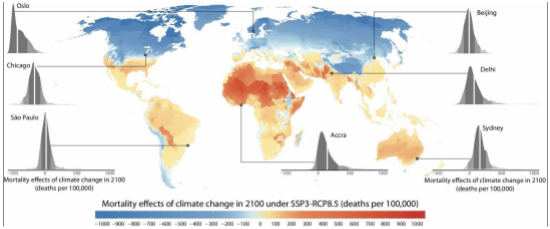
Innovation and Climate Change

Robin Burgess (LSE and IGC)

BRAC, August 16th, 2023

Two major global challenges

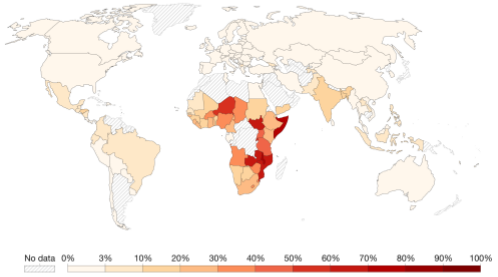
1. Eliminating extreme poverty
2. Confronting climate change
   - The problem is that climate change may make the elimination of extreme poverty more difficult.
   - The global challenge of the century, therefore, is to achieve a balance between growth and the externalities from growth.
   - Today, I will be looking at three areas of policy innovation that might help us achieve this balance:
     1. Climate justice
     2. Smart conservation
     3. Clean energy



Share of population living in extreme poverty, 2019

Our World in Data

Extreme poverty is defined as living below the International Poverty Line of $2.15 per day. This data is adjusted for inflation and for differences in the cost of living between countries.



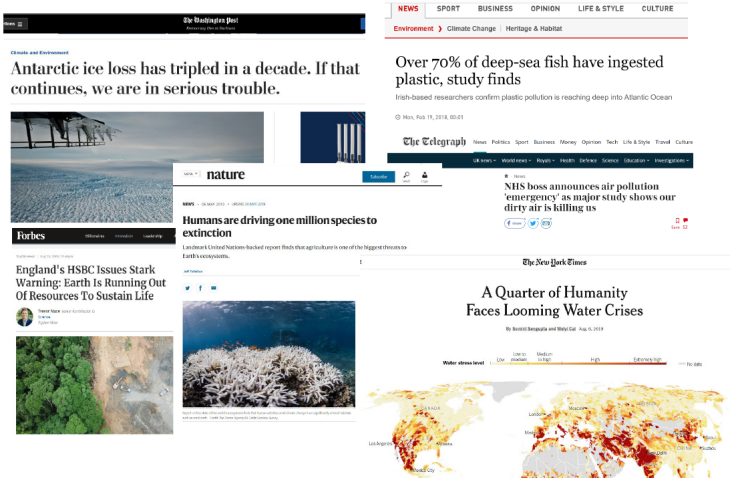
Source: World Bank Poverty and Inequality Platform (2022)

OurWorldInData.org/poverty • CC BY

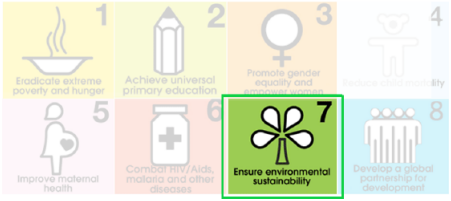
Note: This data is measured in international-$[1] at 2017 prices. Depending on the country and year, it relates to income measured after taxes and benefits, or to consumption, per capita[2].

1. International dollars: International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living

Defining the Problem



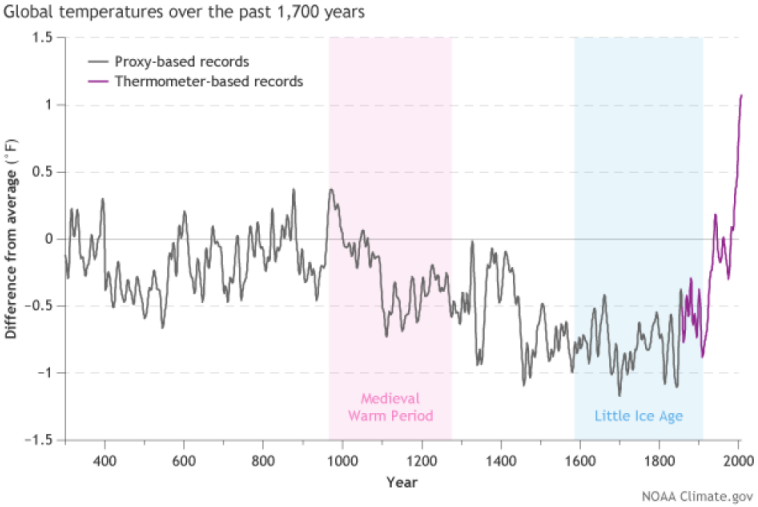
Defining the Problem



MDGs
2000

SDGs
2015

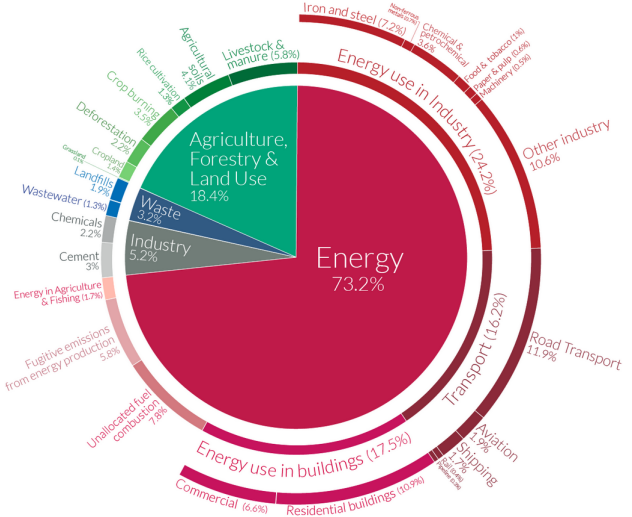
Defining the Problem



Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.

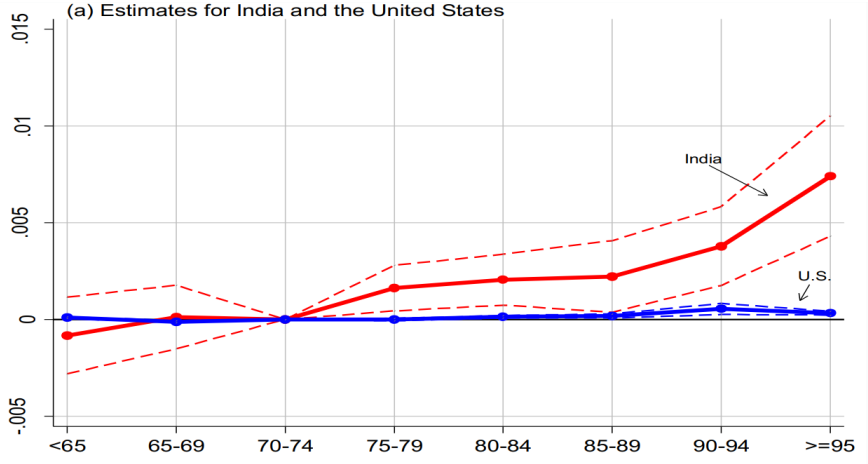
Our World in Data



OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).

Climate Justice

Figure: Estimated Impact of Daily Temperature on Log All-Age Mortality Rates (Burgess et al. 2023)

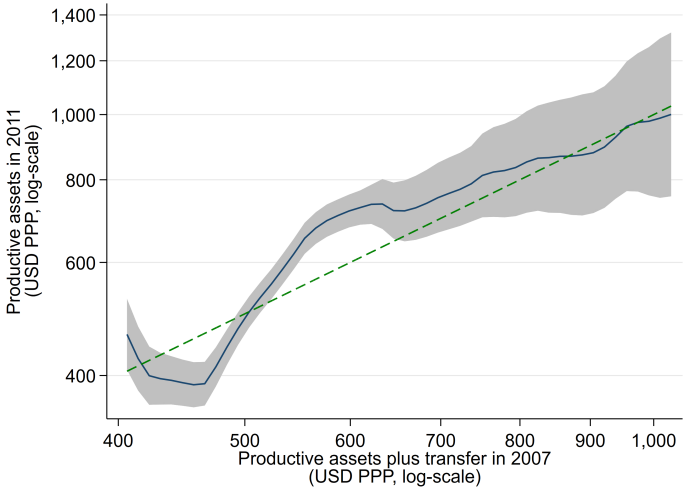


Climate Justice

- Clare Balboni (LSE), Oriana Bandiera (LSE), Robin Burgess (LSE), Maitreesh Ghatak (LSE), Anton Heil (LSE). Why Do People Stay Poor?. The Quarterly Journal of Economics, 2022
- Oriana Bandiera (LSE), Robin Burgess (LSE), Narayan Das (BRAC), Selim Gulesci (Bocconi), Imran Rasul (UCL), Munshi Sulaiman (BRAC). Labor markets and poverty in village economies. The Quarterly Journal of Economics, 2017

