

The background features abstract, overlapping green geometric shapes in various shades, creating a modern and dynamic feel. The shapes are primarily triangles and polygons, some semi-transparent, layered on a white background.

The CO2 Question: Technical Progress and the Climate Crisis

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Innovation and Climate Transition

- ▶ Innovation and “green” technological change are considered the solution to achieve net zero
 - ▶ Existing literature largely considers green patents as equivalent to lower future emissions
 - ▶ Many argue that more funding to brown firms is desirable because it favors the adoption of capital-intensive greener technologies (see, e.g., Cohen, Gurun, Nguyen, 2022; Hartzmark and Shue, 2023)
 - ▶ And policymakers are subsidizing green innovation. The Inflation Reduction Act in the US and the Green Deal Industrial Plan in the EU largely aim to subsidize/decrease the costs of green innovation
- ▶ **Do green patents really lead to lower emissions?**

Do green patents really lead to lower emissions?

- ▶ This paper reminds us that the answer is not an obvious yes
 - ▶ Some green innovation is “brown” because it involves greater energy efficiency of fossil fuel (henceforth, brown patents)
 - ▶ Brown patents can increase the consumption of fossil fuels by reducing costs and boosting demand (Jevons paradox)
 - ▶ **Emission intensity vs absolute emissions?**
 - ▶ Green patents, new technologies that substitute fossil fuels
- ▶ Brown companies do not engage in actual green R&D; firms with higher green patent ratios lose market share to firms with high emission
- ▶ Overall, no significant impact on future carbon emission reductions
 - ▶ For the patenting firms
 - ▶ Other firms in the patenting firm’s industry
 - ▶ Firm in related industries
- ▶ Documented with (too) many different proxies; explain which are your favored one? Main results?

What can work?

- ▶ A (Global) carbon tax (e.g., Nordhaus 1993; Golosov et al. 2014) possibly combined with subsidies for green innovation (e.g., Acemoglu et al. 2016; Aghion et al. 2016).
- ▶ Martisson, Stromberg, Lajtos, and Thomann (2022) document a statistically robust and economically meaningful negative relationship between emissions and marginal carbon pricing
 - ▶ Presumably arising from technological change—even without subsidies that could help financially constrained companies
- ▶ **Are there cross-country differences in the impact of patenting on emissions that arise from regulation and carbon taxes etc.?**
- ▶ Puzzling that in a US sample firms developing more climate-related patents (filed with United States Patent and Trademark Office) reduce more direct carbon emission intensity (Hege, Pouget, and Zhang, 2023)
 - ▶ Are most patents from states that regulate emissions such as California?
 - ▶ Or classification of green patents? Hege et al results are driven by green patents that are related to climate change
 - ▶ Need a serious attempt to reconcile the findings

Comment 1: Produced patents vs purchased patents

- ▶ Purchased and produced patents are currently conflated.
- ▶ Which firms produce and which firms purchase patents?
- ▶ Do purchased patents have different effects on future emissions?
- ▶ Are we observing **killer acquisitions (Cunningam, Ederer and Ma, 2021)** of green patents by brown firms?
 - ▶ Suspicion arising from the fact that patenting intensity seems to be less path dependent for high market share firms...
 - ▶ **Do young firm with patents have lower emissions or cut more emissions after patenting?**

Comment 2: Are some patents more important than others?

- ▶ First batch of climate-related patents may be a much stronger signal to the market about a firm's commitment to corporate climate action than follow-on patents (Hege et al, 2023)
- ▶ Not all patents are equal. Some firms may innovate to fool E&S conscious investors, while others may patent breakthrough innovations
 - ▶ **Go beyond citations to measure path breaking innovation** (e.g., Li and Wang, 2023 for patents in general)
 - ▶ E.g., A patent is radical if it draws on knowledge that has never or rarely been used before by inventors in the same field.

Smaller but important comments— Measurement issues

- ▶ Why **green/brown patents relative to total patents**? Consider using number of green/brown patents
- ▶ Especially green patents are prototypes Is the sample period long enough? It may take more than three-five years to implement the new technology
- ▶ Measuring emissions: absolute levels vs intensity
 - ▶ Jevons paradox holds for the absolute level
 - ▶ What about intensity?
 - ▶ Define clearly (or larger fonts...) what you are actually using...
- ▶ Why distinguishing between listed and unlisted companies? No reason to expect different spillovers/effects from their patents. Explain or drop

Smaller comments-Shorten the descriptive analysis on the geography of green patenting

- ▶ **Sample representativeness.** Findings are currently discussed as if the paper captured the population of patents
- ▶ **But** apart from the differences in coverage of financial data in Europe vs the US in Orbis, the authors rely on data filed with the **European Patent Office...**
- ▶ North American and especially US firms are much more likely to file with the US patent office...
- ▶ **Make clearer distinction between a very comprehensive sample and the still unobserved population...**avoid sentences suggesting that the number of patents for North America is smaller ...

Conclusion

- ▶ Terrific dataset and extremely important questions
- ▶ I look forward to reading the future papers!