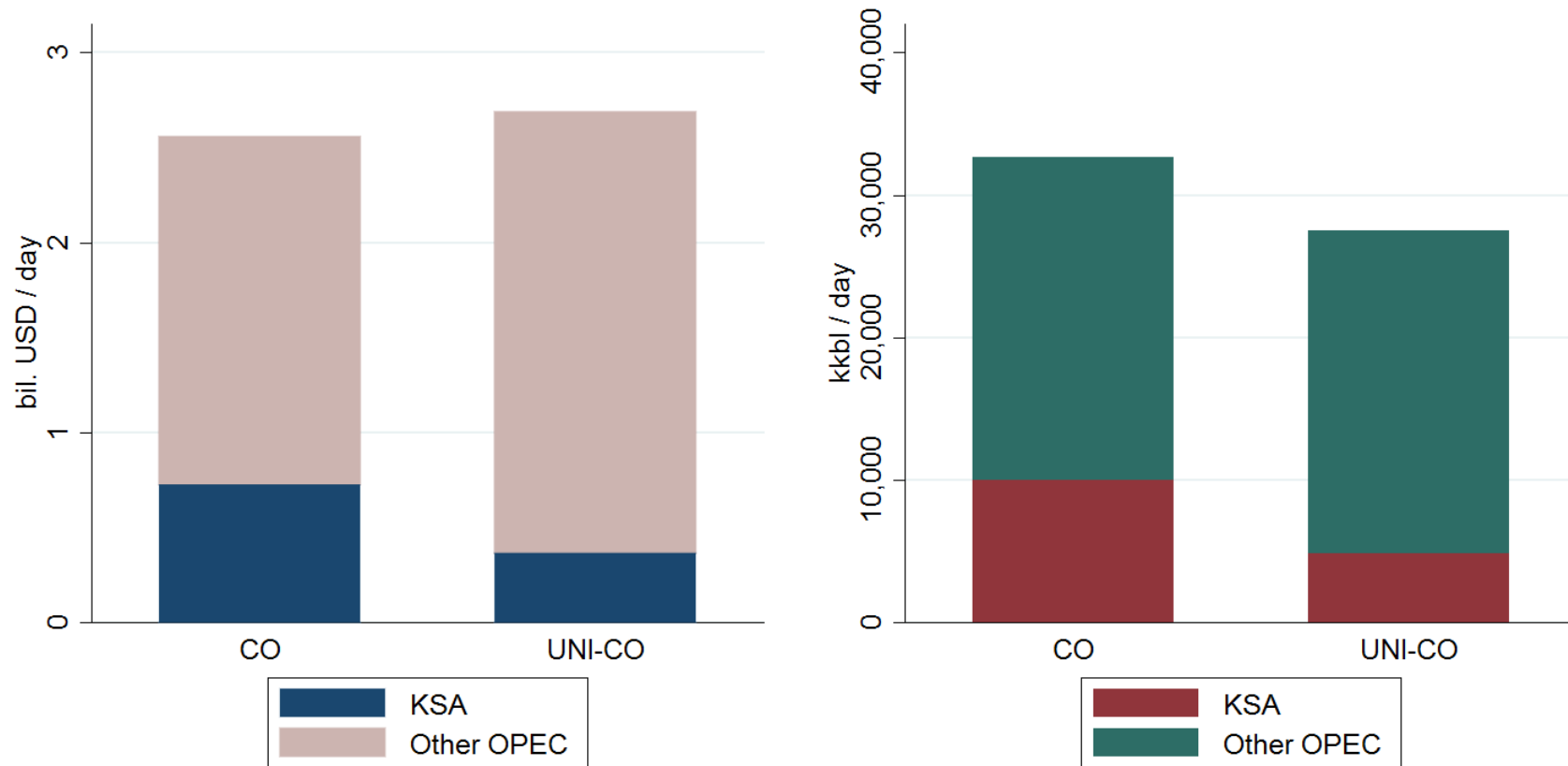
Share in global crude production capacities

