Perspectives on the Relationship between IT Investment and Economic Performance

A Firm-Level Critical Literature Review

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ABSTRACT

As a result of competition becoming increasingly fierce, firms are challenged to seek effective ways to improve their performance. Investment in IT is considered as a feasible strategy to influence company performance and preserve competitive advantage. Based on the existing Information Systems literature in this field, this paper reviews the different perspectives on how researchers understand the relationship between IT investment and economic performance. On one hand, several authors view productivity as an indicator of the economic performance of firms, and explore the impacts of IT capital by examining the production process. On the other hand, other works take a more holistic view, highlighting the importance of complementary factors and organisational changes. Another perspective concentrates on researching firm performance, through studying the costs incurred in an economic exchange. They adopt Transaction Cost Theory to analyse the effects of IT on transaction costs, and to find the true costs of IT outsourcing. It is suggested that future research should consider identifying the relationship between IT investment and firm profitability, understanding the timing of payoff from IT investments, and analysing the effects of industry and country differences.

Introduction

Mahoney and Pandian (1992) propose the term Resource Based View, which recognises that IT is one of the firm's resources, and IT has a significant impact on firm performance. In order to keep competitive advantage, companies need to consider how to maximise the economic utility of their IT investment.

Investment in Information Technology (IT) has close relationships with economic performance. Dedrick et al. (2003) propose that firms usually take deliberate approaches to maximise the economic utility of their IT investments. In general, IT capital is defined as investing in hardware, software and services, computers and telecommunications, while various economic measures are analysed at different levels, such as GDP per capita at the macro-level, and labour productivity and intangible benefits at the micro-level.

The relationship between IT investment and economic performance can be understood from exploring the production process through which inputs are transformed into outputs. Dedrick et al. (2003) develop a conceptual framework to identify the input-output relationship, which is a mix of production factors to determine the various outcomes. More specifically, labour and capital investments are regarded as inputs, and economic growth and labour productivity increase are deemed as outcomes. The increases in levels, quality and productivity of inputs contribute to the growth in outputs (Bresnahan, 1999; Brynjolfsson & Hitt, 2000).

Brynjolfsson and Hitt (1998) bring forward that productivity growth can be gained from reducing the direct cost of IT capital such as plants and equipment, while Athey and Stern (1997) point out the complementary investments in organisations also have an impact on firm performance. The framework proposed by Dedrick et al. (2003) points out that there are various complementary factors that contribute to the outcomes of IT investments. Brynjolfsson (1996) and Brynjolfsson et al. (2000) indicate that the complementary factors at firm-level include organisation and management practices, and prove that the structure and business practices of the firms contribute to the returns of IT capital. Furthermore, Brynjolfsson et al. (2000) state that these organisational investments lead to productivity increases not only by reducing costs, but also by improving intangible aspects such as quality and variety.

Moreover, Transaction Cost Theory (TCT) is another perspective to understand the relationship between IT investments and economic performance. Ciborra (1993) highlights the firm performance can be affected by the transaction costs, which are the consequence of incomplete distribution of information among the economic agents. Ciborra (1981) emphasises that TCT is a solution that can reduce transaction costs. IT realises the lower cost information communication to decrease transaction costs (Malone et al., 1987), and IT lowers coordination costs within the value chain to reduce transaction costs. However, Cordella (2006) argues that previous studies underestimate the impact of interdependence of factors, which could cause the negative effects of IT on transaction costs. Indeed, an assessment of interdependence can help practitioners to evaluate the real costs and make judgements on the feasibility of IT outsourcing.

This literature review is organised to discuss IT's influence on economic performance at firm-level. The emphasis on firm-level analysis has important measurement advantages for discussing the effects of intangible organisational investments (Dedrick et al., 2003). This paper begins by explaining the productivity paradox, and then discusses the arguments of IT investment impact from production process framework. Moreover, TCT as another perspective is used to examine the issues of IT capital and organisational performance. Finally, the concluding points of this review consider the limitations of restricting the analysis at the firm-level, and boost understanding of the topic for future research.

IT Investment, Productivity and Organisational Changes

Scholars have categorised extensive researches and addressed various aspects of IT's influence on economic performance, which is classified between process performance and company performance (Melville et al., 2004). Many researchers agree that process performance intermediates the impact that IT investment has on company performance (Kim et al., 2006; Mittal & Nault, 2009). Among many process measures, productivity estimates the rate of output per unit of input, and is perhaps the one that is discussed most frequently in the literature (Smith, 2008).

