The Welfare Impact of Market Power[1]

Jan De Loecker (KUL)

J-J Laffont Keynote Lecture
CRESSE, 2023

[1]Under ERC Grant MPOWER 816638.

Impact of market power

- Known welfare losses (triangles and rectangles).
- Macro tradition: washes out in the aggregate (Harberger).
- Recent evidence of *economy-wide* rising margins, concentration, and associated facts (labor share, inequality, etc.)
- However, complicated relationship:
  - technological change,
  - globalization,
  - anti-trust,
  - political economy: lobbying, regulatory capture,
  - etc.
- Market power tends to coexist with other *frictions*
- Need for deep-dive on time-series of (single) industries with institutional details.

The welfare impact of market power. The OPEC Cartel

- Joint work John Asker (UCLA) and Allan Collard-Wexler (Duke U).
- Study a single large-scale industry with known cartel activity.
- Taking stock across industries.

Empirical analysis of a cartel's welfare impact

- Tradition empirical work study (single-industry):
  1. Conduct/demand approach: **no focus on productive inefficiency**,

     Bresnahan-Porter, e.g. Asker (2010) – *auction/demand lit.* (*)

  2. Cost /supply approach: **no focus no dead weight loss**.

     Borenstein et al (2002), Asker et al (2019) – *cost/prod lit.* (*)

- Theoretical analysis (Stigler (1964)) largely based on identical firms, ignoring important aspects of firm heterogeneity.
- In both traditions heroic task of modeling the cartel behavior (the *family*) – same applies for market power abuse more generally.
- Market power evaluated in absence of other distortions.

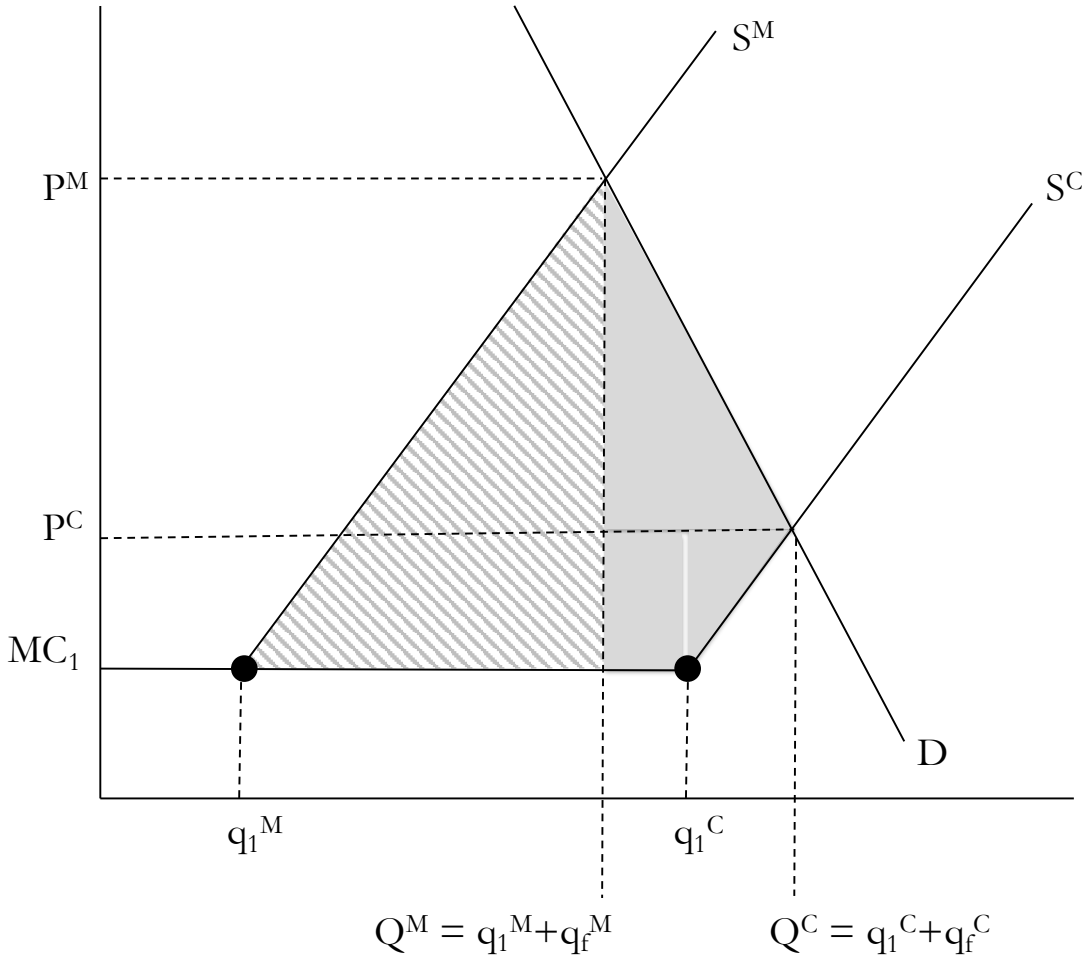
This paper: OPEC Cartel (1970-2021)