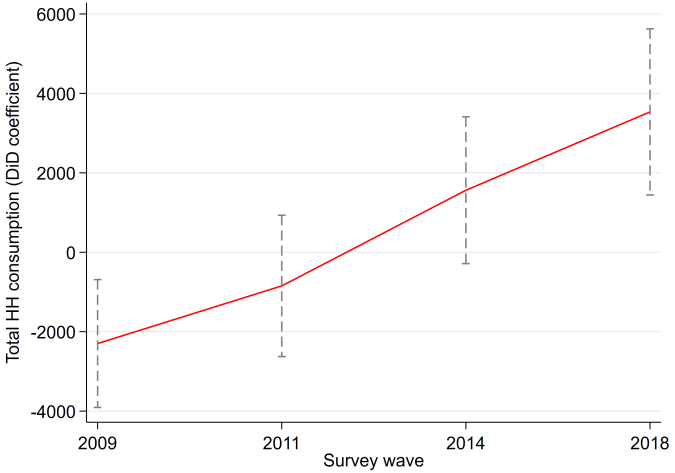
Climate justice

Figure: Estimated Transition Equation (Balboni et al. 2022)



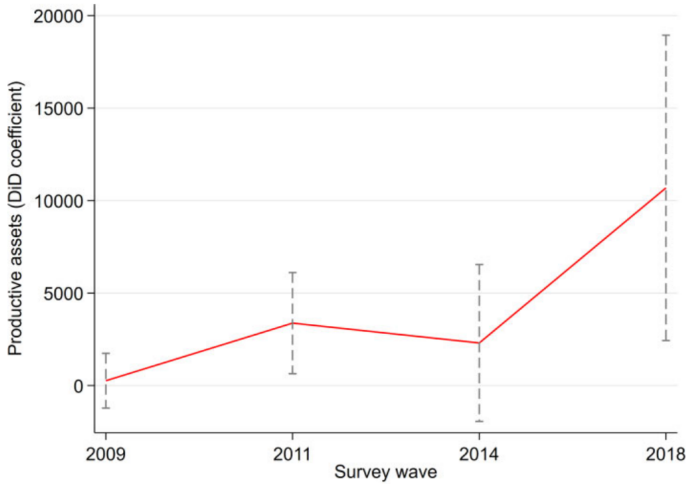
Climate justice

Figure: Estimated Total Consumption in the Long-run (Balboni et al. 2022)



Climate justice

Figure: Estimated Productive Assets in the Long-run (Balboni et al. 2022)

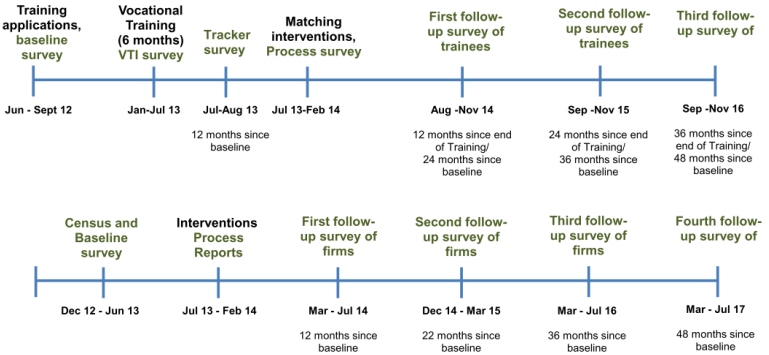


Climate Justice

- Livia Alfonsi (UCB), Oriana Bandiera (LSE), Vittorio Bassi (USC), Robin Burgess (LSE), Imran Rasul (UCL), Munshi Sulaiman (BRAC), Anna Vitali (UCL). Tackling youth unemployment: Evidence from a labor market experiment in Uganda. Econometrica. 2020

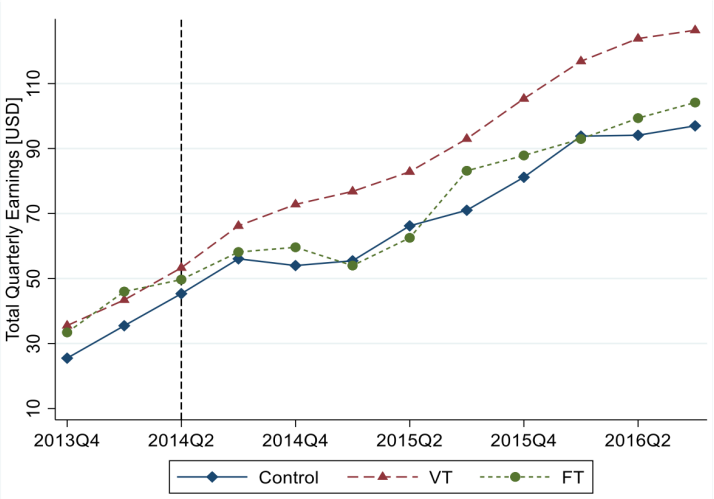
Climate justice

Figure: Timeline (Alfonsi et al. 2020)



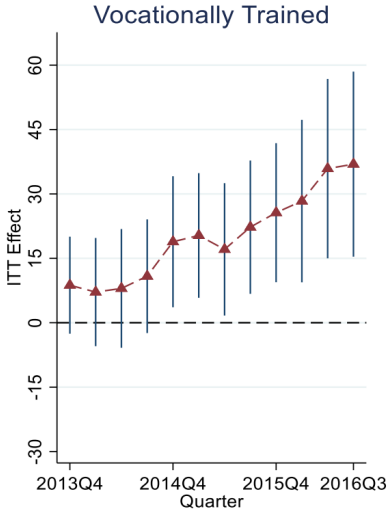
Climate justice

Figure: Total Quarterly Earnings (Alfonsi et al. 2020)



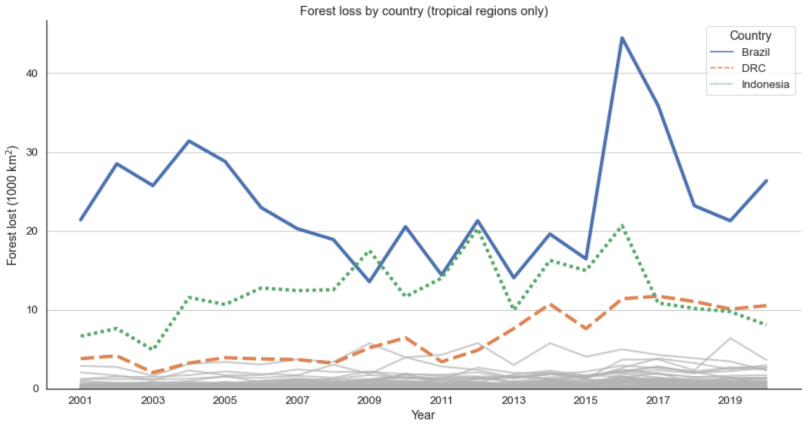
Climate justice

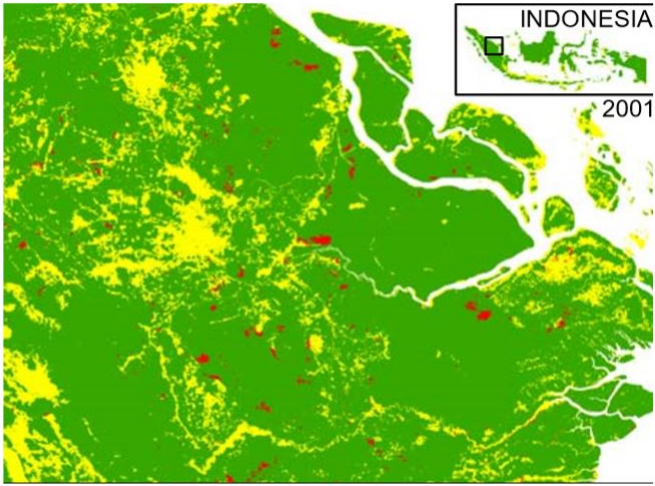
Figure: Total Quarterly Earnings (Alfonsi et al. 2020)

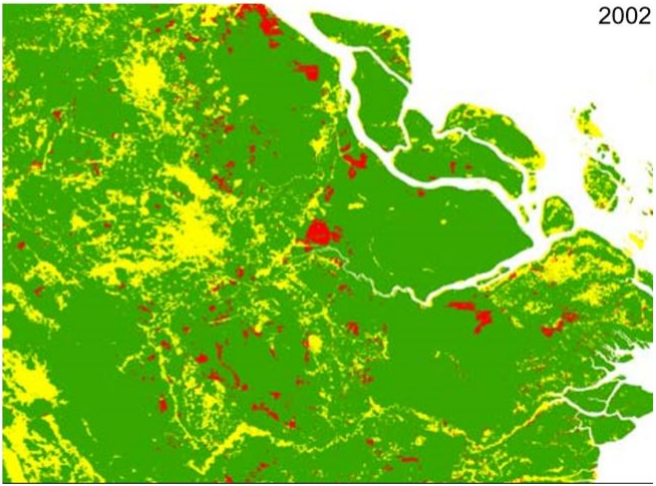


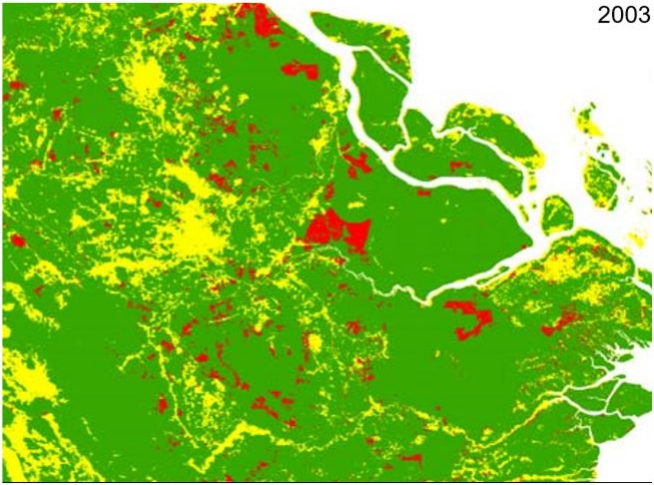
Natural capital

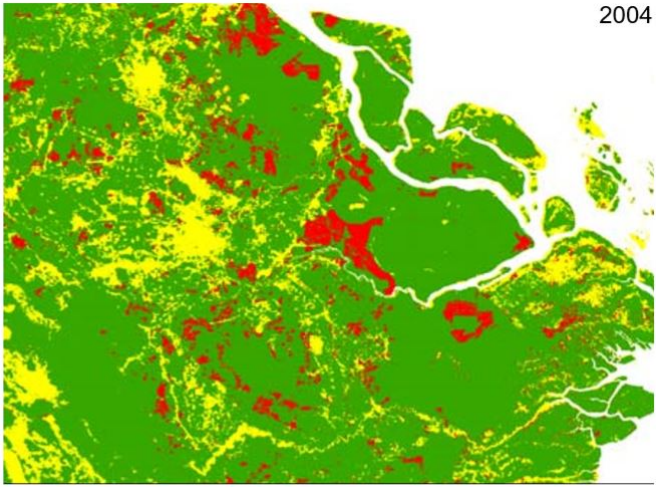
Figure: Figure: Forest loss by country (tropical regions only) (Balboni et al. 2023)

