



Programme on
Innovation and Diffusion

Growth and Green Industrial Policy: European Perspective

World Bank ECA
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John Van Reenen

LSE and MIT



Summary

- Europe (& world) has **growth problem** following Pandemic & Ukraine crises - but even before these crises, problem of **low productivity growth** since 2008-9 Financial Crisis
- **Opportunity** for policies to focus on equitable and environmentally sustainable **growth**
- **Innovation & Diffusion** of better *technologies* and *management practices* are key
- Europe needs to focus on Innovation Policy, Industrial Policy & Competition Policy
- We know much about *what* to do. Main challenge is political *will* to do it
 - The missions of “security” : **climate, defense & health**

OUTLINE OF TALK

Growth Problems: A European perspective

Understanding Growth

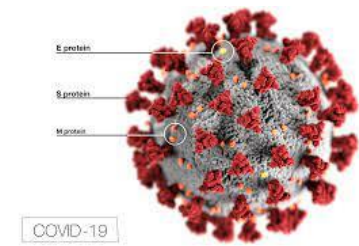
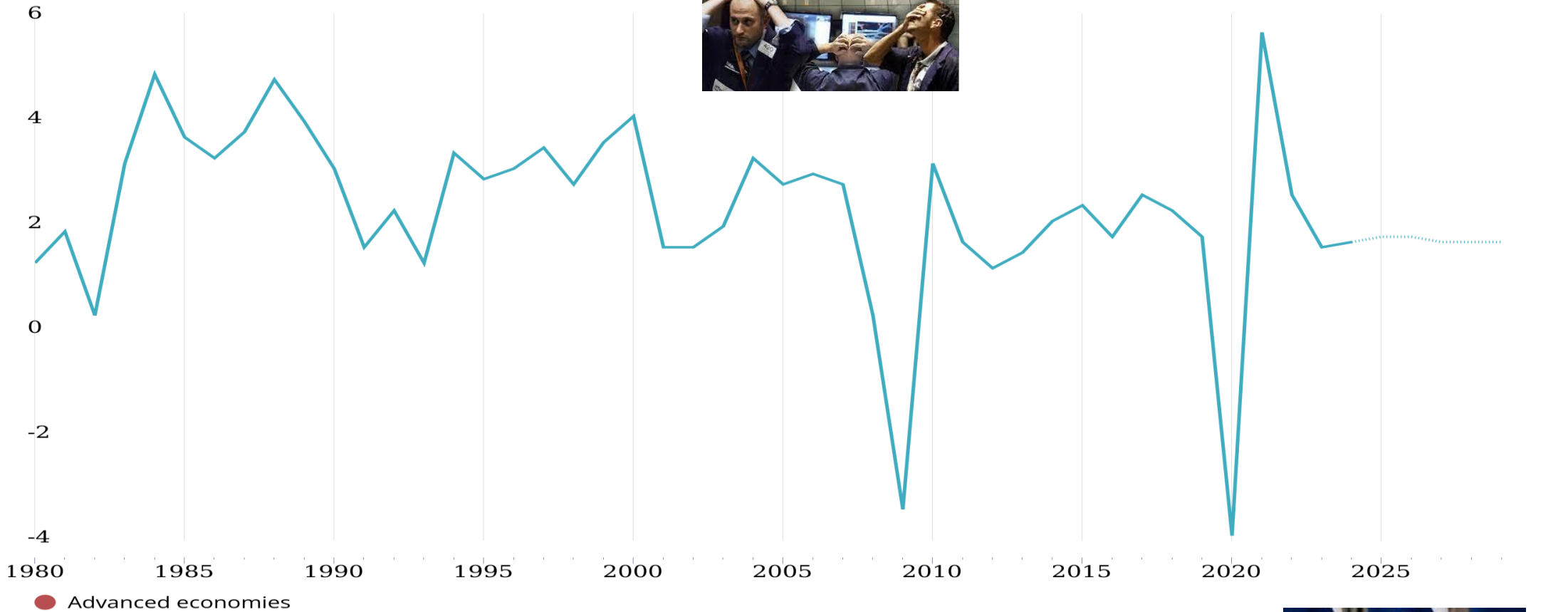
Innovation and Diffusion Policy

Industrial Policy

Getting Growth in Europe

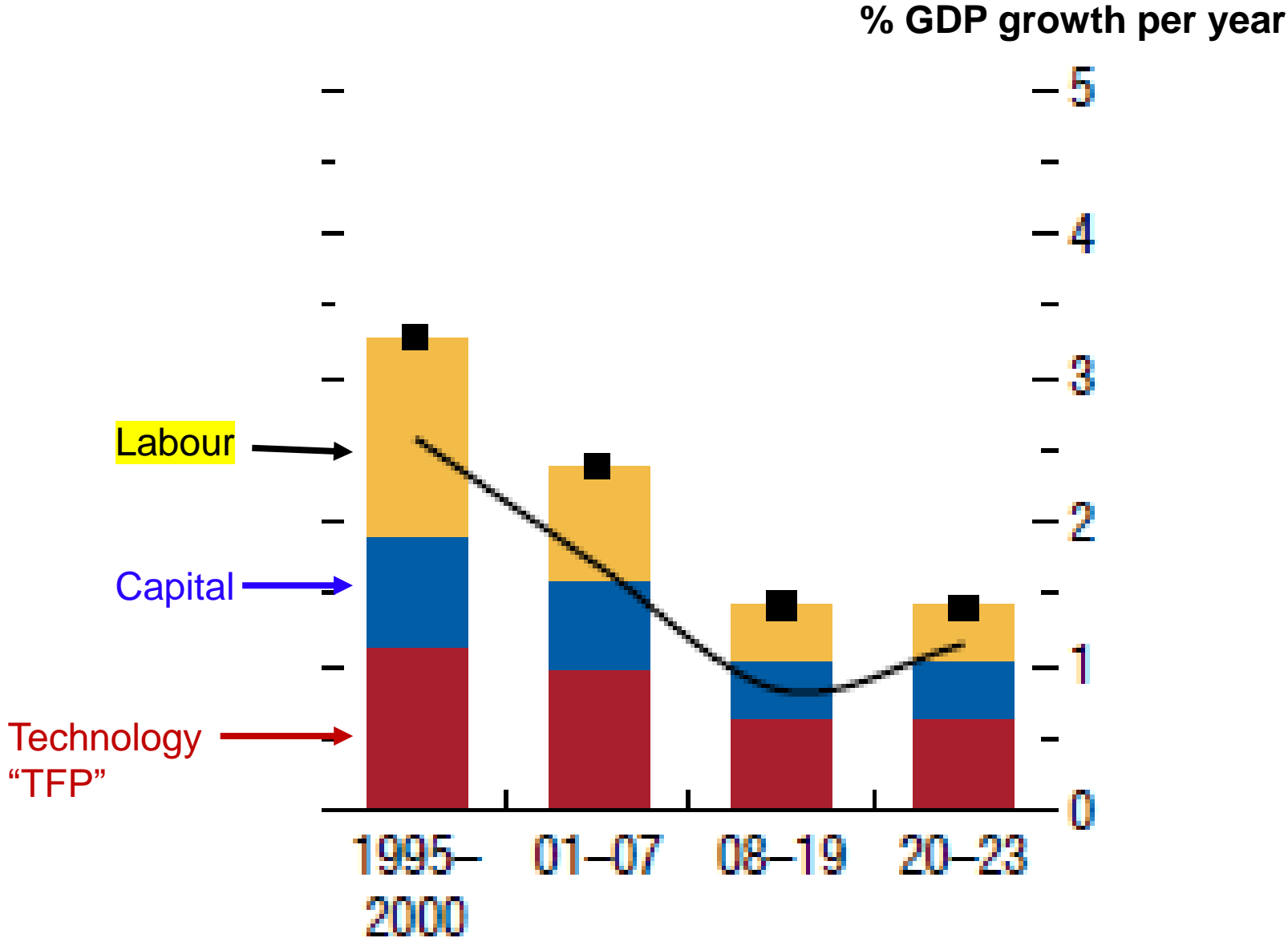
The Big Hits: GDP growth in Advanced Economies, 1980-2024

IMF DataMapper



Source: IMF (2024)

Growth slowdown in the Advanced Economics over last 30 years

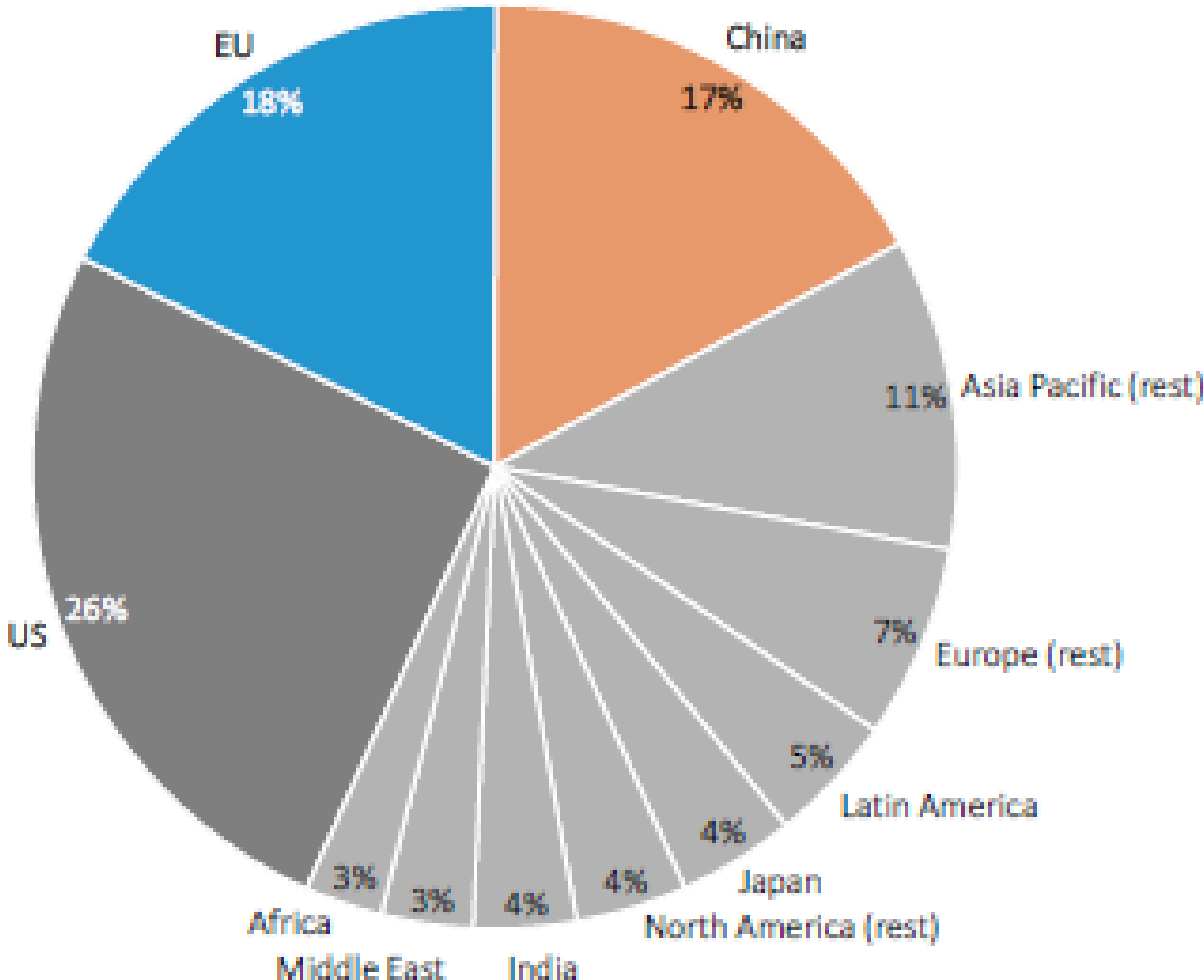


Source: IMF (2024)

