Innovation and the Environment

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UCSD-WB Conference on Climate Adaptation

March 8, 2024

Talk Today

- Ideas to help build a climate adaptation agenda for South Asia

Elements of my approach:

1. Focus on human welfare
2. Focus on occupational change
3. Focus on productivity

Two big areas of policy:

1. Climate resilience
2. Clean energy

Climate Resilience

- Robin Burgess (LSE), Olivier Deschenes (UCSB), Dave Donaldson (MIT), and Michael Greenstone (Chicago), 2024, 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, 137(2): 785-844
- Clare Balboni (LSE), Oriana Bandiera (LSE), Robin Burgess (LSE), Anton Heil (LSE), Clément Mazet-Sonilhac (Bocconi), Munshi Sulaiman (BRAC), and Yifan Wang (LSE), Weathering Poverty, working paper

$\rightarrow$ Working on the design and evaluation of a climate adaptive rural graduation program with Gharad Bryan, Stephano Caria, Jack Thiemel, Oriana Bandiera, Munshi Sulaiman (BRAC), and Rohini Kamal (BRAC)

$\rightarrow$ Working on the design and evaluation of a urban graduation program in Bihar with India urban livelihoods program with Clare Balboni, Oriana Bandiera, and Anton Heil

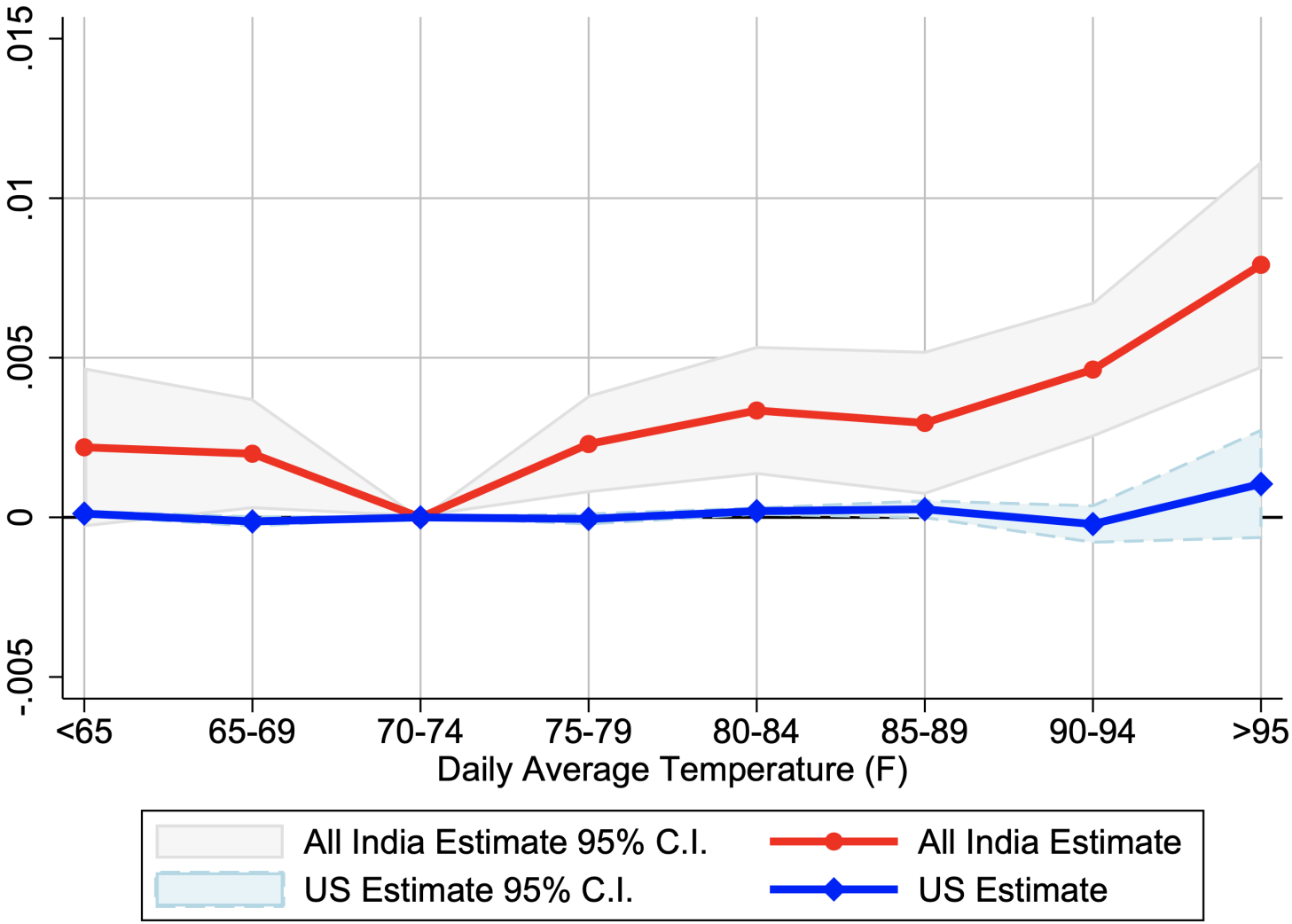
Clean Energy

- Ignacio Banares-Sanchez (LSE), Robin Burgess (LSE), David Laszlo (LSE), Pol Simpson (LSE), John Van Reenen (LSE & MIT), and Yifan Wang (LSE), 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, Econometrica, 91(5): 1659-1693

$\rightarrow$ Working on global diffusion of solar energy with the Ignacio Banares-Sanchez, David Laszlo, Pol Simpson, John Van Reenen, and Yifan Wang

Climate Resilience

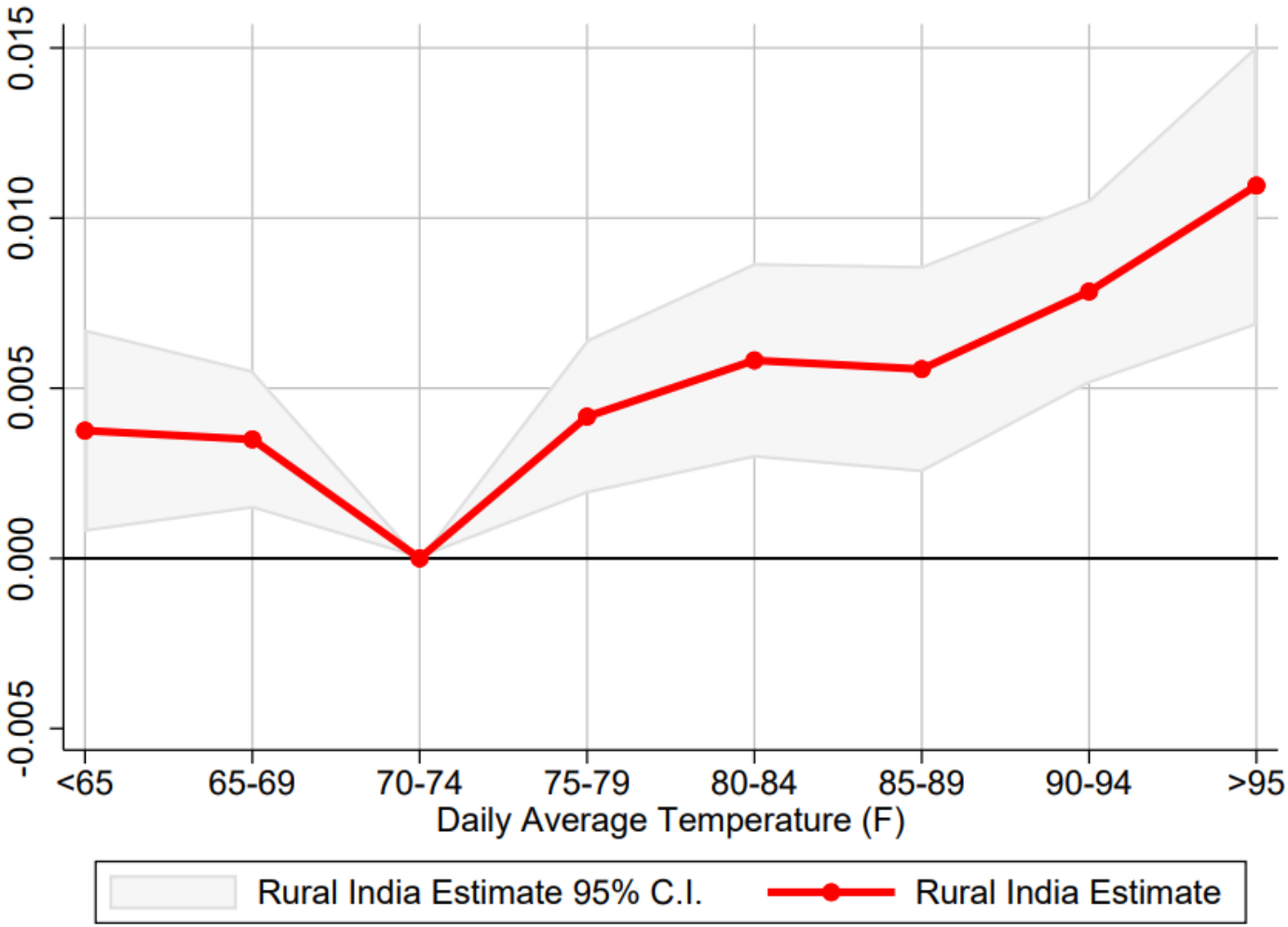
Figure 1: Estimated Impact of Daily Temperature on Log All-Age Mortality Rates in India and the United States



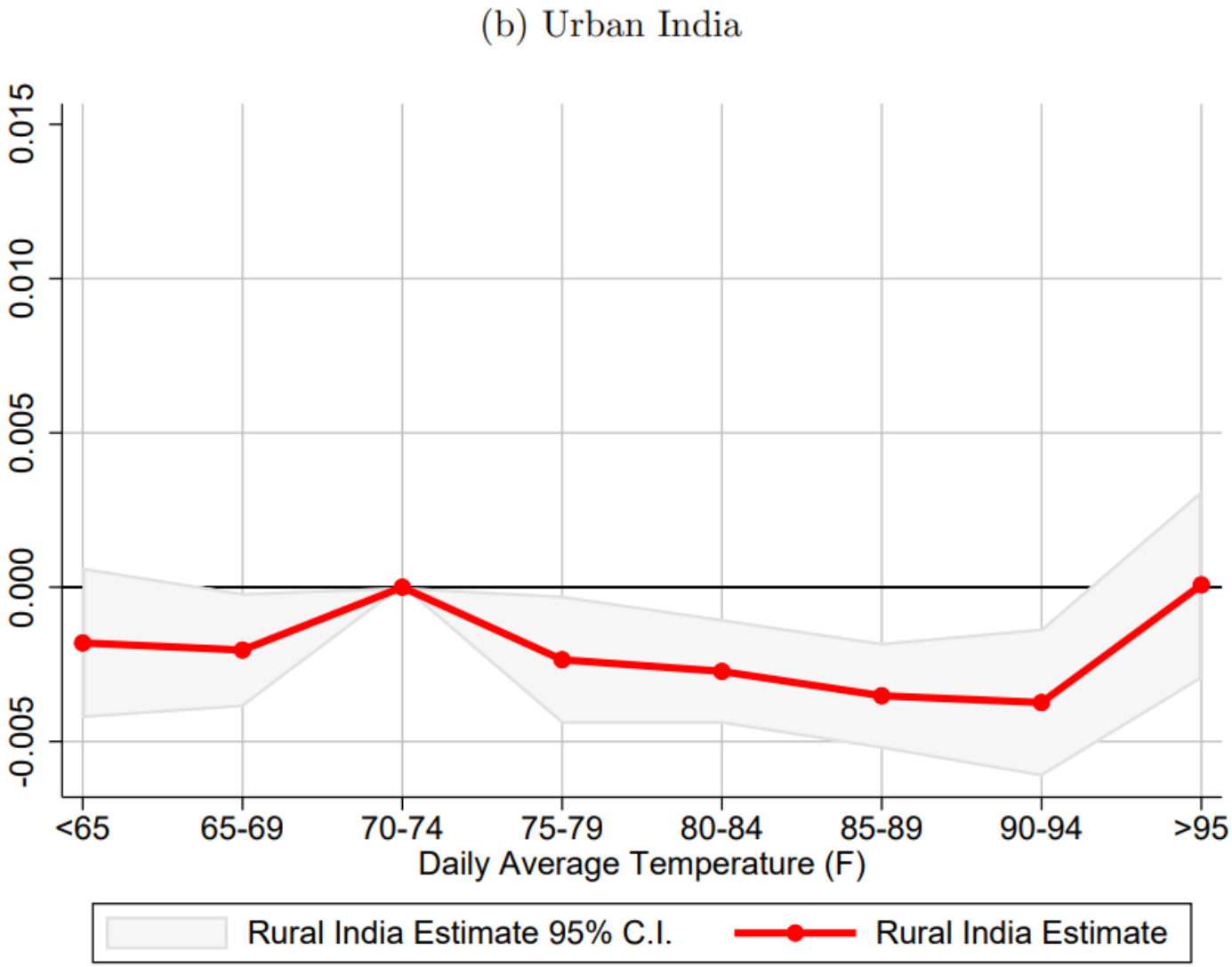
Climate Resilience

Figure 3: Estimated Impact of Daily Temperature on the Log All-Age Mortality Rate

(a) Rural India



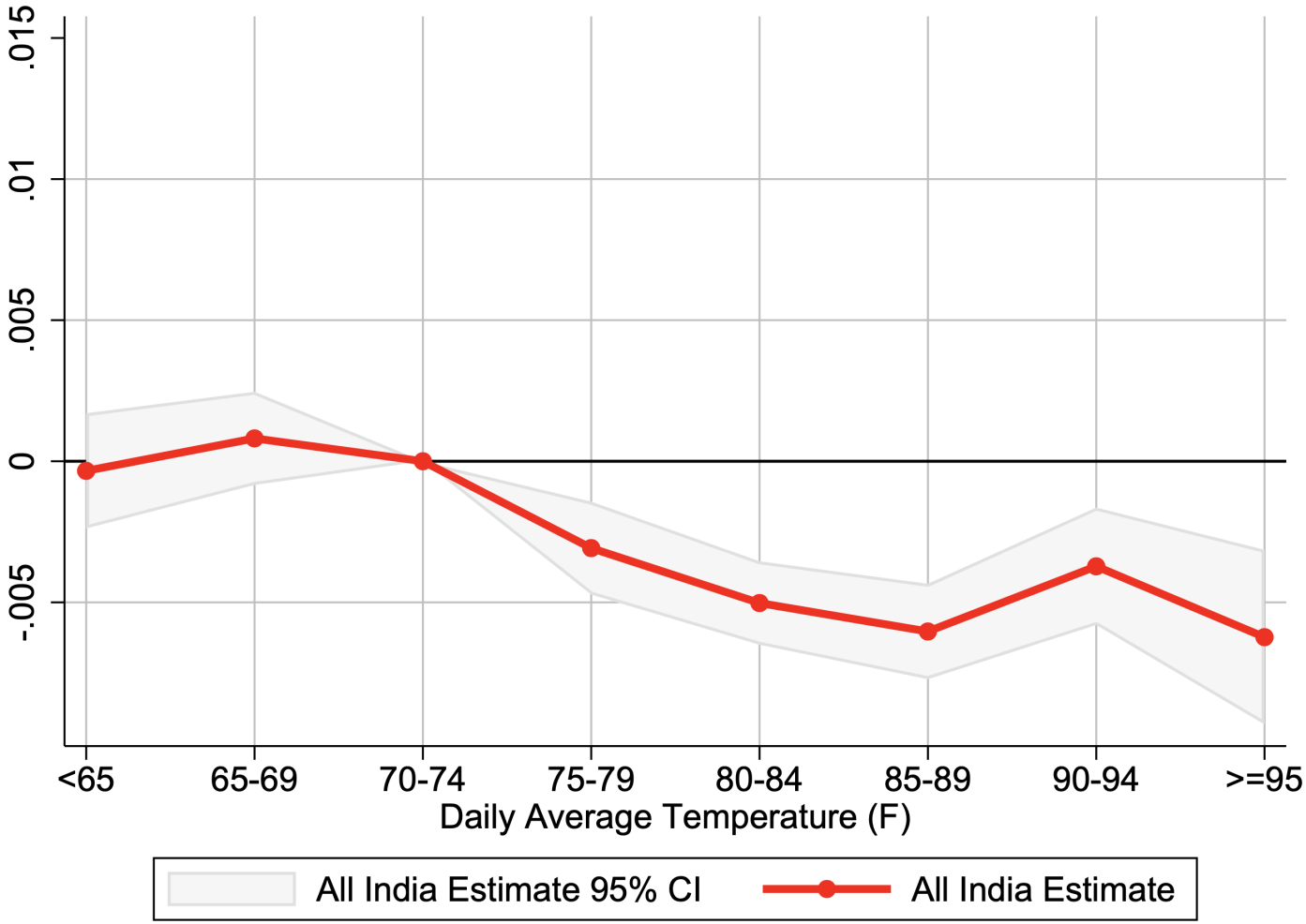
Climate Resilience



Climate Resilience

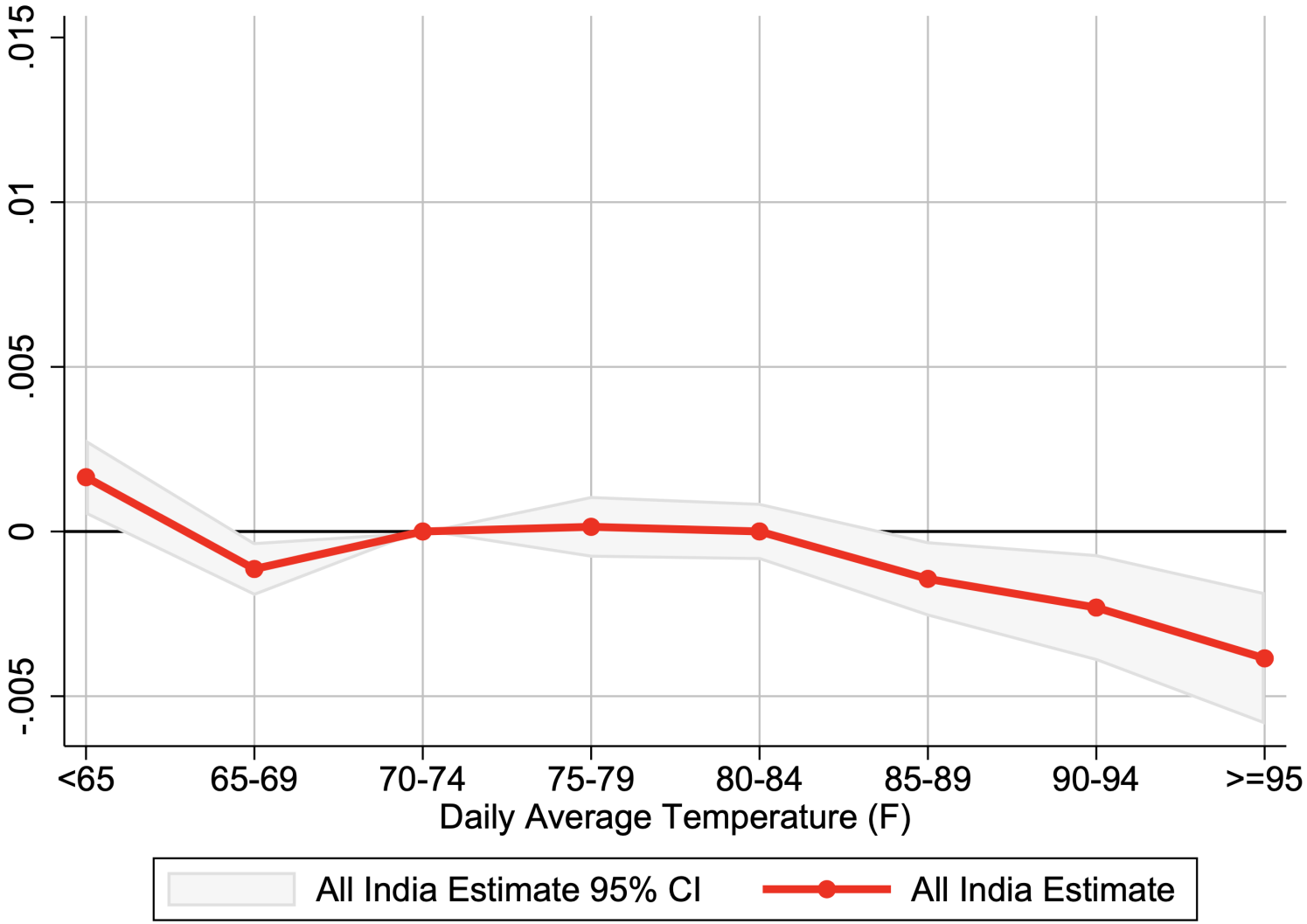
Figure 6: Impact of Daily Temperature on Log Agricultural Productivity Outcomes

(a) Agricultural Yield



Climate Resilience

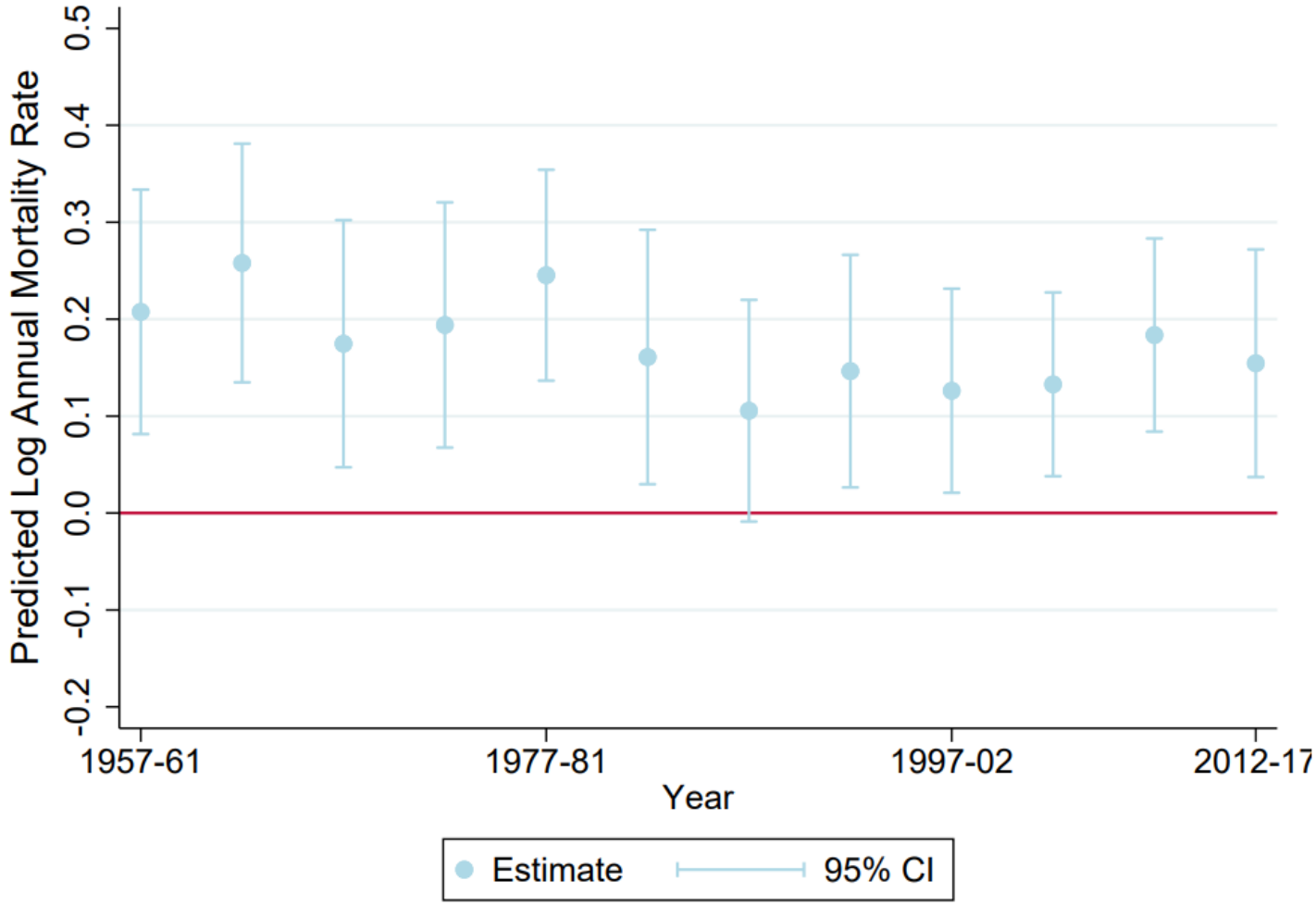
Figure 7: Estimated Impact of Daily Temperature on Log Agricultural Real Wages



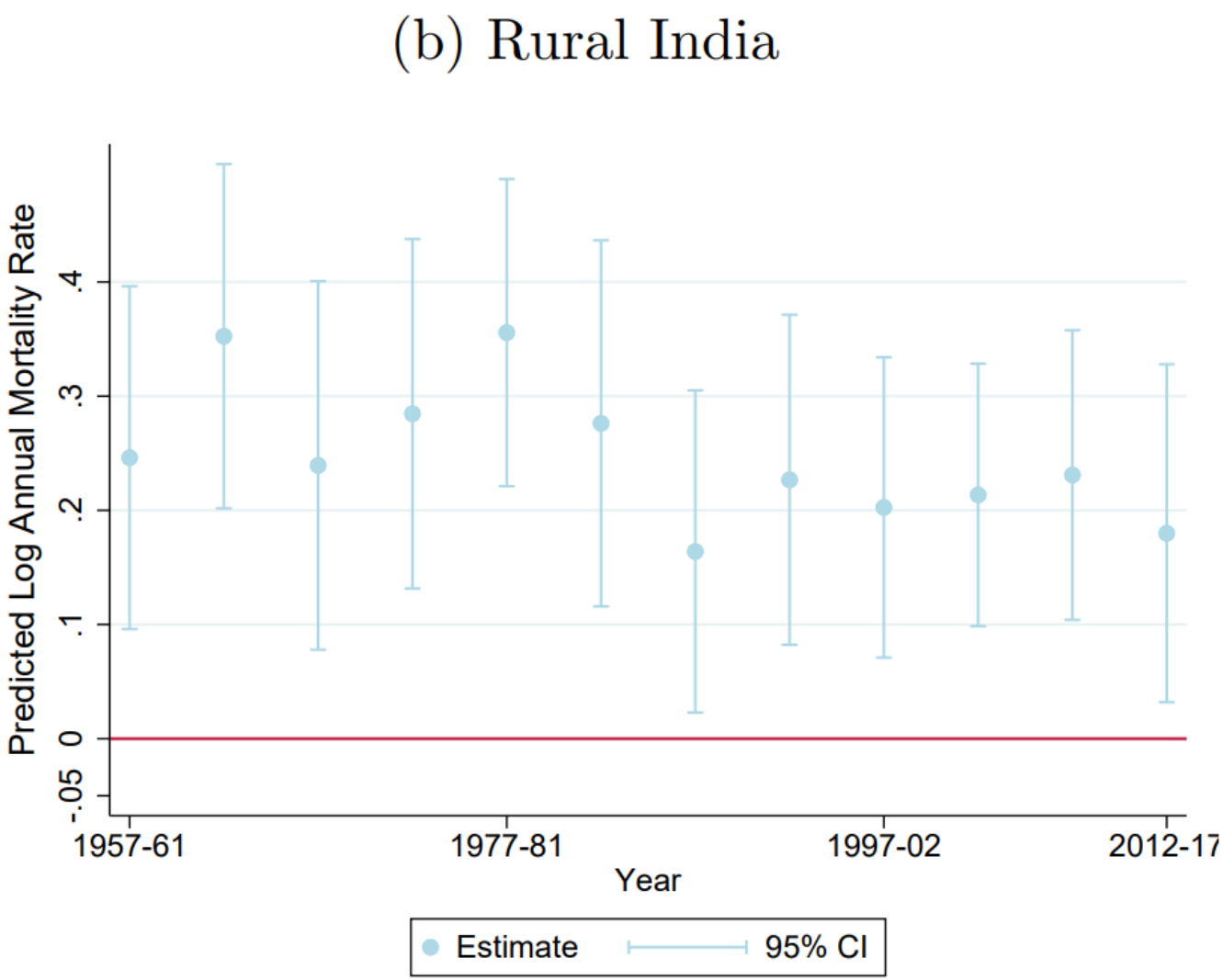
Climate Resilience

Figure 8: Estimated Impact of Daily Temperatures on Log All-Age Mortality Rate by Five Year period

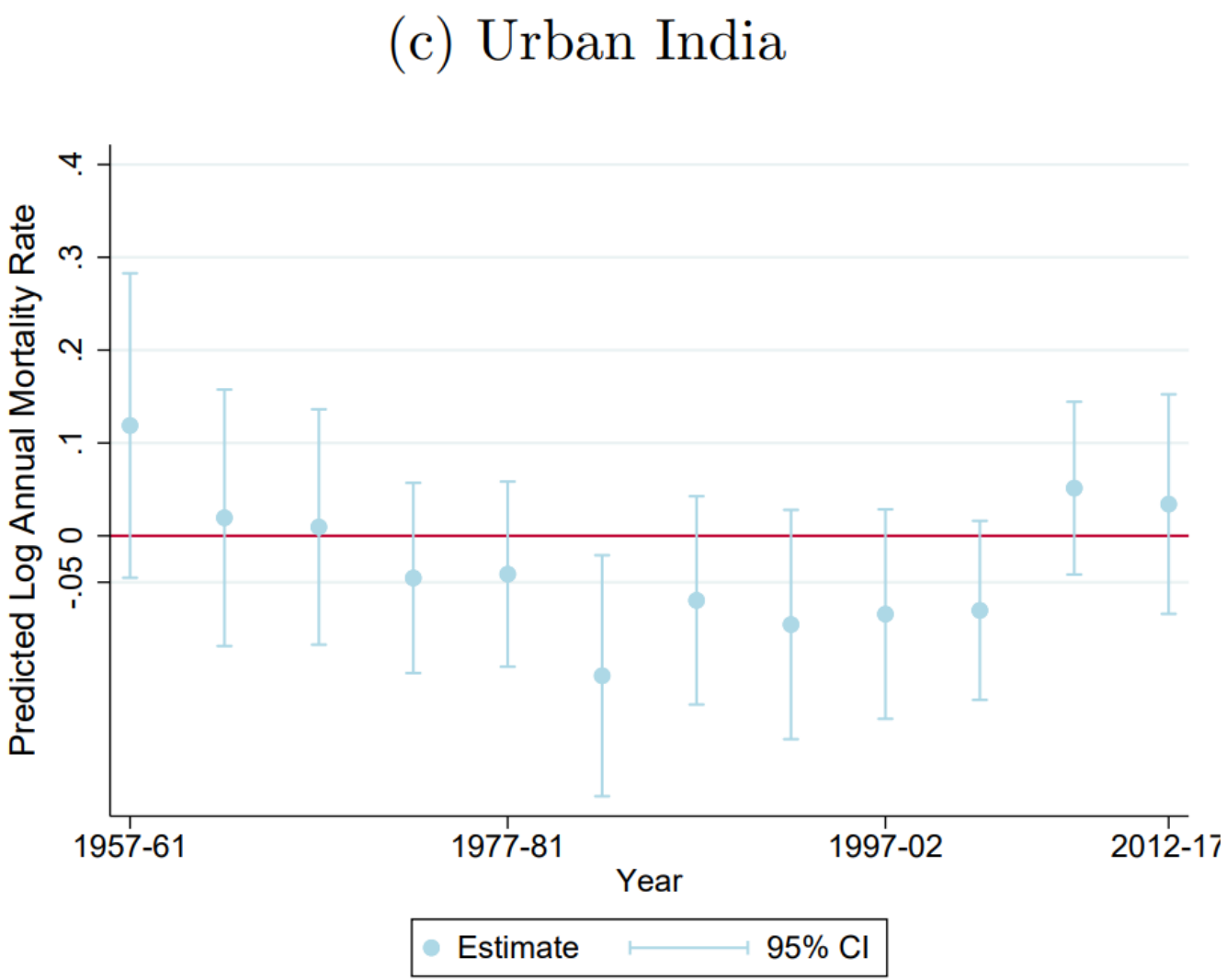
(a) All India



Climate Resilience



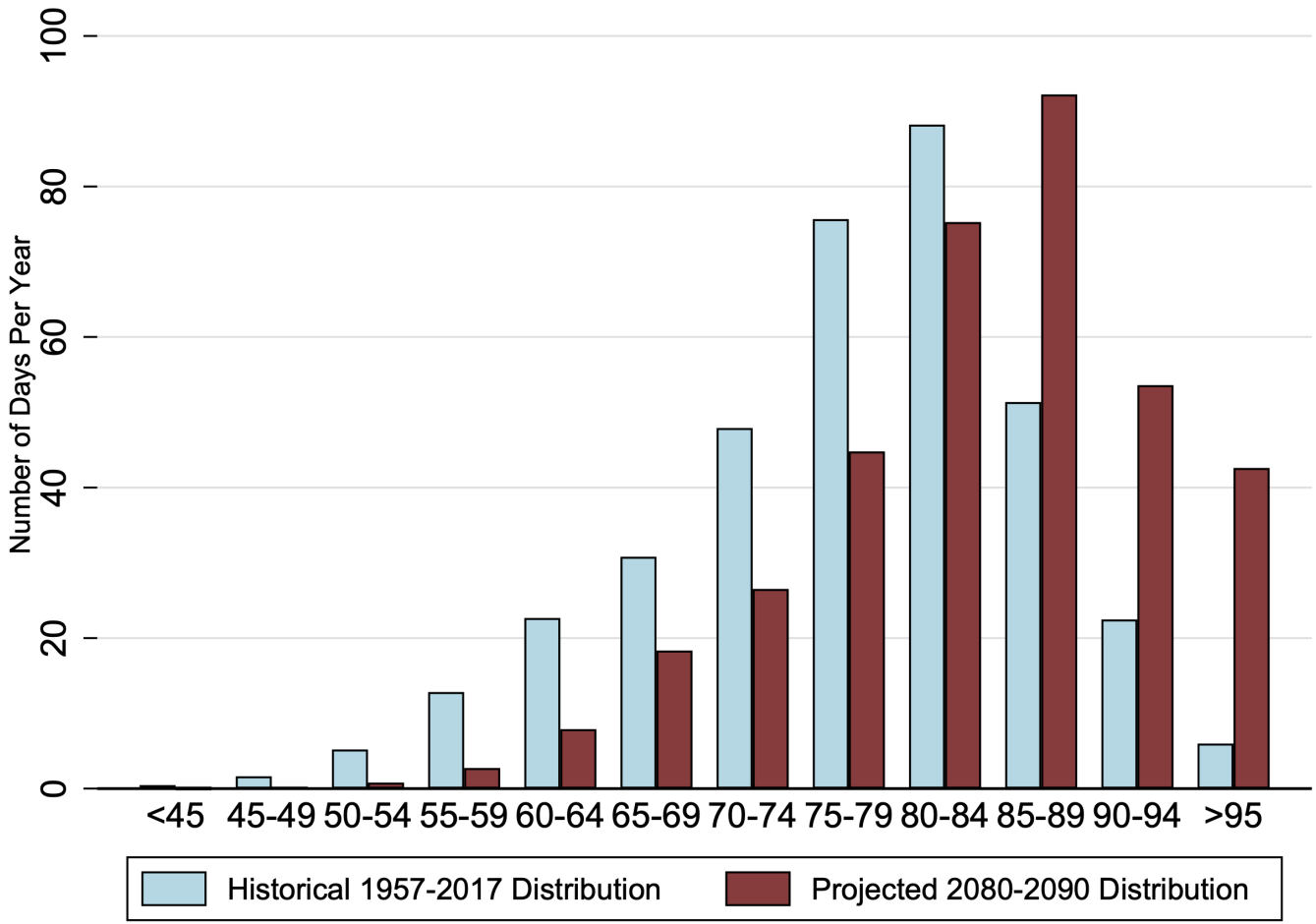
Climate Resilience



Climate Resilience

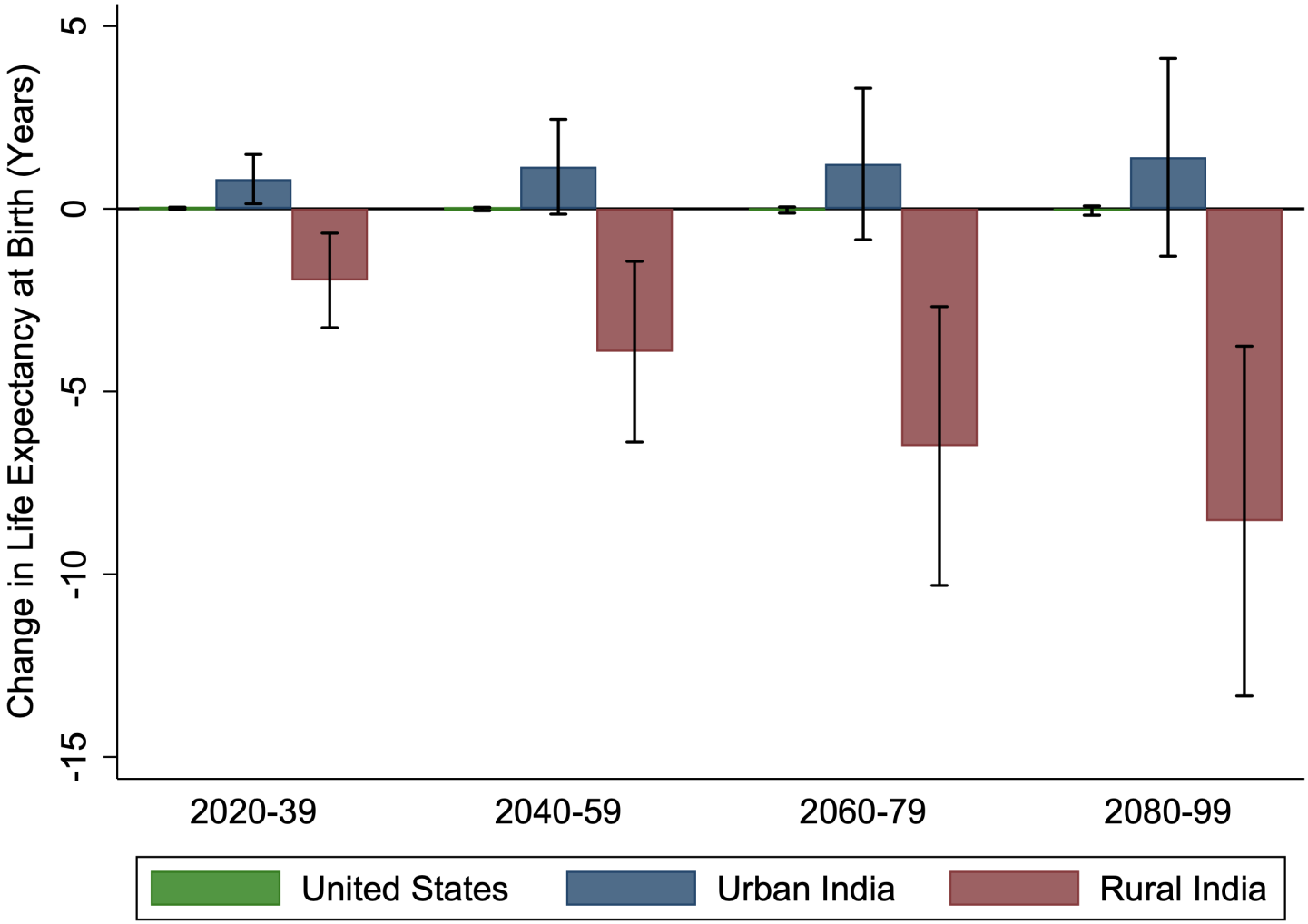
Figure 2: Temperature Distribution in 1957-2017 and 2080-2099

