BREAD-IGC Virtual PhD Course on Environmental Economics

Robin Burgess (LSE, BREAD and IGC)

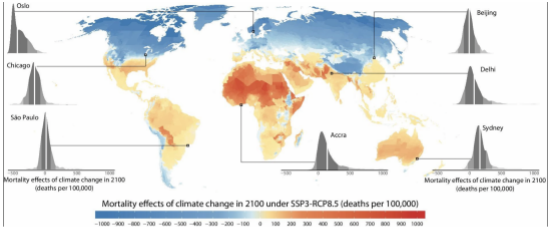
Lecture 1, Introduction

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 adaptation
     2. Natural capital
     3. Clean energy

Why study environmental economics in LMICS?

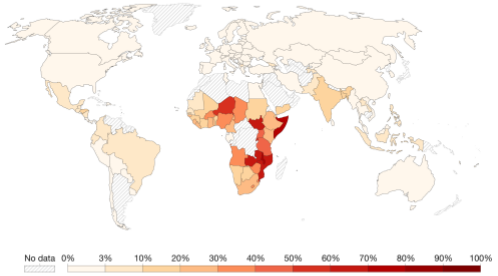
1. human wealth - this is where the extreme poors are located
2. environmental damages are greater in LMICS
3. this is where energy consumption and emissions are growing most quickly



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.

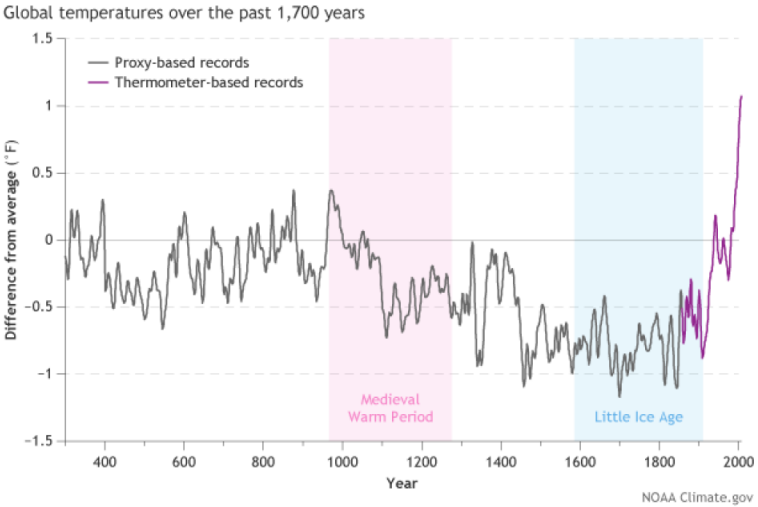


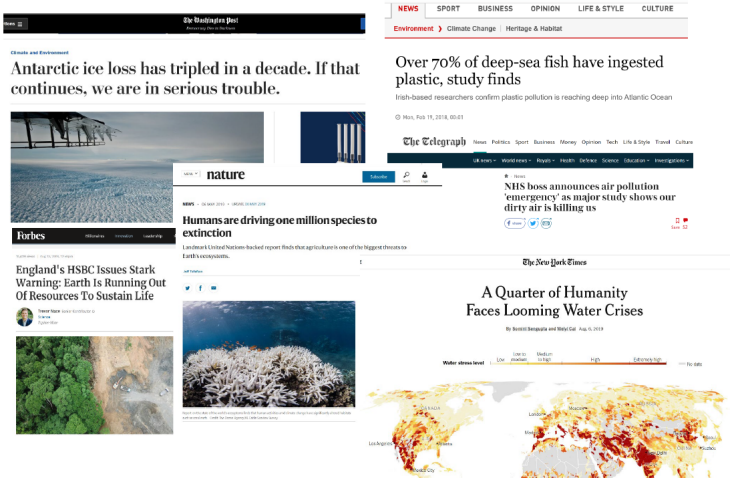
Source: World Bank Poverty and Inequality Platform (2022)

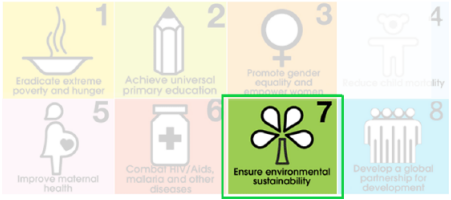
OurWorldInData.org/poverty • CC BY

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


Global temperatures over the past 1,700 years
Proxy-based records
Thermometer-based records
Difference from average (°F)
1.5
1
0.5
0
-0.5
-1
-1.5
400
600
800
1000
1200
1400
1600
1800
2000
Year
Medieval
Warm Period
Little Ice Age
NOAA Climate.gov


The Washington Post
Climate and Environment
Antarctic ice loss has tripled in a decade. If that continues, we are in serious trouble.
NEWS SPORT BUSINESS OPINION LIFE & STYLE CULTURE
Environment › Climate Change | Heritage & Habitat
Over 70% of deep-sea fish have ingested plastic, study finds
Irish-based researchers confirm plastic pollution is reaching deep into Atlantic Ocean
Mon, Feb 19, 2018, 00:01
The Telegraph
News Politics Sport Business Money Opinion Tech Life & Style Travel Culture
UK news World news Royals Health Defence Science Education Investigations
News
NHS boss announces air pollution 'emergency' as major study shows our dirty air is killing us
Forbes
England's HSBC Issues Stark Warning: Earth Is Running Out Of Resources To Sustain Life
nature
Subscribe
NEWS
Humans are driving one million species to extinction
Landmark United Nations-backed report finds that agriculture is one of the biggest threats to Earth's ecosystems.
The New York Times
A Quarter of Humanity Faces Looming Water Crises
Water stress level
Low
Low to medium
Medium to high
High
Extremely high
No data
Los Angeles
Lisbon
Madrid
Athens
Cairo

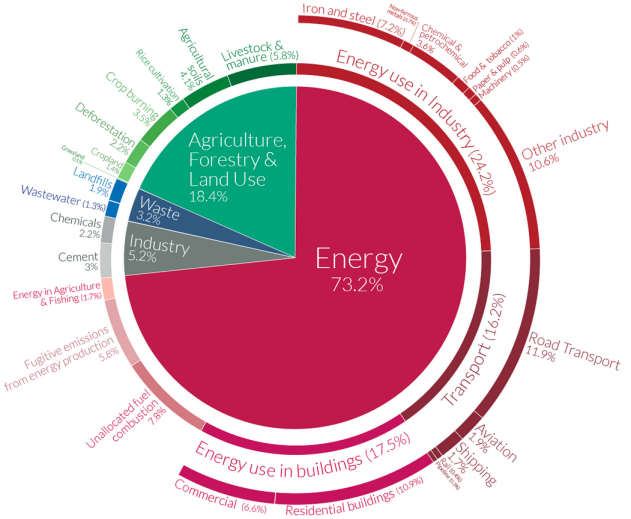


MDGs
2000

SDGs
2015

Global greenhouse gas emissions by sector

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



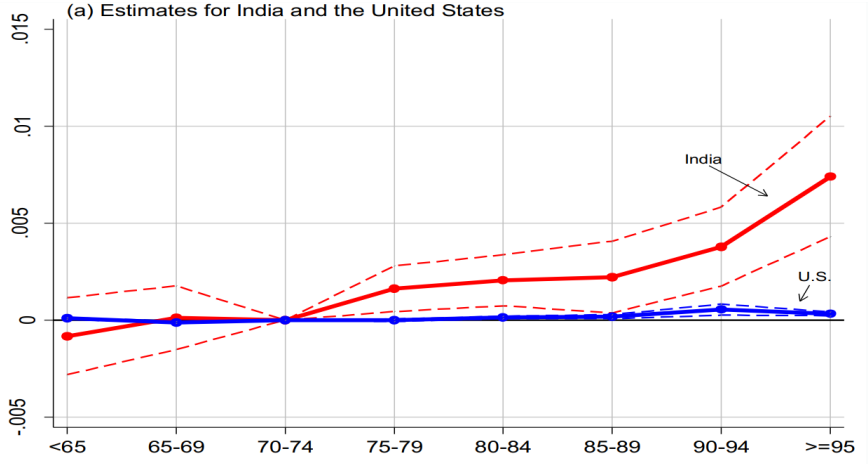
OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).