Levels: EU economy slightly larger than China. Europe as a whole as big as US

Share of world GDP

GDP at current prices, 2023 forecast



Europe's standing over time

- Overall growth has been slower in EU. 2002-2022 GDP growth per year:
 - 1.4% in EU
 - 2.1% in US
 - 8.7% in China

Europe's standing over time

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Europe's standing over time

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- But mainly due to fast US population growth. GDP *per person* growth per year
 - 1.2% in EU
 - 1.3% in US
 - 8% in China
- **Still, EU GDP per capita a third lower than US (worse than 2002, at 31%)**
 - **This is almost all (~85%) due to lower TFP, rather than capital intensity**

OUTLINE OF TALK

Growth Problems: A European perspective

Understanding Growth

Innovation and Diffusion Policy

Industrial Policy

Getting Growth in Europe

Understanding Growth: Three fundamental sources

- **Innovation:** *Frontier Productivity Growth*
 - Ideas that are new to the world



Understanding Growth: Three fundamental sources

- **Innovation:** *Frontier Productivity Growth*
 - Ideas that are new to the world
- **Diffusion:** *Catching up to frontier*
 - The spread of these ideas



Understanding Growth: Three fundamental sources

- **Innovation:** *Frontier Productivity Growth*
 - Ideas that are new to the world



**Example:
The Wheel**


- **Diffusion:** *Catching up to frontier*
 - The spread of these ideas



- **Reallocation:** *Creative Destruction* - More productive & innovative firms displace less efficient



Schumpeter



Foreword by
Emmanuel Macron

The
ECONOMICS
of
CREATIVE
DESTRUCTION

New Research on Themes from Aghion and Howitt

Edited by **UFUK AKCIGIT & JOHN VAN REENEN**

OUTLINE OF TALK

Growth Problems: A European perspective

Understanding Growth

Innovation (and Diffusion) Policy

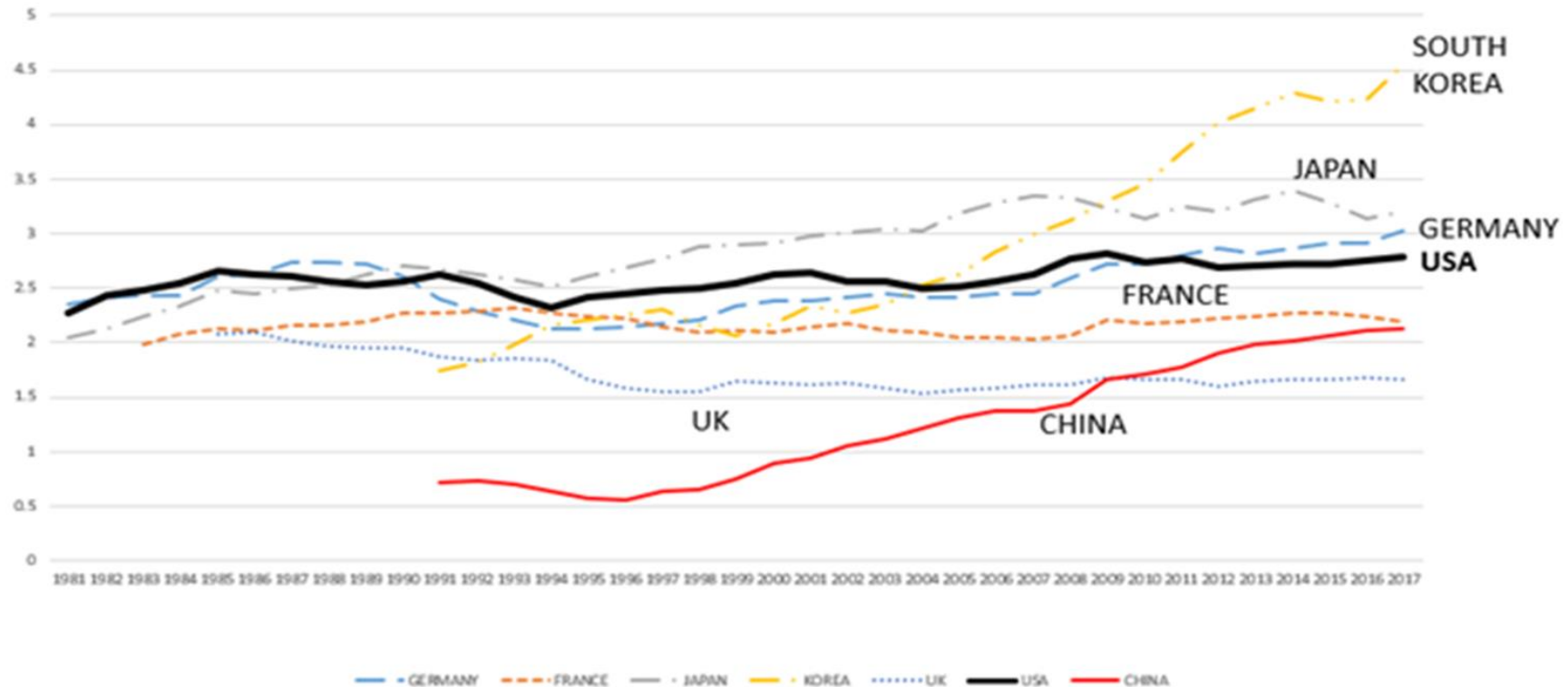
Industrial Policy

Getting Growth in Europe

Europe invests less in Research & Development & falling behind

- R&D as a share of GDP
 - US 3.5%
 - China 2.4%
 - EU 2.2%

Total R&D to GDP ratio since 1981



Source: Bloom, Van Reenen and Williams (2019) using OECD

Why should the government subsidize innovation?

- Knowledge spillovers means market failure
 - R&D investments mainly benefits other firms and people
- **Data shows big role for knowledge spillovers:**
 - Social return to R&D about four times private return (Bloom et al. 2013; Lucking et al, 2020; Jones and Summers, 2023)



Innovation Policy: The “Lightbulb” Table

| (1) | (2) | (3) | (4) | (5) | (6) |
|--------|---------------------|----------------------------|----------------|-------------|----------------------|
| Policy | Quality of evidence | Conclusiveness of evidence | Benefit - Cost | Time frame: | Effect on inequality |



Source: Bloom, Van Reenen and Williams (2019, JEP)

Innovation Policy: The “Lightbulb” Table

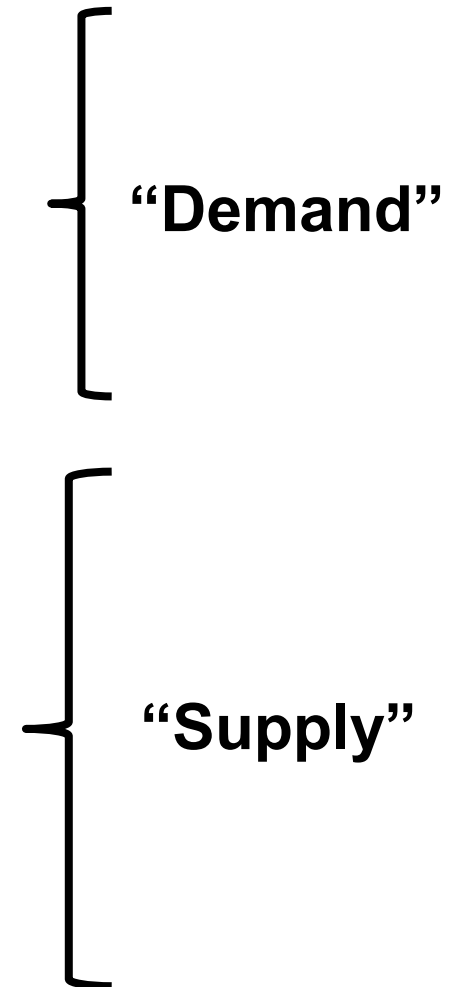
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| Policy | Quality of evidence | Conclusiveness of evidence | Benefit - Cost | Time frame: | Effect on inequality |
| Direct R&D Grants | Medium | Medium |  | Medium-Run | ↑ |
| R&D tax credits | High | High |  | Short-Run | ↑ |
| Patent Box | Medium | Medium | Negative | n/a | ↑ |

“Demand”



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| Patent Box | Medium | Medium | Negative | n/a | ↑ |
| Skilled Immigration | High | High | 💡💡💡 | Short to Medium-Run | ↓ |
| Universities: incentives | Medium | Low | 💡 | Medium-Run | ↑ |
| Universities: STEM Supply | Medium | Medium | 💡💡 | Long-Run | ↓ |
| Exposure Policies | Medium | Low | 💡💡 | Long-run | ↓ |
| Trade and competition | High | Medium | 💡💡 | Medium-Run | ↑ |



Successful Innovation Policies

- **R&D tax credits**
- Direct government grants
- Human capital supply
 - Expanding STEM workforce
 - Universities
 - Immigration
 - “Lost Einsteins”
- Competition and trade policy