(a) India



Climate Resilience

Figure 9: Predicted Impact of Climate Change on Indian and US Life Expectancy at Birth, Based on Bias-Corrected CCSM4 Model: 2020-2099



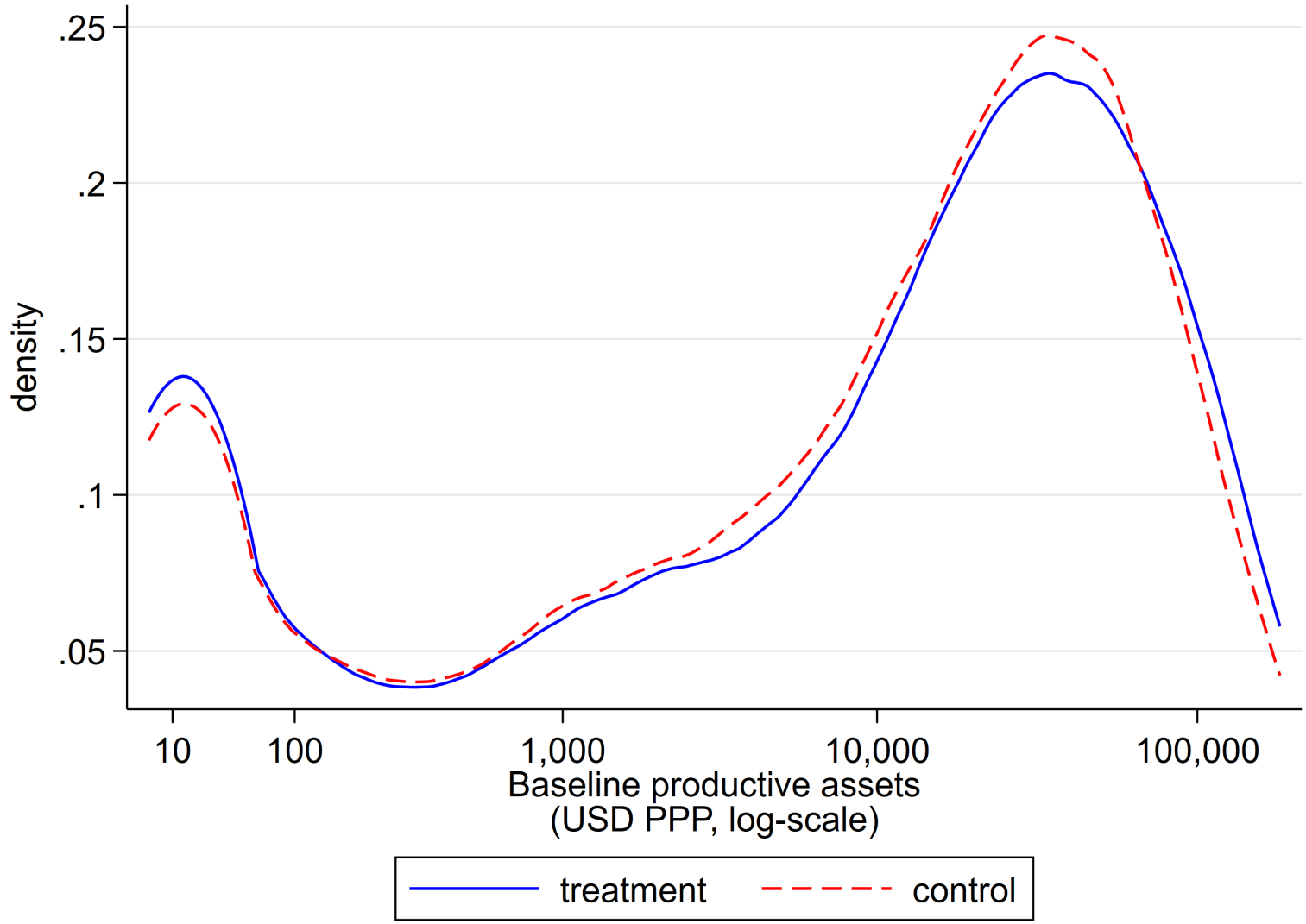
Climate Resilience

TABLE I

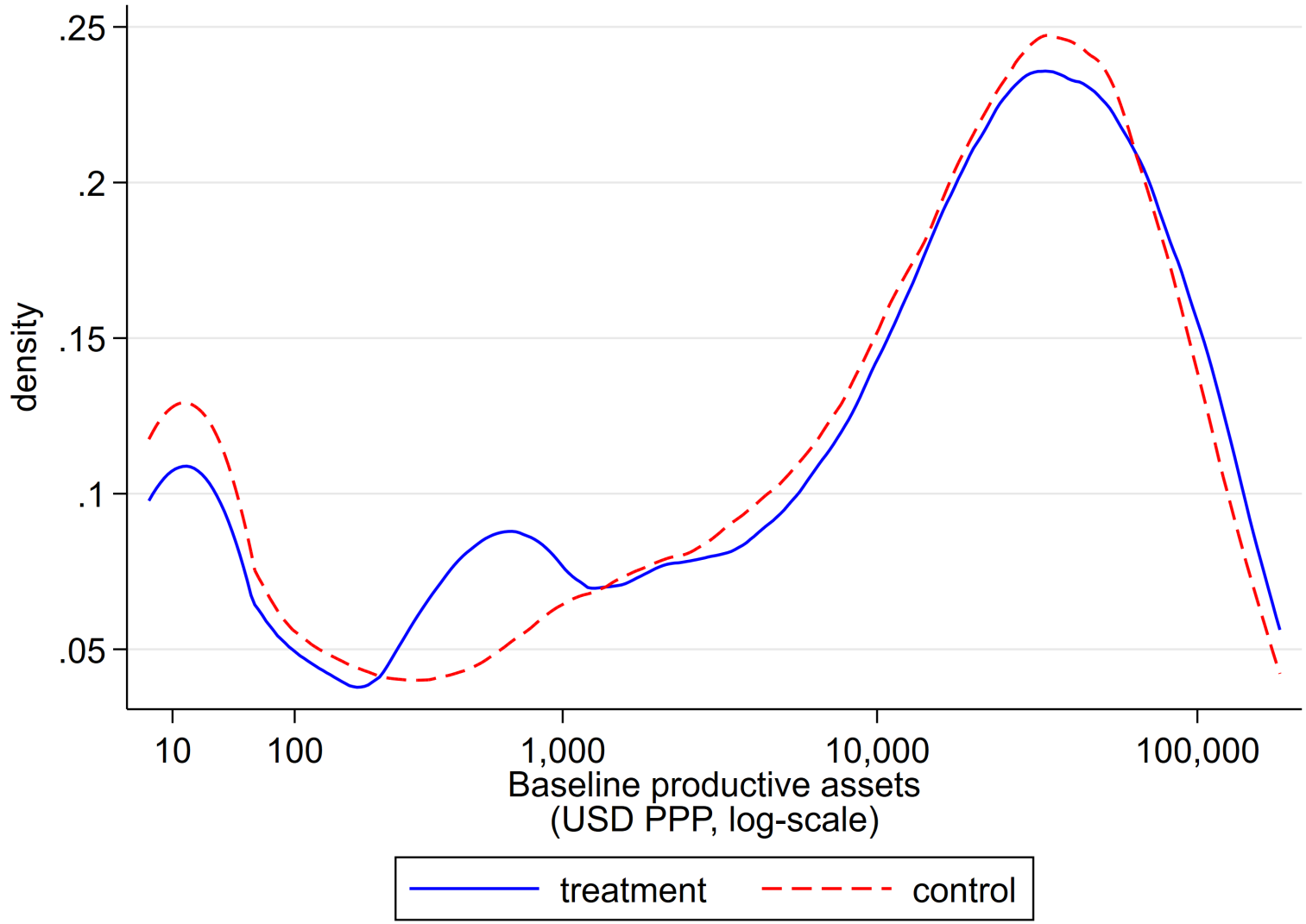
THE ECONOMIC LIVES OF WOMEN IN BANGLADESHI VILLAGES AT BASELINE

	Ultra-poor (1)	Near poor (2)	Middle class (3)	Upper class (4)
In labor force	0.74	0.67	0.69	0.71
	(0.44)	(0.47)	(0.46)	(0.46)
Total hours worked per year	990.91	767.62	555.83	496.83
	(893.68)	(811.72)	(596.80)	(493.42)
Total days worked per year	252.06	265.07	303.55	325.62
	(136.74)	(141.27)	(122.21)	(102.25)
Hourly income (BDT)	5.61	5.63	9.83	21.67
	(21.22)	(10.93)	(38.09)	(69.95)
Years of formal education	0.56	1.26	1.99	3.72
	(1.63)	(2.43)	(2.99)	(3.74)
Literate	0.07	0.17	0.27	0.51
	(0.26)	(0.37)	(0.44)	(0.50)
Body mass index (BMI)	18.38	18.96	19.49	20.60
	(2.40)	(2.56)	(2.82)	(3.40)
Household savings (1,000 BDT)	0.15	0.40	1.62	8.61
	(0.83)	(1.24)	(10.62)	(29.29)
Productive assets (1,000 BDT)	5.03	12.87	145.36	801.77
	(30.43)	(71.59)	(310.50)	(945.29)
Productive assets + loans (1,000 BDT)	5.64	14.77	150.22	812.83
	(30.92)	(72.47)	(312.51)	(947.65)
Observations	6,732	7,340	6,742	2,215

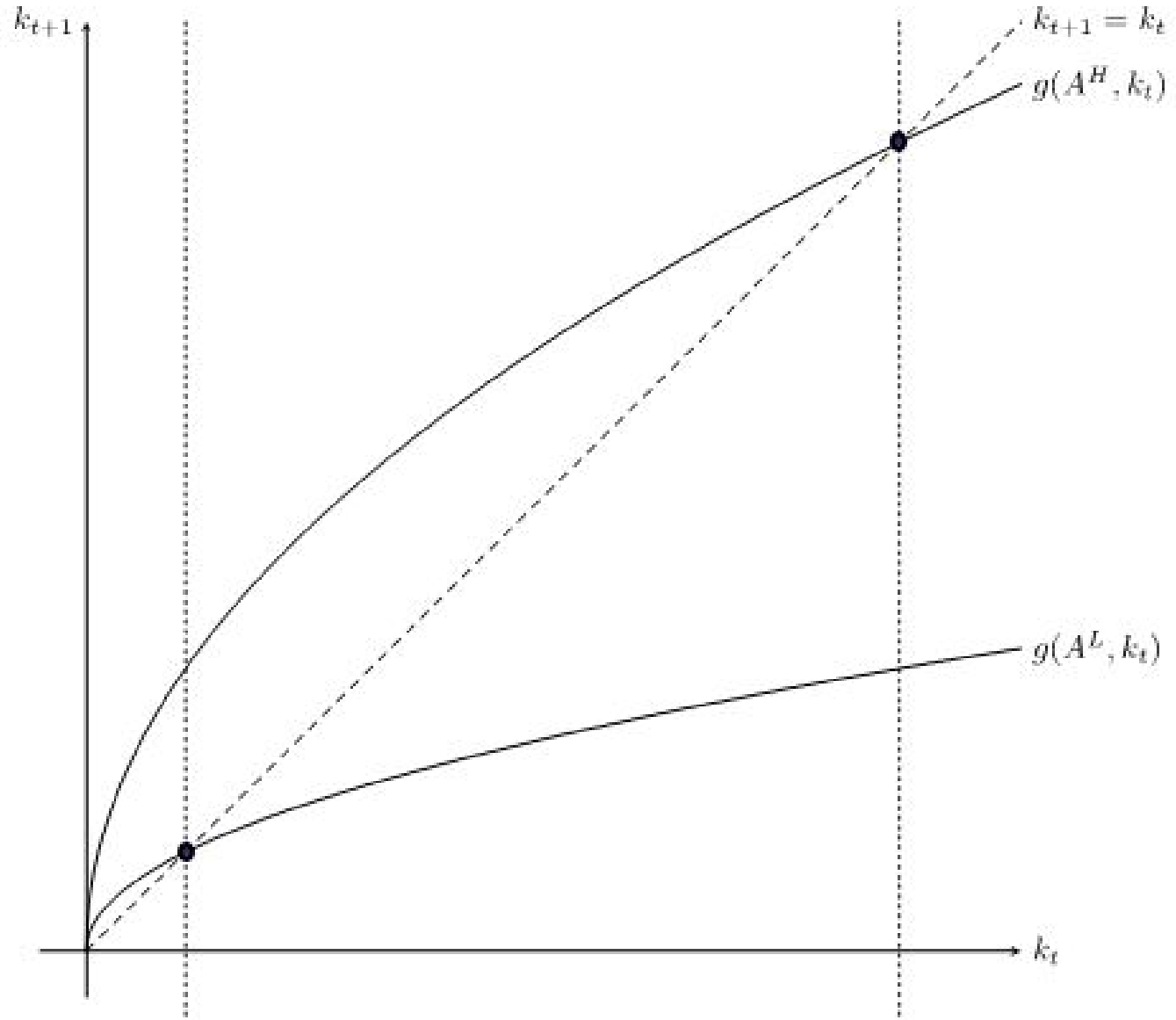
Climate Resilience



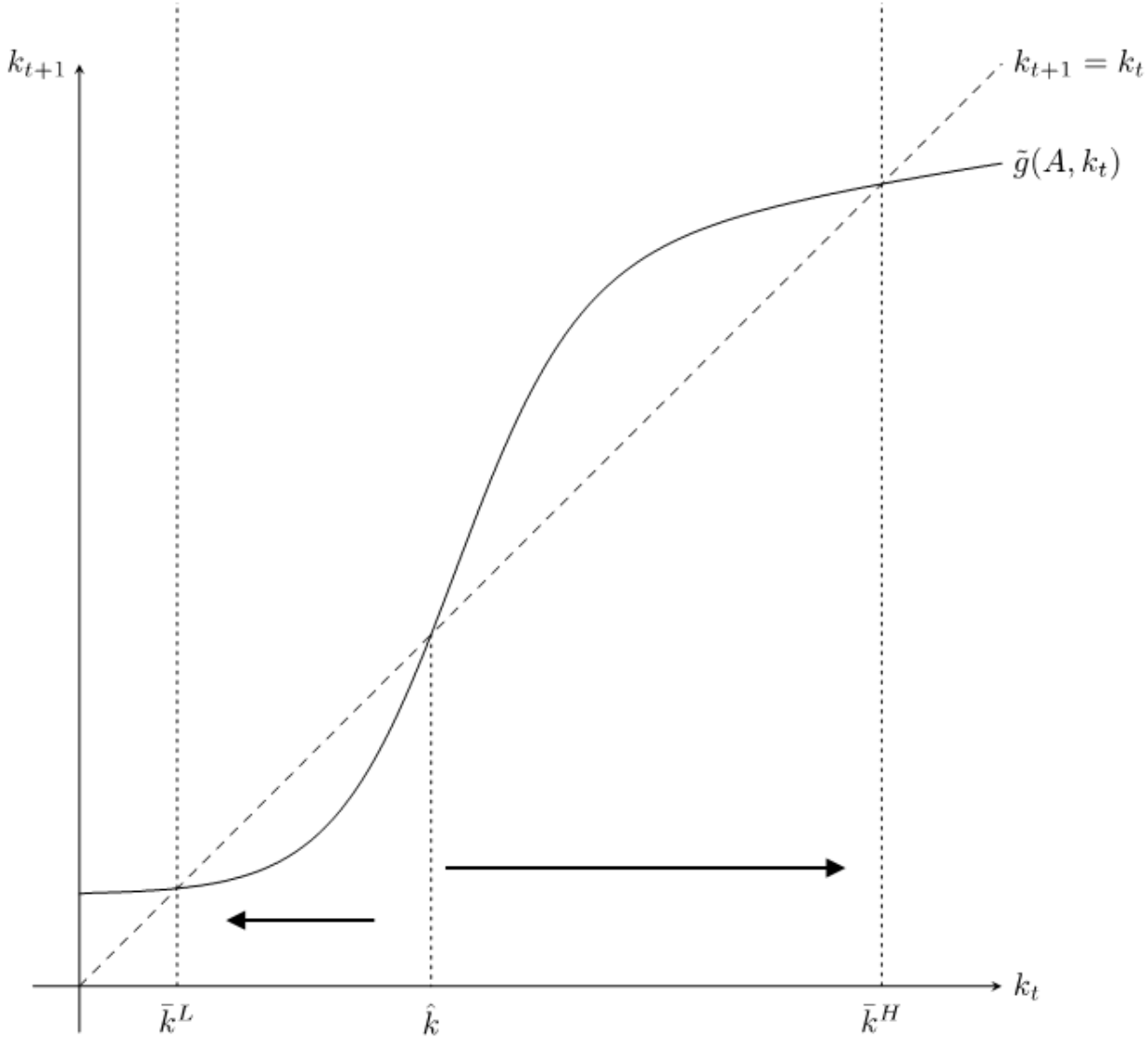
Climate Resilience



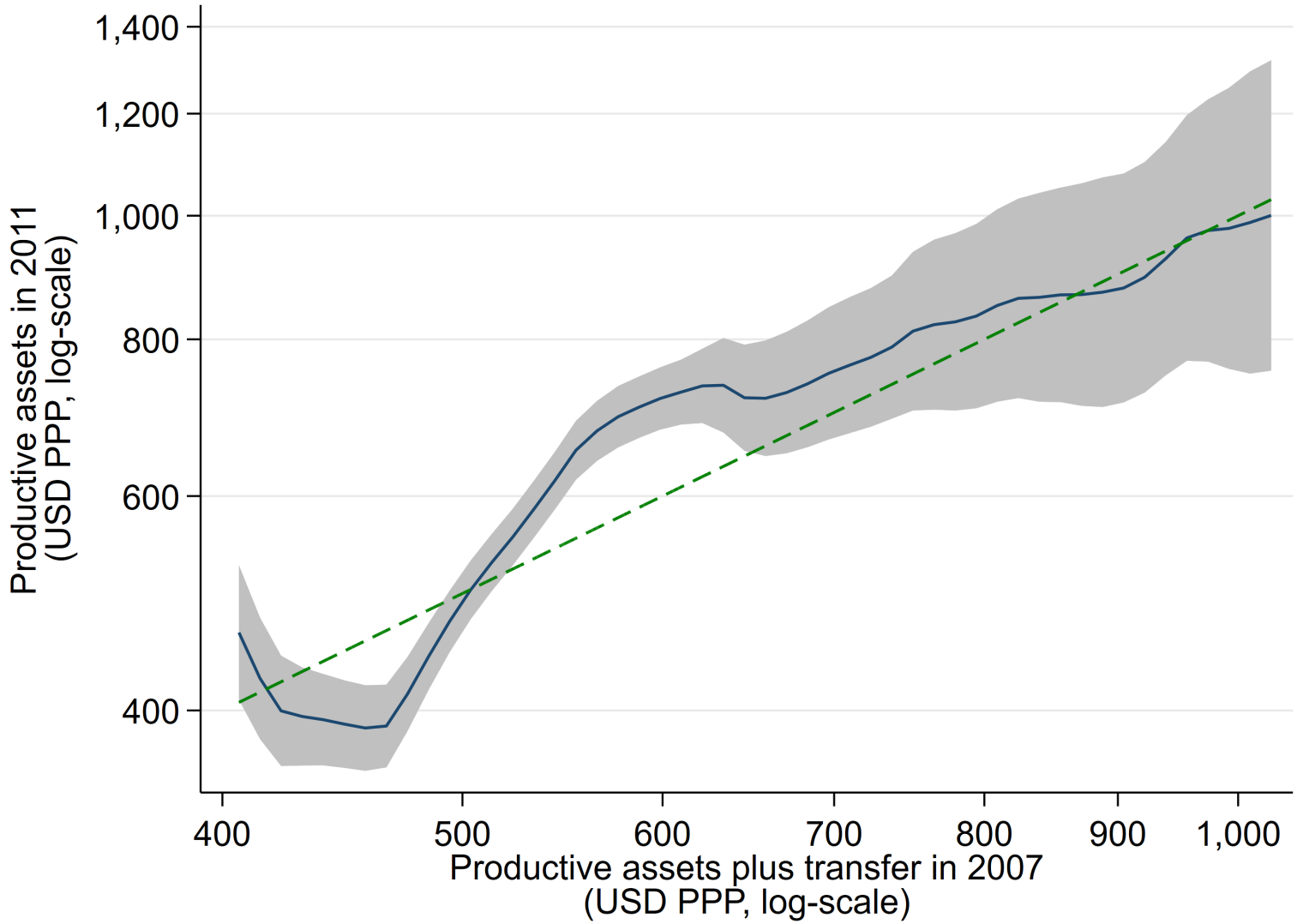
Climate Resilience



Climate Resilience



Climate Resilience



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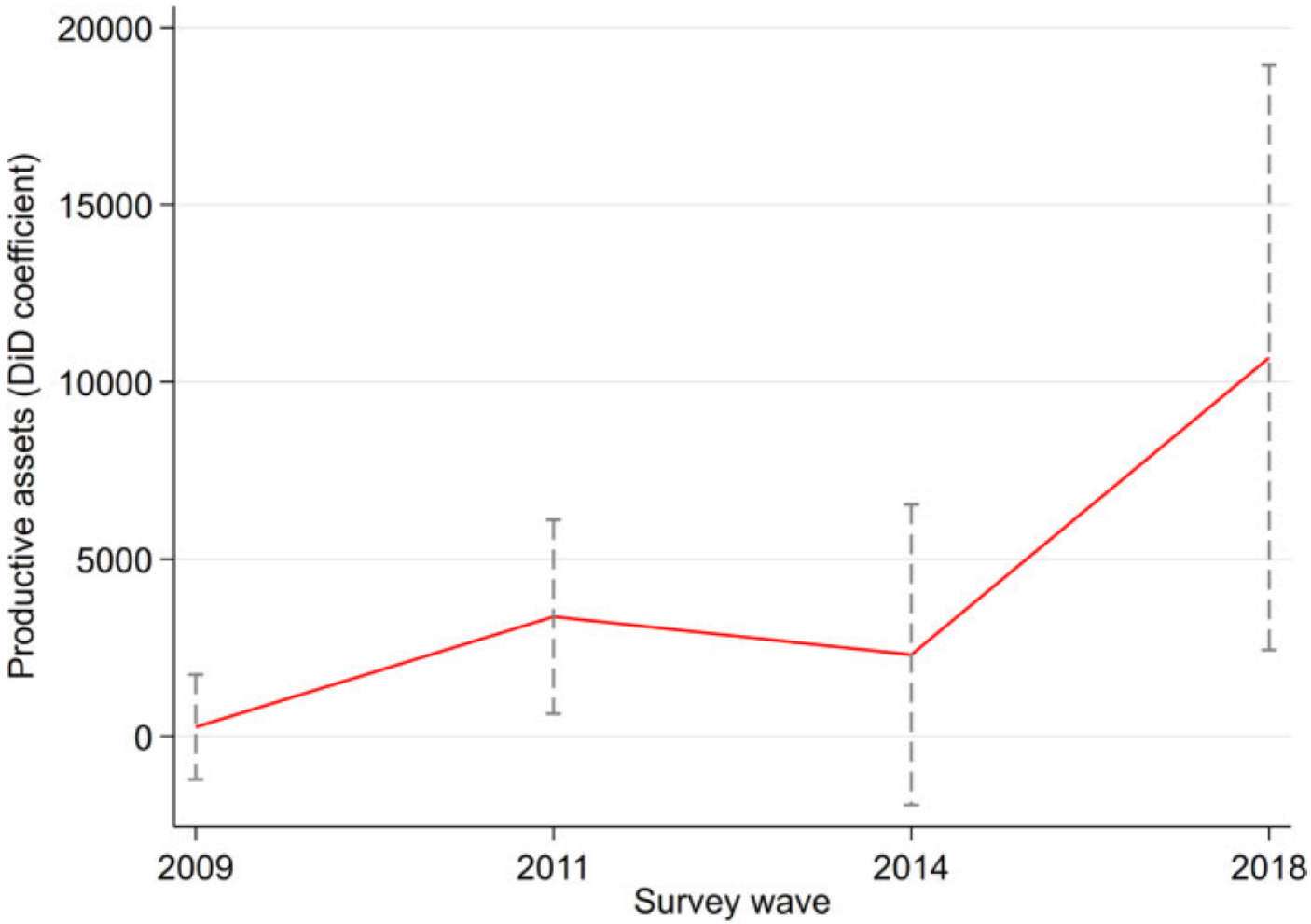
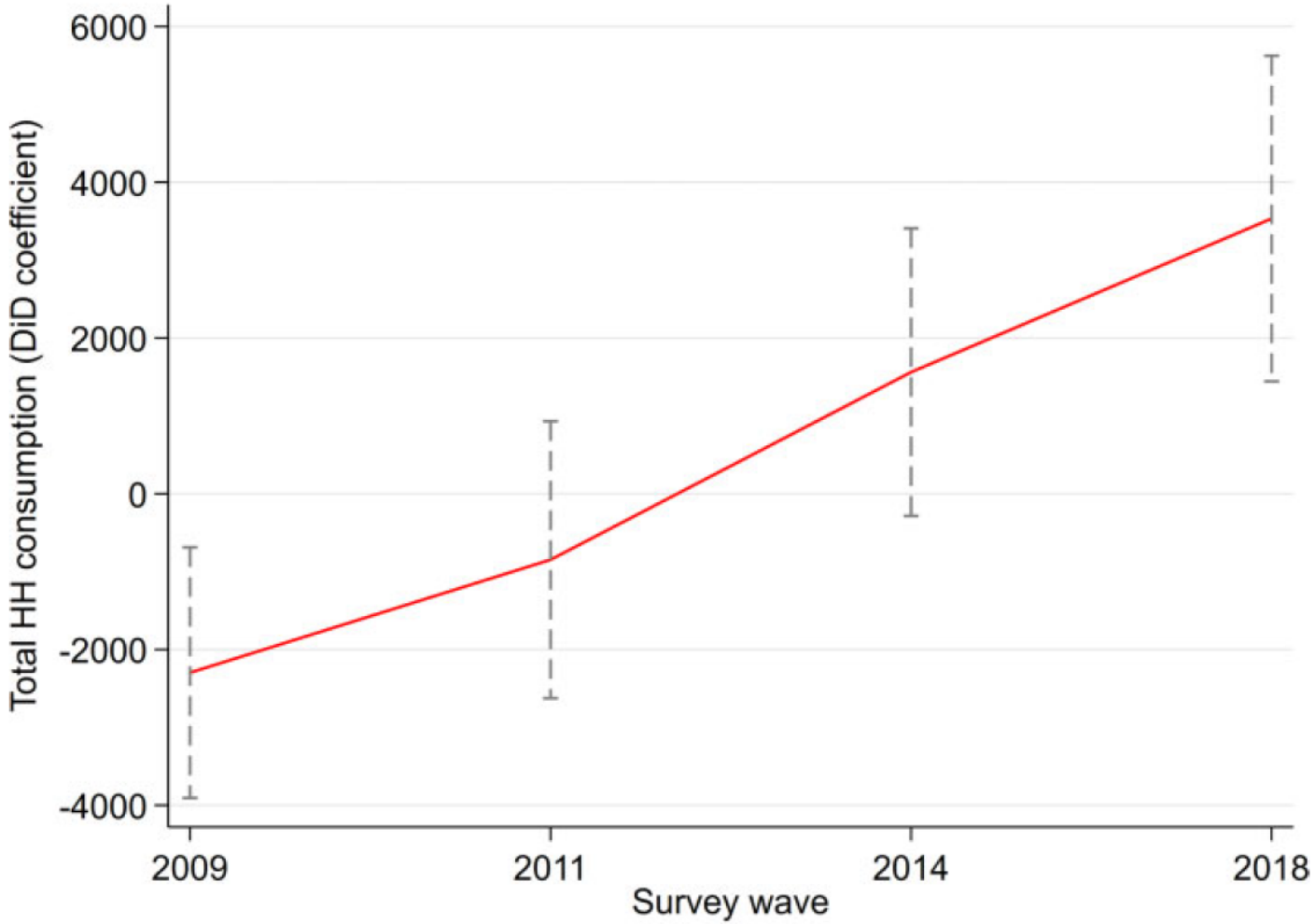


(A) Productive Assets

Climate Resilience



(B) Total Consumption

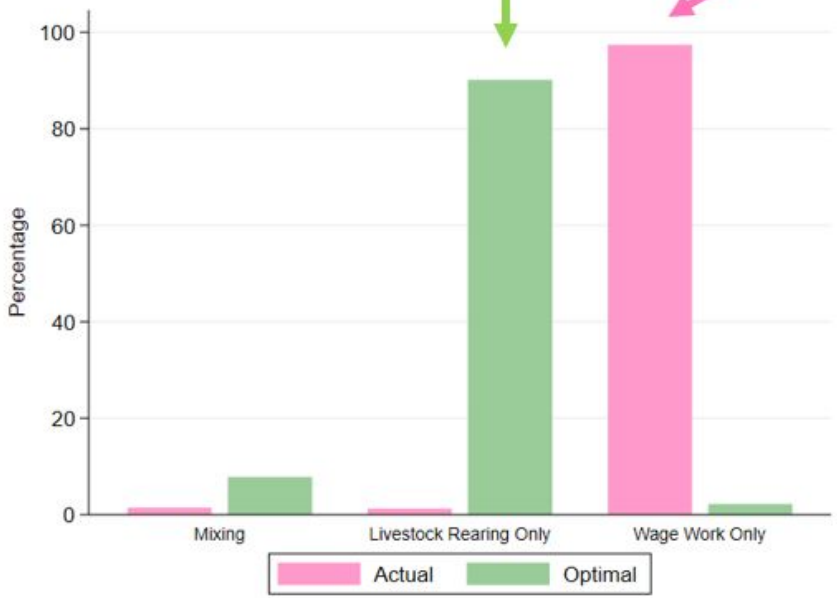
Climate Resilience

1

- Assume ultra-poor had assets = upper mode
- Use model to estimate optimal occupation
- Compute payoff at optimal occupation

2

Compute payoff at actual occupation

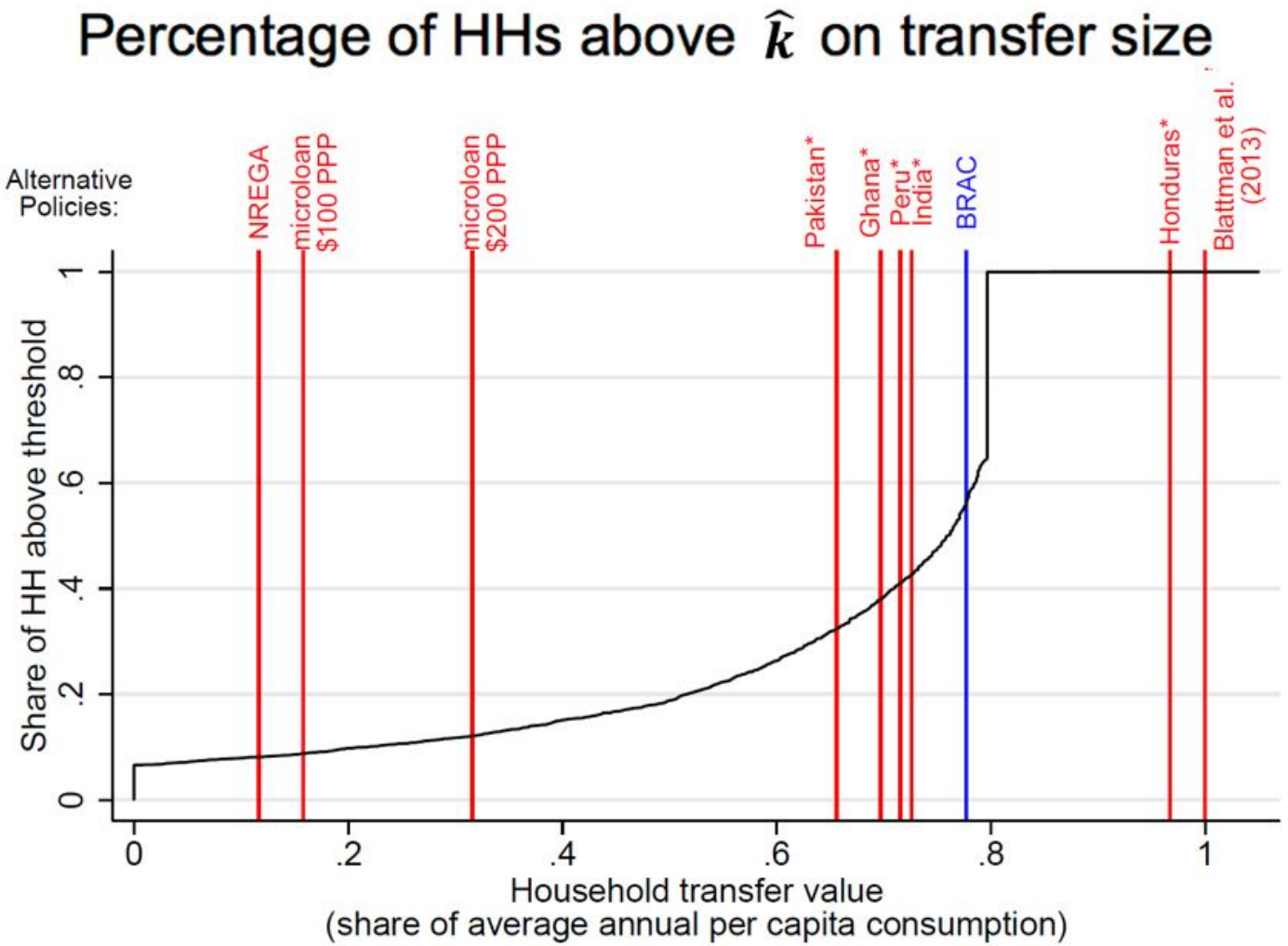


At capital of middle and upper class 90% should specialise in livestock

At baseline capital 97% specialize in wage labor

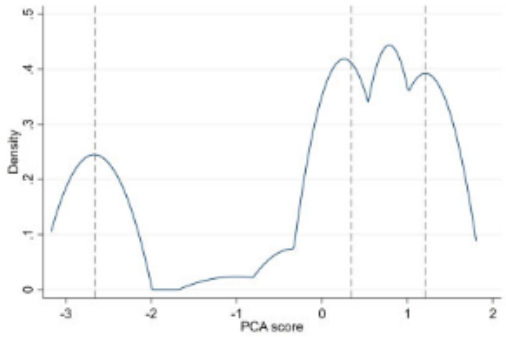
Model suggests that 96% of individuals are misallocated at baseline

