



Discussion of

**“Knowledge Spillovers from Clean
Innovation. A Tradeoff between Growth and
Climate?”**

Ralf Martin & Dennis Verhoeven

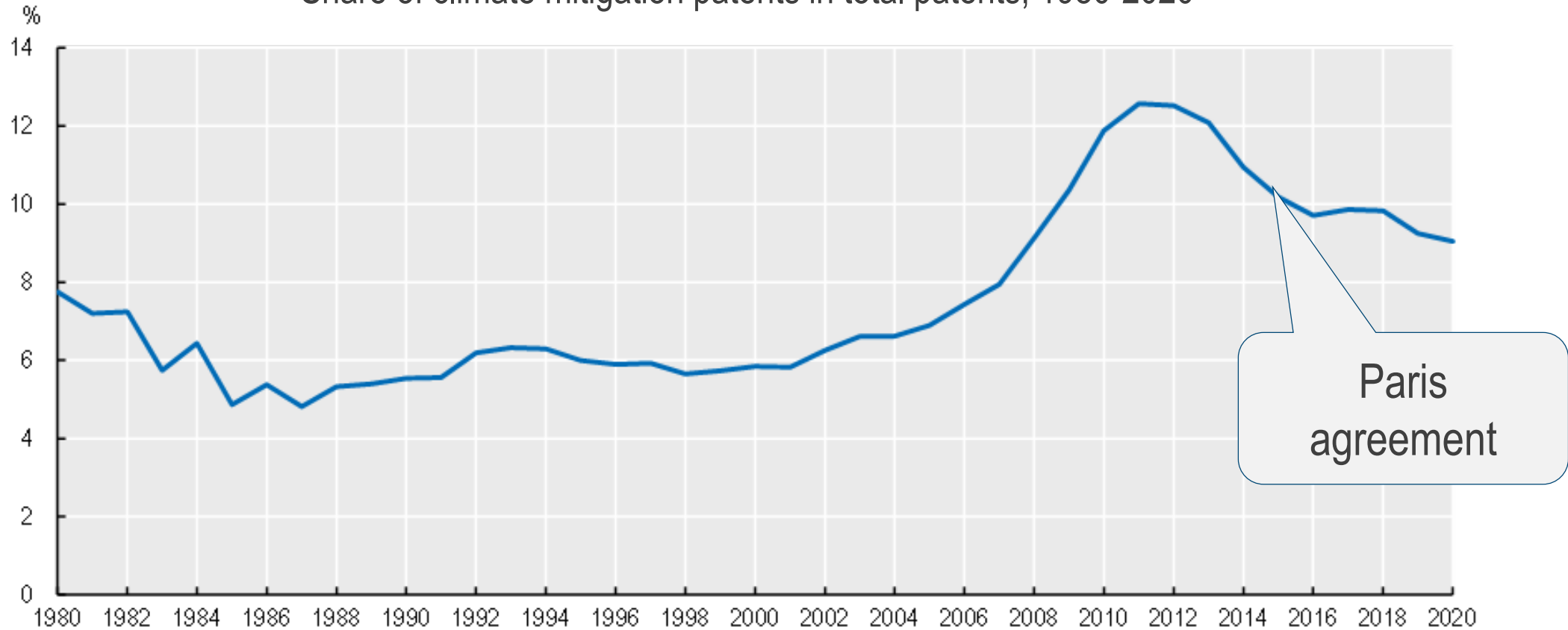
Antoine Dechezleprêtre, OECD

PSE-CEPR Policy Forum, 30 June 2023



Background: The pace of low-carbon innovation has slowed down

Share of climate mitigation patents in total patents, 1980-2020



Source: OECD STI MicroData Lab, Worldwide Patent Statistical Database (PATSTAT)

