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The Impact of Information Technology on Productive Efficiency: An International Comparison

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INTRODUCTION AND A LITERATURE REVIEW

The economic measures of IT benefits in organizational performance frequently used include *profitability, productivity, costs, quality, operative efficiency, consumer surplus,* and *Tobin's q* (cf. [22]). Quite a few research results were able to confirm the contribution of IT in organizations. However, some of them derived only weak or even inconclusive results. For example, the so-called *productivity paradox of IT* [3] has confused both managers and researchers during the 1980s [14] and is claimed to have disappeared in early 1990s. The productivity paradox of IT suggests that the huge amount of investments in IT has been found uncorrelated with significant organizational performance improvement in aggregate output productivity. Typical explanations to the productivity paradox include the following: (i) massive investment in IT started only from recent years [26]; (ii) because of the time-lagged effects of IT, it takes time to realize the benefit of IT [11]; (iii) output mismeasurement [5, 33]; (iv) input mismeasurement [8]; (v) overinvestment in IT [26]; and (vi) lack of organizational changes accompanying the IT investment [6].

A performance measure called *productive* (*technical*) *efficiency*, which has been rarely used in the past and was introduced by Lin and Shao [20] to evaluate the business value of IT at the firm level in the MIS literature for the first time, is becoming more frequently applied to the measurement of the impact of IT investments in production processes. The use of productive efficiency is motivated by the following reasons: (i) productive efficiency exerts a positive effect on productivity growth [7]; (ii) productive efficiency can be applied to all types of organization, unlike some financial measurements that can only be applied to financial organizations; (iii) productive efficiency is closely related to productivity and effectiveness; and (iv) if combined with other measures, a more complete analysis of IT contribution can be provided.

There has been too much emphasis on U.S. firm and lack of cross-country studies [24] as far as the business value of IT is concerned; and, as a consequence, knowledge accumulation concerning macro-characteristics and IT value at the country level has been inhibited. This suggests that research in IT business value at the macro-level is needed.

Indeed. research on IT value at the firm level appears to be abundant as reflected by a long list [1, 2, 4, 9, 12, 18, 21, 23, 26, 28, 30, 31, 33, 35, among many others]. On the contrary, the studies devoted to IT value at the country level are countable. First, our attention is paid to the Kraemer and Dedrick's study [16] which, using correlation analyses to examine the payoffs from IT investments on productivity and economic growth in twelve Asia-Pacific countries over the period 1984 to 1990, has collectively concluded that IT investment has paid off in productivity improvement and challenged the so-called productivity paradox, where by collectively we mean that it is not possible to determine whether the paradox does or does not exist in an individual country within its methodological framework.

Second, the cross-country research of Dewan and Kraemer [10] has again been concerned with the productivity paradox for seventeen developed countries over the period 1965 to 1994. Its analysis suggests that, collectively, the developed countries are receiving a positive and significant return on their IT investments, implying the absence of the paradox.

Third, Dewan and Kraemer [11] have examined the relationship between IT and productivity by estimating Cobb-Douglas regression models, based on a country-level panel data set from thirty-six countries (of which twenty-two are considered developed and fourteen developing) during the 1985-1993 period, without replying on any performance measure. Collectively, the sign and significance of the estimated coefficients of the IT input have led them to conclude that the productivity paradox disappears from the group of developed countries but does exist in the developing countries.

Fourth, Lin and Chen [19] have provided an comparative analysis of the productive efficiencies of major industries in Taiwan and China, using a two-equation model. They have concluded that the industries in Taiwan perform more productively efficient than their counterparts in China. More interestingly, they are able to identify the contributors of productive (in)efficiency from the financial, educational, economic, political, social, and geographic differences between Taiwan and China.

Fifth, by Shu and Lee [32], productivity and three types of efficiencies (i.e., productive, allocative, and scale) of IT industries have been analyzed for fourteen OECD countries, within the framework of the Cobb-Douglas function estimated by a full information maximum likelihood procedure. It has concluded that individual countries' productive efficiencies are low, with the U.S. having the best productive efficiency (0.6268), followed by Japan (0.6229), and Norway having the worst productive efficiency (0.4142). Since it has used the same performance measure as used in the present study, we are particularly interested in its estimated results of the productive efficiency. We will provide a comparison of this study's IT-efficiency with Shu-Lee's IT-efficiency and Jorgenson's IT-Productivity in the G7 countries [15].

Sixth, [13] represents a good example analyzing the growth of productivity and productive efficiency in OECD industrial activities. But, it does not consider the role of IT investments and, therefore, is of little interest to us.

Seventh and final, Lee [17] have undertaken an investigation on twenty countries (including sixteen developed/newly industrialized and four developing economies FROM 1980-2000) in a Cobb-Douglas production regression. Results show that IT contributes to economic growth in many developed and newly industrialized economies, but not in developing countries.

This research joins the short list of relatively few studies to address the important issue of accessing the business value of IT at the country level. Thus, the objective of this paper is two-fold: to assess the impact of IT on the productive efficiency between developed and developing countries collectively and to compare the productive efficiencies with and without IT of individual countries across different stochastic production frontiers (the Cobb-Douglas function, Box-Cox and Box-Tidwell transformations, and translog functions).

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Complete results and discussions will be presented in the 2006 IRMA Conference.

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