Climate Resilience

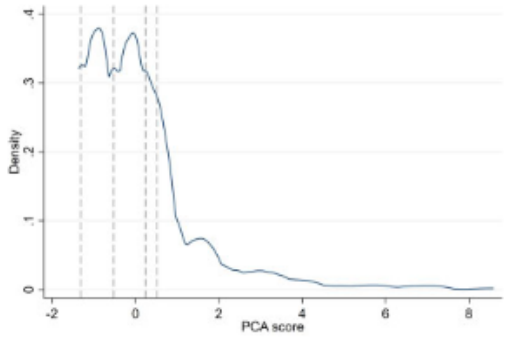


* Country names refer to study sites in Banerjee et al. (2015)

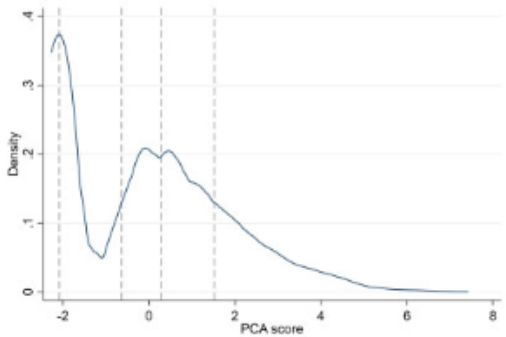
Climate Resilience



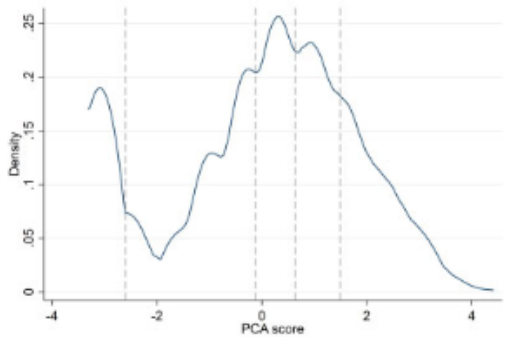
(A) Bangladesh, 2014



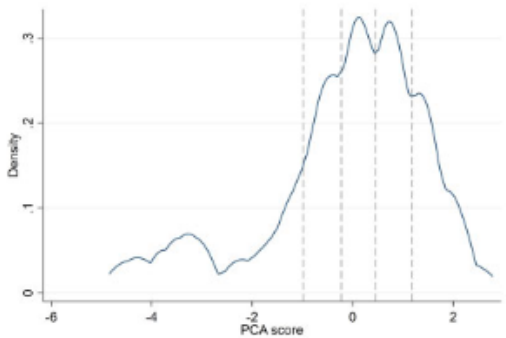
(B) India, 2015



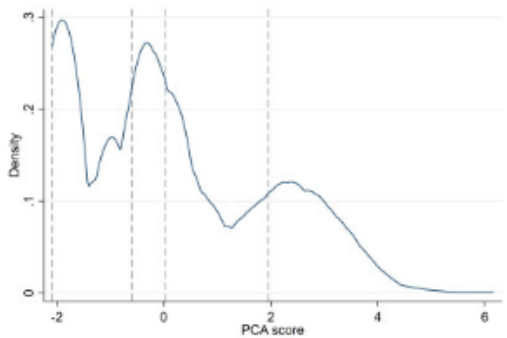
(C) Pakistan, 2017



(D) Afghanistan, 2015

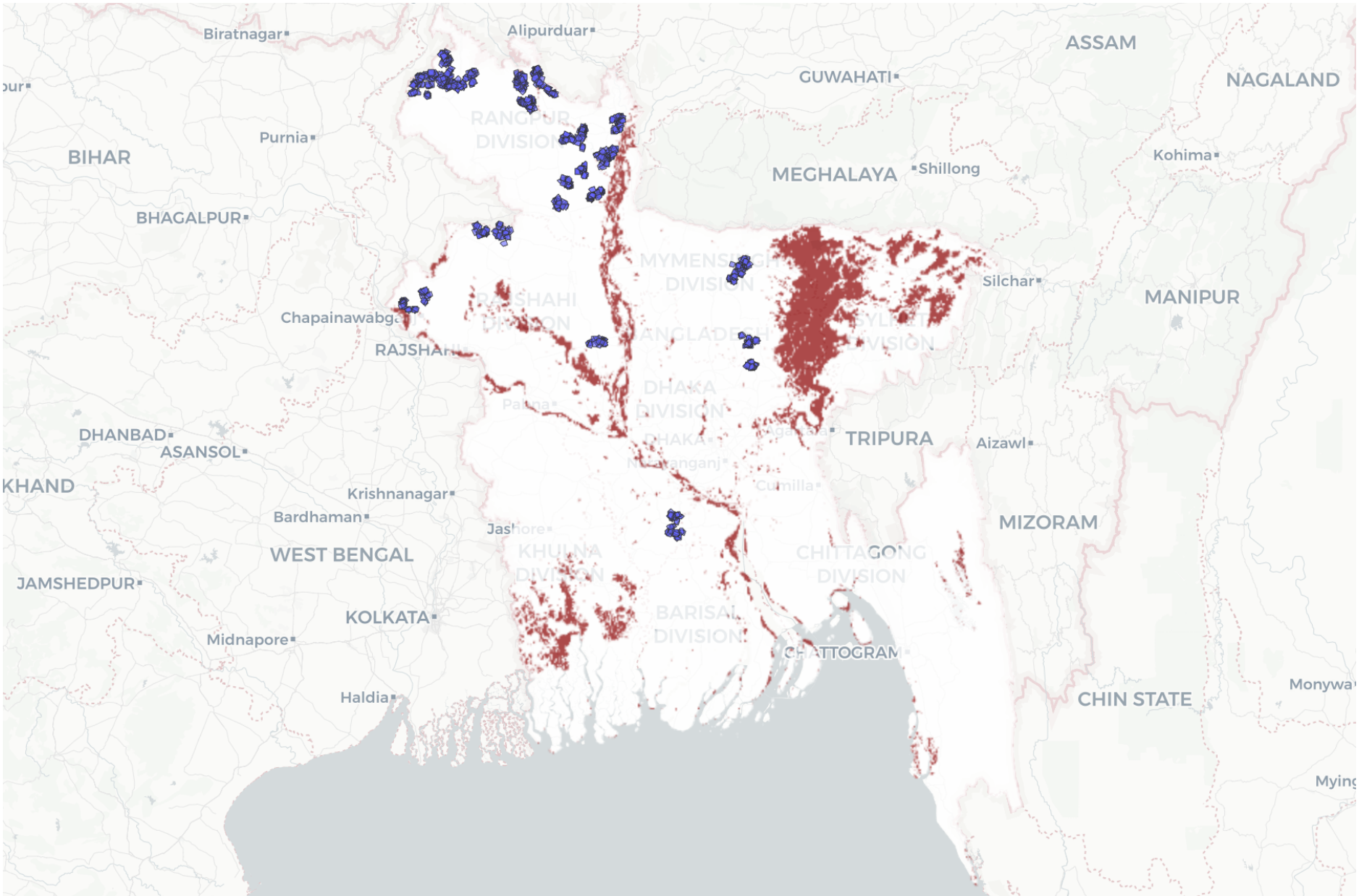


(E) Nepal, 2016

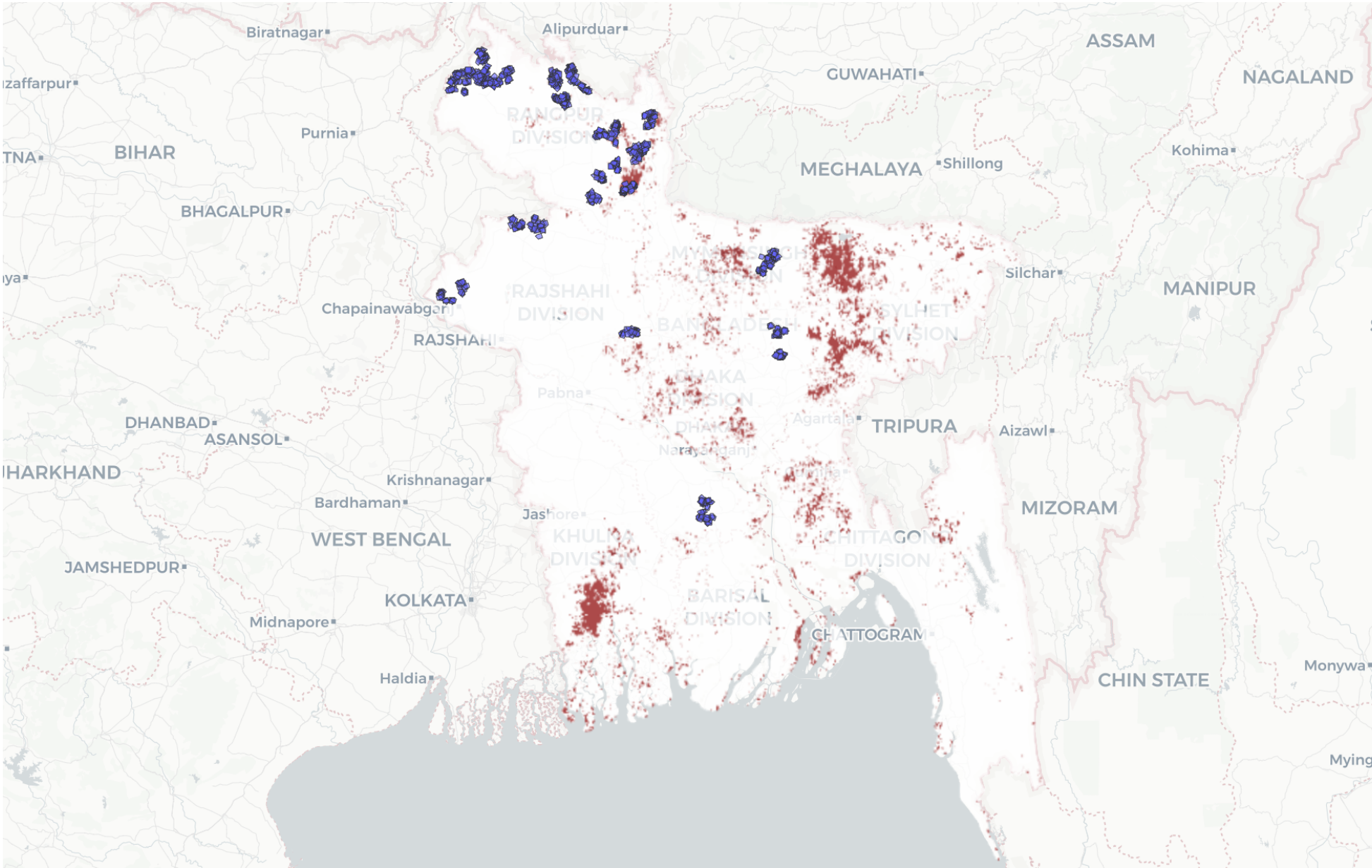


(F) Myanmar, 2015

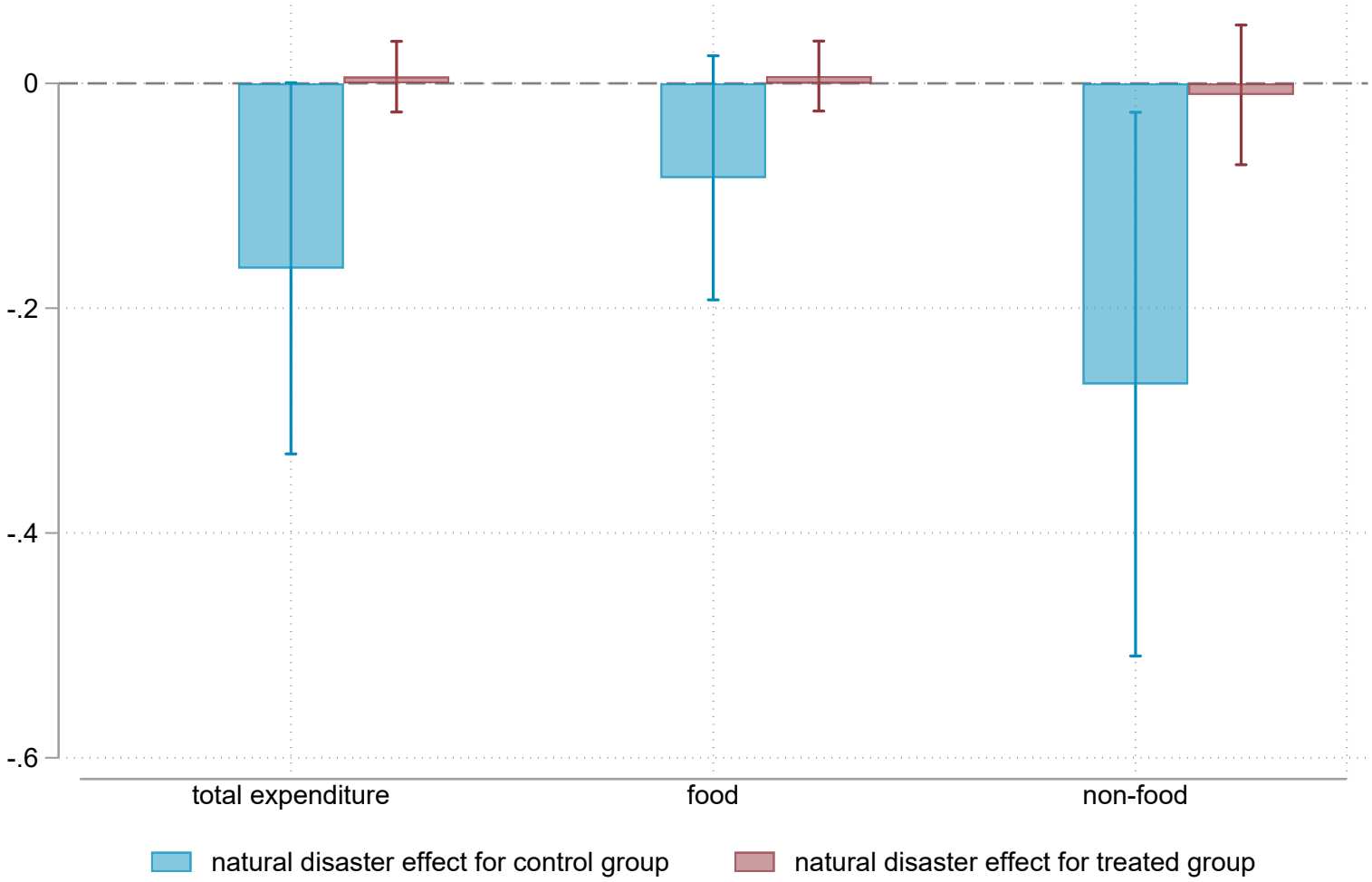
Climate Resilience: flood on Oct 10th, 2010



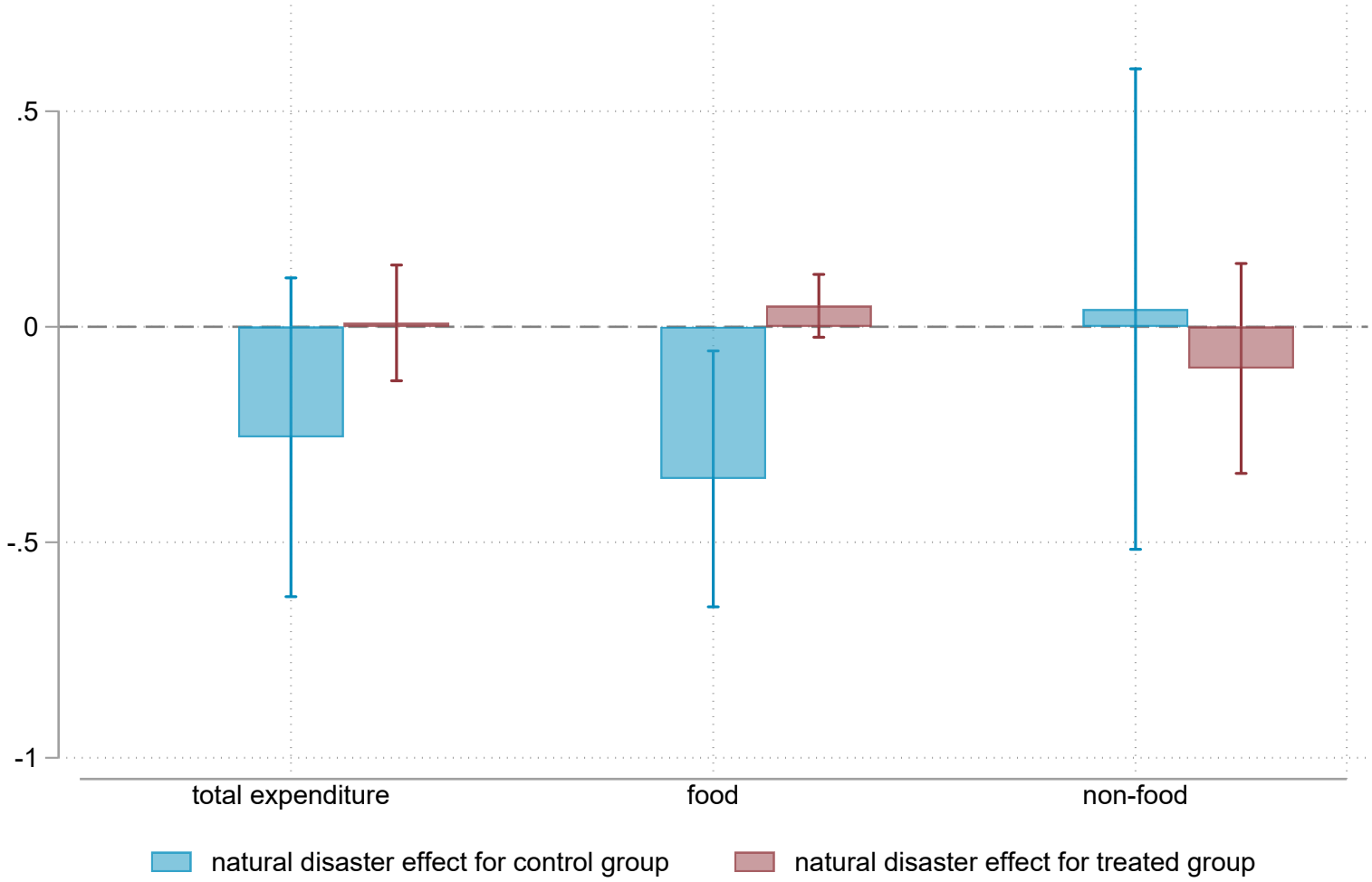
Climate Resilience: drought on June dekad 1, 2011



Climate Resilience: consumption



Climate Resilience: consumption (unexpected shock)



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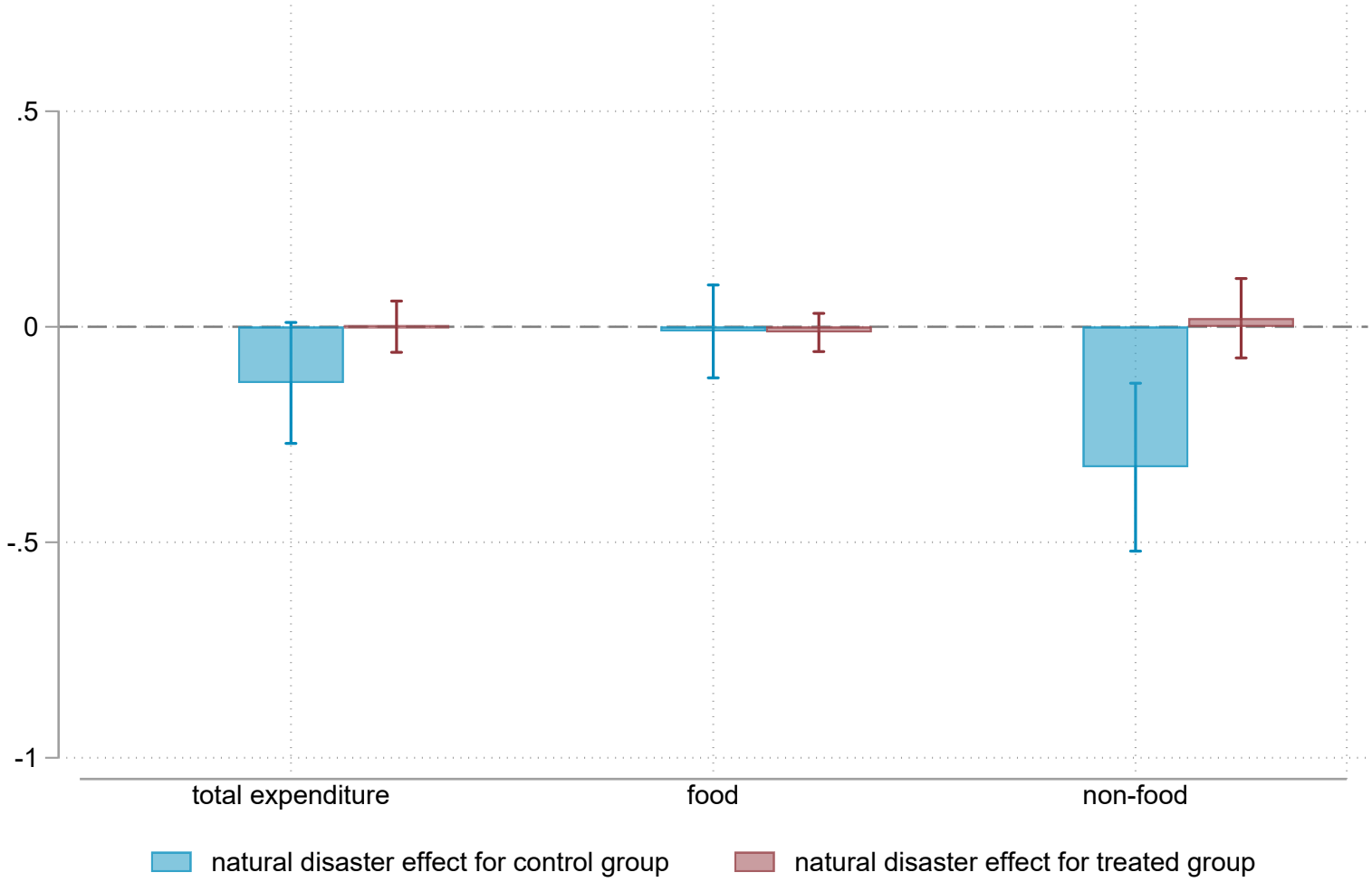
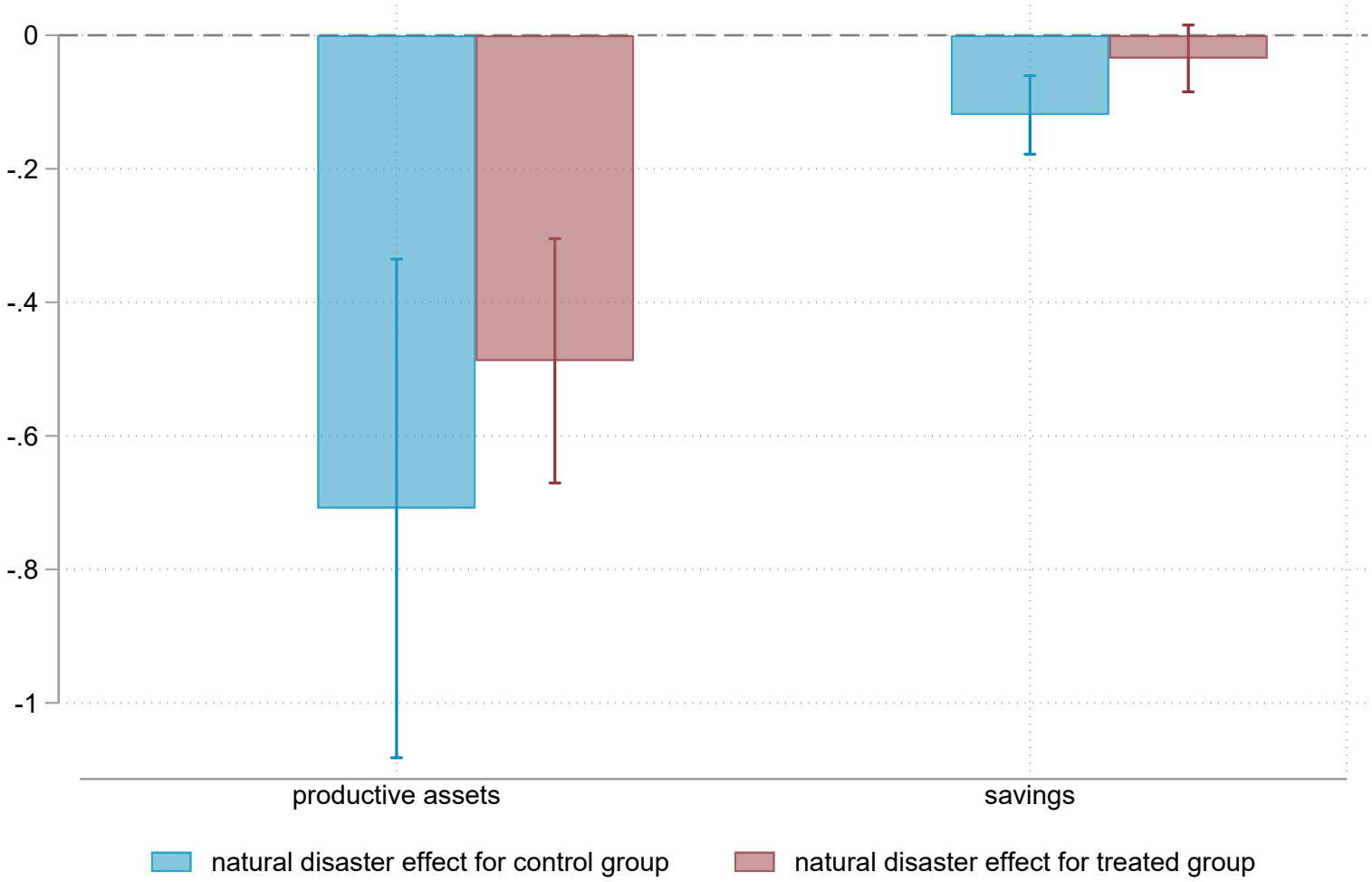
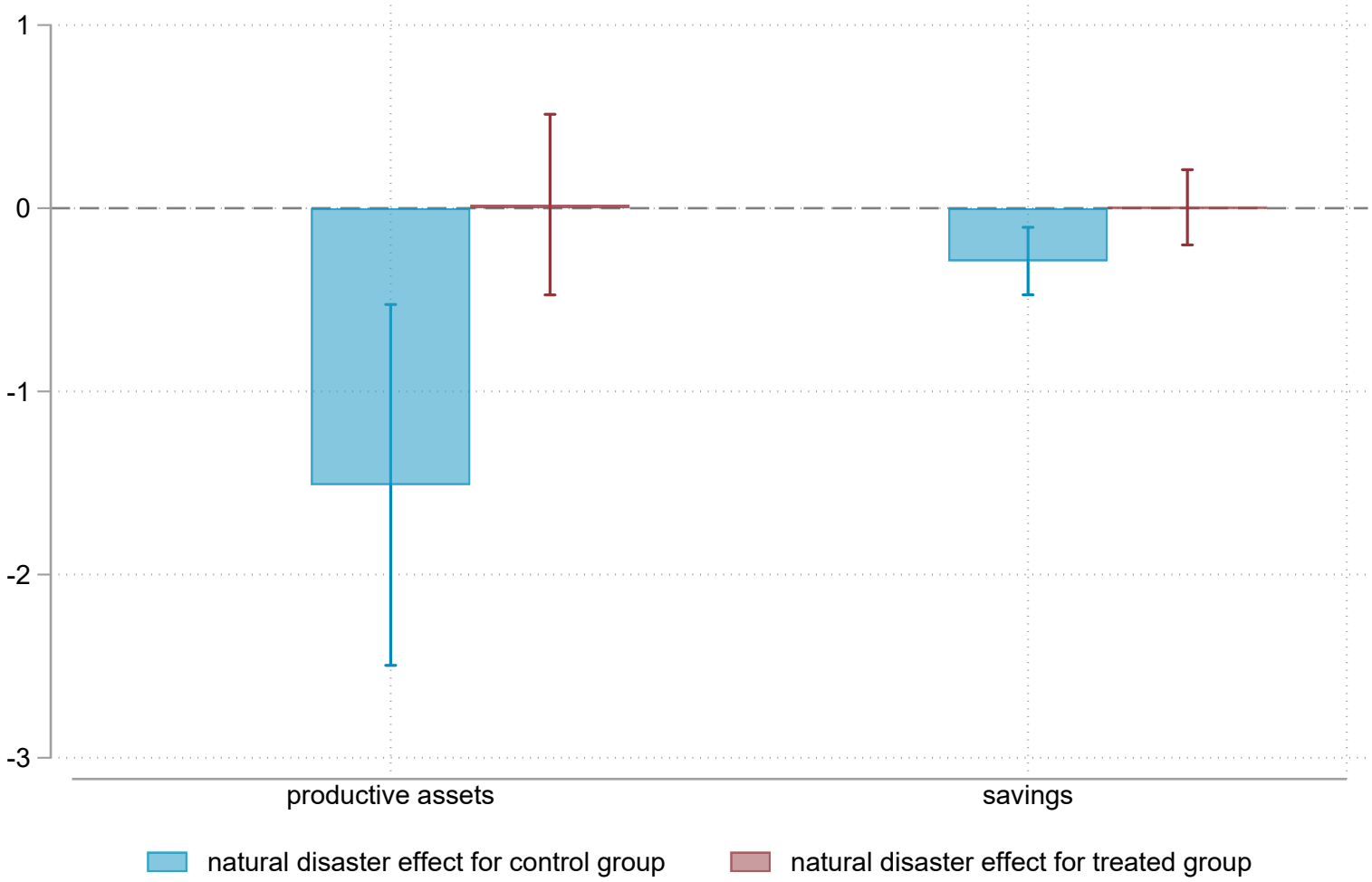


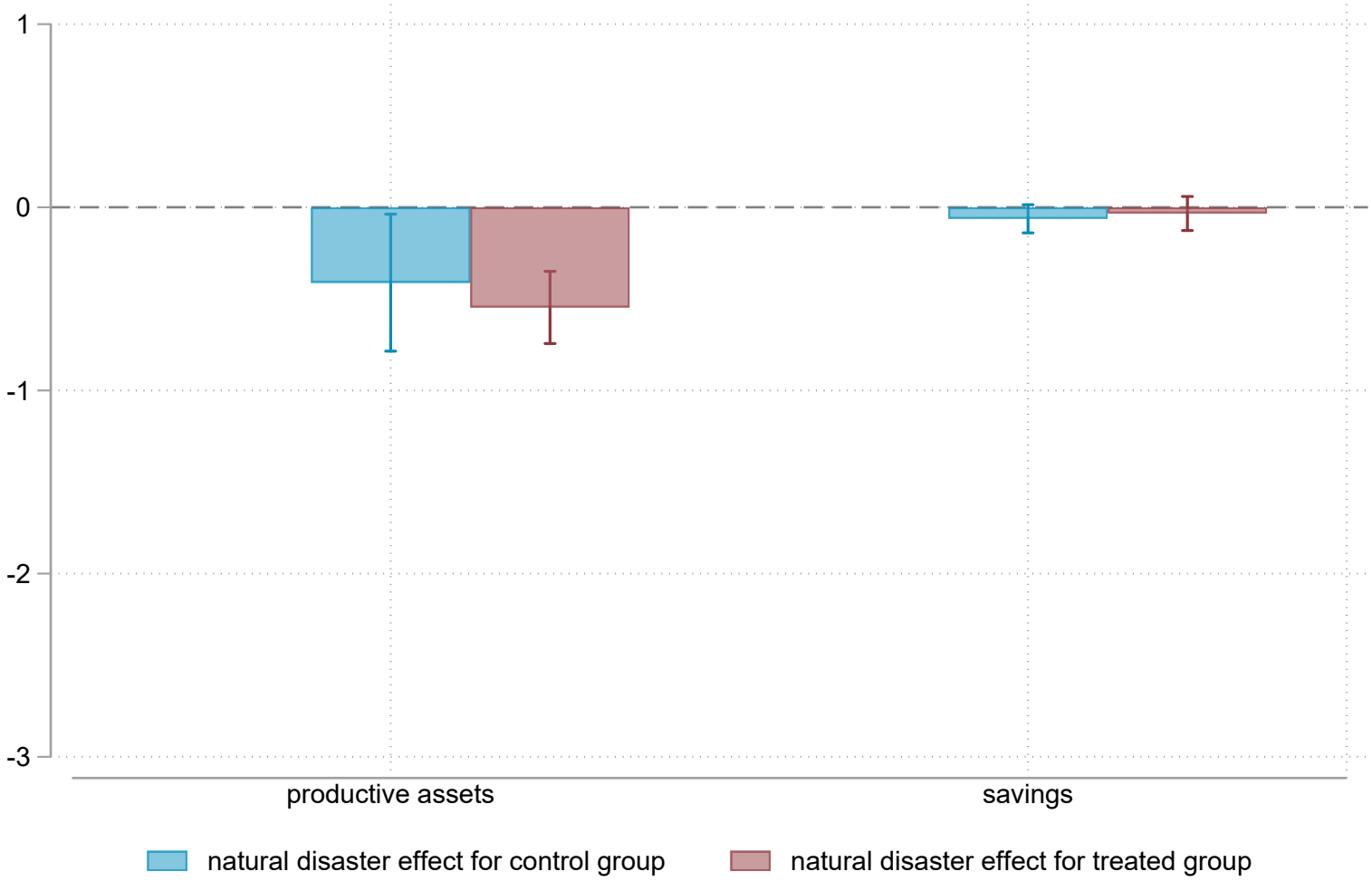
Climate Resilience: assets and savings



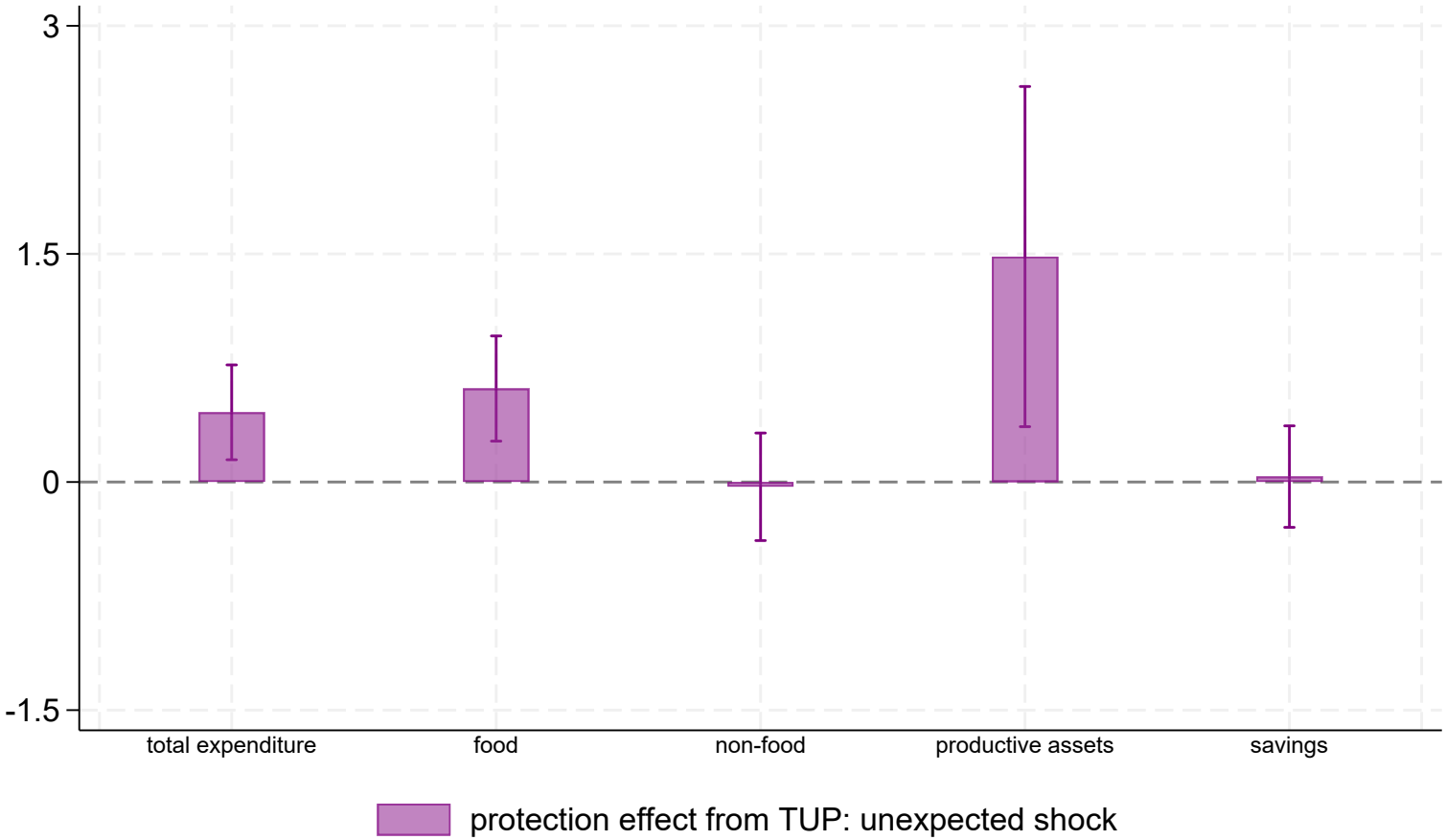
Climate Resilience: assets and savings (unexpected shock)



