Technological Forecasting & Social Change 115 (2017) 111–116

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Diversely moving towards a green economy: Techno-organisational decarbonisation trajectories and environmental policy in EU sectors

Massimiliano Mazzanti *, Ugo Rizzo

Department of Economics and Management, University of Ferrara, Ferrara, & SEEDS (www.sustainability-seeds.org) Italy

ARTICLE INFO

Article history:
Received 13 May 2014
Received in revised form 12 September 2016
Accepted 23 September 2016
Available online 27 October 2016

JEL classification:
L52
O33
Q58

Keywords:
Techno-organisational change
Climate change
EU 2030 2050 targets
Sectors
Eco-innovations
Climate policy
Energy policy

ABSTRACT

This paper adopts an ex ante perspective to investigate the potential techno-organisational dynamics related to reducing greenhouse gas (GHG) emissions in the EU by 2030 and 2050. We provide a qualitative analysis based on interviews with representatives from the main manufacturing sectors in the EU. Path dependency and enhanced carbon pricing may support the 'incremental path'. More radical changes are achievable through strong techno-organisational reorganisation and new policy support. It follows that technological innovation is sufficiently effective only if coupled with organisational innovation. Earmarking 'environmental revenues' to support sector R&D is a way to enhance the governance of the innovation-policy realm and create opportunities for radical innovation.

© 2016 Published by Elsevier Inc.

1. Introduction

In October 2014, the European Council set a new climate change mitigation target of a 40% cut in greenhouse gas (GHG) emissions for 2030 with respect to 1990 levels (EUCO, 2014). This adds to the already binding 20% cut to be reached by 2020 and has the purpose of helping the EU meet the more stringent goals proposed for 2050. The EU also led the way in the effort to conclude the "first-ever universal, legally binding global climate deal" that established a 1.5 °C threshold increase in global temperatures (Paris Agreement COP21). The challenge is to combine competitiveness with decarbonisation to meet these targets (Fankhauser et al., 2008).

The path to decarbonisation needs to be characterised by a portfolio of actions in which innovation compensates for the economy-scale effects on emissions, namely, GDP and population growth (EEA, 2014). Consequently, changes to the energy mix, greater energy efficiency and other incremental and radical solutions are required (McGlade and Ekins, 2015). Furthermore, technological, organisational and behavioural innovations are increasingly important (Costantini and Mazzanti, 2013; van den Bergh, 2007; Edenhofer et al., 2012), and environmental innovations, or eco-innovation (EI),[1] represent a crucial component of techno-organisational change (Jaffe et al., 1995).

The 2020 EU target (a 20% reduction in emissions) seems to be achievable, but this is partly due to the EU's ongoing scenario of low economic growth, very high unemployment and deflation. This challenge is linked to another issue that tends to be overlooked: the (non-binding) EU strategy established in 2012 to move from a 16% share of manufacturing to 20% (of GDP) by 2020 (EC, 2010). This in turn suggests that environmental and economic targets should be integrated. In the short term, re-manufacturing might increase direct emissions, but at the same time, manufacturing is more (eco-) innovative than services (Cainelli and Mazzanti, 2013; Gilli et al., 2013).

The 'decarbonisation burden' in fact mostly falls on the industrial and transportation macro-sectors, which are generally more polluting but also more innovative than service sectors (Cainelli and Mazzanti, 2013; Gilli et al., 2013). Moreover, Mazzanti et al. (2015, p.729) show that inter-sector integration and knowledge sources matter and that sectors with more emission-intensive upstream 'partners'

* Corresponding author at: Department of Economics and Management, University of Ferrara, via Voltapaletto 11, 44121 Ferrara, Italy.
E-mail address: massimiliano.mazzanti@unife.it (M. Mazzanti).

[1] For a consolidated definition, see Kemp (2010). The definition includes new organisational methods, products, services and knowledge-oriented innovations (see also Kemp and Pontoglio, 2011).

http://dx.doi.org/10.1016/j.techfore.2016.09.026
0040-1625/© 2016 Published by Elsevier Inc.

eco-innovate more to reduce their CO_2 footprints. Sector-specific analyses are therefore required for an in-depth investigation of the role of innovation and structural change towards the decarbonisation of the economy (Kettner et al., 2015).

Sector dynamics are attracting increased interest in environmental research, which has mostly been driven by the integration of evolutionary and environmental economics (see, e.g., Borghesi et al., 2013; van den Bergh, 2007). However, the existing studies (e.g., Marin and Mazzanti, 2013) tend to neglect "the interdependencies between environmental innovations and the industrial dynamics of sectors" (Oltra and Saint Jean, 2009, p. 579).

This work seeks to provide an in-depth investigation of three of the main polluting sectors in the EU. Based on interviews with sector experts (Borghesi et al., 2015a; Carrillo-Hermosilla et al., 2010; Baker et al., 2014), we adopt a qualitative ex-ante approach to the issue at hand that complements (i) the quantitatively oriented literature that assesses the drivers of innovation ex-post (Horbach et al., 2012; Borghesi et al., 2015b, among others) and (ii) work on macro modelling, such as integrated assessment models (McGlade and Ekins, 2015), GTAP-energy models (Antimiani et al., 2013), and agent-based models (Monasterolo et al., 2014). These studies, which are based on plausible assumptions about the endogenisation of technological change and innovation (Costantini and Mazzanti, 2013; Durance and Godet, 2010; Rosen and Guenther, 2015), are aimed at generating medium/long-term scenarios for GDP, CO_2 and other variables of interest. Conversely, as Carrillo-Hermosilla et al. (2010) note, "case studies are able to capture the details of eco-innovations, which are unnoticed in top-down aggregate quantitative analysis" (p.1078). Moreover, "sectors provide a key level of analysis for economists in the examination of innovative and productive activities, [for which] case studies provide a rich (and heterogeneous) set of empirical evidence" (Oltra and Saint Jean, 2009, p. 567).

