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Technovation

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Municipal demand-side policy tools and the strategic management of technology life cycles



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ARTICLE INFO

Available online 30 July 2014

Keywords:

Innovation policy
Demand-side policy tools
Technology life cycles
Sustainability
Smart cities

ABSTRACT

This research is particularly concerned with public policy instruments which may help to accelerate the development and diffusion of sustainable innovations and support local economic development. While sustainable technology sectors are in high demand, firms still face significant barriers in developing and diffusing their technologies in regions throughout the world (Hoff, 2012). This area has been less explored in the extant research yet recent experiences suggest that supply side tools may not always have positive benefits for supporting clean technology evolution, or for taxpayers. Leveraging innovation policy and technology life cycle literature, we develop a model of demand-side policy instruments which could be applied at different stages of the technology s-curve in order to accelerate the adoption of sustainable technologies. Implications for managers, public policy actors and researchers are considered.

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1. Introduction

This research is concerned with public policy instruments which may help to accelerate the development and diffusion of sustainable innovations (for example clean technologies) and support local economic development. Leveraging extant research on innovation policy and the diffusion of innovation, this work seeks to extend current understanding regarding the potential role for demand-side policy in stimulating local sustainable innovation. Aside from the contribution to theory extension, the results of this research generate insights for local government policymakers and for sustainable technology practitioners. This research suggests that different demand-side policy tools may be more impactful in influencing the development and eventual diffusion of sustainable innovation depending on the life cycle of the technology.

Rogers (1962) seminal work introducing a five-step process for the diffusion of innovation has survived more than 50 years of academic scrutiny. A vast research tradition in technology life cycles has been developed over the decades since Rogers (1962) presented the s-curve trajectory of diffusion of innovations. Within the management and technology literature, diffusion of innovation has been explored from a variety of perspectives ranging from marketing and new product development (Henard and Szymanski, 2001) to technology strategy development (Kim, 2003).

In the past few decades public policy scholars have also begun to explore the application of diffusion of innovation to the public realm. In most cases this research has focused on the diffusion of policy innovation (e.g. Mintrom, 1997; Hays and Glick, 1997). In recent decades, scholars have also sought to explore what role government policy can have in stimulating private sector innovation (Kneese and Schultze, 1978; Parry, 1998). The majority of the research in this area, conducted by public policy, management and technology scholars, has focused on the potential role for supply side policies to stimulate local economic development. Yet the extant research has been inconclusive with respect to the impacts supply-side tools such as technology parks, incubators and government grants have had on local economic development and job growth (Audretsch et al., 2008; Capelleras et al., 2008; Storey, 2005).

While sustainable technology sectors are in high demand, firms still face significant barriers in developing and diffusing their technologies in regions throughout the world (Hoff, 2012). This area has been less explored in the extant research yet recent experiences suggest that supply side tools may not always have positive benefits for supporting clean technology evolution, or for taxpayers. A recent, high profile failure of a supply-side intervention was the U.S. government's support of Solyndra, a solar technology company based in California. As part of the American Recovery and Investment Act, the U.S. developed a Clean Energy Package worth \$90 billion in combined public spending and tax expenditures. The program's support of Solyndra through a series of low-interest loans, cost the U.S. taxpayers \$500 million and left pie on the face of the program's administrators and President

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Obama as well. “The federal clean-energy loan guarantee program that gave you Solyndra wasn’t just a multibillion-dollar political debacle – it also didn’t create jobs, didn’t reduce carbon emissions and ran up financial risk for taxpayers.” (Tankersley, 2013).

In light of the mixed results for supply-side tools in promoting sustainable local economic development, the objective of this research is to develop a conceptual framework that helps to understand how local governments might develop demand-side policy tools that stimulate the development and diffusion of sustainable-driven innovations that enhance local economic development.

In the area of sustainable development, municipalities are increasingly becoming a focal point as an alternative to the perceived failure of national governments and multi-lateral efforts to mitigate global environmental challenges such as climate change (Rosenzweig et al., 2011). Cities are on the front line when it comes to major weather events, flooding and effects of climate change. Cities represent only 2% of the earth’s surface but represent more than 50% of the world’s population and nearly 80% of the world’s energy consumption and carbon emissions (Lovins and Cohen, 2011).

