Is restricting oil supply a viable climate policy?

Quantifying supply-side climate policies

Lassi Ahlvik
University of Helsinki, Helsinki GSE

Jørgen Juel Andersen
BI Oslo

Jonas Hveding Hamang
BI Oslo

Torfinn Harding
University of Stavanger

November 24, 2022

Introduction

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  - Demand-side: carbon tax, cap-and-trade, subsidies for green energy, clean electricity standards, information campaigns...
  - Supply-side: regulation of fossil fuel production

Introduction

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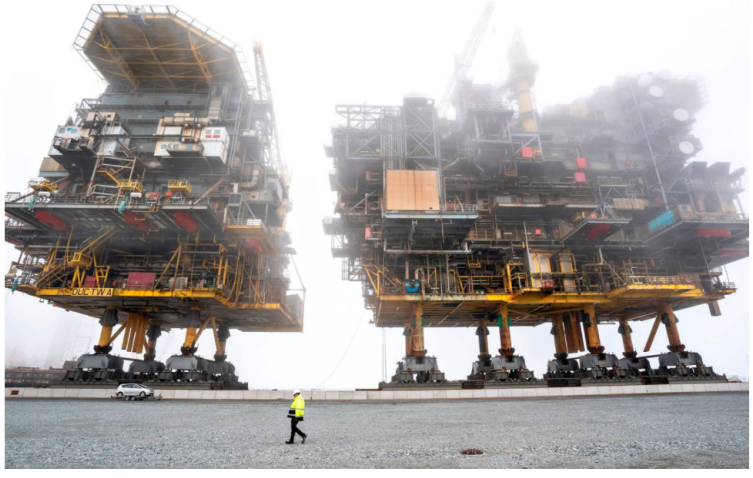
Denmark to End Oil Exploration in Shift Away From Fossil Fuels

Scandinavian country's move is among the most drastic yet to curb carbon emissions



By David Hodari and Dominic Chopping
Dec. 4, 2020 11:22 am ET

Denmark is to end all new oil and gas exploration with immediate effect as part of a plan to phase out fossil fuels by 2050, one of the most drastic moves by a crude-producing nation to curb carbon emissions.

The country's parliament agreed to scrap planned licensing rounds in the North Sea and said extraction of oil and gas must end by the middle of the century, at which point Denmark aims to be carbon neutral.

Introduction

"While Denmark is a small oil producer by global standards, it is the most significant move to ban fossil-fuel extraction, following more symbolic gestures from countries such as France and New Zealand. The move highlights a global shift away from fossil fuels as countries and companies seek to reduce carbon emissions with the aim of limiting global warming."

– Wall Street Journal, December 4 2020

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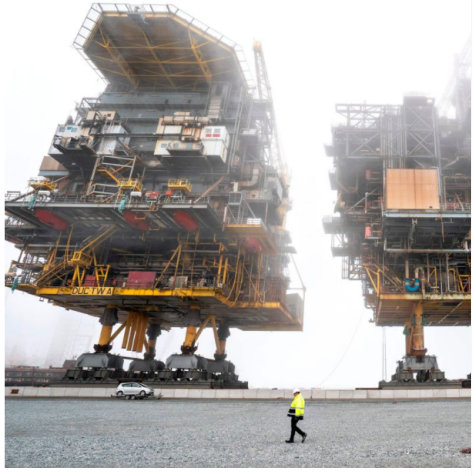

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Brexit UN climate talks Paris Agreement

'Inverse Opec': Kamala Harris plan to wind down oil production awaits its moment

Published on 18/09/2020, 9:54am

The proposal to negotiate a managed decline of fossil fuels is politically and diplomatically sensitive but finds support among a handful of climate leaders

Kamala Harris (Photo: Gage Skidmore /Flickr)

By Megan Darby

The prospect of an "inverse Opec" to tackle climate change came a step closer when Kamala Harris was appointed running mate to US Democratic presidential candidate Joe Biden.

In her climate platform while contending for the top job herself, Harris proposed a meeting of major emitters in early 2021. This was to kick off "the first-ever global negotiation of the cooperative managed decline of fossil fuel production".

Introduction

"The idea [...] is not to replicate the mammoth diplomatic mission of the Paris Agreement. Rather, it would start with a "minilateral" of leading countries – the "inverse Opec" – and build out. New Zealand, France and Costa Rica were identified as natural partners in such an initiative."

–Climate Home News, September 18, 2020

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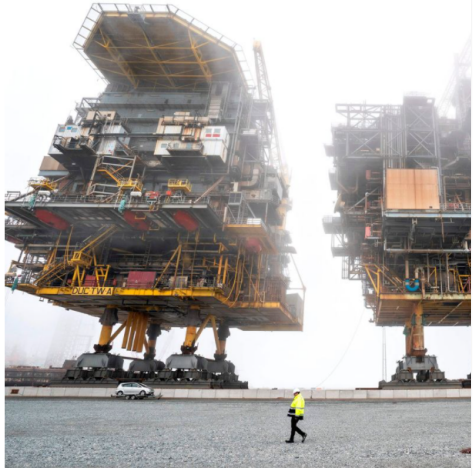

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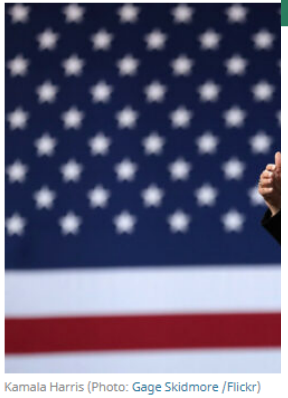

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Department of Energy

Joint Statement on Establishing a Net-Zero Producers Forum between the Energy Ministries of Canada, Norway, Qatar, Saudi Arabia, and the United States

APRIL 23, 2021

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Joint Statement on Establishing a Net-Zero Producers Forum between the Energy Ministries of Canada, Norway, Qatar, Saudi Arabia, and the United States

The United States of America's Intention to Form a Net-Zero Producers Forum

There is no greater challenge facing our nation and our planet than the climate crisis. That's why President Biden has laid out the boldest climate agenda in our nation's history – one that will spur an equitable clean energy economy and cement the United States on a path to net-zero emissions by 2050. To achieve our global climate goals we need cooperation from all major emitters, including oil and gas producing nations, to identify and act on solutions to phase out unabated fossil fuel emissions, while reducing emissions to the maximum extent possible in the interim. For this reason, the U.S. Department of Energy has led on creating a new international forum dedicated to developing long-term strategies to reach global net-zero emissions.