Successful Innovation Policies

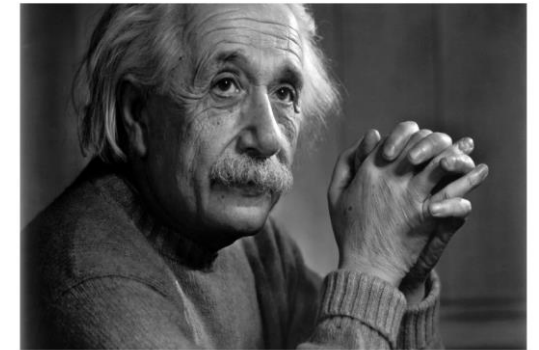
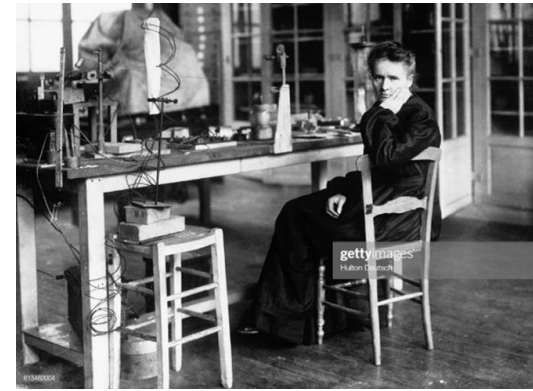
- **R&D tax credits**
- **Direct government grants**
- Human capital supply
 - Expanding STEM workforce
 - Universities
 - Immigration
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Innovation Policies: Human Capital

- R&D tax credits
- Direct government grants
- **Human capital supply**
 - Problem with tax and grants is that they subsidize *demand*. If supply side inelastic, the effect is to just drive up price of R&D (scientist wages) rather than volume of R&D
 - Increasing human capital more effective: directly increases innovation and reduces cost of R&D (reduces inequality)
- Competition and trade policy

Successful Innovation Policies

- R&D tax credits
- Direct government grants
- **Human capital supply**
 - Expanding STEM workforce
 - Universities
 - Skilled Immigration
 - **“Lost Einsteins & Marie Curies”**: Few women, minorities & kids from low-income families in inventor pool = big loss of talent (Bell et al., 2019)
- Competition and trade policy

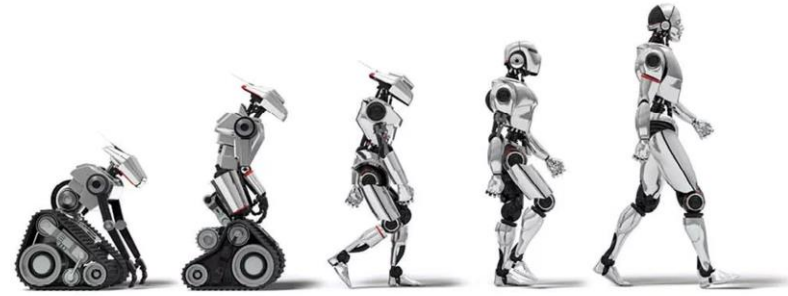


Successful Innovation Policies II

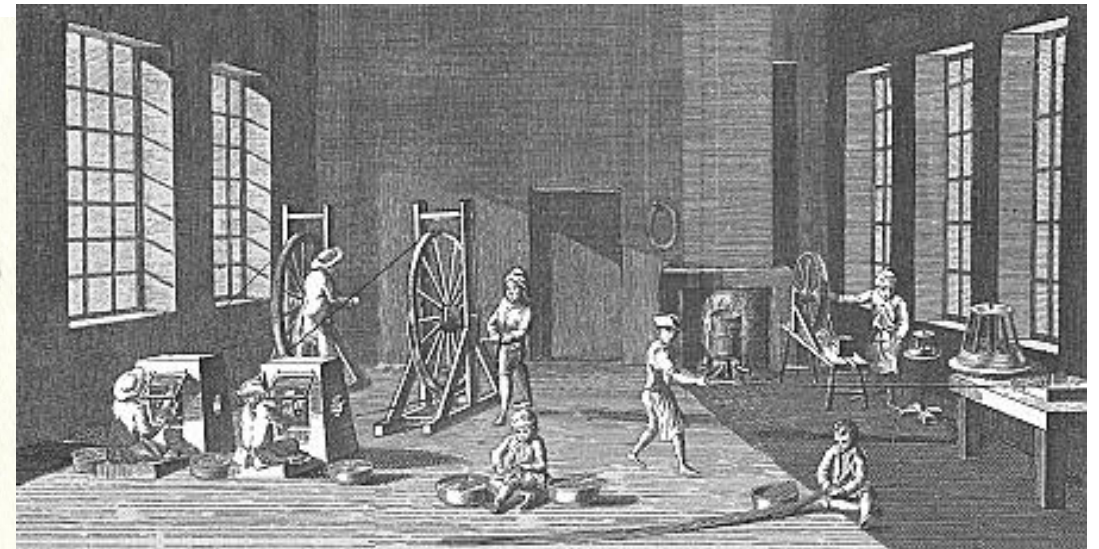
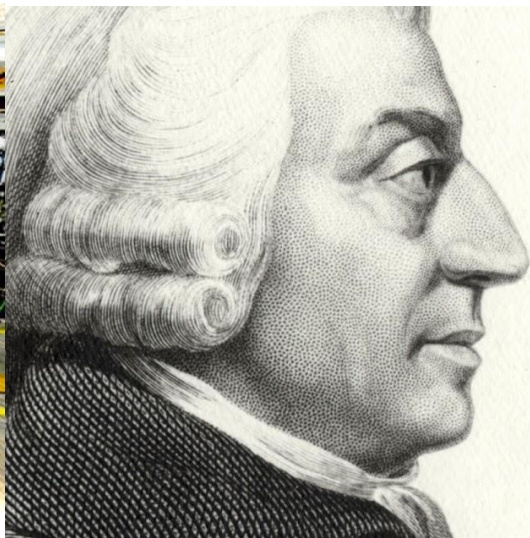
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- **Competition and trade policy**

Two fundamental aspects of diffusion

- Technology
- Management practices



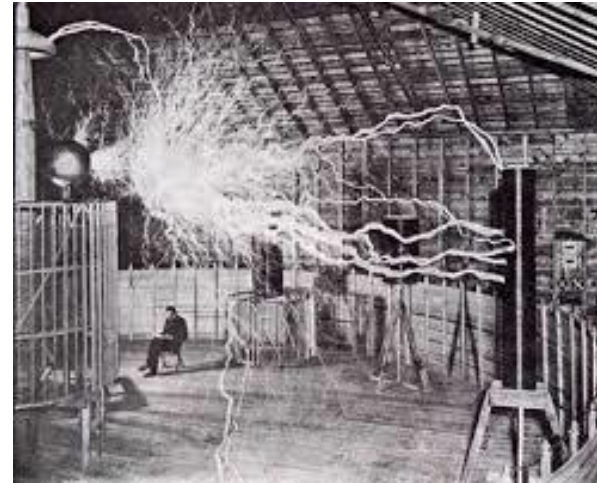
Toyota Plant



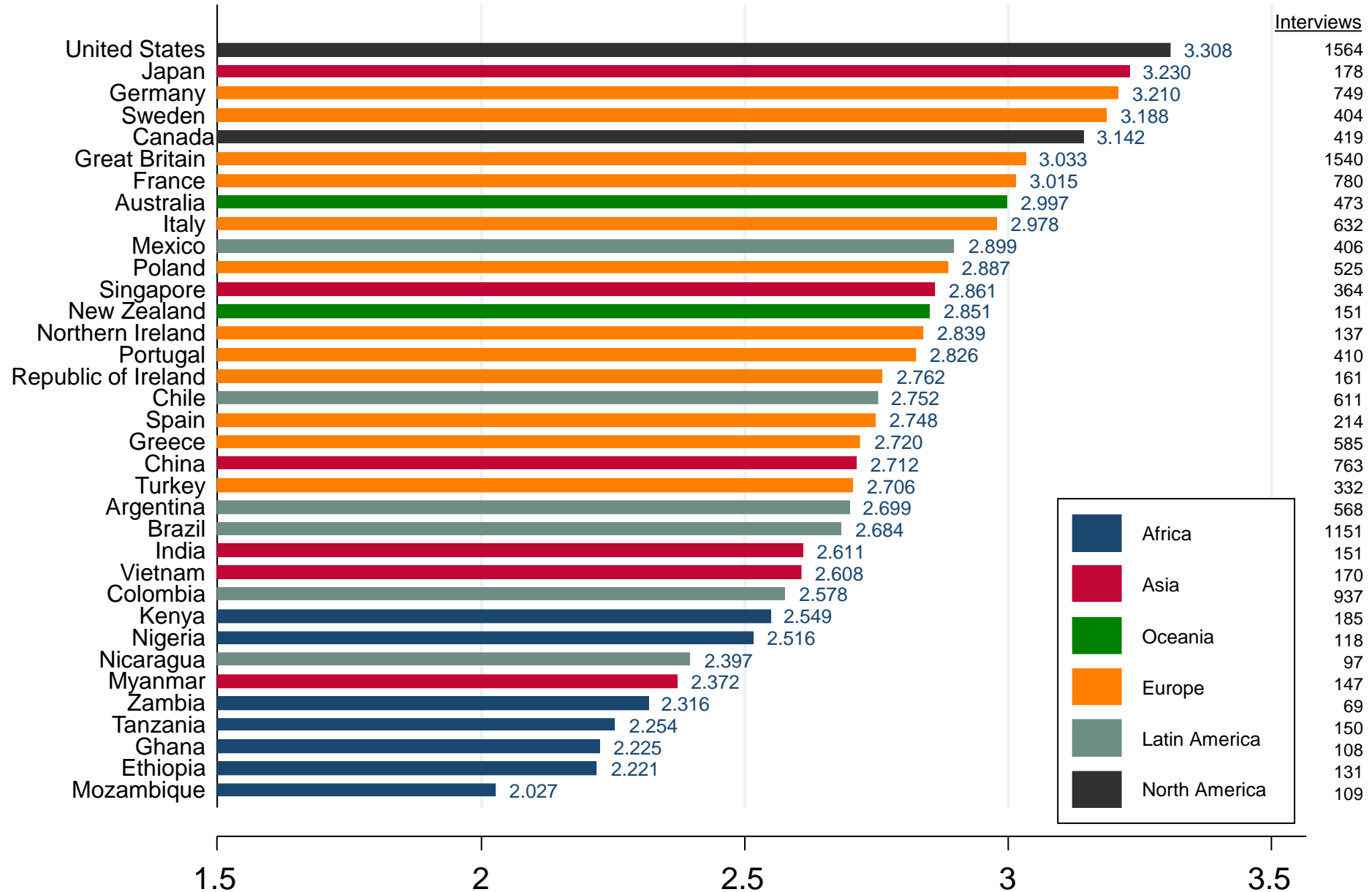
Adam Smith and the Pin Factory

Technology, management & complementarities

- Need to change work organization/management to make best use of innovation (textiles, electricity, computers, AI, ...)