- Introduce empirical framework to quantify total welfare impact: Productive inefficiency (PI) and Dead weight loss (DWL).
- Focus on a large global industry, the market for crude oil with the presence of OPEC.
  1. Large and globally relevant industry with likely macro effects (investment & consumption),
  2. Presence of other distortions (geo-political, local policy, environmental, etc.) likely interacting with market power,
  3. Finite resource extraction introduces inter-temporal substitution (i.e. dynamics).
- Leverage detailed cost/reserve data to simulate social planner's allocation.

Roadmap of the talk

1. Welfare: reminder,
2. Oil industry: cost dispersion and price volatility,
3. Framework: theory measurement,
4. Inputs: cost and demand,
5. Welfare analysis,
6. Concluding remarks.

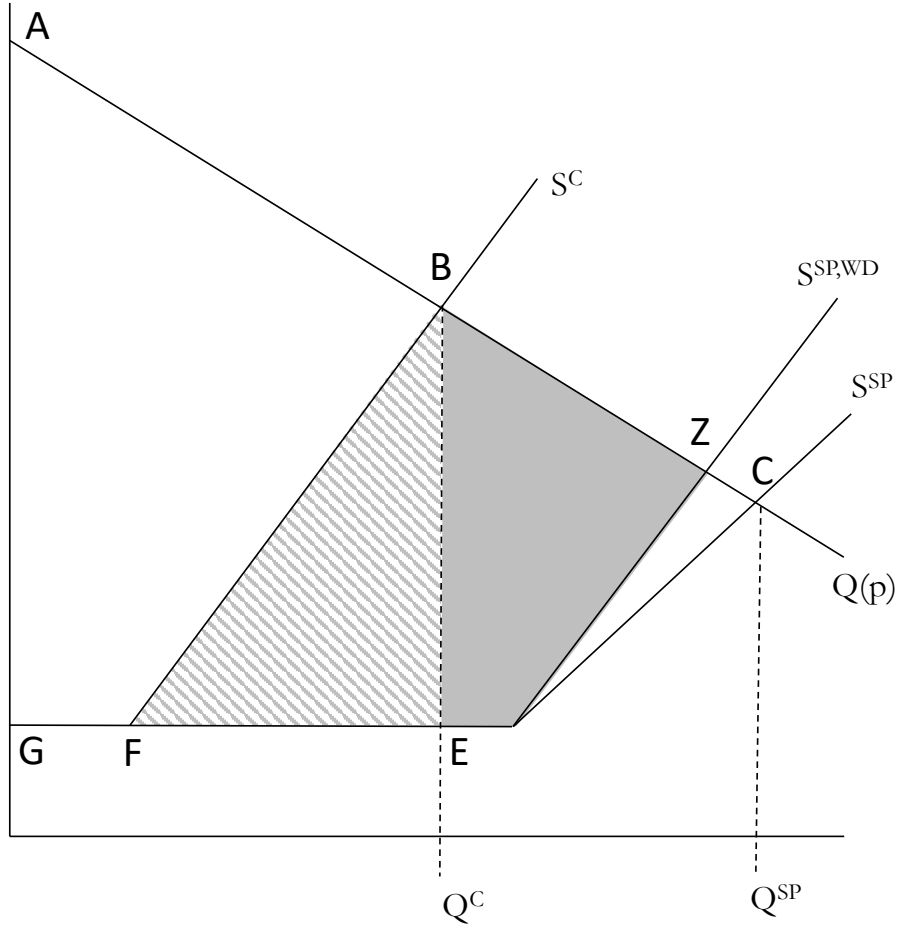
Welfare: dominant firm and fringe: fig



Framework under presence other distortions

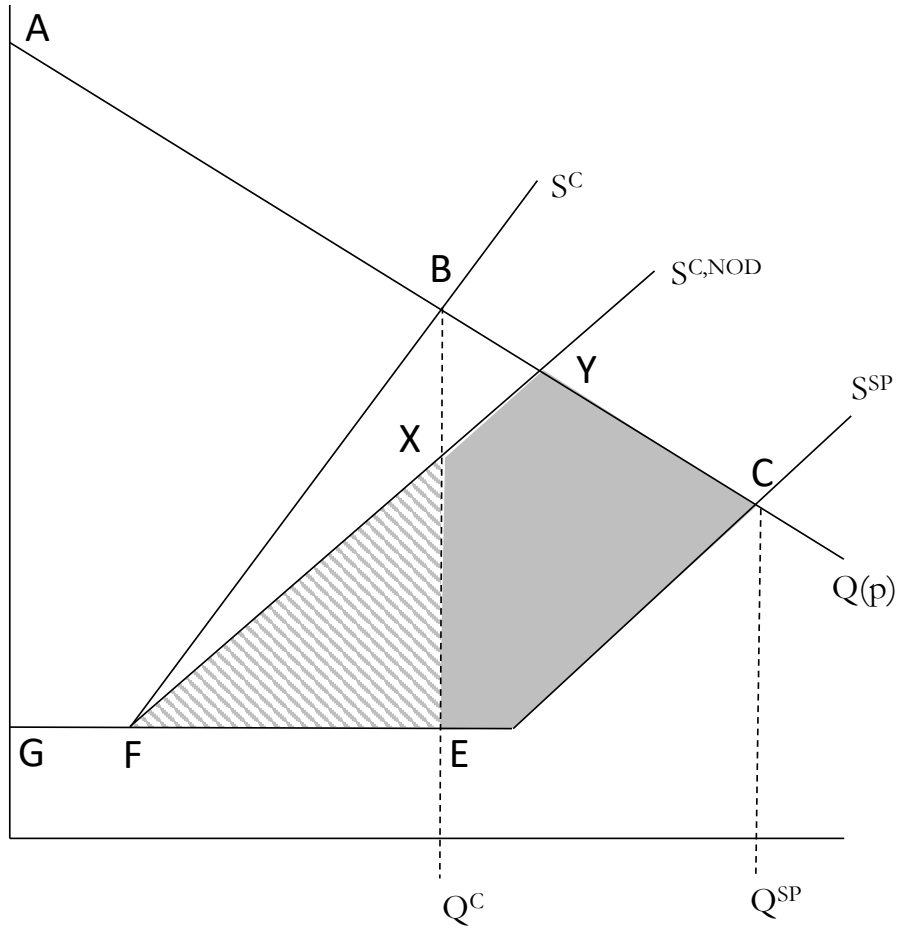
- Marginal approach: Given all other distortions, what is the *marginal* impact of market power?
- Inframarginal approach: *Absent* all other distortions, what is the impact of market power?
- Likely to matter in many applications of market power (corruption, criminal activity, technological constraints, information frictions, regulation, etc.)
- Empirical analogue of Lancaster-Lipsey theory of the 2nd best.

Marginal approach



Add fringe-supply to social planner's cartel's supply

Inframarginal approach



Add social planner's fringe-supply to observed cartel's supply

Required for analysis?

1. Demand curve
   - Challenge global commodity: time series and demand shocks.
2. Cost curve
   - Detailed cost and production data (Rystad, see ACWDL (2019).
   - *Observe* global supply curve.
3. Competitive solution
   - Take static intuitions to a setting with dynamics (finite extraction problem).
   - Main change to intuition: distortion is not *if* the production occurs, instead it is *when*.

The OPEC cartel

- OPEC is Algeria, Angola, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, UAE, and Venezuela.
- OPEC is an imperfect cartel.
- In 2014, 50% of world reserves in OPEC, and the rate of extraction in OPEC was half as fast as in the rest of the world.
- The three biggest producers globally are Saudi Arabia, USA and Russia with 10-15% of global production each.
- OPEC +: includes (perhaps) Russia, Norway, etc.