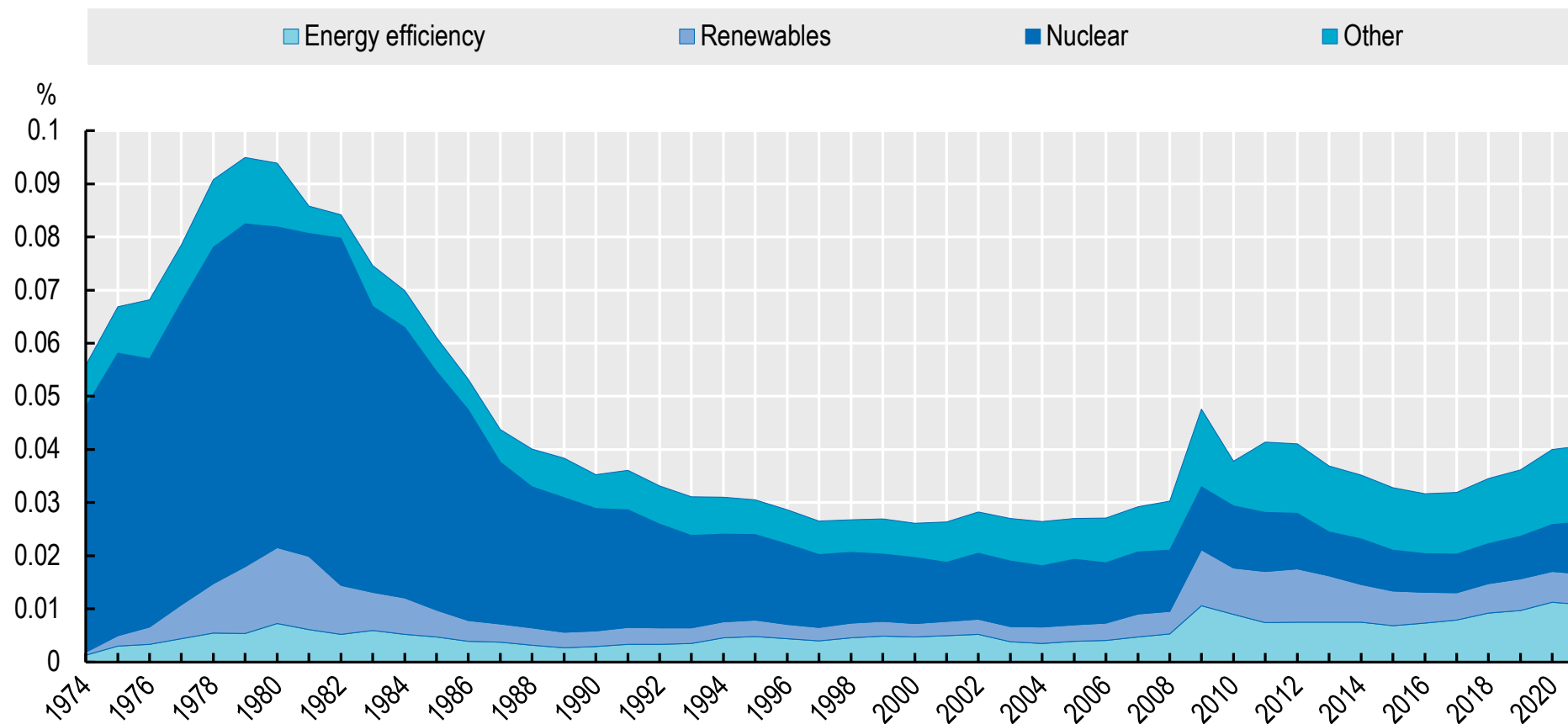
Cervantes *et al.* (2023), "Driving low-carbon innovations for climate neutrality", OECD STI Policy Papers No. 143

