UNLOCKING THE IMPACT OF CLIMATE CHANGE MITIGATION POLICIES: A COMPREHENSIVE STUDY OF CLEAN AND DIRTY INNOVATION DYNAMICS

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Abstract – Achieving the Paris Climate Agreement's goal of limiting global warming to 1.5 °C to 2 °C by the end of the century will require massive investments in environmental technologies and a drastic shift away from high-carbon technologies. This paper investigates the impact of climate change mitigation policies on clean energy innovation. A statistical evaluation of the impact of public policies on the rate and direction of innovation for a lowcarbon future is complicated by the nature of the data and the absence of benchmarks. In addition, the statistical analysis is further complicated by the spillover effects between clean and dirty innovation and by the lag effects. In this paper, the authors assess the effects of both public policies, such as carbon taxes and green subsidies, and economic and environmental conditions, such as oil prices, large recessions, climate-related disasters, etc., on clean innovation using a nonparametric method based on the copula distribution of clean innovation. The authors collect data from the European Patent Office (EPO) Worldwide Patent Statistical (PATSTAT) Database, both on clean and dirty patents. This database is managed by the EPO and compiles data from patent offices around the world. The emphasis is put on inventions for which a patent application has been submitted to the United States Patent and Trademark Office (USPTO). The inventions are dated based on the date of their first patent application. Clean innovation refers to patents in areas such as renewable energy generation and electric vehicles, while dirty innovation refers to fossil-based energy generation and internal combustion engines. The authors employ a novel nonparametric test against pairwise differences, especially in tail dependence structures, which we measure with tail copulas, thereby avoiding the possibility of parametric misspecification. This method also permits to examine the effects of various interventions and economic conditions on different portions of the distribution, with a particular emphasis on tail dependence. The authors identify nonlinear dependence structures between clean innovation, public policies, and economic determinants like the oil price and recession. By comparing the effects of clean and dirty innovation, we can determine whether the effect on clean innovation is distinct. The findings indicate that the tightening of environmental policies since the early 1990s has statistically and economically contributed to the increase in clean innovation. The findings can bolster public support for green R&D. In addition, they suggest that green policies may be able to increase the knowledge diffusion of clean innovation.

Keywords – Climate change; clean and dirty innovation; climate change mitigation policies; nonparametric test