Main Oil Producers

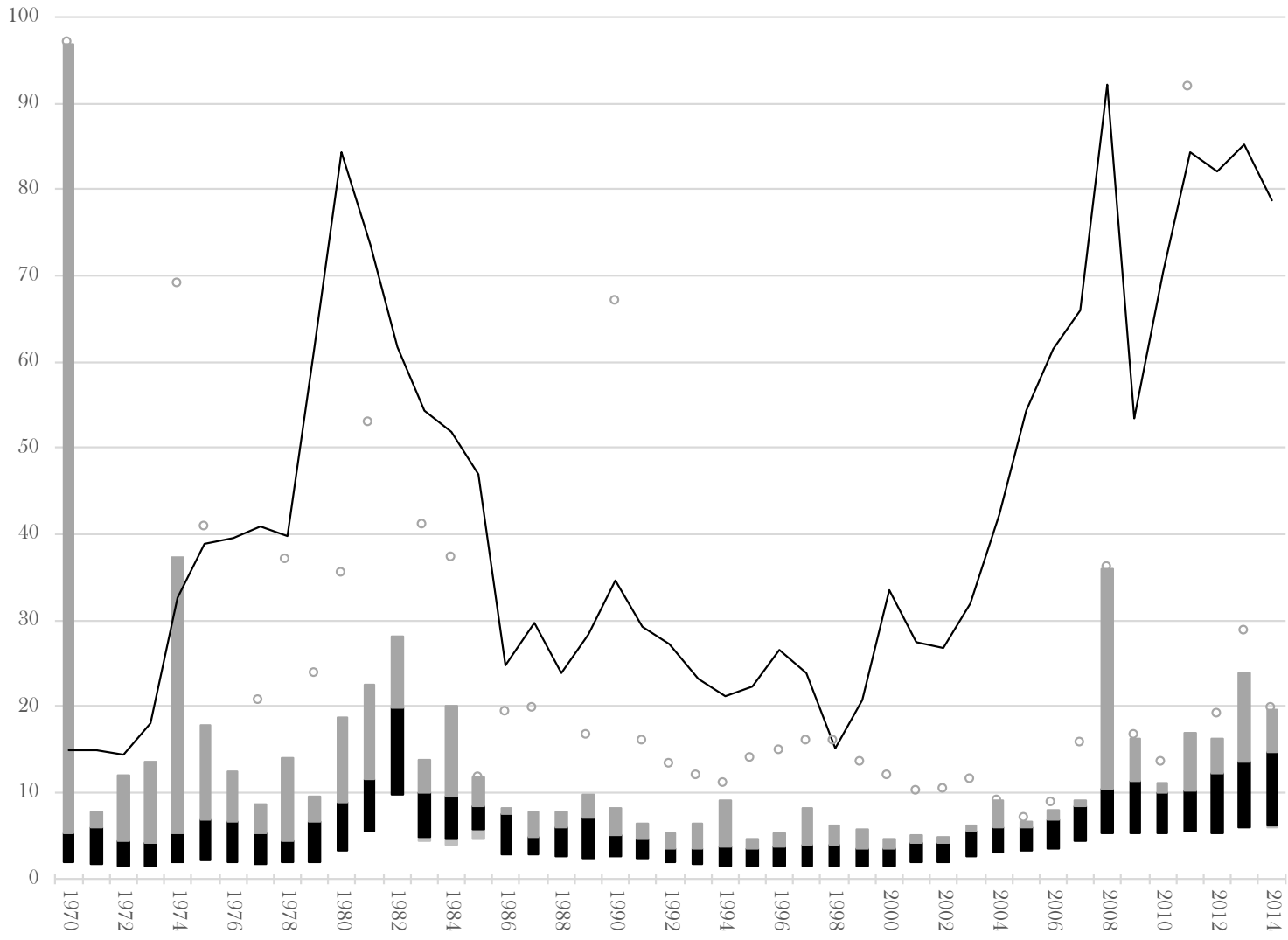
Table: Largest crude producers, % of global production

OPEC		Non-OPEC	
Saudi Arabia	11.8%	United States	14.4%
Iran	5.4%	Russia	13.0%
Venezuala	3.8%	China	4.1%
UAE	3.1%	Mexico	3.7%
Nigeria	2.8%	Canada	3.3%
Iraq	2.7%	UK	2.4%
Kuwait	2.6%	Norway	2.4%

