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## The Impact of Information Technology Investment on Firms Performance

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### ABSTRACT

**Purpose:** The aim of this study is to examine the relationship between information technology investment and firm's performance among Malaysian PLCs.

**Design/methodology/approach:** The analysis employed panel data approach in which it relied on annual report of companies listed in Bursa Malaysia. This study covered a period between 2009 and 2012, therefore only companies listed within this stipulated period were included in the analysis.

**Findings:** Results of the regression estimation of the dependent variables, based on random effect model shows a high significant on return of investment score. The control variables of firm size and industry did not have a statistically significant influence on the test results. However, IT investment is statistically not significant with return on asset, as there is no relationship between IT investment and ROA.

**Research limitations/implications:** First, this study is using a limited sample data as an established large sample data set in relation to IT investment information in PLC's is still unavailable. Secondly, this study is unable to investigate a time lag effect due to the limited information available in the annual reports. State your limitation here. Thirdly, the IT investments are divided into two asset classes, but there is several ways to characterize the firm's investment allocations.

**Practical implications:** This study substantiates the need for PLCs to increase their IT investment as the company grows. Information technology strategies need to be developed at par with company's future direction.

**Originality/value:** This study is one of the first empirically studies done in investigating the relationship between IT investment and firm financial performance in Malaysian PLC's which is using the public listed companies' secondary data.

**Paper type:** Research paper

**Keyword:** IT investment, Return of Investment, public-listed companies, secondary data

### I. INTRODUCTION

The growth and productivity of an organization is reflected by the investment of information technology [1] [2]. The importance of information technology (IT)

investment is viewed as an evidence whilst the use of latest technological equipment or innovative processes resulted the improvement of productivity, gain higher profit, produce better activity outcomes, reduce the costs, attain competitive benefit, market share and increase the performance of the organization [1] [2].

It has been continuously debated whether IT investment promotes higher organization performance. Many studies prove positive relationship between IT investment and firm performance. Nonetheless, there are also conflicting findings that raise uncertainties relating the above matter. The positive relationship is generally findings from studies done in developed countries, mainly the United States [3]. However, Idris et al. [4] and Kim et al. [5] had investigated the relationship between IT investment and firm performance in developing countries, and they found no positive correlation between IT investment and firm performance. Due to this conflicting evidence, therefore, this study investigates the relationship between IT investment and firm performance among PLCs in Malaysia.

This paper is structured into several sections: Section 2 deals with a review of previous studies and hypotheses. The data sources, variables as well as research model are explained in Section 3. Section 4 deals with the results and analysis. Finally, the results, limitations of the research, concluding remarks and future studies are provided in the conclusions and limitations section.

## **II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT**

Mixed results of the previous studies raise a question whether IT investment really provides intended return to the firm. Studies on the relationship between IT investment and firm performance can be categorized into three groups. Firstly, quite a number of researchers found no relationship between IT investments and firm performance [6]. Instead, it asserts that IT investment negatively impacted the efficiency of a firm due to insufficient distribution of resources, elasticity associated with additional administrative activities (like advertising, research and development) as well as other capital on firm performance will be higher than the elasticity of IT investment capital.

Secondly, Ken & Magdi, [7] and Campbell, [8] have affirmed that is a remarkable positive impact of IT investment on firm performance. As firms concern more in IT investment, their performance will improve accordingly. These studies implemented different methods and sample data in describing the positive relationship between IT investment and firm performance. Ken and Magdi [7] studied the effects of investment in information technology (IT) systems, measured the profit gained by banks in the UK for 20 years (1976 to 1996), and the results denoted that the quantity of automated teller machines set up by the banks have a positive effect on bank's profitability. In another relevant study, Campbell [8] considered time lag throughout a period of six years when evaluating firm's IT investment, and found that substantial amount of time is required for a firm to develop its capability to absorb, integrate and install IT resources and then to capitalize on its investment.

