

# Do market-based climate policies affect economic growth?

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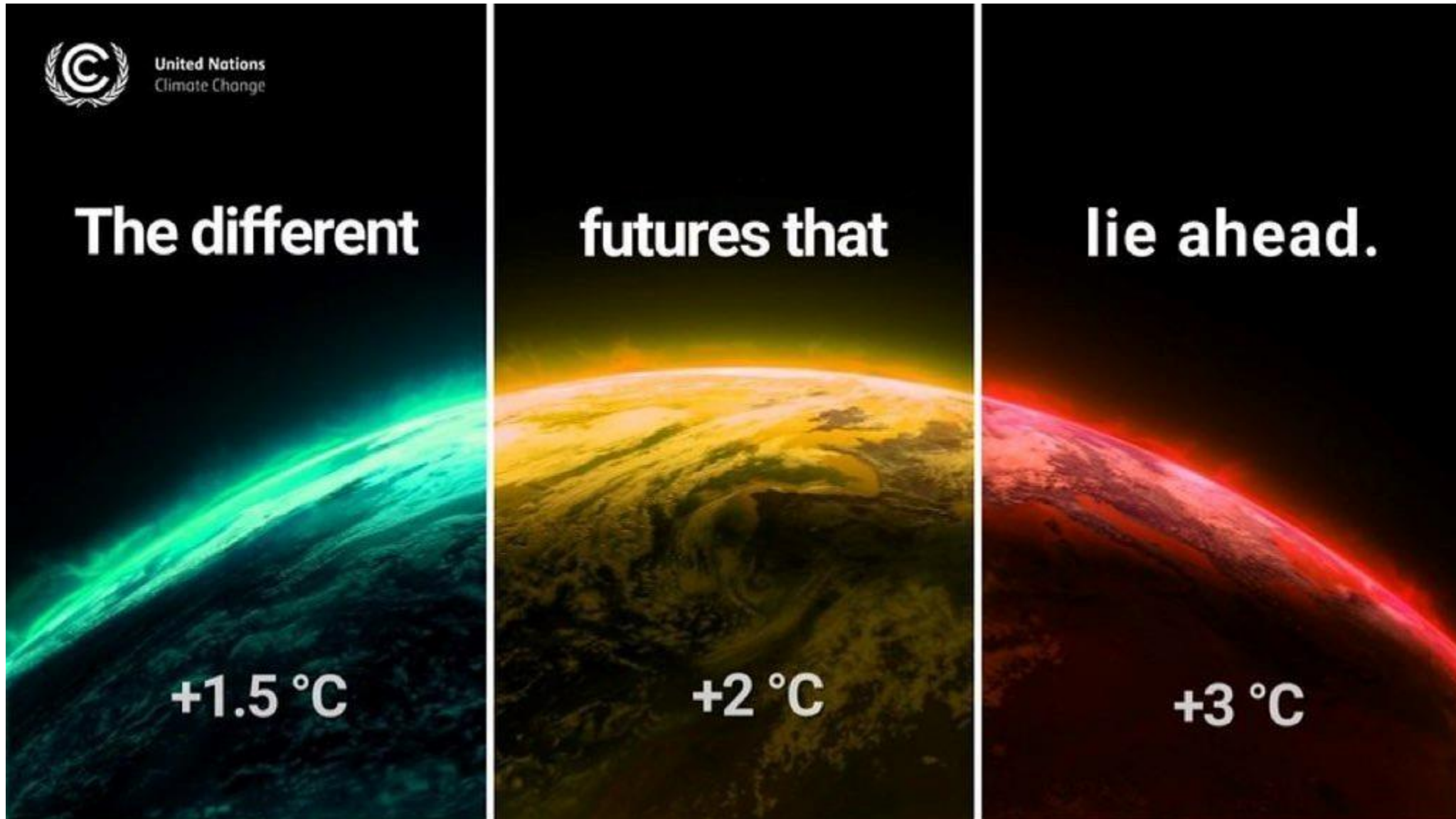
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# Climate change is a global emergency