Climate adaptation

- Robin Burgess (LSE), Olivier Deschenes (UCSB), Dave Donaldson (MIT), and Michael Greenstone (Chicago), 2017, Weather, Climate Change and Death in India. working paper
- Clare Balboni (LSE), Oriana Bandiera (LSE), Robin Burgess (LSE), Maitreesh Ghatak (LSE), Anton Heil (LSE), 2022, Why Do People Stay Poor?. The Quarterly Journal of Economics.
- Oriana Bandiera (LSE), Robin Burgess (LSE), Narayan Das (BRAC), Selim Gulesci (Bocconi), Imran Rasul (UCL), Munshi Sulaiman (BRAC), 2017, Labor markets and poverty in village economies. The Quarterly Journal of Economics.
- $\rightarrow$ See also **lecture on Climate Adaptation** by Esther Duflo (MIT), **lecture on Climate Migration** by Gharad Bryan (LSE) and Melanie Morten (Stanford), **lecture on Inequality of Environmental Damages** by Tamma Carleton (UCSB) and Reed Walker (UCB), **lecture on Economic Impact of Climate Change** by Michael Greenstone (Chicago) and **lecture on Sea Level Rise** by Clare Balboni (LSE) and Allan Hsiao (Princeton)

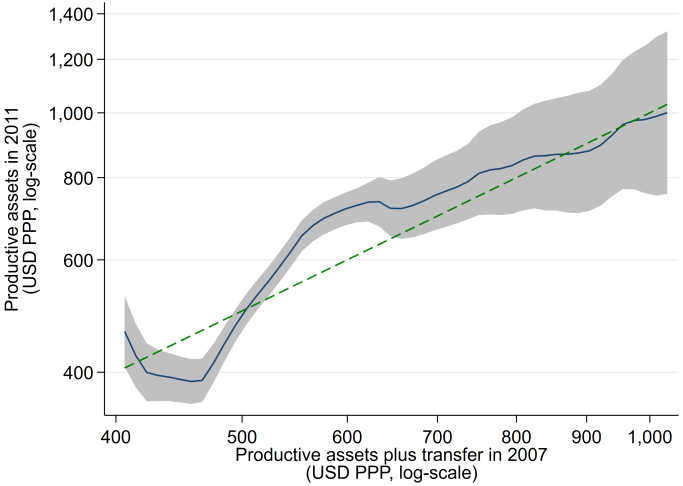
Climate adaptation

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



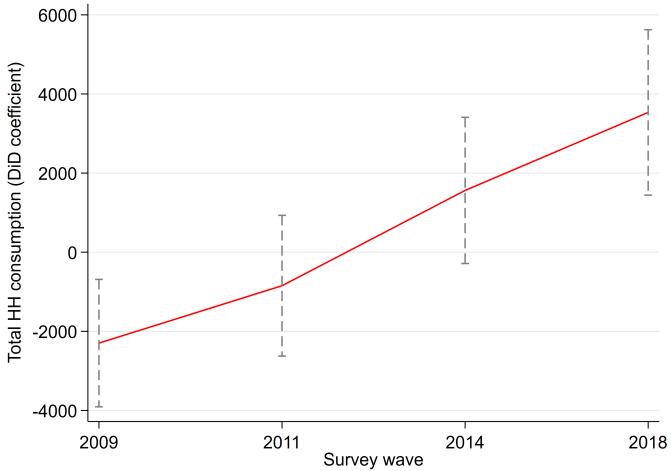
Climate adaptation

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



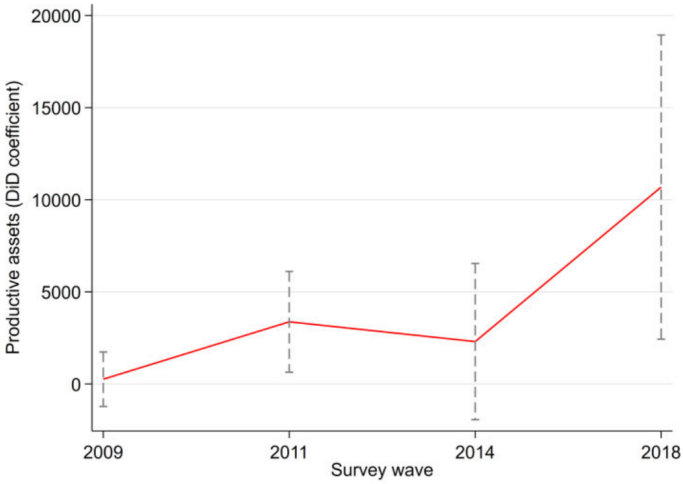
Climate adaptation

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



Climate adaptation

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

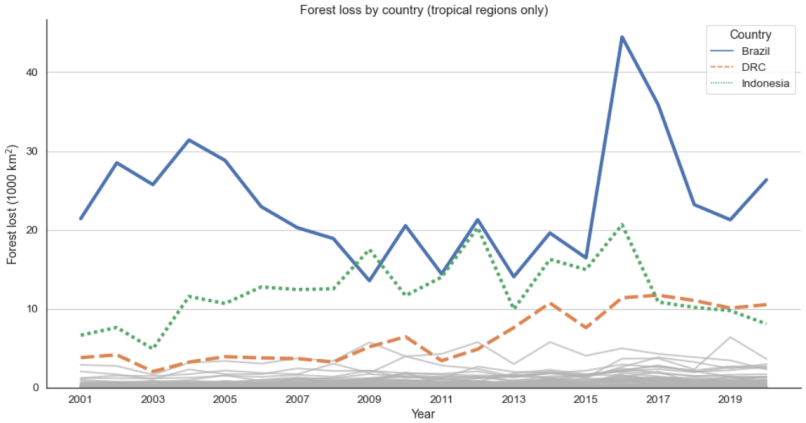


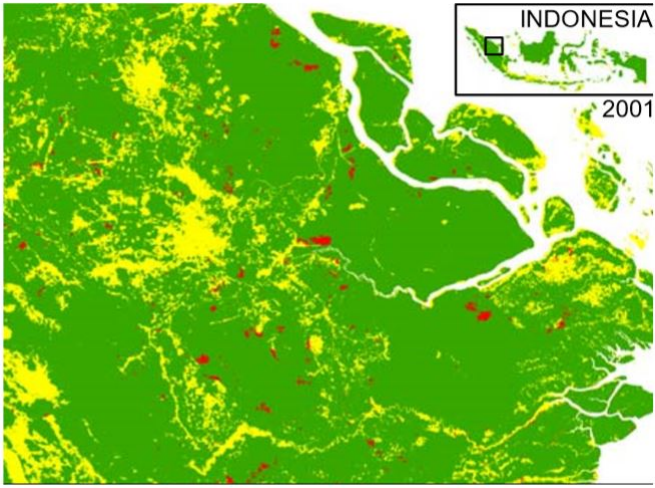
Natural capital

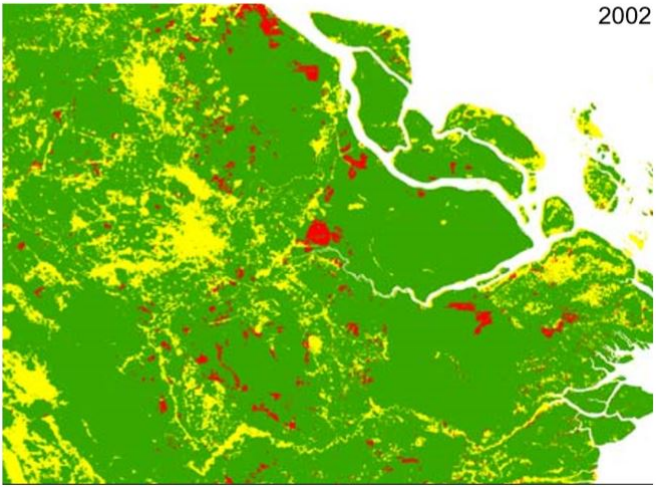
- Clare Balboni (LSE), Aaron Berman (MIT), Robin Burgess (LSE) and Benjamin Olken (MIT), 2023, The Economics of Tropical Deforestation, Forthcoming, The Annual Review of Economics.
- Robin Burgess (LSE), Matthew Hansen (Maryland), Benjamin Olken (MIT), Peter Potapov (Maryland), and Stefanie Sieber (World Bank), 2012, The Political Economy of Deforestation in the Tropics. The Quarterly Journal of Economics
- Clare Balboni (LSE), Robin Burgess (LSE), and Benjamin Olken (MIT), 2023, The Origins and Control of Forest Fires in the Tropics. working paper
- Allan Hsiao (Princeton), 2023, Coordination and Commitment in International Climate Action: Evidence from Palm Oil, Revise and resubmit, Econometrica
- $\rightarrow$ See also **lecture on Economics of Conservation** by Seema Jayachandran (Northwestern) and Benjamin Olken (MIT), **lecture on International Climate Action** by Bård Harstad (Stanford)