Thirdly, partial or combined results were obtained, revealed with probable explanations for the results [9], [10]. It was acknowledged that there are positive and negative impacts of IT investment on a variety of firm performance variables. Therefore,

to clear out these complicated situations, several related studies have employed more extensive and rigorous research framework, large sample datasets, such as additional factors, inclusion of time lag, new empirical approach, the information intensity of the industry as well as new theories (for instance resources based view). Kim et al. [5] investigated the effects of IT investment on five firm performance indicators in China. He then compared the impact of IT investment has in China with the one in the United States. This is mainly due to dissimilarities on the characteristics of the countries themselves, thus may affect the value creation of IT investment. Findings showed a positive relationship between IT investments with profit margin. In addition, no confirmation denotes that IT investment has a positive relationship on ROA, ROE, sales growth, and EPS growth and the effect in China is not different from that obtained in the United States. These studies proved the positive impact, or at least a combination impact of IT investment on the firm's performance.

Several studies [7], [11], [4] were conducted in developed and developing countries in order to investigate IT investment return on assets (ROA), nevertheless the results were inconsistent and the conclusion whether IT investment really have significant impact on firm performance cannot be formed.

Additionally, return on investment (ROI) is one of the components which contribute to the performance of a firm. Karl [12] developed a framework for evaluating the return on information technology investment (ROITI) by utilizing return on investment. His motive was to capture and measure the intangible benefits deriving from an IT investment. Hence, this study attempts to support the evidence by Idris et al. [4] who discovered strong positive correlations between investments in advanced technology and return on investment (ROI). In addition, Ariss et al. [13] tested the effect of many competitive factors and results revealed a positive relationship with firm performance where, it is significant on the factors of net profit margin, return on investment and being more profitable.

### **III. METHODOLOGY**

The research methodology should be clearly described under a separate heading. The significant contribution to the body of knowledge should be clearly stated.

#### *A. Data Source*

Due to the nature of data used in this research, the analysis employed panel data approach in which it relied on annual report of companies listed in Bursa Malaysia. This study covered a period between 2009 and 2012, therefore only companies listed within this stipulated period were included in the analysis. Distressed companies that were listed within the time period, were also omitted to avoid the effect of their financial status on the results of this study. Similarly, companies that had undergone significant mergers or restructuring were also being excluded from the study, as well as those which did not generating online annual reports. However, 120 companies from the main market were selected for the research purpose. After data cleaning exercise such as removing of outliers, the initial sample of 120 firms for 3 years was 360 firm-year observations for IT

investment and performance measure. The reason of choosing the main market was that the main market listed more established companies while the second market were for relatively smaller companies or new companies.

The data were collected and examined on an annual basis for three (3) consecutive years starting from year 2009 to 2011 for IT and 2010 to year 2012 for performance measure. This was to allow for analysis of lagging effect of IT investment in the preceding year on the current financial year. Considering the fact that the IT investment made today, its performance can on be realized in the following year. The panel datasets covered 2009-2012 and this panel data analysis were used in controlling those factors and moderate the effect of omitted data on the final result. The data set obtained from six sectors listed in Bursa Malaysia which include industrial product, construction, plantation, properties, finance and IPC [14]. The data collected were based on the requirements in calculating the IT investment, return on investment and return on assets, all these variables were calculated according to the formula used in previous studies.

### *B. Independent and Dependent Variable*

Information technology investment can be explained by various measurements, for instance, the ratio of IT budget to sales ([15][5], IT capital [16] and IT stock. Generally, IT funds is well-defined as overall investment of software, communications devices and systems, computer hardware, as well as the IT personnel and additional resources that support these capabilities. The capital and stock of IT are associated with software, communications devices and systems, computer hardware, but not the IT labor. Sarosa and Zowghi [16] define the components of information technology into hardware (scanner, printer, computer, etc), and software (operating systems, application development language, office application, etc.).

This study decided that the ratio of IT capital on computer hardware and software is the operational definition of IT investment in line with previous researches [16]. Therefore, this particular research focused on measuring the investment in IT capital on computer hardware and computer software. Information technology investment is considered as the main independent variable in the model. This variable was measured by total information technology expenditure divided by net sales revenue. This measure provided information about each company's IT investment intensity and denoted by IT in the model and was log-transformed.