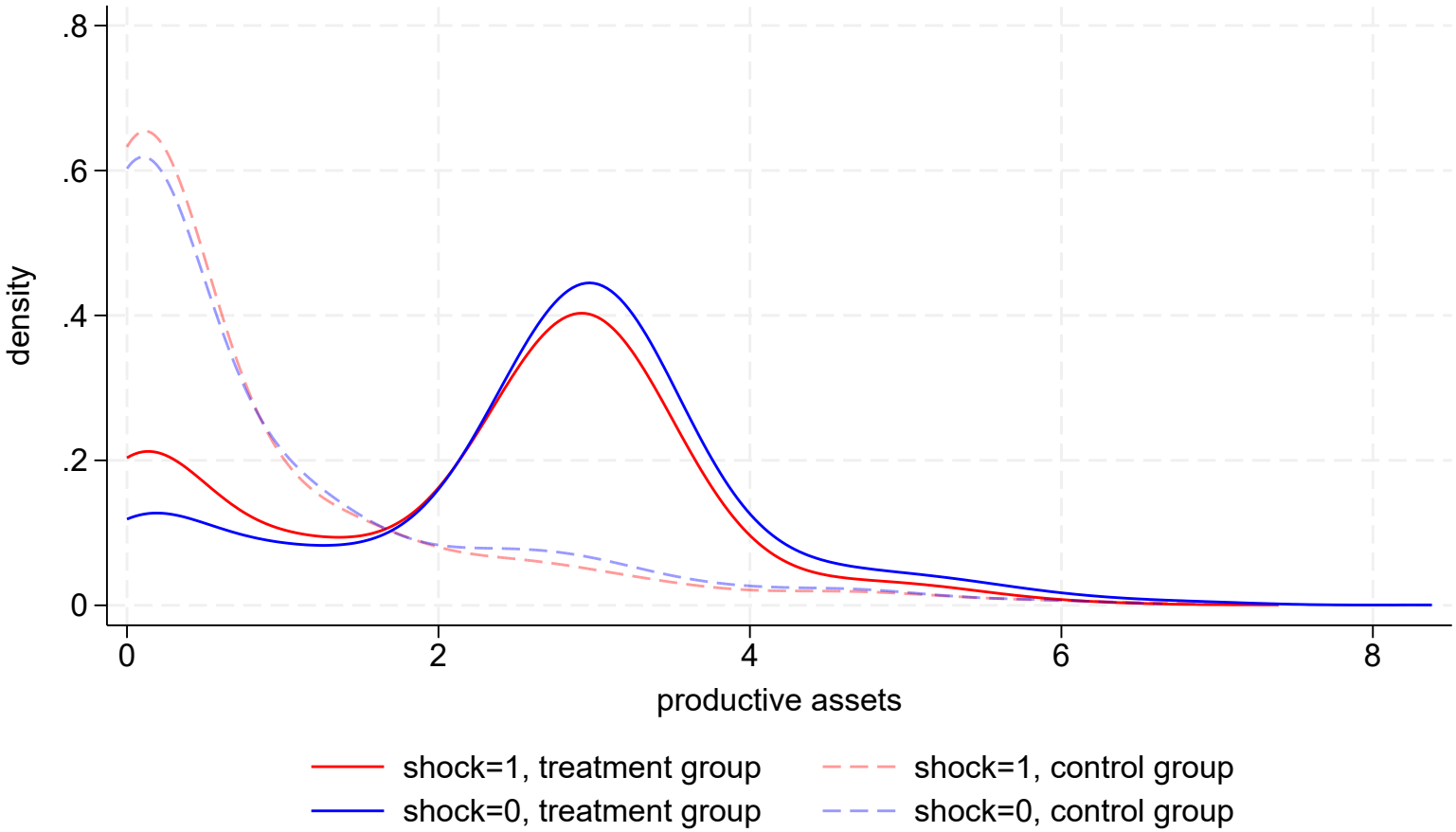
Climate Resilience: assets and savings (expected shock)



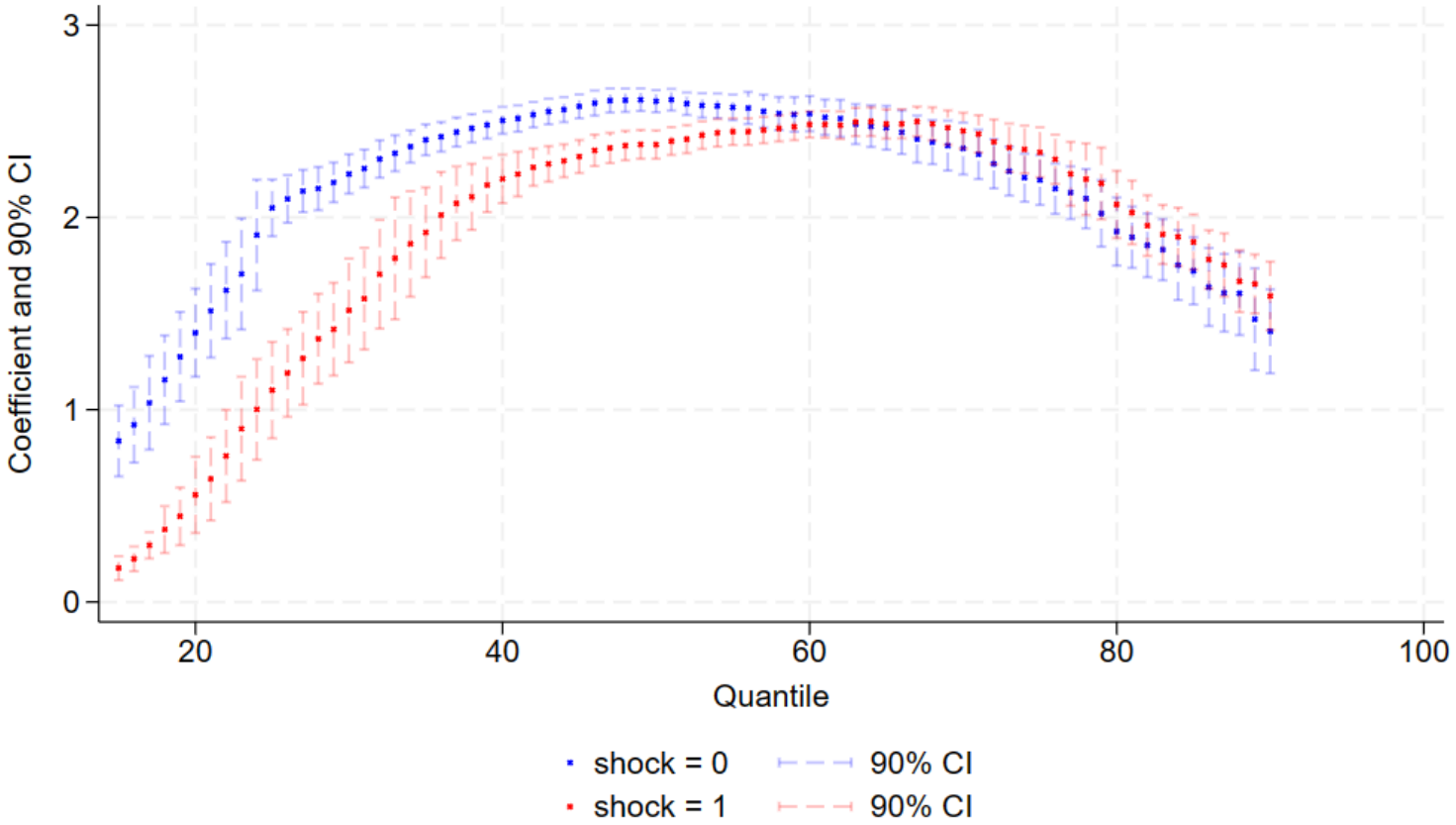
Climate Resilience: DDD (unexpected shock)



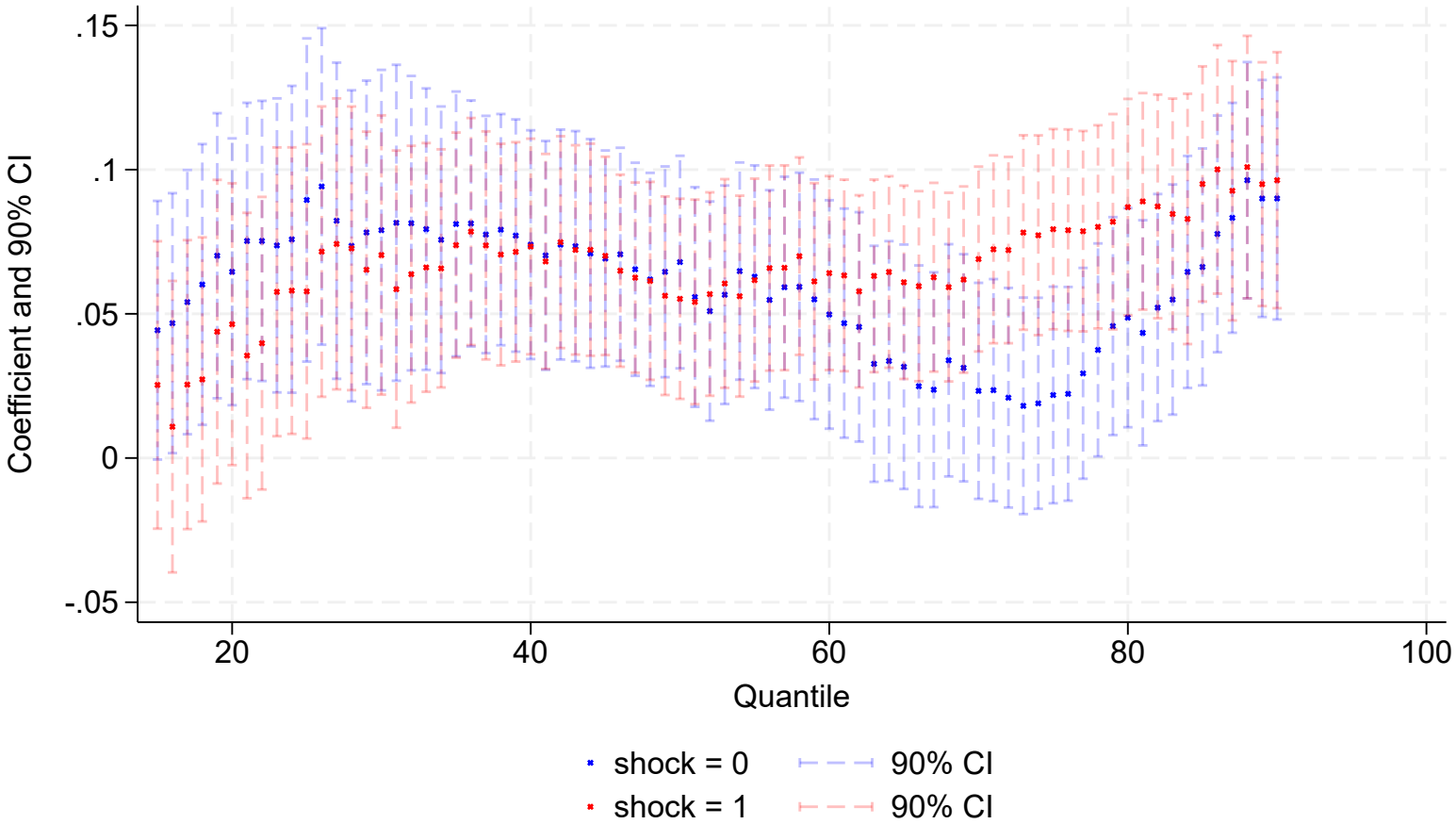
Climate Resilience: productive assets



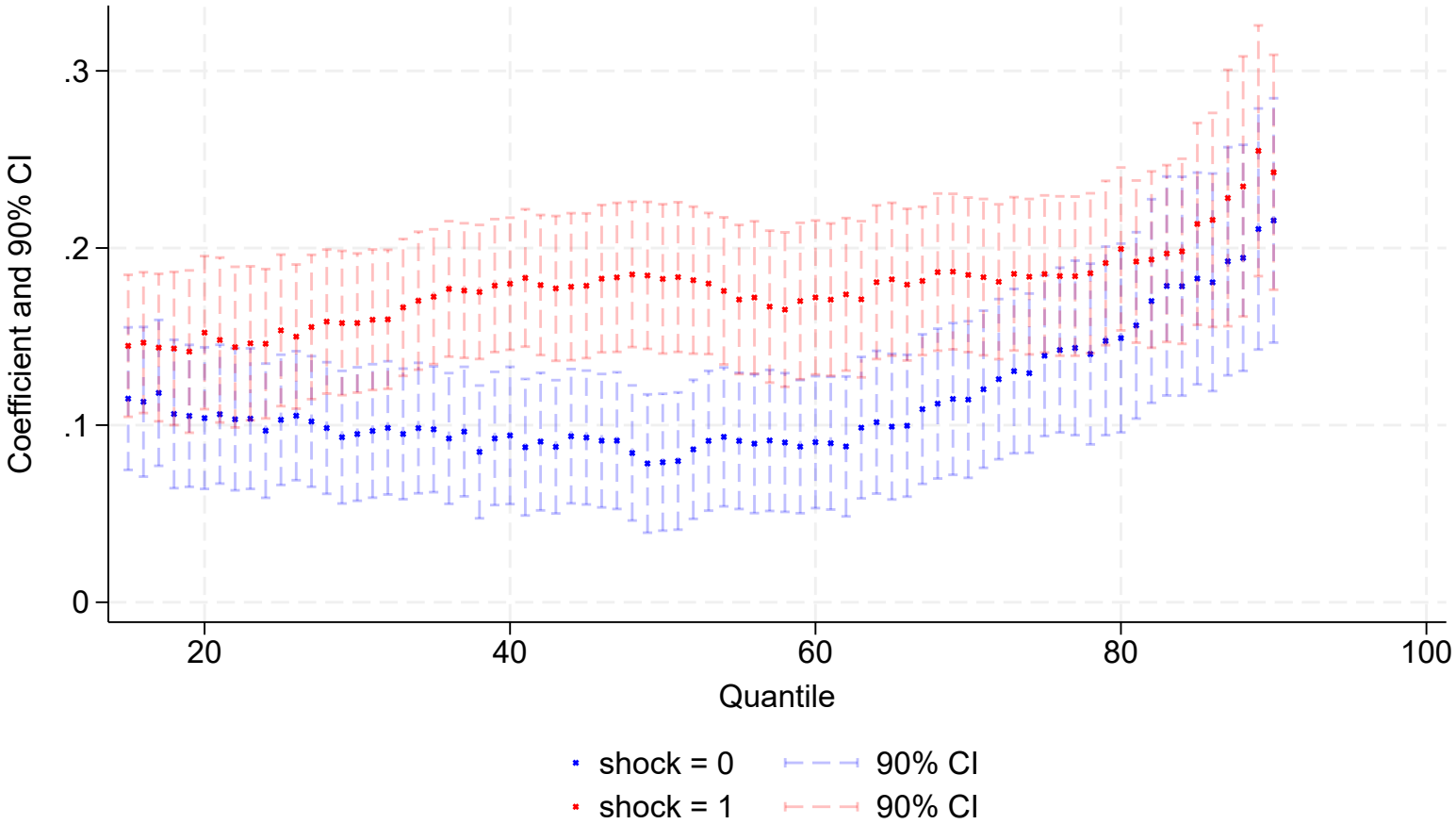
Climate Resilience: productive assets



Climate Resilience: food consumption



Climate Resilience: nonfood consumption



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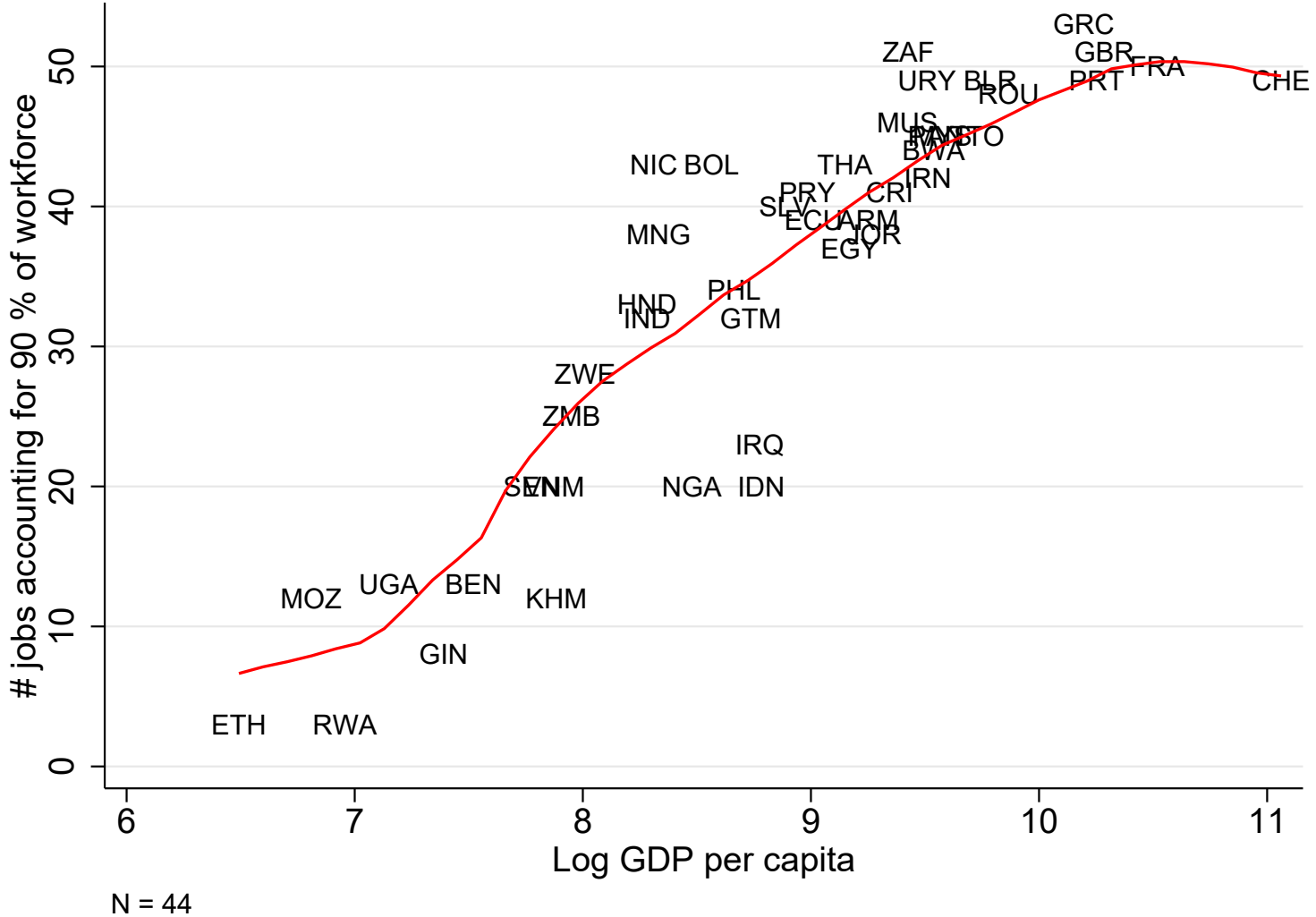

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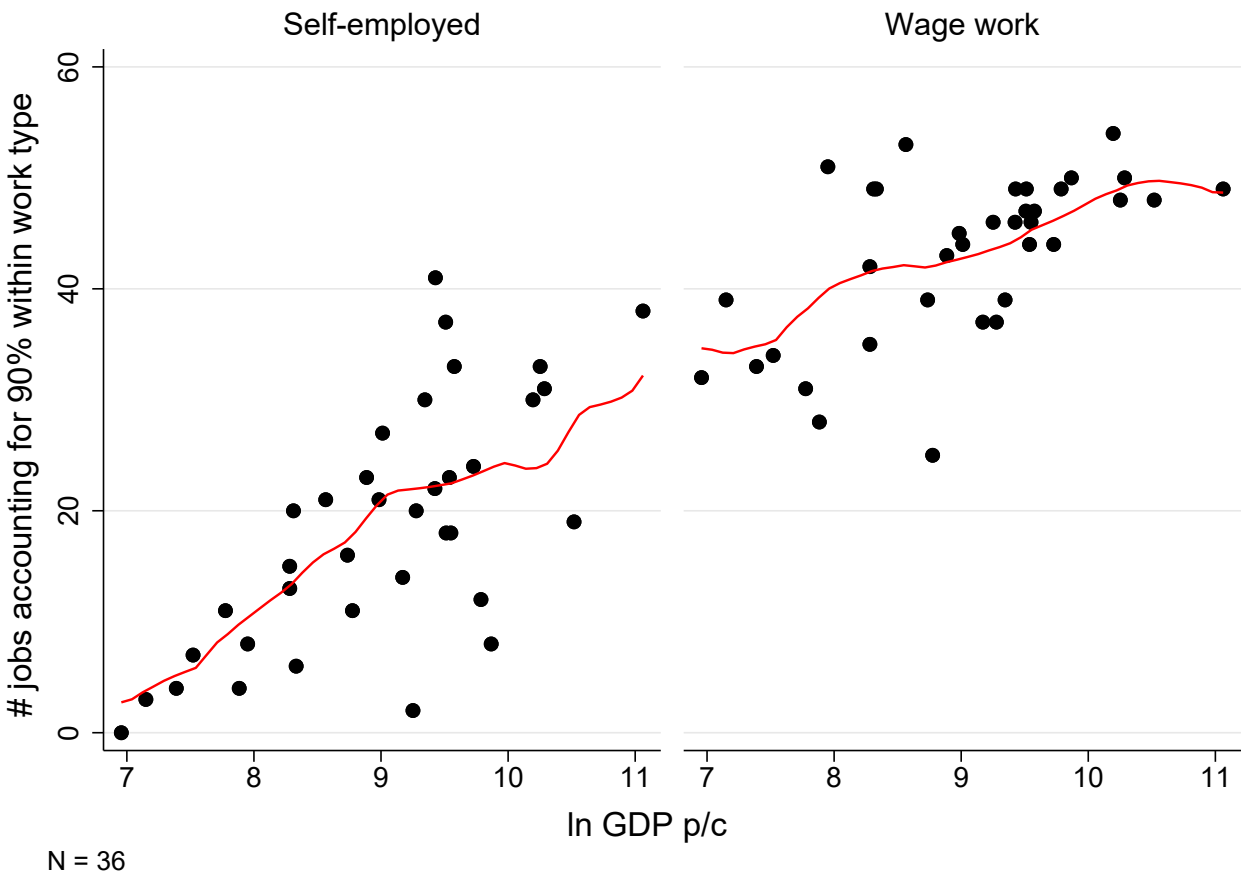

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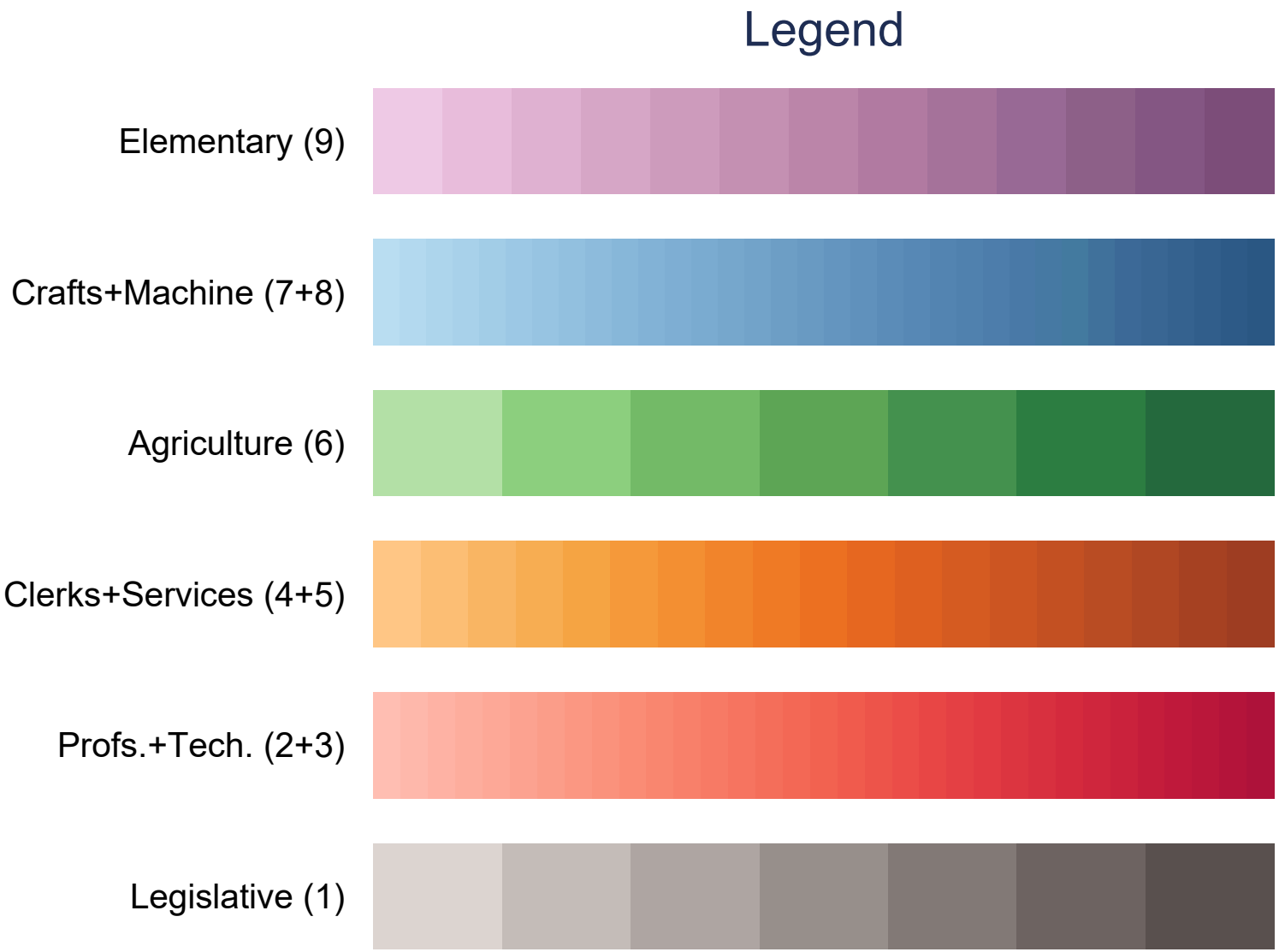

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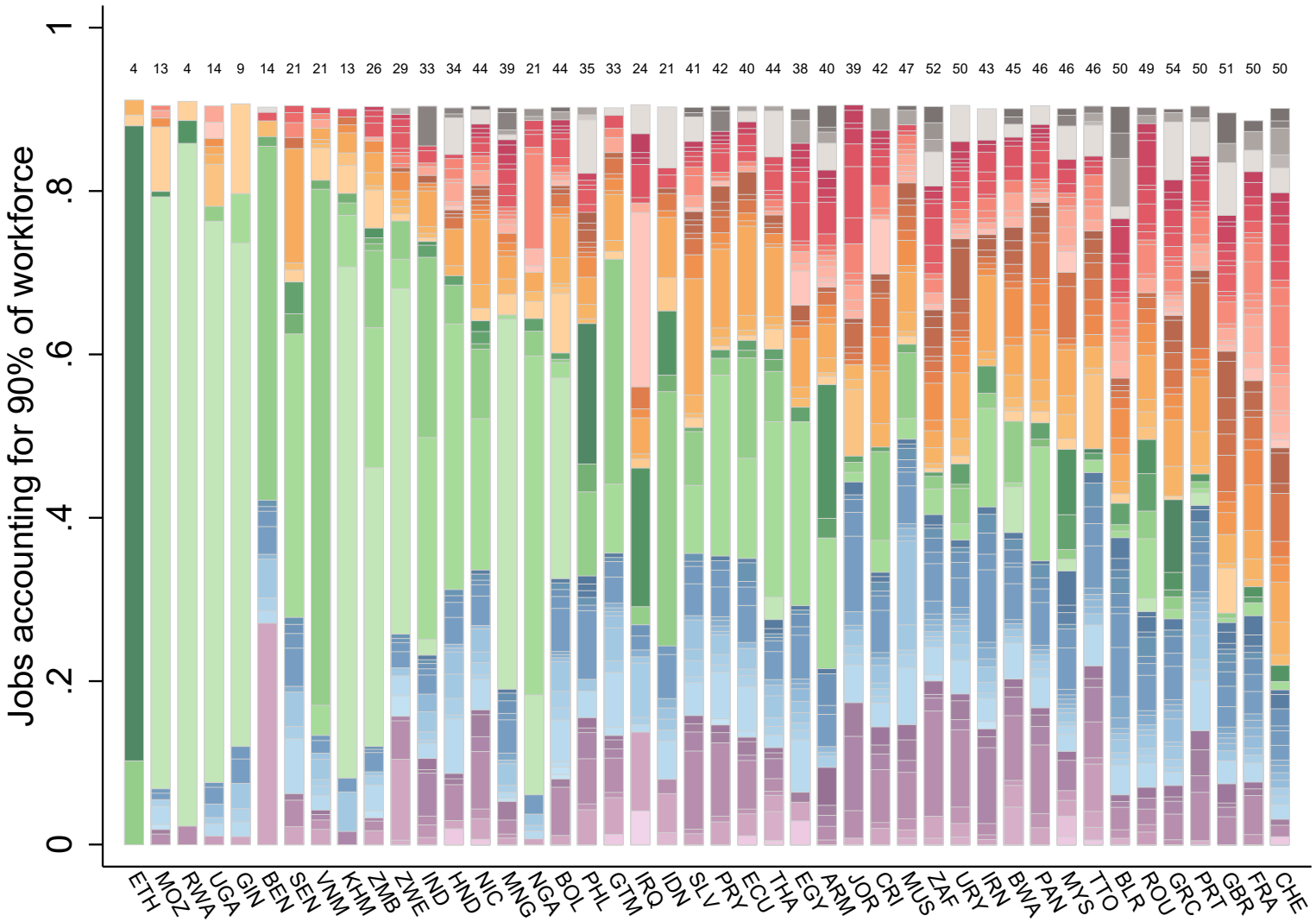