Average Management Scores by Country



Source: Bloom, Sadun, Schuh & Van Reenen (2022).

Note: Unweighted average management scores; # interviews in right column (total = 15,489); all waves pooled (2004-2014)

OUTLINE OF TALK

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Getting Growth in Europe

Resurgence of Industrial Policy

- A dirty word in economics for many years due to many bad experiences of failed national champions (e.g. British Leyland, Groupe Bull, etc.)
- Now back in fashion: US Chips & Science Act; Inflation Reduction Act
 - Climate Change: green industrial policy (directed technical change)
 - Success of **China** (and South Korea, etc.)
 - Greater acceptance of many market failures & frictions in economics
 - New theories: Liu and Song, 2022; Bartelme et al., 2021; Itskhoki & Moll, 2019; Liu, 2019; Buera et al., 2013
 - Changes in capitalism? Growth of superstar firms (Autor, Dorn, Katz, Patterson and Van Reenen, 2020)
 - Policy makers will do it anyway (Tirole, 2022, for Deaton Inequality review)!

What is Industrial Policy?

- Interventions at specific industries (firms or technologies).
- Distinct from **horizontal** policies that are not explicitly aimed at specific industries (e.g. tax and competition policy)
- **Rationale**
 - Different market failures in specific sectors (innovation, skills, etc.)
 - Co-ordination (interoperability, standardization)
 - Missions: climate change, defense, health

Problems with Industrial Policy

- Subsidy races among places – this is why EU state aid rules developed (and WTO anti-dumping policies)
- Subsidies allocated through lobbying/corruption as agencies captured
- Even benign state does not have enough information to know who to target effectively
- These can cause misallocation, but also policies may simply be **ineffective**

Recent empirical literature is more positive

- Early literature negative, but deep identification problem as industrial policy often directed at places and industries in trouble
- More recent literature has been identification
- Lane (2020, 2021); Aghion et al. (2015); Juhasz et al. (2022); Choi & Levchenko (2021); Choi & Shim (2022); Liu & Ma (2022); Bai et al. (2019); Kline & Moretti (2014); Branstetter & Li (2024), Kalouptsi (2018); Barwick et al. (2019, 2021)
- Focus on two examples from own research:
 - Cricuolo et al (2019, AER). UK
 - Banarea-Sanchez et al (2024). China

Some Causal Effects of an Industrial Policy[†]

By CHIARA CRISCUOLO, RALF MARTIN, HENRY G. OVERMAN,
AND JOHN VAN REENEN*

We exploit changes in the area-specific eligibility criteria for a program to support jobs through investment subsidies. European rules determine whether an area is eligible for subsidies, and we construct instrumental variables for area eligibility based on parameters of these rule changes. Areas eligible for higher subsidies significantly increased jobs and reduced unemployment. A 10-percentage point increase in the maximum investment subsidy stimulates a 10 percent increase in manufacturing employment. This effect exists solely for small firms: large companies accept subsidies without increasing activity. There are positive effects on investment and employment for incumbent firms but not Total Factor Productivity. (JEL E24, G31, H25, L25, L52, R23)

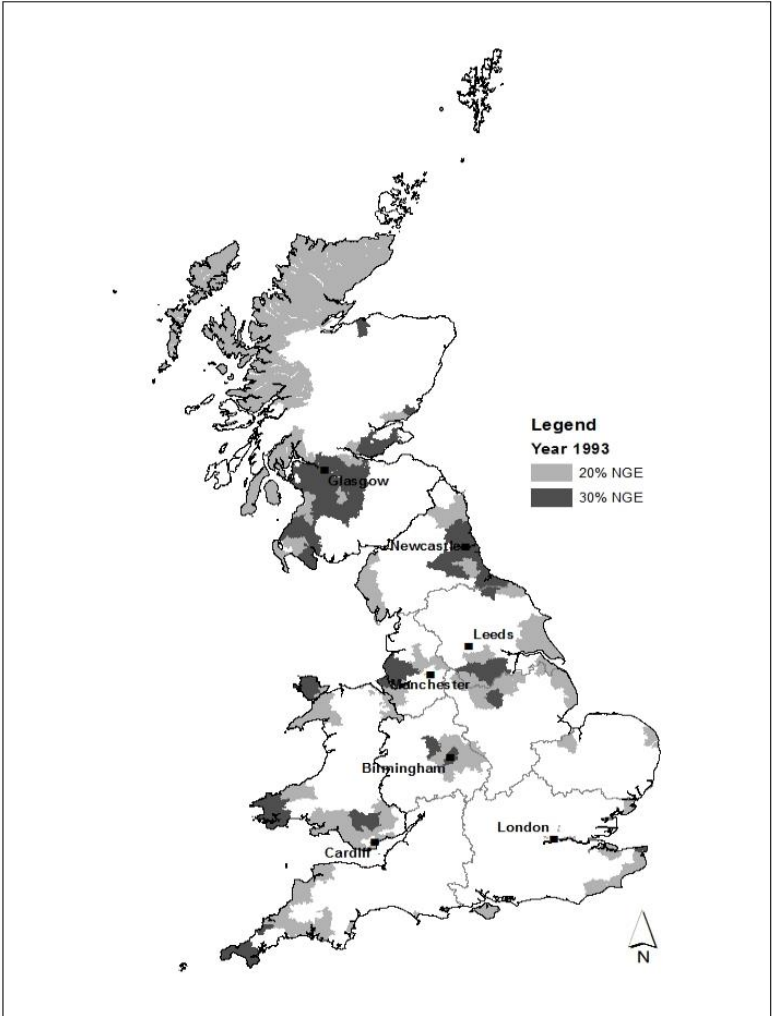
The Great Recession brought industrial policy back into fashion.¹ Governments around the world granted huge subsidies to private firms: most dramatically in financial services, but also in other sectors like autos. Business support policies are not new, however. Most governments offer subsidies that claim to protect jobs, reduce unemployment, and foster productivity, particularly in disadvantaged geographical

Criscuolo et al. (2019)

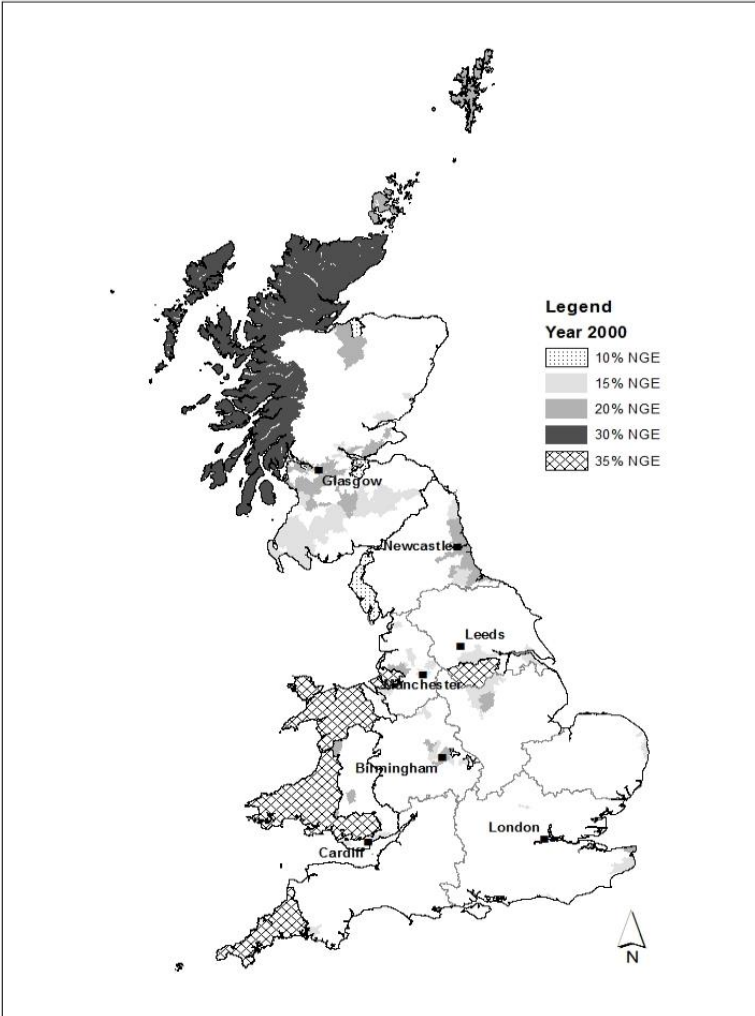
- EU State Aid Rules ban subsidies except in limited circumstances, e.g. if an area is disadvantaged
- Criteria change every 7 years, so some areas “randomized” in and out of being eligible for investment subsidies
- Enables an evaluation of area and firm level effects
- Broadly positive assessment:
 - Higher investment, more jobs, lower unemployment
 - Cost per job was low
 - Affected areas (by design) were less advantaged
 - Heterogeneity: big impact for SMEs, but near zero for large firms

