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Environmental innovations in services: Manufacturing–services integration and policy transmissions

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ABSTRACT

This paper investigates the relevant factors behind the almost unexplored realm of environmental innovation in services, using a dataset of 8161 Italian service firms. Specifically, we test whether manufacturing-services integration matters for environmental innovations. In addition, taking account for the heterogeneity of the service industries, we analyse whether environmental policies for manufacturing transmit 'induced innovation' effects to services. Our findings show that: (i) the drivers of environmental innovations related to carbon abatement and energy efficiency differ across industries, and (ii) cooperation, training, environmental management systems and public funding play key roles in these processes. The integration of services and manufacturing through push and pull-effects, and the environmental policy transmission effect from manufacturing to services, generally do not seem to have a positive impact on the diffusion of environmental innovations.

1. Introduction

The increasing share of services in the advanced economies and the greater efficiency of production especially in the manufacturing and energy industries, due in part to more stringent environmental policies, are key promoters of sustainability. There is a somewhat conventional view that the immateriality of services production is resulting in better environmental performance of the economy (Kander, 2005). This paper investigates this argument.

In line with the pattern of structural change that became established in the 1990s, the structure of the EU economy has shifted even more towards a service-dominated economy. Between 1997 and 2009, the share of agriculture in GDP decreased to 2.4% in the EU27, the share of manufacturing decreased from over 20% to around 15%, while the shares of construction, non-market services (e.g. Public Administration), and especially market services increased. Currently, market and non-market services in the EU27 together represent more than 74% of GDP (ETC, 2013). The new WIOD (World Input–Output Dataset) makes it possible to observe that while CO_2 output levels in manufacturing reduced by 9% over the period 1995–2008, it increased in services by 26%.

It should be noted that, at least in the EU, increased tertiarisation (ETC/SCP, 2012) is not leading necessarily to lower environmental impacts. In fact, innovation and environmental efficiency in the (lighter) services industries needs to be assessed alongside an analysis of the (growing) interlinks between services and manufacturing. The intensity of intermediate inputs bought in from other sectors has increased (ETC/SCP, 2012; EC, 2009) and the level of intermediate inputs, which is growing more than value added and output (Fig. 1),[1] is a sign of increasing integration (EC, 2009).[2]

There are many reasons why research in innovation and environmental economics should pay more attention to these phenomena.

First, services are usually subject to less strict environmental regulations and economic instruments such as environmental taxation because of their lighter weight. This may reduce the innovation-induced effects in line with Porter type arguments (Costantini and Mazzanti, 2012). Deficiencies in environmental innovation (EI) dynamics can undermine both economic and environmental performance. This seems to be the case for EI based on

[1] By using available KLEM data it is possible to observe that this gap between the growth of intermediate inputs and output is even more relevant for Italy, if compared for example to Germany and the trend we show in Fig. 1.

[2] Note also that reductions in resource use (RU) and pollution in the EU have been driven more by 'emission efficiency' than the composition of 'industry mix' effects (ETC/SCP, 2012): 'Sectors from environmental extended input–output (EEIO) models highlight that a service dominated economy is unable per se to bring the European Union to a green economy because of the interdependence between services and manufacturing, which limits the progress towards a resource-lighter economy, and because of the limited resource innovativeness of service sectors' (ETC, 2013).

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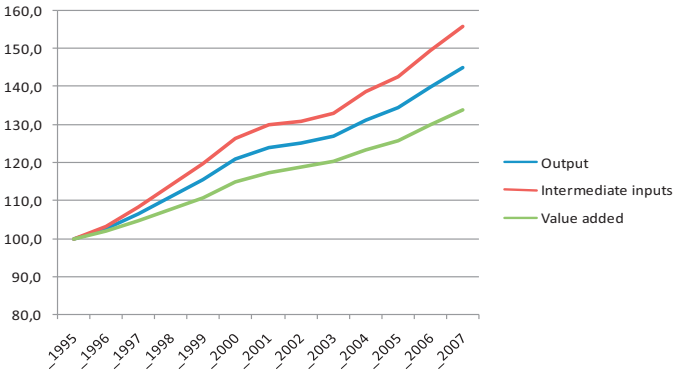

Fig. 1. Relative growth of Intermediate inputs, output and value added in volume, EU27, index 1995 = 100.

the evidence provided by the most recent Community Innovation Survey (CIS).