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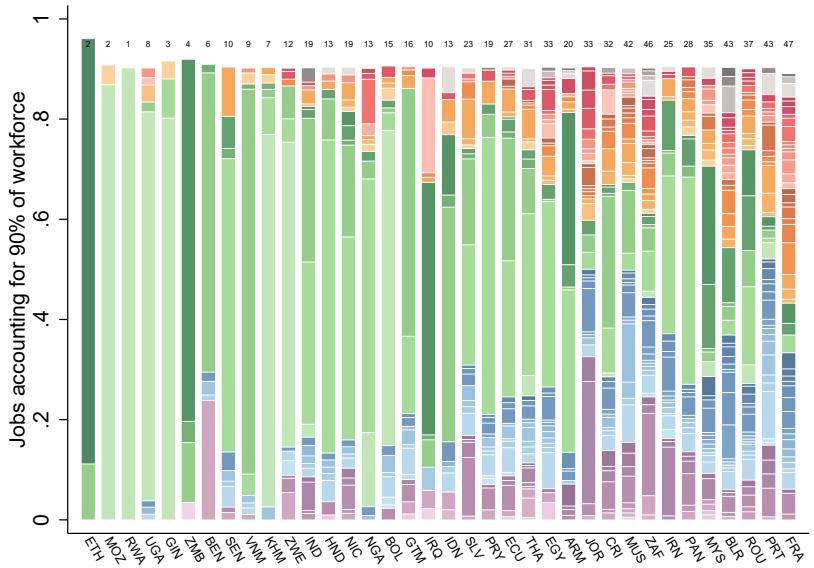
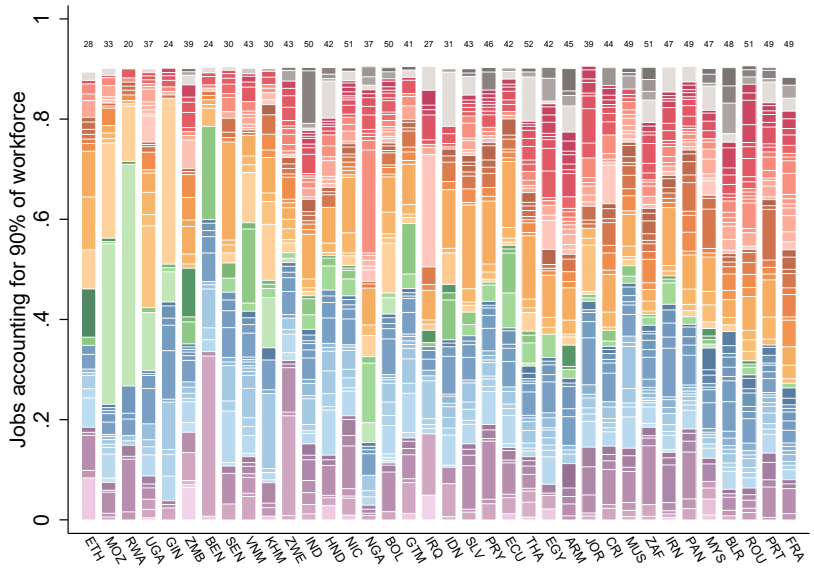
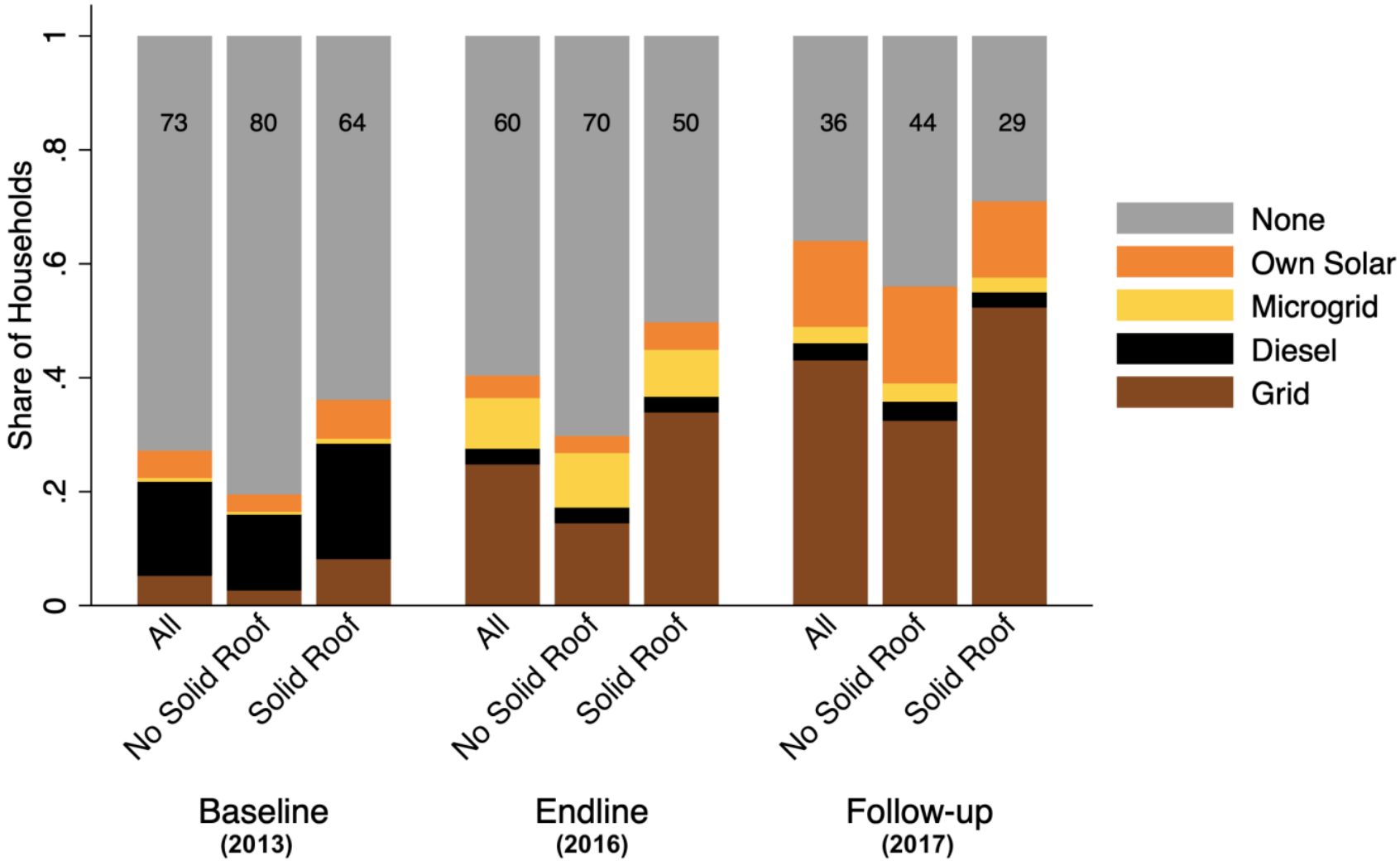


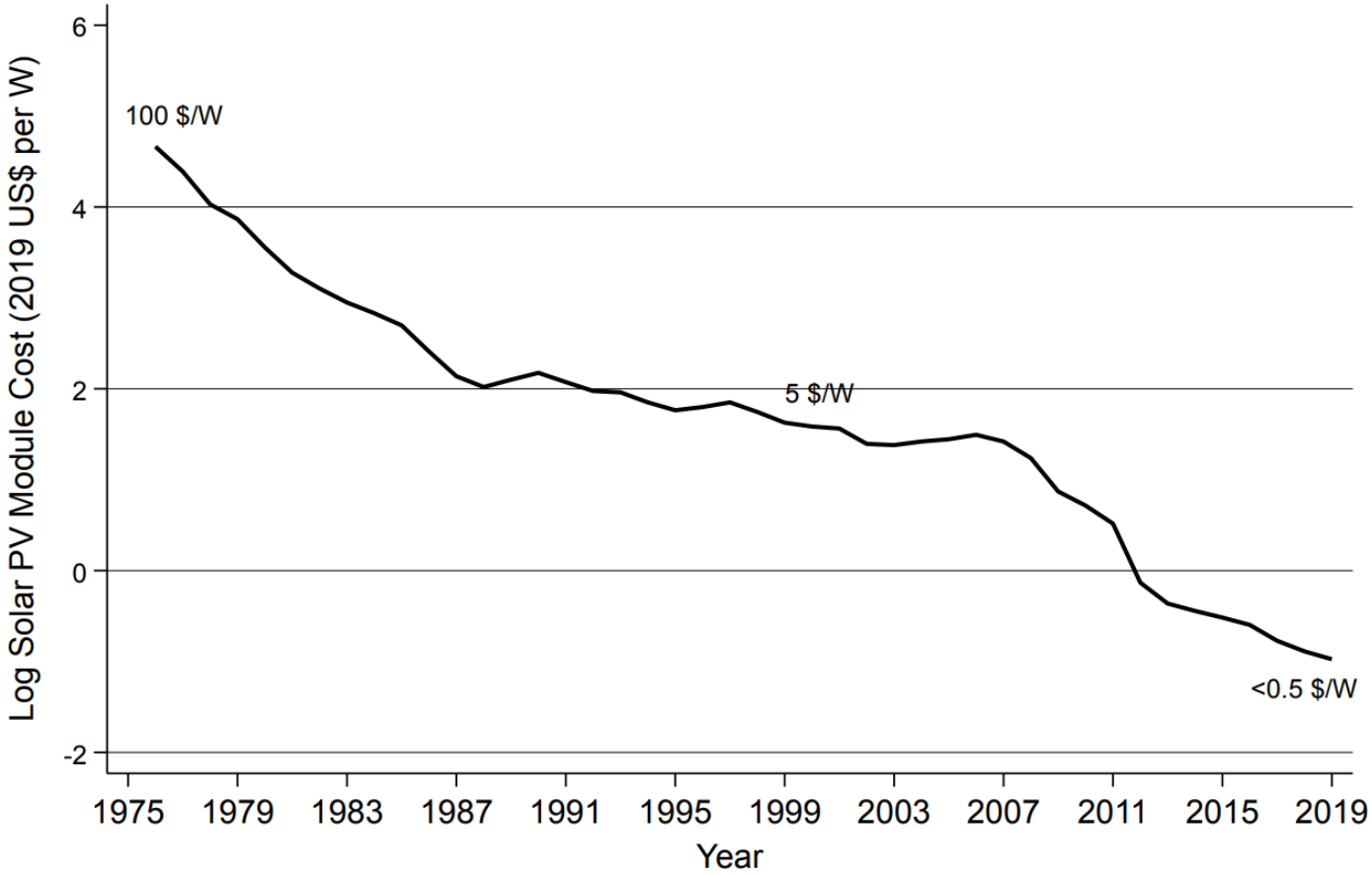


Clean Energy



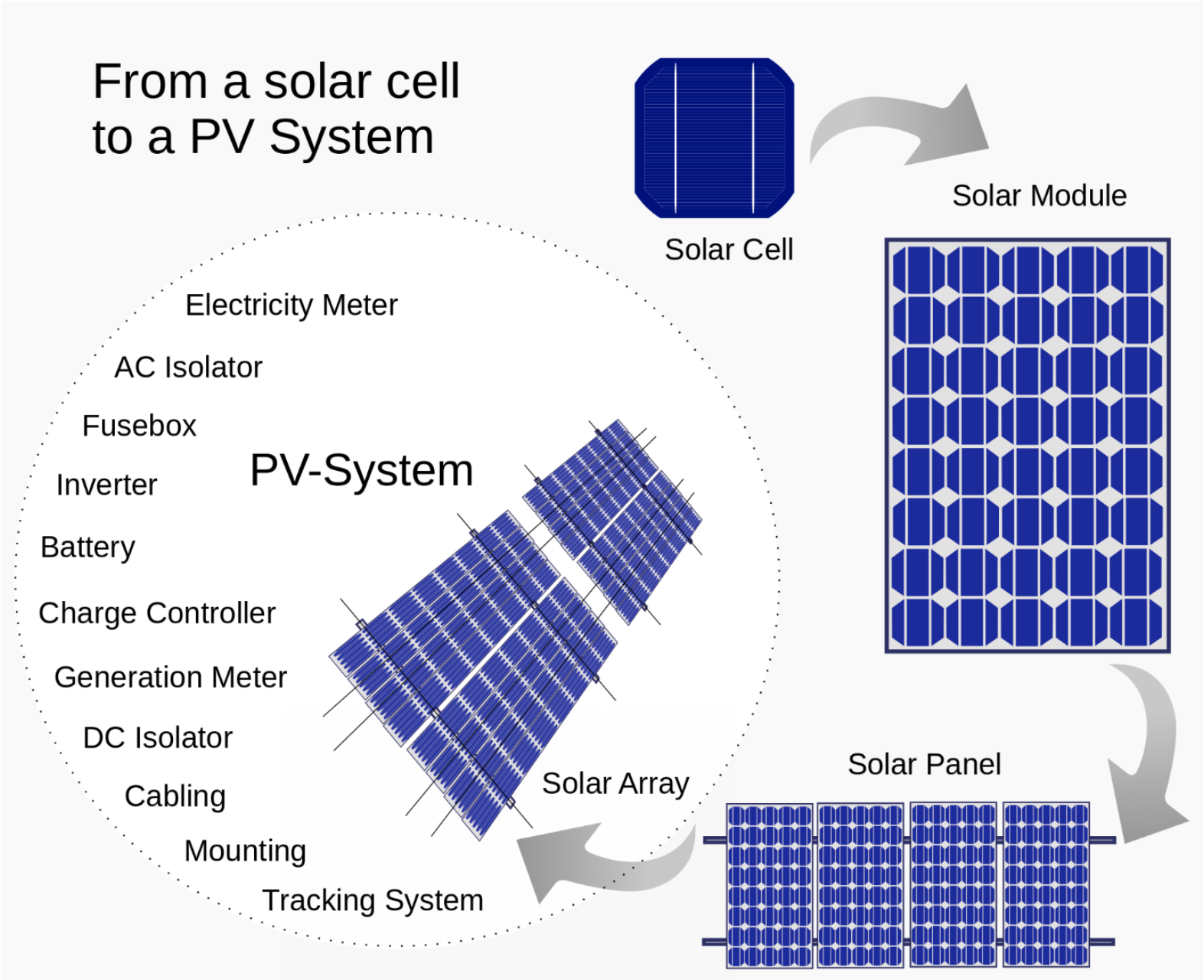
Clean Energy

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



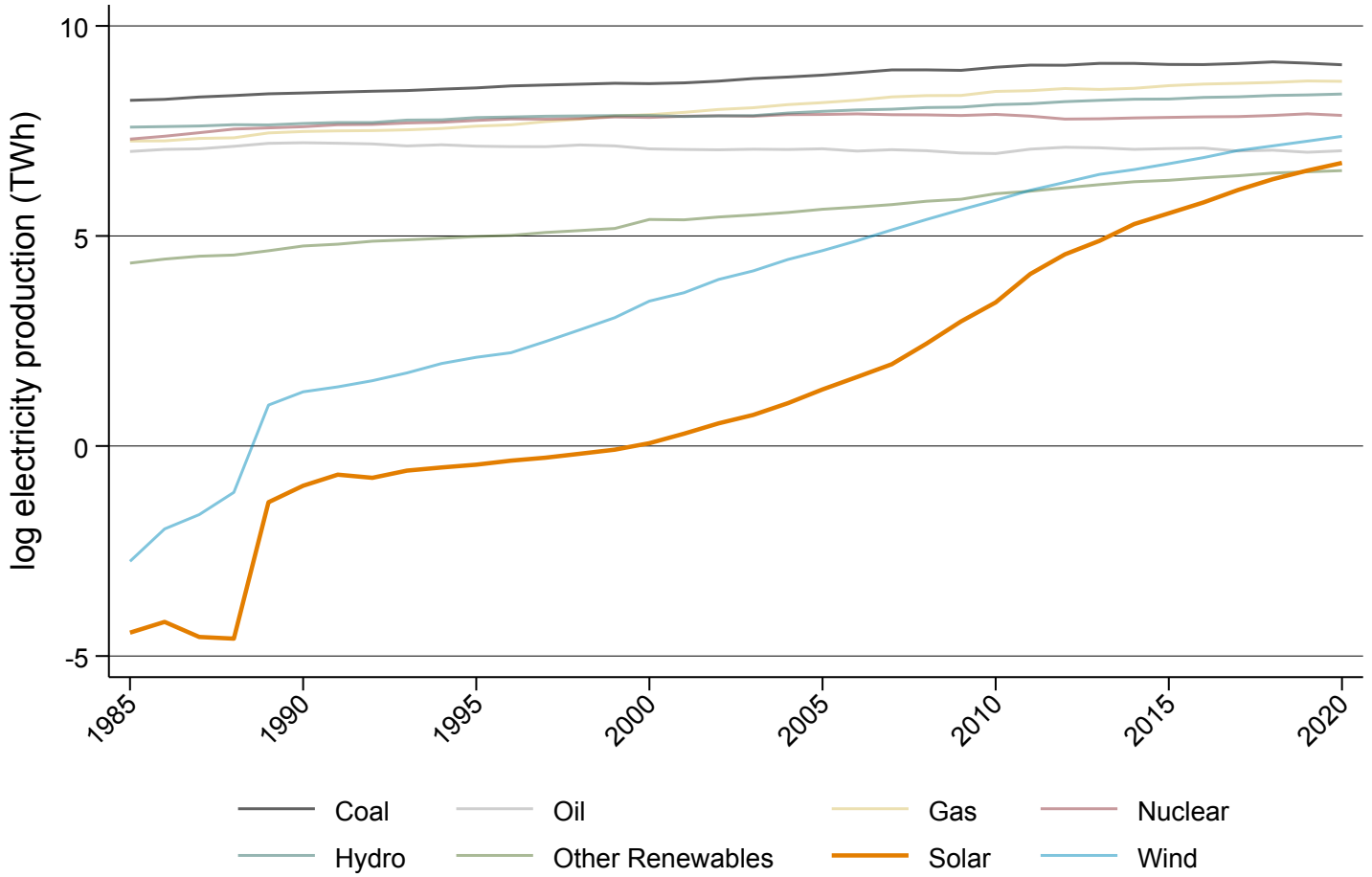
Source: LaFond et al. (2017) & IRENA Database

Clean Energy



Clean Energy

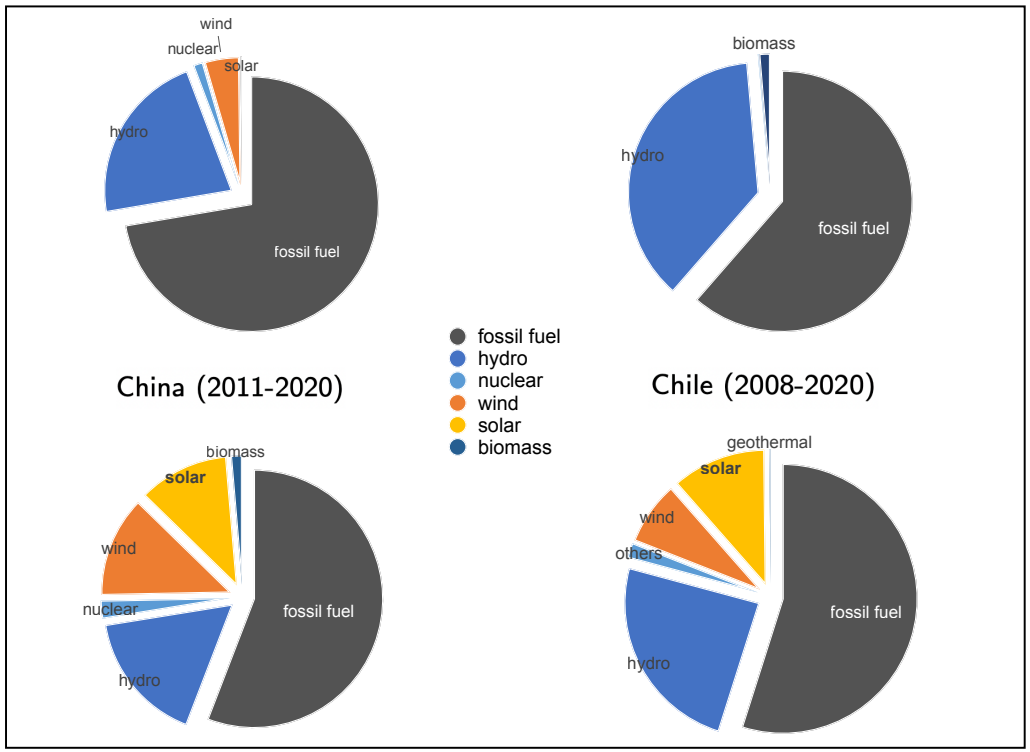
Figure: World electricity production by source



Source: International Energy Agency (IEA) Shares

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%

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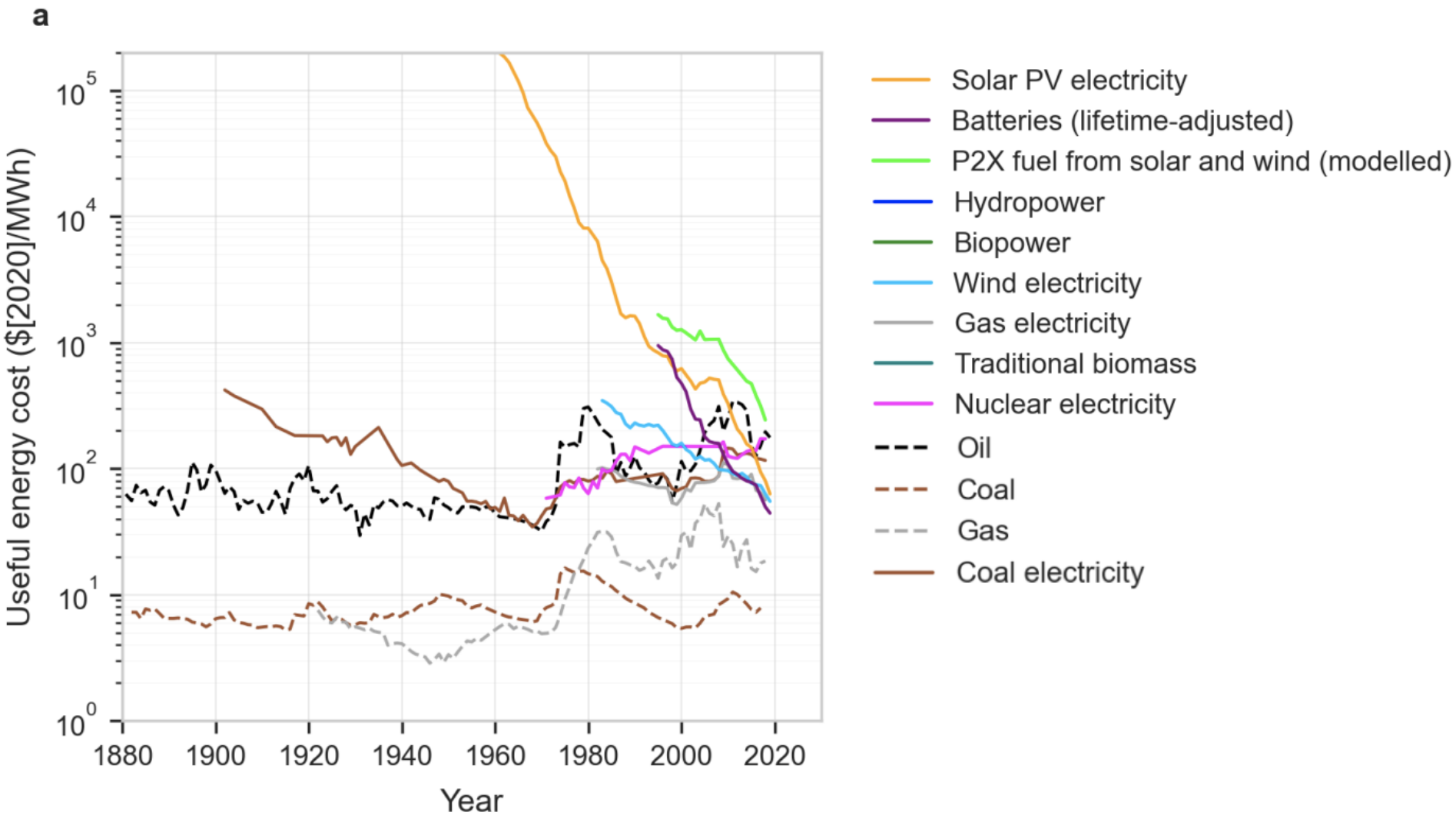

Source: Way, Ives, Mealy and Farmer (2021) "Empirically grounded technology forecasts and the energy transition"

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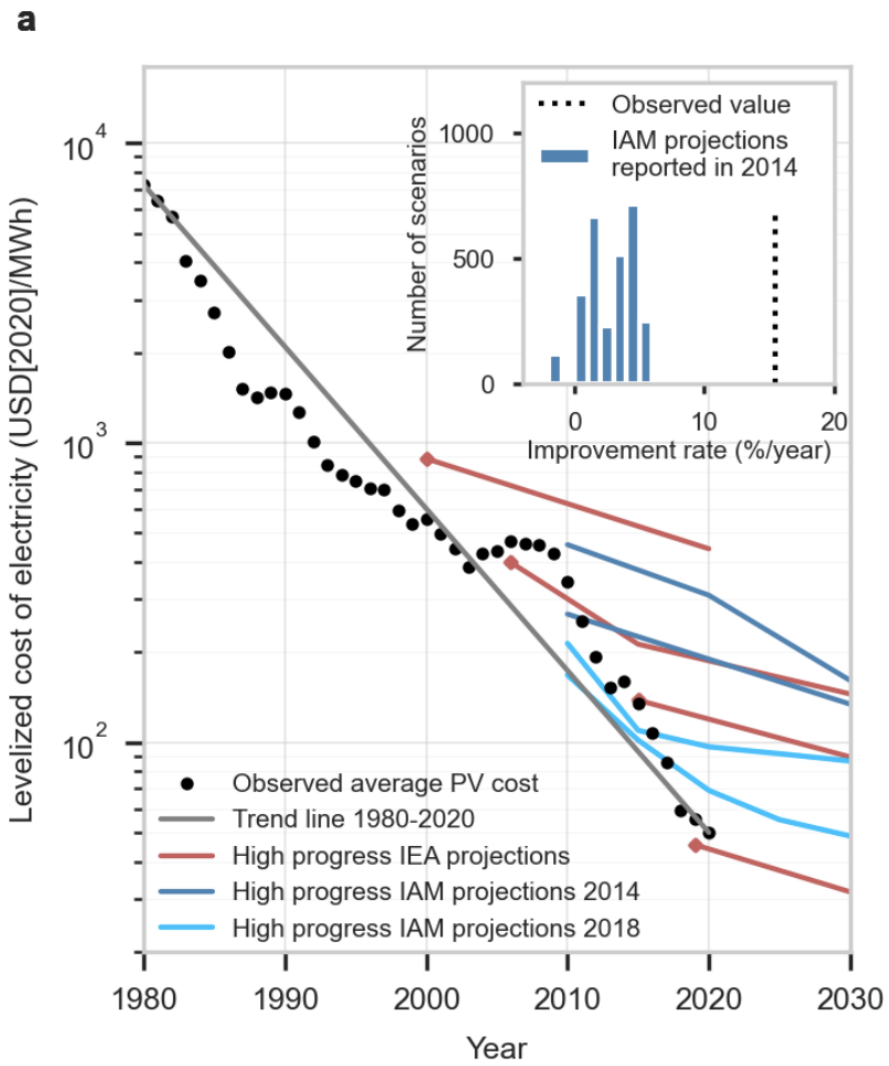

Source: Way, Ives, Mealy and Farmer (2021) "Empirically grounded technology forecasts and the energy transition"

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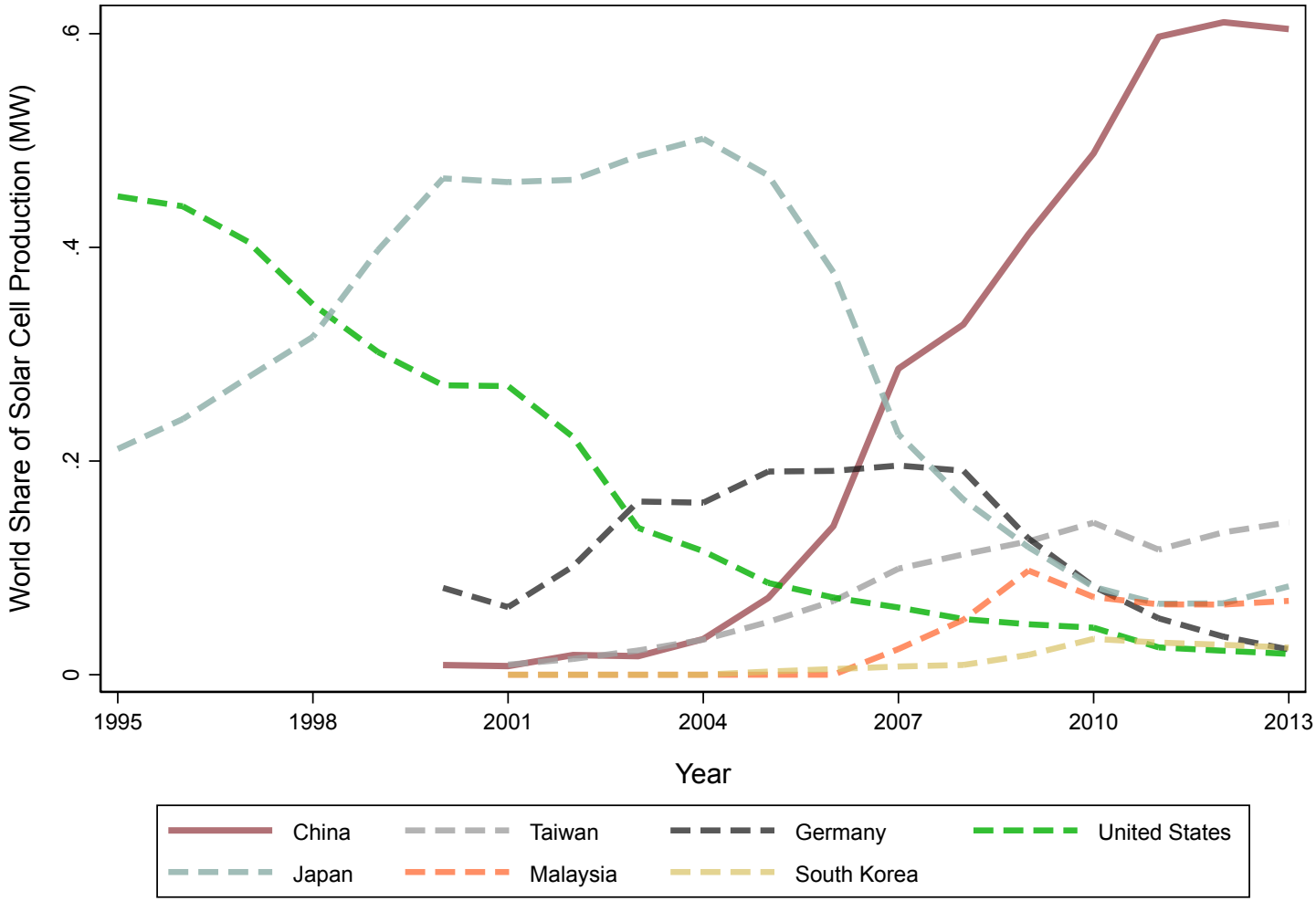
Figure: Share of Annual Solar Photovoltaics Cell Production in Leading Countries, 2000-2013



Note: The original data was compiled by the Earth Policy Institute from GTM Research, PV Cell Module Production Data, electronic database, updated June 2014.

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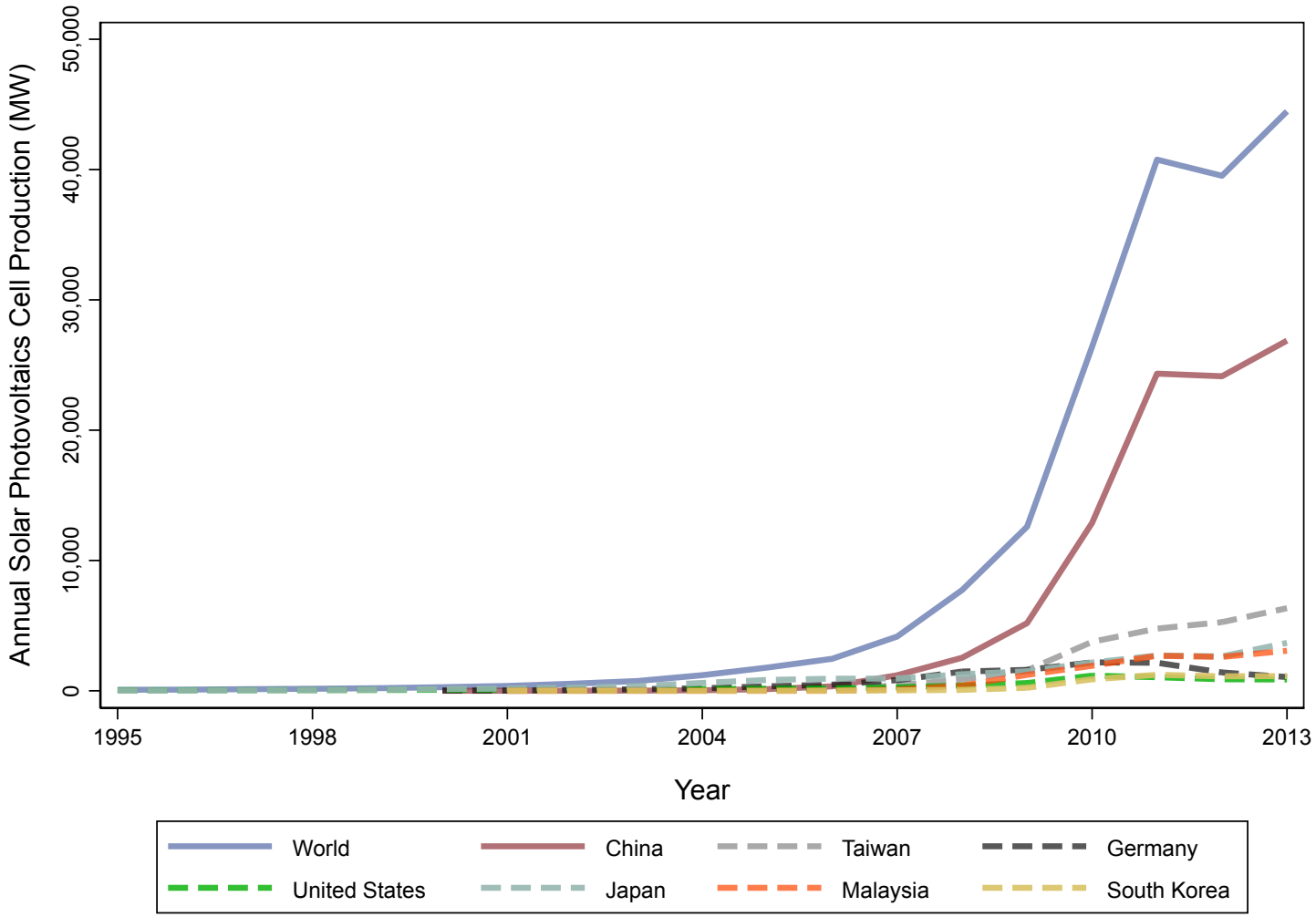
Figure: Solar PV cell production 2000-2013



Note: The original data was compiled by the Earth Policy Institute from GTM Research, PV Cell Module Production Data, electronic database, updated June 2014.

