

# Explaining the inconsistent results of the impact of information technology investments on firm performance

Information  
technology  
investments

359

## A longitudinal analysis

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### Abstract

**Purpose** – The purpose of this paper is to identify potential reasons for inconsistent results of the economic value of information technology (IT) investments. Furthermore, the study aims to develop framework and propositions to explore future opportunities and directions for research that examine the returns on IT investments.

**Design/methodology/approach** – This study conducted a longitudinal analysis of the literature review concerning the impact of IT investments on firm performance to identify the reasons to the so-called “IT productivity paradox” and to explore future opportunities and directions for future research.

**Findings** – The study provides and discusses the reasons for the inconsistent results in the prior research that examines IT investments payoff and suggested a framework and propositions for future research. Results of prior studies should be interpreted in the context of research questions raised, data used, level of analysis, IT investment measures, firm performance measures, time horizon and industry characteristics.

**Practical implications** – IT managers and researchers should align IT investments with the environment in which a firm operates and competes and with firm’s business strategies as important determinants of the return on IT investments.

**Originality/value** – Understanding the link between firm performance and IT investments assists researchers and practitioners to understand why firms continue to pour enormous resources into IT and, more importantly, specifies the conditions under which firms are likely to achieve competitive advantages from their IT investments.

**Keywords** Organizational change, IT investments, IT paradox, Return on IT investments

**Paper type** Literature review



### 1. Introduction

There is an extensive belief that investment in information technology (IT) improves firm performance; however, empirical evidence has not been conclusive (Tambe and Hitt, 2012; Stoel and Muhanna, 2009). An elusive relation between investment in IT and firm

performance has led to what researchers refer to as the “IT productivity paradox”. It is imperative for both management and researchers to understand the impact of investment in IT on firm performance owing to the following reasons:

- an association between IT investments and organizational improvements that cut across different functional and organizational boundaries; and
- a high failure rate may overshadow the implementation of firm’s IT strategy.

Business executives struggle to identify the payoffs from IT investments. For instance, School of Economics surveyed of 659 CEOs and revealed that only 25 per cent of the CEOs were satisfied with the benefits achieved by IT investments in their firms (Compass Group, 1999). Similarly, 20 per cent of CIOs believe that IT investments are likely not to generate the expected returns (McAfee, 2006). Thus, there are considerable differences in returns that firms achieved from their investments in technology. Therefore, the debate of whether IT investments pay off moves from the question of “What is the impact of IT investments on firm performance?” to the question of “Under what conditions, firms reap significant benefits from their investments IT?”. The last question raises concerns of the availability of certain organizational complementary that facilitate business organizations to reap some benefits from investments in information technology. The current study attempts to answer the following research questions:

- RQ1.* What cause the inconsistent results in the research examining the return on IT investments?
- RQ2.* Do IT investments improve directly or indirectly firm performance?
- RQ3.* Under which circumstances can IT investments affect firm performance?
- RQ4.* What are the mediating factors under which IT investments contribute to firm performance?
- RQ5.* Which performance measures that better capture benefits generated from a particular IT investment?

The puzzle regarding the economic benefits of IT investments can be attributed to different factors. Brynjolfsson (1996) suggests four different reasons for the controversy relating to IT payoff including measurement problems, time lags between IT investments and their impacts, redistribution of outputs within an industry and mismanagement of IT assets. The ambiguity of the definition of IT investment and the lack of consensus of the measures of IT effectiveness also contribute to the confound results.

This study contributes to several lines of research. The study contributes to the ongoing debate about the value of IT investments. The current study identifies the potential reasons or limitations that cause the inconsistent results when studying the economic value of IT investments (IT paradox). The study also adds to the literature on the accounting information systems that called for a refined framework to track the impact of IT investments on firm performance. We propose a contextual framework that builds on the premise that the return on IT investments is contingent on the alignment between IT investments, measures of IT benefits, IT strategy, business environment, non-IT organizational resources and IT management capabilities. The framework provides a basis for developing propositions to guide future research.

The remainder of this paper is organized as follows. Section 2 reviews the literature that examines the return on IT investments at the firm level. Section 3 identifies causes of

inconsistent results in prior research. Section 4 discusses the suggested framework and the study's propositions. Section 5 provides summary and conclusion.

## 2. Literature review

A number of studies have investigated IT investment and its effect on firm performance. Many studies have focused on the ability of IT to add economic value to a firm by following a strategy that either reduces its costs or differentiates its products or services from those of other firms that operate in the same industry (Bhattacharya *et al.*, 1997; Mahmood and Mann, 1993). While other studies question the likelihood that IT investments result in significant productivity gains for firms (Griffith and Northcraft, 1996). Furthermore, IT role in sustaining the firm's competitive advantage is also investigated (Porter and Millar, 1985; Mata *et al.*, 1995). Other studies examine the market reaction to IT-related announcements to investigate whether capital market rewards the announcements firms by increasing their stock prices (Dos Santos *et al.*, 1993; Khallaf and Skantz, 2007).

Table I summarizes the results of studies that investigate the impact of IT on firm performance from 1983 to 2014. The purpose of reviewing prior literature is to assemble meaningful information for the development of a framework for IT investment valuation that better links IT investments to their expected benefits. In this summary, we focused on the studies that empirically link IT investments to firm performance. We started in the early 1980, as this period represents major shifts in global competition and IT developments. Although we do not present a comprehensive list of research on the return of IT investments, we provide a reasonable coverage of research papers that highlight the nature of this research from different perspectives.

We classified the studies on the IT investments payoff into five categories:

- (1) studies that examine the impact of IT investments on firm's productivity;
- (2) studies that examine the impact of IT investments on firm's operating performance;
- (3) studies that examine the impact of IT investments on firm's financial performance;
- (4) studies that examine the impact of IT investments on firm's market value; and
- (5) studies that examine the impact of IT investments on the performance of IT capable firms.