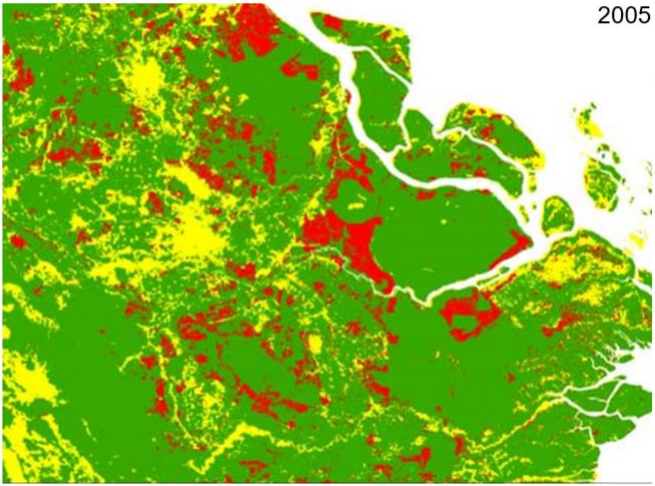


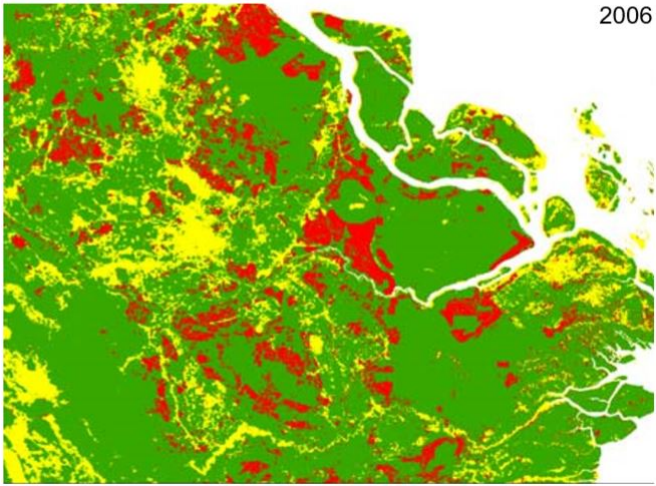

INDONESIA
2001

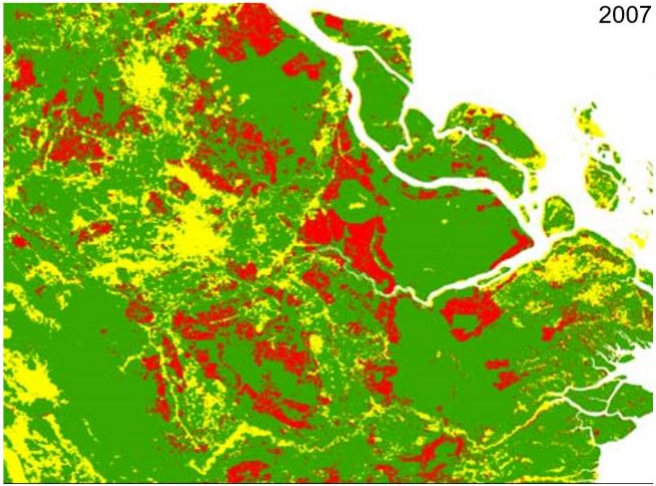

2002

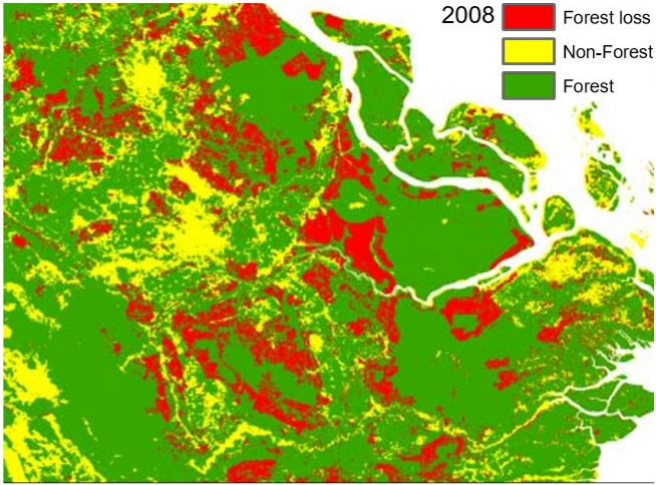

2003


2004


2005


2006


2007

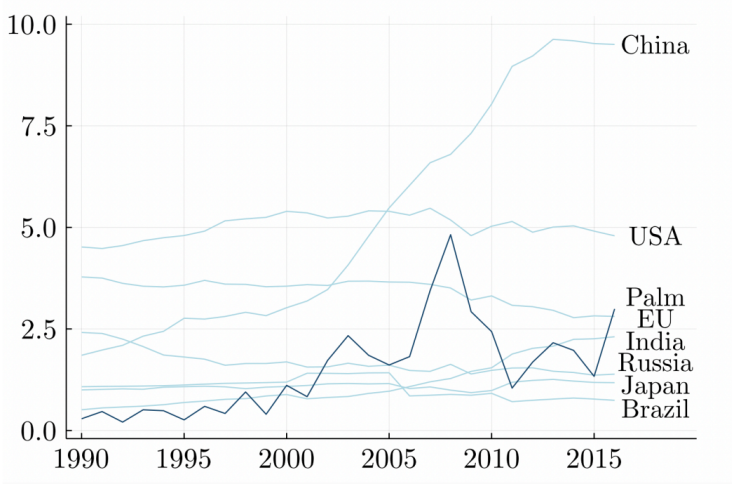

2008
Forest loss
Non-Forest
Forest

Smart conservation

- Allan Hsiao (Princeton). Coordination and Commitment in International Climate Action: Evidence from Palm Oil. R&R, Econometrica. 2023

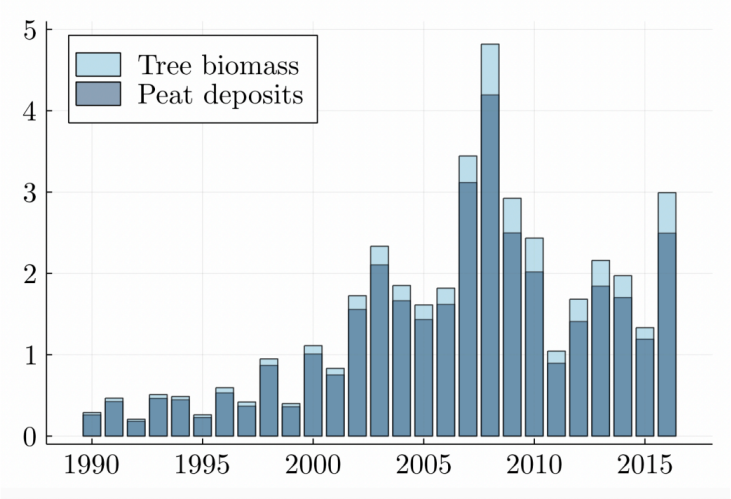
Smart conservation

Figure: Figure: Global CO2 emissions (Hsiao 2023)

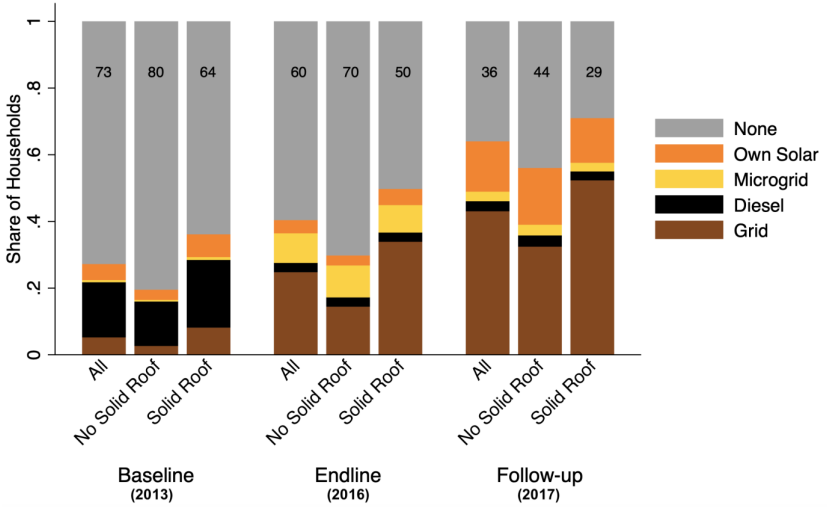


Smart conservation

Figure: Palm emissions (Hsiao 2023)