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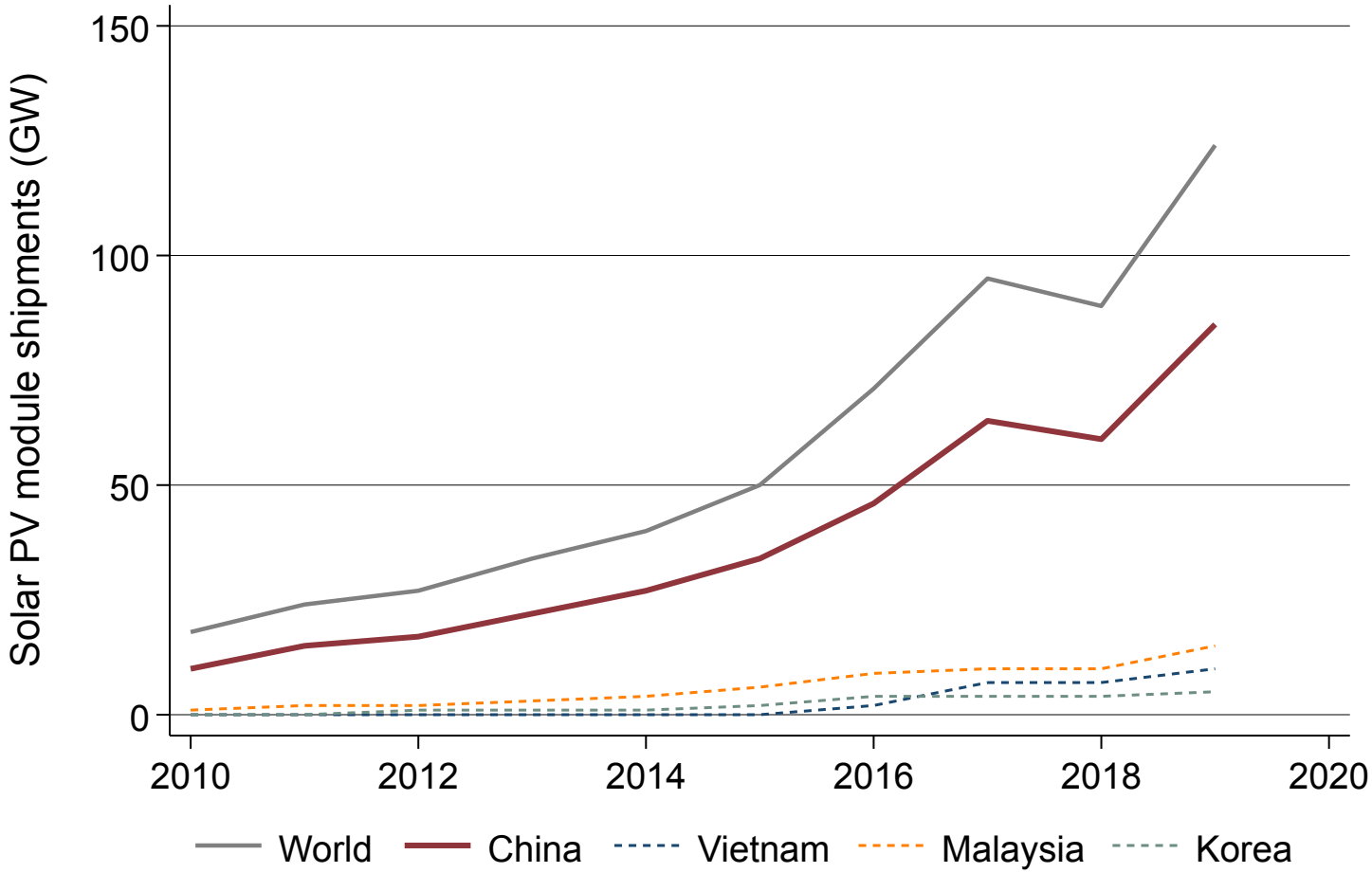
Figure: Solar PV module shipments (GW) by country of origin, 2010-2019



Source: International Energy Agency (IEA)

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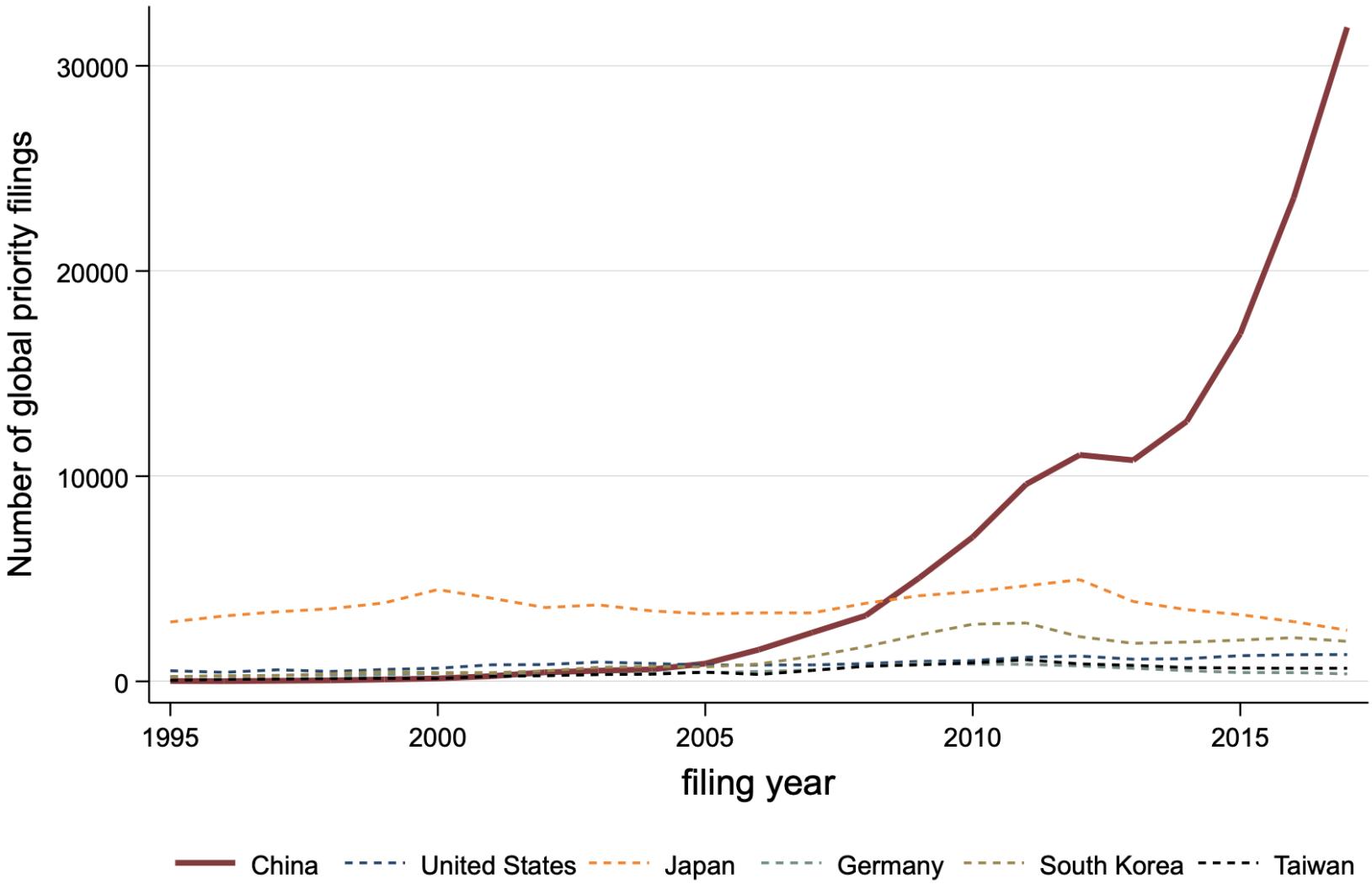

Source: PATSTAT - solar patents based on IPC/CPC codes

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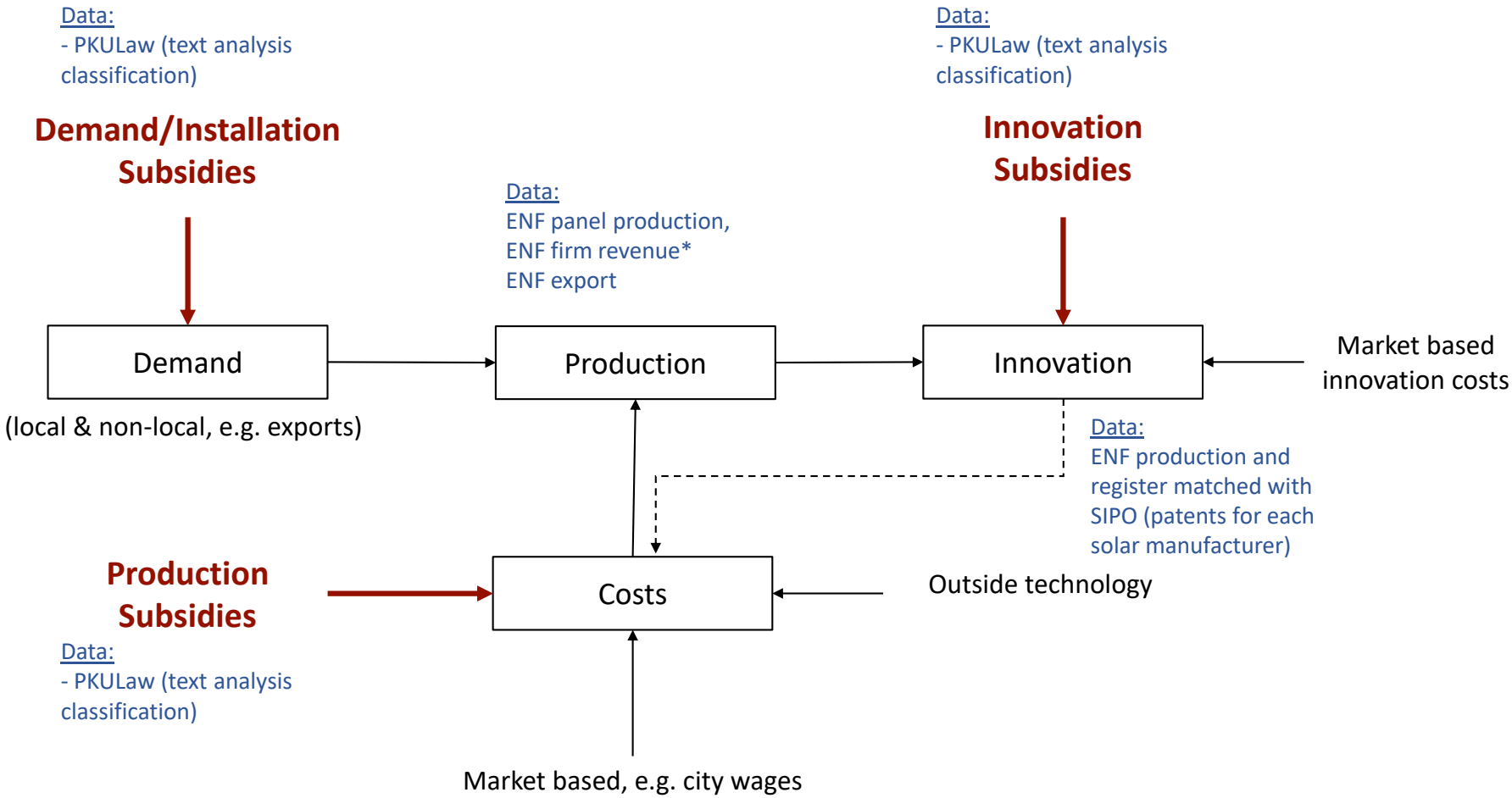


Firm count: ENF register matched with Chinese firm registration platform (firm entry and exit dates for each solar manufacturer)
*ENF firm revenue: ENF register matched with Orbis platform

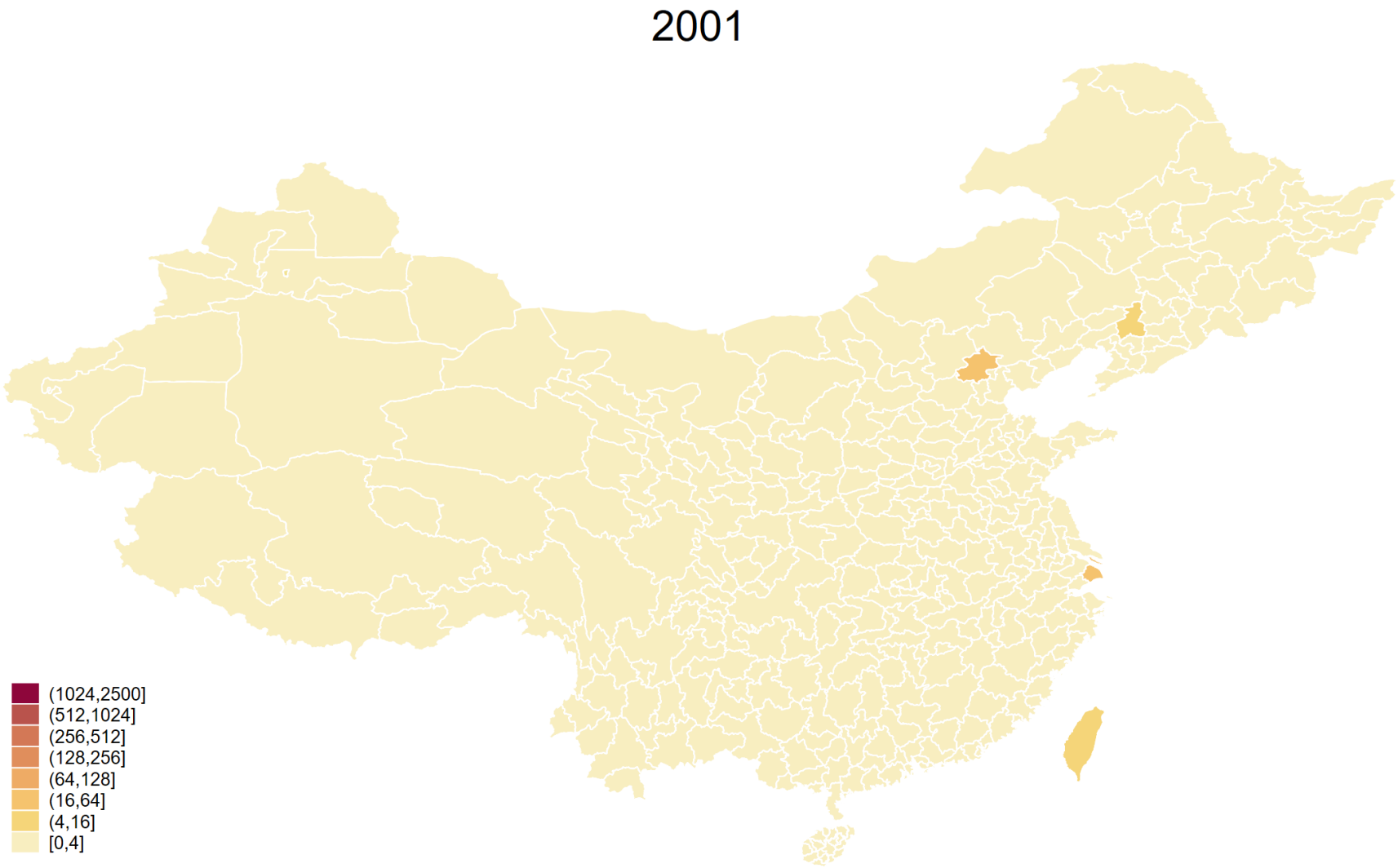
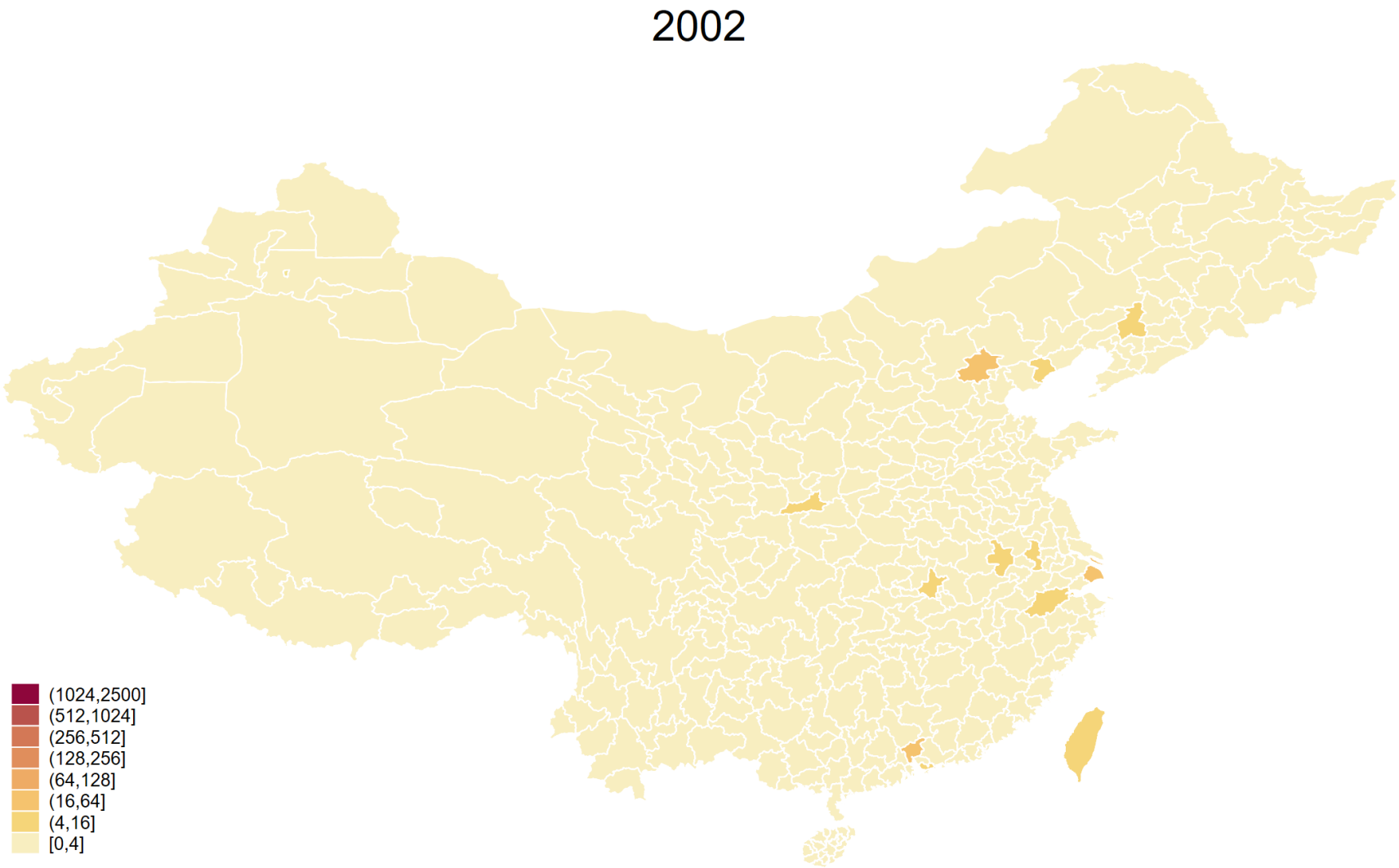


Figure: Solar Innovation and Policy Support in China



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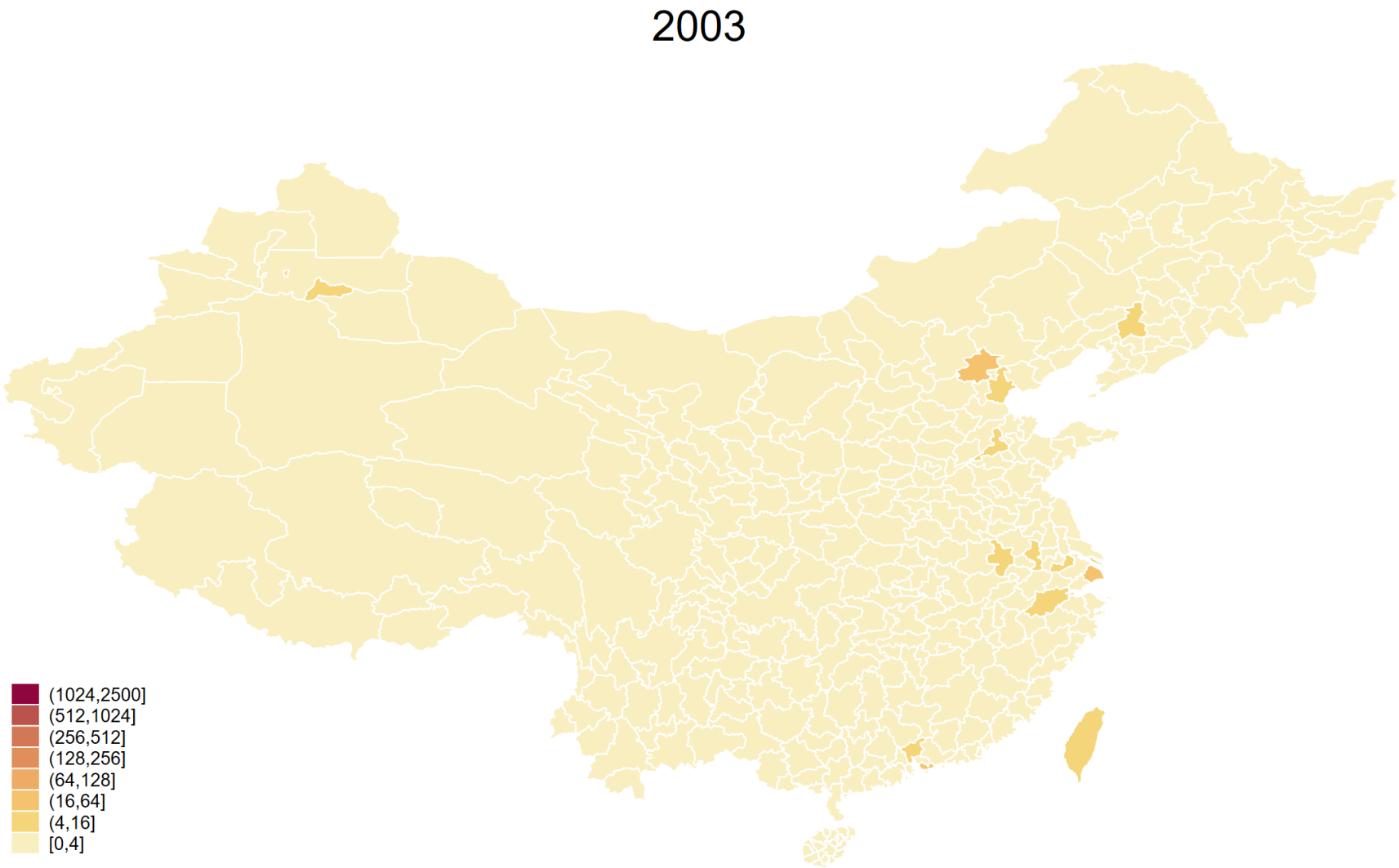
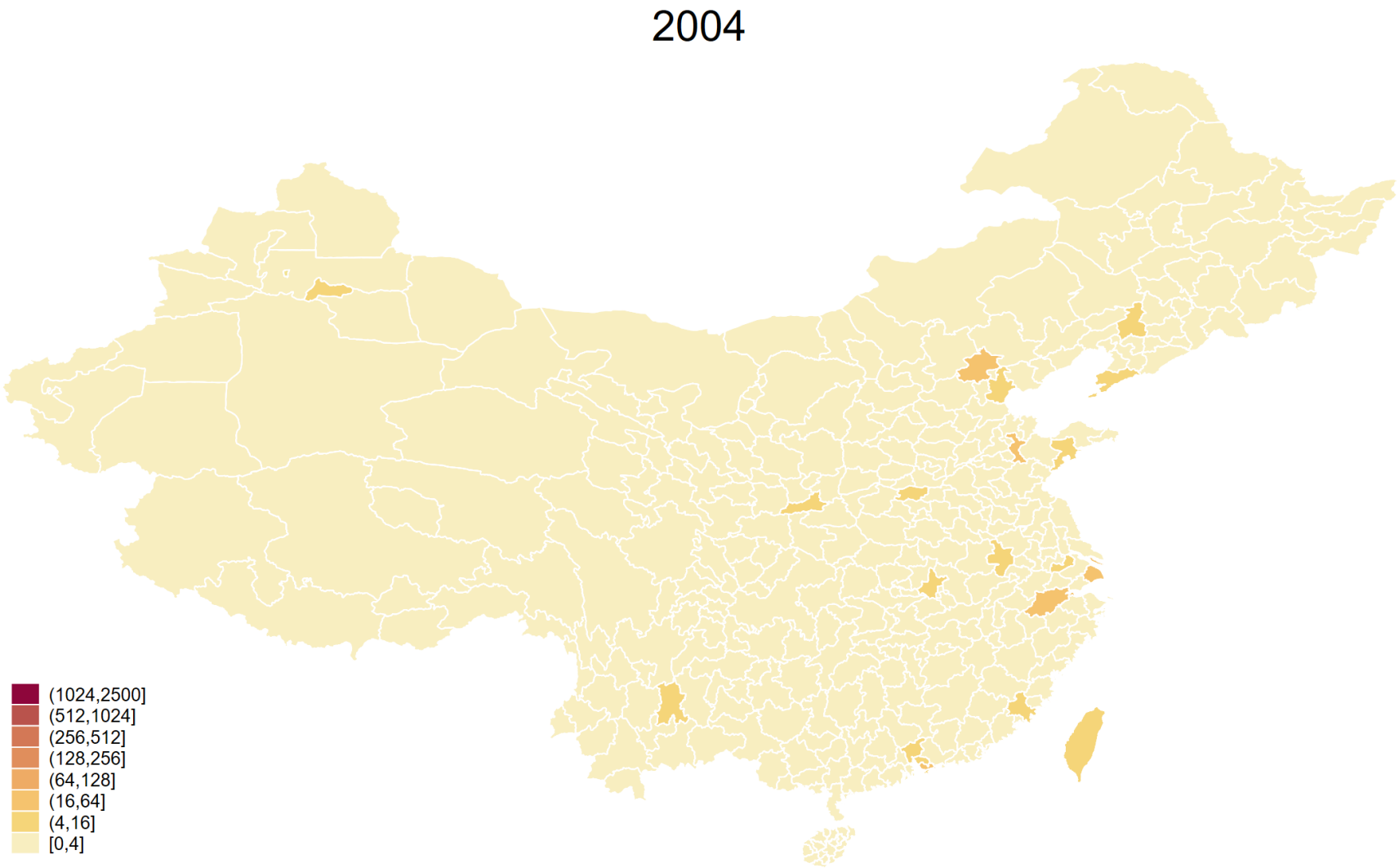


Figure: Solar Innovation and Policy Support in China



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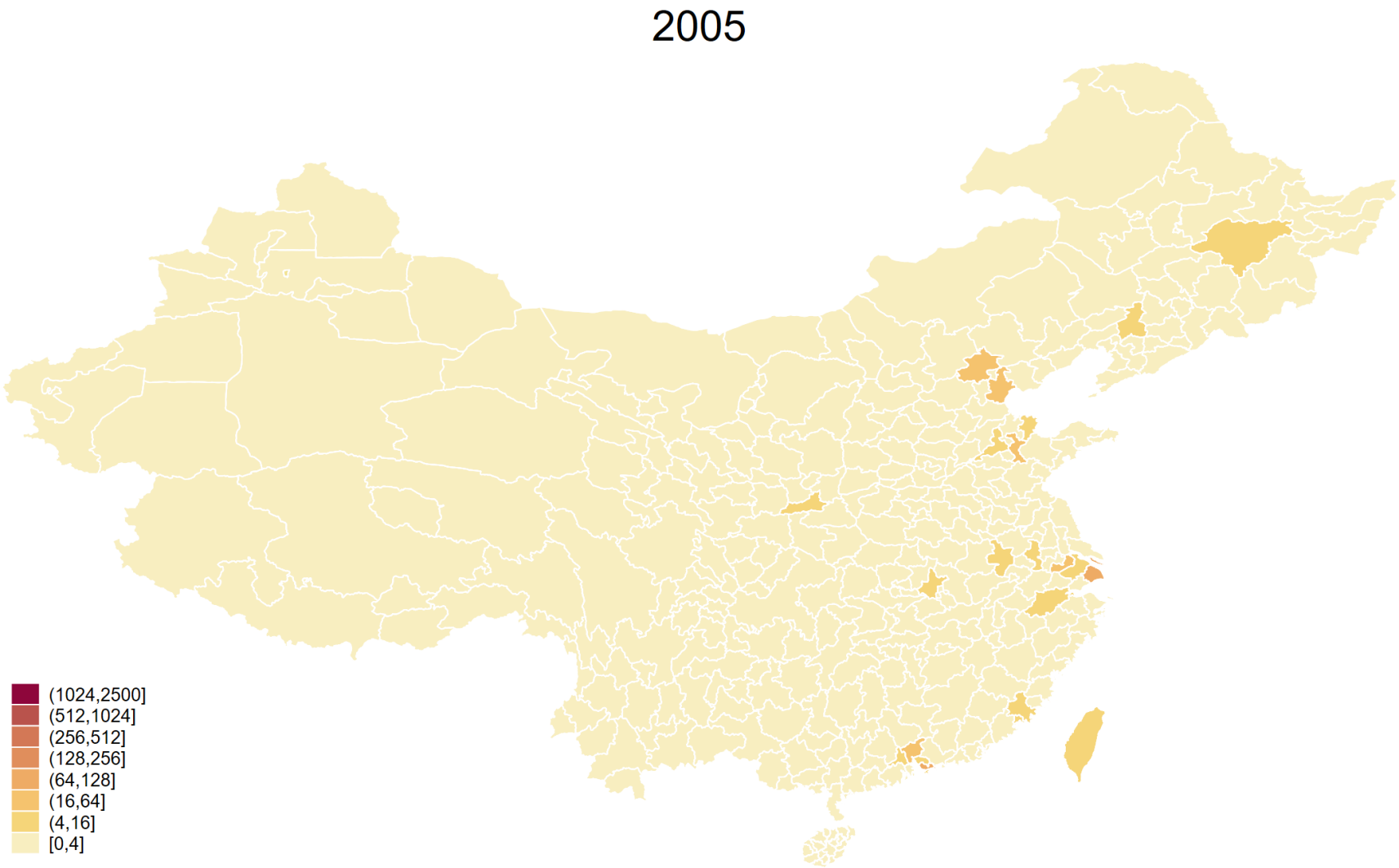

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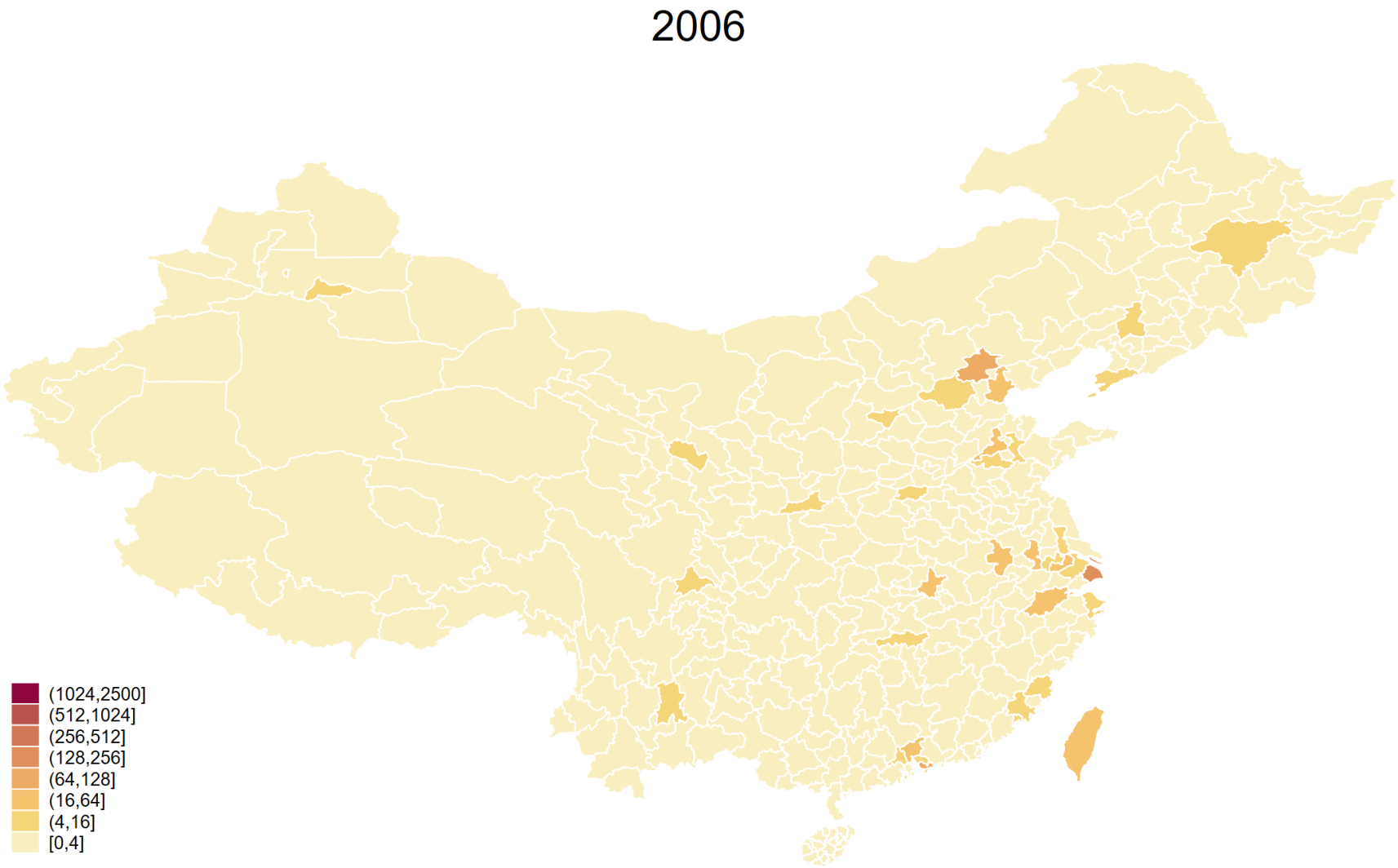


