

Productivity of production labor, non-production labor, and capital: An international study

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Abstract

Productivity is defined as the amount of output produced with certain combinations of input resources (capital, labor, etc.). Recent studies have indicated the value of non-production labor (e.g., engineers, product designer, quality inspectors, and administrators) to a manufacturing plant's productivity. However, the effect of non-production labor compared to other input resources such as production labor and capital on factory productivity has not been fully investigated. Without understanding how individual input resources affect productivity, manufacturing firms can mismanage resource investment, which will ultimately hinder the growth of productivity. This study examines the relative effect of input resources on factory productivity across countries. We use data collected from 508 manufacturing plants in 16 countries to estimate and compare productivity of input resources between countries. Statistical results are presented and directions for future research are suggested.

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1. Introduction

Productivity is an index that measures output relative to input. Plants with higher productivity produce more output for a given level of input than plants with lower productivity. This higher productivity results in lower input levels to produce the same good or service, giving the firm a potential competitive advantage in the international marketplace (Lowe and Fernandes, 1994; Grubbström and

Olhager, 1997; Mefford, 1991). Due to the significance of this issue, many researchers in various disciplines (e.g., economics, operations management, and engineering) have continuously studied the subject of productivity. There are various research issues pertaining to productivity including productivity measures, factors that affect productivity, office vs. factory productivity, and ways to improve productivity (Stevenson, 2004).

Productivity is defined as the amount of output produced with certain combinations of input resources (e.g., capital, labor, etc.). While there can be many possible input resources, labor and capital have been the two primary input resources considered in most productivity research in the

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fields of economics and operations management. More recently, many studies have begun to discuss the value of non-production workers (i.e., managerial, technical, and support staff such as engineers, product designers, quality inspectors, purchasing managers, and administrators) to a manufacturing plant's productivity (Gray and Jurison, 1995; Gunasekaran et al., 1994; Kang and Hong, 2002; Krajewski and Ritzman, 2004). As automation technology replaces traditional workers, the productivity of non-production workers relative to other input resources becomes critical to improving factory productivity. The relative contribution of different input resources to productivity is an even more significant issue from the perspective of international manufacturing and outsourcing. Facing the trend of globalization, many multinationals have been investing in overseas facilities to improve international competitiveness. Since different countries can have over- or under-investment of different input resources (Cörvers, 1997), it is likely that managers in different countries must manage resources differently to improve plant productivity. Unfortunately, very few studies have specifically examined the international productivity of manufacturing plants on a large scale. The relative impact of various input resources (including non-production labor) on productivity between countries has not been studied despite the increasing establishment of foreign facilities. The lack of understanding of the management of plant productivity in different countries can mislead resource investment and ultimately hinder the growth of productivity.

This study examines the relative influence of various input resources on manufacturing plant productivity across countries. We use data collected from 508 manufacturing plants in 16 countries to perform empirical analysis. The following section reviews relevant studies of international productivity followed by a discussion of research methodology. Both input and output measures of productivity are suggested. The statistical results and discussion are presented, followed by suggestions for future research.

2. Literature review

The trend of increasing contributions to productivity from non-production workers definitely presents a new challenge to productivity research and practice that traditionally include only production workers (Gray and Jurison, 1995; Krajewski and

Ritzman, 2004). While no studies have specifically examined the productivity of non-production workers, a few researchers have empirically observed the value of non-production activities. For instance, Hayes and Clark (1986) investigated how organizations used different strategic resources to improve productivity. They analyzed 12 factories of three companies over time, and their findings indicated that productivity increase was associated with capital investment in new equipment; reductions in material waste, work-in-process inventory, and the number of engineering change orders, and increased employee learning rates. Accordingly, they suggested that investment in both human and equipment resources improved plant productivity. Schmenner (1991) analyzed factories in North America (USA and Canada), Europe (France, Germany and England), and Korea. His results revealed that investment in new equipment and increased worker participation increased the productivity of the plants. Lieberman (1989) found manufacturing productivity increased from various non-production activities such as well-defined tasks, employee improvement suggestions, and interaction between production employees and equipment/tooling engineers. A stream of research has also suggested that various improvement activities performed under the names of quality management and environmental management increased plant productivity (Flynn et al., 1995; Karmarkar and Pitblando, 1997; Klassen and Whybark, 1999; Sousa and Voss, 2001). Finally, the concept of supply chain management has verified the contribution of non-production activities to productivity.

While researchers have begun to recognize the contribution of non-production workers to productivity, none have investigated the relative effect of non-production workers and other input resources on plant productivity. Flaherty (1996) compared manufacturing firms in Singapore, Mexico, and Taiwan and reported the differences in their "sensitivity" of productivity growth to labor and capital investment. No explanation was offered for why such difference occurs. Cörvers (1997) investigated variables affecting labor productivity within the EU member states. His results showed over-investment of human capital in some countries and under-investment in other countries. Yamada et al. (1997) studied the influence of labor, capital, and R&D on productivity and found a higher productivity contribution from capital resources (measured as value-added).

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