Joint Statement on Establishing a Net-Zero Producers Forum between the Energy Ministries of Canada, Norway, Qatar, Saudi Arabia, and the United States

Introduction

"To achieve our global climate goals we need cooperation from all major emitters, including oil and gas producing nations, to identify and act on solutions to phase out unabated fossil fuel emissions, while reducing emissions to the maximum extent possible in the interim."
–US Department of Energy, April 23, 2021

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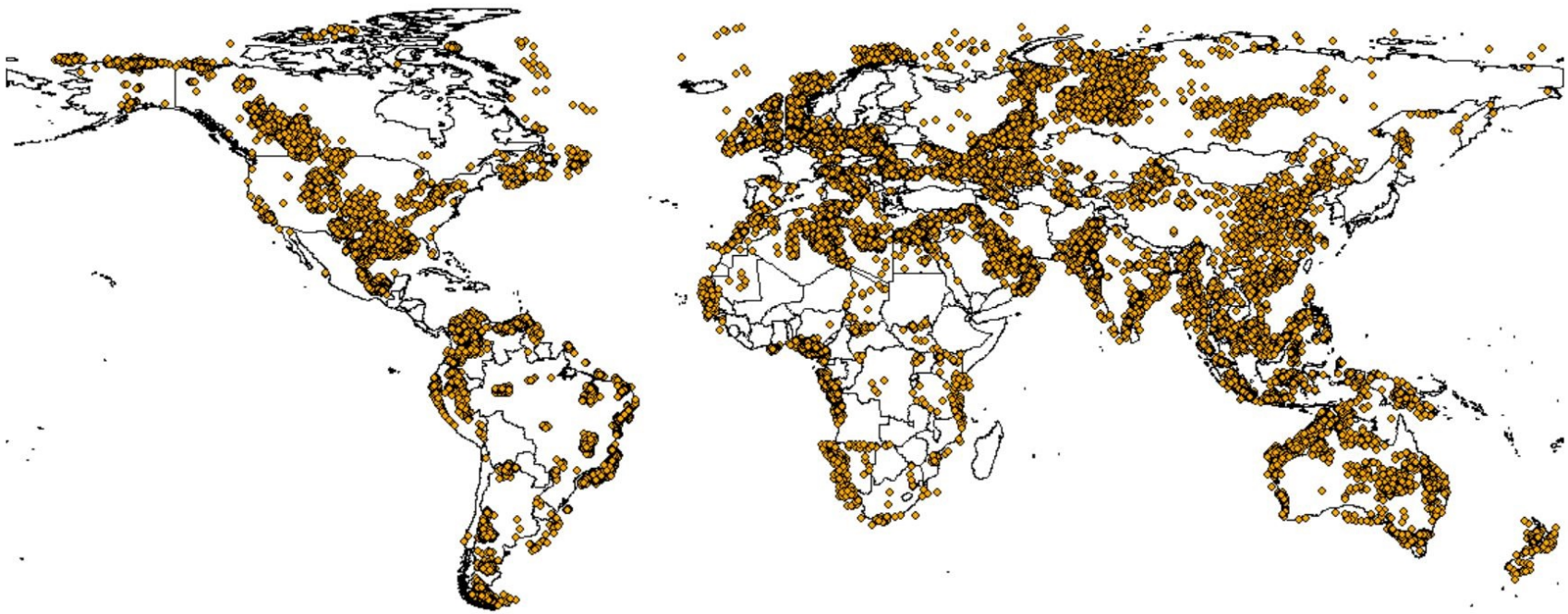
Key policy questions related to supply-side climate policies:

1. How would the oil companies respond?
2. What is their potential to reduce climate change?
3. What would the tax incidence be between consumers, producing companies and governments?

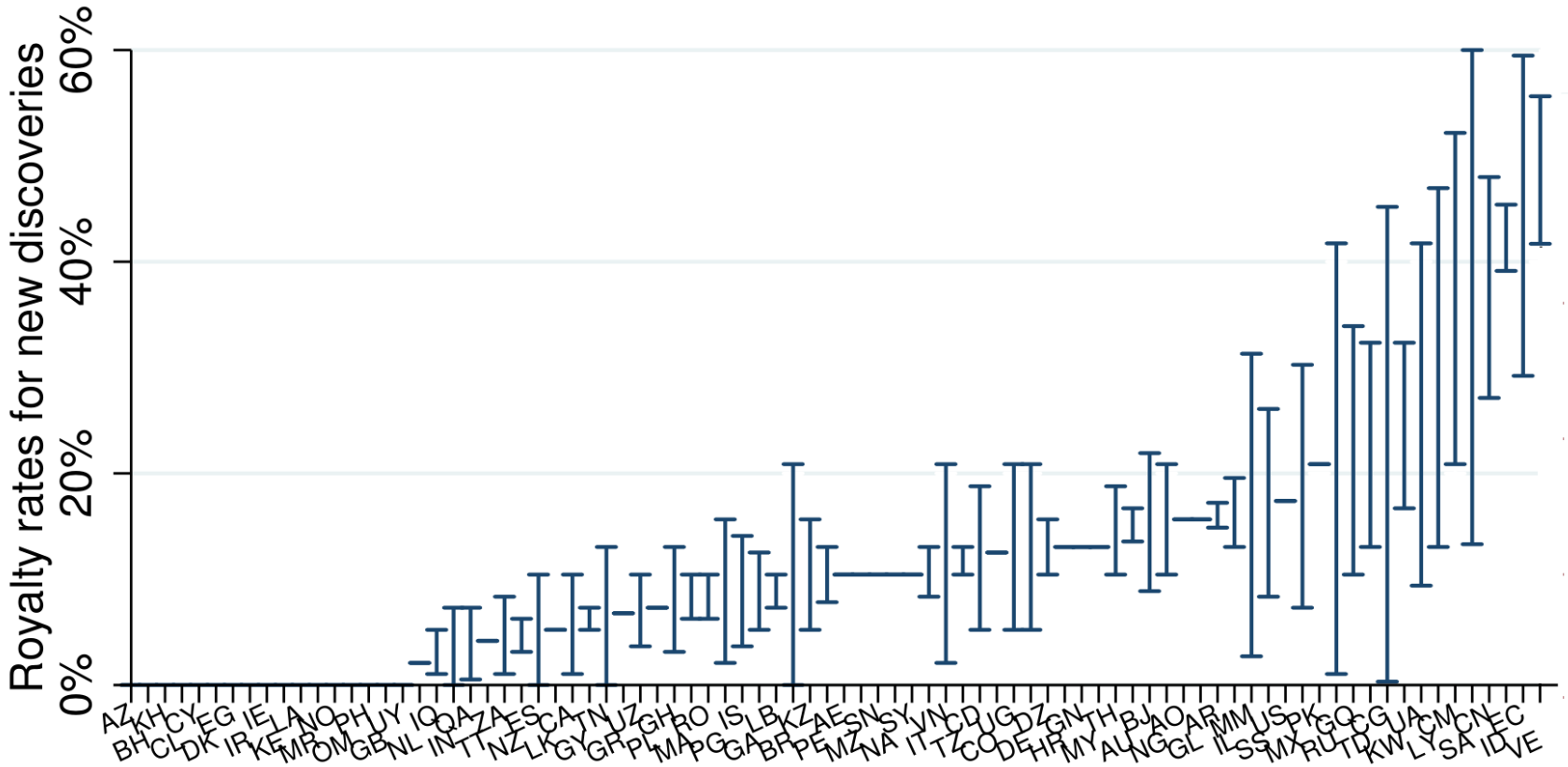
Data: Rystad Energy

Global data on oil production for 2000-2019

- Oil and gas production, investments (opex, capex, exploration capex) and discoveries (depth, size, breakeven prices) from Rystad Energy
- In total: 69,277 assets by 4,352 unique firms in 84 countries



Data: Implicit CO_2 taxes



Notes: Bars represent lower and upper range for production-based taxes in a country. Implicit CO_2 price calculated using \$70/bbl oil price and average carbon dioxide coefficient of oil is 430 kg CO_2 per barrel.

