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Demand-pull and environmental innovations: Estimating the effects of innovative public procurement

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ABSTRACT

This paper contributes to the emerging literature on the adoption of environmental innovation, by investigating the so far unexplored role of governmental demand in stimulating 'greener' production choices. Specifically, the role of innovative public procurement in driving the adoption and diffusion of sustainable manufacturing technologies is analysed. Results, based on firm-level data in the 28 Member States of the European Union, Switzerland and the USA, are obtained through non-parametric matching techniques. Those outline the crucial role of innovative public procurement in the uptake of environmental innovations. This confirms the relevance of such policy instrument in allowing countries to achieve a decarbonised and sustainable growth path which is compatible with competitiveness goals.

1. Introduction

It is difficult to identify the right amount of resources for the market to invest in knowledge creation. This creates the space for market (Arrow, 1962) or even broader systemic failures. The market may fail to provide adequate levels of research and development (R & D) investments because of the limited appropriability of such activities and the intrinsic uncertainty that characterises any innovation project. This condition may lead to sub-optimal supply of knowledge and, as a consequence, to overall social losses, unless properly designed policies for science, technology and innovation are adopted. Rationales for such policies are discussed by Laranja et al. (2008) and Flanagan et al. (2011).

Within this framework, a broad research effort has aimed to understand the role of specific policies to stimulate innovation. Most of it has been focused on the role of R & D subsidies to counterbalance such under-investment and to stimulate firm's innovative activities, as well as on R & D subsidies' negative side-effects, experienced when they crowd out private investments ((Antonelli and Crespi, 2013; Bloom et al., 2002; David et al., 2000; Hussinger, 2008), among others).

Only recently has there been a turn towards demand-oriented innovation policies, in particular on public procurement (Edler et al., 2012; OECD, 2011), to stimulate innovation, and very few (though robust) empirical analyses have been focused on understanding the effects of public procurement on innovative activities as an alternative or complementary policy instrument (Aschhoff and Sofka, 2009; Guerzoni and Raiteri, 2015). In parallel, a new and fast-growing research field has emerged about a peculiar typology of innovation, that of environmental innovations, whose investigation requires a more systemic lens than 'standard' innovations (Rennings, 2000). As these environmental innovations are of importance for both the policy and the business realm and have the potential to lead to win-win solutions whereby competitiveness and environmental sustainability are combined (EEA, 2014), it is relevant to investigate whether or not governmental demand can play a role and foster their development and diffusion.

This article bridges these two research lines and investigates, empirically, whether or not public procurement is a valuable policy instrument to stimulate environmental innovations and, indirectly, to contribute to decoupling economic growth and environmental pressure in order to meet European 2020 and 2030 climate and energy targets (EC, 2014). This is, to the author's knowledge, the first paper to explore such a research question empirically, which is the first way in which this article is original. The analysis of the role of procurement for sustainability is not new; indeed, there are crucial contributions on the topic such as the extensive work of the Organisation for Economic Co-operation and Development (OECD) on sustainable procurement (e.g. (OECD, 2015)) and the United Nations Environmental Programme's work on sustainable procurement (e.g. (UNEP, 2013)). Sustainable procurement has been put at the centre of the international agenda, as the United Nations *2030 Agenda for Sustainable Development* explicitly states the need to 'promote public procurement practices that are

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sustainable, in accordance with national policies and priorities' to reach one of the 17 Sustainable Development Goals (UN, 2015). The main originality lies in the empirical testing of the presence of a statistically relevant effect of procurement in stimulating environmental innovations. The second element of originality is that generalisable results are provided, as the empirical approach is grounded on firm-level data from a wide range of countries: the EU-28, Switzerland and the USA. The empirical approach accounts for the non-randomised nature of the assignment of public procurement tenders to applicant firms by applying a quasi-experimental approach through non-parametric matching techniques.

The rest of the paper is structured as it follows: Section 2 discusses the background literature, Section 3 describes the empirical strategy, Section 4 discusses the main results and Section 5 provides concluding remarks and identifies future lines of research.