Gini coefficient: 0.505
Data: IEA and own calculations

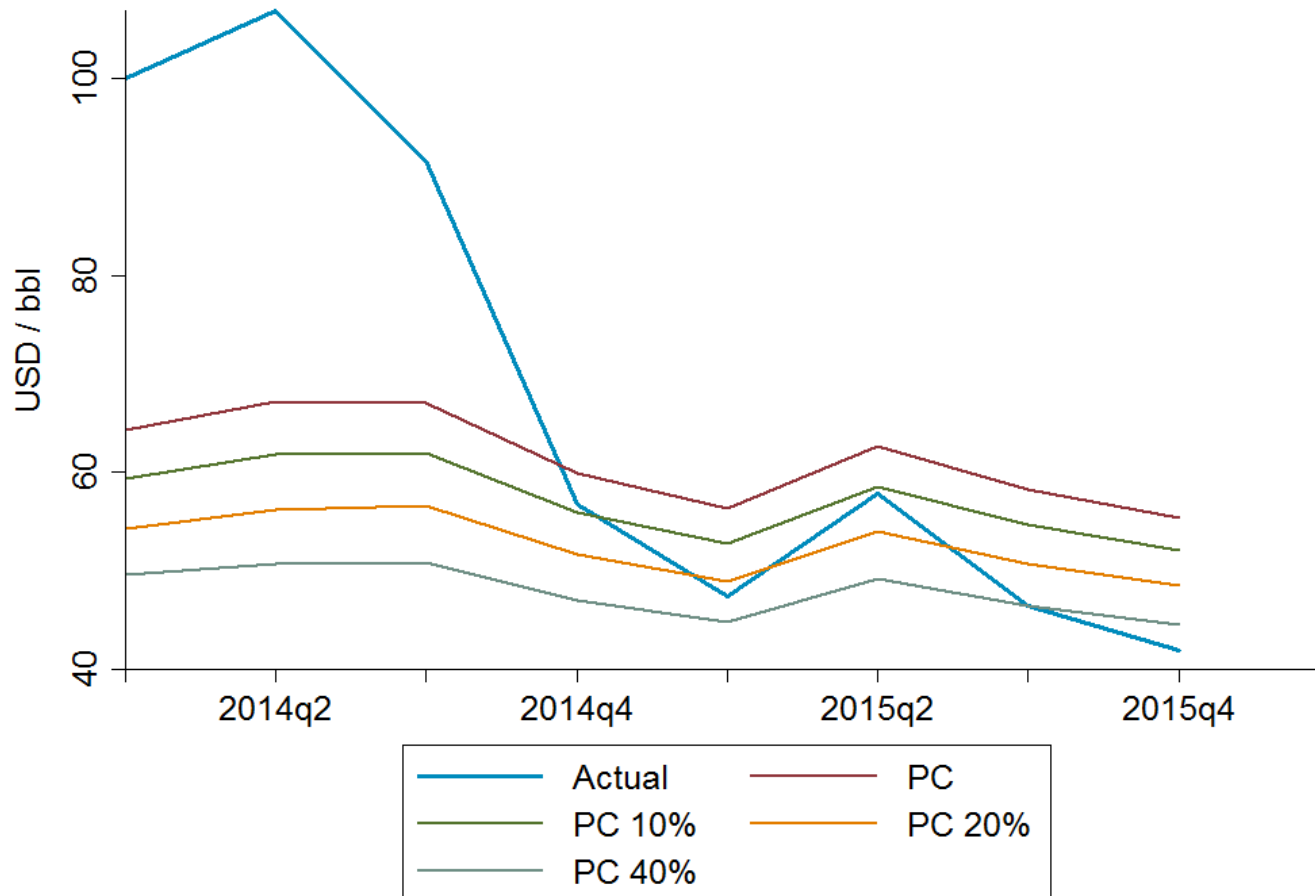


Goodness of fit

ARME in %	KSA-FR	PC	KSA-CO	Cournot	UNI-CO
Overall	23	27	35	52	120
First period	25	31	24	43	121
Second period	18	18	63	75	119