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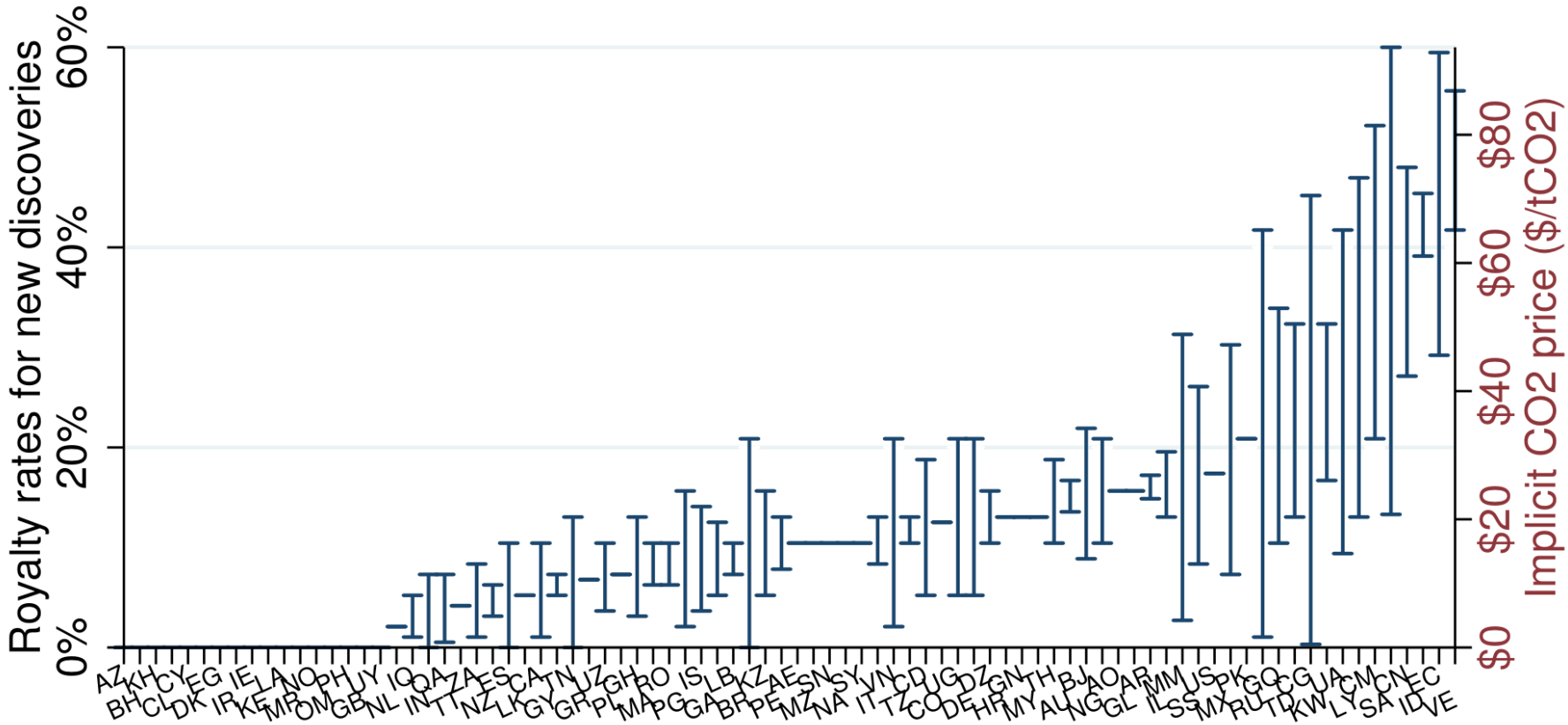

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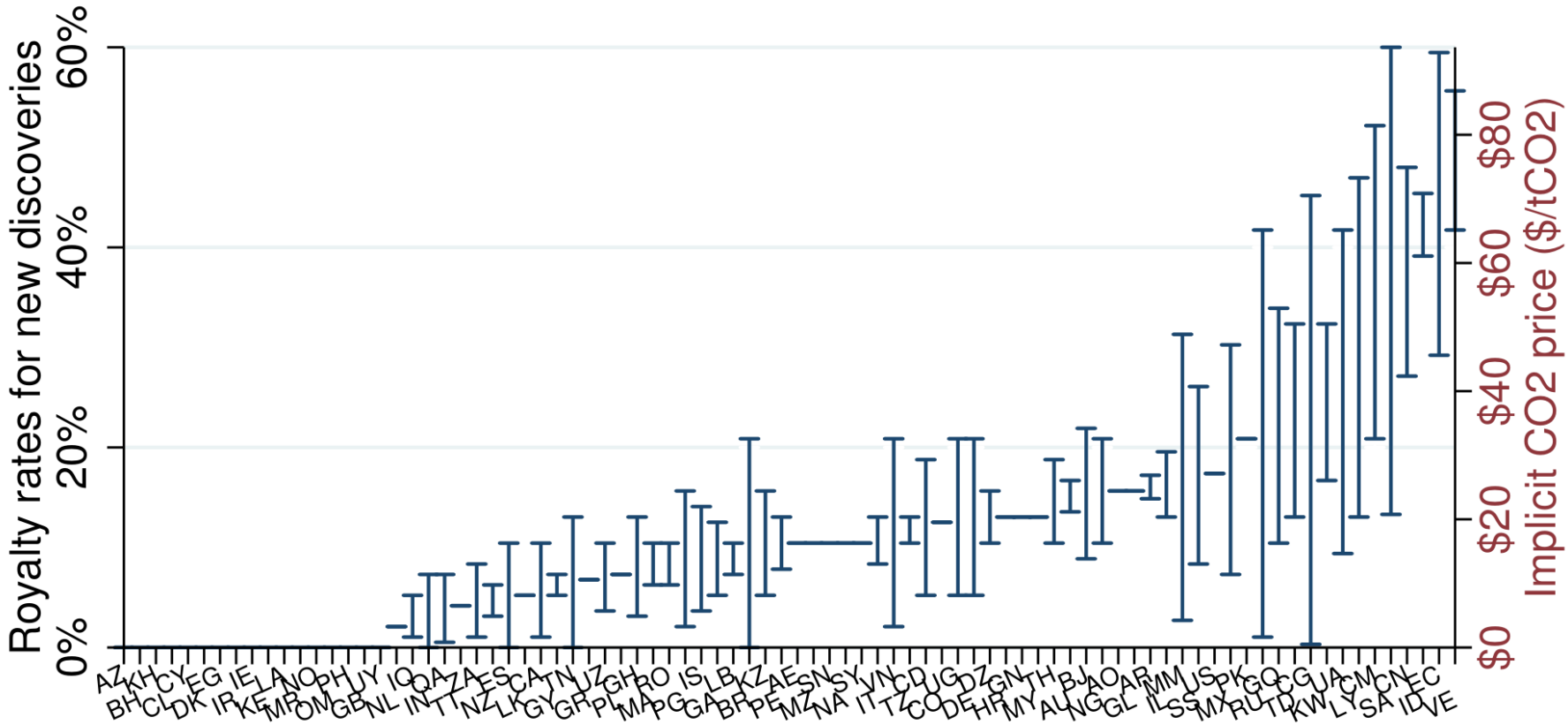

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Our identification is based on 130 oil tax reforms between 2000-2019

Empirics

- Main estimation:

$$Y_{ijt} = \beta_R Royalty_{jt} + \beta_{PT} ProfitTax_{jt} + \gamma_{ij} + \gamma_{it} + \gamma_{rt} + \epsilon_{ijt}$$