Figure: Solar Innovation and Policy Support in China

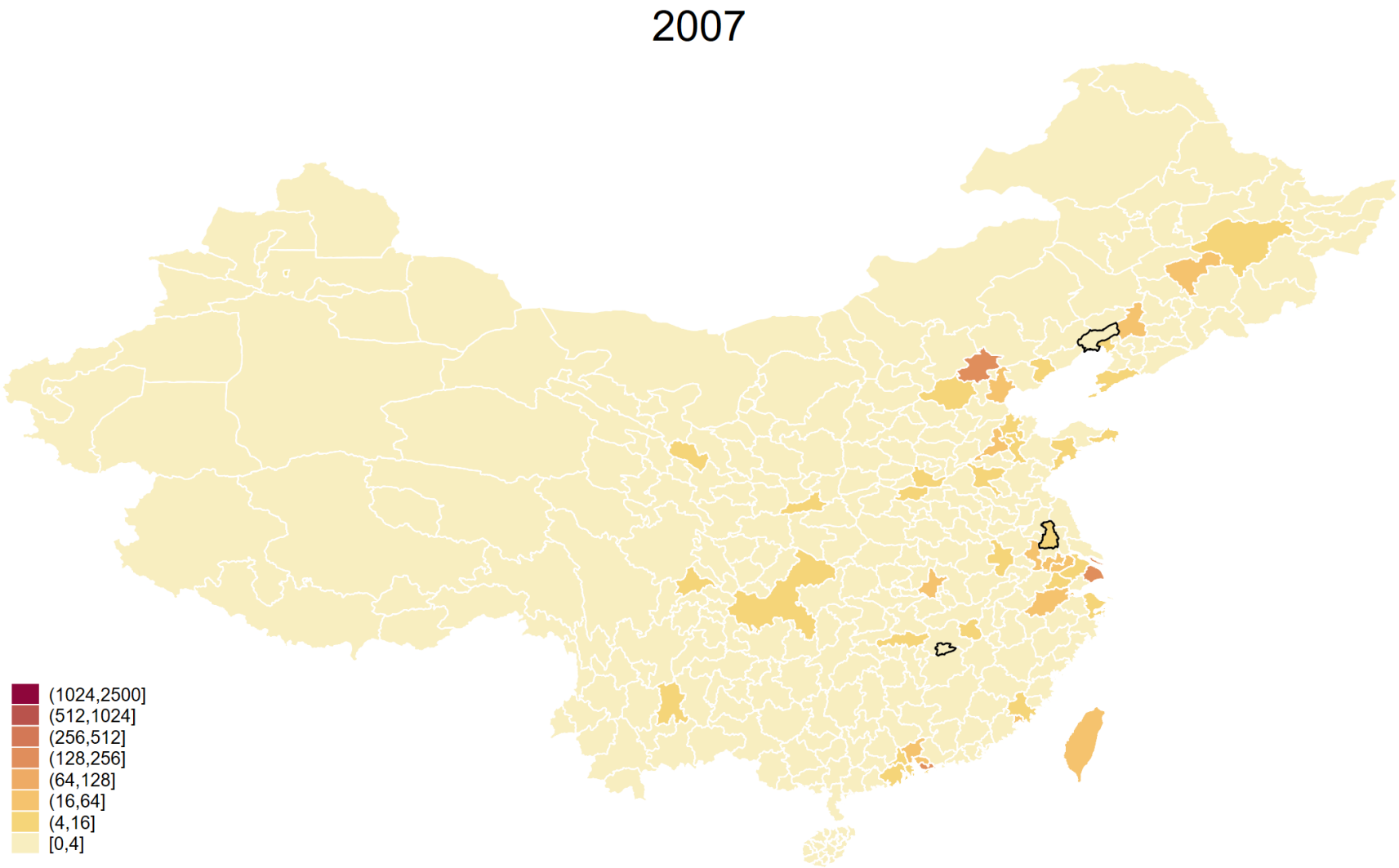


Figure: Solar Innovation and Policy Support in China

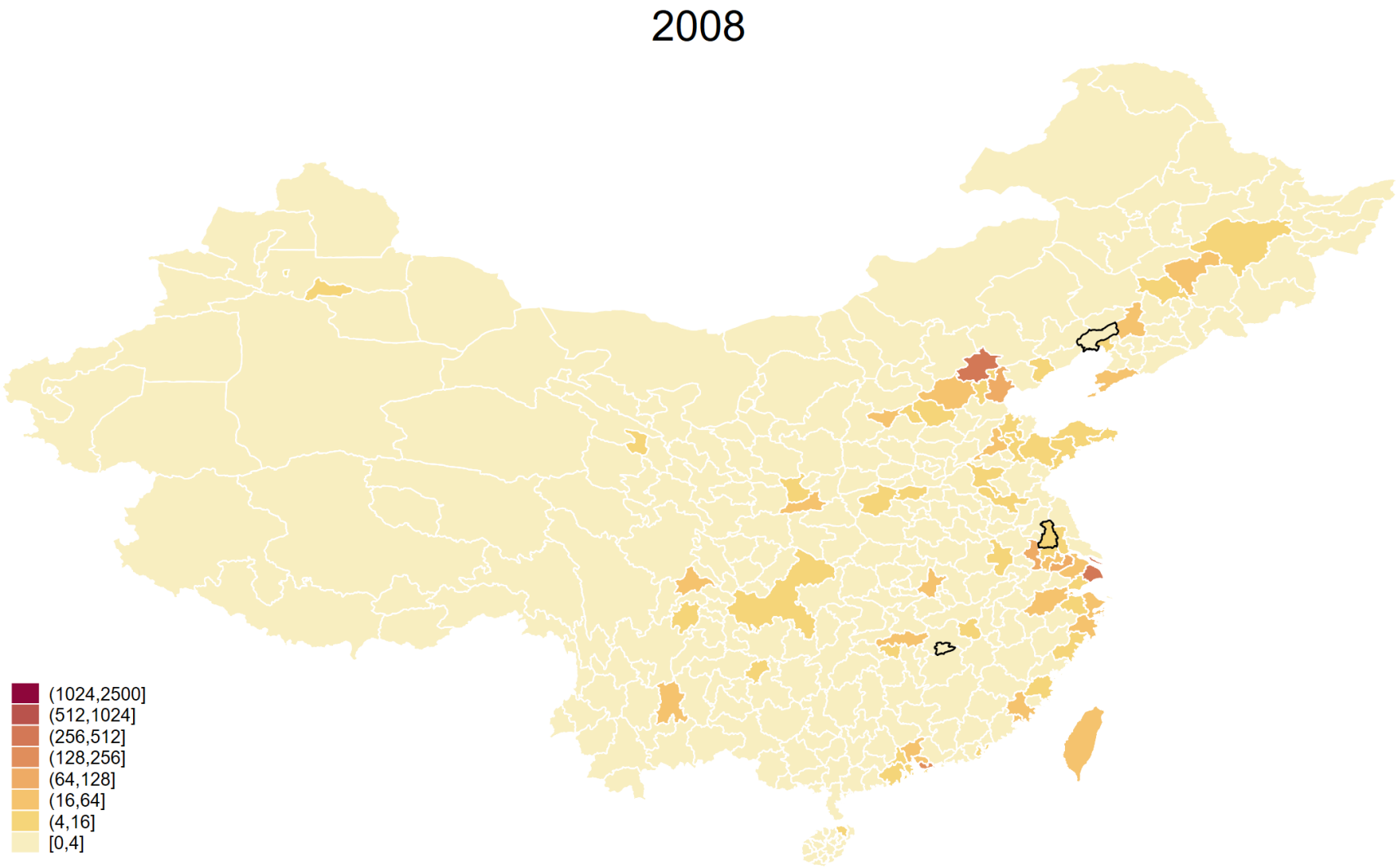


Figure: Solar Innovation and Policy Support in China

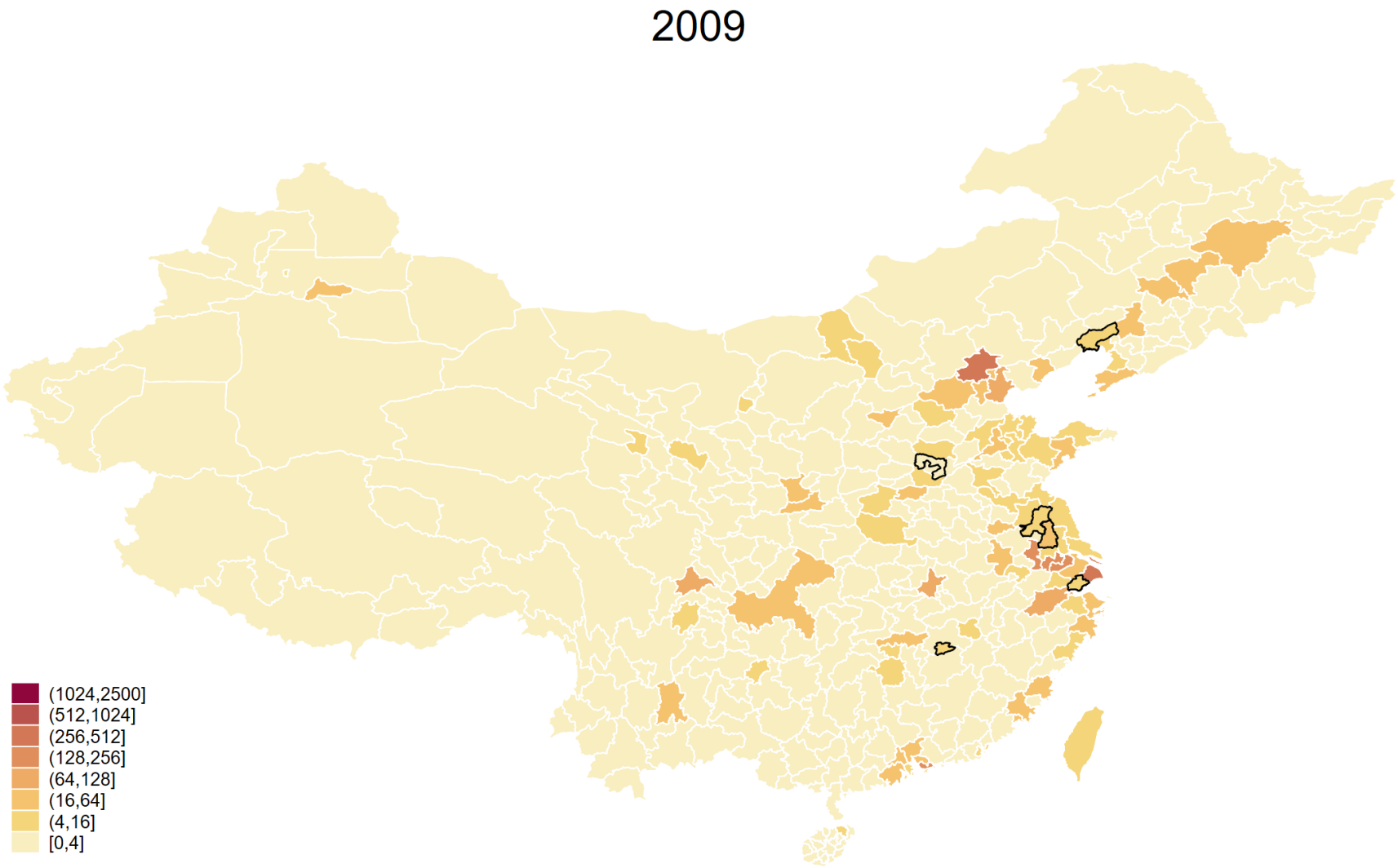


Figure: Solar Innovation and Policy Support in China

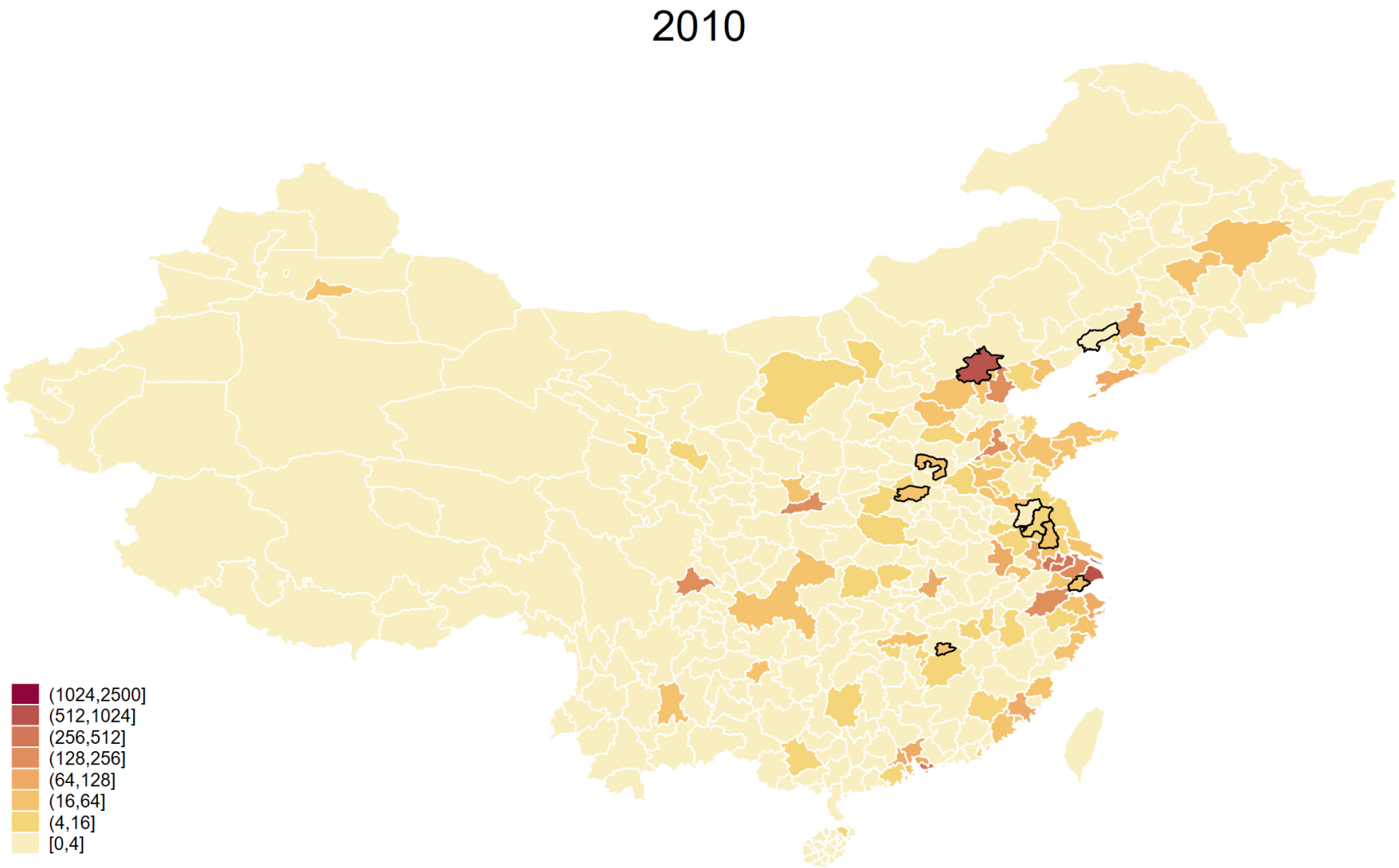
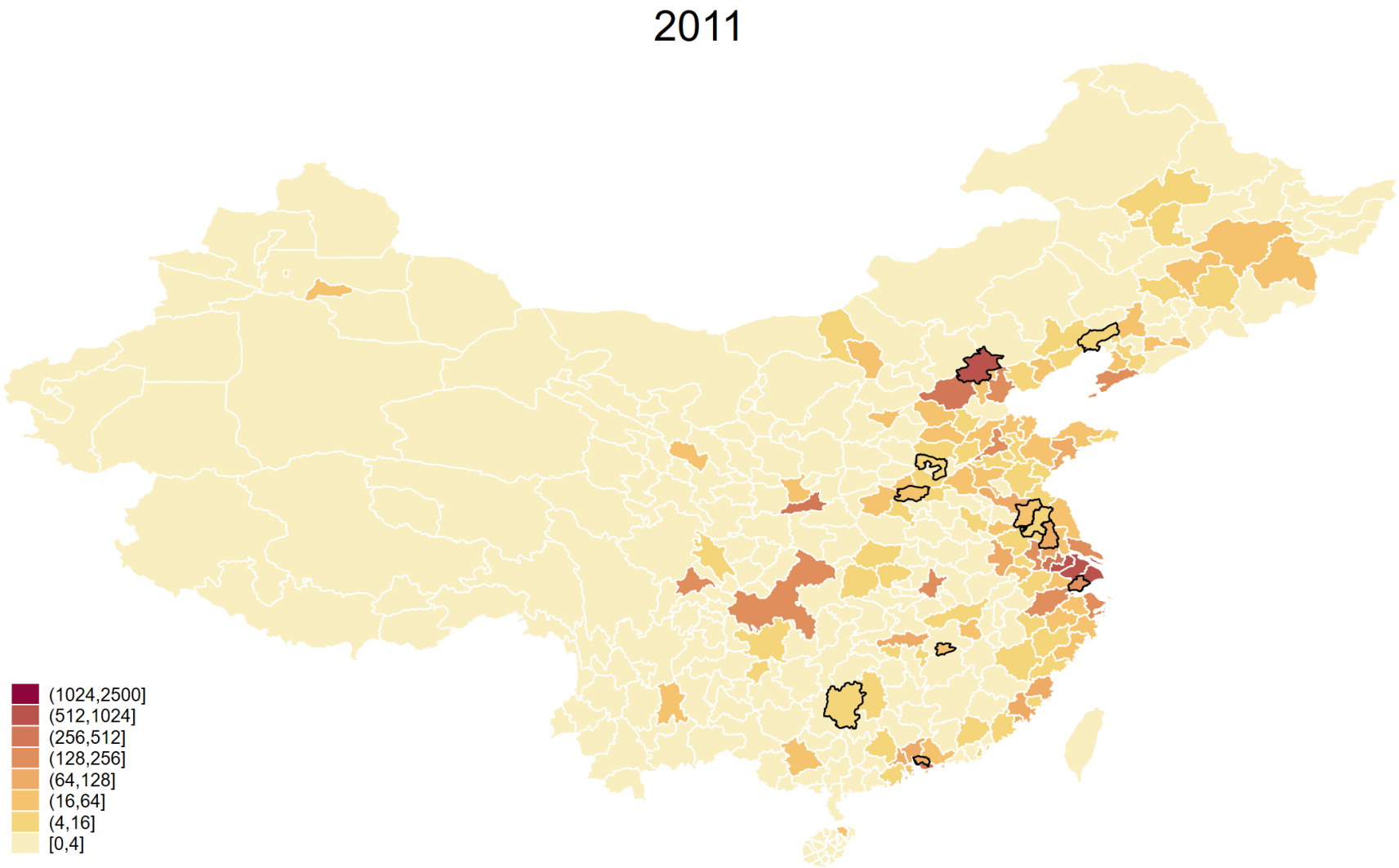


Figure: Solar Innovation and Policy Support in China



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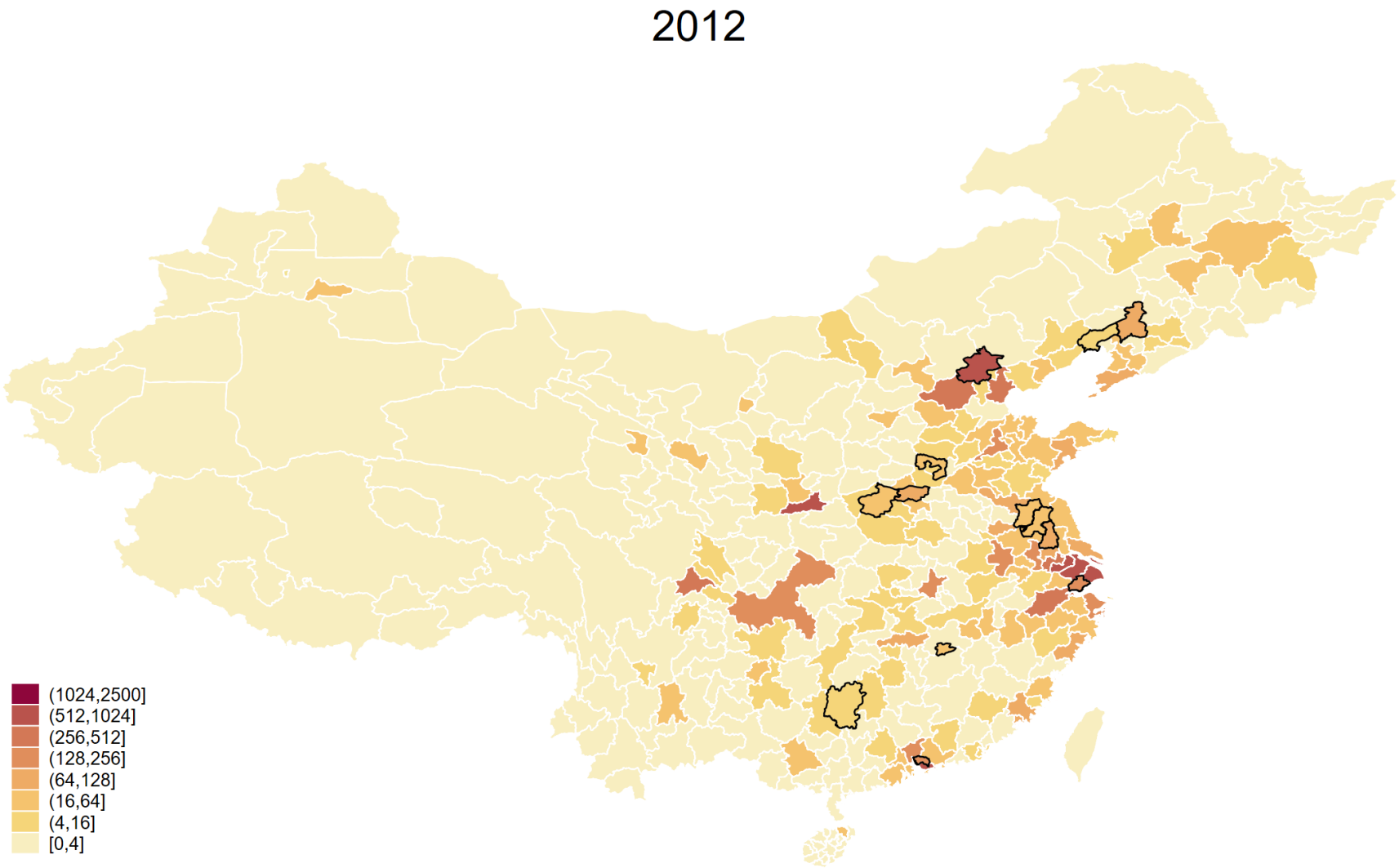


Figure: Solar Innovation and Policy Support in China

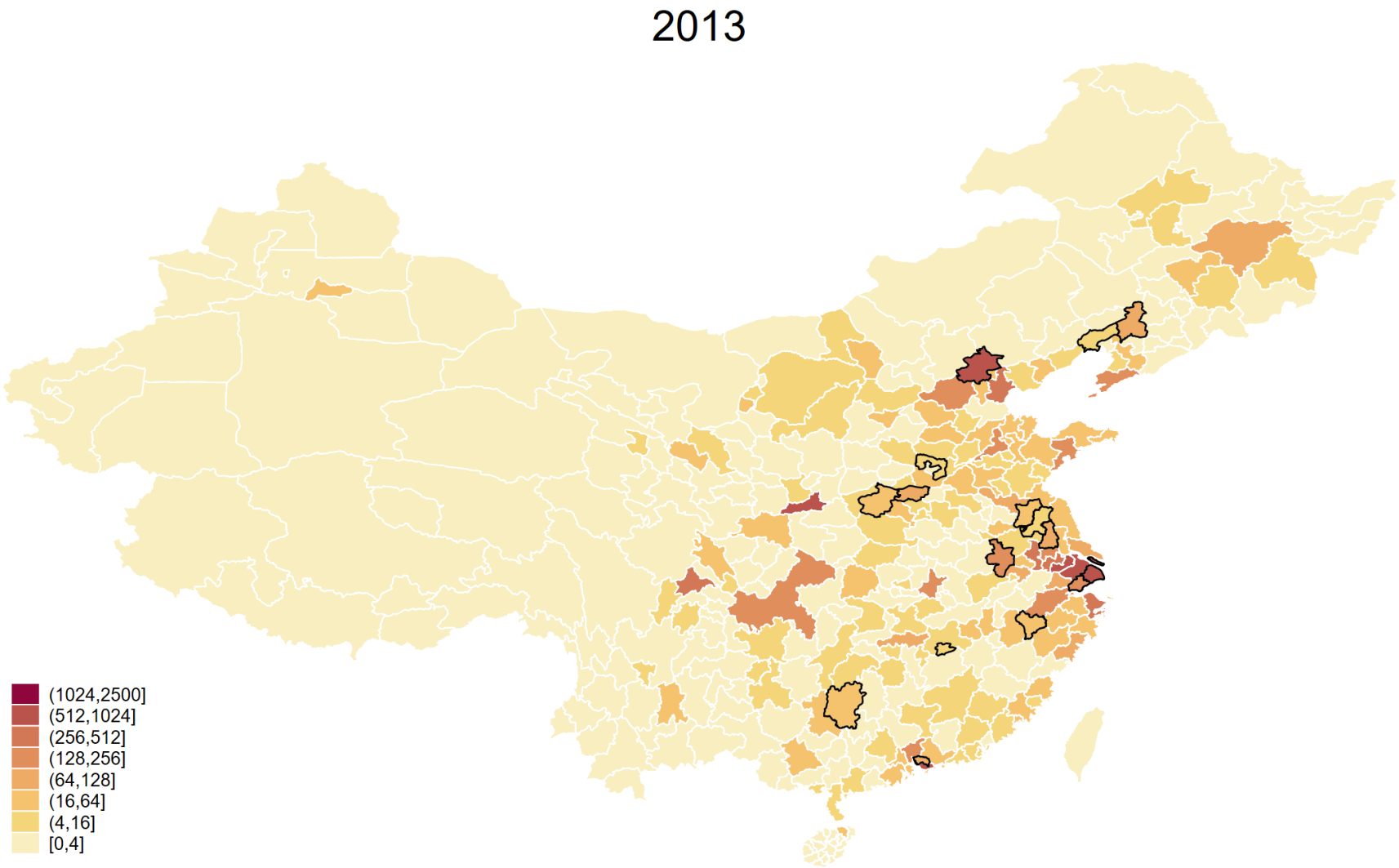
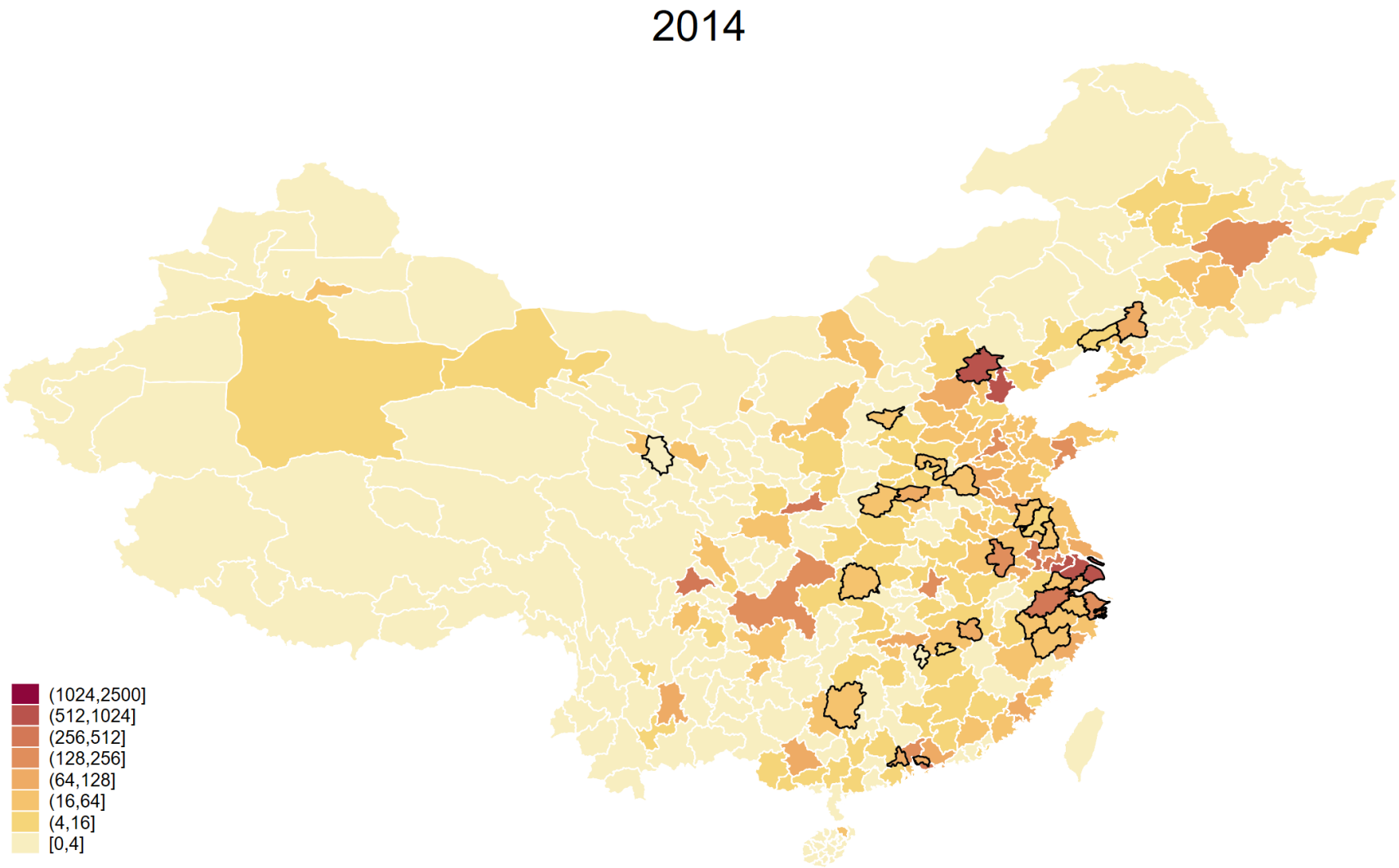


Figure: Solar Innovation and Policy Support in China



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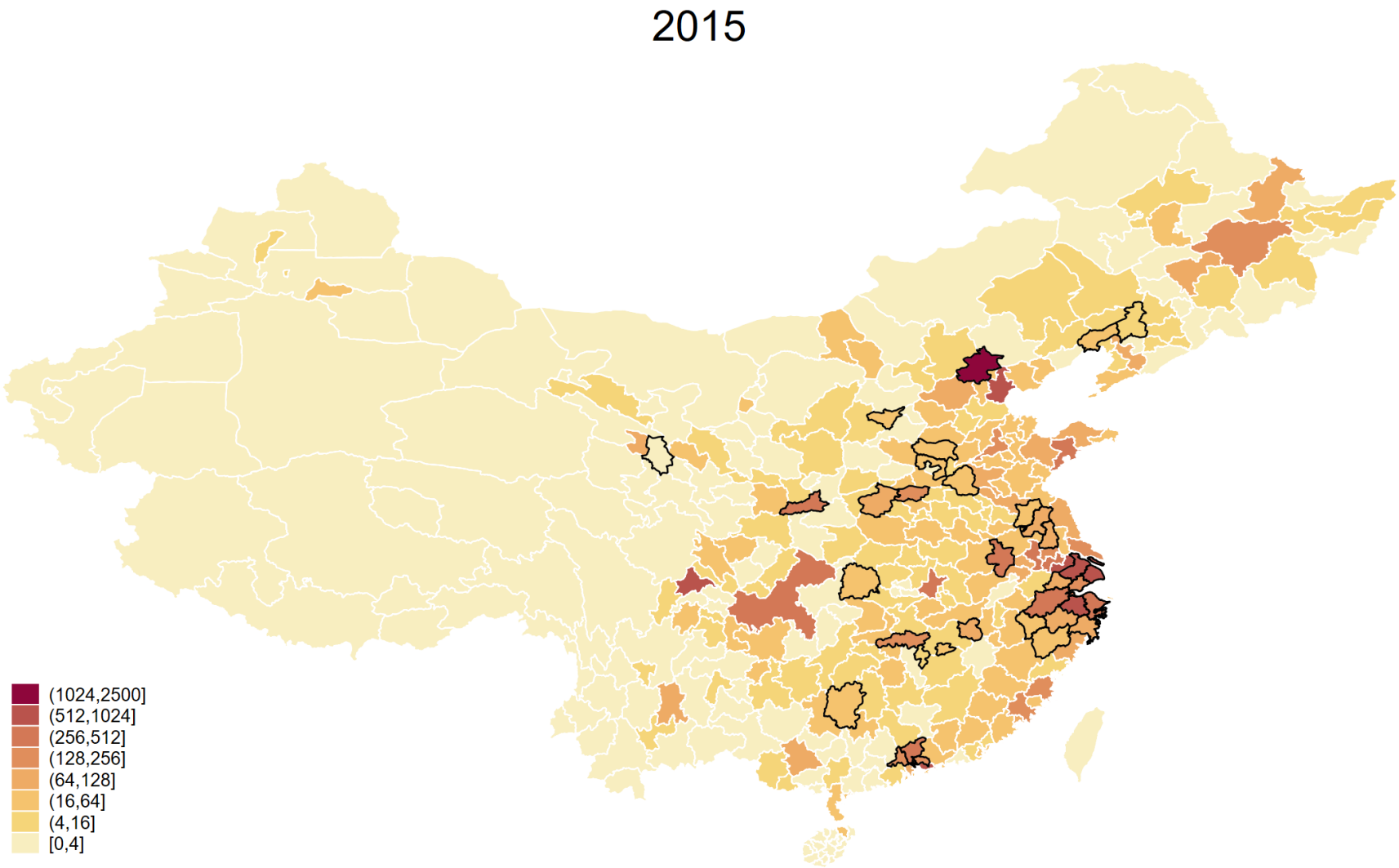
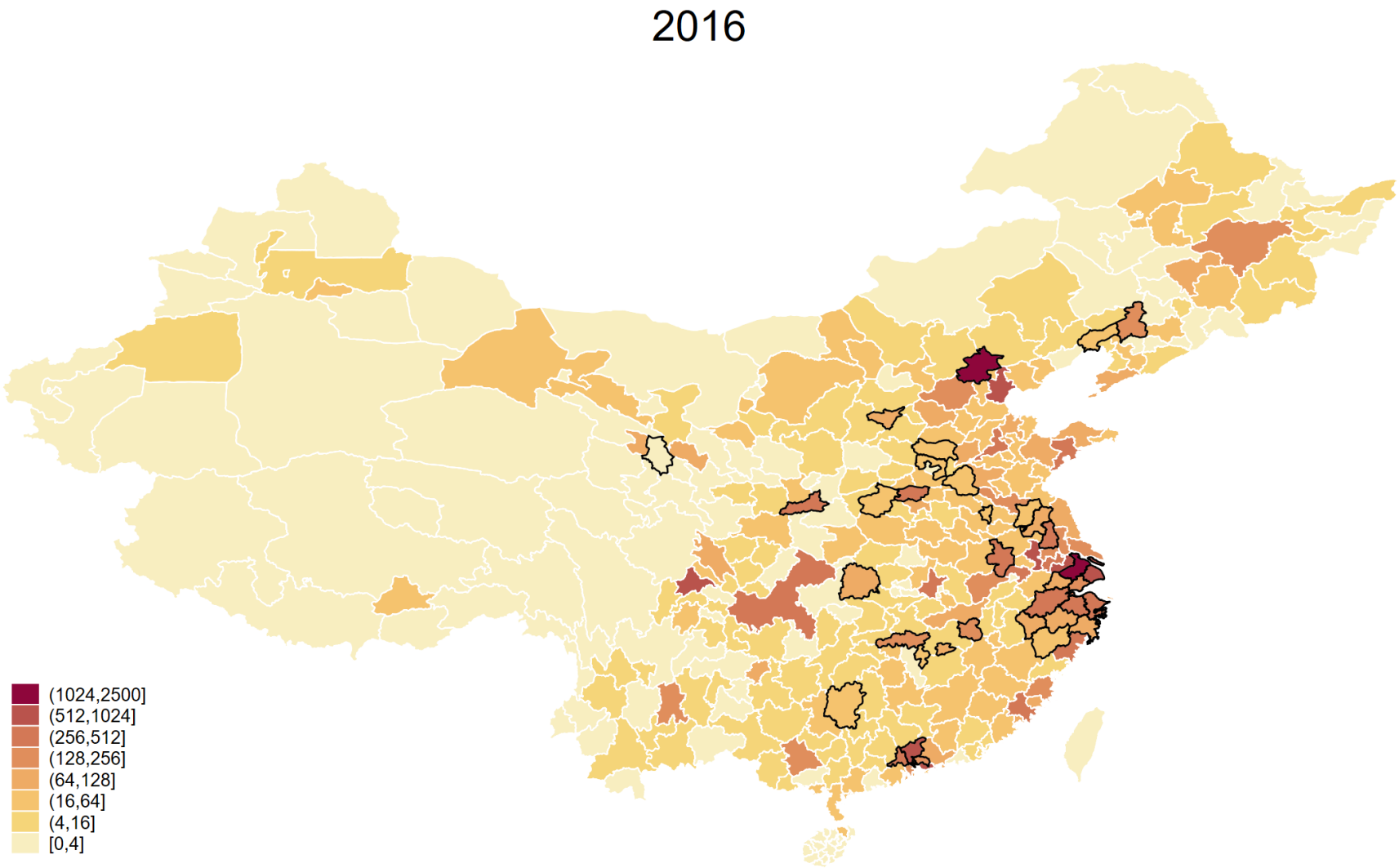


Figure: Solar Innovation and Policy Support in China



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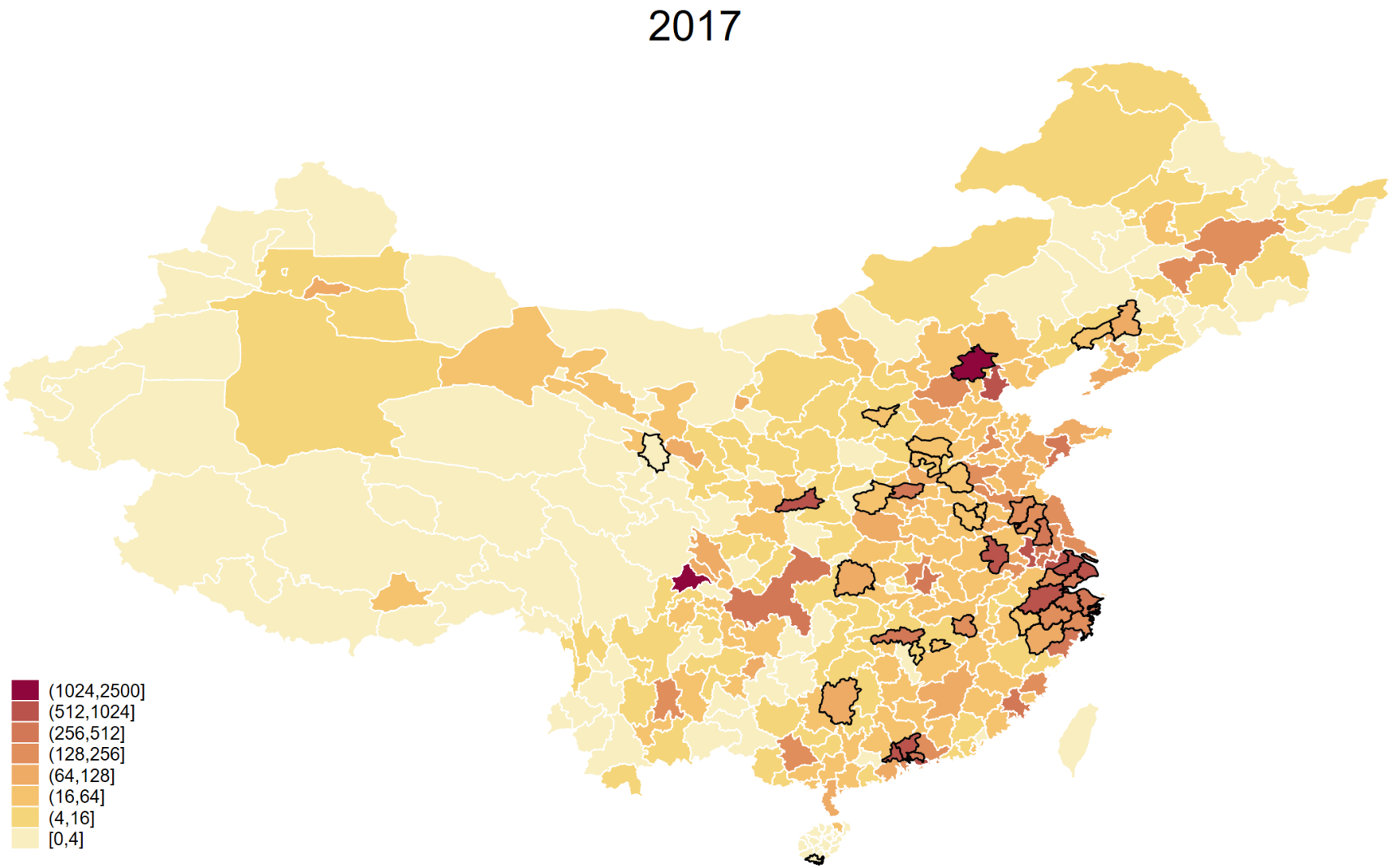