Prior studies tend to measure the correlation between IT investments and different firms' performance measures. The correlation is measured by isolating the contribution of IT while controlling for other factors that may affect firm performance. Zero or very low correlation is found in many of these studies, which could lead to the perception that IT investment has been unproductive.

To overcome the problem of under-valuation or the uncertainty of IT benefits, Dos Santos *et al.* (1993) and Im *et al.* (2001) investigate the market perceptions of IT investments as a more contemporaneous measure of the impact of IT on firm value. The results of these studies are also mixed. While Dos Santos *et al.* (1993) find no significant change in stock price in its sample, Im *et al.* (2001) find positive abnormal return over time and for smaller firms. It is worth noting that managers might be reluctant to disclose particular investments in IT if it is characterized by proprietary information. Therefore, findings should interpret with caution.

Li and Ye (1999) examine the effects of IT investments in firms that experience environmental changes. The results indicate that IT investments have a positive effect on

**Table I.**  
An overview of IT  
impacts on firms'  
performance

Study and journal	Methodology	IT investment measures (independent variables)	Firms performance measures (dependent variables)	Conclusion
<i>Studies that examine the impact of IT investments on firm's productivity</i> Hitt and Brynjolfsson (1996) <i>MIS Quarterly</i>	Longitudinal analysis of 370 large firms over the period 1988-1992	Productivity, profitability, and consumer surplus of IT stock	Gross marginal product, ROA, return on equity (ROE), surplus	IT may increase productivity and consumer surplus, but not necessarily leading to supernormal profit IT investments enhance firm productivity over time
Kudyba and Diwan (2002) <i>Information Systems Research</i>	Firm-level analysis of IT investment through the use of a production function over the period of 1995 to 1997	IT labor and IT capital	Sales and value added	IT returns are substantially lower in midsize firms than in Fortune 500 firms, the measured marginal product of IT spending is higher from 2000 to 2006 than in any previous periods and the productivity of IT investments is higher in manufacturing sector
Tambe and Hitt (2012) <i>Information Systems Research</i>	Longitudinal analysis for 1,800 firms from 1987 to 2006	Non-IT capital expenditures, IT capital, non-Employees, IT employees	Value added per IT employee	
<i>Studies that examine the impact of IT investments on firm's operating performance</i> Bender (1986) <i>Management Information systems</i>	Survey of 132 life insurance companies for one single period analysis (1983)	The ratio of information processing expenses (IPE) to total operating expense (TOE), IPE/TOE	The ratio of TOE to premium income PREM	Higher IPE/TOE ratio is associated with better firm performance
Harries and Katz (1991) <i>Organization Science</i>	Time-series analysis of 40 insurance firms from 1983 to 1986	IT expenses ratio and IT costs efficiency ratio	The operating cost efficiency ratio to premium income	IT investment leads to re-education in operation cost
Barua, Kriebel, Mukhopadhyay (1995) <i>Information Systems Research</i>	A two-stage analysis of intermediate variables for industry and economy-wide exogenous variables for IT contributions	IT capital, IT services purchased for production or market activity, innovation (R&D)	Capacity utilization, inventory turnover, product quality, price reductions and new product	The most significant contributions of IT investments occur at low organizational levels where they are implemented

(continued)

Study and journal	Methodology	IT investment measures (independent variables)	Firms performance measures (dependent variables)	Conclusion
Shao and Lin (2002) <i>Information and Management</i>	Survey of 500 <i>Fortune</i> firms from 1988 to 1992 to investigate the impact of IT on technical efficiency in a production process	IT hardware value and IT staff expenses	Technical efficiency scores	IT investment associated with a positive impact on technical efficiency
<i>Studies that examine the impact of IT investments on firm's financial performance</i> Cron and Sobol (1983) <i>Information and Management</i>	Survey of 138 medical wholesalers' firms (small business) in one single period analysis (1979)	Computer utilization measured using four different levels of computer usage ranging from none to heavy computer usage	Pre-tax return on assets, return of net worth, pre-tax profit as a percentage of sales, average sales growth	Organizations characterized as heavy computer users performed either very strongly or very weakly. Limited computer usage is associated with poor performance
Mahmood and Mann (1993) <i>Journal of MIS</i>	Survey of 100 firms reported in the <i>Computerworld</i> list for 1989	IT budget as a % of revenue, value of an organization's IT as a % of revenue, % of IT budget spent on staff, % of IT spent on the training of IT staff, number of PCs as a % of total employees	Return on investment (ROI), return on sales (ROS), growth in revenue, sales by total investment, sales by employee, market to book value	A weak relationship exists between the individual IT investment measures and individual organization performance model measures
Lee and Mithas (2014) Working paper	Using a secondary data set comprising more than 200 Indian companies, the study examines whether the effect of IT investments on firm revenues is associated with the dimensions of IT-business alignment	IT investments, proxies for IT-business alignment	Firm revenue	Firms with IT change-business change alignment and IT delivery-business priority alignment experience higher revenue at higher levels of IT investments than firms with IT investment-business strategy alignment
Mithas, Tafti, Bardhan and Goh (2012) <i>MIS Quarterly</i>	An empirical investigation using archival IT data from 1998 to 2003	IT investments, R&D investments, advertising expenses, firm size dummy, industry Tobin's q, industry	Revenue per employee, operating expense per employee and net income per employee	The impact of IT investments on sales and profitability is higher than that of other

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Table I.