<https://oe.cd/il/lowcarboninnov>



Public support to RD&D flat and likely insufficient

Low-carbon public R&D expenditures in GDP, 1974-2021



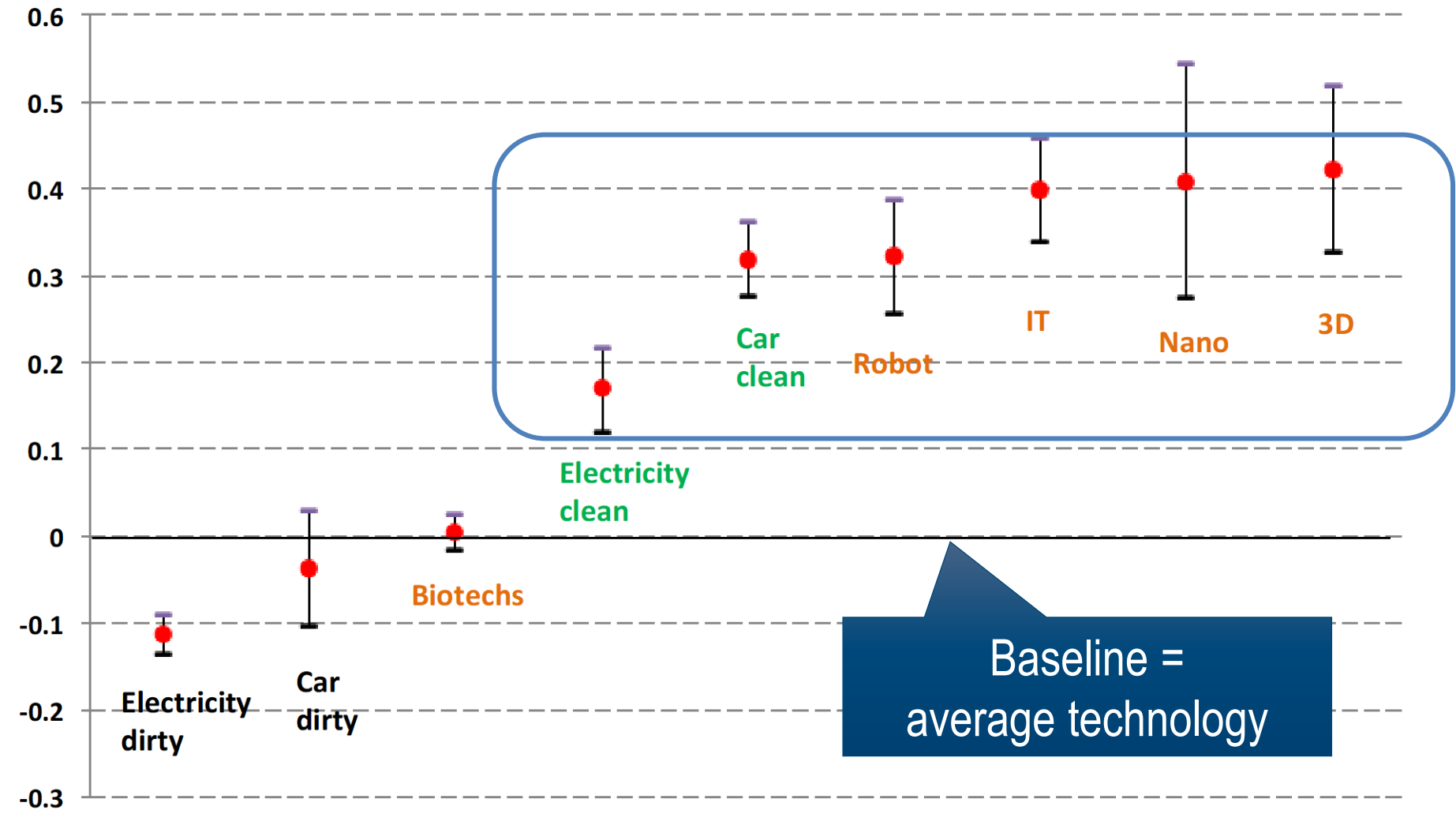
Source: IEA Energy RD&D public expenditures (2023)

Cervantes *et al.* (2023), "Driving low-carbon innovations for climate neutrality", OECD STI Policy Papers No. 143

<https://oe.cd/il/lowcarboninnov>



Despite strong justification for support, including large knowledge spillovers from clean tech



Source: Dechezleprêtre, A., R. Martin and M. Mohnen (2014), “Knowledge spillovers from clean and dirty technologies”, CEP Discussion Papers No. 1300