Second, the relationships between manufacturing and services have become stronger. Understanding the emergence and adoption of innovation in all sectors is crucial for understanding economic performance in strongly interrelated economies. Innovation diffuses through many mechanisms, including industry interdependence. EI can contribute to mitigating low productivity dynamics, while ensuring sustainability and competitiveness. There are few analyses of EI in services. Most studies focus on manufacturing, given its direct polluting effects and the role of regulatory pressure (Horbach, 2008; De Marchi, 2012; Veugelers, 2012; Horbach et al., 2012; Cainelli et al., 2011a,b, 2012). The shift towards a service economy in Europe may not be leading to sustained emissions reductions for a number of reasons, especially the potential innovation gap.

Third, direct and indirect (activated through sector interrelations) emissions related to services make the size of their environmental effects comparable to that of manufacturing (Marin et al., 2012). If we look at the interdependencies between services and manufacturing shown by input–output (I–O) tables and inter-industry 'multipliers', we observe that manufacturing is the driver of many service activities, and vice versa (European Commission, 2009). More specifically, as the client, manufacturing creates a pull-effect on other sectors (measured by the share of its production value accounted for by inputs bought from a specific sector), market services production is triggered by manufacturing final demand. At the same time, there is a push-effect of manufacturers on other sectors (pull-effect of services) when services acquire inputs from manufacturing industries. In other words, in an I-O environment, 'integration' is represented by the share of intermediate inputs derived by one sector from another (activated by demand); for example, 23% of the intermediate inputs to agriculture come from the food sector while 32% of the inputs to the food sector come from agriculture. As a client, average EU manufacturing pulls 17% of its total production; the values for Italy are very high (19.5%), and second only to Sweden. All industrialised countries present high values. The push-effect of manufacturing on services is also very high in Italy (10.9%), which is towards the top of the EU ranking (EU average 8%), and only slightly lower than the values for Poland and Sweden. Thus, Italy is a good case for analysing the importance of the manufacturing-services interlinks in economic and environmental terms. Given the role of services and their interdependence with manufacturing, we need a more comprehensive analysis of innovation adoption and diffusion within an integrated innovation system.

This paper examines EI in services focussing on phenomena such as the increasing tertiarisation and integration of our economies. It exploits eco-innovation information provided by the most recent CIS to provide specific evidence on EI in services. The CIS provides data on climate change related issues, for example, energy efficiency and adoption of CO_2 abatement technology in EI.[3] The investigation is motivated by the challenges related to CO_2 abatement and the fact that integration with services of the manufacturing sectors are subject to regulations and policies aimed at cutting CO_2 emissions. Given the lack of research attention to innovation in services generally, in our view this paper represents a unique contribution (Cainelli et al., 2006).

The paper is organised as follows. Section 2 discusses some important issues related to EI and services-manufacturing integration and their relevance for an analysis of economic-environmental-innovation performance and presents the research questions. Section 3 describes the dataset and the empirical methodology. Section 4 presents and discusses our main results. Section 5 concludes.

2. Environmental innovations in services and manufacturing-services integration

2.1. Ei definition

Definitions of EI highlight the 'eco' attributes of new processes, products and methods from a techno-ecological perspective (Kemp, 2010, 2000; Kemp and Pearson, 2007). For example, the MEI (Measuring Eco-Innovation) research project defines eco-innovation as the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its life-cycle, in a reduction of environmental risks, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives. (Kemp and Pearson, 2007).

The inclusion in this definition of new organisational methods, products, services and knowledge-oriented innovations differentiates it from the definition of environmental technologies as 'all technologies whose use is less environmentally harmful than relevant alternatives'. EI is neither sector nor technology specific and can be part of any economic activity not just those included in the rather loosely defined 'eco-industry' sectors. EI is not limited to environmentally motivated innovation; it also includes the 'unintended' effects of any innovation. When considered outside the purely technical dimension of (improved) environmental impacts, EI can be seen to have a *systemic and behavioural dimension* (Kemp and Pontoglio, 2011).

The focus in this paper is EI on services. As is known, the features of innovations are rather specific in this sector (Hipp and Grupp, 2005). They are often non-technology-oriented, closely related to intangible and knowledge intensive routines that are partly 'behavioural' in the sense that they pertain to the sphere of relations with clients. However, we believe that a focus even on technological EIs sufficiently wide to analyse 'technological EI' in services since it includes radical, incremental, process and product EI. We do not aim to provide specific information on defined innovation processes: this is a subject for further research. The aim is to provide insights on the differences across sectors, which may

[3] The study by Veugelers (2012) on Belgium uses Belgian CIS data is in line with this; however, although it includes services firms it does not specifically focus on this sector. It must be acknowledged that services are an important locus of innovation and play an integral part in the innovation systems of modern economies (Metcalfe and Miles, 1999). Gallouij and Savona (2009) provides a survey of research since 1990, highlighting the need to study the 'specificity' of services innovation.