  - Where Y_{ijt} is the log of exploration capex (discoveries/break-even prices/production) in tax regime j by firm i at year t
  - $Royalty_{jt}$ and $ProfitTax_{jt}$ are tax rates. Cumulative effect for countries with multiple tax changes.
  - Fixed effects:
    - γ_{ij} captures firm-tax regime specific fixed effects, like nationality or geological competence
    - γ_{it} is the firm-year fixed effect, capturing firm's reaction to climate risk, oil price expectations, financing and cash flow
    - γ_{rt} is the region-year fixed effect, capturing area-specific economic developments

Results: Exploration

Result 1: One pp increase in taxes decreases exploration by **3.03%**

	(1)	(2)	(3)	(4)
Panel A: Impact on exploration				
Royalty rate	-.0262***	-.0289***	-.0268***	-.0301***
	(.0055)	(.0060)	(.0067)	(.0063)
Profit tax rate				-.0094*
				(.0045)
N	41737	41737	41539	41539
Year FEs	x			
Region-year FEs	x		x	x
Company-year FEs			x	x

Notes: Notes: The table presents OLS coefficients for the time period 2000-2019 with log exploration capex (in $) as the dependent variable. The treatment dummy is the royalty rate or profit tax rate. All specifications include company-by-tax revime fixed effects. Robust standard errors in parentheses clustered on company and country-level. *** p<0.01, ** p<0.05, * p<0.1

Comparison to earlier studies

Results: Production

Result 2: There is no statistically or economically significant effect on production (as in Anderson 2018, *JPE*)

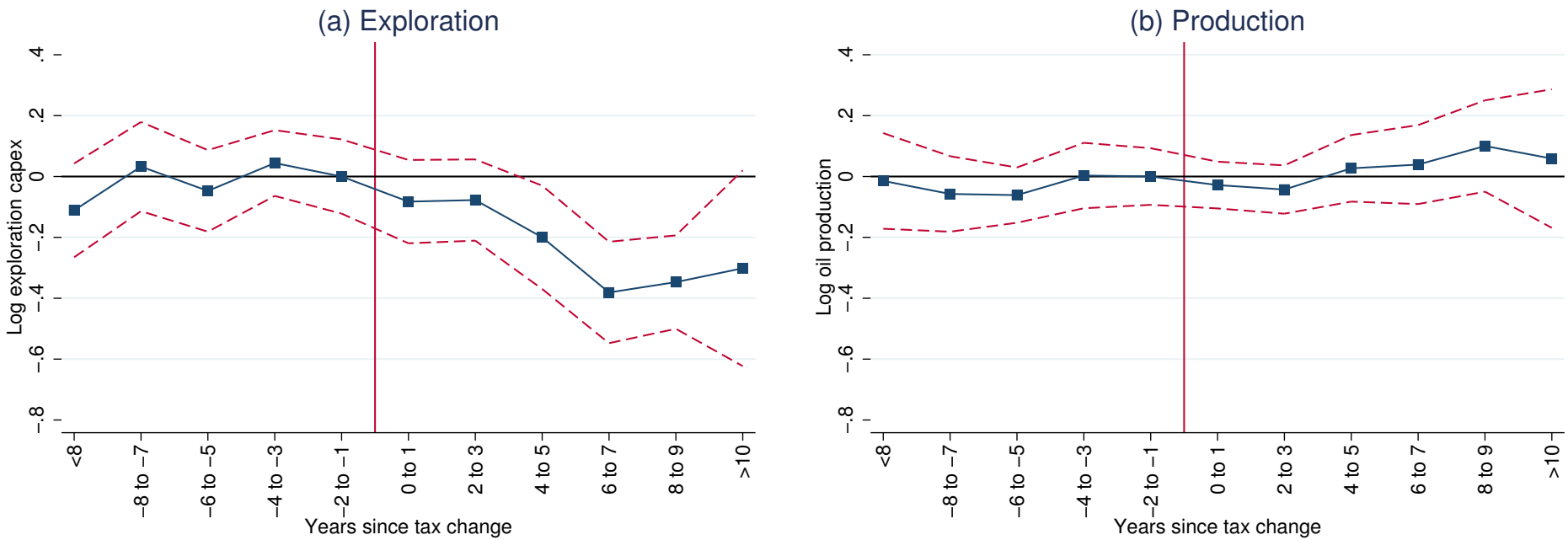
	(1)	(2)	(3)	(4)
Panel B: Impact on production				
Royalty rate	-.0009	-.0003	-.0012	-.0007
	(.0052)	(.0075)	(.0061)	(.0059)
Profit tax rate				.0019
				(.0048)
N	23823	23823	23045	23045
Year FEs	x			
Region-year FEs		x	x	x
Company-year FEs			x	x

Notes: Notes: The table presents OLS coefficients for the time period 2000-2019 with log oil production (in bbl) as the dependent variable. The treatment dummy is the royalty rate or profit tax rate. All specifications include company-by-tax regime fixed effects. Robust standard errors in parentheses clustered on company and country-level. *** p<0.01, ** p<0.05, * p<0.1

Comparison to earlier studies

Results: Event study I

Estimated impact of royalty reforms on exploration and production



Notes: Graphs show coefficients on year-since-royalty-change indicators, where royalty increases are given value 1 and decreases value -1. The graph is readjusted such that the coefficient for year −1 equals zero and other coefficients can be interpreted as changes relative to that year. Connected dots show yearly values, dashed lines show 90% confidence interval. Standard errors are two-way clustered by country and company. Data covers years 2000-2019.

Results: Discoveries

Result 3: One pp increase in taxes decreases discoveries by **4.38%**

	(1)	(2)	(3)	(4)
Panel C: Impact on discoveries				
Royalty rate	-.0413**	-.0556***	-.0440*	-.0438*
	(.0125)	(.0153)	(.0197)	(.0203)
Profit tax rate				.0014
				(.0064)
N	14836	14836	13981	13981
Year FEs	x			
Region-year FEs		x	x	x
Company-year FEs			x	x

Notes: Notes: The table presents OLS coefficients for the time period 2000-2019 with log discoveries (in bbl) as dependent variables. The treatment dummy is the royalty rate. All specifications include company-by-tax revime fixed effects. Robust standard errors in parentheses clustered on company and country-level. *** p<0.01, ** p<0.05, * p<0.1.

Results: Breakeven prices

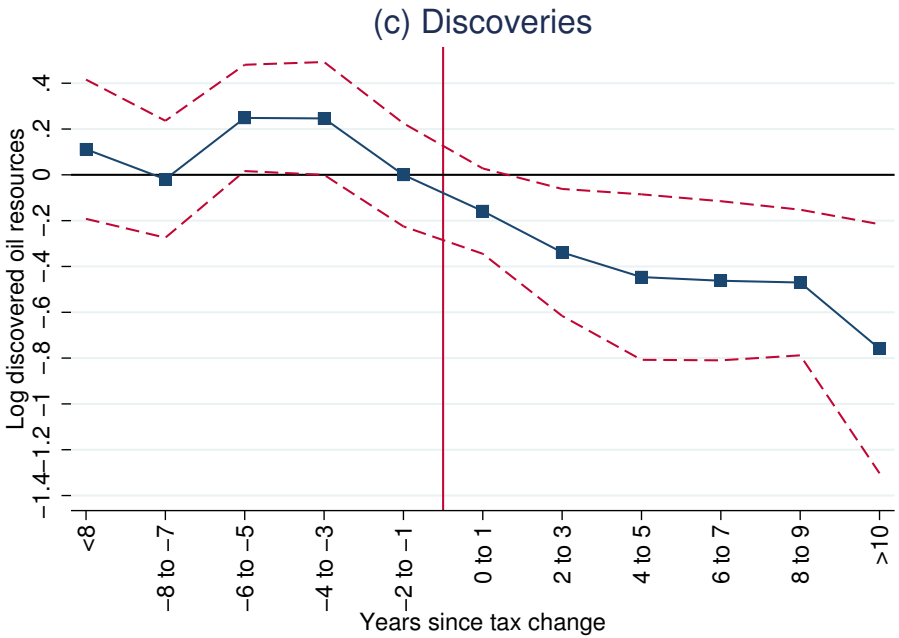
Result 4: Taxes have no effects on expensive discoveries are found (as in Swierzbinski and Mendelsohn, 1989 *IER*)

