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Drivers of eco-innovation in the manufacturing sector of Nigeria

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ABSTRACT

This paper contributes to the empirical literature on the drivers of eco-innovation within the context of a developing country. It explores the dynamics of the determinants of eco-innovation in the manufacturing sector of Nigeria. Virtually all the major manufacturing firms in Nigeria generate electricity through diesel-powered plants with implications for cost of production and greenhouse gas emissions. Meanwhile, eco-innovative manufacturing firms have the potentials to decouple economic growth from excessive resource use and environmental pressure. The paper investigates the determinants of eco-innovation in the manufacturing sector of Nigeria based on empirical data from the Nigerian innovation survey. The econometric estimations find strong support for innovative organizational strategies, the need to meet regulatory standards and access to formal sources of knowledge as drivers of eco-innovation. While eco-innovative manufacturing firms are usually more technical and highly innovative, determinants of both products and process eco-innovations are heterogeneous. The paper highlights policy recommendations for enhancing firm's green competitive advantage in a latecomer economy.

1. Introduction

Innovative pathways to economic growth and understanding country-specific challenges in terms of technological capabilities are crucial to an environmentally sustainable economic development. Innovation process ingrained in sustainable development has been touted to play an important role in this context. Outcomes of such innovation process are termed eco-innovation, defined as “the production, assimilation or exploitation of a product, production process, service or management or business methods that are novel to the firm [or organization] and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use) compared to relevant alternatives” (Kemp and Pearson, 2008:10). Such innovation helps in decoupling environmental pressure and economic growth whether or not that effect is intended (OECD, 2009). This category of innovation is not necessarily new to the world but it should be new to the firm or organization implementing or adopting it (OECD, 2005). In recent years, eco-innovation has gained prominence in the literature not only because of its “double externality” nature (Rennings, 2000), but also for the fact that it adds value to firm competitiveness and transition to sustainable societies (Carrillo-Hermosilla et al., 2010; Machiba, 2010).

Based on the specificity of double externalities, eco-innovation has been designated as a *special* type of innovation because it reduces the negative environmental externalities and it is also subjected to knowledge spillover both of which could reduce firm's investment in eco-

innovation (Ghisetti and Pontoni, 2015; Ghisetti and Rennings, 2014; Rexhäuser and Löschel, 2014; Rennings, 2000). Based on this fact, eco-innovation is conceptualized as being strongly policy-driven as well as influenced by “policy push/pull effect” (Cleff and Rennings, 1999; Rennings and Rammer, 2009). Other distinguishing characteristics of eco-innovation is that it is also affected by organizational, social and institutional settings (Horbach, 2008; Rennings, 2000).

In view of the above, drivers of eco-innovation have been receiving increasing attention in the mainstream literature in the past few years. Meanwhile, understanding the drivers of eco-innovation could assist policy makers in developing economic instruments that would encourage its development and adoption in the industrial sector of the economy. Some scholars have traced these trends and carried out a thorough review of the determinants of eco-innovation at international, national, industrial, sectoral and firm levels (for e.g. see del Río et al., 2016; Ghisetti and Pontoni, 2015; Díaz-García et al., 2015). Theoretical bases for many of these studies have come mainly from innovation economics (Rennings, 2000), environmental economics (Jacob et al., 2002), evolutionary economics (Unruh, 2000; Foxon et al., 2005, etc.) and resource-based view (Kammerer, 2009).

Emerging literature has shown that eco-innovation is driven by both “market-pull” and “technology-push” dynamics. However, as a result of the double externality issue, policy (regulatory) push/pull effect has been identified as crucial to its implementation and adoption by firms (Horbach et al., 2012). In recent times, drivers of eco-innovation have been grouped into: “market-pull”, “technology-push”, “firm-specific

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factors”, and “policy” determinants (Horbach et al., 2012). Factors under “market-pull” include cost savings (Rennings, 2000), market share (Triguero et al., 2013), economic performance (Adelegan et al., 2010; Wagner, 2007), market demand for green products (Rehfeld et al., 2007; Triguero et al., 2013) and customer benefits (Kammerer, 2009). With regard to the “technology-push”, some of the factors are firms’ technological and management capabilities (e.g. engagement in R&D, staff training, in-house software acquisition, etc.) (Horbach, 2008; Horbach et al., 2012); collaboration with research institutes, access to external knowledge (Triguero et al., 2013); organizational innovation and management strategies (Rehfeld et al., 2007; Wagner, 2008). For the policy (regulatory) driver, the factors include the existing regulations, expected future regulations, access to existing subsidies and fiscal incentives (Horbach, 2008; Triguero et al., 2013).

Despite the relatively large empirical evidence on the drivers of eco-innovation, some other critical issues are still largely unexplored. For instance, there has been an increasing trend in the role played by the changing local consumption patterns in many African countries most especially the emerging economies such as Nigeria. This new consumption pattern could have a lot of implications for eco-innovation. In the past, environmental awareness about the impact of consumption was common among the well-educated and rich consumers in the developed countries. In recent time however, many of the consumers in the emerging economies are becoming aware of the level of impact of the goods and services they consume (Guarin and Knorrninga, 2012). Therefore, it goes to show that firms in the developing countries must necessarily tap into this new market so as to be able to satisfy customer demands while reducing the environmental impact of such goods and services.