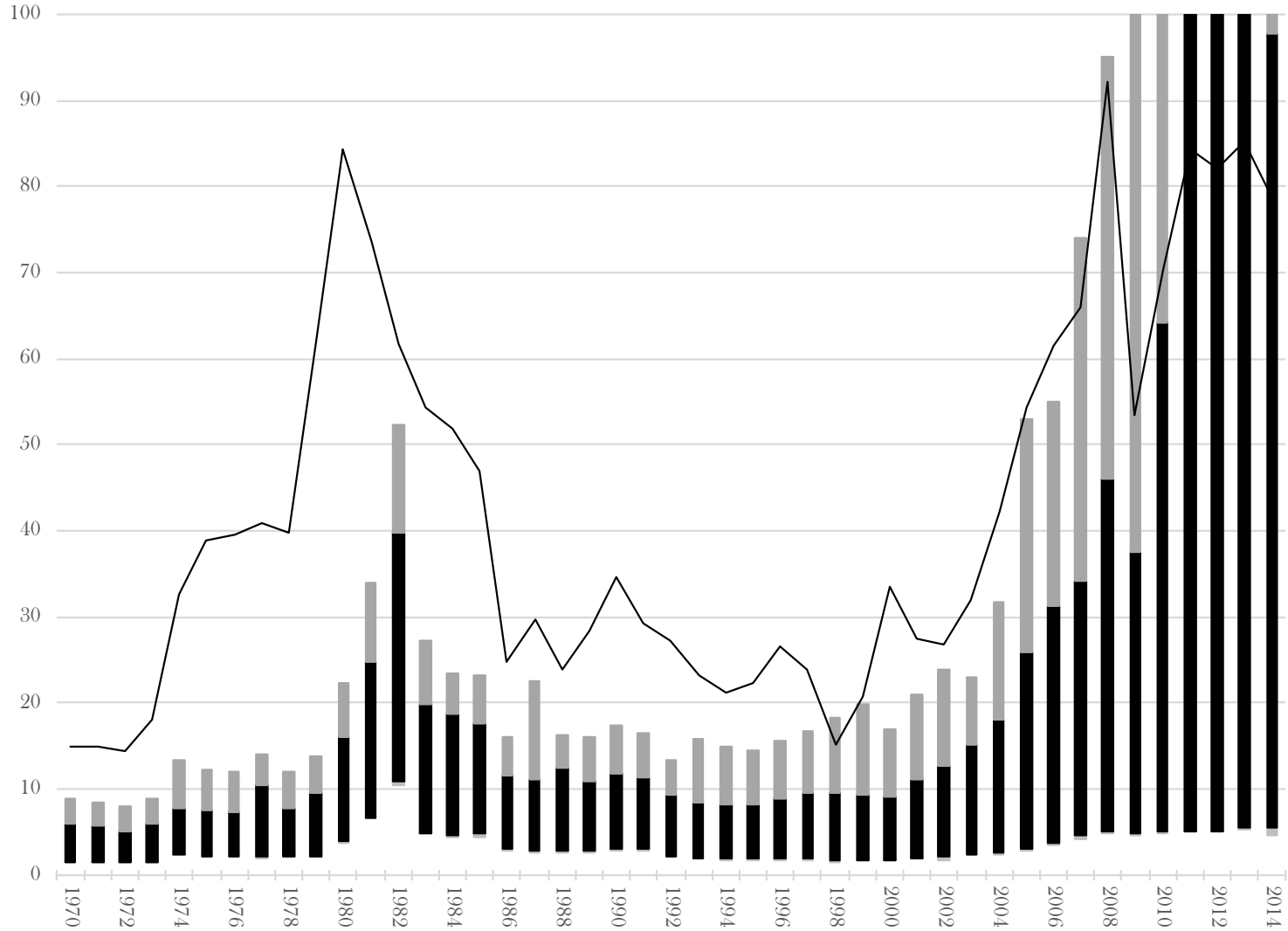
Notes: Global production from 1970-2019 was 1,156 billion barrels. Collectively these 14 countries account for 85.4% of global production.

Cost Changes over time: Saudi Arabia

black: 95%, grey: 99% and circle: max.



Cost Changes over time: United States



Summarizing basic facts

1. Large cost dispersion across producers,
2. OPEC lower costs than non-OPEC at all percentiles ≥ 25,
3. Large price variation, low response from low-cost producers.
4. OPEC markup about 2-3 times higher than non-OPEC.

Cost diff. map into PI and large price swings into DWL.

Inputs into simulations: cost and demand

One – internally consistent – empirical framework:

- Cost estimates from rich micro-level cost and production data,

$$c_{fts} = c_f \mu_{st} \exp\left(\epsilon_{f,t,s}\right)$$

- Demand estimation using market-clearing (annual) prices and use costs to construct instrument.

$$Q_t = \begin{cases} \alpha_p + \beta P_t + \gamma GDP_t + g(t) + \epsilon_t, & \text{if } P_t < 200 \\ 0 & \text{otherwise} \end{cases}$$

Theory: Modeling issues

- Define a production function that allows a coherent interpretation of cost data with focus *across* fields.
- Account for dynamics (since oil is a finite resource)
  - Oil not used today is used in the future
  - Hotelling rents need to be accommodated
  - Productive inefficiency: a cheap barrel not extracted today is produced next year (perhaps) - intertemporal substitution
  - Deadweight loss: consumption forgone today is enjoyed at the very end of the path of production - again, intertemporal substitution