HOW MAPS OF ASSISTANCE CHANGED IN 2000

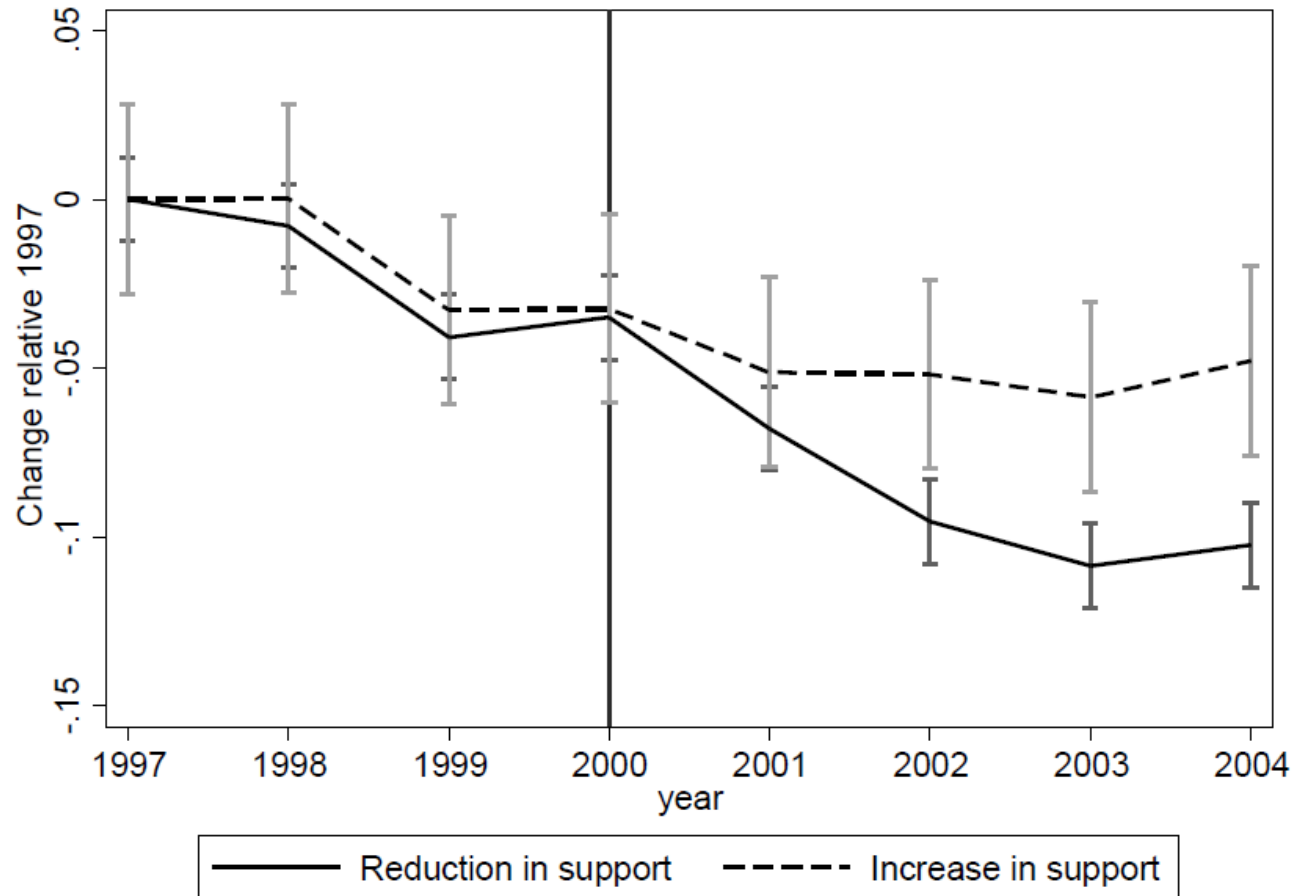
Area Eligibility in 1993



Area Eligibility in 2000



Manufacturing employment higher in areas with exogenously increasing support



Notes: Average changes relative to base year of 1997 in $\ln(\text{employed})$ in a geographical area (“ward”). The dashed line shows average employment in wards that had an increase in support (as predicted by our policy rule IV). The solid line is average manufacturing employment in wards that had a decrease in support (as predicted by our policy rule IV). 95% confidence bands also shown. The vertical line in 2000 shows when the change in policy occurred.

Ray of Hope? China and the Rise of Solar Energy

Bocconi

Ignacio Banares-Sanchez¹, Robin Burgess¹, David Laszlo¹,
Pol Simpson¹, **John Van Reenen**^{1 2 3}, Yifan Wang¹

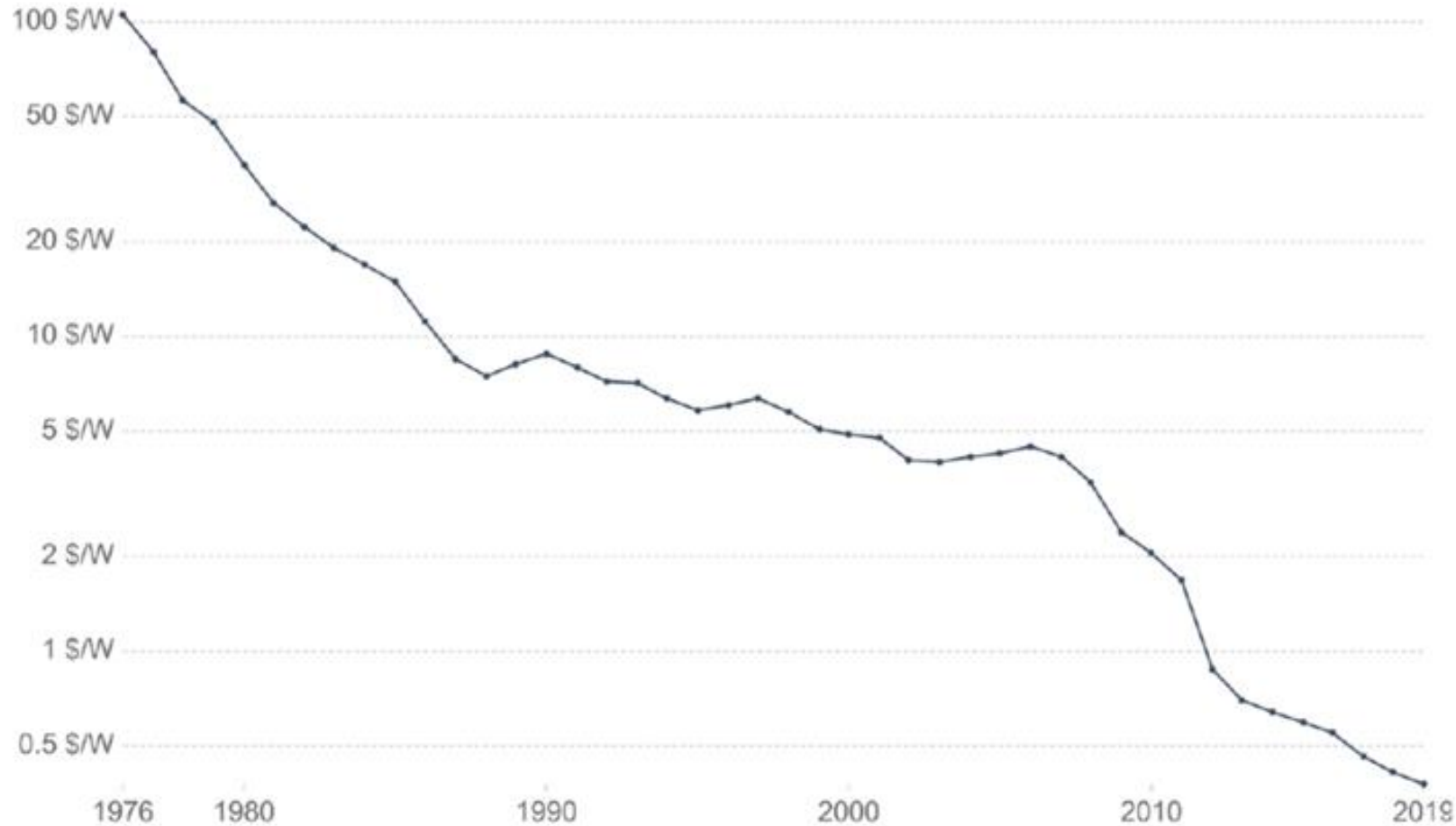
¹ London School of Economics ² MIT ³ NBER

May 20, 2024

Some Good news: The rapidly falling cost of solar energy

Solar PV module prices

Global average price of solar photovoltaic (PV) modules, measured in 2019 US\$ per Watt.



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

OurWorldInData.org/energy • CC BY

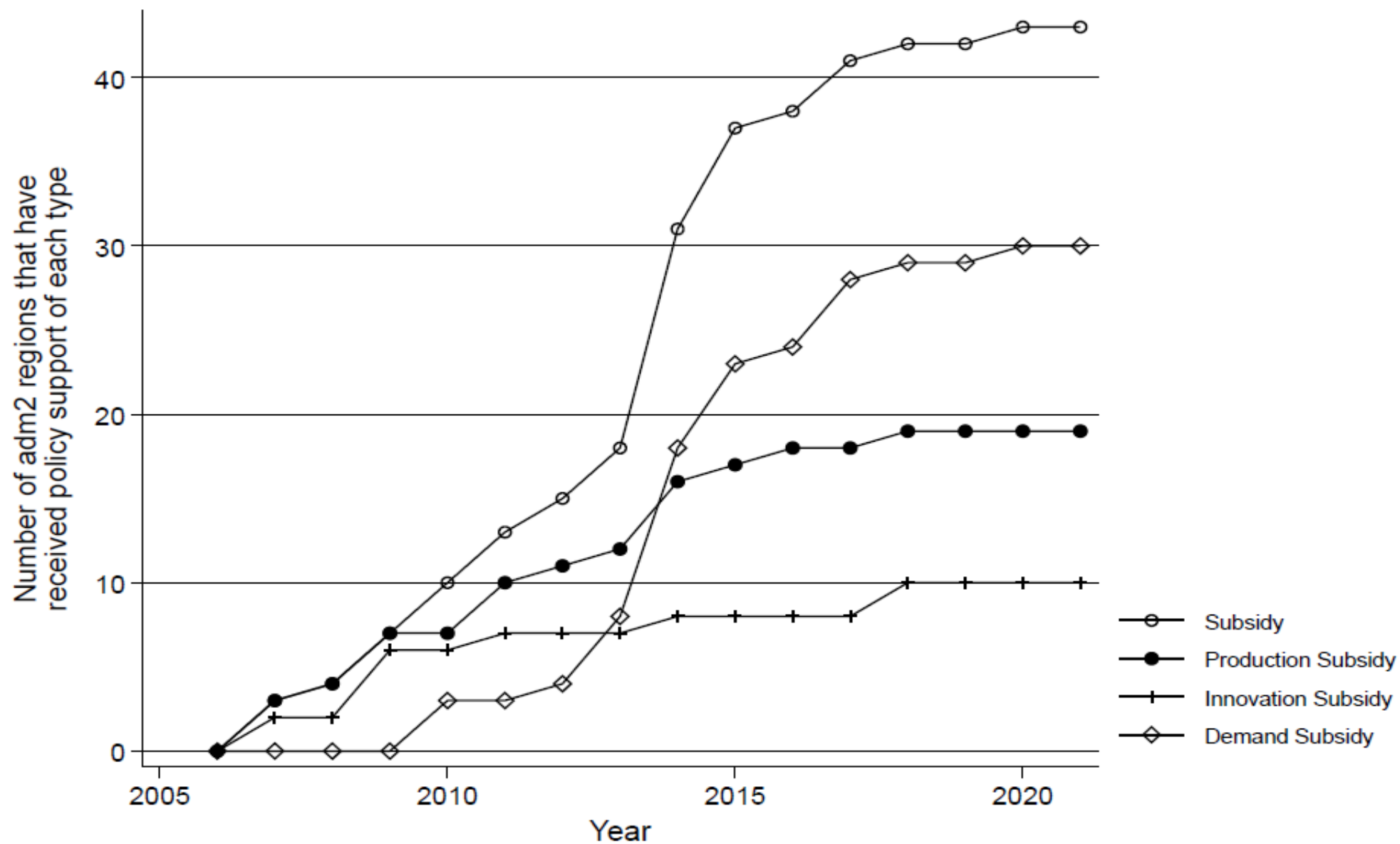
Measure solar industrial policy using PKULaw Database