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Study and journal	Methodology	IT investment measures (independent variables)	Firms performance measures (dependent variables)	Conclusion
<p><i>Studies that examine the impact of IT investments on firm's market value</i></p> <p>Dos Santos, Peffers and Mauer (1993) <i>Information System Research</i></p>	<p>Event study to measure the market reaction to IT investment announcements over the period from 1981 to 1988</p> <p>Firm-level analysis based on IT budget data set reported by IW 500 from 1988-1993</p>	<p>capital intensity (physical capital/value added) Herfindahl (measure of industry concentration)</p> <p>Sample is break downs by the industry (manufacturing and finance) and by the type of the investment (innovative and non-innovative)</p> <p>Ratio of IT to sales</p>	<p>CARS over the event window (-1, 0)</p> <p>Tobin's q</p>	<p>discretionary investments, such as R&amp;D and advertising</p> <p>Overall, no significant CARS to the IT investment announcements. However, CARS is significant to innovative IT</p> <p>IT investments have a significantly positive association with Tobin's q value</p>
<p>Bharadwaj Bharadwaj and Konsynski (1999) <i>Management Science</i></p> <p>Im Dow and Grover (2001) <i>Information systems research</i></p>	<p>Event study</p>	<p>Size, industry and time effect</p>	<p>Abnormal price and trading volume</p>	<p>There is a positive market reaction to announcements made by small firms. Price and volume reacted positively to new announcements</p> <p>Results suggest that both firm and IT characteristics have main and interaction effects in explaining the market reaction to IT investment announcements</p>
<p>Oh Kim and Richardson (2006) <i>Journal of Information Systems</i></p>	<p>Event study to investigate the moderating effects of firm and IT characteristics on the market reaction to IT investments announcements</p>	<p>Growth opportunity and firm uncertainty measures, IT investments characteristics and the interaction between these variables</p>	<p>CARS over three different windows; pre-event period, event period and post-event period</p>	<p>IT leaders outperform their competitors in all of the profit ratios</p>
<p><i>Studies that examine the impact of IT investments on the performance of IT capable firms</i></p> <p>Bharadwaj (2000) <i>MIS quarterly</i></p>	<p>Matched pair design that compare IT enabled firms (IW 500) to their direct competitors using the resources-based theory</p>	<p>ROA, relative market to book value, and sales</p>	<p>An indicator value equal one for IT leader as (defined by IW 500) and zero otherwise</p>	<p>IT leaders outperform their competitors in all of the profit ratios</p>

(continued)

Study and journal	Methodology	IT investment measures (independent variables)	Firms performance measures (dependent variables)	Conclusion
Stratopoulos and Dehning (2000) <i>Information &amp; Management</i>	The CWP100 list is used to identify the successful users of IT. CWP firms are matched with a control group representing those firms that do not appear in the CWP100	Profitability measures (growth in net sales, gross profit margin, net profit margin, ROA, ROE, ROI) and efficiency measures (fixed assets turnover, total assets turnover, inventory turnover)	An indicator value equal one for IWP100 and zero otherwise	While the successful users of IT outperform the less successful users, the financial performance advantage is short-lived
Dehning and Stratopoulos (2002) <i>International Journal of Accounting of Information Systems</i>	Matched pair design that compare IT enabled firms (CW 100 premier) to their direct competitors using DuPont analysis (return on assets composition)	ROA, net profit margin and total assets turnover	An indicator value equal one for IT leader (defined by CW 100) and zero otherwise	IT leaders outperform their competitors in all profitability and efficiency ratios
Masli, Richardson, Sanchez and Smith (2011) <i>International Journal of Accounting of Information Systems</i>	Examine the link between IT superior capability and firm performance using sample of firms that won the CIO 100 awards relative to their industry's benchmark during 1988 and 2007	An indicator variable that equals for CIO 100 awarded firms and zero otherwise	ROA, ROS, Tobin's Q, sales growth, asset turnover	CIO 100 multiple awarded firms outperform their counterparts in the same industry

Table I.

the financial performance of firms that undertake greater organizational changes, particularly where there is strong ties between the chief executive officer (CEO) and the chief information officer (CIO). Lee and Mithas (2014) align the level IT investments with the changes in business strategies and examine whether the effect of IT investments on firm performance is associated with the dimensions of IT–business alignment. Findings show that IT delivery–business priority alignment and IT change–business alignment are more strongly moderate the relationship between IT investments and firm performance than other dimensions of IT–business alignment.

While prior research that examines the impact of IT investments on firm performance reports valuable insights, this stream of research undergoes some considerable limitations that lead to inconsistent results. In the following section, we provide potential explanations that researchers and managers should consider in their attempts to understand or interpret the inconsistent results associated with this line of research.

### 3. Reasons for the inconsistent results

The lack of consistent results in the prior research that examine the impact of IT investments on firm performance can be attributed to many potential explanations that can be identified as follows.

#### 3.1 Using different theories to explain the impact of IT investments on firm performance

A well-defined theory should suggest causal links between IT investments and performance measures at several levels inside organizations (Murthy, 1997). Prior research of IT value suggests three different economic approaches to estimate the impact of IT investment on firm value (Brynjolfsson and Hitt, 2000). Specifically, prior research applied the theories of production, competitive advantage and consumer surplus to estimate the value of IT investments. The economic theory of production posits that firm's output is related to its inputs through a production function in which each input contributes to the overall output. If investment in IT is productive, then one can expect that more output would be realized from a given investment in IT. Accordingly, firms will continue to invest in IT until such investment no longer contributes value to the total output.

Contrary to this approach is the theory of competitive advantage, which predicts no specific association between IT and firm performance metrics such as profitability, sales growth and market value. In view of this theory, there is no reason to expect, *a priori*, that companies that spend more on IT projects would, on average, have higher profitability or stock market returns (Brynjolfsson, 1996). This theory is based on the assumption that in a competitive market, where there are no barriers to entry, firms would not, in the long run, be able to achieve abnormal return. That is, the existence of such profit would encourage other firms to replicate the investment in IT. However, one possible way for a firm to have a sustained competitive advantage is through an innovative use of IT. According to resource-based theory, a firm is said to have a competitive advantage when it is implementing strategies or has resources that are unique, rare, valuable and difficult to imitate by competitors (Mata *et al.*, 1995).

The third economic approach links IT investments to consumer welfare (Brynjolfsson, 1996). Because intangible benefits of IT investment are overlooked in conventional financial performance measures and productivity statistics, this approach hypothesizes that benefits gained from IT investment are transferred to consumers. Thus, exclusive dependence on financial performance measures to evaluate the return on IT investments could be misleading.