During the late 1980s and early 1990s, much literature indicated that IT investment had a limited impact on productivity at various levels (Baily, 1986; Berndt & Morrison, 1995; Loveman, 1994). Specifically, Brynjolfsson and Yang (1996) surveyed over 150 studies, and then stated that the relationship between IT investment and productivity is uncertain, while Dedrick et al. (2003) also failed to identify this relationship. The phenomenon that IT investment was unable to increase productivity leads to the term "productivity paradox". The paradox was supported by sufficient evidence that labour productivity decreased with IT investment increasing (Strassmann, 1990; Mahmood & Mann, 2005). However, the paradox was overturned as productivity gains were observed in 1990s. As more research has been carried out, researchers have gradually found the positive relationship between IT capital and productivity growth. Even though the evidence implies that impacts of IT investment take time to exert an influence (Brynjolfsson & Hitt, 2000; Mahmood & Mann, 2005), growing investments in IT contributes to boosting the productivity (Smith, 2008; Colecchia & Schreyer, 2001). The labour productivity growth is an indicator of the economic performance of firms (Dedrick et al., 2003). However, the impact of IT investment is difficult to measure by labour productivity growth directly since IT enables complementary organisational investments.

These investments, in turn, lead to improvement in intangible assets.

Costs of Direct Investment

The issue of how to measure the productivity growth from IT investment is controversial in academia nowadays. Previous researchers mainly examine the effects of direct investment by using quantitative analysis. Brynjolfsson and Hitt, (1998) and Brynjolfsson (2003) point that the labour productivity improvement from IT capital can be achieved by either decreasing IT expenditure or increasing business benefits. Del Gatto et al. (2009) demonstrate that quantifying IT contribution on organisational productivity growth is a requisite step for empirical analysis. Scholars use the statistical tools to estimate the average annual contribution of IT investment to total output in order to determine the significant factors in labour productivity growth (Brynjolfsson & Hitt, 1995; Lichtenberg, 1995).

Moreover, Brynjolfsson and Hitt (2000) find that returns of IT investment occur not only in labour productivity growth but also in Multifactor Productivity (MFP) increases. Gilchrist et al. (2001) prove that IT has a substantial influence on increasing labour productivity and MFP.

In addition, the influence of IT investments on productivity varies among different companies (Brynjolfsson & Hitt, 2000). At the firm level, the phenomenon can be explained by complementary investments in organisational capital such as the structure and business practices.

Costs of Complementary Investment

Brynjolfsson and Hitt (2000) conduct productivity studies to figure out that output elasticities of IT exceed the input shares. The result can be explained as previous quantitative research articles neglect the

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importance of intangible complementary investments. The unmeasured assets such as decentralising decision making, improving business process or acquiring highly skilled staff are not recorded in a company's balance sheet, but they have significant effects on the payoff to IT investment (Brynjolfsson and Hitt, 1995).

Athey and Stern (1997) prove that complementarities are the most plausible explanation for the link between IT and economic performance after empirical evaluation, and Brynjolfsson and Hitt (1998) find that the greatest IT benefits appear to be realised when an IT investment depends mostly on complementary organisational investments. Even though Bertschek and Kaiser (2004) indicate that output elasticities of IT capital do not differ significantly whether the company reorganise its workplace, major authors claim IT intensive firms tend to be more productive, and the returns of IT investment vary among companies because of unique characteristic and special features (Brynjolfsson & Brown, 2005; Brynjolfsson & Hitt, 2000). Moreover, firms will gain higher organisational productivity if they use IT to decentralise decision making process (Smith, 2008). Decentralised decision making restructures the information flow of a firm, and it makes more employees working and less people managing, which empowers lower-level workers to take responsibilities (Brynjolfsson and Brown, 2005). Interestingly, Black and Lynch (2001) find that the importance of IT usage at high level is not significant, but increasing the percentage of non-managerial employees who use computers has a decisive effect on company performance. Melville et al., (2004) support this view that IT investment coupled with increased delegation authority realises productivity improvement. Moreover, Smith (2008)'s research indicates that business processes improvement could lead to productivity growth at firm-level. Generally, business process is the daily operation of a company and it is embedded into the company culture, so IT is used to solve difficulties of business process changes. In addition, Keller (2004) adds that productivity improvement comes from the existing business unit rather than from a new investment, and Kudyba (2004) puts forward that IT must be integrated into current business processes.