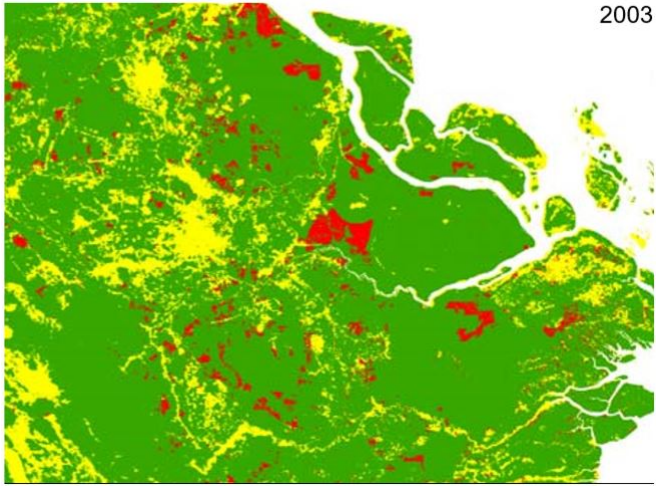
Natural capital

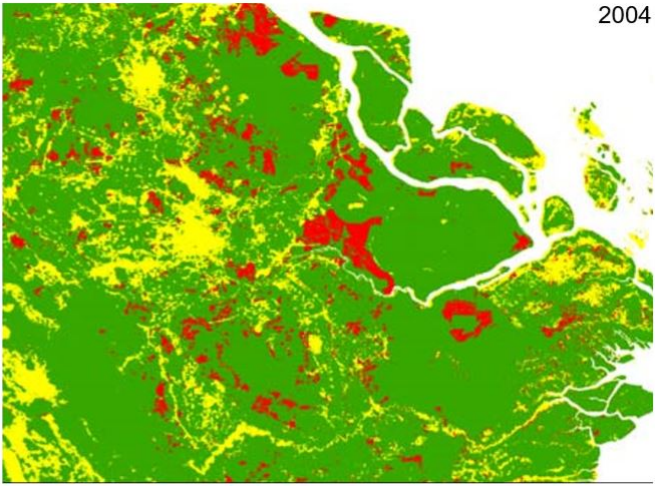
Figure: Forest loss by country (tropical regions only) (Balboni et al. 2023)

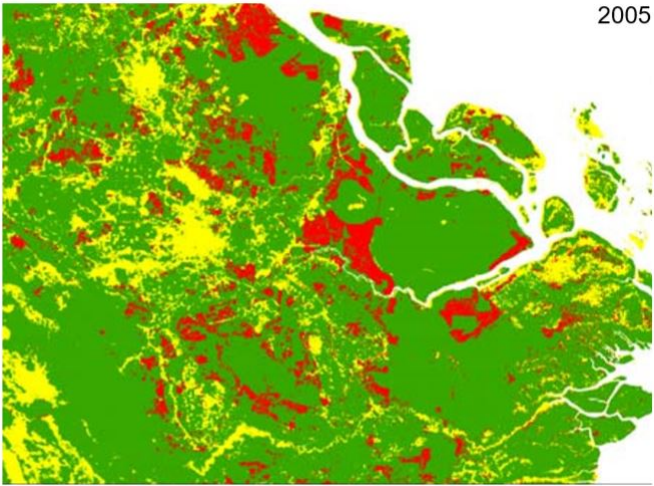


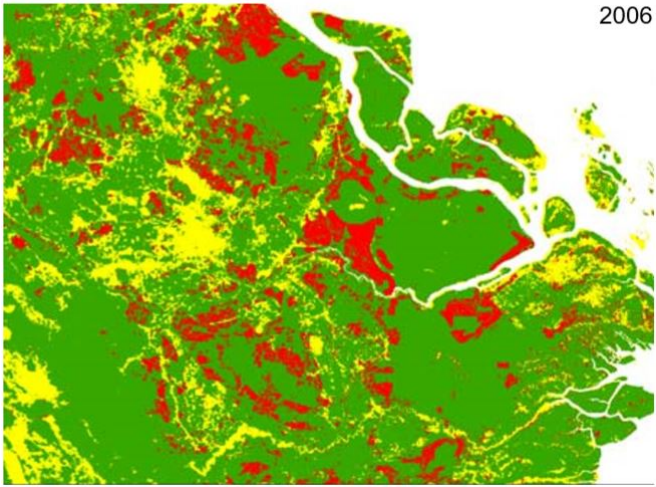

INDONESIA
2001

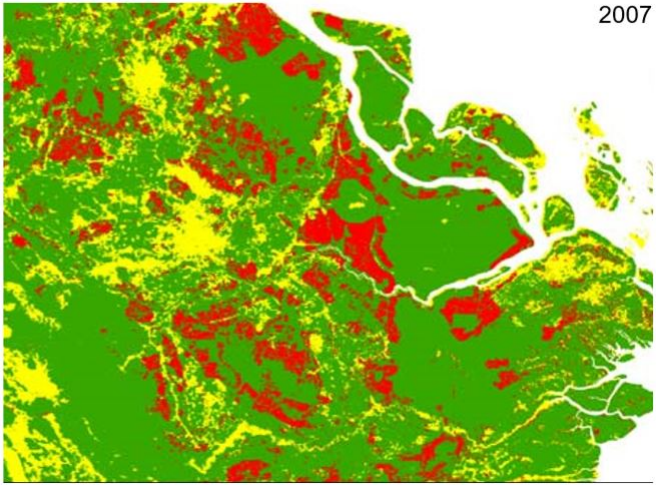

2002


2003


2004


2005


2006


2007

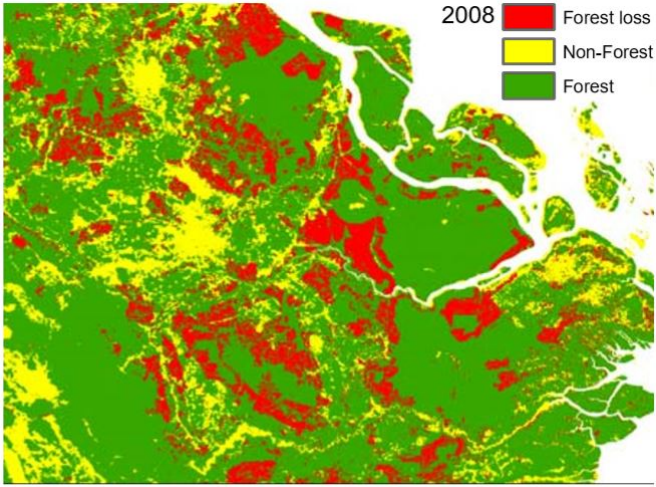
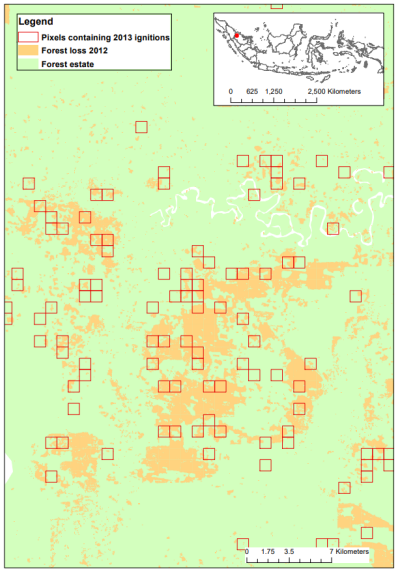
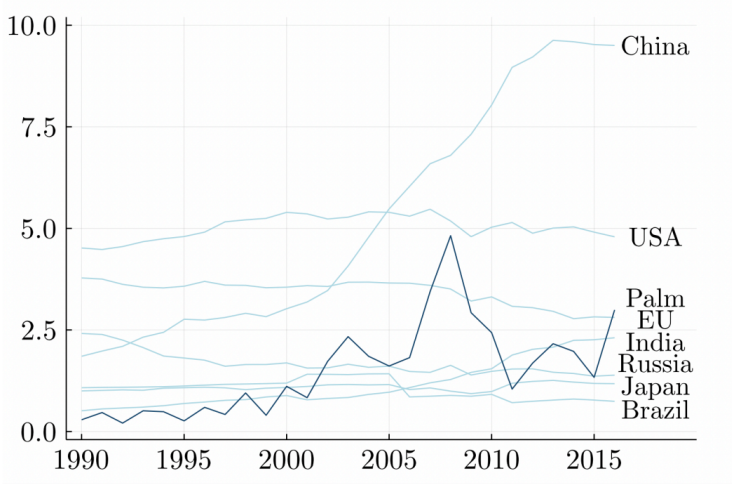

2008
Forest loss
Non-Forest
Forest

Figure: 2012 deforestation and 2013 ignitions in Riau (Balboni, Burgess and Olken, 2023)