Specifics: Social planner's problem (inter-temporal)

- *Sorting Algorithm: lowest cost fields are extracted first in any competitive equilibrium – i.e. cost minimization ordering yields sequence of barrels*
- *Ingredients:*
  1. *horizon (deplete total capacity),*
  2. *discounting (common δ).*
- *Resource constraints implies price-marginal cost wedge (i.e. markup) due to discounting. In essence:*

$$p_1 - c(q_1) = \delta(p_2 - c(q_1)) \tag{1}$$

- *Generates price path to maximize value from transactions.*

Algorithm: illustration (1)

- q_f observed output of field f,
- $\tilde{q}_f$ optimal output given reserves/extraction – i.e. social planner's output of field f,
- $\tilde{Q}_n$ is total output at step n; and depends on the counterfactual model.

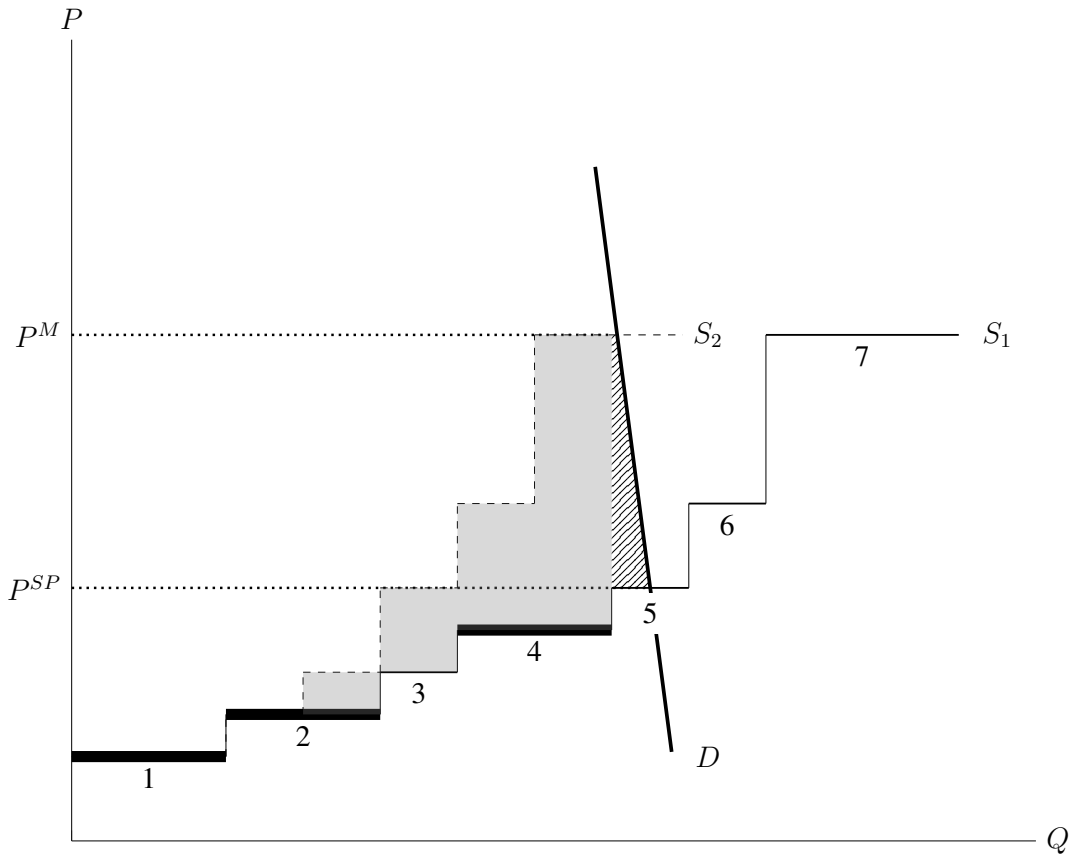
Algorithm: illustration (2)

Rank cost	quantity	OPEC	Soc Pl. $\tilde{Q}$	Marginal $\tilde{Q}$	Inframarginal $\tilde{Q}$
c_1	q_1	1	$\tilde{q}_1$	$\tilde{q}_1$	q_1
c_2	q_2	1	$\tilde{q}_2 + \tilde{q}_1$	$\tilde{q}_2 + \tilde{q}_1$	$q_2 + q_1$
c_3	q_3	0	$\tilde{q}_3 + \tilde{Q}_2$	$q_3 + \tilde{Q}_2$	$\tilde{q}_3 + \tilde{Q}_2$
c_4	q_4	1	$\tilde{q}_4 + \tilde{Q}_3$	$\tilde{q}_4 + \tilde{Q}_3$	$q_4 + \tilde{Q}_3$
c_5	q_5	0	$\tilde{q}_5 + \tilde{Q}_4$	$q_5 + \tilde{Q}_4$	$\tilde{q}_5 + \tilde{Q}_4$
c_6	q_6	0	$\tilde{q}_6 + \tilde{Q}_5$	$q_6 + \tilde{Q}_5$	$\tilde{q}_6 + \tilde{Q}_5$