Because the aforementioned theories that relate IT investments to firm performance are distinctive in terms of their economic justifications, the level of analysis and the utilized firm performance measures, one can expect inconsistent results when measuring the impact of IT investments on firm performance.

### *3.2 Using different proxies to identify IT investment components*

The prior research (Table I) reveals that firms use different proxies to measure IT investments. The most commonly used proxy among these measures of IT investment is the firm's MIS budget. According to Murthy (1997), the MIS budget reflects a comprehensive measure that likely includes different types of IT investments: IT capital such as hardware, software and application developments, as well as IT labor – including maintenance, personnel and training costs. Mata *et al.* (1995) discuss four attributes of IT that might play a different role in creating firms' sustained competitive advantage. These attributes include IT capital requirements, propriety technology and technical and managerial IT skills.

According to the resource-based theory, physical IT capital is unlikely to be considered a source of competitive advantage unless these assets are not currently possessed by competing firms (Barney, 1991). This can be due to the possibility of replicating physical IT capital by competitors in a short time period. On the other hand, Mata *et al.* (1995) conclude that of the four attributes of IT, management skills are “often heterogeneously distributed across firms” and may not be entirely mobile, and can thus be long-lasting. Therefore, the difference in the economic benefits that firms can gain from investing in IT can be credited to their managerial skills. As IT investments incorporate different types of investments, the inconsistent results found in measuring the return on these investments hang on the type of IT investments that is being measured or incorporated in the research model.

### *3.3 Utilizing different levels of analysis when measuring the impact of IT investment*

In an attempt to quantify the benefits realized from IT investment, prior research has used data collected at different levels of analysis such as economy, industry and firm levels. Barua *et al.* (1995) suggest that a key factor in identifying the impact of IT investments on firm performance is the selection of an appropriate unit of analysis (operation level, firm level and macro level). Prior studies use different levels of analysis when evaluating the impact on IT investment on firm performance. Comparing the findings of these studies without taking into account their level of analysis may contribute to the so-called “IT productivity paradox”.

### *3.4 The inter-firm heterogeneity of IT investments*

The type and the level of IT investments differ according to the characteristics of each industry, the degree of competition among firms and their business strategies. Therefore, a potential explanation of mixed findings in previous research can be partially ascribed to the fact that some studies overlooked the unique characteristics of a single industry and do not control for industry-specific value drivers. Production environment, including factors such as technology, is expected to be highly correlated with industry as defined by the Standard Industrial Classification (SIC) codes (Ely, 1991). Therefore, inter-firm heterogeneity in IT investments and firm performance relationship could cause a mixture of results.

Although IT investment is important for every industry, measuring the impact of this investment should control for the variations among industries. Firms invest in IT to obtain competitive advantage within an industry (Mata *et al.*, 1995). This competitive advantage can be achieved if firms outperform their industry counterparts. Studies in this line of

research should avoid adopting a direct valuation approach in which firms' value and performance are not estimated relative to their direct competitors or their industry average performance measures.

### *3.5 Determination of firm performance measures*

One of the most difficult tasks involved in measuring the economic impact of IT investment is to relate IT investments to specific organization performances (Mahmood and Mann, 1993). Independent variables in research studies that attempt to quantify the benefits realized from IT investment "are often what could be easily or empirically measured rather than what ought to have been measured" (Murthy, 1997, p. 71). Accordingly, the mixed findings from prior studies that measure whether IT investment has paid off are not unexpected (Murthy, 1997).

### *3.6 Data used in evaluating the impact of IT investment on firm performance*

Studies that have attempted to measure whether IT investment pays off have used different data sets in their analysis. For example, Bhattacharya *et al.* (1997) and Mahmood and Mann (1993) used data reported in *Computerworld*, owing to the unavailability of publicly existing data of IT investment. Others use the *Information Week* 500 survey that identifies firms with superior IT capability within an industry (Bharadwaj *et al.*, 1999). The majority of studies that investigate the impact of IT investments on firm performance used data collected from structured surveys on IT spending (Brynjolfsson and Hitt, 2000; Barua *et al.*, 1995).

The existence of different data sets was further confounded by using different methodologies in addressing the impact of IT investment on firm performance has made it difficult to compare the merits of IT literature findings. Therefore, comparing prior research findings should be limited to those studies that use the same data set.

### *3.7 The time horizon utilized in IT investments payoff*

Prior research reveals that studies interested in measuring IT value differ with respect to time horizon. Some studies used a single cross-sectional analysis (Cron and Sobol, 1983); others applied a panel of cross-sectional analyses (Harries and Katz, 1991; Mahmood and Mann, 1993) and yet others have investigated this issue using time-series and cross-sectional analysis (Barua *et al.*, 1995; Bhattacharya *et al.*, 1997).

Studies that use a single year to evaluate the impact of IT investment in firm performance are the most problematic because of the time lag between IT investment and its realized economic benefits. Owing to the significant learning curve associated with IT investments, the true contribution of IT investments is more likely to be reflected in firms' future profit streams (Bharadwaj, 2000).

### *3.8 The conservatism nature of generally accepted accounting principles*

According to generally accepted accounting principles (GAAP), investments in intangible assets such as R&D and IT are immediately expensed owing to the uncertainty associated with their benefits. However, the benefits derived from these investments are recognized over a longer period. For example, Lev and Sougiannis (1996) find that R&D is value-relevant to investors and should not be expensed, as the benefits of current R&D expenditures carry over to subsequent periods. Therefore, the current accounting treatment of intangible assets violates the matching concept and adversely affects financial performance measures. Lev and Zarowin (1999) validate this conjecture by indicating that

the usefulness of financial information has been declining over the past 20 years and associate this decline with the increasing rate of change in business enterprises particularly in firms characterized as having a high composition of intangible assets.

Barron *et al.* (2001) argue that analysts attempt to mitigate the mismatching problem associated with the current GAAP treatment of intangible assets by adjusting accounting earnings to account for non-recurring revenue and expenses. They find that in high-intangible firms, analysts give more weight to their private information. Therefore, researchers should consider the implications of GAAP treatment to the investment in IT when they either measure the return of IT investments or justify the economic value of these investments.