In the same light, majority of the firms in the developing countries have always had to compete with imported goods from developed countries and emerging markets in Asia. Eco-innovative products are no exception. Therefore, there is the need for eco-innovative firms in the developing countries to be creative in order to be able to compete favourably with these imported goods. These issues are of paramount importance for many firms in the developing countries such as Nigeria where incremental innovation predominates because of inadequate technological capabilities. In the meantime, the empirical evidence to corroborate these assumptions are extremely limited.

Another area of importance that is yet to be thoroughly explored in eco-innovation studies is that of the regional dynamics of eco-innovation. Majority of empirical evidence on eco-innovation come from Western and Southern Europe and USA (Cainelli et al., 2012; De Marchi, 2012; del Río et al., 2013; del Río et al., 2016; Díaz-García et al., 2015; Gee and McMeekin, 2011) with studies conducted in newly industrializing and developing countries largely missing. Very few studies from newly industrializing countries such as China are slowly emerging (Cai and Zhou, 2014; Yang and Yang, 2015). Meanwhile, it is critically important to explore the regional dynamics of eco-innovation since it is usually difficult, if not impossible, to generalize studies from one country to other regions given the great disparities in national innovation systems, willingness-to-pay for green products by buyers and the environmental readiness of firms (del Río et al., 2016). Kemp and Oltra (2011, p. 252) have also substantiated this fact by stating that “eco-innovation is context-specific which is why we need research from those countries, by researchers from those countries who understand the broader context and societal processes in which eco-innovation is embedded”.

Capability of firms to produce eco-innovative products is a function of their competence to combine product and process innovations with environmental goals (Oltra and Saint Jean, 2005). Very few empirical evidence exist for comparative analysis of the drivers of product and process eco-innovations. Meanwhile, some of the few evidence on the determinants of product eco-innovation suggest that technological and managerial capabilities are very crucial to the development of product eco-innovation (Horbach, 2008) as well as networking with the

research agencies. In terms of process eco-innovation, it has been reiterated that they are internally stimulated at the firm-level. As a result of this, technological capabilities within the firm are therefore important determinants of process eco-innovations. Some scholars have shown that process eco-innovations that are connected to material and energy use are positively affected by networking with knowledge institutions such as universities and research institutes (Horbach et al., 2012). Study on the drivers of product and process eco-innovations such as this could provide insight into the understanding of policies that could be used to promote either product or process eco-innovation among the manufacturing firms (Pujari, 2006; Pujari et al., 2003).

It is within these existing knowledge gaps that this paper intends to contribute. The article is structured as follows. The second section discusses relevant literature on the drivers of eco-innovation in the manufacturing sector. Section 3 specifies the methodology adopted for the study. Section 4 reports the analysis of data and discussion of results. Section 5 concludes and suggests policy recommendations.

2. Drivers of eco-innovation in the manufacturing sector

Many inventions have failed to make it to the market because of complexities surrounding drivers and barriers of innovation (Bleischwitz, 2007). Eco-innovation as a *special* type of innovation is not an exception. Within the context of eco-innovation, drivers are generally understood as specific factors leading to increase or reduction of pressure on the environment (Bleischwitz et al., 2009). In broad term, these factors can be viewed either from the demand or supply side of eco-innovation. Empirical analyses on the determinants of eco-innovations only started coming out around late 1990s. In the 1990s, some scholars clamoured for research activities to explore the relationship between environmental management and production strategy (Gupta, 1995; Sarkis and Rasheed, 1995), and the impact of firms’ activities on the environment (Kitazawa and Sarkis, 2000). At the same time, many firms have engaged in eco-innovation activities for many other reasons. One of the critical factors has been an improvement in business performance (Adelegan et al., 2010; Bansal and Gao, 2006; González-Benito and González-Benito, 2005). One of the few articles on eco-innovation in the manufacturing sector of Nigeria also found out that the pulp and paper industry in Nigeria showed a strong relationship between green technology use and financial performance (Adelegan et al., 2010). In the studies of Darnall et al. (2008) and Ahmad and Schroeder (2003), they found out that engagements in environmental management practices or eco-innovation activities were positively related to the financial result and greater operational efficiency. Some authors have also opined that when firms adopt eco-innovative management strategies, they tend to be more competitive through cost reduction, quality improvement and implementation of new processes and products (Bresciani and Oliveira, 2007; Parnell, 2008; Shrivastava, 2008; Yang et al., 2010). In addition to these factors, adoption of environmental management systems like ISO 14001 is also said to influence market share, firm’s image, risk portfolios, firm’s efficiency and international sales growth (Jacobs et al., 2010; Zeng et al., 2008; Wagner, 2007).

Both the fields of innovation and environmental economics have made a lot of contributions to the determinants of eco-innovation both at the micro and macro levels. For instance, in the field of innovation, studies have shown that demand factors in general (Horbach, 2008; Horbach et al., 2012) and collaboration with environmentally concerned stakeholders in particular (Wagner, 2007) are crucial in the production of eco-innovations. Meanwhile, management literature on corporate social responsibility strategy had indicated that societal pressure and demand for environmentally-friendly products and processes may not necessarily be prerequisites to increase investments in eco-innovation. Most of the scholars in this field are of the opinion that more often than not, firms respond to the societal pressure and demand for environmentally-friendly products by putting in minimum

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