Note:

1. Stop everywhere $p(\tilde{Q}_n) = c_n$ (unit is a bbl).
2. Dynamics: inter-temp w/ discounting and update state.
3. Ownership indicator is flexible: OPEC $+$: add turn Russian wells to $\chi_i = 1$.

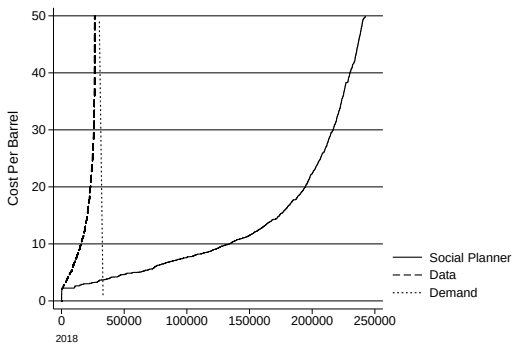
Welfare in the data

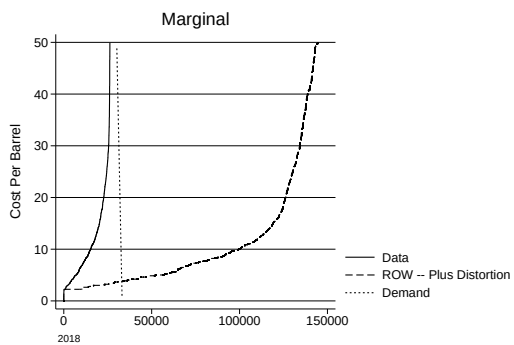


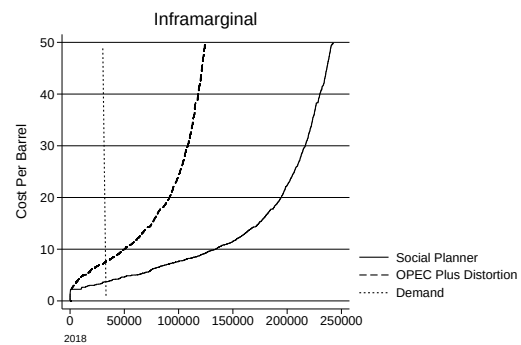
Fields 1, 2, and 4 are in the OPEC Cartel.

Welfare Impact

- Take the state of the world up to 2018, and run counterfactuals.
- Cond. static ($\delta = 0$) to provide graph. representation.