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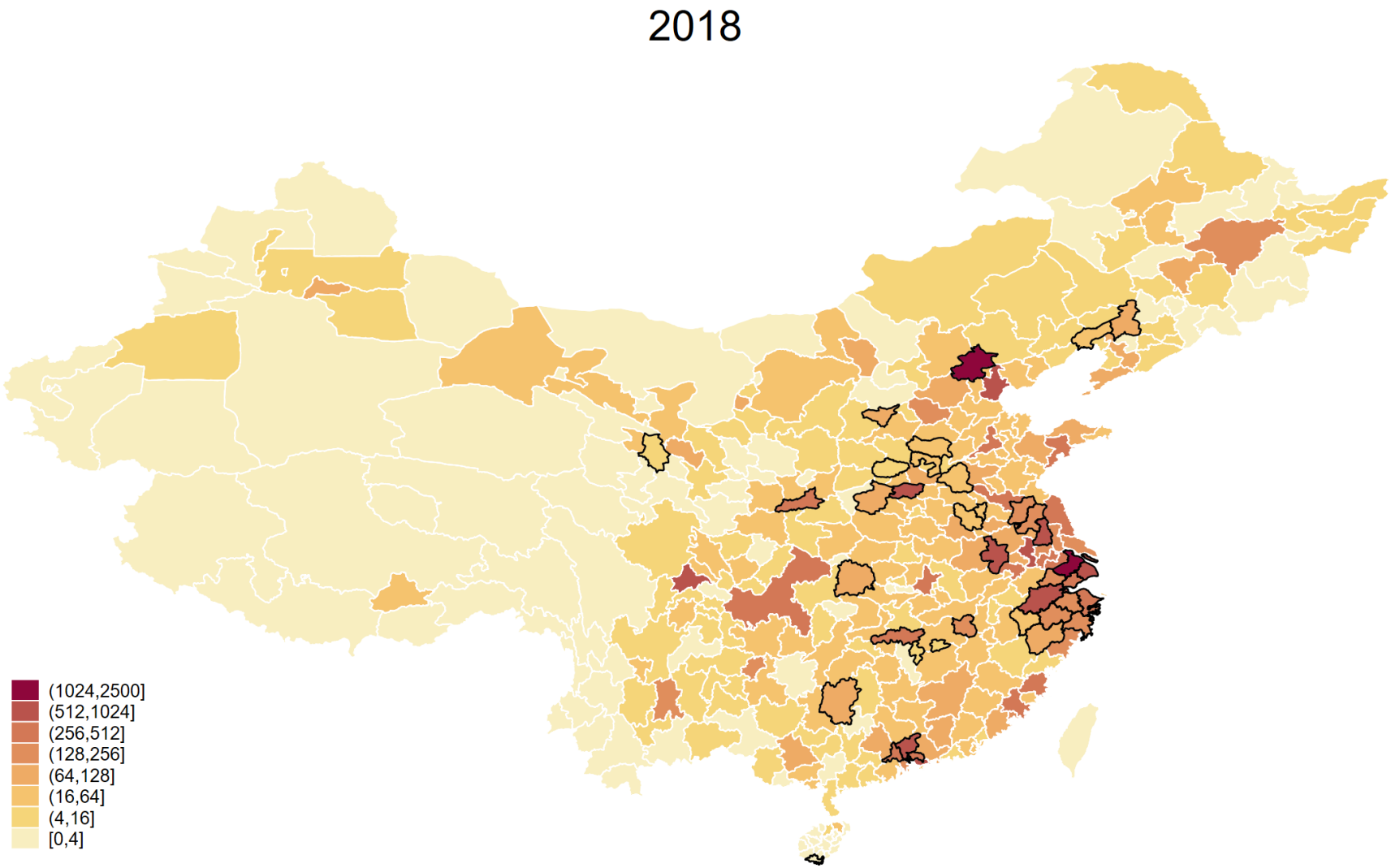


Figure: Solar Innovation and Policy Support in China

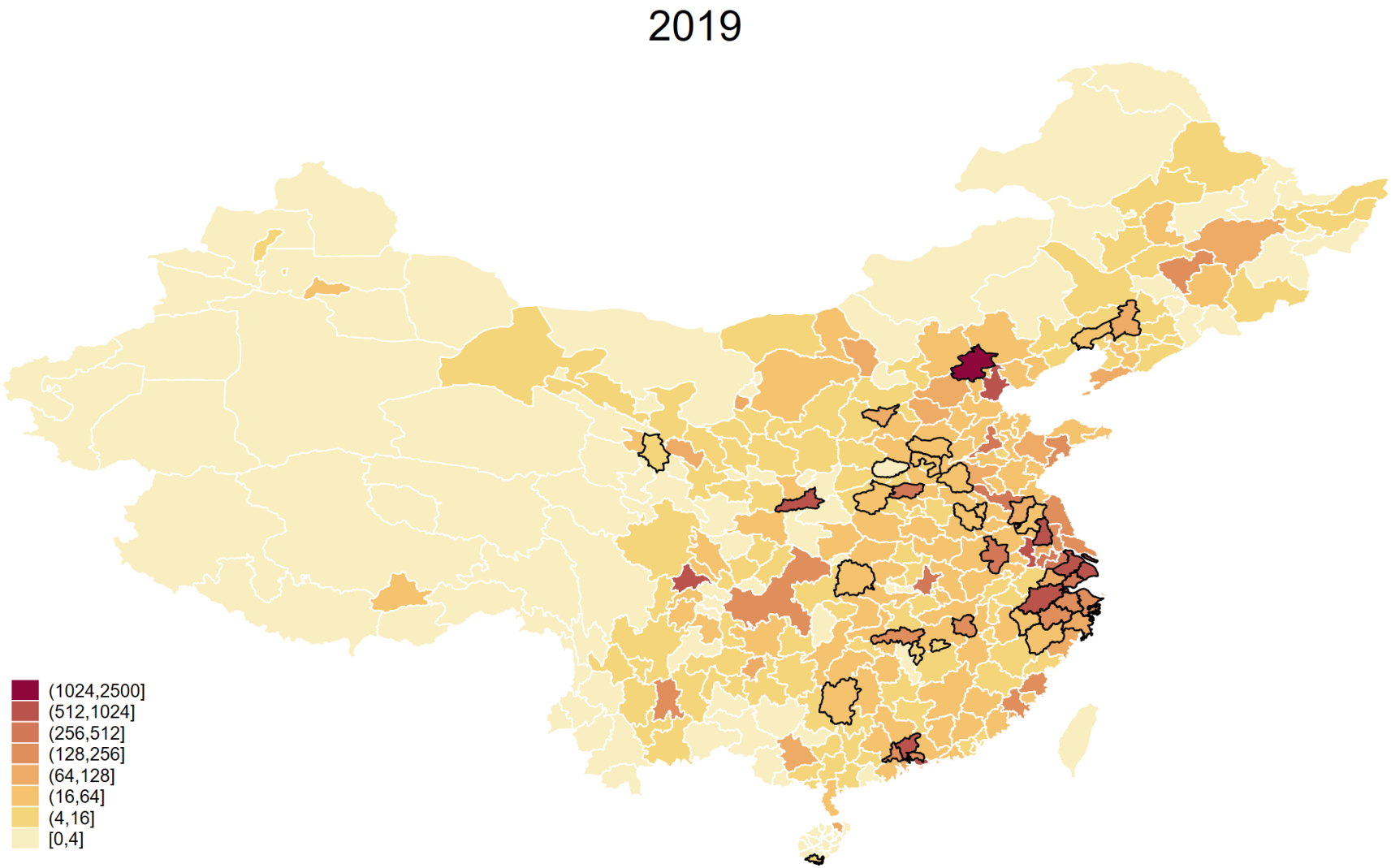
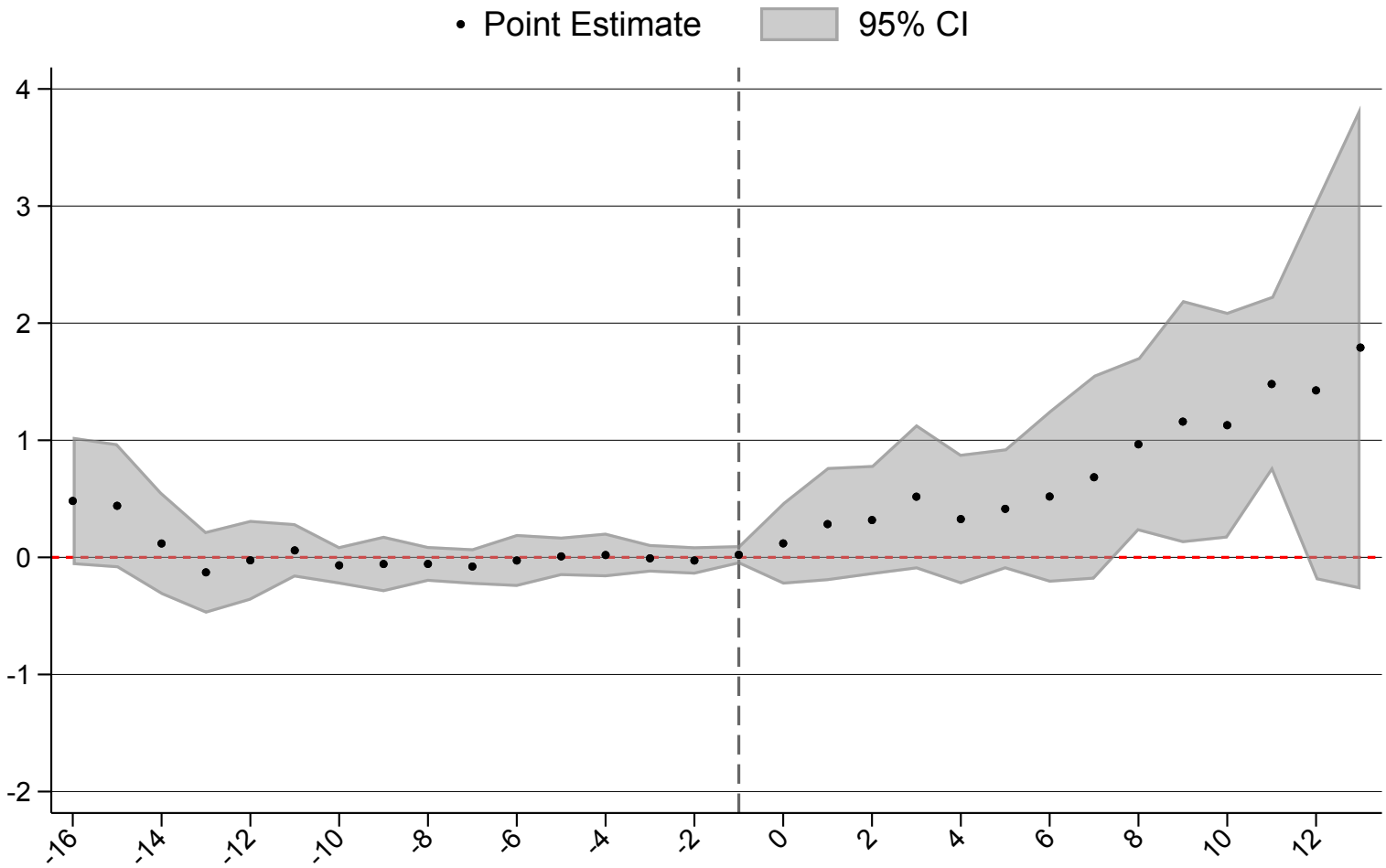


Figure: Solar Innovation and Policy Support in China

Clean Energy: patents, any subsidy

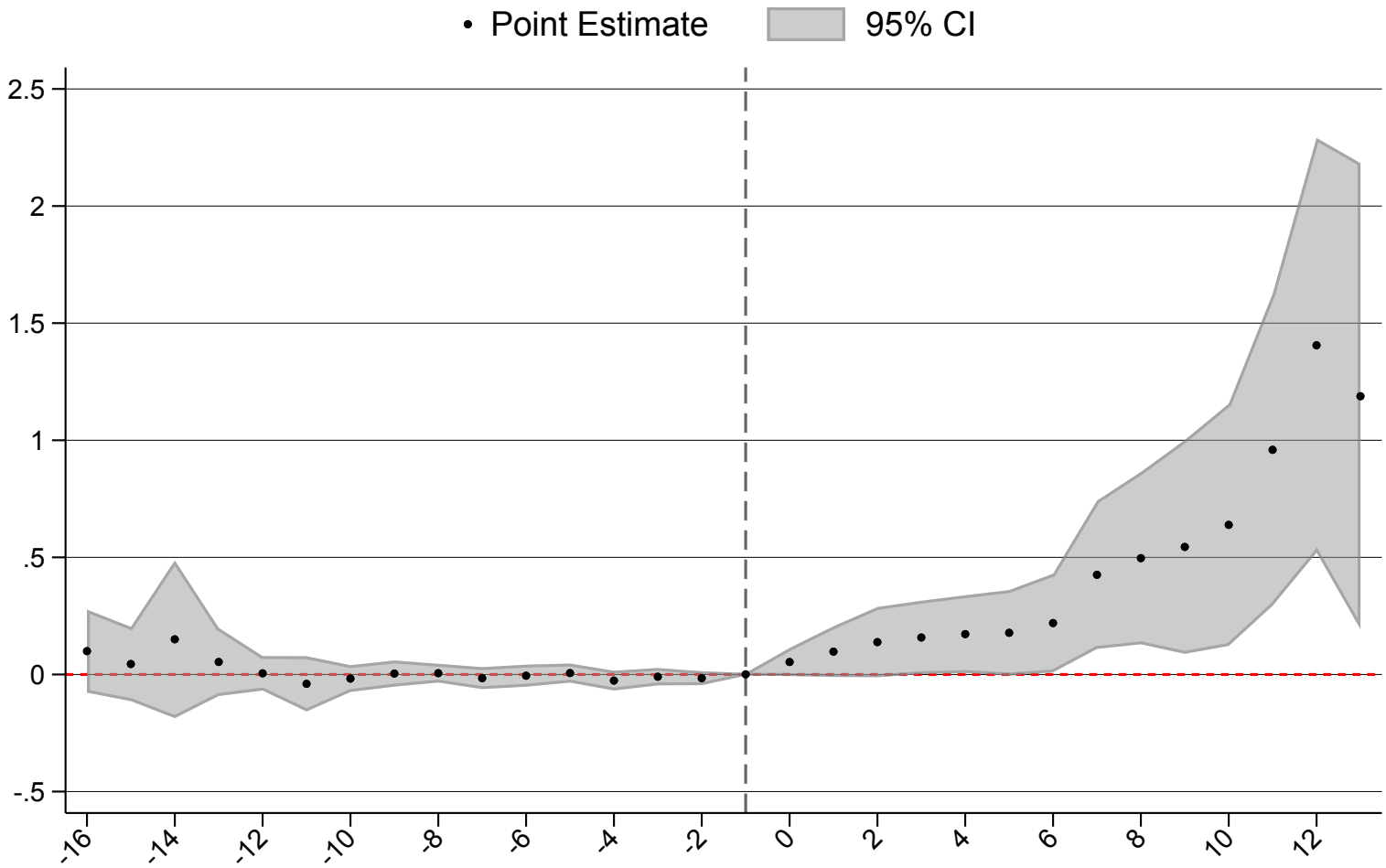


Clean Energy

Table 3: ALL PATENTS

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *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

Clean Energy: firm count, any subsidy

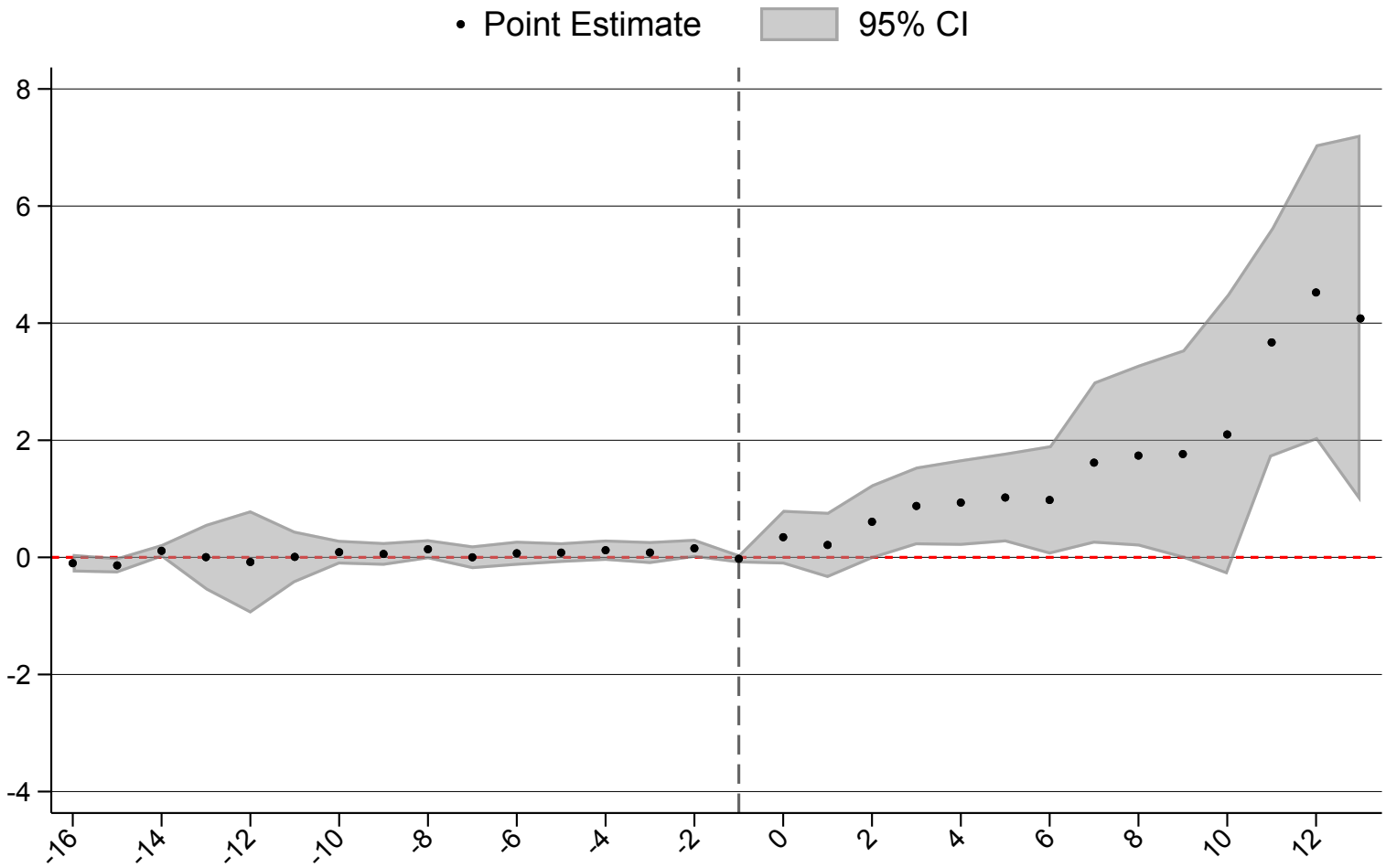


Clean Energy

Table 4: Firm Count

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *Innovation subsidy*
Firm count	0.186***	0.060	0.288***	0.381***
	(0.064)	(0.043)	(0.090)	(0.135)
Observations	6,086	6,086	6,086	6,086

Clean Energy: revenue, any subsidy

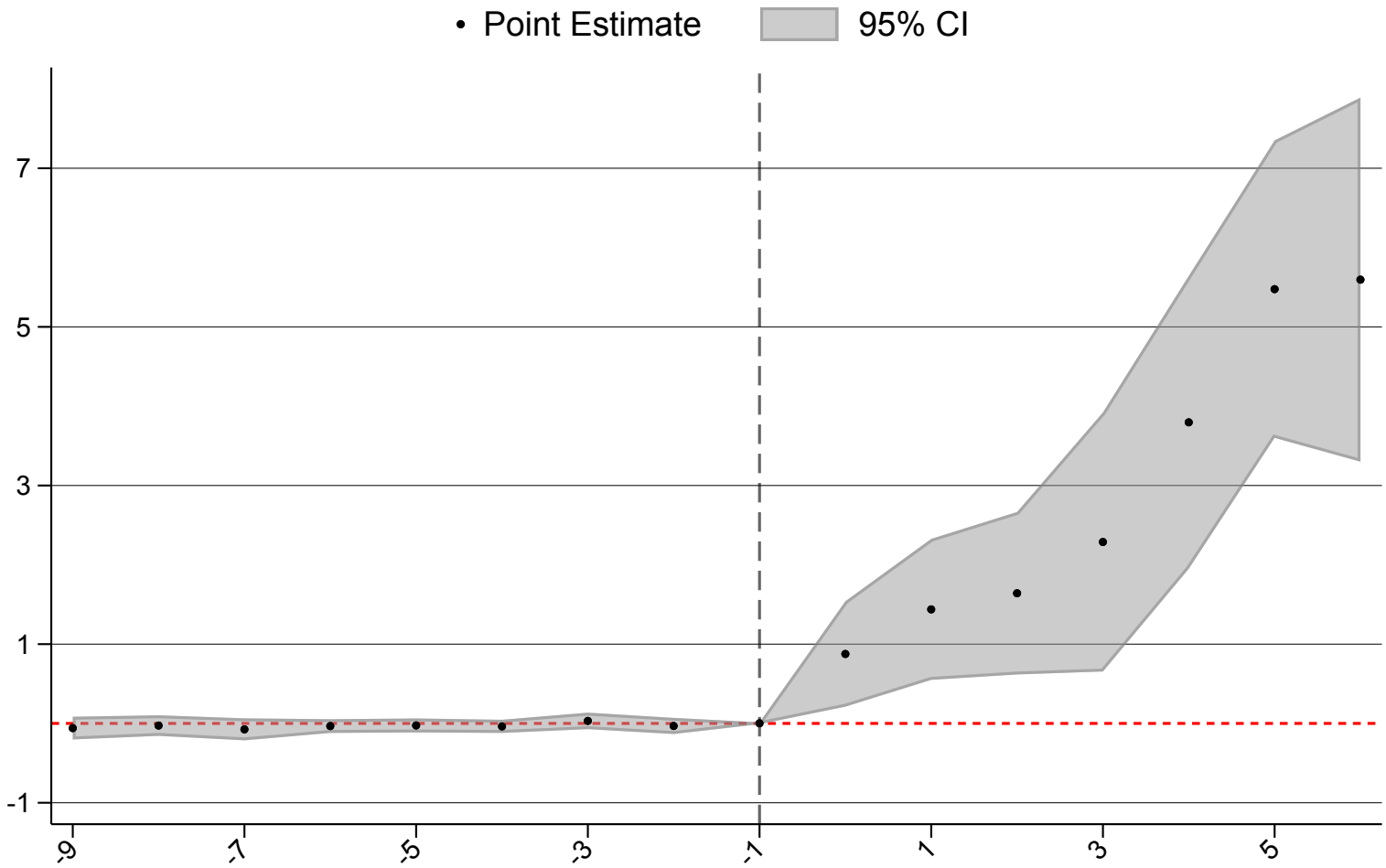


Clean Energy

Table 5: Revenue

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *Innovation subsidy*
Revenue	1.015**	0.069	1.802***	2.563***
	(0.455)	(0.277)	(0.629)	(0.844)
Observations	6,086	6,086	6,086	6,086

Clean Energy: panel production capacity, any subsidy

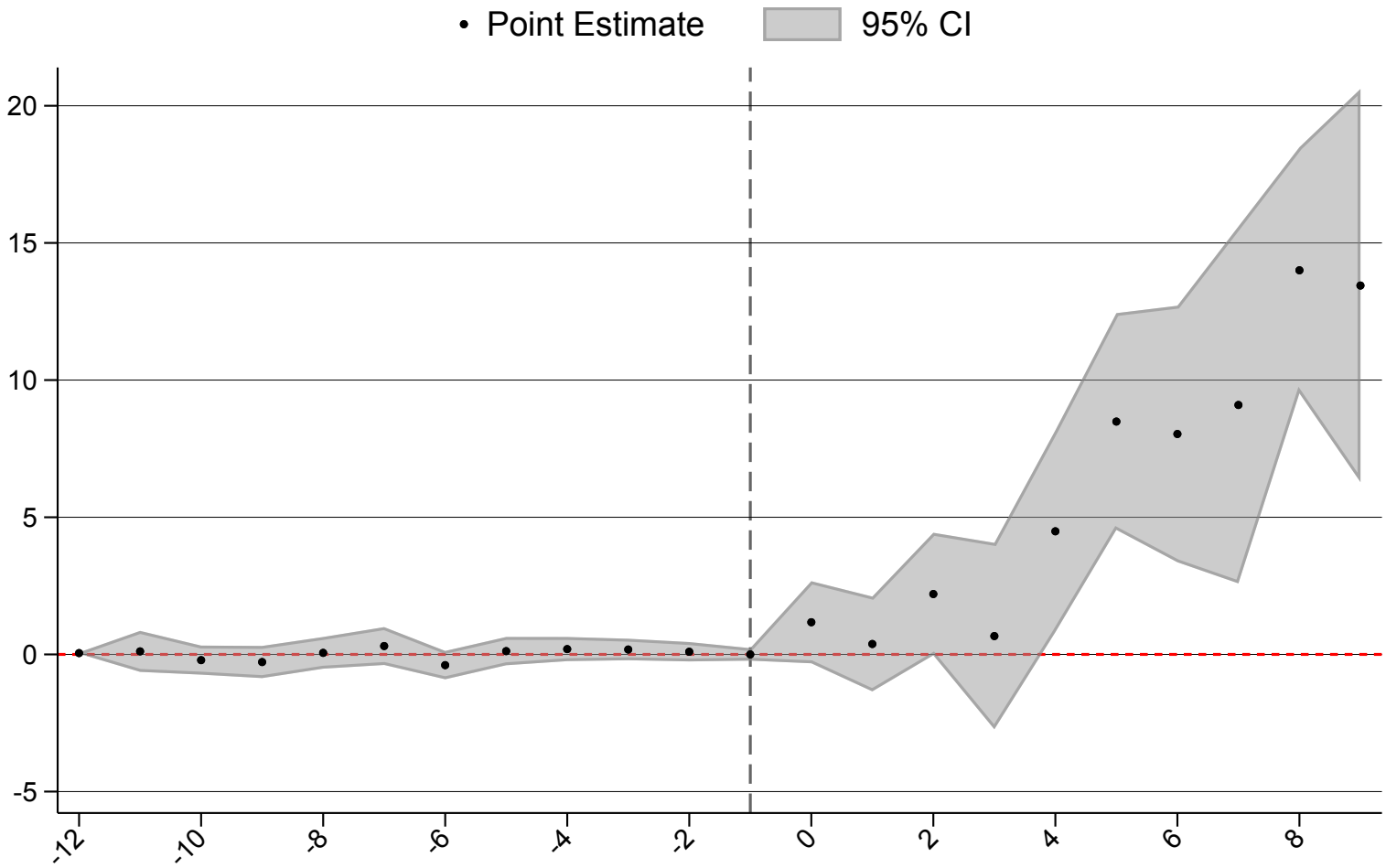


Clean Energy

Table 6: Panel Production Capacity

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *Innovation subsidy*
Panel capacity	2.098***	0.587	2.496***	2.930***
	(0.532)	(0.467)	(0.575)	(0.773)
Observations	3,580	3,580	3,580	3,580

Clean Energy: solar export, any subsidy



Clean Energy

Table 7: EXPORTS

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *Innovation subsidy*
Solar export value	3.192***	1.153	4.298***	6.092**
	(1.231)	(1.145)	(1.498)	(2.366)
Export value	2.451**	0.658	3.217**	4.160**
	(1.178)	(1.130)	(1.443)	(2.143)

Clean Energy

Table F.10: PM 2.5 CONCENTRATION

	(1) *Any subsidy*	(2) *Demand subsidy*	(3) *Production subsidy*	(4) *Innovation subsidy*
PM 2.5 concentration	−0.611	−1.192***	−0.167	−0.161
	(0.441)	(0.581)	(0.394)	(0.584)
Observations	6,086	6,086	6,086	6,086
Mean of Dep. var.	38.58	38.58	38.58	38.58

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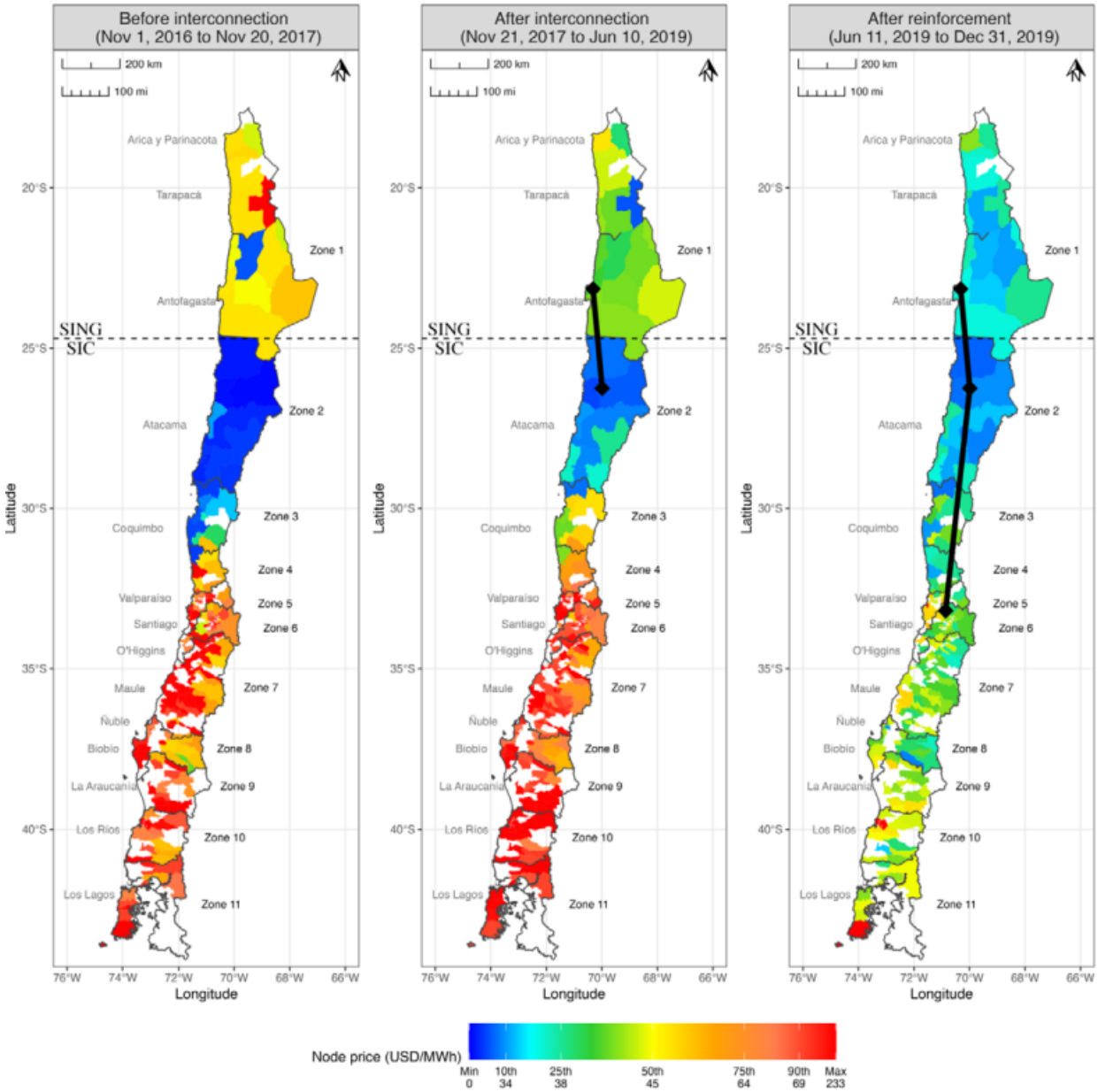

Clean Energy

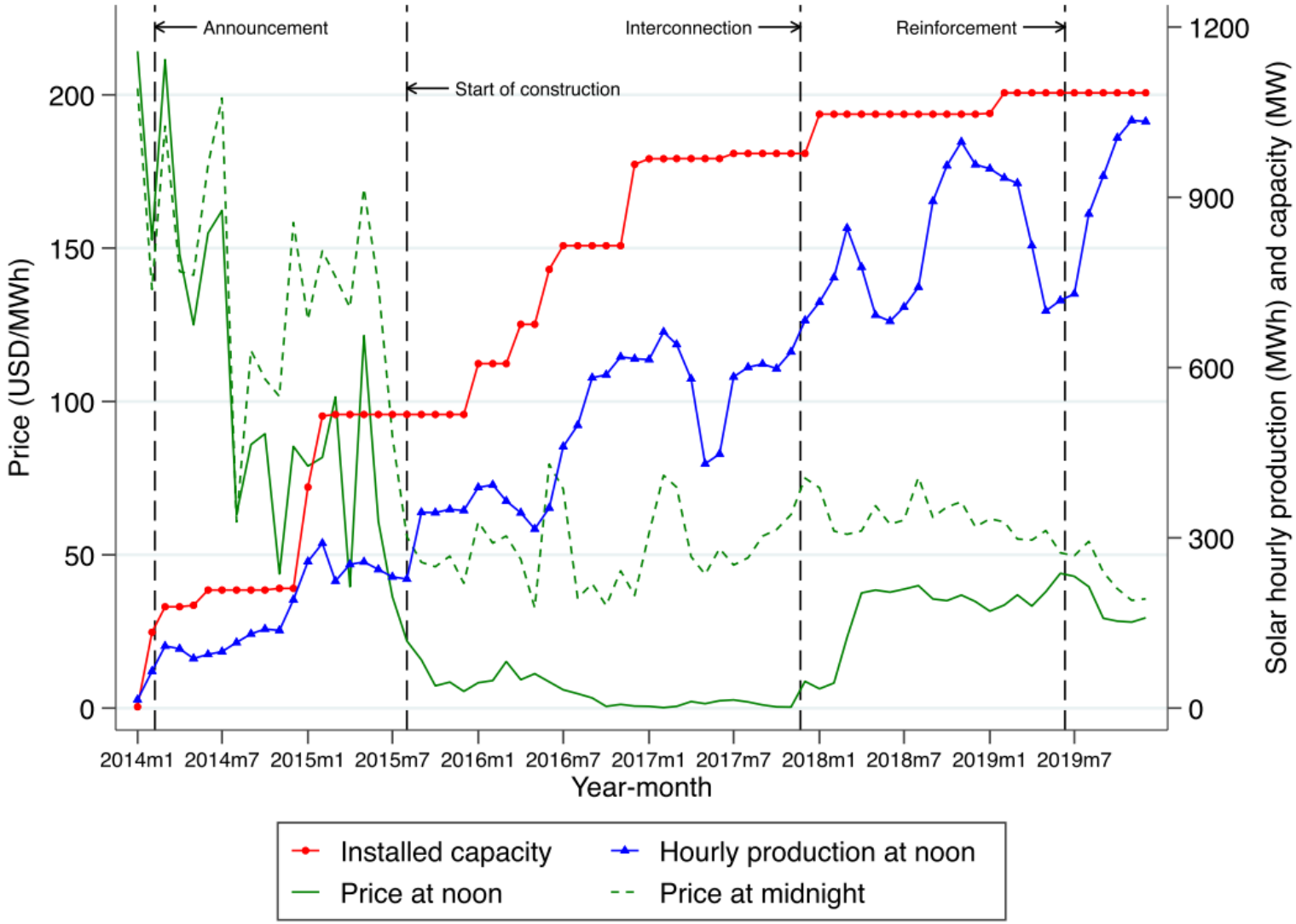

FIGURE 4.—Impacts of market integration on solar expansion.