## There are actions ...

- Countries are acting on this challenge under the UNFCCC framework through their nationally determined contributions (NDCs).
- Climate laws and policies provide the legal mandates and / or guideline to implement different mitigation and adaptation strategies.
- The aim of climate policy is to determine an efficient balance between the cost of GHG abatement today and the benefits of reduced climate damages in the future (Nordhaus 2007; Stern et al. 2006; Weitzman 2007).
- As of 02/28/2023, there are 3,124 climate laws and policies in 196 countries / constituencies.
- Since enactment and enforcement of climate laws and policies are expensive, they are economic decisions that should be based on robust benefit-cost analysis.

## Economic analysis is important because ...

Bolsonaro had promised to pull Brazil out of the Paris climate accord, dismantle the environment ministry and reduce the extent of protected areas if he won.

Liz Truss tabled the “*Retained EU Law (Revocation and Reform)*” bill to revoke ~570 key pieces of environmental legislation which were rolled over following Brexit.



“*My view is that we don't know what's causing climate change on this planet. And the idea of spending trillions and trillions of dollars to try to reduce CO2 emissions is not the right course for us.*”

Mitt Romney  
Former governor of Massachusetts  
and former U.S. presidential candidate

Environmental policy failures  
contributed to Sri Lanka's people  
power revolution

# Big Question

- Do climate laws and policies
  - provide the benefits that they are intended for? and
  - do they do so without unintended externalities?