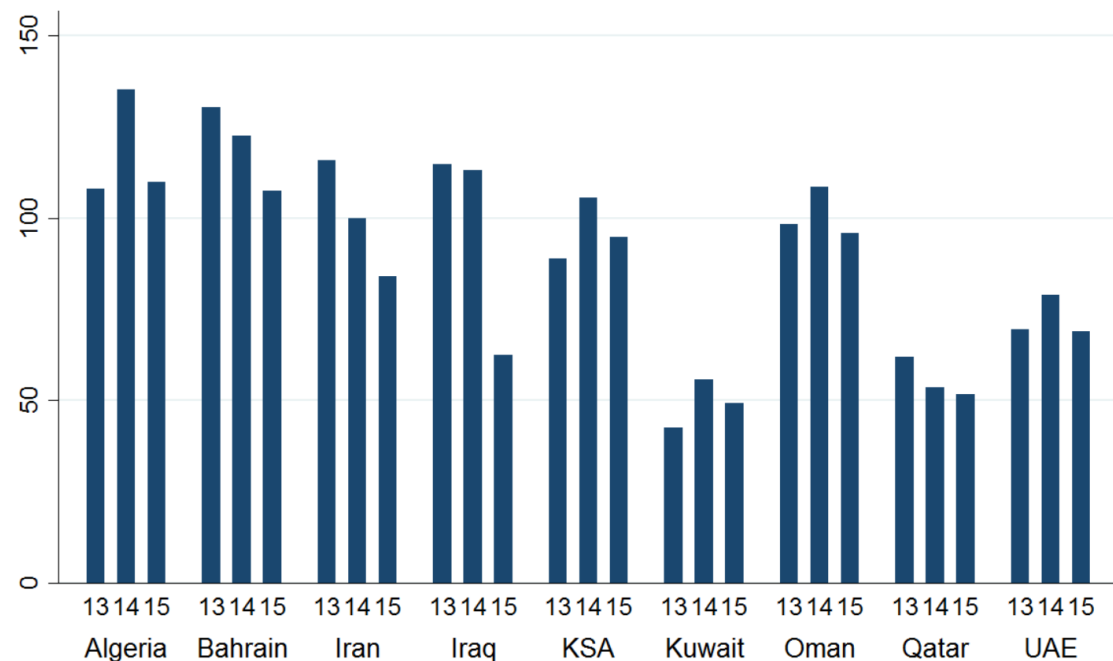
Computed profits (left) and production quantities (right) in the United OPEC setup in Q1 2015 by Saudi Arabia (KSA) and other OPEC members



Robustness of the perfect competition results to cost variations (overall cost reductions in %)