Furthermore, greater influence of IT is combined with decentralised company structure, more knowledge workers and comprehensive training programmes (Brynjolfsson and Hitt, 2000). Brynjolfsson (2003) reveal that organisational productivity growth is associated with not only decentralised decision making, restructured business process, highly skilled employees and greater emphasis on training, but also automated routine tasks and powerful performance-based incentives.

Beyond Productivity

IT is described as general purpose technology, which affects a number of sectors and economic activities. IT is not simply a tool for automating business processes, but is an enabler of organisational changes (Dedrick et al., 2003; Kretschmer, 2012). Smith (2008) asserts that firms change the way they conduct business due to the investment in IT, and managers search for new ways to measure economic performance beyond productivity.

According to Brynjolfsson and Hitt (2000), firms have transformed the organisation such as supplier relationship and customer services by combining with IT. To elaborate, computer-based information systems facilitate supply chain management. With the Internet, Lee (2002) proposes that firms in a supply chain can be connected in real time with information and knowledge shared continuously, new products and services can be designed to fit special market segments, and new supply chain structures can be developed to serve customers in a more direct manner. Additionally, the Internet offers more opportunities for companies to interact with customers. Different from traditional models, Dell has built a customer-driven order business model, which eliminates its distribution and retailing costs and attracts more customers on the website. Brynjolfsson and Hitt (1995) complement that firms should focus on how IT has the ability to address other strategic levers such as company reputation, product quality and position, so there are many dimensions to affect economic performance beyond productivity. Both intangible benefits and productivity are organisational performance measures and can be used to describe the relationship between IT investment and economic performance at firm-level.

Transaction Cost Theory

The Impact of IT on Transaction Costs

TCT has been used to analyse the potential of IT to reduce transaction costs, thereby improving organisational economic performance in markets and hierarchies (Islamoglu and Liebenau, 2007). Malone et al. (1987) define that demand and supply forces determine production in markets. The relationship is described as a single buyer can select from different possible suppliers and choose the one that provides the best portfolio of characteristics. Therefore, markets involve relatively high coordination cost such as gathering information and negotiating contracts, but low production cost due to economies of scale. In addition, hierarchies coordinate the flow of materials and services controlled at a higher level. Thus buyer's choice is restricted to a single predetermined supplier so that the production cost is higher than that in the market arrangement, but coordination cost is low in the hierarchical structure because this arrangement eliminates the producer's need to analyse information.

However, many scholars have criticised the imperfections of TCT. Collin and Larsson (1993) review that the theory fails to take the power of stakeholders into consideration. Lacity and Willcocks (1995) argue that the definition of the factors that contribute to transaction cost is ambiguous. Additionally, several authors question that this theory does not take into account wider background issues that have effects on sourcing decisions (Collin, 1993; Dietrich, 1994).

Even though there are various criticisms of TCT, IT is considered as an effective approach to lower transaction costs. New information technologies have fundamentally reduced the time and cost of processing and communicating information in the past several decades, so organisations can decrease high coordination cost by enlarging investments in IT (Malone et al., 1987). Islamoglu and Liebenau (2007) support this general trend towards markets, and Ciborra (1993) proposes that IT capital is able to reduce information asymmetry, so IT enables an easier matching between suppliers and customers once products have been located, which reduce transaction costs.

IT has become the major enabler of the efficient information exchange in organisations, but conflicting approaches indicate that IT is either a powerful tool to support the economic system managing information or, conversely, to create a more complex system that is difficult to manage. Palme (1984) highlights the problem of information overload, which underlines the negative effects of IT.

Generally, there are four key reasons to explain why there are transaction costs being caused in the market. They are environmental factors (uncertainty and small numbers) and human factors (opportunism and bounded rationality) (Williamson, 1975; Moe, 1984). Cordella (2006) argues that previous research on examining the effects of IT on transaction costs underestimates the interdependences among these factors, and he insists that lower transaction costs can be achieved when the costs associated with IT adoption do not exceed the cost of the externalities that are affected by this adoption. Furthermore, the impact of adoption of IT is not always positive, and the interdependence of factors affects the increase of transaction costs. Thus the relationship between IT investment and economic performance of the firm is not certain.