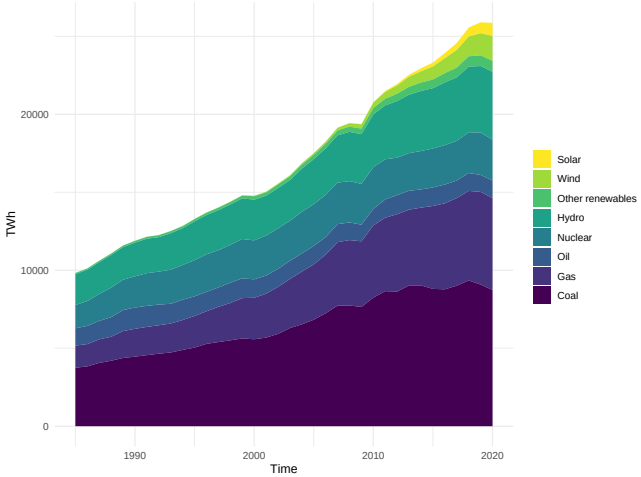


Household electricity sources over time in rural India



Renewable electricity capacity, especially solar, has grown rapidly

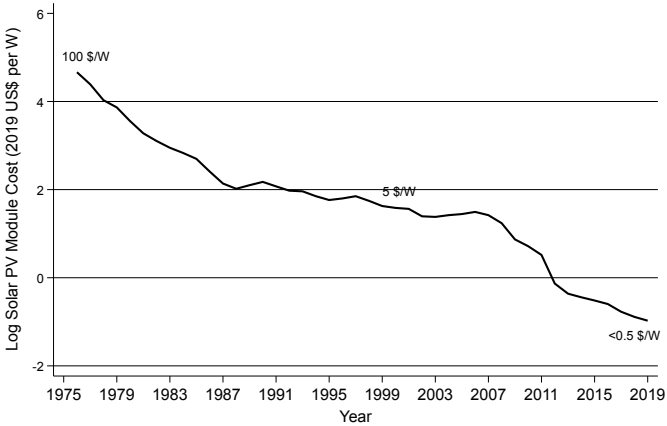
Figure: World electricity generation by source



Source: International Energy Agency (IEA)

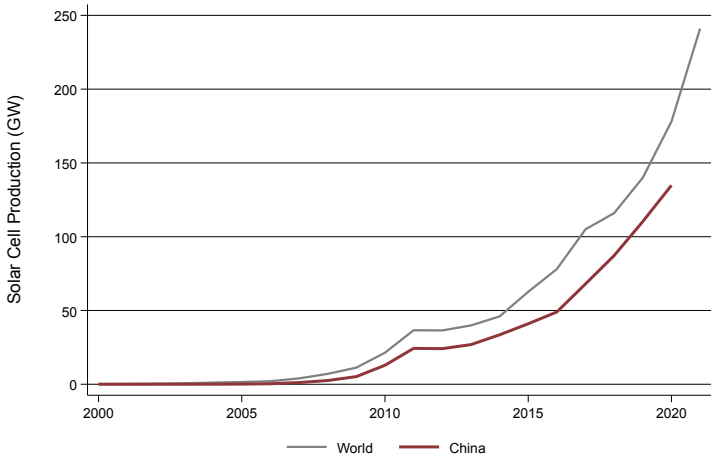
Cost of solar has fallen dramatically

Figure: Global average price of solar PV modules (in 2019 US$ per Watt)



Source: LaFond et al. (2017) & IRENA Database

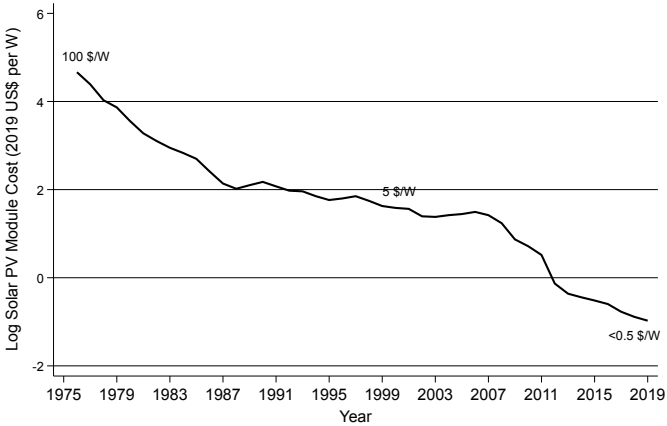
China leads worldwide solar production...



Source: IEA - Trends in Photovoltaic Applications 2022

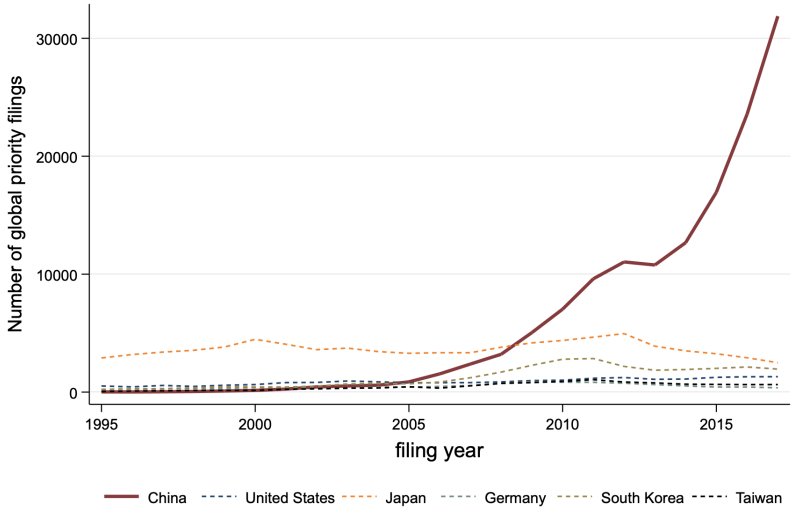
Cost of solar has fallen dramatically

Figure: Global average price of solar PV modules (in 2019 US$ per Watt)



Source: LaFond et al. (2017) & IRENA Database

... and innovation



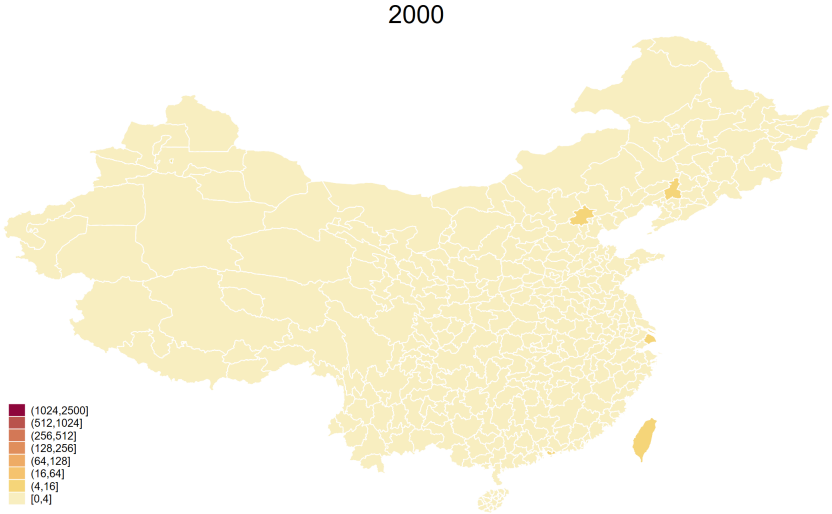
Source: PATSTAT - solar patents based on IPC/CPC codes

Clean Energy

- Ignacio Banares-Sanchez (LSE), Robin Burgess (LSE), David Laszlo (LSE), Pol Simpson (LSE), John Van Reenen (LSE & MIT), Yifan Wang (LSE). Ray of Hope? China and the Rise of Solar Energy. Working paper

Our analysis compares policy and outcomes at the city level

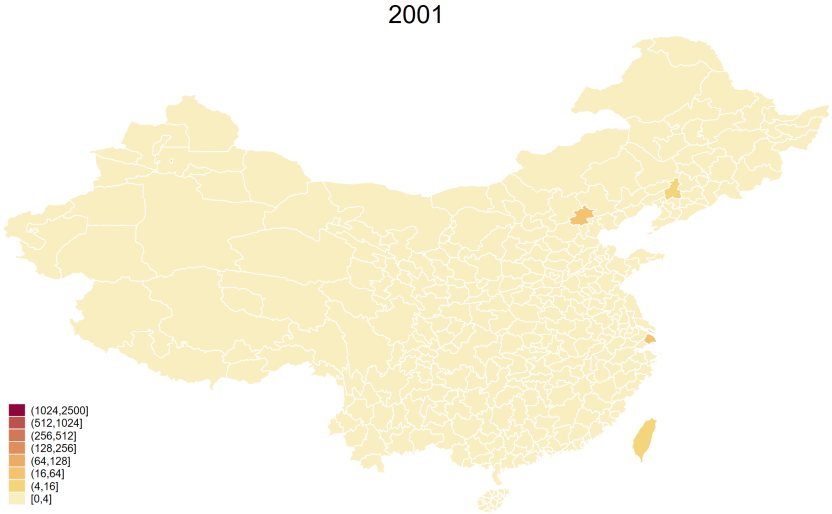
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