Table: City-level solar policies

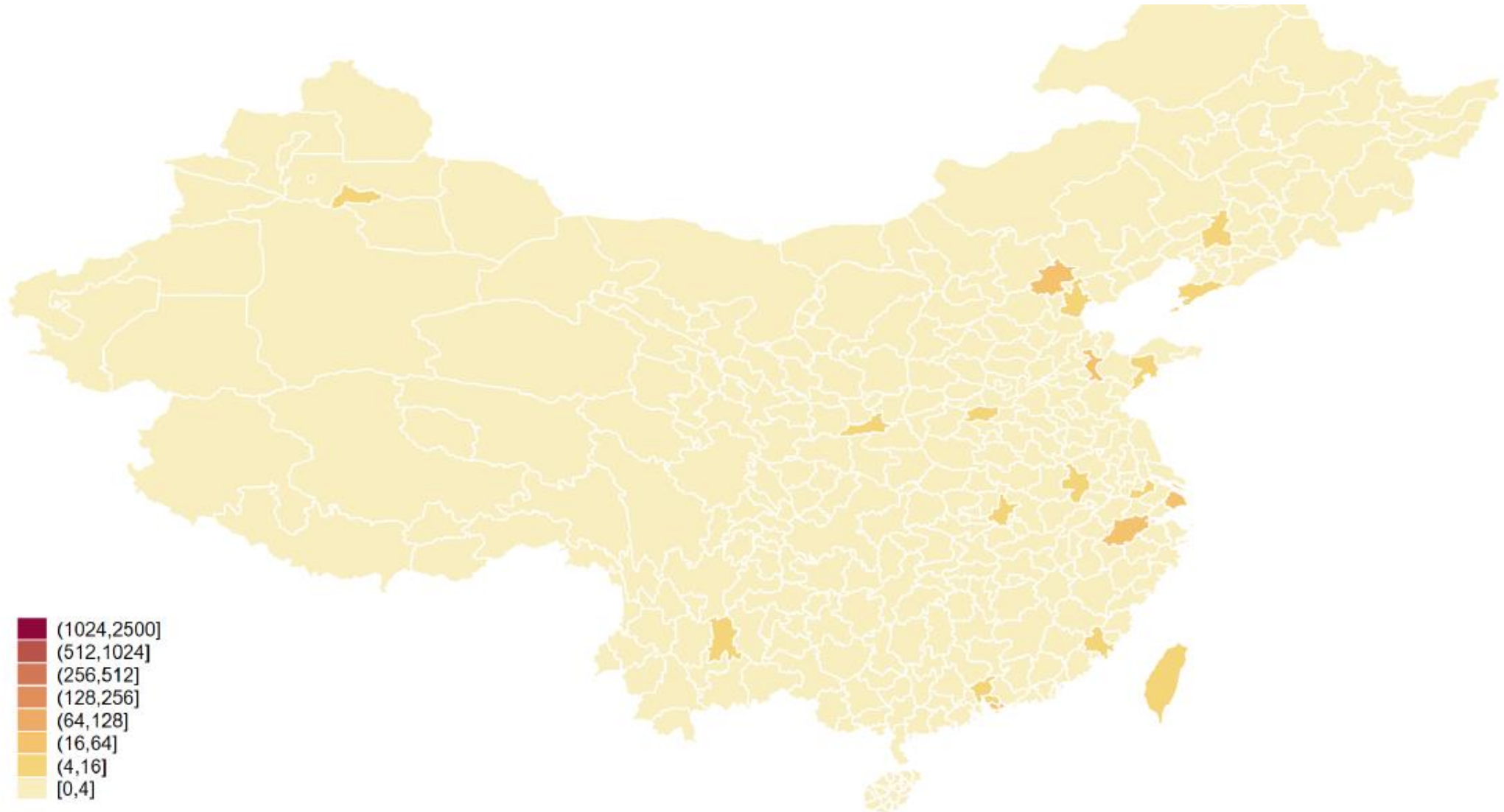
| Type of policy | Number | Example |
|------------------------------|--------|---|
| Subsidy | 78 | |
| 1. Production subsidy | 27 | <i>“The cost of a new solar production line built in Hefei will be subsidized by 12% (2018)”</i> |
| 2. Innovation subsidy | 12 | <i>“Firms will be awarded 10,000 RMB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

