Innovation Types and Productivity Growth: Evidence from Korean Manufacturing Firms

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ABSTRACT The purpose of this paper is to investigate productivity growth according to three types of innovation: product innovation, product improvement, and process innovation, using firm-level data from the Korea Innovation Survey 2002 about Korean manufacturing companies. This study is conducted in two steps. The first step measures firm-level Malmquist productivity index by data envelopment analysis (DEA). The second step estimates econometric regression models by weighted least square utilizing the productivity index as a dependent variable and each of the innovation types and other characteristics of firms as independent variables. The empirical results partly support the idea that the types of innovation matter in productivity growth. Specifically, process innovation may result in higher productivity performance than product innovation in the short run. This result stems from the difference in efficiency growth when productivity growth is decomposed into two components: efficiency growth and technical growth. That is, product innovation by definition involves product development and radical innovation and so, it can deteriorate efficiency growth relative to other types of innovation due to the process of product development and the adjustments that are needed to new innovations whereas process innovation is implemented to reduce defects, lead time, costs and other factors, and as such is very efficiency orientated. Consequently it helps improve efficiency growth.

KEY WORDS: Productivity growth, innovation types, product innovation, process innovation, product improvement

Introduction

A large number of empirical studies have been conducted on the linkage between innovation and productivity since the pioneering studies of Griliches (1958, 1980), and Mansfield (1965). The early literature employing firm-level data reached the general conclusion that productivity is positively associated with innovation (Griliches & Mairesse, 1984). The scope of the studies was then gradually extended to the industry level (Mansfield, 1984; Bullard & Straka, 1986; Klette & Kortum, 2002) and then to the national level (Mun et al., 1991; Nadiri & Kim, 1996; Frantzen, 1998; Aghion & Howitt, 1998), confirming the same conclusion as had the firm-level studies.
Most previous studies have used R&D expenses as a proxy variable for innovations, assuming a proportional relationship between R&D expenses and innovations (Balteiro et al., 2005; Hjalmarsson & Veiderpass, 1992). This assumption, however, has been criticized because of the fact that R&D expenses just represent activities leading to innovations and not the realization of innovations themselves (Lee & Stone, 1994). Since a few of these activities lead to the realization of innovations, R&D expenses do not capture the true number and intensity of innovations. In this regard this paper has a contribution to the literature by using realization of innovations firms to declare themselves as explanatory variables.

Another drawback in the previous studies was ignoring the innovation process by analyzing the direct relationship between R&D expenses and productivity. The innovation was treated like a black box (Pilat, 1995; Pyo et al., 1992). In spite of the same amount of R&D investment, the productivity performance can differ for several reasons, for instance, because of the different ways of innovation process, the types of innovation firms implement and firms’ characteristics and so on. This study focuses on the types of innovation among the reasons. That is to say, this study delves into the black box of innovation by classifying the innovations into three types and exploring the linkage between productivity performance and each of the types. The three types are product innovation, product improvement and process innovation. This classification system is in consent with that of the OECD Oslo manual for CIS (community innovation survey).

Product innovation is defined as the development of new products that differ considerably from existing products. Product improvement is defined as a significant improvement in the existing product technologically. Product innovation is a relatively radical change for a firm compared to product improvement, which is called incremental innovation. And process innovation is defined as a considerable reform of the production process to reduce waste, defects, and costs and other factors.

This paper examines the difference in productivity growth according to the types of innovations. Firstly, we expect that the productivity performance will differ according to whether a firm carries out product-related innovations (product innovations and product improvements) or process innovations. Product innovations are to exploit new markets or expand the existing markets through putting the new products into the markets whereas the objectives of the process innovations are to change the production process of the existing products to reduce expenses, defects, wastes and lead time or improving production efficiency and eventually to increase sales and profits of a firm (Llorca, 2002).

The firm’s activities for reducing expenses, defects or improving efficiency lead to productivity performance instantly (Huergo & Jaumandreu, 2004). On the contrary, putting new products into the market does not directly connect to the productivity performance. As the new products sell well in the market, the firm could invest more and produce a mass quantity of the products, resulting in productivity improvement due to the benefits of economies of scale and learning effects, and so on. Since a long-term period is required to ensure new products are well known to the markets in general, the product innovations do not lead to high productivity improvement in the short run. Moreover, new product production tends to entail high defect rates and problems in the early stage to be adjusted (Hong, 1999). Because the adjustments require time, product innovations may possibly have a negative impact on