As cities continue to experience increased migration from rural areas, they can become major engines of economic growth that spill over to the region (Venkataraman, 2004) and to other cities (Jacobs, 1984). While innovation in municipalities has been the domain of public policy scholars (e.g., Ihrke et al., 2003; Bartlett and Dibben, 2002), we argue here that the role of municipalities in providing the enabling conditions for private sector innovation should also be within the domain of the innovation and technology literature, where there is a dearth of research exploring how local governments such as municipalities foster, support and aid in the creation and diffusion of innovation opportunities (Lember et al., 2011).

This research explores three distinct demand-side tools: (1) procurement, (2) voluntary standards and incentives, and (3) regulations in the context of technology life cycles (Kim, 2003) providing a model for conceptualizing the utility of these different instruments and their technology objectives to achieve a municipal sustainability agenda, and how this agenda can be aligned with private sector business.

The rest of the manuscript is structured as follows: we provide a summary of innovation policy with a focus on supply and demand-side policy tools. We then provide an in-depth analysis of three demand-side policy tools which have the potential to support sustainable technology development and diffusion. Next we develop a model based in the technology life-cycle literature which explores the relationship between those three demand-side tools, procurement for innovation, voluntary standards and regulation, and private sector innovation throughout the life-cycle of new sustainable technology. By integrating innovation policy and technology life cycle theories, the model we have developed supports further theoretical understanding of the role for demand-side innovation policy in the development and diffusion of new technologies.

2. Different approach of innovation policy: supply-side versus demand-side policy.

Extant research has been inconclusive in regards to how and under what circumstances governments can positively influence innovation and entrepreneurship activity (Dolfsma and Seo, 2013; Parker, 2007; Capelleras et al., 2008; Shane, 2009). Innovation policy is concerned with promoting the development and diffusion of new products and services (Lundvall and Borrás, 1999) and to support local economic and societal development.

A useful lens to explore innovation policy is to distinguish between supply-side and demand-side instruments. In the 1990s public policy scholars began exploring the relationship of public policy entrepreneurs and the diffusion of policy innovation (Mintrom, 1997; Hays and Glick, 1997). Yet only recently have researchers begun to explore the differential impacts of supply-side versus demand-side innovation policy on job creation (Kandil, 2009) and the development of technology innovations (Edler and Georghiou, 2007). Below we provide a review of the extant literature related to innovation policy and technology diffusion. Later we construct a model to explore how different demand-side policy tools might be used, in collaboration with the private sector, across the s-curve for supporting the development and diffusion of sustainable innovation.

2.1. Supply side innovation policy

Research on the effects of prevailing supply-side tools has shown mixed results with respect to desired outcomes of job growth and stimulating local economic development. Existing research on the municipal role in stimulating innovation has primarily focused on supply-side policy tools such as tax breaks, grants and technology parks creation (e.g., Edler and Georghiou, 2007). Unfortunately researchers have found that in many cases these tools have failed to achieve the desired innovation and economic development objectives.

Tamasy, 2007, illustrated results suggesting that incubators have primarily failed instruments for stimulating local innovation and economic development. Neck et al. (2004) demonstrated through a review of prior initiatives that many if not most planned silicon valley replications fail to live up to expectations. Through a study of the Boulder, Colorado ecosystem, Neck et al. (2004) found that numerous factors such as the quality of life, quality of local research universities, the presence of large technology firms and others all have an impact on the development of local technology ecosystems and that some of these factors are difficult if not impossible for innovation policy to influence.

A recent, high profile failure of a supply-side intervention was the U.S. government’s support of Solyndra, a solar technology company based in California. As part of the American Recovery and Investment Act, the U.S. developed a Clean Energy Package worth \$90 billion in combined public spending and tax expenditures. The program’s support of Solyndra through a series of low-interest loans, cost the U.S. taxpayers \$500 million and left pie on the face of the program’s administrators and President Obama as well. “The federal clean-energy loan guarantee program that gave you Solyndra wasn’t just a multibillion-dollar political debacle – it also didn’t create jobs, didn’t reduce carbon emissions and ran up financial risk for taxpayers.” (Tankersley, 2013).

Reviewing the mixed results in the literature, it is far from certain that supply-side tools are successful in facilitating sustainable local economic development. The strategic and smart use of public funds for stimulating innovation and sustainable local economic development is critical. The mixed results on supply-side tools suggests that research and policy makers may need to explore alternative approaches in order to obtain the desired results of increased sustainable local economic development and enabling the growth of a local sustainable and clean technology sector.

2.2. Demand side innovation policy and sustainable development

In the face of fiscal and political pressures, governments tend to rely on macroeconomic policies (e.g., monetary and fiscal policy), framework conditions (e.g., competition, tax or entrepreneurship policies) and to support market demand. In order to address

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