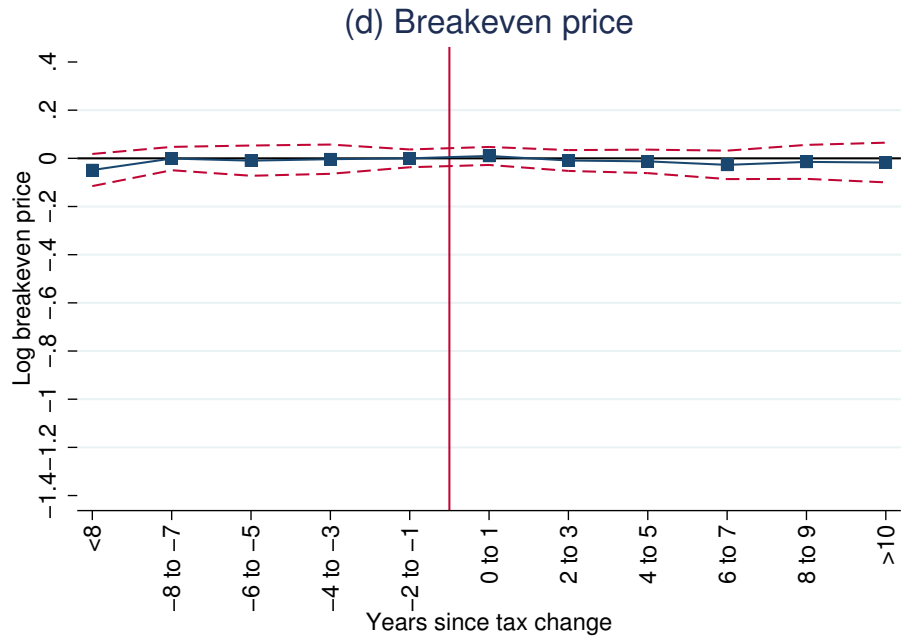
	(1)	(2)	(3)	(4)
Panel D: Impact on breakeven prices				
Royalty rate	-.0001	-.0003	-.0018	-.0024
	(.0052)	(.0052)	(.0057)	(.0051)
Profit tax rate				-.0039*
				(.0018)
N	14041	14041	13136	13136
Year FEs	x			
Region-year FEs		x	x	x
Company-year FEs			x	x

Notes: Notes: The table presents OLS coefficients for the time period 2000-2019 with log mean-weighted breakeven price per company (in $/bbl) as dependent variables. The treatment dummy is the royalty rate or profit tax rate. All specifications include company-by-tax revime fixed effects. Robust standard errors in parentheses clustered on company and country-level. *** p<0.01, ** p<0.05, * p<0.1.

Results: Event study II

Estimated impact of royalty reforms on discoveries and breakeven prices





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1. Is the result biased by the staggered difference-in-differences design?
   - We run a stacked regression where we use never-treated countries as controls (as in Cengiz et al. 2019) Link

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   - Spillovers by company activity shifting? We use companies that drill in one country only Link

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4. Other issues
   - A range of tax changes? We use upper and lower bounds of tax changes and find consistent results Link
   - Market power? Results are robust when OPEC is dropped Link

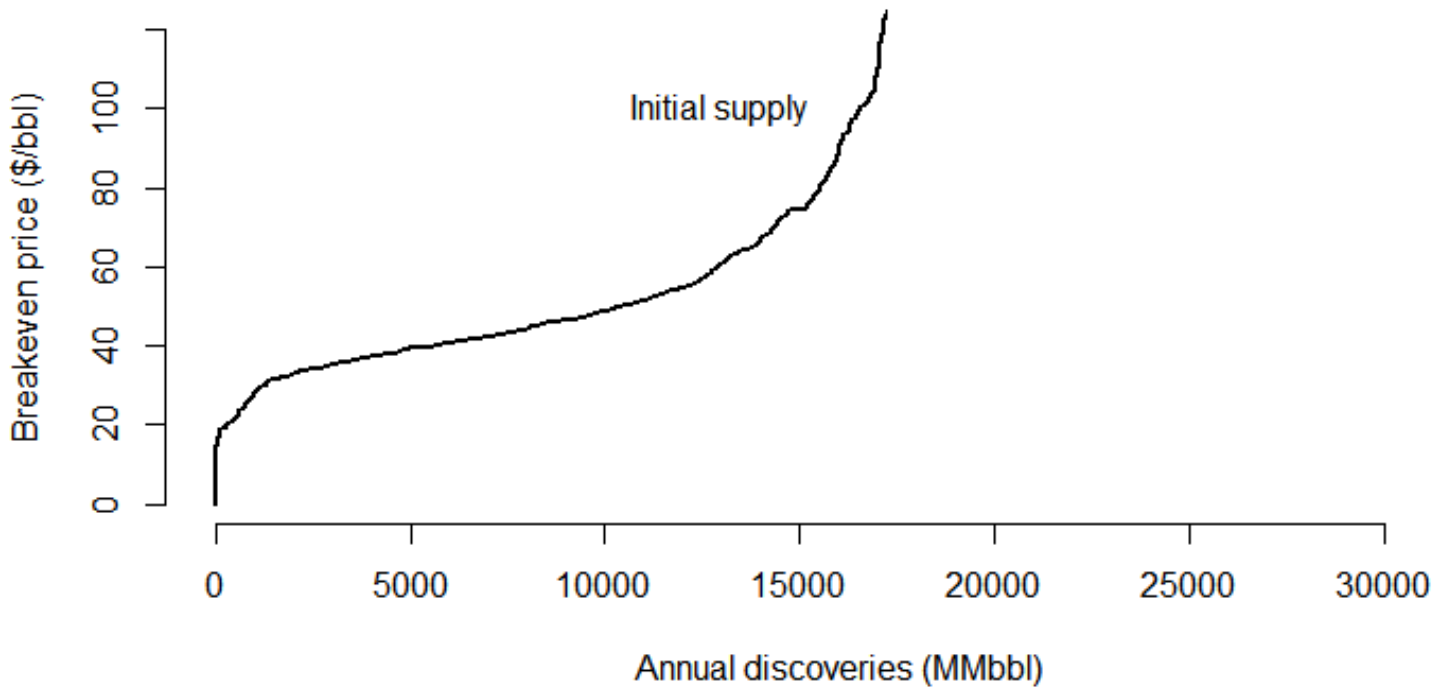
Quantification

- What is the impact of unilateral policies on global emissions and tax revenues?
- What is the impact of production tax on global CO_2 emissions?
- Who pays? Tax incidence: producing companies, consumers vs. governments

Quantification: what if today's taxes were removed?

We use the estimates to quantify a model of the global oil market.

- Consider a hypothetical climate royalty surcharge that (1) replaces existing taxes, (2) is levied on new discoveries and (3) is constant



Notes: The black line denotes the original oil supply curve, the red line is the post-tax oil supply (development effect) the blue line the new supply curve with exploration when all production-based are set to zero (exploration effect). The effect is calculated based on our preferred estimate in Panel B of Table 1.