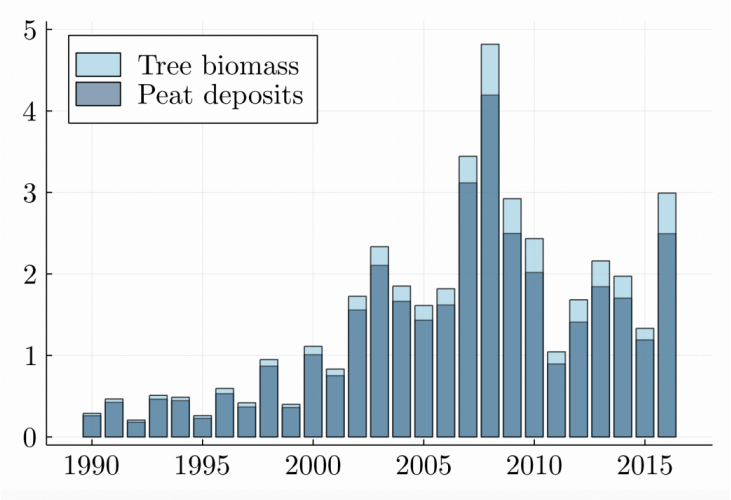
Natural capital

Figure: Figure: Global CO2 emissions (Hsiao 2023)



Natural capital

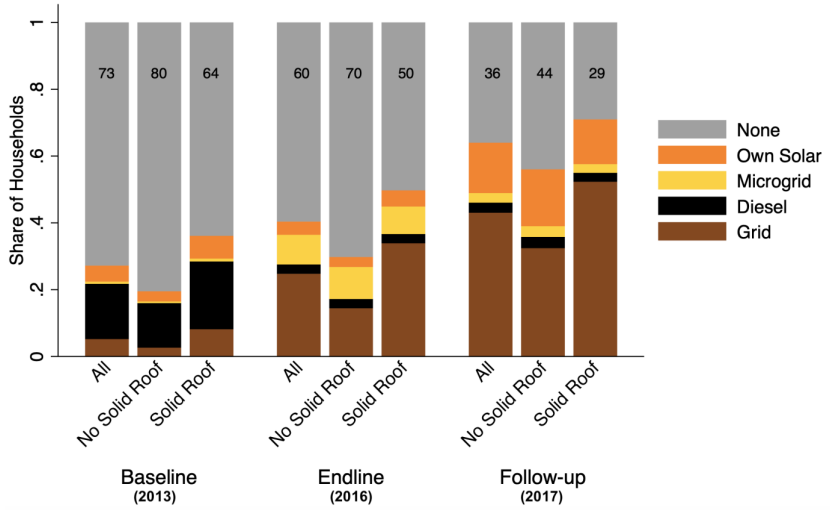
Figure: Palm emissions (Hsiao 2023)



Clean energy

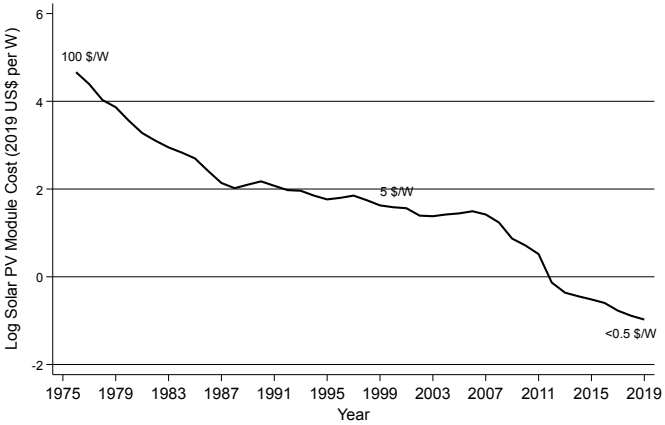
- Robin Burgess (LSE), Michael Greenstone (Chicago), Nicholas Ryan (Yale), and Anant Sudarshan (Warwick), 2023, Electricity Demand and Supply on the Global Electrification Frontier. working paper.
- Ignacio Banares-Sanchez (LSE), Robin Burgess (LSE), David Laszlo (LSE), Pol Simpson (LSE), John Van Reenen (LSE), Yifan Wang (LSE), 2023, Ray of Hope? China and the Rise of Solar Energy. working paper
- Luis Gonzales (Pontificia Universidad Católica De Chile), Koichiro Ito (Chicago), Mar Reguant (Northwestern), 2023, The Dynamic Impact of Market Integration: Evidence from Renewable Energy Expansion in Chile, Revise & Resubmit, Econometrica
- $\rightarrow$ see also **lecture on Renewables** by John Van Reenen (LSE) and Mar Reguant (Northwestern), and **lecture on Regulation and Pollution** by Rohini Pande (Yale) and Nicholas Ryan (Yale)

Clean energy



Clean energy

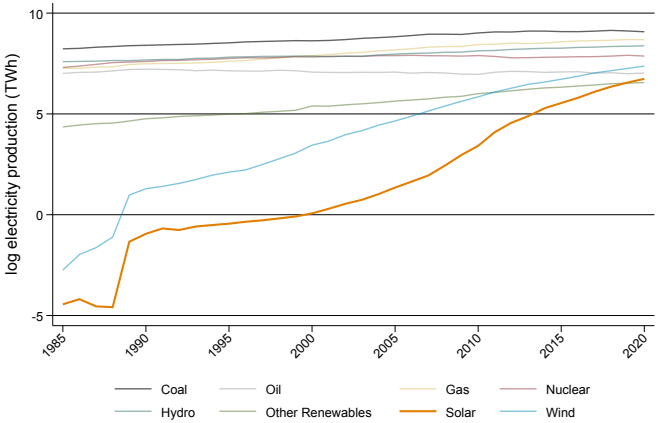
Figure: Global average price of solar PV modules (in 2019 US$ per Watt)



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

Clean energy

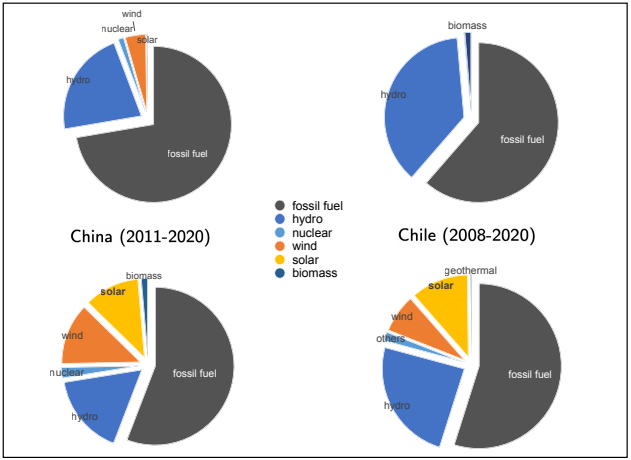
Figure: World electricity production by source



Source: International Energy Agency (IEA)

Clean energy

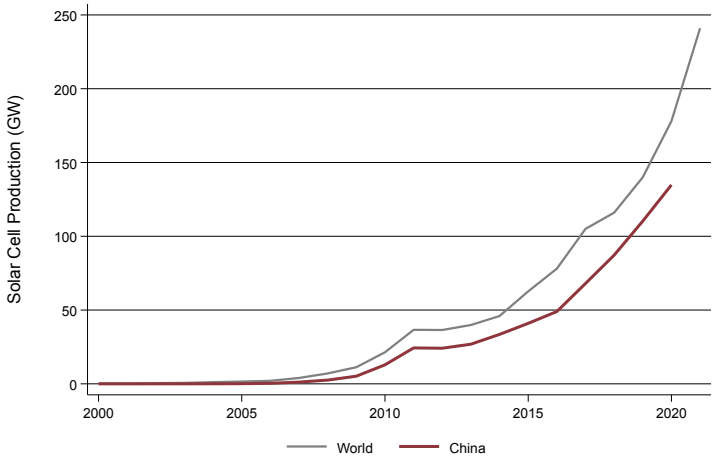
Figure: Installed Electricity generation capacity in China and Chile by source



Source: State Grid New Energy Cloud & CNE

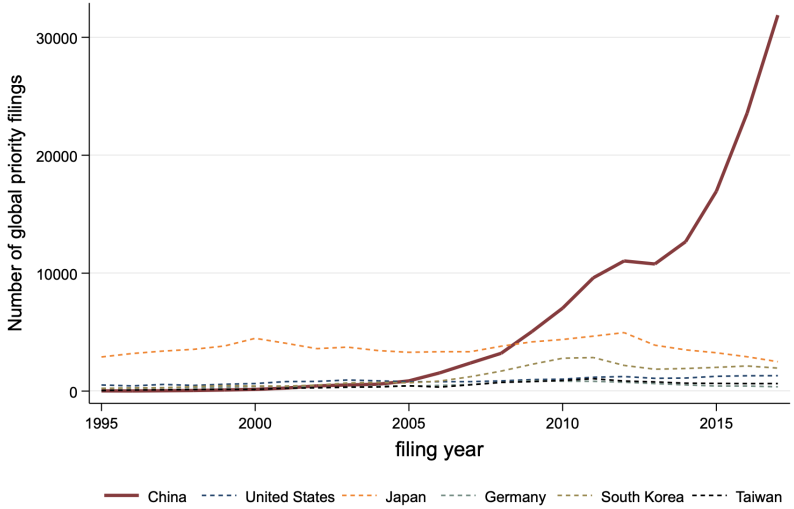
- **World, 2011 to 2020**: installed solar capacity went from 0.8% to 6.8%
- **China, 2011 to 2020**: installed solar capacity went from 0.19% to 11.35%
- **Chile, 2008 to 2020**: installed solar capacity went from 0% to 12%

