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The Skill-Content of Green Technologies

Abstract:

In the wide spectrum of expected impacts of the transition towards environmentally sustainable economies, those that affect employment are among the most relevant due to their societal importance. This is due to the opportunities and the threats that job creation, destruction and reconfiguration pose to modern society, especially in turbulent times of crisis. In contrast with the traditional wisdom that environmental protection harms economic growth and job creation, recent evidence suggests that the technological transition towards a greener and low carbon economy engenders opportunities that can exert positive effects on employment (Bazdek et al., 2008). A staple of these studies is that the adoption of environmental innovations is associated with positive employment effects. Further elements emerging from this literature are mostly concerned with the uneven impact of different types of environmental innovation, e.g. end-of-pipe versus cleaner production technologies (e.g. Horbach and Rennings 2013; Licht and Peters, 2013).

We believe that the persistent lack of detailed analyses on the skill content of the jobs created, modified (or destructed) by 'green technological change' is a significant shortcoming of this literature that, ultimately, limits the capacity to define problems and identify possible solutions for the educational and training system.

The present paper seeks to fill this gap by proposing a framework that analyses in detail the task- and skill-content of green occupations. In the framework adopted here skills are individual abilities necessary for performing work and tasks activities in a certain occupation (Autor et al, 2003; Levy and Murnane, 2004). The skill-content of an occupation usually reflects the knowledge mix that is relevant in a particular industrial sector at a specific moment. By the same token, as industry needs change over time, occupations evolve and so do the tasks and the relevant skill mix. The emergence of novel configurations in the skill mix primarily reflects technological changes that redistribute tasks and responsibilities across heterogeneous workers.

The case of green technologies represents an interesting application for this approach. Not only green technologies are the most direct way to address climate change problems and resource scarcity, but they also involve fundamental changes in the way products are designed, processed and disposed off. We hence expect the skills required in jobs more exposed to green technologies to differ considerably from the ones in twin jobs not exposed to green technologies.

To test whether skill content of jobs differs depending on the exposure to green technical change, we develop a new and original dataset merging together data on skills and patents. For the skill part, we rely on the Occupational Information Network (O*NET) electronic database of the U.S. Department of Labour (DOL). O*NET collects information on job

characteristics for 900 detailed occupations (8-digit), assigning importance scores to a common set of 98 tasks used at the workplace. We use statistical techniques as principal component analysis to build four skill indicators. The first is an indicator of skill specificity to capture the fact that green jobs usually require technical and vocational qualifications. The second is the indicator of routinization, usually employed in the literature (Autor et al. 2003), while the third is an indicator of job offshorability, which is crucial to assess the effective employment impact of green technologies. The fourth is an indicator of skill diversity that captures the fact that green technologies recombine knowledge from different domains; hence, occupations more exposed to green technologies are likely to require a broader skill mix compared to non-green occupations.

O*NET dataset has three main advantages. First, it allows us to distinguish between green and non-green jobs as it includes a list of green occupations (see Dierdorff et al., 2009). Second, the skill content of each occupation is continuously revised over time reflecting task reconfiguration within each occupation. Third, O*NET uses the Standard Occupational Classification (SOC) system and can hence be matched with other sources of occupational information such as the US Bureau of Labor Statistics (BLS). This allowed us to merge O*NET data with BLS employment shares by occupation and 6-digit NAICS sectors. The sectoral dimension is crucial to build our proxies of technology exposure, measured with patents. We attribute USPTO patents to NAICS sectors using the concordance between IPC classes and economic activities proposed by Lybbert and Zolas (2014). The concordance, based on an 'algorithmic link with probabilities' (ALP), reflects the relevant knowledge available to the sector rather than the actual knowledge creation, making it more suitable for our purposes than other concordances aimed at measure knowledge creation. Furthermore, we are also able to identify patent applications related to environmental technology fields (based on IPC classes), which are expected to capture the 'green side' of technological change. Additional information on structural features of US manufacturing sectors has been retrieved from the NBER-CES Manufacturing Industry Database, mainly: ICT capital intensity, trade exposure, energy and material input (and costs).

Given the scant of literature on green skills, the main goal of our empirical analysis is to identify the skill profile of green occupation and, as a second step, to explain differences in the skill content using our measure of technology exposure. More in detail, our empirical strategy is designed to compare green and non-green occupations along the four skill dimensions defined above. A key aspect of this comparison is to identify the right control group for the comparison. In the first exploratory part, we rely in the classification of green occupation proposed by O*NET and test whether the group of green differs from the group of non-green in any of the four skill indicators. Second, we use our continuous measure of exposure to green and non-green technology to test whether significant skill differences, if any, are explained by technology exposure. Finally, we redefine our control group of non-green occupations keeping only those occupations similar in terms of broad occupational characteristics, i.e. engineers or technicians, and carry out a standard difference-in-difference estimator, also exploiting the time variability of our data. This last step seeks to identify causal effect of green technology exposure on the skill composition of the workforce.

JEL: O33; Q55; J21

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