Topic: The Geography of Startup Innovation in the Clean Energy Sector

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Abstract: *We use micro-data from the USPTO and Bloomberg New Energy Finance to study trends in the geography of innovation and finance in the clean energy sector. We document the changing share of radical innovation in clean energy being done in startups vs. large firms, and within the US relative to other countries. We also find a sharp fall in the funding for startups commercializing clean energy in the US and highlight the potential market failure this stems from. Our findings have important implications for US policy aiming to facilitate innovation by startups in this sector.*

Introduction

The need for a revolution in clean energy in the US is driven not just by environmental consequences of energy use, but also by the need for energy security, to address growing concerns about a crisis in the balance of payments, and as a potentially important source of domestic jobs. Yet, relatively little attention has been paid in the academic and policy circles to the particular challenges associated with commercializing clean energy innovations, and the important implications these could have in terms of the geography of innovation in the energy sector going forward. Three related features of this sector are critical to consider in this context:

1. First, the extreme capital intensity of these technologies, coupled with their high risk, has caused the traditional model of venture capital finance to break down and leave many promising technologies unfunded. Ghosh and Nanda (2010) describe how the mismatch between the current structure and of the venture capital industry and the needs of startups in the clean energy sector is leading to this market failure.
2. Second, the European and Chinese governments have been far more aggressive in trying to address these market failures than the US, with important implications for where innovation in this sector will be commercialized over the next several decades.
3. Third, some authors have argued that many industries, including energy, require a tight link between the geography of manufacturing and the geography of innovation (Fuchs and Kirchain, 2010; Rotman, 2012). Precisely identifying such links remains difficult, however, due to the challenges of finding and combing data at the level of the person, technology, and firm. Without such micro-data, it is difficult to quantify concerns about the geographical "hollowing out" of innovation, commercialization, and manufacturing.

Data and Methods

Our paper aims to shed light on these issues by using a unique combination of micro data and spatial models to illustrate the geography of finance and innovation in clean energy.

1. Bloomberg New Energy Finance has firm-level data on financing of clean energy projects, from venture capital, private equity and project finance sources. The data source also classifies firms

by detailed technology classes, allowing a fine-grained analysis of financing trends across sub sectors in the clean energy sector.

2. Patent data from the USPTO helps us break down the geography of innovation in clean energy sectors along four dimensions. First, we can observe the geography of innovation (from inventor addresses). Second, we can tell who invents clean energy: established firms, startups, independents, or universities. Third, we can observe how science investment and infrastructure influences clean energy invention. Finally, we can observe how radical the innovation is within a patent class (measured as impact or novelty or product vs. process). These analyses will highlight the extent to which radical innovation is taking place in the US relative to other countries, how much of it is taking place outside of large, established firms, how science policy affects clean energy development, and to what extent clean energy innovation is co-located with financial investment and manufacturing capabilities.

Our primary approach will be to describe, and where possible, relate observed changes in financing or innovation behavior to the timing of changes in policies (e.g. the expiration of production tax credits in the US have had profound and noticeable effects in terms of a fall in investment in wind projects in the US; feed-in-tariff policies in Germany and Spain have had measured effects on increased investment in solar projects in those countries). These facts, together with data on the geography of investment and patenting will provide a detailed picture of the geography of finance and innovation in clean energy, with the goal of informing policy making in reaction to possible market failures in the industry.

Project Status

We have access to all the data that will be used in this project and are familiar with it (Lai et al. 2012). We have IT professionals and RAs currently cleaning the data and designing and populating databases. Both authors are also familiar with institutional details in clean energy sectors (Fleming 2011). This will be helpful for examining how the trends relate to observed changes in policies across countries

References

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