- What is the value of the clean spillover premium?
 - Return rate of subsidy to clean innovation (targeted vs untargeted R&D support policy)
 - National vs cross-border spillovers
 - Benefits of international coordination of clean innovation policy
- Data and method
 - Global patent data (PATSTAT)
 - Estimate private value of patent grants based on share price changes for listed firms (ORBIS); out of sample prediction for non-listed firms
 - Estimate spillover value based on actual citations network (distinguishing between national and cross-border value)
 - Calculate rate of return of subsidy in each field, based on spillover value of innovations just under the “quality threshold” above which innovation is privately pursued (observable as expected value was presumably greater than actual value ex post)



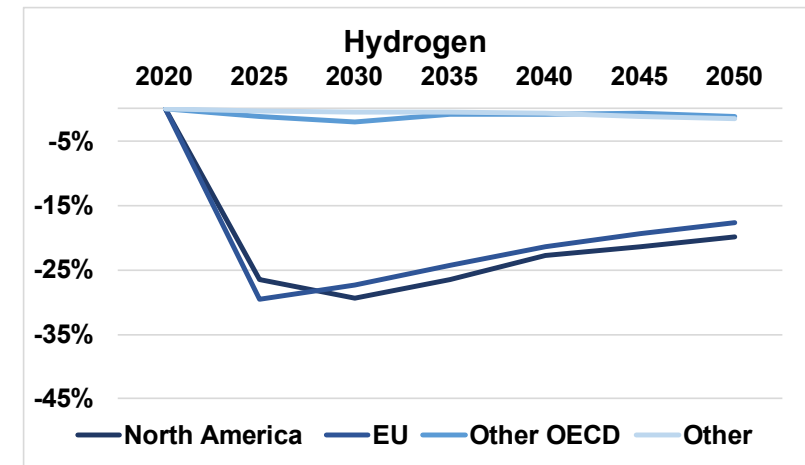
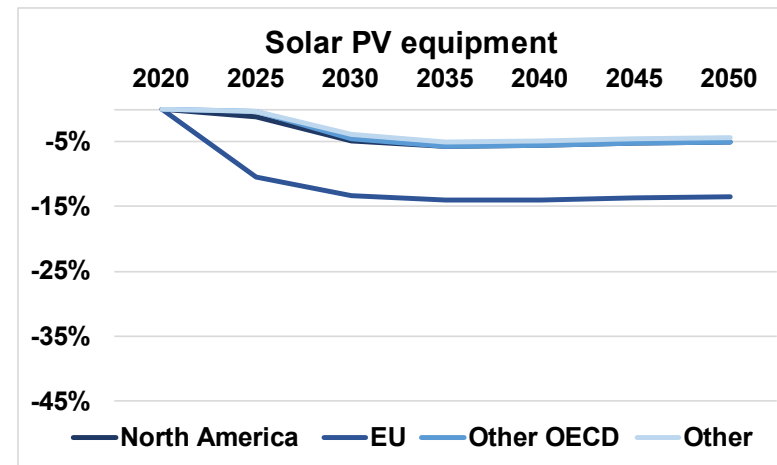
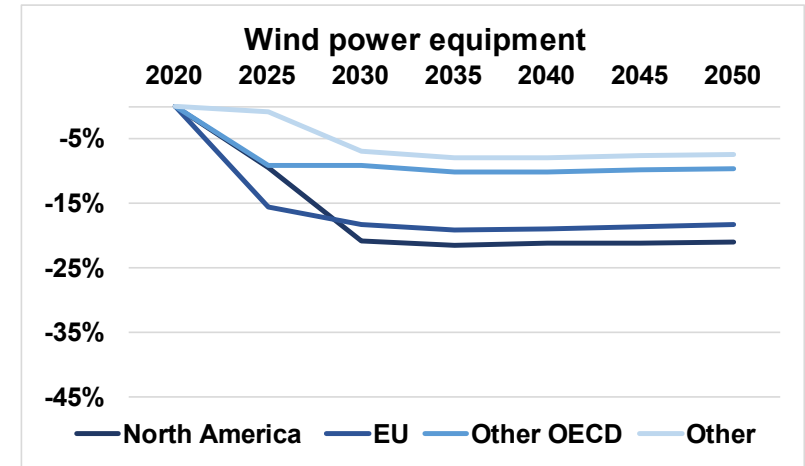
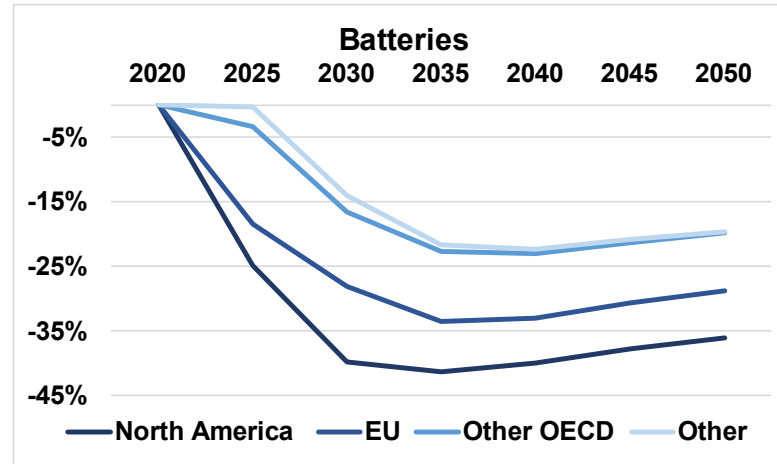
Findings