Our research questions are related to the extent to which both policy and market factors induce environmental innovations[2] aimed at reaching GHG reduction targets for 2030 and 2050. We focus on both technological and organisational innovations - incremental and radical - (Carrillo-Hermosilla et al., 2010) and on the links among different innovations. As in the work by Oltra and Saint Jean (2009), we are interested in the ex-ante assessment of the drivers of EI at the sectoral level. Patterns of sectoral innovation develop as the result of the interplay between "technological regimes, market demand conditions and environmental and innovation policy" (Oltra and Saint Jean, 2009, p.572), and environmental policies are scrutinised through a political economy lens (Pearce, 2006). We also rely heavily on ideas of dynamic efficiency in policies and the governance dimension of EI (Carrillo-Hermosilla et al., 2010).

2. Eco-innovation, sectoral specificities, and environmental policies

The evidence highlights some key points about the role of innovation in moving towards a green economy. First, incremental innovation adoption has primarily characterised the dynamics of EI in the EU (Horbach et al., 2012; Cainelli et al., 2011), which indicates some heterogeneity across sectors (Borghesi et al., 2015a, 2015b). Incremental innovations prompted the trend towards the achievement of 2020 targets. However, radical innovations are necessary with respect to 2050 targets. This requires assessing both the economic feasibility of a blockbuster, i.e., very costly technologies such as carbon capture and storage (CCS), and the enhancement of *complementary* technological and organisational innovations. These radical changes are related to the structural development of human capital/skills (Carraro et al., 2014; Vona et al., 2015) and may represent a more feasible route to effective and innovation-intense climate strategies, even in the short and medium term (Wagner, 2013; Antonioli et al., 2013). Complementarity in innovation is a radical asset that can strongly enhance performance through innovation and the redesign of corporate strategies (Mohnen and Roller, 2005; Ambec et al., 2013).

Some authors refer to the transition towards the long-term climate change targets as the '6th technological revolution', an 'age of a low carbon – resource efficient economy' (Grubb, 2014; Perez, 2009). The low carbon economy has the potential to open "a vast innovation opportunity space and [provide] a new set of associated generic technologies, infrastructures and organisational principles that can significantly increase the efficiency and effectiveness of all industries and activities" (Perez, 2009, p. 6).

The diffusion of innovation is crucial; therefore, it is important to understand how innovations are *idiosyncratically* and *jointly* adopted by firms in different sectors and subsequently spread through sectors. Sectoral issues are of considerable interest in the literature on the economics of innovation (Malerba and Orsenigo, 1997) and, more recently, environmental economics (Jaffe et al., 1995; Crespi, 2013; Costantini and Mazzanti, 2012).

Various studies have increased our understanding of the interconnections among firms in different sectors. Castellacci (2008) argues that manufacturing and services are deeply interconnected and that knowledge exchange across different industries is the source of national competitive advantage. The author also maintains that this knowledge exchange positively affects the technological development of more traditional industries. Similarly, Consoli and Rentocchini (2014) draw on the composition of skills in different industrial sectors to illustrate how industrial organisation relies on the knowledge base of a firm and the interactions among the knowledge bases of others.

Heterogeneity among sectors must also not be neglected in the context of environmental policy. The relatively higher efficiency of carbon taxes (economic instruments in general) with respect to command and control regulation (e.g., technology standards) largely relies on the differences in marginal emission abatement costs across firms: a tax brings about different abatements across agents and consequently enhances greater efficiency and social welfare than a command and control tool (e.g., Stiglitz, 2015). Even outside a strictly 'optimal' Pigouvian design, a price signal minimises pollution abatement costs through its static and dynamic efficiency properties (Fig. 1), and it does this regardless of market structure. We can exploit environmental policies focusing on 'efficiency without optimality' (Baumol and Oates, 1988). Cost minimisation and the ongoing incentives to innovate are key tools through which environmental taxes and other economic instruments may better operate in a context of heterogeneous agents in which both economics and political economy arguments are relevant (Pearce, 2006).

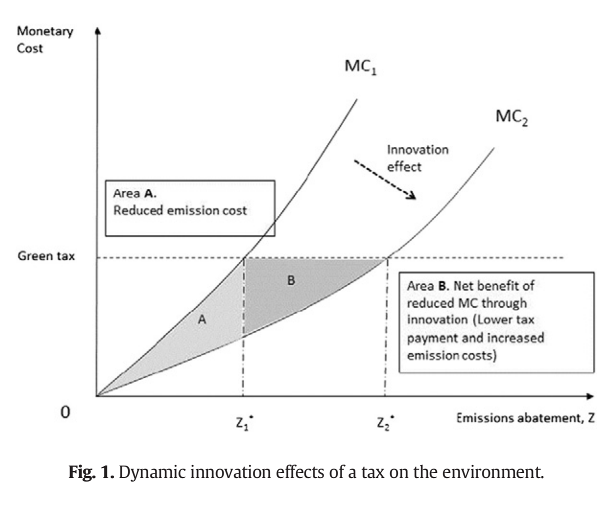

Fig. 1. Dynamic innovation effects of a tax on the environment.

[2] For a comprehensive analysis and taxonomy of EI, we mainly refer to Carrillo-Hermosilla et al. (2010) and Huppes et al. (2008).

دانلود مقاله

http://daneshyari.com/article/5037119

daneshyari
دانشیاری

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات