

# Chapter 16

## Revisiting the Impact of Information Technology Investments on Productivity: An Empirical Investigation Using Multivariate Adaptive Regression Splines (MARS)

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### ABSTRACT

*This article revisits the relationship between IT and productivity, and investigates the impact on information technology (IT) investments. Using the MARS techniques, we show that although IT Stock is the greatest predictor variable for productivity (Value Added), it is only significant as an interaction variable, combined with Non-IT Capital, Non-IT Labor, Industry, or Size.*

### INTRODUCTION

Information technology (IT) investments by U.S. organizations have steadily increased since the

1980s, and continue to receive the attention of researchers (Lin & Shao, 2006). Although a great number of studies have examined the impact of IT investments on organizational productivity to

quantify the business value from IT, results from empirical studies are largely mixed. Earlier studies were inconclusive (Loveman, 1994; Weill, 1992), but more recent studies show the positive IT impact on productivity at the firm level (Brynjolfsson & Hitt, 1995; Dewan & Min, 1997; Kudyba & Diwan, 2002a, 2002b; Kudyba & Vitaliano, 2003; Lichtenberg, 1995; Menon, Lee, & Eldenburg, 2000; Shao & Lin, 2002). Dedrick, Gurbaxani, and Kraemer (2003) attributed these positive results to better data sets and analytical tools used to measure the true impact of IT investments.

Although there have been many firm level IT & productivity studies, most of them have used either data envelopment analysis (DEA) or econometrics to test the relationship between IT investment and productivity. In this study, we used a relatively new data mining technique - multivariate adaptive regression splines (MARS). This tool overcomes many shortcomings of the traditional approach, which assumes a linear relationship between dependent and independent variables and normality of the error distributions. MARS offers a flexible regression technique that can uncover a range of possible relationships in the data, including nonlinear relationships (if they exist), and may provide additional insight for investigating complex issues, such as the impact of IT on productivity.

While results of the previous studies made significant contribution to IT & productivity studies, we contend that the complexities of the relationship between IT investment and productivity cannot be determined without reviewing the interaction of its variables. In addition, we contend that the relationship between productivity and IT investment is not linear.

While a number of studies have investigated the IT impact on productivity at the industry level, these studies often have contradicting findings. Hu and Quan (2005) found no significance between IT investment and productivity in the IT-intensive industries, while findings from Kudyba and Diwan (2002b) and Lee and

Kim (2006) indicated otherwise. Therefore, the purpose of this article is to revisit the relationship between IT and productivity using MARS, and to attempt to quantify the values from IT. In addition, we included contextual variables to investigate if and how these factors influence the overall organizational productivity.

This article is organized as follows: The Literature Review section reviews previous IT and productivity research. This is followed by the Research Model and Hypotheses section. The Methodology section describes MARS, the data set, and the production function. This is followed by the Results and Discussion of Results sections that include MARS analysis and discussion of the empirical results. Next, we compare our results with those of previous studies. The final section provides the conclusions of the article, including suggestions for future research.

## **LITERATURE REVIEW**

Numerous researchers have examined the relationship between IT investment and productivity within a variety of firms and industries. However, findings from these studies have been inconsistent. Following is a summary of previous studies, categorized by their results and level of analysis.

### **IT Investments and Productivity at the Firm Level**

#### **No Significant Relationship at the Firm Level**

Loveman (1994) examined 60 manufacturing business units within the U.S. and Western Europe. Despite disaggregating the use of IT according to IT intensity, industry, and market share, he found no significant impact of IT investments on productivity at the firm level.

Hu and Plant (2001) argued that there is causality between IT investment in the preceding years

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