IT Outsourcing

Many firms have adopted outsourcing in recent years as a means of supplementing in-house IT investments. The main purpose of them choosing IT outsourcing is to decrease service and transaction costs and increase organisational value and performance (Ngwenyama and Bryson, 1999). TCT has been widely applied to explain outsourcing decisions and analyse the true costs of IT outsourcing (Karimi-Alaghehband et al., 2011). Based on transaction costs and incomplete contract theories, Aubert et al. (2004) test an explanatory model of IT outsourcing behaviour. The result shows that uncertainty and technical skills affect the outsourcing decision. Ngwenyama and Bryson (1999) indicate that firms suffer the risks of shirking and opportunistic bargaining, because the loss of control is associated with their outsourcing decisions. To combat the risks, Porter (1985) suggests that the vendors will bargain fairly with the buyers if they are suffering the threat of losing customers. Then Porter (1985) points out that outsourcing cost should include the costs of building relationships and coordinating with the vendors, in addition to the cost of information processing service. Ngwenyama and Bryson (1999) add the switching cost which is the cost to alter supplier in case of failure. Then they apply TCT to model single vendor and multi-vendor outsourcing strategies to examine which strategy maximise the buyer's objective function. Their model demonstrates the probability and the cost to the buyer of vendor shirking under the single vendor strategy.

Additionally, Karimi-Alaghehband et al. (2011) propose there are three key attributes (asset specificity, uncertainty and frequency) distinguishing transactions and find the empirical results of IT outsourcing research are mixed. For example, Poppo and Zenger (2002) demonstrate the effects of asset specificity on IT outsourcing is negative, which is opposite to Aubert et al.'s (2004) position. One explanation for this finding is that the contemporary models fail to comprise all the essential elements of TCT. Moreover, Lacity et al. (2011) complement Karimi-Alaghehband et al.'s (2011) contribution by arguing to build endogenous IT outsourcing theory. In summary, these researches are important to practitioners because they can evaluate the transaction elements and conduct cost analysis to make effective IT outsourcing decisions.

Conclusion

This review has discussed how IT investment contributes to economic performance growth at the firm-level. The positive relationship is explained by direct investments or complementary investments in organisational capital. IT is not a simple approach for automating current processes, but enables organisational changes to improve performance beyond productivity (Zuboff, 1988). Another perspective is to examine the impacts of IT on transaction cost and organisational performance

through TCT. IT capital could be effective to reduce transaction costs, but these costs emerge due to the interdependencies among various factors. In addition, practitioners can apply TCT to explore the true costs and make IT outsourcing decisions.

This paper only discusses the relationship between IT investment and organisational economic performance at firm-level, but in reality it is also meaningful to conduct studies at macro-level, because the research results might have considerable divergence in different industry sectors or countries. Dedrick et al. (2003) research the industry data and then prove IT capital contribute to labour productivity growth in both the manufacturing and services sectors. Moreover, due to innovation of technologies, MFP has increased in the service industries, but the measurement problem is difficult. Similarly, IT expenditure contributes to long-term productivity and economic growth at aggregated level, but Dedrick et al. (2003) argues that IT investment may not lead to productivity growth and states productivity paradox still exists in the developing countries. Authors traditionally use growth accounting to link the returns of IT capital to macroeconomic performance, but this approach neglect the intangible assets (Brynjolfsson and Hitt, 2000). Quah (1999) puts forward the weightless economy concept, which suggests the economic performance is measured in terms of information-based products. Quah (1999) also argues that economies will grow through trading intangible commodities such as design and software.

Firm-level studies fail, to some extent, to identify the relationship between IT investment and firm profitability, for example, Brynjolfsson and Hitt (1996) prove that IT investment does not improve profitability, so it should be considered to explore this relationship in future studies. Moreover, it is suggested to understand the timing of the returns from IT investments, because some systems will realise immediate payoffs, but others will realise the returns after a lag.

Furthermore, researchers should study whether intrinsic characteristics of various industries and countries can affect the returns of IT capital on economic performance at firm-level, and whether there is interaction across different levels.

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