Clean energy



Source: IEA - Trends in Photovoltaic Applications 2022

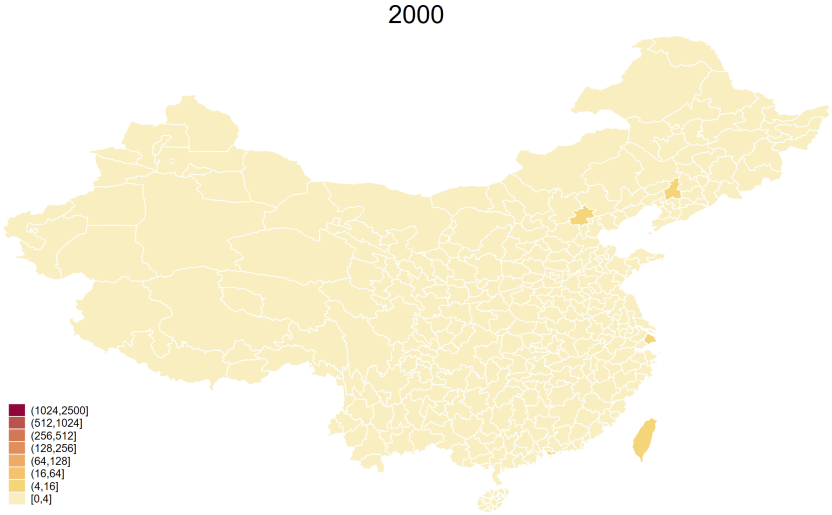
Clean energy



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

Our analysis compares policy and outcomes at the city level

Here: patent counts and any subsidy



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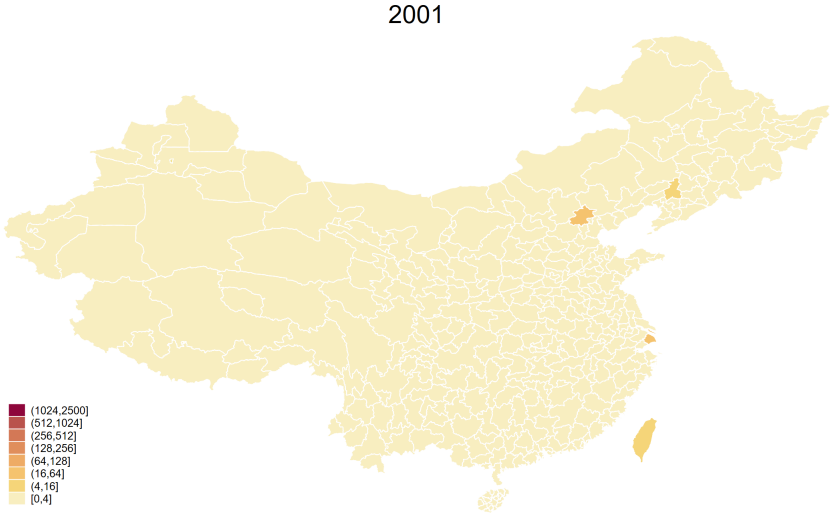

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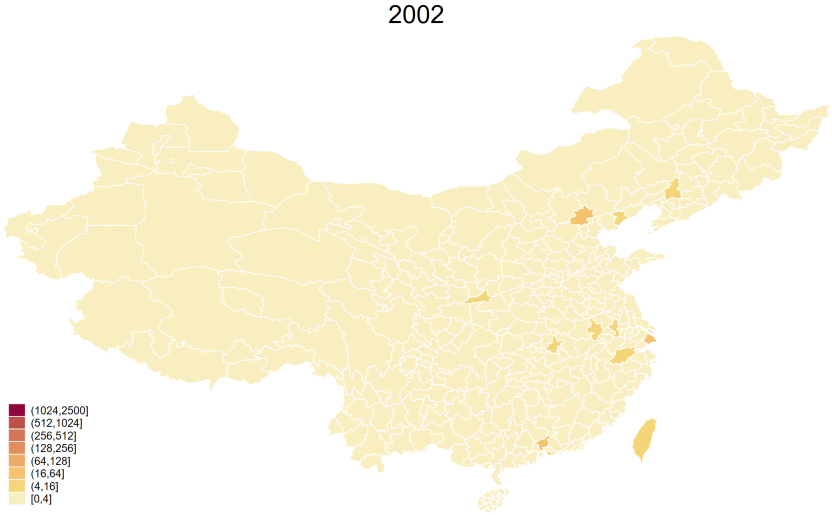

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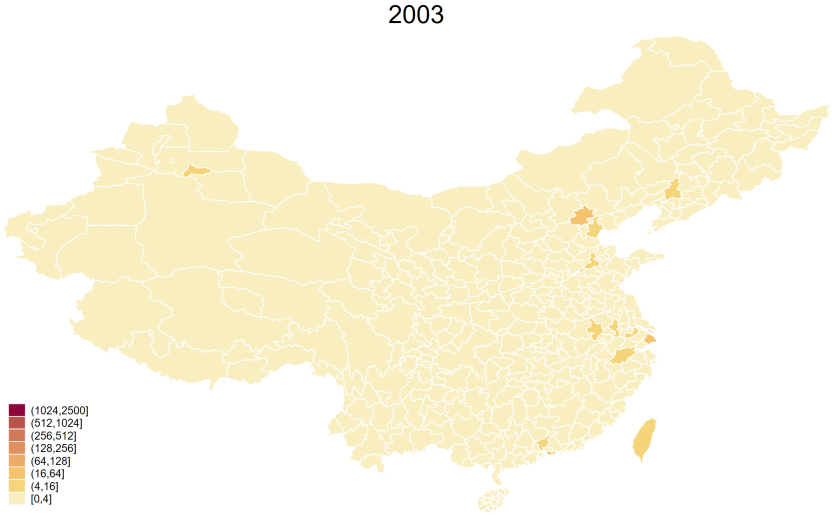

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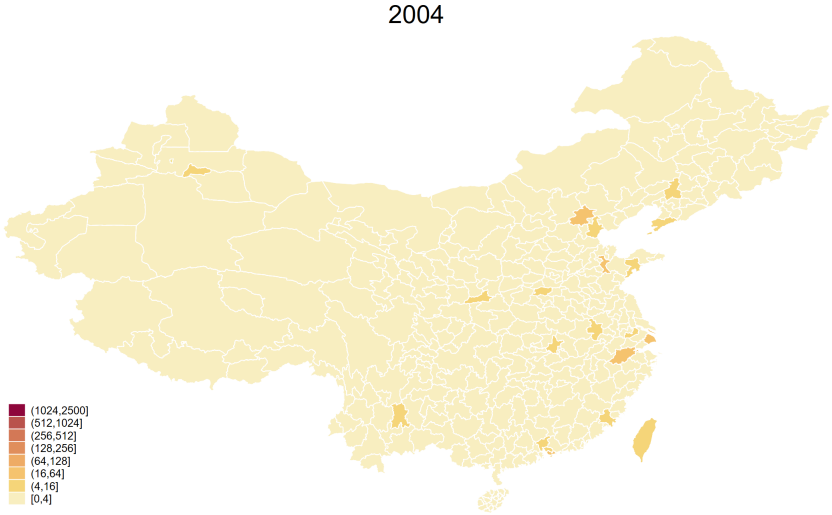

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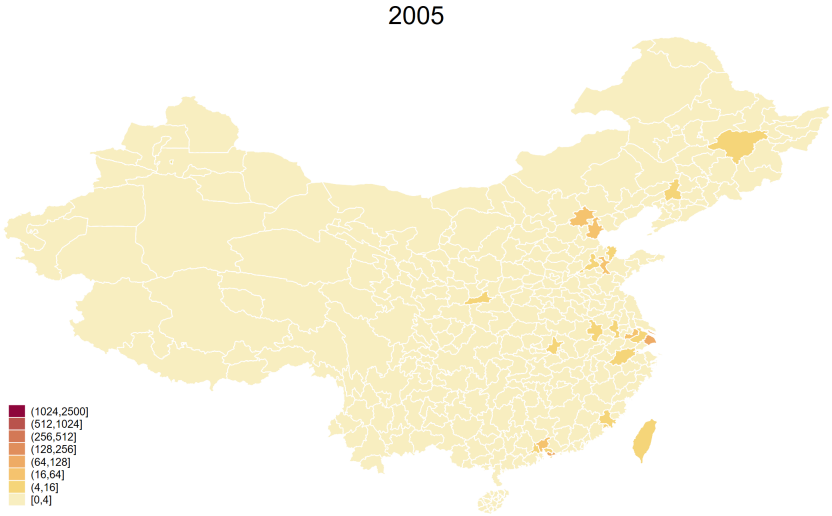