For performance measure, this study considered ROA and ROI as a financial performance measures. In order to have a better picture on how efficiently a firm is in generating earnings from its assets, return on assets is a better performance indicator [11]. Return on asset is calculated by separating a company's net income (usually annual income) to its total assets, and is presented as a percentage [5]. Therefore this study calculates return on assets as:

$$ROA = \frac{Net\ Income}{Total\ Assets} \times 100\%$$

Return on investment measurement (when applied correctly) is an influential tool in evaluating the existing information technology (IT) investment. It is also used to make an

informed decisions on software acquisitions and other projects. This study considers Ariss et al. [13] definition of return on investment as the new revenue that results from a project less the total project costs, divided by the project’s total inputs (total costs), and expressed as a percentage. The total project cost is the cost of IT investment. The formula to calculate return on investment in this research is as follows:

$$ROI = \frac{Revenue - IT\ investment}{IT\ investment} \times 100\%$$

C. Control Variable

Potential confounding factors were controlled to account for variations in firm performance due to inter-industry differences or inter-firm differences. First, it was necessary in controlling the size of the firm because large firms often use IT differently, can more easily achieve economies of scale and scope [8], and may encounter greater organizational inflexibility and administrative costs [8] than small firms. A firm’s choice of IT investment and its financial performance are influenced much by the size. Large firms benefit a lot from the economies of scale in the form of lower costs. In addition, the internal coordination costs effect the size of the firm in a multiunit firm, as coordination costs rise exponentially with firm size. Most researchers used number of employees [8], [17], market capitalization, total assets and sales [5] as the proxy to firm size. This variable was log-transformed. In this study, natural logarithm of total assets (LNTA) was used as a proxy for firm size.

Secondly, it was necessary to control for industry to remove effects that may be present in particular industries. Industry effect has been shown to account for a majority of the variance in firm performance [8]. Industry effect has influent the organizational structures as well as business strategies of a firm. Therefore, it is necessary for the researchers to control the heterogeneity in the industry environment as this is not being observed. Each dummy will equal to 1 if a company belongs to that particular categories and 0 otherwise.

In order to test the hypotheses the following model has been developed:

$$\text{Model 1 } ROA_{it} = \alpha + \beta_1 Ln(IT_{it}) + Control_{it} + \varepsilon_{it}$$

$$\text{Model 2: } ROI_{it} = \alpha + \beta_1 Ln(IT_{it}) + Control_{it} + \varepsilon_{it}$$

where:

$i = 1, 2, 3, \dots, N$  ( $N = 120$  companies) and  $t = 1, 2, \dots, T$ ,  $Ln(IT_{it})$  refers to the log of information technology investment for company  $i$  in the year  $t$ ,  $\alpha$ : refers to the intercept of one hundred and twenty companies included in our sample,  $ROA_{it}$ : refers to the return on assets of company  $i$  for year  $t$ ,  $ROI_{it}$ : refers to the return on investment of company  $i$  for year  $t$ ,  $control_{it}$ : refers to the control variables for company  $i$  in the year

$t$ . (including firm size and industry),  $\varepsilon_{it}$ : refers to the error term for company  $i$  in year  $t$ .

#### **IV. RESULTS AND DISCUSSION**

It is shown in Table 1 that out of 120 firms in the data sets in 2010, 40 firms invested in software, which is equivalent to 33.33%. The hardware investment was of 35 which is equivalent to 29.17% and that of software and hardware was 45 which is equivalent to 37.50%. 51 firms were invested in software in the year 2011, which is equivalent to 42.50%, that of hard is 22 which is equivalent to 18.33% and that of hardware and software is 47, equivalent to 39.17%. Furthermore, in 2012, 57 firms were invested in software, this is equivalent to 47.50% that of hardware is 29 which is equivalent to 24.17% and that of hardware and software were a total of 34 firms which is equivalent to 28.33%.

It can also be seen in Table 2 that the total investment of all 120 firms is classified according to their sectors. The total number of investment by the sectors and their respective percentages are: 43 industrial products (35.8%), 15 construction (12.5%), 10 plantation (8.3%), 30 properties (25%), 15 finance (12.5%) and 7 IPC (5.8%).

*Table 1- Component of IT investment*

Year	2010		2011		2012	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Software	40	33.33%	51	42.50%	57	47.50%
Hardware	35	29.17%	22	18.33%	29	24.17%
Software and hardware	45	37.50%	47	39.17%	34	28.33%
Total	120	100%	120	100%	120	100%

*Table 2 - Firm count by industry*

Industry	Frequency	Percentage
Industrial product	43	35.83%
Construction	15	12.50%
Plantation	10	8.33%
Properties	30	25.00%
Finance	15	12.50%
IPC	7	5.84%

This study implemented the combination of cross-sectional and time-series data. However, the standard OLS regression technique is inappropriate for the analysis [18]. Therefore, panel data techniques and the Hausman test was performed in order to adopt whether a fixed or random effects model is more appropriate. Table 4.3 and Table 4.4 show the results of the relationship between IT and firm performance. The results presented a summary statistics about the relationship between IT investment and return on asset and return on investment.