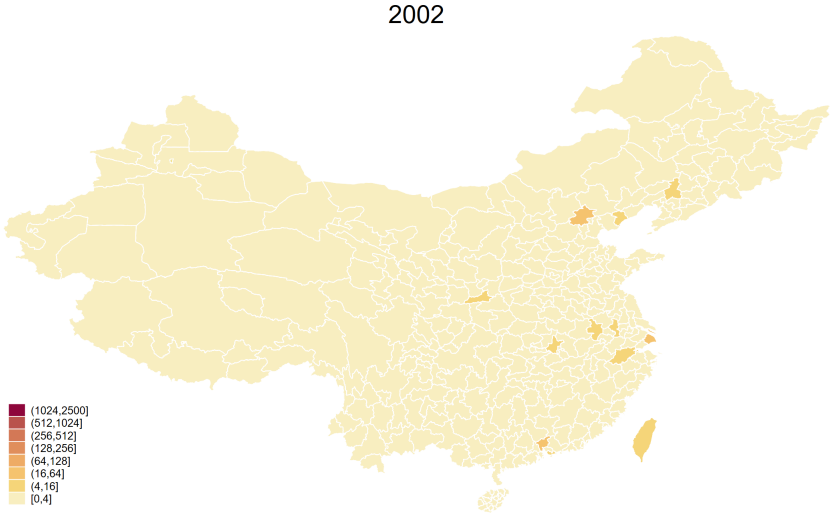
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

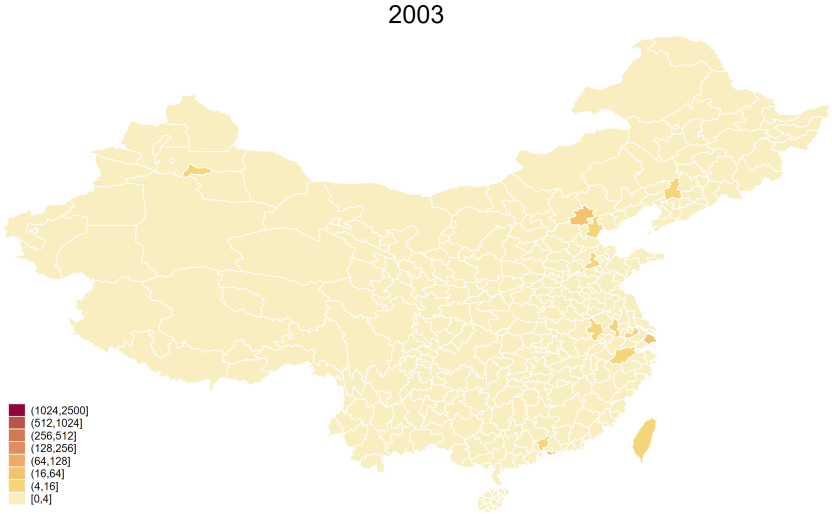
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

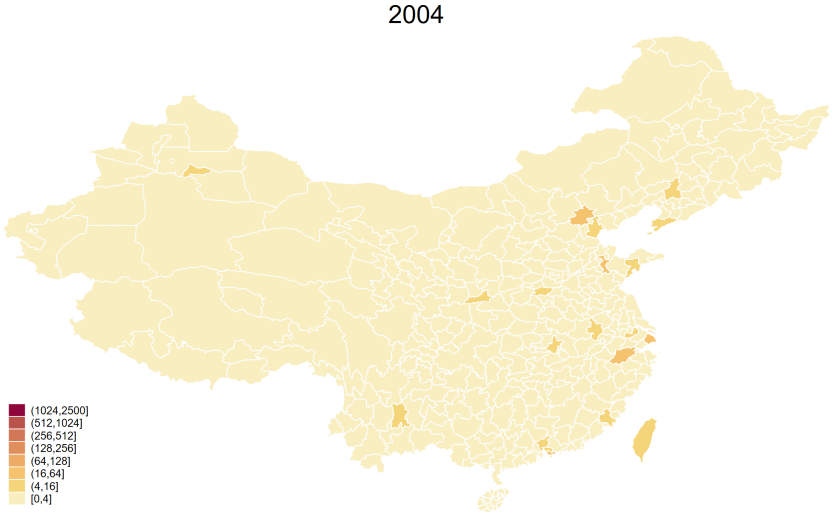
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

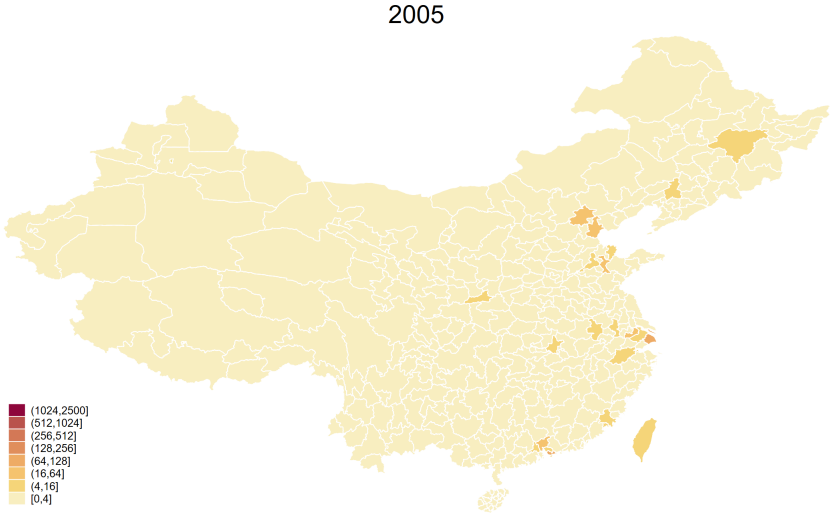
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

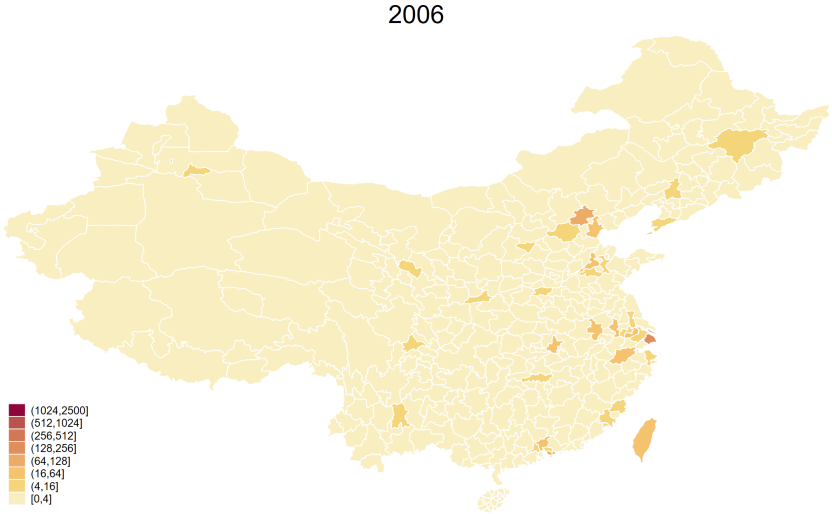
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

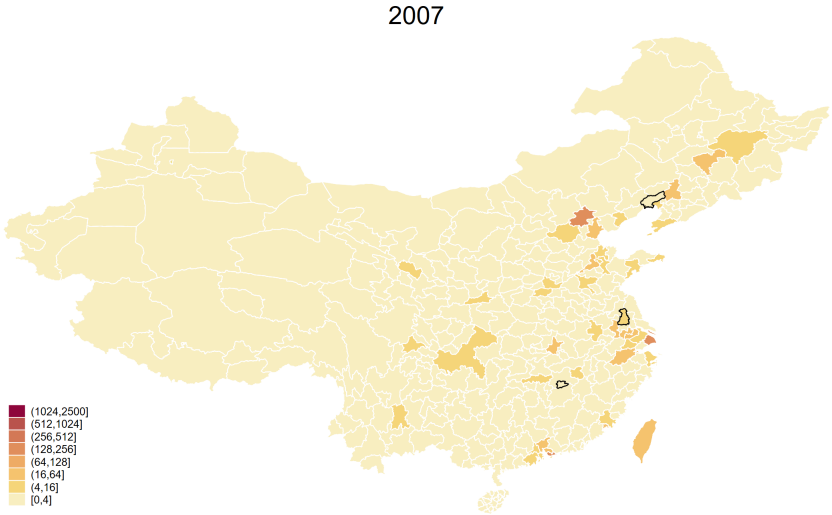
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

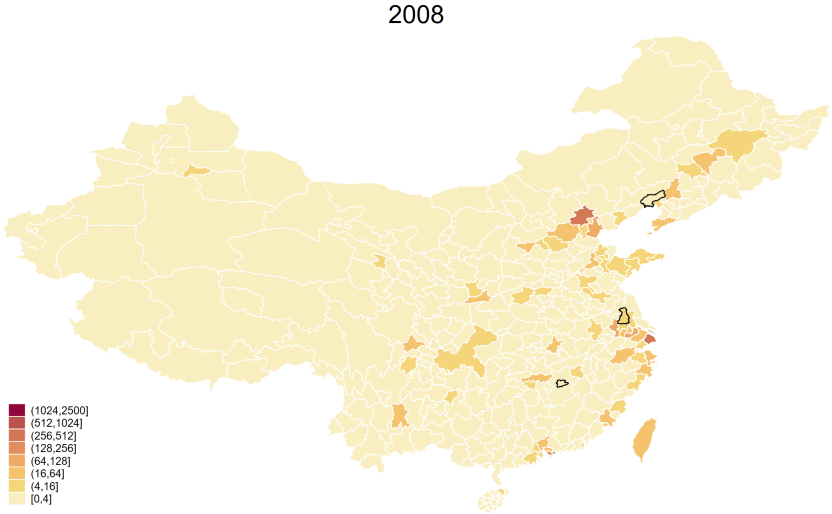
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