2. Innovative public procurement and environmental innovations: discussion of the literature

The role of governmental demand in shaping the direction and speed of technological change has been recognised as crucial in the economics of innovation literature: an analysis of seven industries in the USA (semiconductors, commercial aircraft, computers, agriculture, pharmaceuticals, motor vehicles, residential and construction) dating back to 1982 confirmed the pivotal role of public policies in guiding technical progress (Nelson, 1982). Governmental support to innovative activities through public procurement (PP) is seen as a fundamental driver for the uptake of crucial technologies, as happened in the case of general-purpose technologies, which were driven by defence-related procurement in the USA (Ruttan, 2006). Those technologies – mainly steam engines, electric motors and semiconductors – in turn played the role of enabling technologies that fostered widespread technical progress and eventually led to economic growth (Bresnahan and Trajtenberg, 1995). Geroski (1990) expresses a preference for PP over subsidies to stimulate industrial innovation because of subsidies' inefficiencies, characterised by their being 'unconscionably expensive' and by the high probability that they attract 'second-best' projects in which the rate of return on publicly funded R & D will be lower than that on privately funded R & D. In contrast, Geroski observes that government procurement has a positive net effect on R & D investments over a broad cluster of innovations (including electronic devices, nuclear power, chemical products, and engines and transport equipment). PP is recognised as a successful stimulus for innovation when certain conditions are met: (i) when it expresses a clear and consistent set of needs to be addressed by the innovative effort in a clear contract specification; (ii) when *quality* is placed at the centre of the tender, rather than merely *price*; (iii) when it provides an assured market for early products with uncertain commercial possibilities; and (iv) when it forces contractors to share information and encourages the entry of new competitors so that it stimulates technology diffusion (Geroski, 1990). The author concludes that 'there is very little question that procurement policy can stimulate industrial innovativeness, and more than a vague suspicion that it can be a far more potent stimulus than a policy of generalised R & D subsidies' (Geroski, 1990).

Only recently there has been an increasing tendency to reconsider the role of demand-oriented policies in European innovation policies and a discussion has emerged on the role of innovation policies to support 'Grand Challenges' in terms of societal and economic goals (Edler et al., 2012; Foray et al., 2012). Those challenges relate to the fields of health, pharmaceuticals, energy, environment, transport and logistics, security, and digital content (Aho et al., 2006). Among the array of demand-side policy instruments, PP helps to reduce the risks linked to innovation investments with unknown demand, very low expected market size or uncertain development, all of which discourage firms from bearing the costs of innovation (Helpman and Trajtenberg, 1994).

In line with this trend, the European Commission has chosen to set a non-binding target of 50% of public tendering to be compliant with its sustainability requirements by 2010, in order to favour improvements in the environmental, energy and social performance of products and services and the development of a Green Public Procurement initiative (EC, 2008). This initiative outlines common criteria to be followed and the need to increase information on the benefits and life cycle costs of environmental friendly products. The strategy has been explicitly linked not only to the creation of market opportunity for existing green small and medium-sized enterprises (SMEs) but also to a stimulus for innovation and diversification in traditional sectors[1] via the increase in demand for green(er) products and services. In principle, the strategy should stimulate a critical mass of demand for greener goods and services which otherwise would be difficult to get onto the market, as European public authorities are consumers for an amount of EUR 2 trillion per year (16% of the EU's gross domestic product (GDP)) (EC, 2008). Overall, 'green' PP is a (procurement) procedure that leads to the purchase of 'greener' products, whose impact on the environment throughout their whole life cycle is lower than comparable products or solutions. This provides a stimulus for innovation and creates a minimum critical mass for sustainable goods and services, thus helping to overcome the problem of under-investments in innovation due to the uncertain demand. In reality, this non-binding target has not been reached, as mutually reinforcing obstacles are hindering those organisations that should launch and promote 'green' tenders from doing so (for a discussion see (Testa et al., 2016)).

The focus of the current study is not on 'green' PP, usually referred to as an environmental policy tool (for a discussion see (Lundberg and Marklund, 2011), or (Parikka-Alhola, 2008)), but rather on *innovative* PP, a category that has recently received attention and is increasingly seen as a crucial instrument for innovation policy. *Regular* PP occurs when a public institution buys already existing products or services for which no R & D is involved and supplier selection depends on readily available information about price, quantity and performance, given the existence of standardised markets (Edquist and Zabala-Iturriagagoitia, 2012; Uyarra and Flanagan, 2010). *Innovative* PP (IPP) occurs whenever public institutions invest in products or services that have not yet been developed but could be developed within a reasonable timeframe, and that can help satisfy human needs or solve societal problems; thus IPP explicitly stimulates an innovative effort (Edquist and Zabala-Iturriagagoitia, 2012). The latter case of procurement (IPP) is the main object of the current study. Public procurement for innovation has been acknowledged as an important demand-side policy instrument, as it has 'the potential to improve delivery of public policy and services, often generating improved innovative dynamics and benefits from the associated *spillovers*', but, at the same time, 'it has been neglected or downplayed for many years' (Edler and Georghiou, 2007), probably because of the stringent competition rules adopted in Europe (Edquist et al., 2000).

The rationale for using PP to stimulate innovation is threefold, as discussed by Edler and Georghiou (2007): (i) IPP is a major part of local demand and this affects decisions by multinational enterprises (MNEs) about where to locate and the dynamics of innovation in countries; (ii) IPP can help overcome market (information asymmetries) and system (poor interaction) failures relating to innovative products; and (iii) purchasing innovative solutions contributes to improving public infrastructure and services. Intelligent and tailored intermediation services may, however, be needed to make this instrument more effective in connecting supply and demand (Edler and Yeow, 2016). Predicting longer term societal needs and trends in emerging technologies can also make this instrument more effective, as discussed in the case of an

[1] Although the traditional sector might not benefit from green procurement stimulus because it lacks systemic perspectives and skills in negotiation and inter-organisational planning (Rizzi et al., 2014).