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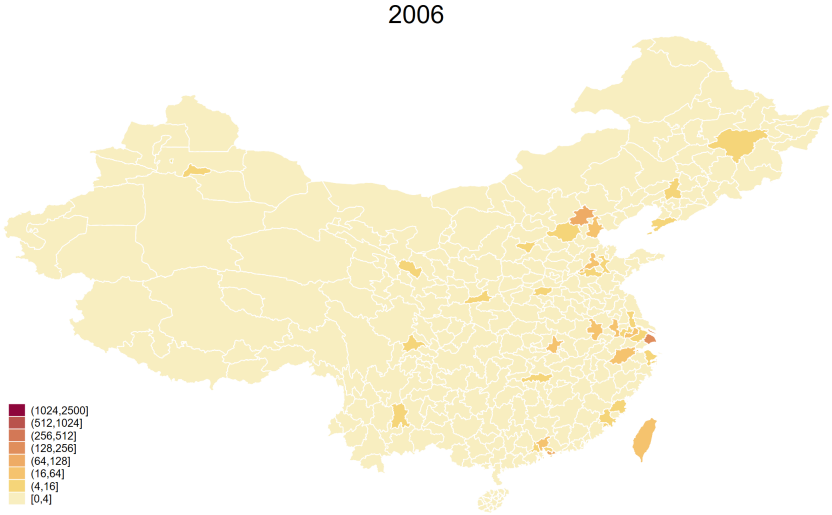

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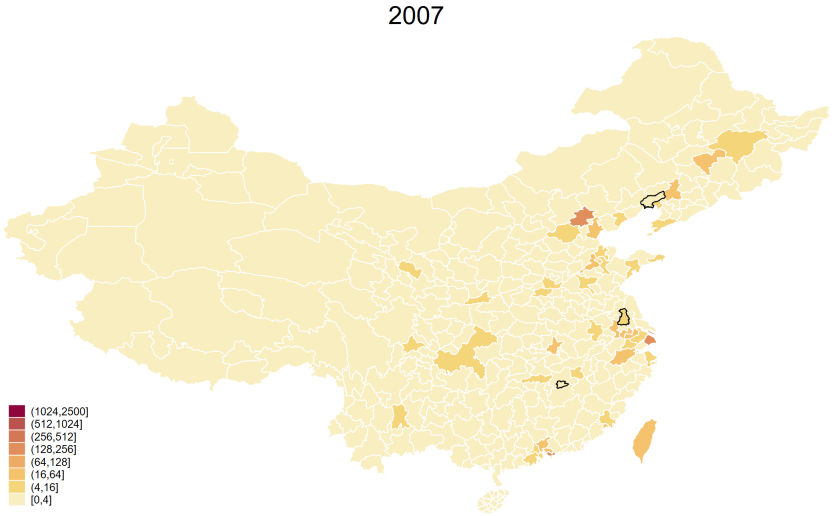

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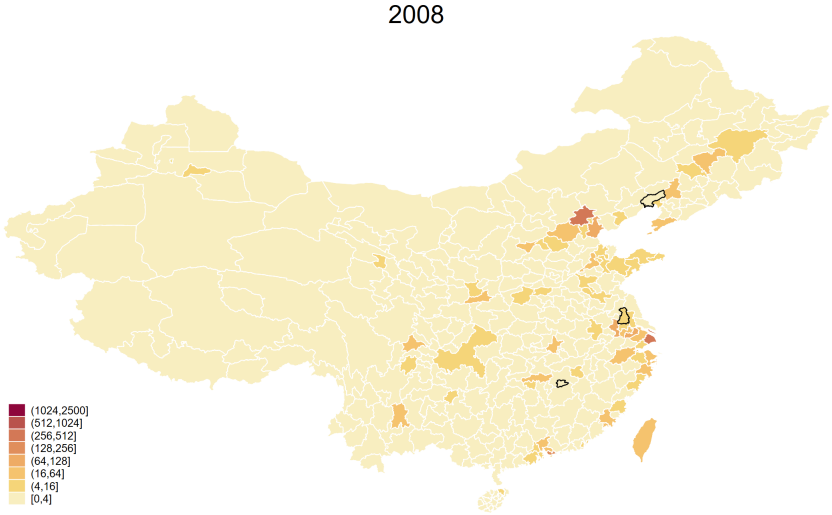

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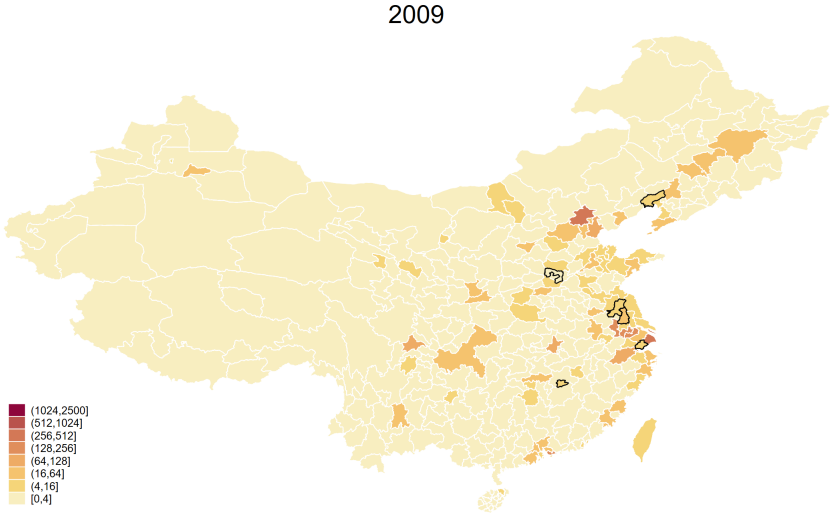

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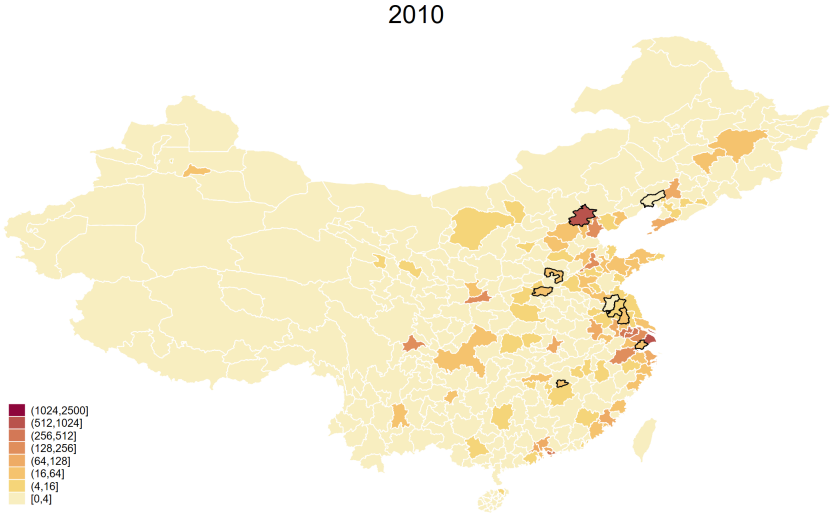

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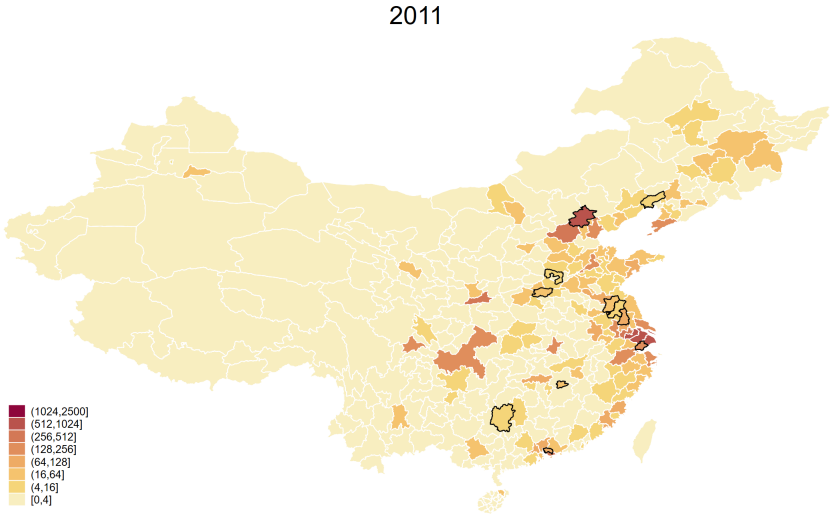