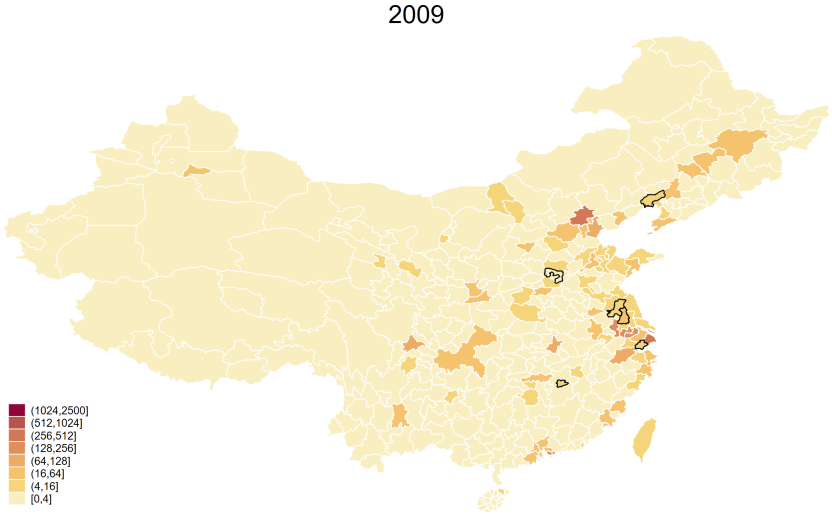
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

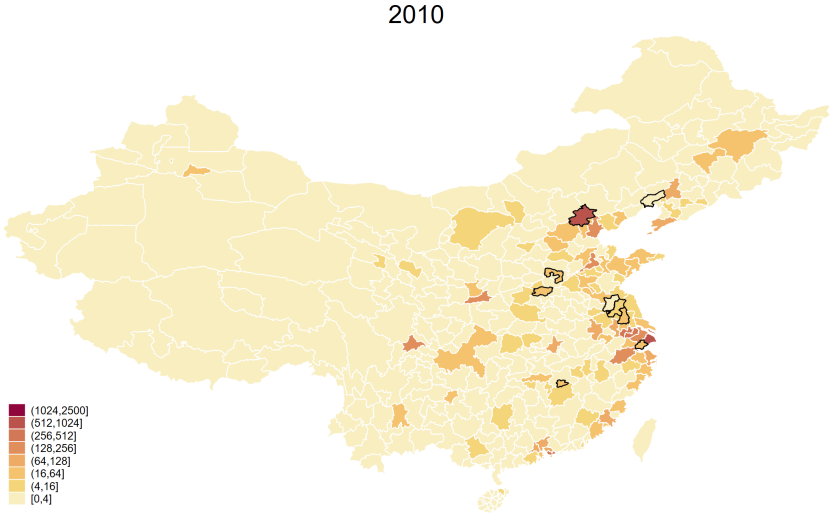
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

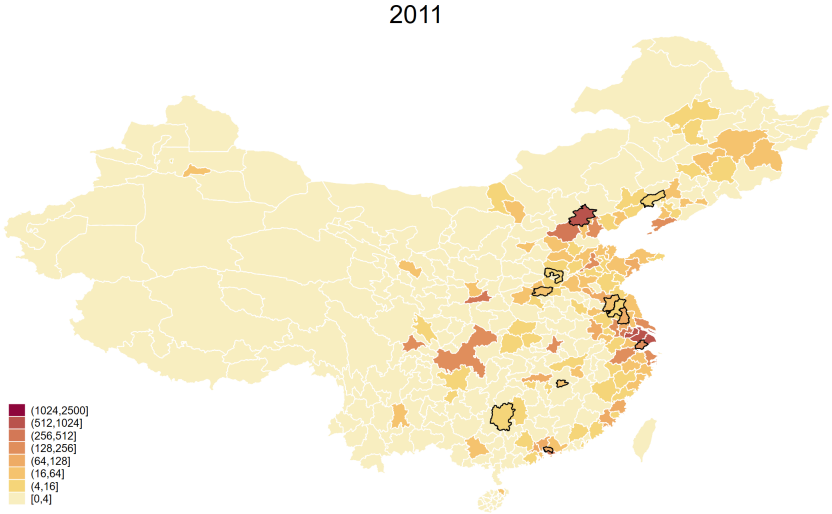
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

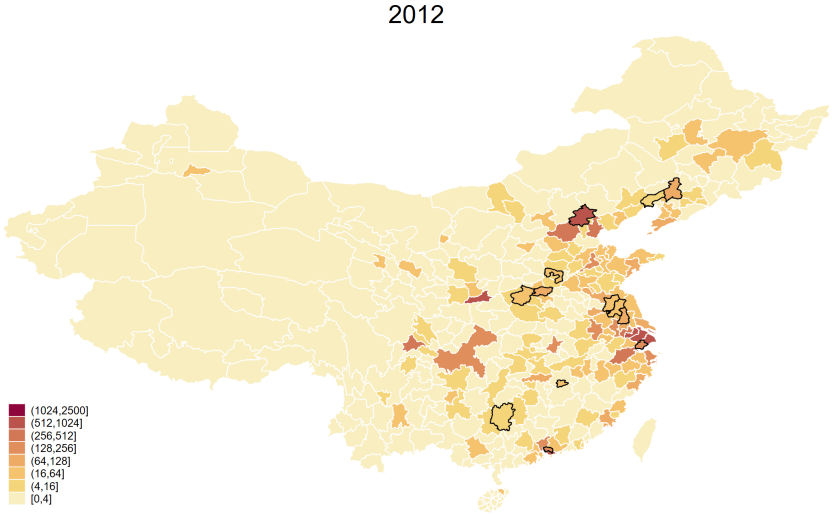
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

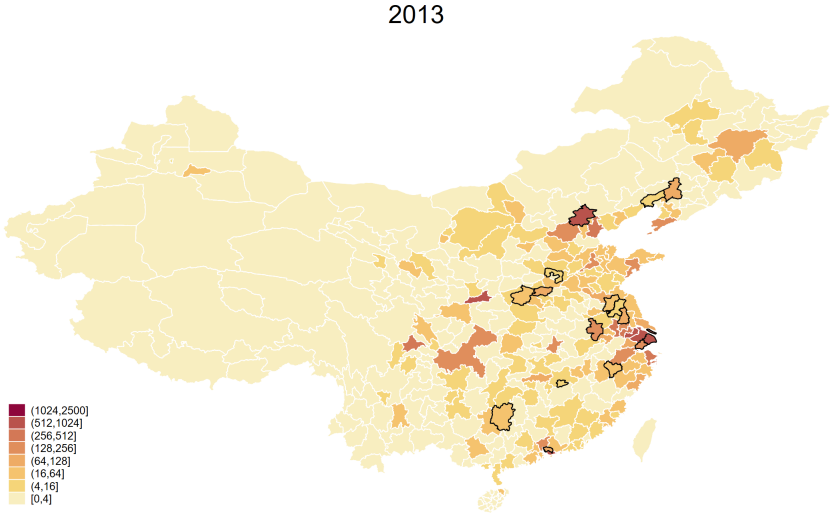
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

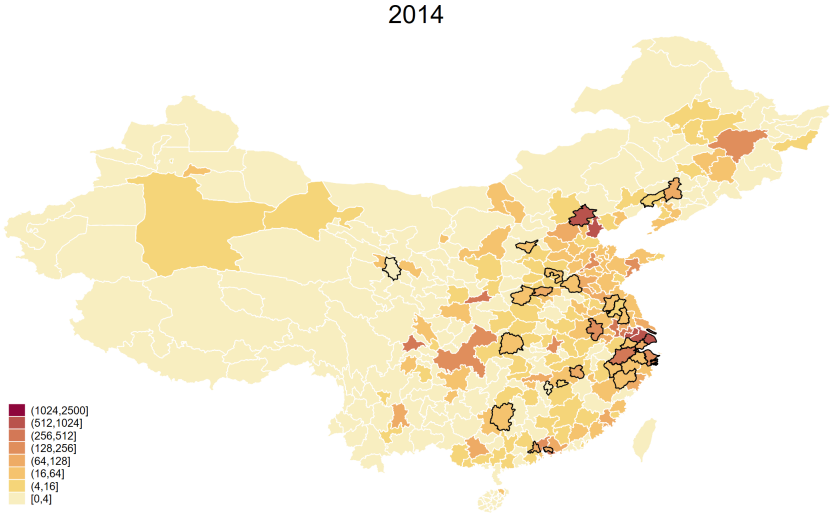
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