Source: Own analysis using PKULaw data

Figure: Number of cities treated with supply & demand subsidies



Chinese Solar Subsidy policies (none!) and solar patenting: 2004, city level



Note: black circled cities are treated by any subsidy policy

Chinese Solar Subsidy policies and solar patenting: 2019, city level

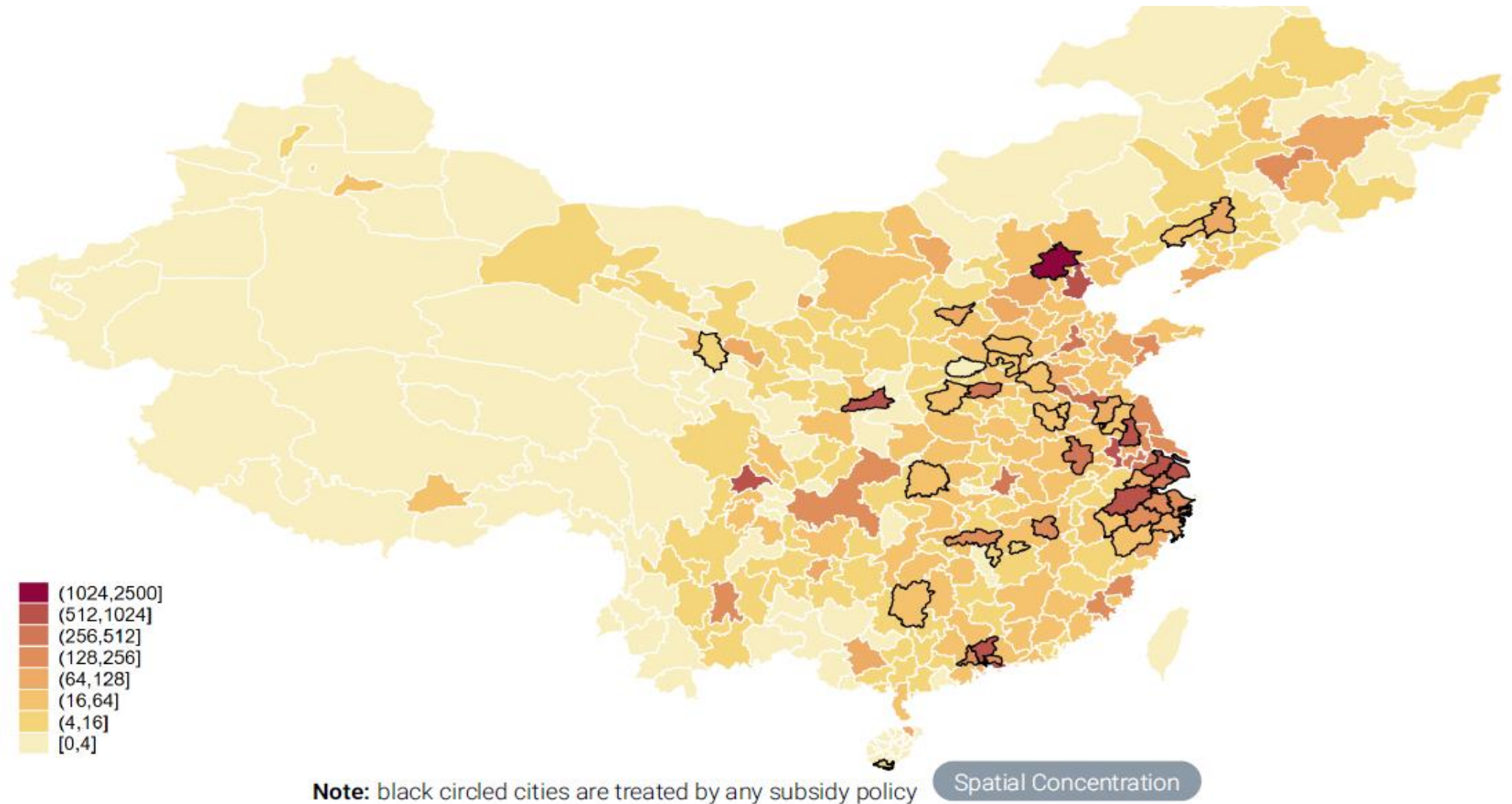
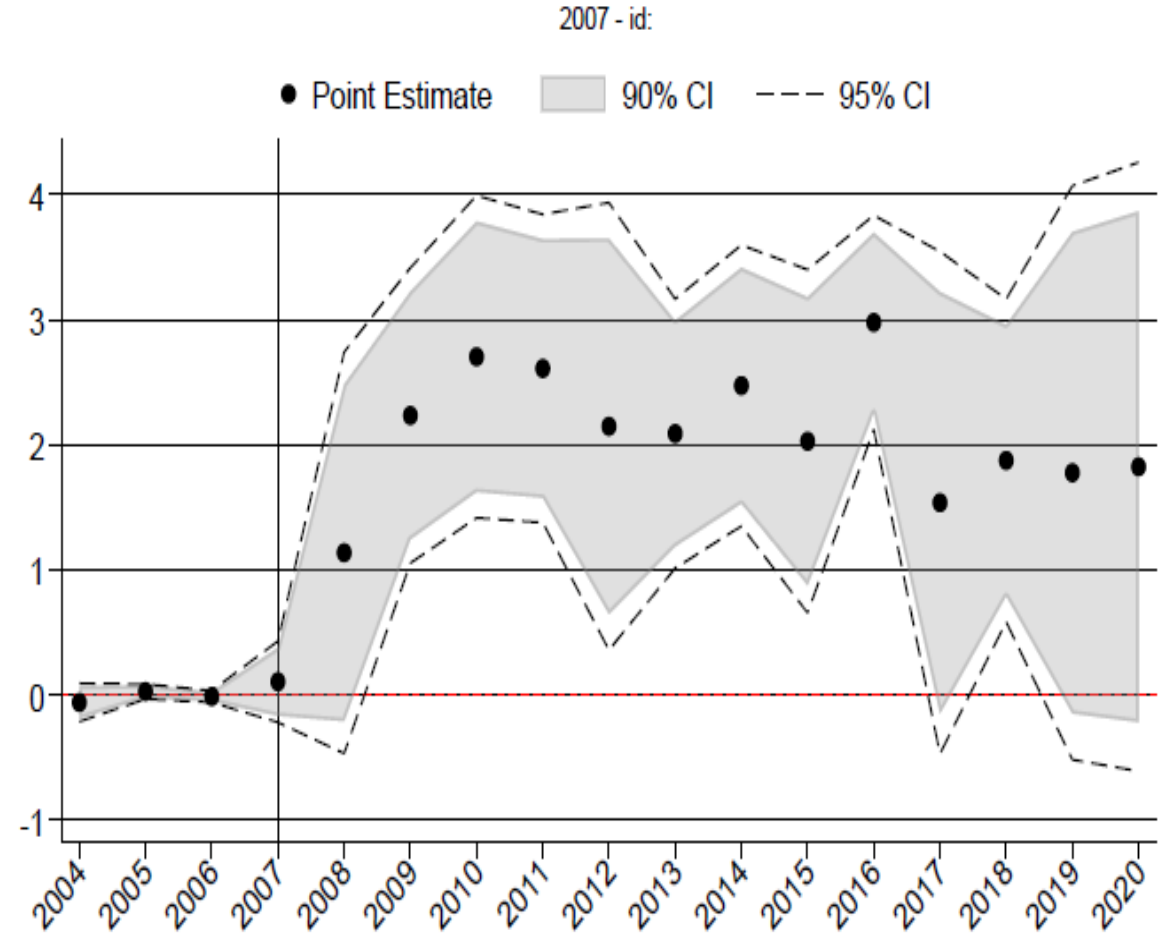
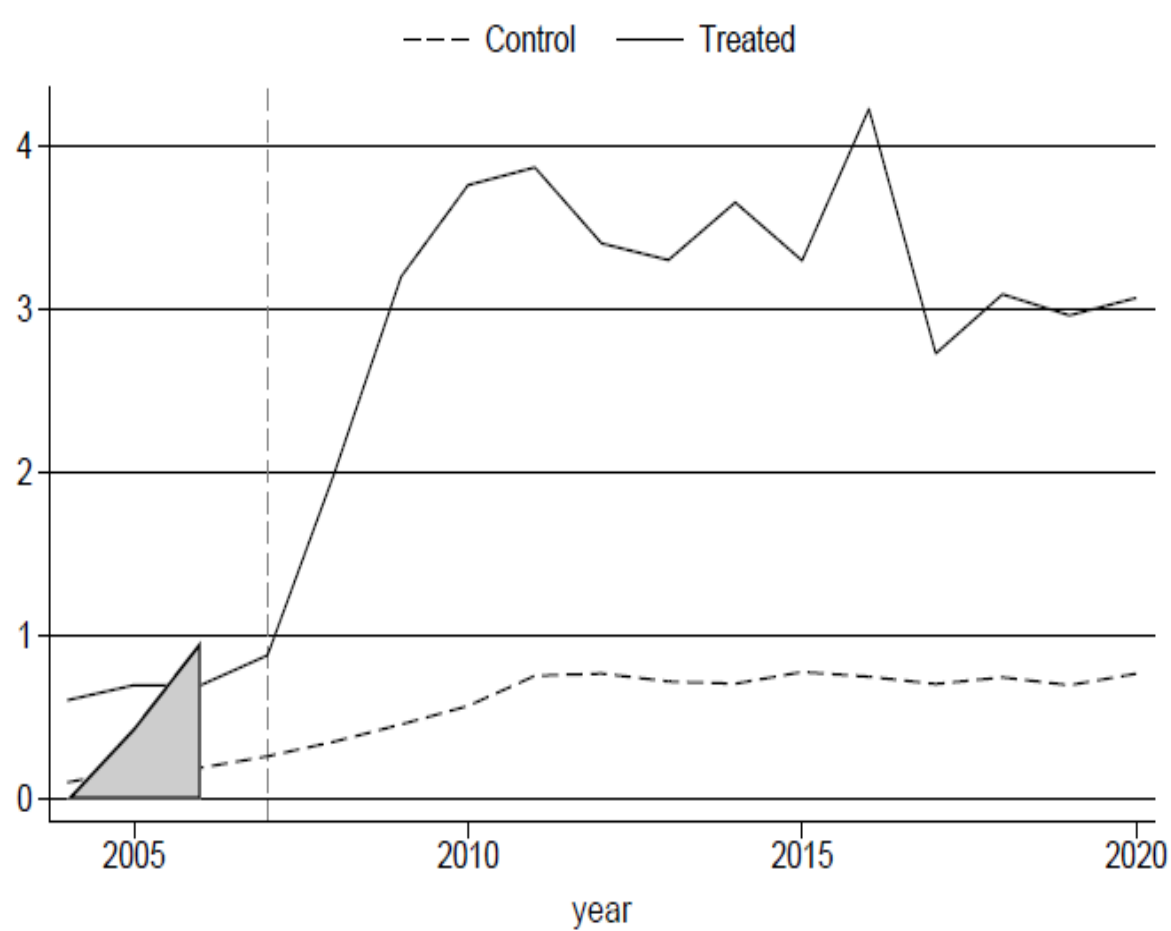


Figure: Number of patents by solar firms - Any subsidy (2007 example)



Notes: SDID on 358 cities, 3 (Jonzhou, Xinju & Yangzhou) introduced policy in 2007. Outcome: IHS of patents by solar firms in a city-year. SE cluster bootstrapped by city.

Results: Patents

Table: Patent Counts (Aggregate ATT)

| | <i>Any subsidy</i> | <i>Demand subsidy</i> | <i>Production subsidy</i> | <i>Innovation subsidy</i> |
|--------------|--------------------|-----------------------|---------------------------|---------------------------|
| All patents | 0.496** (0.200) | 0.236 (0.275) | 0.871*** (0.227) | 1.060*** (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 patent count by solar firms in city-year pair (level av. = 13.1). SE cluster bootstrapped by city.

Results summary

- Chinese place-based subsidies effective in growing a solar industry
- Policies not just through producing more, but also innovating. Through learning by doing, create a self-sustaining industry
- Local effects are strongest for supply side policies (production and innovation subsidies) rather than demand side (renewable price supports like feed-in tariffs)
- Preliminary estimates suggest benefits to China of Solar industrial policy where 2-4 times greater than costs

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Guidelines for Industrial Policy

- Don't replicate things market already provides. Focus on activities where there are likely to be market failures
 - **Examples:** Innovation, diffusion and training
- Leverage existing mission-oriented activities
- Institutions: expertise & independence to reduce policy ADHD (Bank of England vs. UK Industrial Strategy Council)
- Using evidence on “what works”
 - **Carefully look through evidence (“Policy Toolkits”)**
 - Design policies to enable learning (piloting, RCTs, etc.)
 - Accept some inevitable failures

Innovation Policy

- EU should be a “Research and Innovation Union”
- We have a lot of knowledge of what works.
- Focus on mission areas: environment, defense, health
- EU has successful models such as European Research Council/Horizon
 - Focus on involving scientists in decision making
- University reform: more autonomy and supporting spinouts
- Growing Venture Capital funding

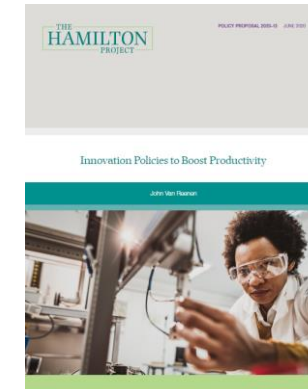
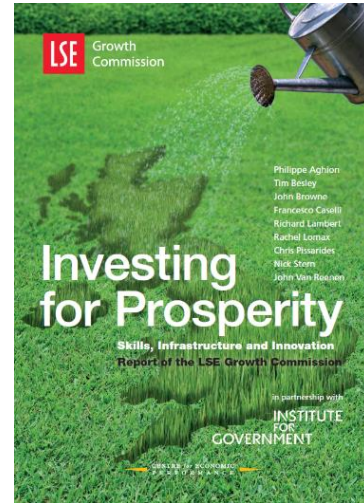
Competition Policy

- Major driver of productivity growth. But weakening in era of de-globalisation. China & US have huge domestic market
 - Helps firms grow to **scale**
- Need to strengthen **internal market** (Letta Report), especially for services (e.g. mutual recognition of qualifications)
- Need to modernise competition rules
 - Mergers about innovation & future competition
 - Digital Markets Act tackles “Gatekeepers”