- Targeted innovation policy yields higher returns (+12%) than untargeted policy (eg R&D tax credits), with heterogeneity across countries
- Major international knowledge spillovers: only 23% of clean spillover value retained domestically
 - Clean spillover premium much lower for only domestic spillovers: can explain lack of focus on clean R&D policy
 - Supranational coordination of clean innovation policy increases returns by 25% in EU and 60% globally
- EU benefits strongly from US support to clean tech
 - 1\$ of clean US subsidy generates 1.26\$ of spillovers in Europe
 - Important in context of IRA discussions



Clean tech support in COVID recovery packages (incl. IRA) leads to large cost decreases

- R&D investments, knowledge spillovers and learning by doing trigger large cost reductions:
 - **Batteries -40% in US, -30% in EU**
 - **Hydrogen -30%**
 - **Wind -20%**
- These cost reductions trigger 400Mt of emissions reductions outside OECD and EU by 2050



Source: Aulie et al. (2023), “Did COVID-19 accelerate the green transition? An international assessment of fiscal spending measures to support low-carbon technologies”, OECD STI Policy Papers No. 151, <https://oe.cd/il/lowcarbonrecovery>



Measuring private value

- Value based on granted patents
 - what about patent applications (also generate value presumably)?
- Out of sample predictions based on few covariates (application year, technological classification, family size, number of claims) for non-listed firms
 - large measurement error for very large number of patents
 - smaller firms may be different
- Cost and shape parameters
 - Assumption (?) = observed innovations are privately produced
 - In practice, many benefit from innovation policies (R&D tax credits, R&D grants, demand-side policies eg FITs).
 - Implications?



Measuring spillover value

- Are patent applications set at 0 private value for the computation?
- Spillovers internalized at group level?
 - Eg UK subsidiary of US company filing the patent in UK
- Parameter σ (marginal contribution of spillovers to invention's value) set uniformly to 0.5
 - does not affect ranking but affects the value significantly
 - could be easily made firm-specific from patents
- Business stealing?
 - Bloom, Schankerman, Van Reenen 2013
- Citations made by applicants and examiners?
- Citation availability differs widely across patent offices & time in PATSTAT
 - Can affect result that only 23% of spillovers are retained domestically