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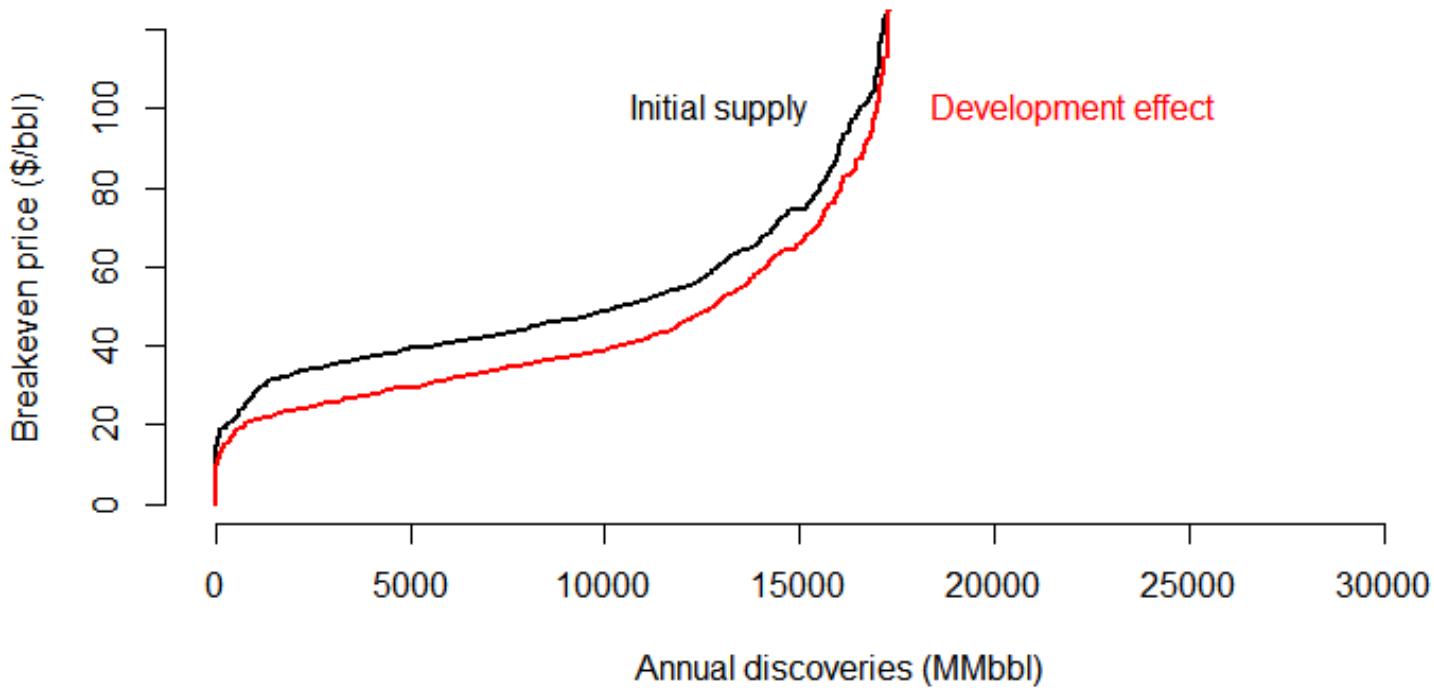

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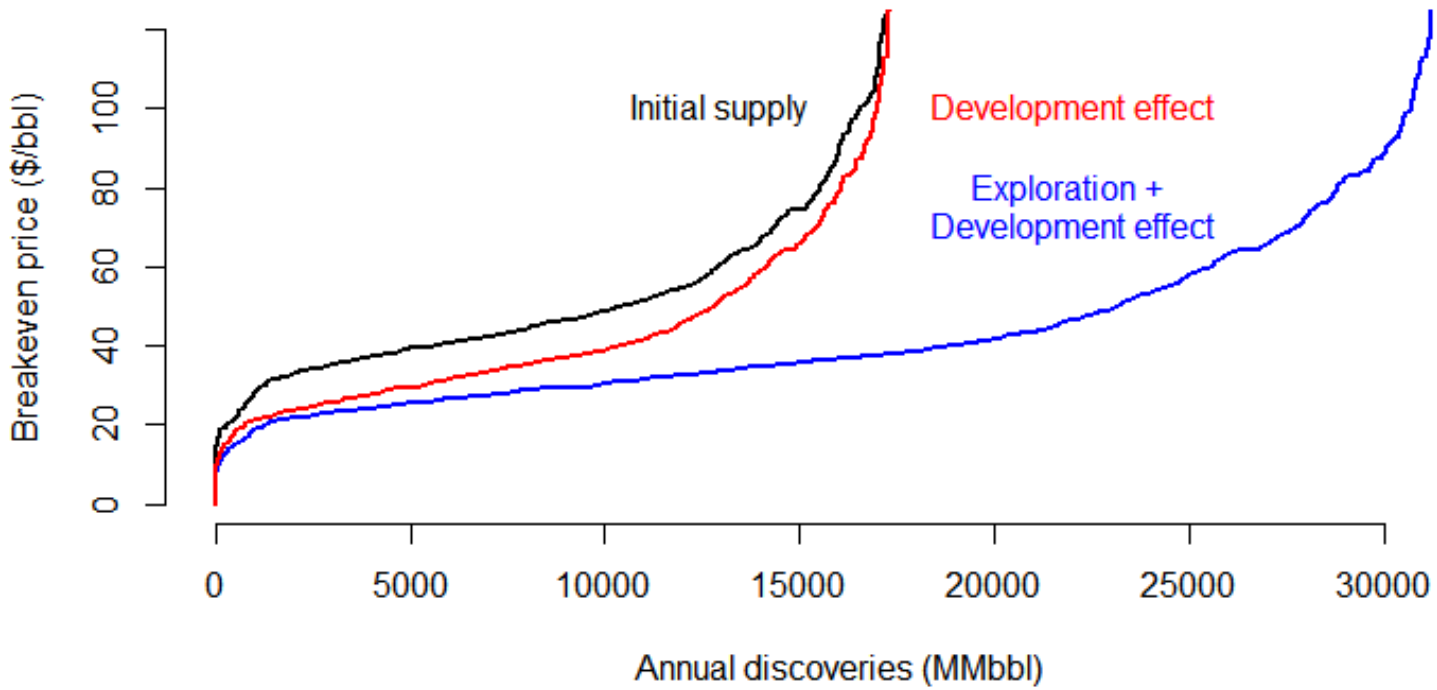