### 3.9 Firms' capital structure

It is logical to expect that the impact of IT investment is likely to vary across firms, depending on their access to capital. Mata *et al.* (1995) discuss access to capital, proprietary technology and technical IT skill as variables that may impact a firm's ability to use IT to sustain a competitive advantage. IT investment payoff is uncertain and, hence, capital needed to invest in IT can be costly. When the amount of capital invested in IT is large, only a few firms will be able to acquire the capital with access to a lower cost and, therefore, gain a competitive advantage (Mata *et al.*, 1995). Consequently, the impact of investment in IT on firm's financial performance may vary among firms with respect to their capital structure.

### 3.10 Over-investing in IT projects

According to the agency theory, one explanation of the lack of the economic justification of IT investment is that management may over-invest in IT expenditures, which would negatively affect firm performance (Khallaf, 2012). In general, managers over-invest when they gain private benefits from channeling firm resources in a direction that furnish them with some value. Jensen (1993) argues that managers, in their attempt to derive some benefits from controlling more assets, make inefficient and negative net present value (NPV) investment decisions that cause firm performance to decline. Therefore, a manager with small ownership stake would have incentives to build a comfortable but unprofitable empire of IT (e.g. perquisite, increasing the number of MIS personnel).

### 3.11 The existence of confounding events or the absence to control for relative factors

To evaluate the impact of IT investments on the market value of the firm, one should consider the probability that a firm may publicize other announcements such as earnings or dividends in the same time frame of IT announcements which makes it difficult to determine whether the market is reacting to IT announcements or to the other confounding announcements. Therefore, it is essential to search for announcements that might contaminate the market reaction to IT announcements and exclude them from the sample. In addition, market reaction to IT investment announcements might be contaminated as a result of not controlling for factors such as firm size, industry diversification, high-tech firms, growth and firm's past performance.

### 3.12 Reliance on financial indicators

As indicated above, IT investments are not generally correlated with financial performance measures and, thus, exclusive reliance on financial measures to evaluate IT value is insufficient and misleading. Accounting measures are lag indicators that report the outcome of past actions and are not forward-looking. Using accounting measures can be problematic

in evaluating the potential of capital investment such as IT that may take several years to affect the firm's bottom line due to the substantial learning curve associated with the use of IT (Bharadwaj *et al.*, 1999).

According to Brynjolfsson (1996), Shao and Lin (2002) and Khallaf (2012), IT investment has led to improvements in areas such as product quality, innovation and customer service. Such improvements are usually overlooked in aggregated statistics, leading to an underestimation of IT benefits. Amir and Lev (1996) find that accounting measures of earnings and various growth measures reveal limited explanatory power for market values for firms in high-technology industries. The decline of the value relevance of financial measures has raised a number of questions regarding the value relevance of non-financial information.

The anticipated benefits from IT investments can be traced through chains of intermediate levels. In general, organizations invest in IT to support certain activities and process. The return on these investments should be assessed at the operation level where the first-order effect may be realized (Khallaf, 2012). As many benefits arising from IT investments are intangible in nature, tracing these benefits and link it to IT investments remains an important issue of concern.

#### 4. Suggested framework and propositions

IT investments are necessary in sustaining the vitality and competitiveness of firms and are critical for their survival and progress particularly in the new business environment that faces various organizational changes. Accordingly, understanding the impact of IT investments on firm performance is important for both researchers and managers. The uncertainty associated with measuring the return on IT investments and the challenge to link these investments to firm performance measures call for a new scheme of research. In the following, we address a number of key issues that should be taking in consideration as pathways that link IT investments with their economic return.

##### *4.1 The need for integration well-grounded theories that illustrate the potential impact of IT investments on firm performance*

As discussed earlier, researchers applied three different theories to illustrate the link between IT investments and firm performance, namely, the theories of production, resource-based and consumer surplus. According to the production theory, a firm will cease its investment in IT when such investment will no longer contribute to the total output. However, this assumption contradicts the fact that many firms keep their investments in IT to stay competitive in the market, and perceive IT investments as a strategic necessity (Brynjolfsson, 1996).

On the other hand, the resource-based theory posits that firms will have a competitive advantage if the acquired resources are unique, rare and difficult to imitate. Because IT investment is easily duplicated, this investment by itself does not create a competitive advantage for a firm. Rather, it is how a firm heterogeneously leverages its IT investment to build unique resources and managerial skills that determine its ability to achieve a competitive advantage (Bharadwaj, 2000).

Finally, the consumer surplus theory hypothesizes that transferred to consumers and are overlooked by traditional financial measures. Because most of the previous studies do not integrate IT intangible benefits in their estimated production function, the value created by these intangibles tends to be overlooked or incorporated in the coefficient of other variables. Therefore, a suitable metrics of nonfinancial and financial measures that fits industry's specific characteristics and captures the tangible and intangible benefits of IT investments should be considered.

Furthermore, based on the upper echelon theory, the capabilities of top executives are important drivers in determination of firm success (Hambrick and Mason, 1984). Smaltz *et al.* (2006) reveal that CIO's capabilities captured through their IT knowledge, interpersonal skills and political savviness are positively associated with their role effectiveness. Accordingly, the impact of IT investments on firm performance could be contingent on the capabilities of the appointed CIO.

Although the premises on which the above theories are based differ, IT investments research should not look at these theories as competing views. Instead, studying the impact of IT investments on firm performance should build on the complementarity among these theories. For example, a number of researchers have adopted a market-driven perspective to investigate the impact of IT investments on firm market value based on the premise that firms utilize IT to differentiate themselves from their competitors (Im *et al.*, 2001; Oh *et al.*, 2006). On the other hand, several researchers have utilized a resource-based theory to examine the contribution of IT investments on firm performance based on the perspective that considers the firm as a bundle of unique resources that are both heterogeneous and immobile (Melville *et al.*, 2004). In addition, IT support for firm's assets is likely to influence IT support for firm's strategy, suggesting that IT researchers should consider integrating both resource-based and competitive advantage perspectives rather than conceptualize the two perspectives as competing views (Rivard *et al.*, 2006). For example, a consistent support for IT-based infrastructure can play, over the long term, a crucial strategic role in shaping organizational responses to the environmental changes and improves its competitive advantage.