A Hausman test with IT as independent variable and ROI as the dependent variables was conducted and the findings indicated that random effects model is more efficient than fixed effect model. If a Hausman test revealed a value of ( $p < 0.05$ ), the fixed effect model is more consistent while if it is at ( $p > 0.05$ ) the random effect model will be used, and in this study the Hausman test ( $p = 0.505$ ). Based on the Hausman specification test, it is confirmed that the superiority of the random effect model is over the fixed effect model. A further discussion on the results of the random effects model need to be discussed. A summary of the results of the regression estimation of the dependent variables, based on random effect model shows a high significant on return of investment score. This proves that there is highly significant effect of IT investment on return of investment.

The results for analyzing the relationship between IT and firm performance are provided in Table 3. The results present a summary statistics about the relationship between IT investment and return on investment. The control variables of firm size and industry did not have a statistically significant influence on the test results, given the significance of the control variables, the test interpretations were made on the analyses where firm size and industry have been controlled for.

*Table 3- Return on investment and IT*

<b>Coefficient</b>	<b>Estimate</b>	<b>Std. Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
INTERCEPT	1.306	1.748	7.471	6.439***
LN(IT)	5.261	2.210	2.380	0.017*
LN(SIZE)	-1.405	8.276	-1.6975	0.090
CONSTRN	-6.845	6.612	-1.035	0.301
FINCE	-7.556	6.705	-1.126	0.260
IPC	-4.140	8.924	-0.463	0.642
PLANTN	1.330	7.622	0.174	0.861
PRPTS	-2.568	5.242	-0.490	0.624
R-Squared	: 0.046			
Adj. R-Squared:	: 0.0452			
F-statistic	: 1.894			
p-value	: 0.006			

The table above shows the results of IT investment and firm performance model 2. Findings show that IT investment has a significant impact on the return on investment of the firms while there is no significant effect in terms firm size and industry. The results are consistent with the studies on the business value of IT investment [4], [13] where findings revealed strong positive correlations between investments in IT and return on investment (ROI). However, this finding does not support the productivity paradox theory.

*Table 4. Return on Assests (ROA) and IT investment*

<b>Coefficients</b>	<b>Estimate</b>	<b>Std. Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
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INTERCEPT	-37.153	18.664	-1.990	0.047*
LN(IT)	0.693	0.534	1.296	1.296
LN(SIZE)	2.621	0.874	2.997	0.002**
CONSTRN	5.944	7.029	0.845	0.398
FINCE	-19.695	7.043	-2.796	0.005**
IPC	1.331	9.519	0.139	0.888
PLANTN	-0.612	8.140	-0.075	0.940
PRPTS	-6.160	5.530	-1.114	0.266
Adj. R-Squared:	0.048			
F-statistic	0.019			
p-value	2.609			
Adj. R-Squared:	0.012			

Table 4 shows that IT investment is statistically not significant with return on asset, as there is no relationship between IT investment and ROA. A significant effect is only observed with control variable size and finance industry. Size of firms is said to have a positive effect on performance of the firms. This means that bigger firms possess a higher performance than the small ones. The results proposed that the larger the size of the firm was, the greater the effect of IT investment would be because larger firms spend more on information technology than small ones.

This tells us that as the firm grows, the effect of IT investment on firm efficiency is greater. This result suggests a significant relationship between IT investment on firm size and finance industry. It suggests that the firm size in the sampled firms is effective and some industries performed better than others. Consistent with García-Morales et al. [19] which indicated that firm size is supposed to increase firm performance. However, the result does not support the effect of return on asset on IT investment. Thus, the hypothesis of positive relationship between IT investment and return on assets is not supported. It implies that IT investment is not considered a way to increase firm performance.