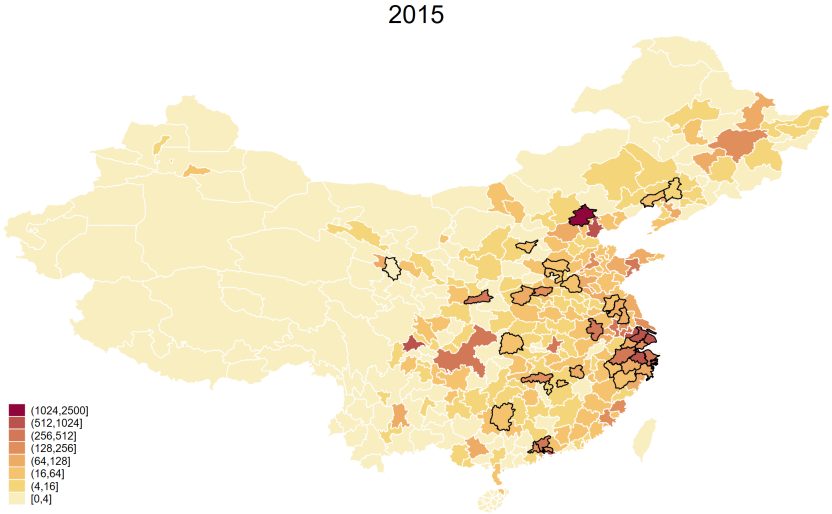
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

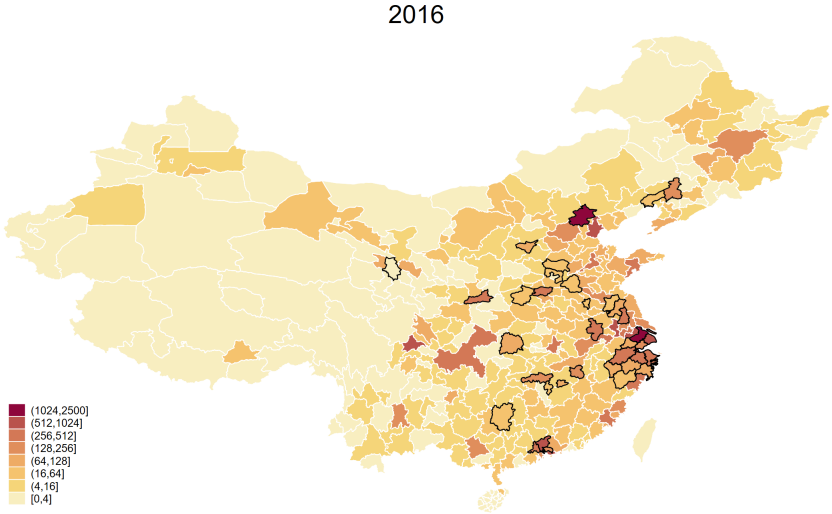
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

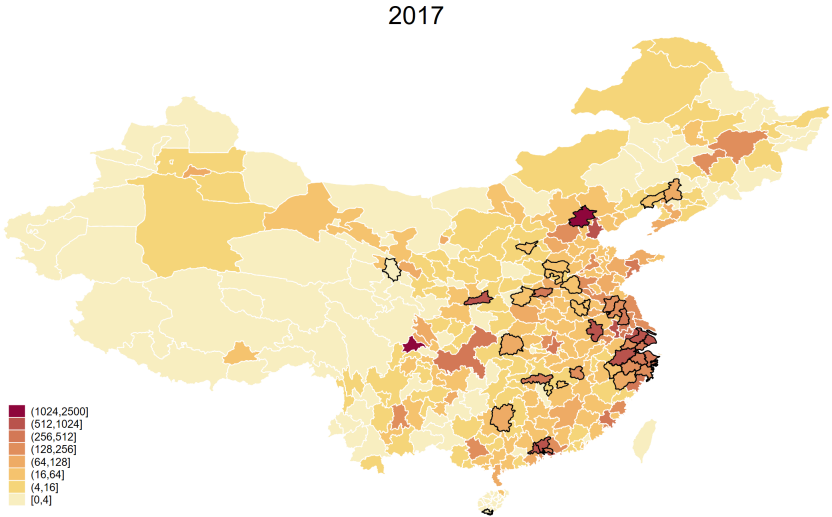
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

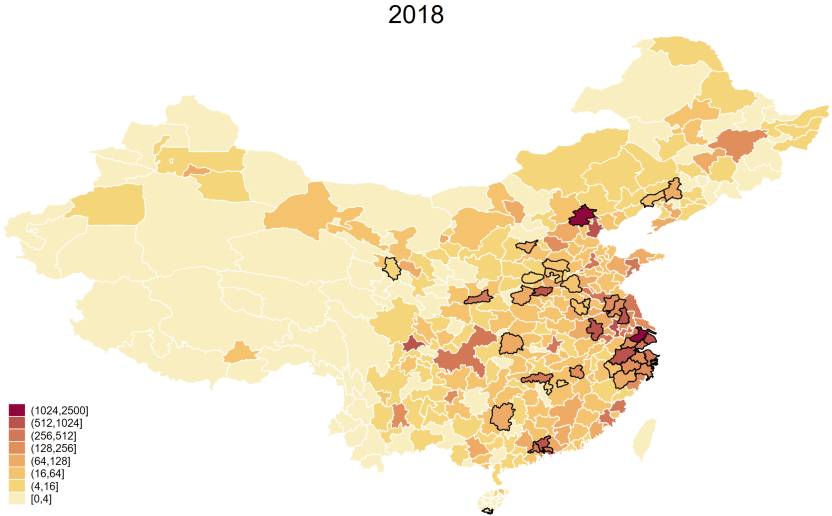
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

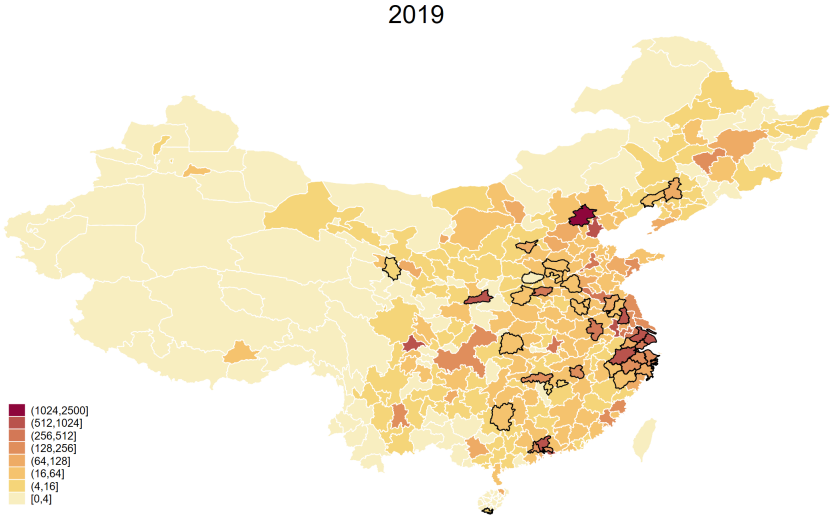
Here: patent counts and any subsidy



Note: black circled cities are treated by any subsidy policy

Our analysis compares policy and outcomes at the city level

Here: patent counts and any subsidy



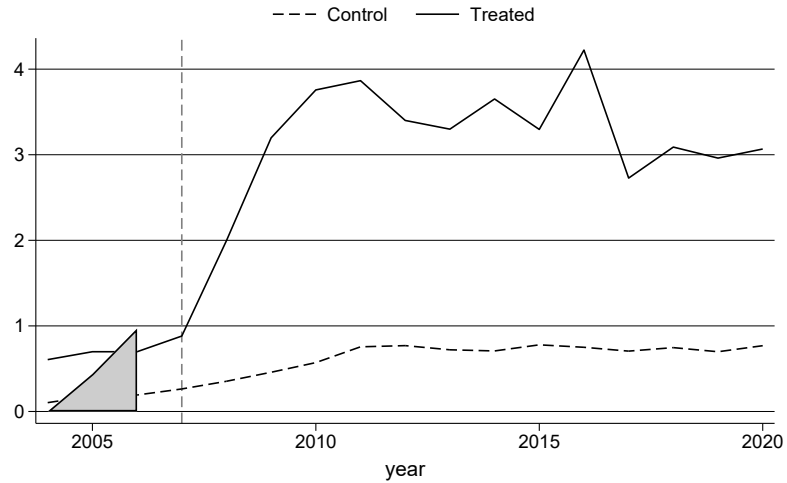
Note: black circled cities are treated by any subsidy policy

Table: City-level solar policies

Type of policy	Number	Example
Subsidy	78	
1. Production subsidy	27	*"The cost of a new solar production line built in Hefei will be subsidized by 12% (2018)"*
2. Innovation subsidy	12	*"Firms will be awarded 10,000 RMB if they earn provincial level R&D center certification (Guilin, 2011)"*
3. Demand subsidy	61	*"1 RMB per watt for the electricity generated by solar projects installed in Beijing (2010)"*

Source: Own ellaboration using PKULaw data

Results: Patents



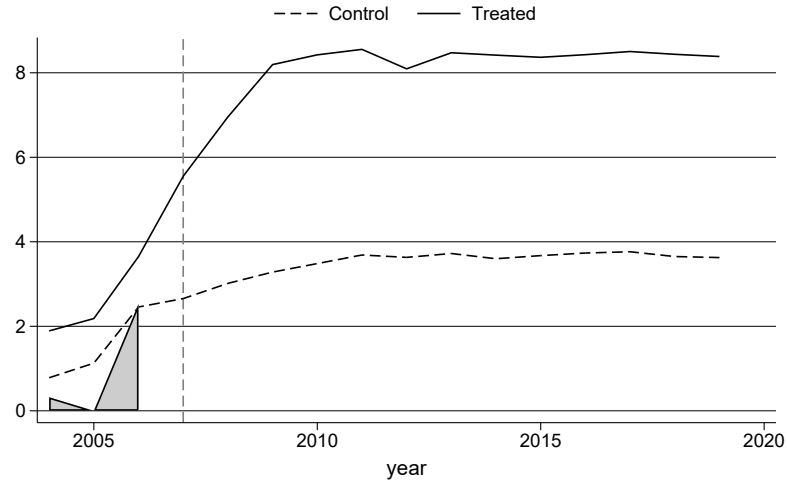
Results: Patents

Table: Patents (Aggregate ATT)