#### *4.2 The need to identify the appropriate level of analysis when measuring the impact of IT investment*

Most of the prior research that examines the return of IT investments bypasses the impact of IT at the lower level in the firm. Exceptions to these studies are Barua *et al.* (1995) and Bhattacharya *et al.* (1997). Barua *et al.* (1995) who argue that the effect of IT would be more pronounced at lower levels within a firm where the "first-order effect" of IT investment occurred. Using a two-stage model to understand how IT investment affects firm's business process and how that process, in turn, influences firm performance provides insight into the contribution of IT on firm performance. Barua *et al.* (1995) argue that impact of IT investments on firm performance lessens as much as the distance between the cause and effect broadens. That is, the association between IT investments and a particular firm performance is mediated by intermediate process. To examine whether IT investments associate with improvement at business operational level, the following proposition is proposed:

- P1.* IT investments leads to improvement on measures of firm efficiency at the business operational level.

#### *4.3 Alignment of IT investments with business strategies*

Firms invest in IT to keep abreast with the changes in business strategies and with the changes in the surrounding environment. Measuring the expected benefits associated with firms' investment in IT requires a clear definition or a description of what constitutes IT investments. While many IT investments are in the form of capital investments (e.g. computers, software and networks), others can be associated with the personnel appointed to manage and operate IT resources (e.g. costs associated with obtaining and training IT human resources). Examining the impact of different types of IT investment on firm

performance can help managers justify a specific type of IT investment that might otherwise be overlooked based on aggregate IT investments.

Aral and Weill (2007) classify IT investments according to their strategic purposes into the following types:

- *IT infrastructure* (e.g. computers, networks, shared customer databases and help desk);
- *transactional investments* (e.g. automate the billing system, order processing and insurance renewal);
- *informational investments* (e.g. sales analysis, data mining); and
- *strategic investments* (e.g. introduction of the ATM in the banking industry or new iPhone applications).

In general, a firm can achieve an abnormal return when it implements a strategy that is not simultaneously adopted by its competitors (Mata *et al.*, 1995). Out of the four types of IT investments, strategic innovative IT investments can lend a firm a competitive advantage by locking it in a position with uniqueness and value creation. For example, Dos Santos *et al.* (1993) find positive abnormal returns for firms that invest in innovative IT activities, suggesting that first movers reap the most benefits of these investments.

According to their strategic goals, IT investment is also classified into two groups: *externally focused IT investments* and *internally focused IT investments* (Stoel and Muhanna, 2009). Because firms follow distinctive IT business strategies that are internally or externally focused and because the objectives of each IT strategy are different (i.e. lower cost vs improve market value), segregating IT investments into their subcomponents assists the process of mapping IT investment type to a particular and suitable performance measure. Investments in IT intend to generate value in various ways including productivity enhancements, flexibility and responsiveness increments, cost reduction and competitive advantage improvements. The preceding discussion leads to the following proposition:

- P2. The segregation of IT investments according to its business strategy (i.e. IT investment type) better associates a particular type of IT investment with the related performance measures.

#### 4.4 Complement IT with organizational resources

Improvements in firm performance will not be achieved by merely investing in IT. To increase the likelihood of successful returns on IT investments, IT applications should be accompanied with significant organizational changes in aspects including rules, policies, work practices, employee skills, level of training programs and organization structure (Brynjolfsson and Hitt, 2000; Melville *et al.*, 2004). It is necessary for firms to modify their processes, structures and boundaries in line with their IT investments to gain significant benefits.

Complementary organizational resources will take place when synergy between a specific IT application and organization resources exists. Business value derived from IT investments and its impact in firm performance is contingent on non-IT physical capital and non-IT human capital complementary organizational resources. The preceding discussion synthesizes the following proposition:

- P3. The impact of IT investments on firm performance is contingent on certain non-IT organizational resources.

#### 4.5 Alignment of IT investments with contextual business environment

According to the contingency theory, the impact of IT investments on firm performance is contingent on the alignment between IT investments and the contextual environment in which a firm competes (Stoel and Muhanna, 2009). The environment describes the uncertainty surrounding a firm. There are three different dimensions of the environment that are expected to have an impact on firm performance over time which include environmental dynamism, munificence and complexity. While environmental dynamism (turbulence) depicts the rate of market instability, environmental munificence describes the degree to which environmental resources back up sustained growth (McArthur and Nystrom, 1991). The likelihood that a firm acquires those resources increases when it operates in high munificent environment. Rivard *et al.* (2006) find that increased IT support for a firm's strategy is positively correlated with the threatening environment in terms of competitive rivalry, substitution and buyers' powers.

On the other hand, environmental complexity points to the level of inequalities among competitors. Firms that operate in a high complexity environment have more information process requirements relative to those that compete in a simpler environment. Examining financial performance measures in different environmental conditions will shed light on whether the IT investments payoffs vary according to the environmental characteristics in which a firm operates and competes. Further, linking each type of IT investments with specific environmental characteristics will define which type of these investments closely fits the environment where a firm operates and competes. The prior research findings and discussion lead to the following proposition:

- P4. The impact of specific IT investments on firm performance is contingent on the environment in which a firm operates.

#### 4.6 The role of IT expertise

Firms invest heavily in IT to differentiate its products, reduce the cost and compete in the marketplace. Therefore, managing IT investments is essential to the firm success. The extent to which a firm can maintain the competitive advantage from their investments on IT depends heavily on their managerial IT skills, as these skills are rare and unique to specific firms (Mata *et al.*, 1995). Based on the upper echelon theory, the capabilities of top executives influence their firms' performance (Hambrick and Mason, 1984).