Welfare analysis: results

Impact, 1970 - 2014, in billions of 2014

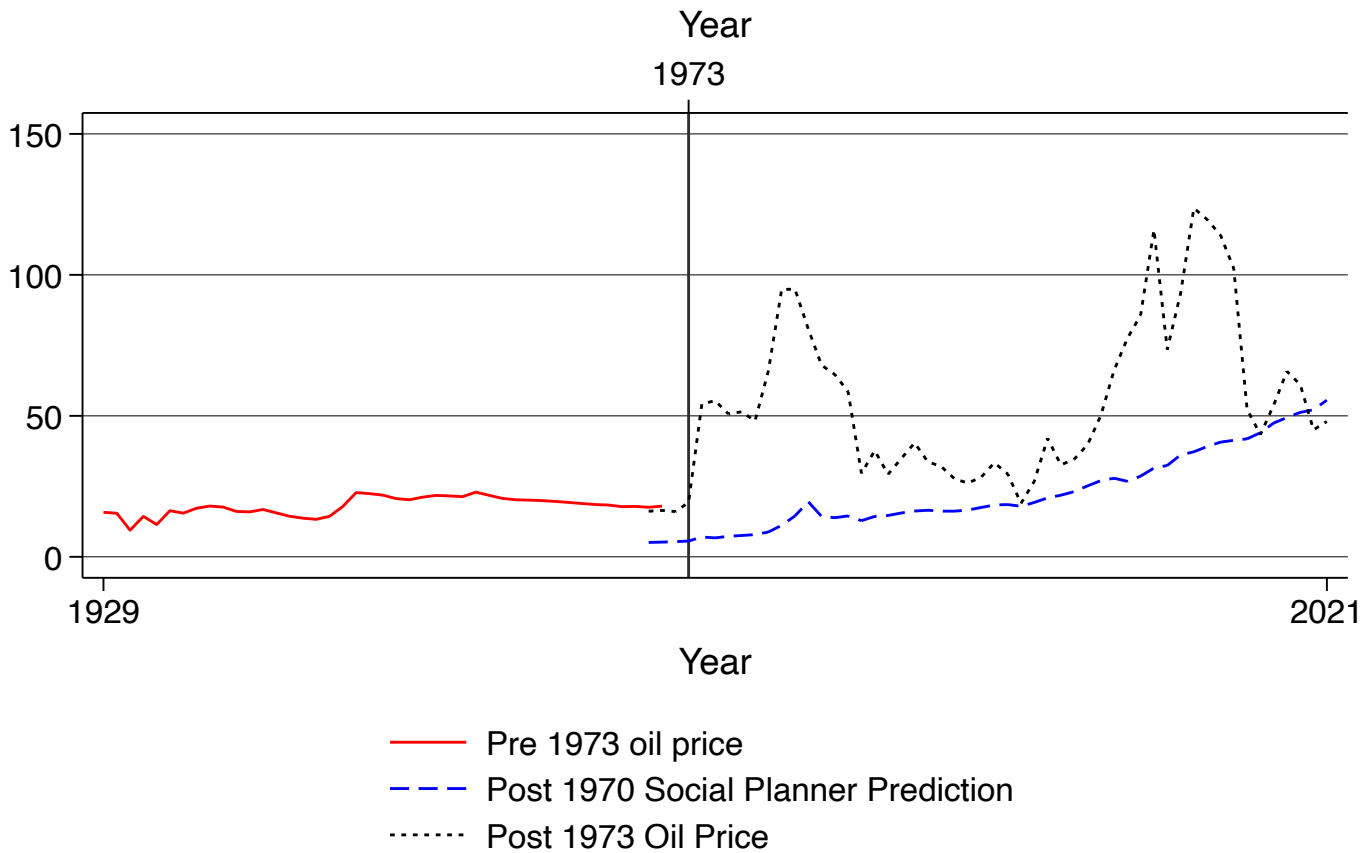
Lost gains from trade	
All distortions included (E = B - A)	6,185
Market power (Inframarginal approach) (F = B - C)	764
Market power (Marginal approach) (G = D - A)	5,730
Deadweight loss due to OPEC market power	
All distortions included (H)	5,177
Market power (Inframarginal approach) (I)	262
Market power (Marginal approach) (J)	4,883
DWL / Lost gains from trade	
All distortions included (H/E)	0.84
Inframarginal decomposition (I/F)	0.34
Marginal decomposition (J/G)	0.85

Interpreting the numbers

1. Large total welfare loss USD 6.1 TR(TWL) in the absence of frictions,
2. Marginal (USD 5.7 TR) close to TWL:
   - Large quantity distortion from cartel,
3. Infra-marginal modest rel. to marginal:
   - large distortions ROW,
   - enables market power impact,
   - No simple attribution (conclusion).
4. Ratio of DWL-Total WL much smaller in infra-marginal.

Impact of the cartel: before and after?

- OPEC formed in 1960.
- Compare social planner solution to price path before 1973:



Fringe supply as a source for market power

- Coordination with non-OPEC members (Russia, Norway, etc.), tacit or otherwise.
- Geopolitical (violations of cost minimization, exogenous perhaps):
  - Berlin Wall, capacity Russia plummets,
  - Gulf wars,
  - Land use regulation,
  - Overall government oil revenue.
- Unpacking work in progress.

Conclusions

- We find large welfare losses from global cartel with sizable DWL, in addition to productive inefficiency.
- Despite inelastic demand price levels high relative to costs.
- Welfare accounting in the presence of cartel (market power broadly):
  - Complicated by the presence of other distortions
  - Data intensive
- Implications
  - Thinking carefully about non-traditional data sources, like accounting data, is likely necessary
  - Theory is crucial to guide data analysis

Implications for cartel policy

- All else equal, harm is higher, the more variance there is across firms in costs (equiv. productivity)
- Cartels can be sustained by distortions introduced by other policy initiatives. Competition agencies may consider advocating for the removal of distortionary policy that limits the responsiveness of competitors.
- This may have an impact that is similar to removing the offending conduct directly.
- The cumulative welfare cost of cartels can measure in the trillions – revisit Harberger and direction for literature on aggregate impact of market power.