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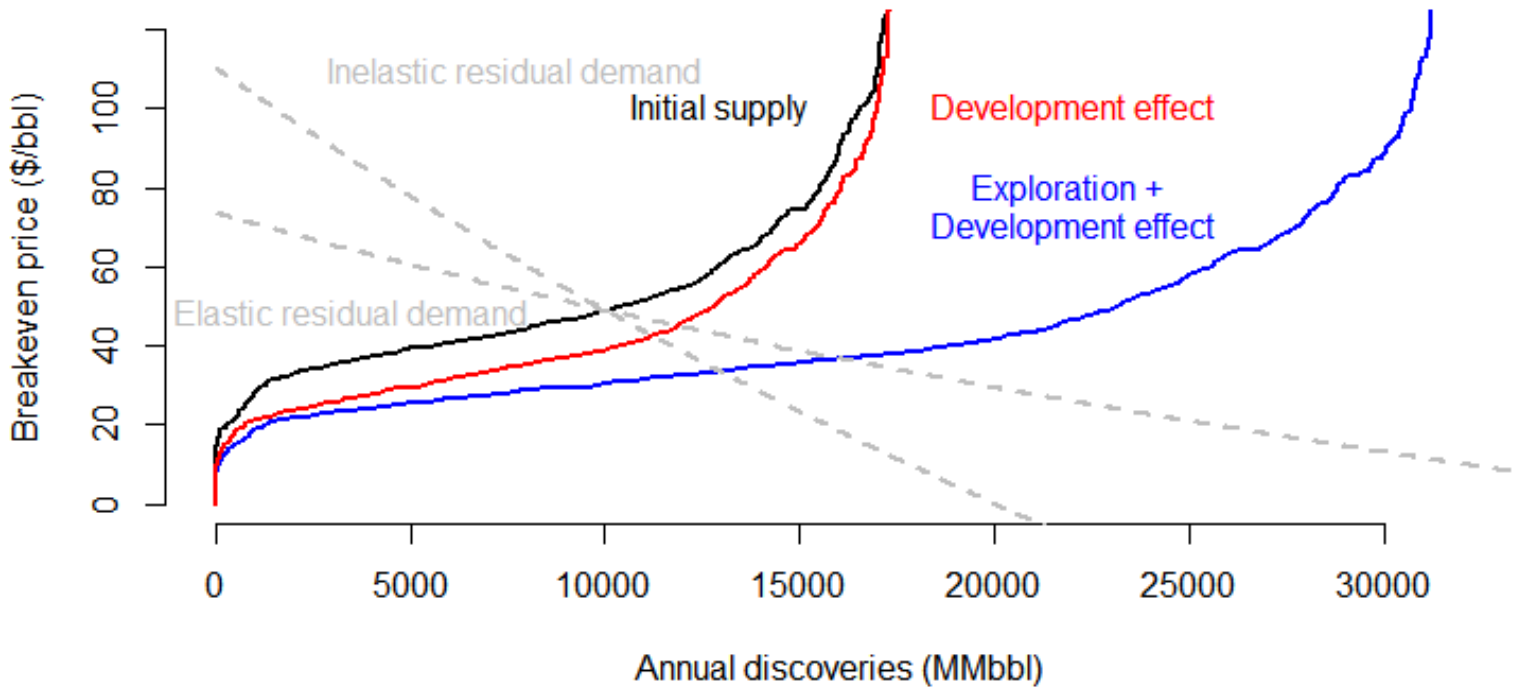

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Policy analysis 1: Unilateral policies

- How effective are unilateral policies?
  - We can quantify this based the formula (where e denotes demand and supply elasticities): $-e_D/(-e_D + e_S)$

    Result 5: Global effect is $9 - 20\%$ of the local production cut

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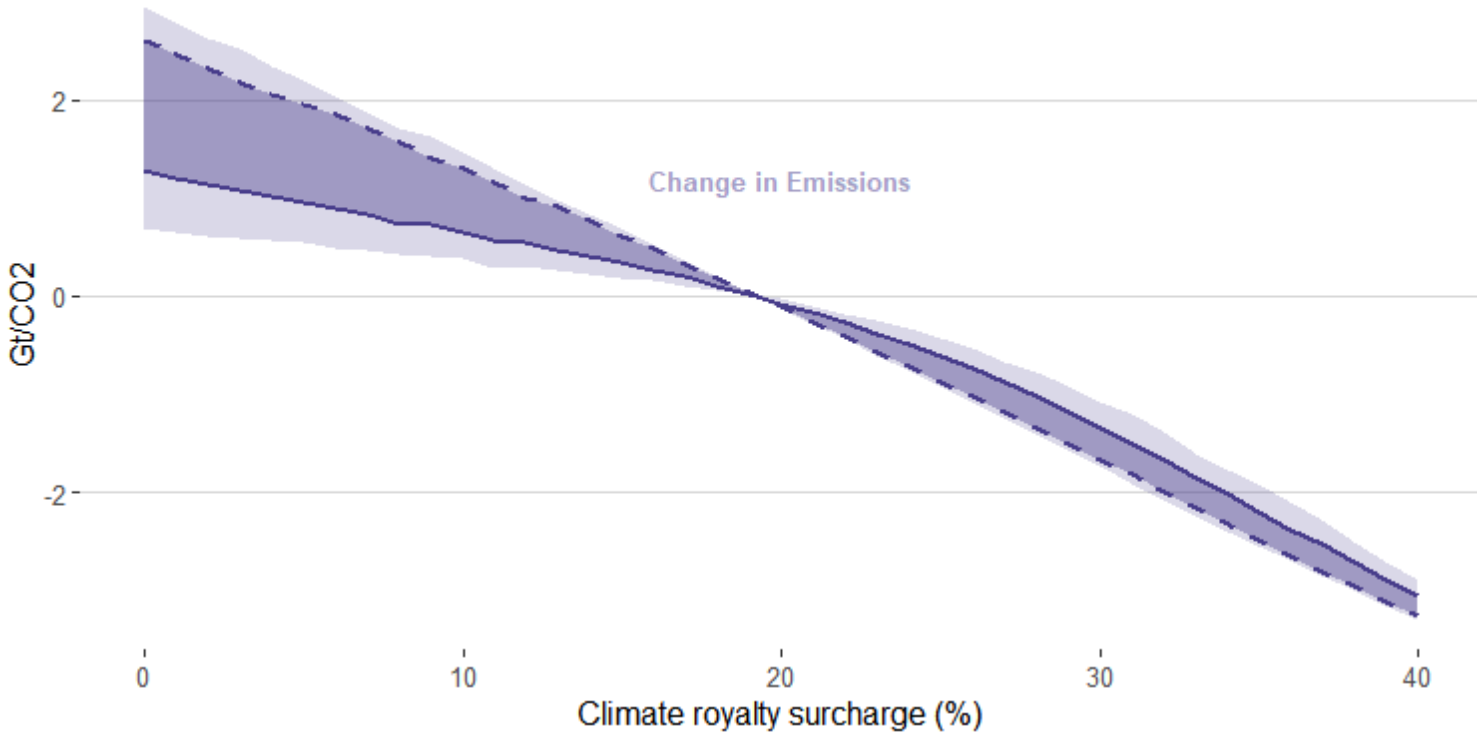
    Result 5: Global effect is $9 - 20\%$ of the local production cut

- What is the tax-revenue maximizing constant royalty rate r set to new production $Q(r)$ when price p is fixed?
  - The top of the Laffer curve is at minus one over the semi-elasticity of discoveries (e.g. Mooij and Ederveen, 2008)