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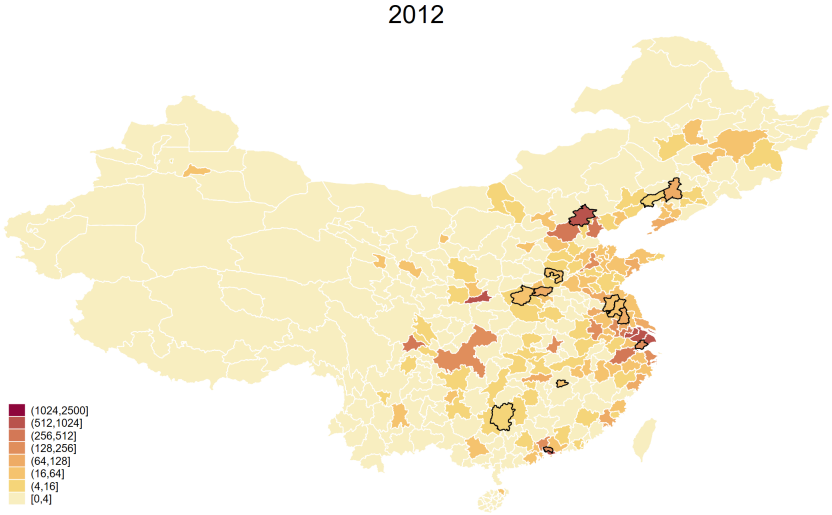

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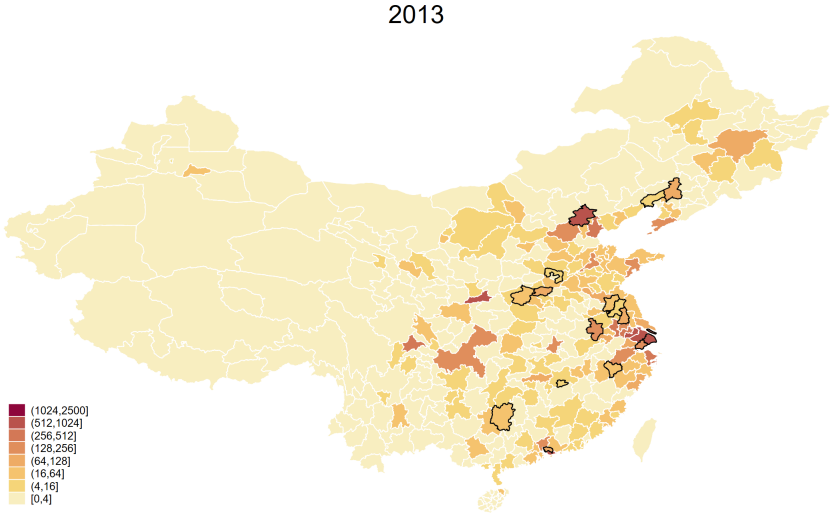

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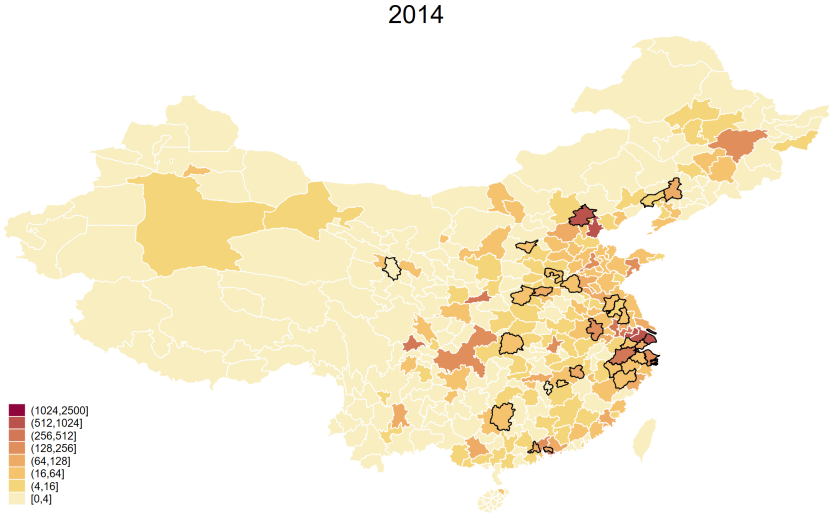

Note: black circled cities are treated by any subsidy policy

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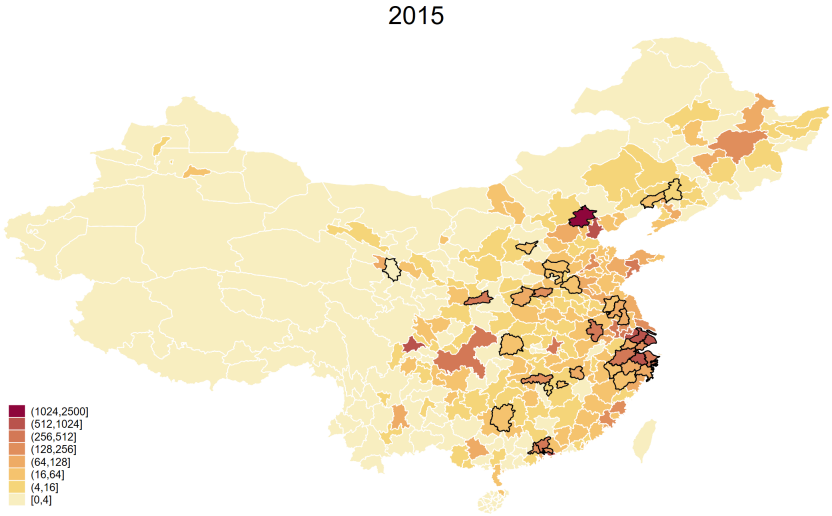

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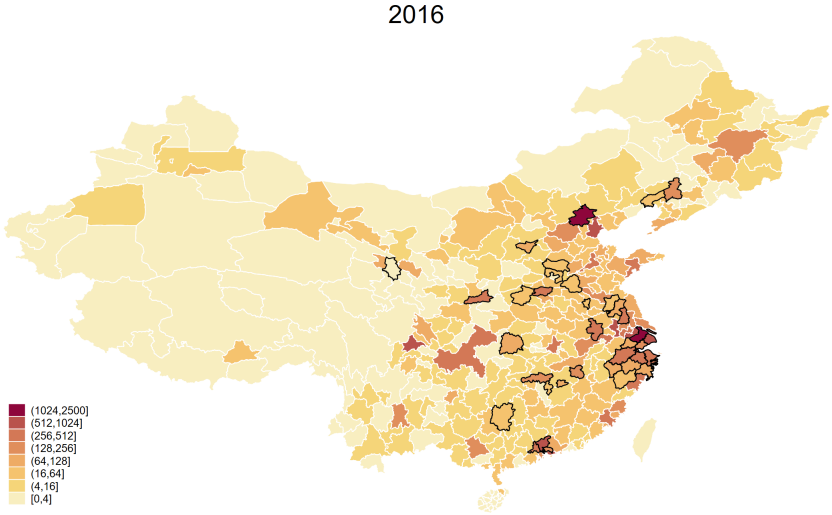

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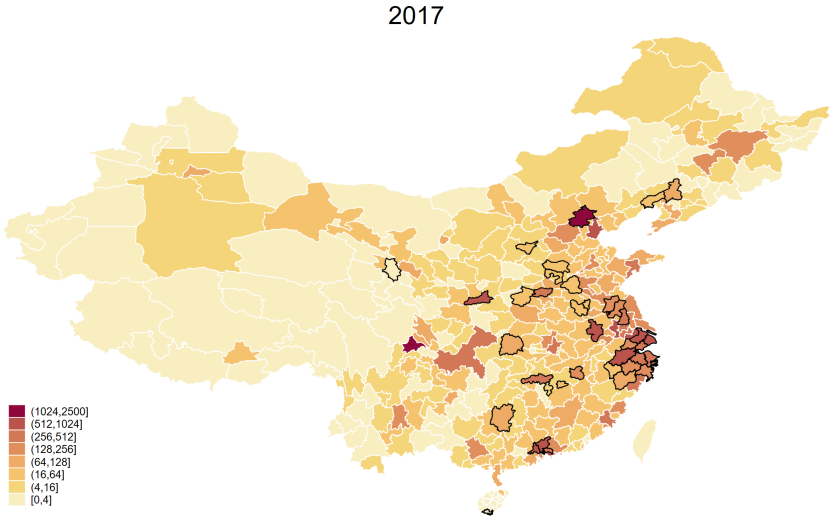