This finding is consistent with previous studies such as studies by Shu and Stressmann [15]. They investigated 12 banks in the US (1989-1997) and from the survey, they observed that information and communication technologies cannot improve banks' earning in terms of return on assets even it is considered as one of the most essential dynamic factors relating all efforts. However, the finding of this model is not consistent with some studies of business value of IT investment. For instance, Kabiru and Farouk [21] investigated the return of assets of information technology investment at selected banks in Nigeria for ten years (2000-2010). Their studies revealed that MIS surrogates (software, hardware investment and number of ATMs) significantly impacted the financial performance of Nigerian banks. This is measured by return on assets (ROA) and

the t-statistics results are all significant at 1 percent. Similarly, Ken and Magdi [7] were using ROA, and they investigated the effects of investment in information technology (IT) systems on bank profitability in the UK from the year 1976 to 1996. The results show that, the quantity of automated teller machines set up by a bank have a positive effect on bank ROA.

Generally, the findings of this study proved that there is a mixed relationship between the IT investment and firm performance. This is consistent with some of the studies on the business value of IT investment (e.g. [10], [22]) that found a mixed effect of IT investment on firm performance. Thouin et al. [10] in their study, have been using return on investment and profitability in investigating the correlation between IT investment and firm performance. Their study found that there is a correlation between IT financial expenses and the number of IT services outsourced. It is also has a correlation with the rise in the profitability of Integrated Healthcare Delivery Systems. However, the increases in IT personnel are not extensively linked with better productivity. In addition, John [22] conducted an investigation of IT investment, if it significantly impacts firm performance as what being measured by firm efficiency. This is by measuring IT investment by physical and human capitals, and the study reveals that the number of physical assets, such as computers where have been used in a firm, maintains a convincing and positive impact on the performance of a company. Nevertheless, he found that if a company is using more human capital (Programmers) in developing the software, the performance of the company is becoming worse. The positive effect of IT investment on firm performance variables were discovered in the random effect model. This is contradicted with what has been expected where a significant effect occurs only between IT investment and ROI. No proof found in regards to the positive relationship between IT investment and ROA. The coefficients of the return on investment (5.337), return on assets (6.813), firm size (-1.527) indicates how much IT investment changes overtime, on average per industry, when the firm performance variables increases by one unit. The coefficients indicate that IT does not change with firm performance variables. The results suggest that IT significantly influence firm performance, supporting H<sub>2</sub> and suggesting that IT investment have a significant relationship with firm's performance.

## V. CONCLUSION

This study is one of the first empirically studies done in investigating the relationship between IT investment and firm financial performance in Malaysian PLC's which is using the public listed companies' secondary data. Among the contributions of this study are: Initially, it is among the first studies to measure the relationship between IT investment and firm-level financial performance in Malaysian PLC's using secondary data. It is also remarkable as this study suggests a positive relationship between IT investment and firm performance in the Malaysian context while the impact of IT investment has been refined largely in the U.S. context. Furthermore, this study adds

to the literature on positive impact of IT investment towards firm performance, hence enlarging the scope of the evidence in the worldwide scale. Similarly, the findings also provide useful implications for managers in planning and evaluating the returns of their IT investments by choosing the appropriate performance measures. By gaining a good

knowledge regarding the relationship between IT investment and firm performance, managers can make sensible investment choices in exploiting their investment business value as well.

As this study is a firm-level empirical analysis in investigating the relationship between IT investment and firm performance in Malaysian PLC's, the following are the findings obtained: Firstly, there is a positive relationship between IT investment and return on investment. Second, IT investments have no relationship with return on assets. However, the limitations of the study are: First, this study is using a limited sample data as an established large sample data set in relation to IT investment information in PLC's is still unavailable. Therefore, early generalization, such as IT investment may impact firm's performance years after investments, was done and this could lead to errors. In addition, the results may underestimate its effects as IT generally needs times of learning and adjustment to achieve full value. For future research, larger longitudinal data sets is needed in exploring causal relationships between IT investment allocations and firm performance.

Secondly, this study is unable to investigate a time lag effect due to the limited information available in the annual reports. In order to understand the business value gained from IT investments from different parts of the world; whether from developed countries or not, future investigations need to be conducted. Other than that, implementing similar approaches and various samples could be crucial in devising an IT business theory. Thirdly, the IT investments are divided into two asset classes, but there is several ways to characterize the firm's investment allocations. Other itemizations might include accumulations of investments in particular IT projects, such as customer relationship management (CRM), enterprise resource planning (ERP), supply chain management (SCM) projects, or other theoretical frameworks which differentiate the types of IT. Finally, this work is hopefully can be a useful starting point for these endeavors.

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