Prior studies investigate the role of IT leadership in business organizations. Chatterjee *et al.* (2001) find that the market reacts positively and significantly to the creation of a new CIO position. In the same vein of research, Khallaf and Skantz (2007) investigate whether the market reacts to the CIO position or to the characteristics of the CIO. Interestingly, results show that the market reaction is more pronounced for firms that hire CIOs from an IT leader firm. These studies show that market participants find that the CIO hiring announcement is informative about the positive role of IT leadership in implementing a firm's IT strategy. The previous findings lead to the following proposition that is proposed:

- P5. The impact of IT investments on firm performance is contingent on IT management capabilities.

#### *4.7 The need to use peer design technique when measuring the impact of IT investment on firm performance*

Measuring firm's IT value relative to its peers can first identify whether a firm has achieved a competitive advantage and, second, isolate the potential effect of exogenous variables, if any. In addition, selecting comparable firms is useful for evaluating the value of IT in cross-sectional analysis because performance measures in this case impound the effect of "variations in firms' growth, profitability, and cost of capital" (Bhojraj and Lee, 2002, p. 409). The economic performance of the peer-matched group serves as a benchmark and provides a vital tool for removing the confounding effects that could affect firm performance. Brynjolfsson and Hitt (2000) report that the value of IT is more pronounced when firms' performance and their investments on IT are benchmarked within their peers in an industry sector.

#### *4.8 Choose the appropriate time horizon that captures the IT payoffs*

Recognizing the shortfalls of the traditional emphasis on accounting measures resulted from the GAAP treatment to IT investments explains the recent trend of IT investment research that investigates the market reaction to salient IT events (Oh *et al.*, 2006; Im *et al.*, 2001). While IT investments' impact on some performance measures spread over many years, the capital market provides an immediate evaluation of the impact of these investments on the market value of the firm. In fact, the impact of change in business enterprises on firm value occurs before accounting events have taken place. For example, when the telecommunications industry was deregulated, stock price declined immediately, reflecting the increased competition, and long before accounting transactions require an accounting record (Lev and Zarowin, 1999).

However, the market reaction to IT investment announcements reflects the economic expectations concerning a firm's future cash flows but provides no evidence as to whether IT investment do, in fact, add long-run value to the firm. Measuring the impact of IT investments on firm performance should consider that benefits expected from these investments are likely to take more than a year to be realized. Determining the appropriate time lag requires a better understanding of the type of IT investment and the benefits expected to be captured from this investment.

#### *4.9 Follow a holistic view in measuring IT investments payoff*

Evaluating the impact of IT investments on firm performance should not bypass the role of IT in service quality and process improvements including its capability to provide reliable and timely information for better decision-making. Accordingly, evaluation of IT investments should consider organization-wide intangible benefits realized from IT investments that are not generally correlated with financial performance measures.

Therefore, it is important to assess the value generated by IT investments through perceptual measures such as the perceptions and expectations of end users about the quality of the IT function within an organization, their satisfactions with IT in terms of its reliability and accuracy and their views about IT support service. The advantage of using perceptual measures is that they can be designed to capture IT value at the point at which value is created (Davern and Wilkin, 2010).

Several studies examine the business value generated through IT investments through improved decision-making (Arnold *et al.*, 2006; Mukhopadhyay *et al.*, 1995). The decision-making process has become more important in recent years with the growth of technology and the increased complexity of business. Prior studies on IT investments suggest that strategic IT investment such as ERP helps firms to gain intangible benefits that improve



operational efficiencies and decision-making process (Mata *et al.*, 1995). It is difficult to connect the intangible benefits realized from using ERP in improving the decision-making (e.g. improved the timeliness and reliability of information) to certain financial indicators.

Measuring the return on IT investment is complex and it requires first adopting a holistic view that recognizes tangible and intangible benefits associated with a particular IT investment, and second selecting a portfolio of measures (financial vs non-financial or independent vs perceptual) that captures the value generated by IT investments. When evaluating the return on IT investments, it is very crucial to consider the causal chain from purpose-built perceptual measures, through to the ultimate independent observable measures such as the market reaction to a specific IT announcement (Davern and Wilkin, 2010). Table II highlights the pros and cons of using financial and non-financial measures to capture the return on IT investments.

The integrated framework described herein links IT investments to firm performance and integrates different economic theories to encapsulate the effects of IT support for business strategy on firm performance, considering the surrounded environment, non-IT organizational resources and role of IT expertise, and to propose different measures (financial and non-financial) to capture the effects of IT investments on firm performance at different levels of analysis. The proposed framework is depicted in Figure 1.