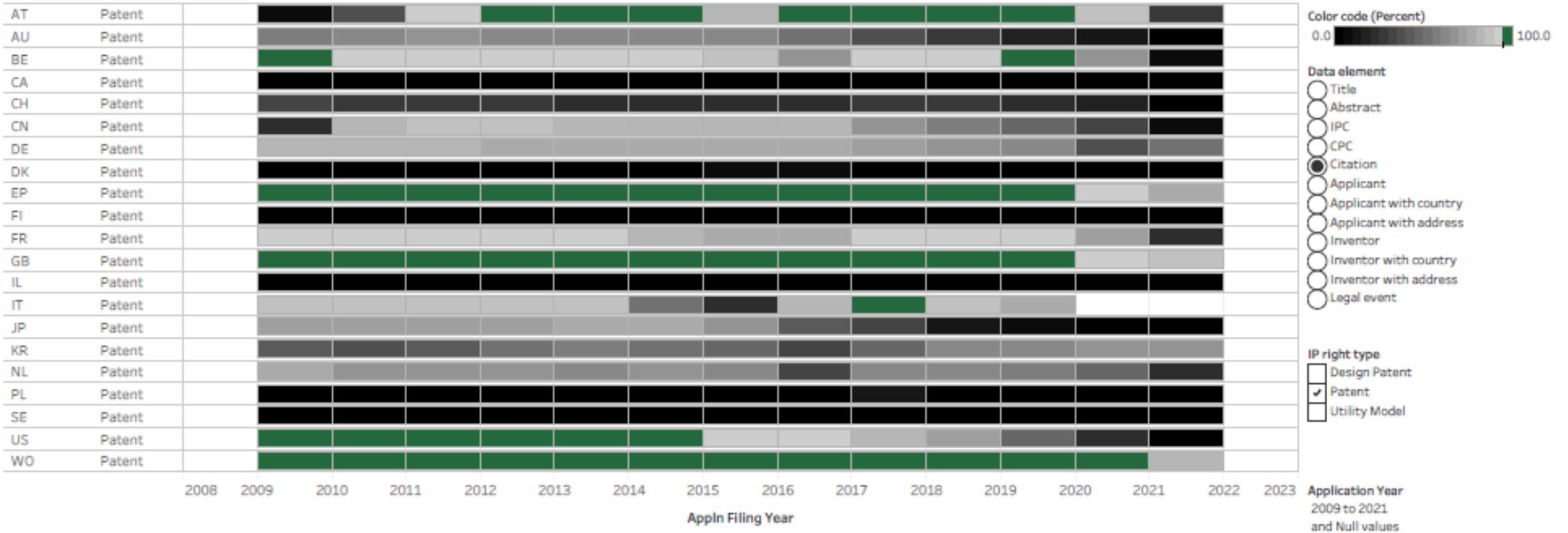
Citation coverage is unequal

Citation coverage in PATSTAT, main patent offices, 2009-2021



Data completeness of PATSTAT Global, 2022 Spring Edition

This chart shows the percentage of patent applications having a certain data element (e.g. CPC classification) by patent authority and application year in PATSTAT Global as of December 2021. Because PATSTAT Global primarily contains data from DOCDB and INPADOC the same information applies similarly also to all other data sets and tools based on DOCDB and INPADOC, like Espacenet, Open Patent Service (OPS) and Global Patent Index (GPI). The only exceptions are the coverage of country codes and addresses for EP and US applications. For these data elements PATSTAT has a higher ..





Simulating the effect of a clean subsidy increase

- Calculate rate of return of subsidy in each field, based on spillover value of innovations just under the “quality threshold”
 - But do you also restrict spillovers to those coming from these ‘infra-marginal’ innovations?
- Increase in the number of clean innovations will affect the spillovers themselves (more patents to cite, more patents citing) and the returns. Looks endogenous



Summing up

- Hugely important research question
 - How much to increase support to clean innovation?
 - Targeted vs untargeted support?
 - Value of international coordination on R&D
 - Benefits from unilateral clean tech policy (US IRA)
- But estimates and numerical simulations questionable
 - Eg local spillovers 23.3% of global spillovers; optimal global subsidy goes 83.9% to China
 - Compounds of multiple parameters all estimated with error
- Suggestions
 - Work out and show confidence intervals
 - Bootstrap
 - Sensitivity tests
 - Restrict on sub-samples (grants, offices with good citation coverage, etc)
 - Focus less on exact point estimates