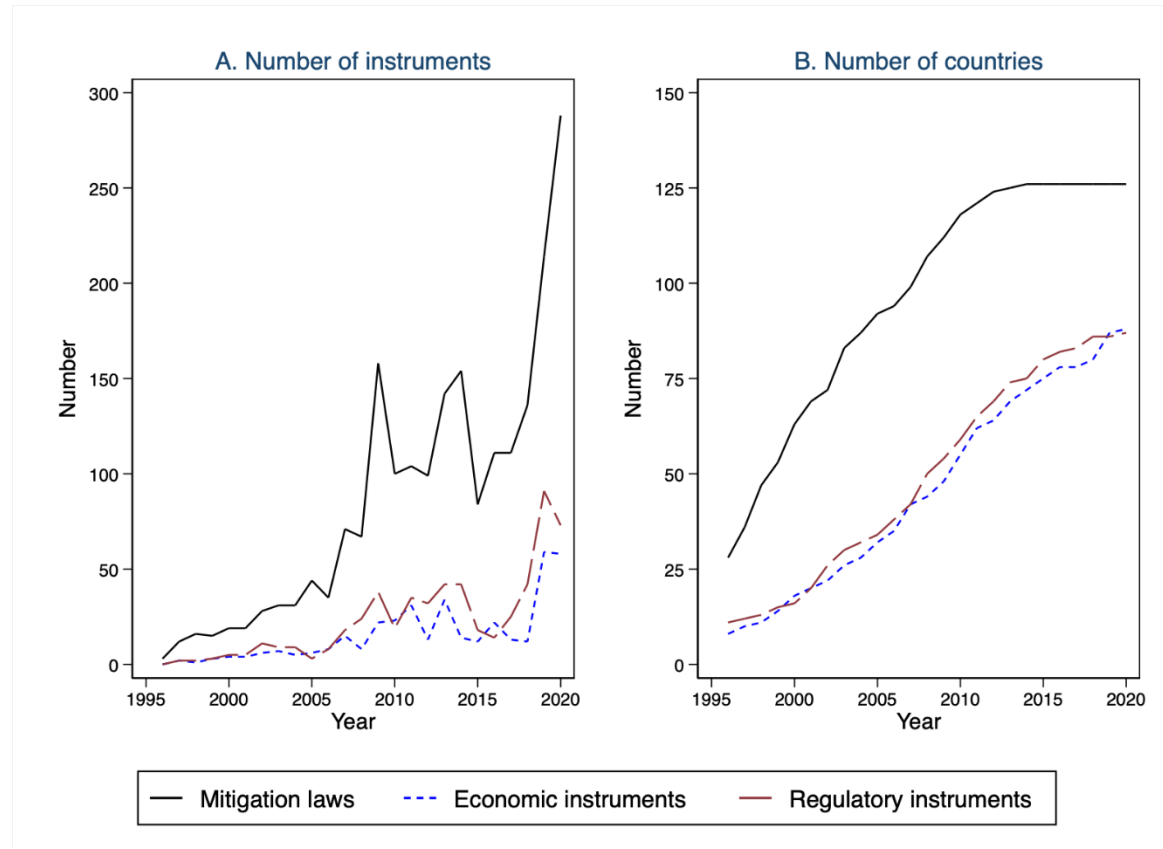
## Our contributions

- **Question 1:** Do climate laws reduce emissions?
- **Question 2:** Do they create / increase carbon leakage?
- **Question 3:** Do they affect economic growth?

### Q3. Do they affect economic growth?

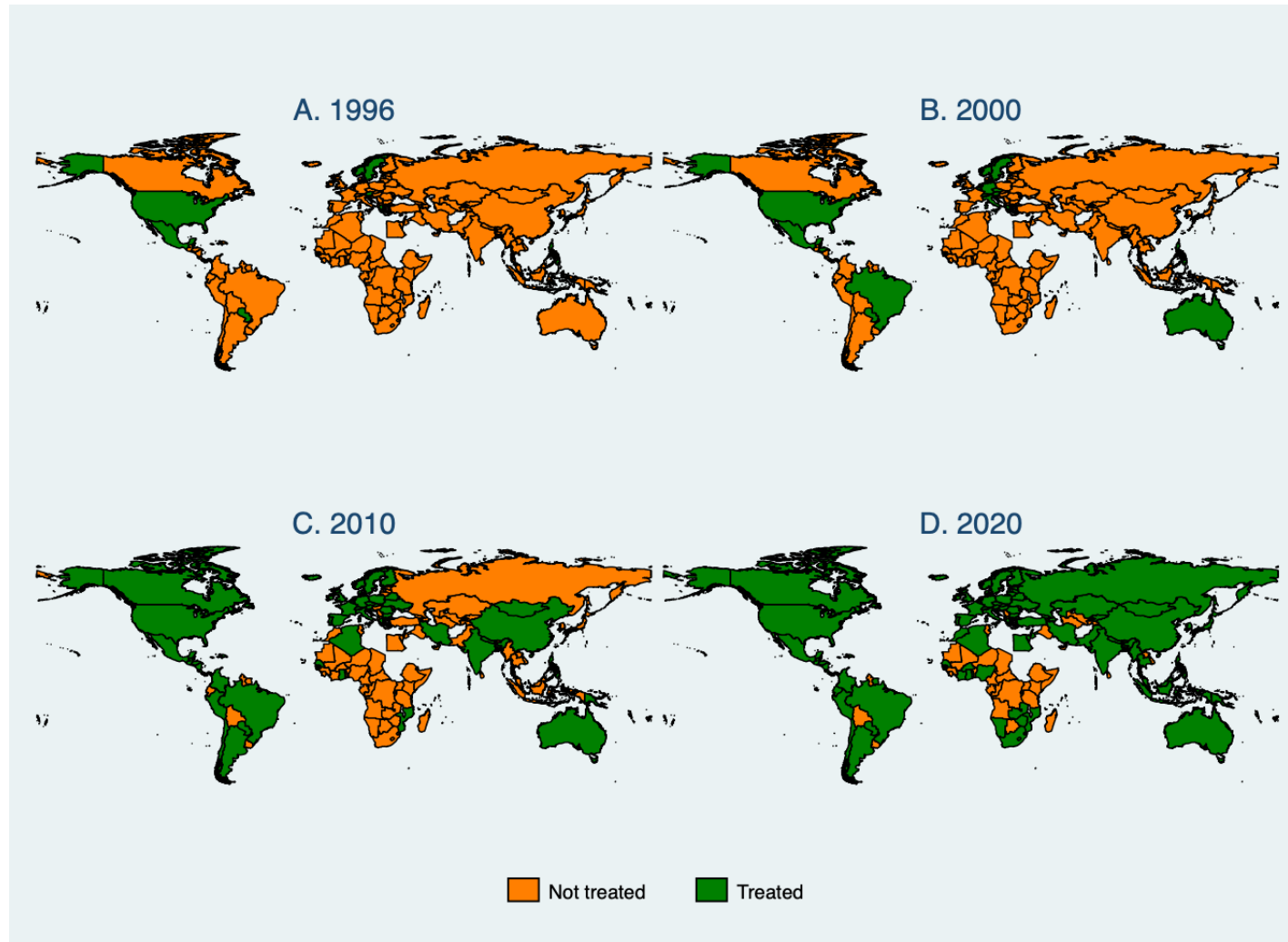
- We are currently investigating this climate-economy debate.
  - 126 countries over 1996-2020
  - open-access data from “Climate Change Laws of the World”, “Global Carbon Budget”, “World Development Indicators”, and “Worldwide Governance Indicators”.
- Only considered the extensive margins: number of laws and instruments.