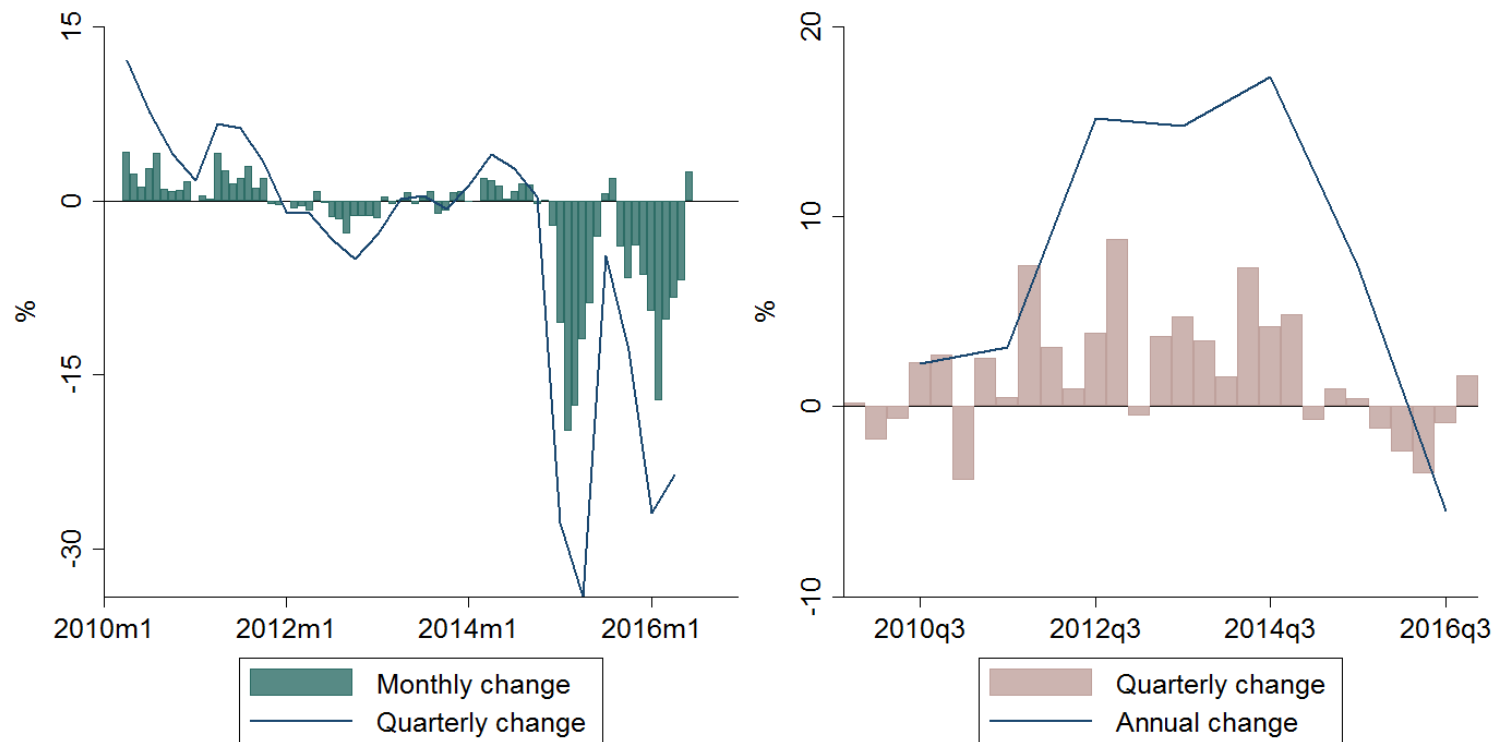
Qualitative discussion: Oil Politics

- **Trade-off** between revenue maximisation and market-shares
- Prolonged low oil prices can result in economic and political havoc
- Geopolitical impact ambiguous, Saudi Arabia advances in refining, Vision 2030
- A toughened oil market endangered by **peak-demand** (climate policies, alternative tech.)
 - Green paradox?
- Similarities to the 1980s?
- Saudi-Arabia's priority in deal negotiations:
 - No moral hazard!
 - No self-harm
- Influence of domestic politics?



Fiscal breakeven prices in USD / bbl 2013 – 2015. Data: IMF

- Shale economics: Different cooperative, financial, and cost structure
- Severe **overvaluation of shale breakeven** before the drop
- Potential misunderstanding of the breakeven concept itself (Kleinberg et al., 2016)
- Significant decrease in production, although far below OPEC hopes (OPEC, 2016)



Month-to-month and quarter-to-quarter changes in US rigs (left) and quarter-to-quarter and year-to-year changes in US daily crude oil production (right). Data: EIA

Summary & Conclusion

- Prices **before the drop** are consistent with **static short-term profit maximisation**.
- **Prices after the drop** can hardly result from such a behaviour but rather from **dynamic calculus or information-revealing behaviour**.
- Shale oil might have altered competition permanently, but **OPEC stays an important player** in the market.
- Oil can potentially continue to move in a price corridor, defined by mutual incentives and technology
- Modelling OPEC is anything but trivial.

Thank you for your attention.



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