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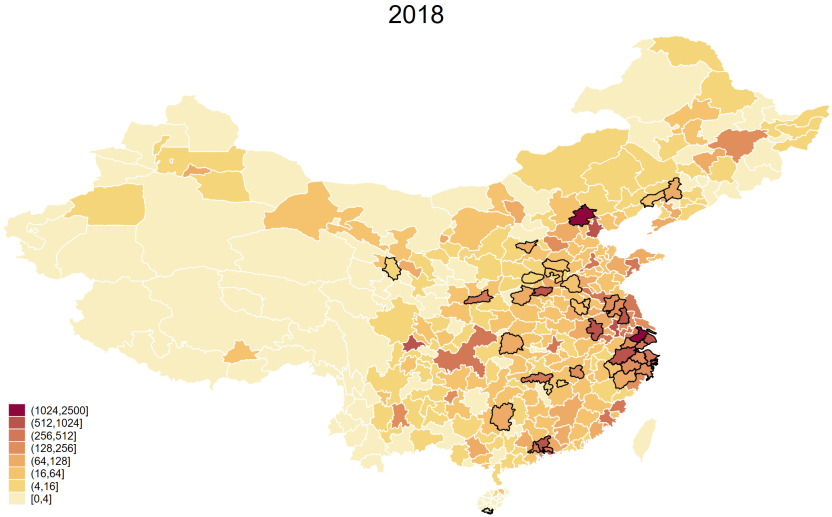

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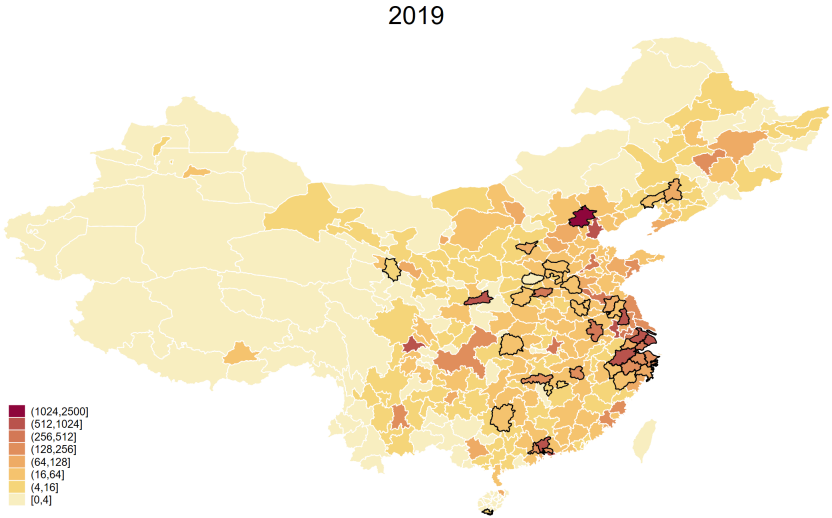


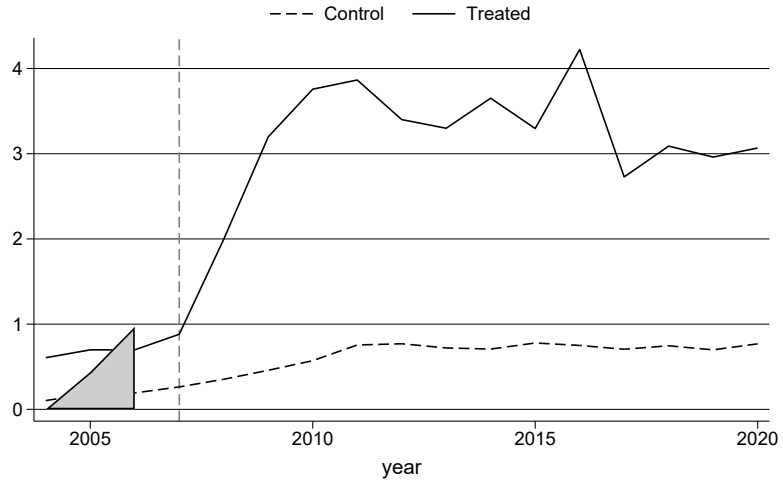
Note: black circled cities are treated by any subsidy policy

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



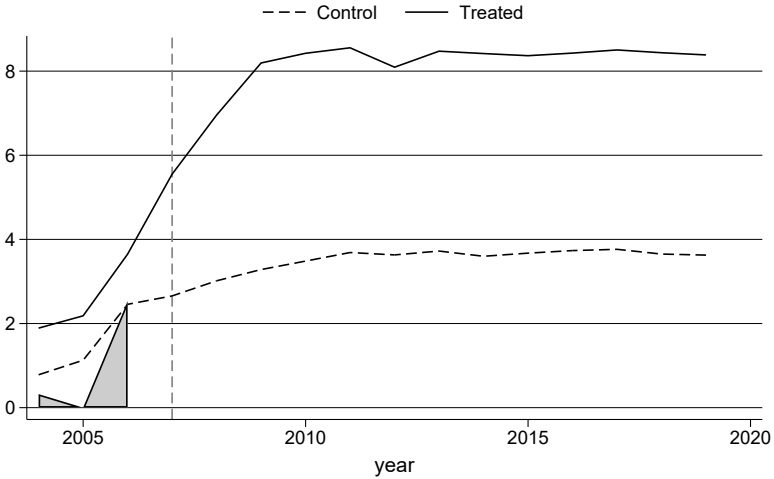
Results: Patents

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 b

Results: Revenue



Results: Exports

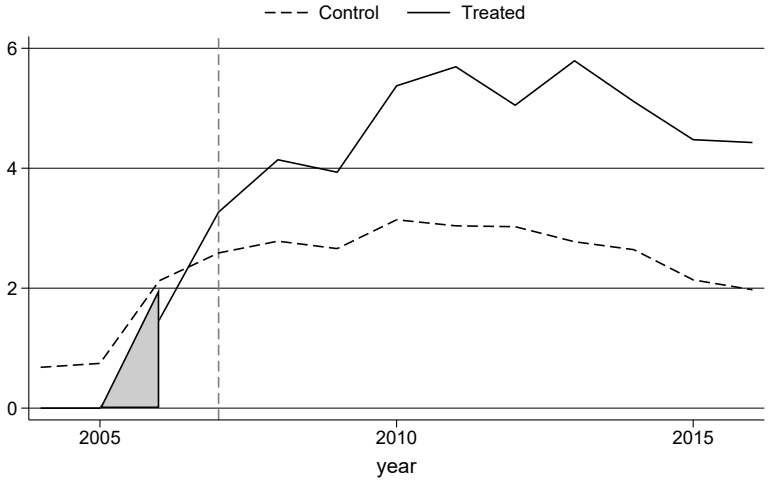
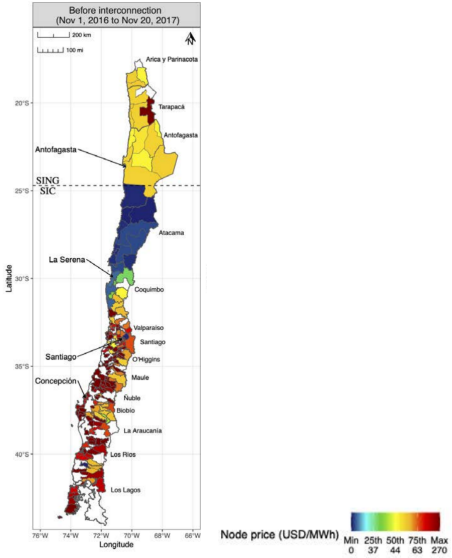


Figure: Market Integration and Spatial Vartiation in Electricity Prices (Gonzales et al. 2023)



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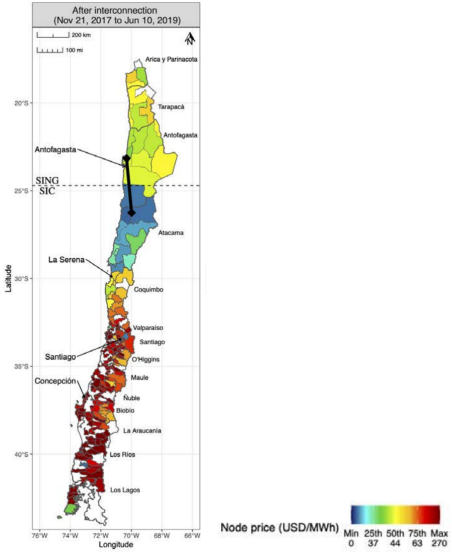

Figure: Market Integration and Spatial Vartiation in Electricity Prices (Gonzales et al. 2023)