# Climate instruments





# Climate instruments



# Hypothesis

- **Hypothesis:** Climate policies deter economic growth.
- Economic growth can be affected, positively or negatively, by different market- and non-market-based instruments that are embodied in enacted climate laws and policies, rather than by laws themselves.
- Different countries are treated at different time, and they also have different stock of climate legislations.
- Policies and instruments take time to be effective, they need to be lagged by one year since they take time to become effective.
- Implementation and enforcement of climate instruments is inherently aligned with institutional quality of the implementing country. That is, climate instruments adopted by effective governments will have a higher real-world impact than those adopted by ineffectual governments (Eskander and Fankhauser 2020).

# Climate instruments

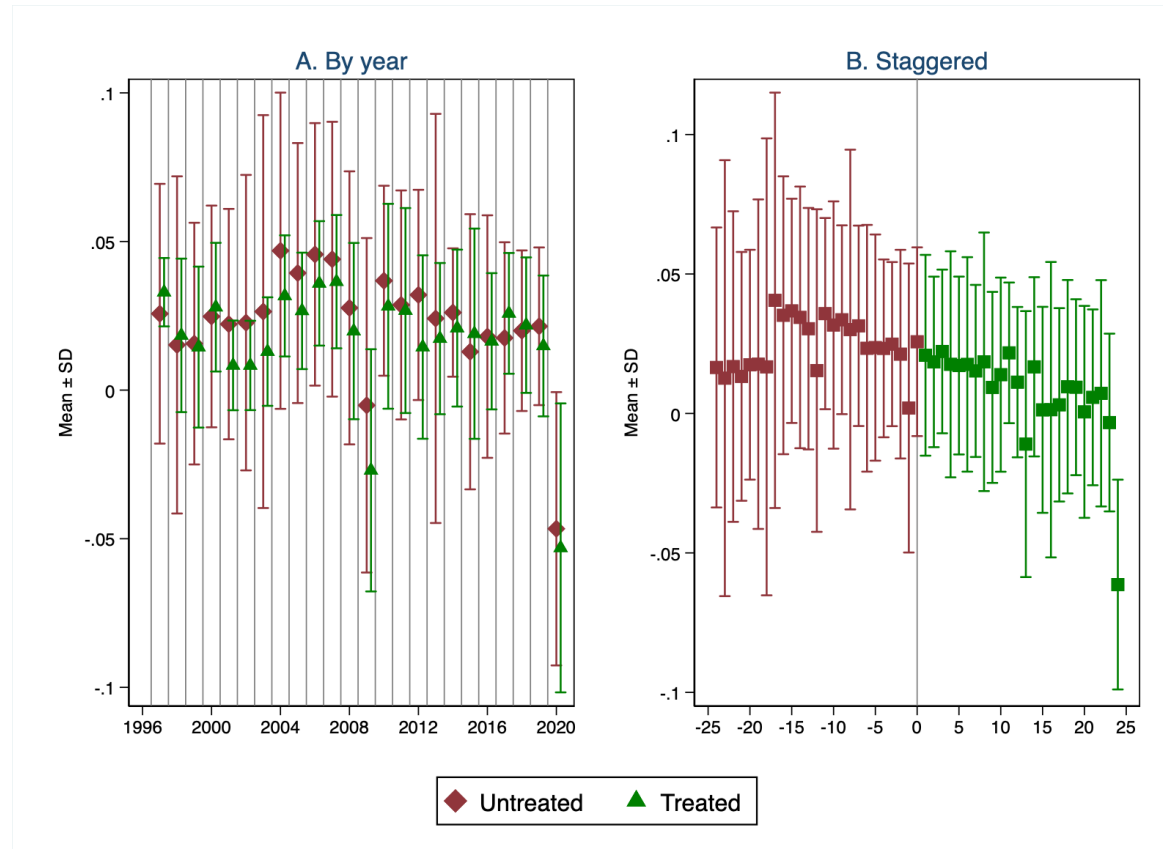
## Market-based instruments:

- Economic instruments
  - Subsidies; Tax incentives; Carbon pricing & emissions trading; Insurance; Climate finance tools; Other
- Investment instruments
  - Provision of climate funds; Nature based solutions and ecosystem restoration; Provision of climate finance; Green procurement; Early warning systems; Other

## Non-market instruments:

- Governance instruments
  - Capacity building; Institutional mandates; Planning; Processes, plans and strategies; MRV; Subnational and citizen participation; International cooperation; Other
- Regulatory instruments
  - Standards, obligations and norms; Disclosure obligations; Moratoria & bans; Zoning & spatial planning; Other
- Information instruments
  - Education, training and knowledge dissemination; Research & Development; knowledge generation

# Growth and Climate instruments



## Empirical specification

- Since the adoption and implementation of climate instruments is a dynamic process and countries start these interventions at a flexible point in time, we adopt a generalized difference-in-difference framework (Beck *et al.* 2010; Chen *et al.* 2021):

$$\ln \frac{y_{it}}{y_{it-1}} = \beta_0 + (\beta_1 - 1) \ln y_{it-1} + \beta_2 L_{it-1} + Z'_{it} \gamma + \delta_i + \delta_t + \epsilon_{it}$$

- $y_{it}$  denotes the per-capita real GDP (2015 US\$) in country  $i$  in year  $t$ .
- $\hat{\beta}_2 \gtrless 0 \Rightarrow$  economic instruments increase/ do not affect / decrease growth

## Empirical specification

- The vector  $Z_{it}$  includes the usual control variables: measures of investment, inflation, terms of trade, population growth, human capital.
  - and the stock of regulatory instruments
- The model is completed by a full set of country and year fixed effects ( $\delta_i$  and  $\delta_t$ ) and the idiosyncratic error term  $\epsilon_{it}$ .
- We adopt:
  - Generalized Methods of Moment (GMM) estimation strategy

# Main results

## Economic instruments

insignificant effects on GDP growth

Variables	(1) Entire economy	(2) Agriculture	(3) Services	(4) Manufacturing
D(Economic instruments) (-1)	<b>-0.0000</b> (0.0319)	<b>-0.0596</b> (0.1218)	<b>-0.0354</b> (0.0608)	<b>0.2514**</b> (0.1189)
Institutional quality index	0.1584* (0.0931)	0.1224 (0.3562)	-0.1667 (0.1729)	0.4679 (0.3628)
Log of real GDP per capita (-1)	-0.0413** (0.0167)	-0.0114 (0.0399)	0.0276 (0.0304)	-0.1235 (0.0797)
Investments	0.0019*** (0.0006)	-0.0009 (0.0019)	0.0013 (0.0010)	0.0047** (0.0019)
Inflation	-0.0001 (0.0001)	-0.0002 (0.0003)	-0.0003** (0.0001)	0.0009** (0.0004)
Growth rate of terms of trade	-0.0736 (0.0624)	-0.5407 (0.3400)	-0.3889** (0.1633)	-0.6450* (0.3638)
Log of fertility rate	-0.0553** (0.0253)	0.0010 (0.0562)	0.0126 (0.0327)	-0.1035 (0.1447)
Human capital	-0.0007 (0.0028)	-0.0048 (0.0086)	0.0045 (0.0046)	-0.0121 (0.0122)
Stock of regulatory instruments	0.0003 (0.0012)	0.0002 (0.0029)	0.0012 (0.0022)	-0.0033 (0.0043)
Constant	0.2269* (0.1243)	0.1367 (0.2639)	-0.2361 (0.2139)	0.6289 (0.6469)
No. of Obs.	3,024	3,024	3,024	3,024
No. of years	24	24	24	24
No. of countries	126	126	126	126
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Hansen test p-value	0.186	0.0815	0.187	0.852
Hansen test df	11	11	11	11
No. of instruments	44	44	44	44