### 5. Summary and conclusion

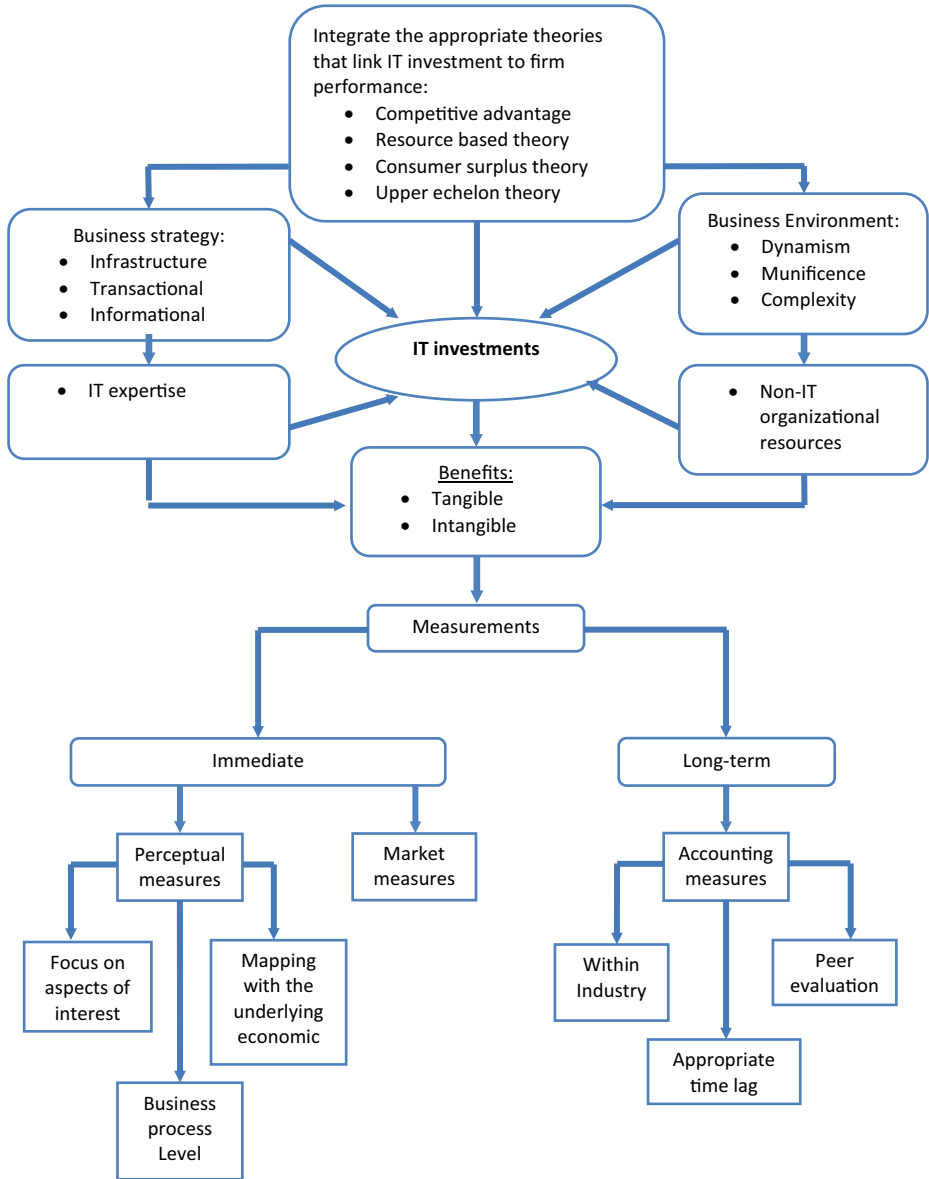
Although IT investments continue to increase, researchers and executives still question their value and return. The dilemma that previous studies attempt to explore is identifying the circumstances or conditions under which investment in IT pays off. Using a longitudinal study, we review prior research that examines the economic value of IT investments from 1983 to 2014.

We identify and discuss 12 reasons that could explain the IT paradox and provide an integrated framework and propositions to guide future research. Inter-firm heterogeneity of IT investments, GAAP conservative treatments of investments on IT, imprecise data set, time horizon, alignment of IT with business strategy and firm environment and relatively limited theoretical underpinnings of the impact of IT investments are examples of factors that contributed to the equivocal or contradictory results noted in the literature.

Barua *et al.* (1995) and Bhattacharya *et al.* (1997) argue that the impact of IT investments on firm performance lessens as much as the distance between the cause and effect broadens. Accordingly, we propose that the effect of IT investments would

Measure	Examples	Pros	Cons
Financial	ROA, ROE, ROI, market share, abnormal return	Objective Quantified Comparable Contractable	Lagging Noisy Broad Aggregate
Non-financial	User satisfaction Perception of quality Capacity utilization Perceived net value	Leading Diagnostic Specific Close to the locus of value creation	Subjective Bias Inconsistent Not comparable Non-contractable

**Table II.**  
Comparison between  
financial and non-  
financial measures



**Figure 1.**  
An integrated  
framework to  
measure the return on  
IT investments

be more pronounced at lower levels of operations where the first-order effect of IT investments occurred.

Investigating the effect of different types of IT investments on firm performance can help managers justify a specific type of IT investment that might otherwise be overlooked based on aggregate IT investments (Aral and Weill, 2007). Similarly, the

impact of IT investments on firm performance is contingent on the alignment between these investments and firm's contextual environment (Stoel and Muhanna, 2009). Because IT investments respond to endogenous (i.e. business strategy) and exogenous (i.e., environment) structures, we propose that the return of IT investment on firm performance is contingent on the alignment between specific IT investment and firm's business strategy and the environment where a firm operates and competes. While IT strategy is likely to affect firm performance via its inimitable activities, the characteristics of the external environment determine the level and type of IT investment that aligns or fits the needs of this environment. These contingencies determine whether IT investments can be transferred into better performance measures or enable creation of a dynamic capability that has a unique value. Consistent with this argument, Dos Santos *et al.* (1993) find positive abnormal returns for firms that invest in innovative IT activities.

Synergy between a specific IT application and organization resources is an important determinant of IT investment payoffs (Brynjolfsson and Hitt, 2000; Melville *et al.*, 2004). Business value derived from IT investments is contingent on non-IT physical capital and non-IT human capital complementary organizational resources. Accordingly, we argue that the impact of IT investments on firm performance is contingent on certain non-IT organizational resources.

Examining the economic value of IT in the post-implementation period as operational options can modify and improve firm's operational performance vs strategic/growth option. This option examines whether the initial adoption of IT investments that created value to a firm is crucial. As a result of the organizational learning curve, IT investment is likely to take time to leverage organizational capabilities to meet business objectives before financial benefits are realized. While mapping IT investments with most appropriate performance measure is crucial in examining the economic value of IT investments (ex post analysis), it would be interesting to explore the factors that contribute to IT investments (ex ante analysis). Studying the driving forces of firm's choice of the level of IT investments is an important future research question.

In conclusion, this study provides a useful insight for researchers and practitioners, as it identifies potential pathways through which IT investments affect firm performance and also help practitioners make appropriate IT-related decisions by providing an integrated framework and propositions that links IT investments to firm performance.

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