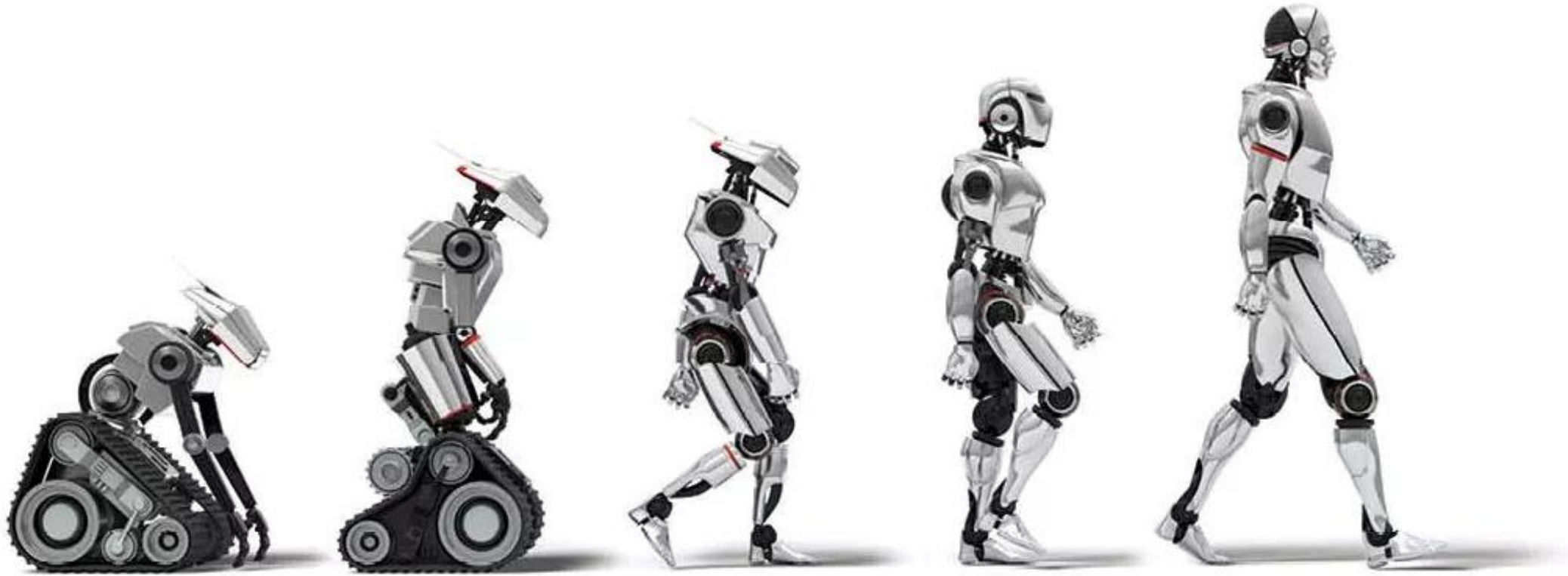


Conclusion

- Big threats, but also opportunities for creative policies, especially around innovation
- We know much about what can be achieved evidence: e.g.:
 - *Structural* (**competition**, trade, skills, tax & subsidies; etc.)
- Industrial policies in strategic areas
 - Guidelines for Member States
 - Commission level in key sectors
- Bind together in a **mission**:
 - Climate Change; Defense; Healthcare



THANKS!



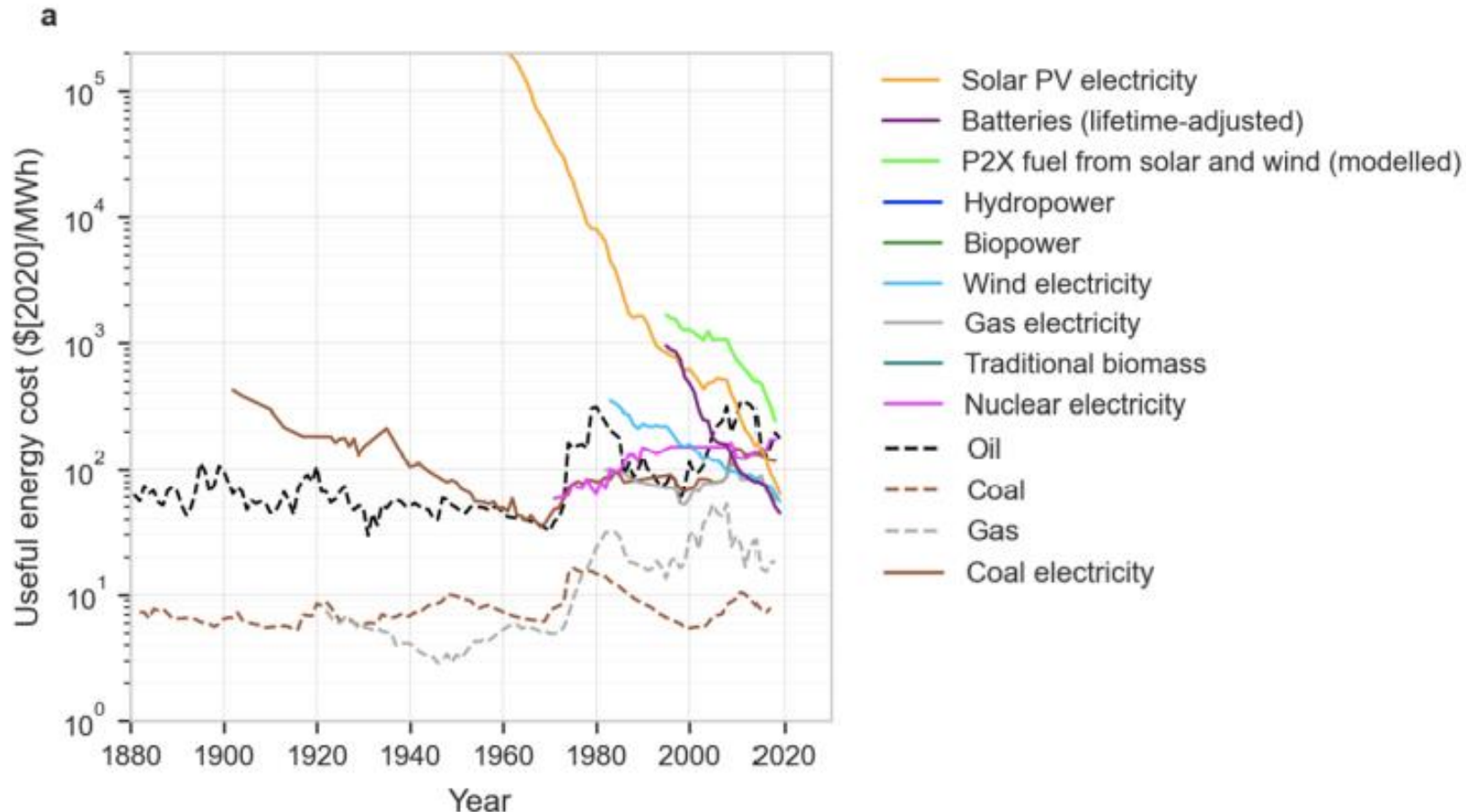
Some Further Reading (and viewing)

- “Innovation Policies to Boost Productivity” (2020) Hamilton Policy Proposal 2020-13
https://www.hamiltonproject.org/assets/files/JVR_PP_LO_6.15_FINAL.pdf webinar
- “A Toolkit of Policies to promote Innovation” (Nick Bloom, Heidi Williams and John Van Reenen), *Journal of Economic Perspectives* (2019) 33(3) 163–184 <http://cep.lse.ac.uk/pubs/download/dp1634.pdf>
- “Why Do We Undervalue Competent Management” (Raffaella Sadun, Nick Bloom and John Van Reenen) *Harvard Business Review* (2017), September-October
- “Measuring and Explaining Management practices across firms and nations” (Nick Bloom and John Van Reenen) *Quarterly Journal of Economics* (2007) 122(4), 1351–1408.
- “Who Becomes an Inventor in America? The Importance of Exposure to Innovation” (Alex Bell, Raj Chetty, Xavier Jaravel, Neviana Petkova and John Van Reenen), <http://cep.lse.ac.uk/pubs/download/dp1519.pdf> *Data Quarterly Journal of Economics* (2019) 134(2) 647–713, [New York Times](#) [Vox Atlantic](#) [Fortune](#) [Conversation](#) [VoxUS](#) [Economist](#) [VC Centrepiece](#) [INET](#)
- “OPENing up Military Innovation: An Evaluation of Reforms to the U.S. Air Force SBIR Program” (Sabrina T. Howell, Jason Rathje, John Van Reenen and Jun Wong), *Vox* 2021 <https://poid.lse.ac.uk/textonly/publications/downloads/poidwp004.pdf>
- “The Intellectual Spoils of War: Defense R&D, Productivity and Spillovers” (Enrico Moretti, Claudia Steinwender and John Van Reenen) <http://cep.lse.ac.uk/pubs/download/dp1662.pdf> [Vox](#)

Further reading

- “The World Management Survey at 18” (Scur, Sadun, Van Reenen, Lemos & Bloom, 2021), *Oxford Review of Economic Policy* <https://poid.lse.ac.uk/textonly/publications/downloads/poidwp002.pdf>
- World Management Survey <http://worldmanagementsurvey.org/>
- “Increasing Difference Between Firms” *Changing Market Structures and Implications for Monetary Policy*, Jackson Hole Symposium (Van Reenen, 2018) 19-65 <http://cep.lse.ac.uk/pubs/download/dp1576.pdf> [NYT](#) [NPR](#)
- LSE Growth Commission Final Report (Aghion et al, 2013) <http://www.lse.ac.uk/researchAndExpertise/units/growthCommission/documents/pdf/GCReportSummary.pdf>
- “Management as a Technology” (Bloom, Sadun and Van Reenen, 2017): <http://cep.lse.ac.uk/pubs/download/dp1433.pdf>
- “Do Fiscal Incentives increase innovation? An RD Design for R&D” (Antoine Dechezlepretre, Elias Einio, Ralf Martin, Kieu-Trang Nguyen and John Van Reenen), CEP Discussion Paper 1413 [Vox](#), <http://cep.lse.ac.uk/pubs/download/dp1413.pdf>

Huge Falls in cost of solar relative to other conventional energy sources (1880-2020)



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

Management policies Toolkit

L = Low; Not politically easy
 M = medium
 H = Highly possible

| Policy type | Strength of evidence | Policy Net benefit (out of 5) | Difficulty of implementation | Time frame |
|-----------------------------|----------------------|-------------------------------|------------------------------|------------|
| Structural | | | | |
| Competition | H | ⊙⊙⊙⊙⊙ | M | medium |
| Trade and FDI | H | ⊙⊙⊙⊙⊙ | L | medium |
| Education | M | ⊙⊙ | M | long |
| Deregulation | M | ⊙⊙⊙ | L | medium |
| Governance | M | ⊙⊙⊙⊙ | M/L | long |
| Direct | | | | |
| Training - consulting | H | ⊙⊙⊙ | H | short |
| Training - formal classroom | M | ⊙⊙ | H | medium |
| Information/benchmarking | L/M | ⊙⊙⊙ | H | medium |

Source: Scur, Sadun, Van Reenen, Lemos & Bloom (2021)