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The impact of policy and uncertainty on innovation in the wind industry: evidence from European countries

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Long Abstract

Frequent changes to environmental policies are expected to weaken innovation. The 2010 moratorium on the level of feed-in-tariffs in the French solar photovoltaic industry offers one of the best illustrations of how impactful an abrupt policy change can be. Fearing the development of a "green bubble", the French government suspended the grid connection permissions for solar PV installations over 3 kilowatts peak for a period of 3 months. Since then, the French solar industry has repeatedly been described as "plunged in an induced coma" with dramatic social and economic consequences. Projects backlog reached ~3.6GW at the end of December 2010 fell by 58% as of June 2012, employment in the French photovoltaic sector declined from 32,500 in 2010 to 18,000 in 2012 while many see the restructuring of solar installation leader Evasol having its roots in the 2010 moratorium. This is one of many examples highlighting the negative impact of policy uncertainty, namely of uncertainty arising from policy change and complexity.

This paper attempts to bridge a gap in the empirical literature by analyzing the econometric relationship between policy uncertainty and innovation dynamics in the wind industry. We focus on dynamic efficiency[3] and estimate the impact policy and its surrounding uncertainty on innovation in the wind industry in 18 OECD countries over the years 1995-2009. [4] We use patents as a key indicator of innovation, as they measure the private sector's efforts to improve the long run cost-effectiveness of wind power generation. Learning-by-researching is indeed one of the main vectors – along with learning-by-doing – of costs reduction for carbon free technologies.[5] We restrict our attention to wind energy because Europe is a leading producer of wind energy, representing the largest share of wind installed capacity in the world. Moreover, this sector is one of the most mature sources of renewable energy, one that received widespread policy support in the past decades.

To measure policy and it uncertainty we build novel proxies which are inspired by the real option theory. We start from the assumption that changes in wind installed capacity can be attributed to three factors: (1) wind availability, (2) wind cost competitiveness and (3) policy. We use regression analysis to extract the policy component of this relationship. We then explore the impact of such proxy and its variability on patenting patterns. Unlike other previous approaches, our proxies for policy stringency and policy volatility are robust to three major concerns. First, we net out the effects of those non-policy factors which might drive

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[3] One may distinguish between four criteria to evaluate a given policy instrument: ecological accuracy (to which extent the instrument manages to achieve emission targets or more generally the ecological objectives of the policy); static efficiency or cost-effectiveness (to which extent the policy instrument allows to reach goals at a cost no greater than any other instrument); dynamic efficiency or cost-effectiveness (to what extent the policy instrument gives the right incentives to develop new technologies and reduce costs over time); and political acceptability (how the policy is accepted by stakeholders, i.e. individuals, interest groups, political parties, firms, etc.).

[4] The countries included in the analysis are: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Portugal, Spain, Sweden and the United Kingdom18 European countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Portugal, Spain, Sweden and the United Kingdom

[5] In most Integrated Assessment Models (IAMs), technological change is driven by both effects, as in the WITCH model (2008).

capacity addition on top of government policies. Second, our proxies account for the fact that rational investors refer to *expected* policy and policy changes, namely future capacity additions rather than *current* ones, to make their decisions. Finally, and more fundamentally, we clean our proxies from the issue of potential reverse causality between installed capacity (and its volatility) and innovation. More specifically, we control for the fact that innovation may stimulate capacity additions through technology improvements resulting in greater efficiency and/or lower costs.

Our empirical analysis address the econometric issues linked with estimation in a count data setting characterized by unobserved heterogeneity. We adopt here the approach suggested in Blundell et al. (2002), where a fixed effect Poisson model is estimated with the Generalized Method of Moments and the data is scaled by the ratio of individual or within-group means to account for individual specific effects. We include in our regression additional controls that are likely to affect innovation, such as knowledge stocks, measures of market size, etc.

We show that a higher level of policy commitment in EU countries is associated with higher innovation in wind energy technologies. Such effect is however lower in those countries where policies are more uncertain. These results are robust across different proxies for innovation and the inclusion of various control variables.

Our empirical findings provide additional evidence on the relationship between environmental policy and innovation. On one hand, we confirm that the level of policy commitment positively affect innovation in wind technologies. On the other hand, we provide novel insights on the relationship between innovation and policy uncertainty. Namely, uncertainty surrounding environmental policy lowers the benefits associated with a given level of policy commitment. Those countries where uncertainty is higher are characterized by less innovation on average and ceteris paribus. This is an important insight for policy making, as it suggests that while planning the strength of the commitment to renewables, governments should also consider that policies which are stable over time or change only slowly would maximize the beneficial effects of policy commitment. Big and sudden changes in government policy are not compatible with private investments in innovation which involve large capital expenditures, are often made on a long-term horizon and are irreversible or quasi irreversible. Policy uncertainty reduces dynamic efficiency, implying higher costs to abate emissions. A key implication is thus that the stability of the policy framework for renewable energy should be a high priority on the government’s agenda. Therefore, government’s policy should be clear and stable over time while regulatory changes should be exceptional or at least predictable.