    Result 6: Tax revenue maximized at 22.8%, on par with today's royalties

Policy analysis 2: Coordinated policy, emissions

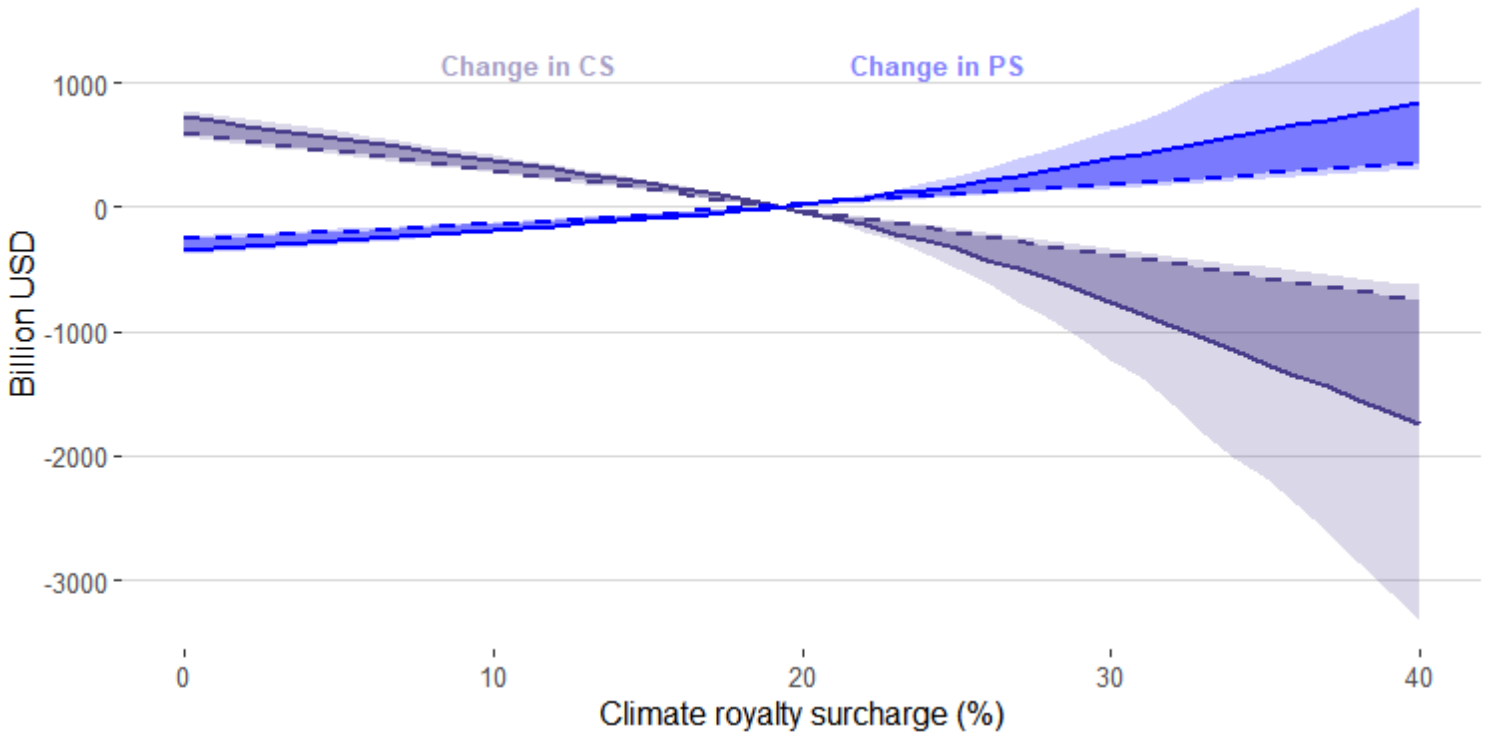
Result 7: Current taxes reduce emissions by 1.3-2.6GtCO$_2$ (4-7% relative to today's annual emissions), 1pp increase reduces emissions by 0.16GtCO$_2$



Notes: The figure shows the welfare effects relative to today's level of varying the uniform global climate royalty surcharge rate. Dark shaded areas show higher and lower bounds for elasticities; -0.2 (solid line) and -0.5 (dashed line). Light shaded areas show a wider range from -0.1 to -0.6. Panel A: Emissions are the embedded CO_2-emissions in oil production annually.

Policy analysis 2: Coordinated policy, incidence

Result 8: Higher taxes transfer rents from consumers to producers



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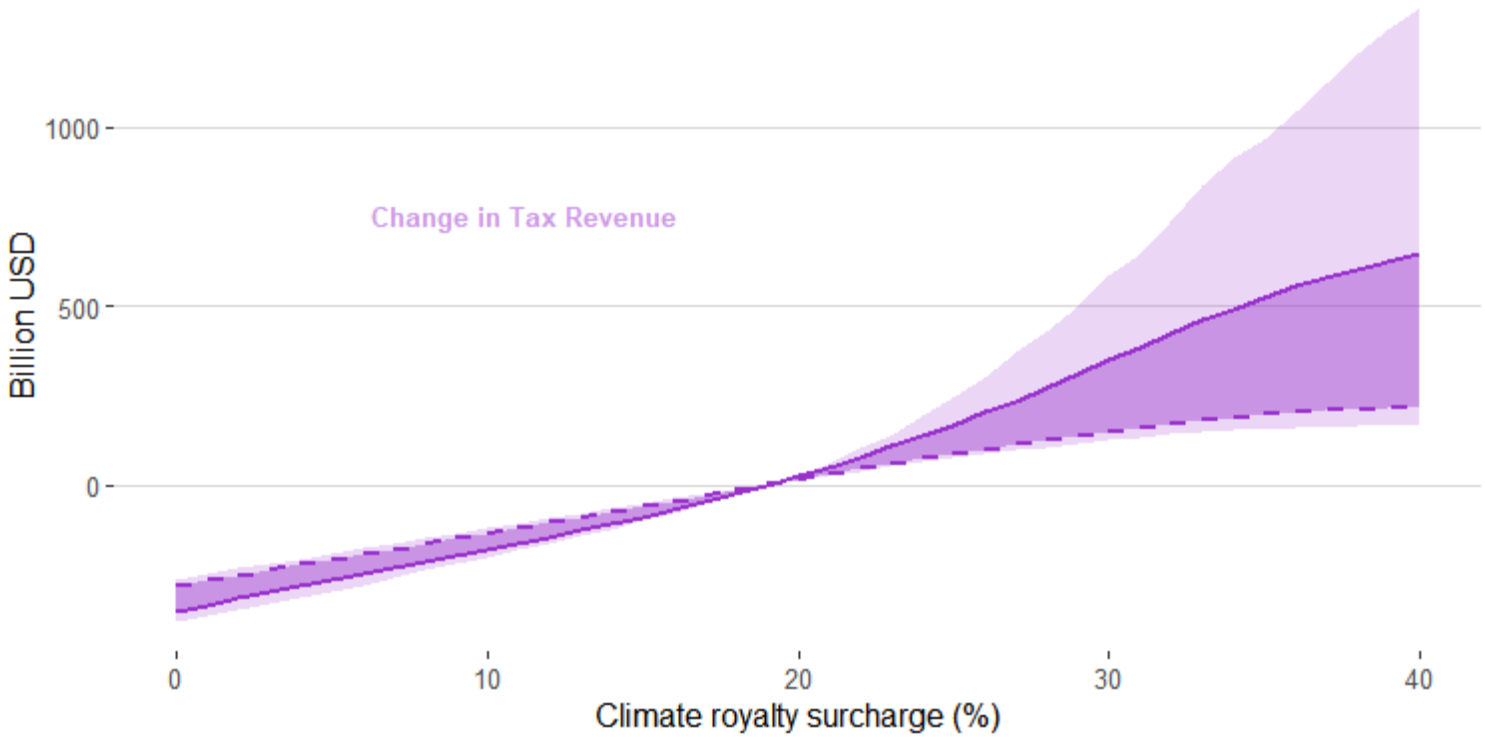
Policy analysis 2: Coordinated policy, tax revenues

Result 9: Higher taxes have potential to increase tax revenue and soften the hit of demand-reducing climate policies



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Thank you