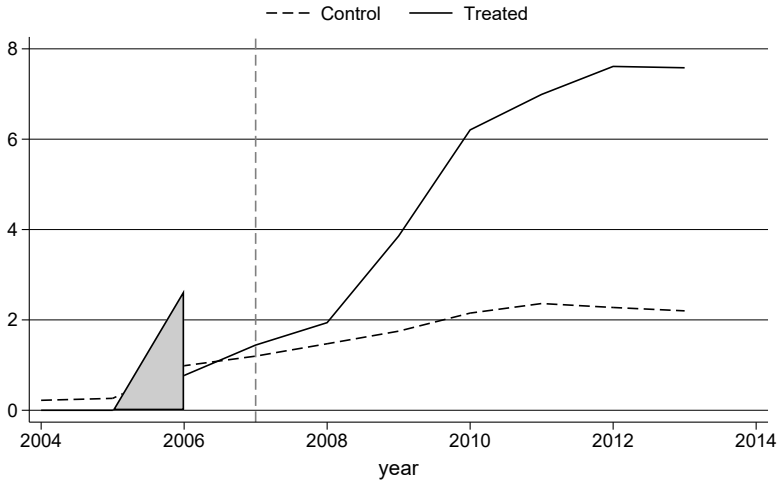
	Any subsidy	*Demand subsidy*	*Production subsidy*	*Innovation subsidy*
All patents	0.496**	0.236	0.871***	1.060***
	(0.200)	(0.275)	(0.227)	(0.367)
Observations	6,086	6,086	6,086	6,086

Notes: * 0.1 ** 0.05 *** 0.01. SDID on 358 cities 2004-2020. Outcome is IHS of patents by solar firms in a city-year pair (av. = 13.1). SE cluster bootstrapped by city.

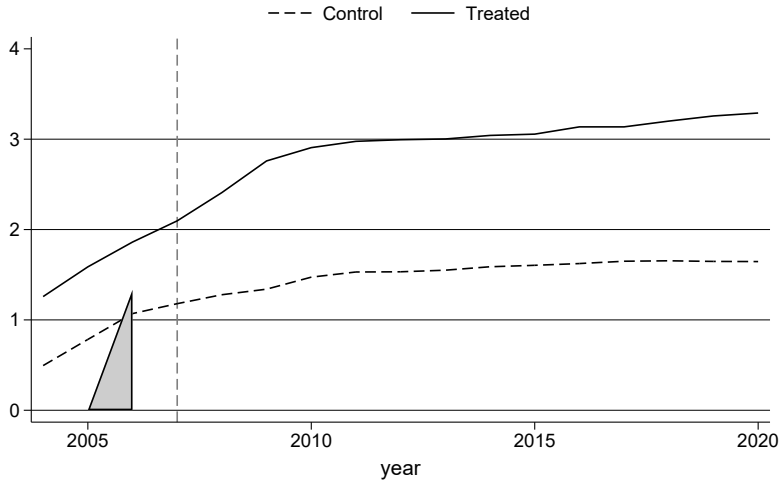
Results: Revenue



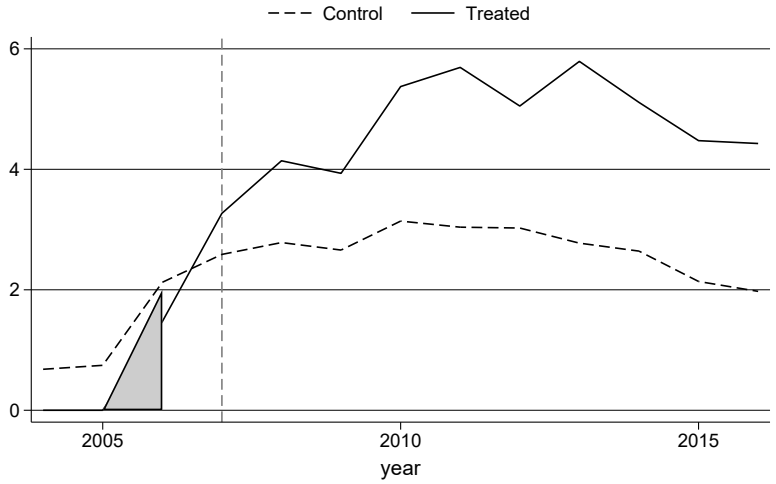
Results: Production Capacity



Results: Firm Count

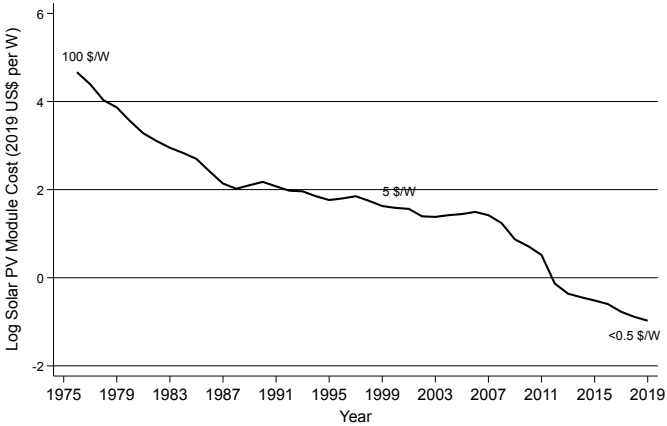


Results: Exports



Cost of solar has fallen dramatically

Figure: Global average price of solar PV modules (in 2019 US$ per Watt)



Source: LaFond et al. (2017) & IRENA Database

Clean Energy

- Luis Gonzales (Pontificia Universidad Católica De Chile), Koichiro Ito (Chicago), Mar Reguant (Northwestern), The Dynamic Impact of Market Integration: Evidence from Renewable Energy Expansion in Chile, Revise & Resubmit, Econometrica, 2023

Figure: Market Integration and Spatial Vartiation in Electricity Prices (Gonzales et al. 2023)

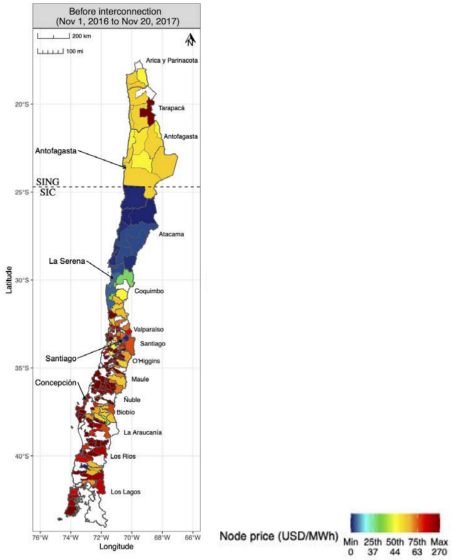


Figure: Market Integration and Spatial Vartiation in Electricity Prices (Gonzales et al. 2023)

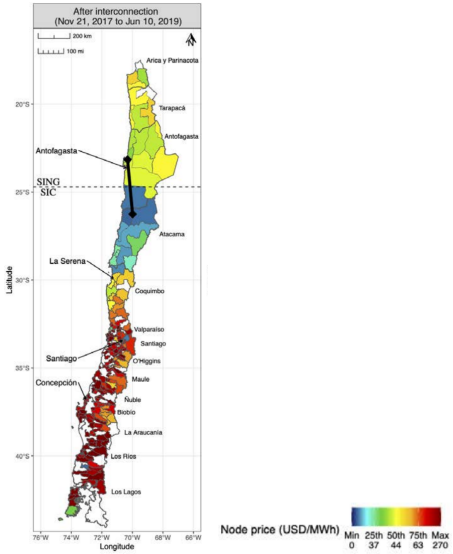
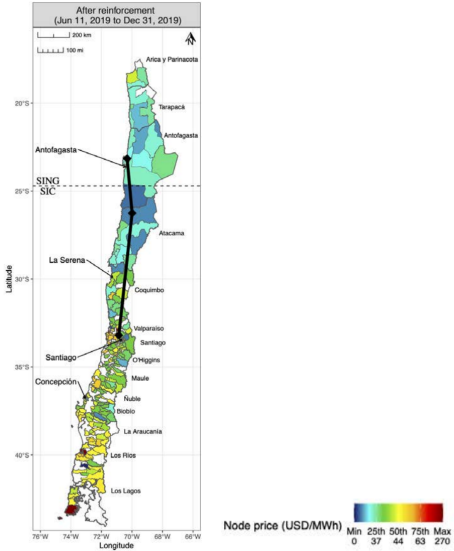


Figure: Market Integration and Spatial Vartiation in Electricity Prices (Gonzales et al. 2023)



The Wealth of People

- The Organization of Labor
  - Subsistence
  - Transformation: Self-employment and micro-entrepreneurship
  - Frontier: Firms
- Markets and Trade
  - Subsistence: Informal exchange
  - Transformation: The emergence of markets
  - Frontier: Globalisation

The Wealth of People

- State
  - Subsistence: Proto-State
  - Transformation: State capacity
  - Frontier: Global governance and justice
- Environment
  - Subsistence: Environmental shocks
  - Transformation: Managing the local environment
  - Frontier: Global environment