Notes: Robust SE clustered at country level in parentheses. \*\*\*, \*\* and \* represent statistical significance at 1, 5 and 10 percent levels.

Dependent variable: real GDP per-capita growth. Year and country FEs are included. In GMM, all variables, except growth of terms of trade and the year effects are instrumented with 2 further lags.

# Mechanisms

	(1)	(2)	(3)	(4)	(5)
	Energy intensity	Exports		Patents	
		% of GDP	Total	Climate patents	Energy patents
D(Economic instruments) (-1)	<b>-2.05***</b> (0.12)	<b>3.63***</b> (0.76)	<b>184.92***</b> (13.37)	<b>339.25***</b> (55.93)	<b>125.84***</b> (21.37)
Constant	6.31*** (0.10)	34.33*** (0.43)	54.56*** (3.14)	79.13*** (13.27)	34.90*** (6.42)
No. of Obs.	2,520	3,024	3,024	1,824	1,824
No. of years	24	24	24	24	24
No. of countries	120	126	126	76	76
R <sup>2</sup>	0.08	0.01	0.09	0.02	0.02

Notes: Robust standard errors are shown in parentheses. \*\*\*, \*\* and \* represent statistical significance at 1, 5 and 10 percent levels, respectively. Dependent variables are described in column headings. All regressions follow a simple OLS specification.



## Do they affect anything?

- **Emissions reduction effects**

Variables	(1) Intensity	(2) Growth
D(Economic instruments) (-1)	<b>-0.0245**</b> (0.0096)	<b>-0.0153***</b> (0.0048)
Institutional quality index (-1)	-0.0810 (0.1074)	-0.0003 (0.0544)
HP Filter (-1)	0.5310*** (0.1791)	0.1709 (0.1195)
Log of real GDP per capita (-1)	0.2528* (0.1363)	0.1365** (0.0626)
Squared log of real GDP per capita (-1)	-0.0443*** (0.0072)	-0.0047 (0.0037)
Import (-1)	0.0005 (0.0005)	-0.0000 (0.0002)
Manufacturing (-1)	0.0055** (0.0024)	-0.0008 (0.0007)
Services (-1)	-0.0001 (0.0009)	-0.0000 (0.0006)
Constant	1.5741** (0.6439)	-0.7999*** (0.2724)
No. of Obs.	2,806	2,806
No. of years	23	23
No. of countries	122	122
R <sup>2</sup>	0.9214	0.1275
Year FE	YES	YES
Country FE	YES	YES

*Notes:* Robust/Corrected standard errors clustered at country level are shown in parentheses. \*\*\*, \*\* and \* represent statistical significance at 1, 5 and 10 percent levels, respectively. Dependent variables are described in column headings. All regressions follow a two-way fixed effects specification which includes year and country fixed effects.

## Additional checks?

- We did / tried:
  - Deeper lags (i.e., Lags 2 and 3) on instruments and institutional quality variables
  - Two-stage DiD
  - Results for mitigation laws
  - GDP instead of GDP growth
  
- Potential extensions:
  - Intensive margins
  - Suggestions?

# Q&A

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Thanks for your patience!!