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Information Technology and Growth of Firms:An Analysis in the Malaysian Manufacturing Industry

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Abstract: *This paper focuses on growth,an essential aspect of firm performance,in the manufacturing sector in Malaysia between the years 2010 and 2016. It analyzesthe effects of IT (information technology) on the growth of 153 firmsduring this period. The evidence suggests that some factors such as productivity, capital-labor ratio, sunk cost, technology usage, and minimum economies of scaleare important for the growth of firms. This paper shows that apart from these variables, information technology expenditurealso affects the growth of firms. Dynamic panel data,a generalizedmethod ofthe moment, is used and observed that IT expenditure negatively affectsfirms' growth,though it is a fast return investment. Moreover, it shows that information technology in firms with a low level of productivity does not stimulate growth.*

Keywords: *Growth of firms, Information Technology, Dynamic Panel Data*

1. Introduction

A lot of studies have been undertaken duringthe past decades on the performance of firms' theory. Good performance of firms in the market could lead to more job opportunities, state-of-the-art technologies, new products, increasedmarket competition, and the development of supply chains. However, poor performances could cause firms' closure or limited growth, accompanied by wastage of social, financial, and physical resources,greater unemployment, and declining economic growth rate.

Therefore,economists and policymakers more often attempt to reduce the demise of firms and increase the survival rate and firms'growth. According to some studies such as Mansfield (1962), Arrighetti (1993), Geroski (1995), Audretsch (1995), Mata and Portugal (2003), Perez and Castillejo (2006), Jamali et al. (2013), Zhang et al. (2016) and Voghouei et al. (2021)the growthof firms increased the survival rate of firms.

A basic framework forthe performance of firms was developed byChurchill and Lewis (1983).They argued that firms experience fivedifferent stages during their growth. The first stage is entry and existence, and in this stage, the main problems encountered by the business are obtaining new markets and delivering the product to them. The next stage is survival, and in this stage,the firm demonstrates that it is workable. It has enough customers and satisfies them with its products enough to keep them. The important matter at this stage is the relationship between revenue and expenses. In the third stage, s*uccess*,the main issue is whether you take advantage of the company's achievements and keep the company stable and profitable. In the fourth stage, the critical problems are how to grow rapidly and finance that growth. In the *resource maturity* stage,the crucial issues are consolidating andcontrolling the financial gains arising fromthe rapid growth and retaining the advantages of small size.

Researchers in their papers pointed out some elementsthat are crucial determinants of the growth of firms. Such as profitability (in the long run) and minimum efficient scale (MES) of firms (Mansfield,1962, Jamali et al. 2014), industry differentiation (Dunne et al.;1988, 1989), size and age of firms (Geroski;1991, 1995),innovation(Audretsch;1995), exports (Bernard et al., 2003 and Melitz, 2003) and strategies of firms whichlet them develop specific assets (advertising and research and development (R&D)) (Esteve-Perez and Manez-Castillejo;2006, Voghouei et al. 2021), and capital formation (Voghouei et al. 2021).

Though previous studieshave consideredseveral factorsthat affect thefirm's growth, the impact of information and communication technology (ICT) isless considered area. Recently, IT has been recognized asan essential technology thatcould be found as a component of products and services (embedded technology). Hence, information and communication technology could help firms reduce the firms' costs, enhance product management and administrative issues, improve information access, and increase productivity.

The current paperfocuses onthe growth of firms inthe Malaysian manufacturing industry and assessesthe effects of ICT onthe growth of 158firms during 2010- 2016. It is going to consider the number of full-time employees as a proxy for the growth of firms.

The following sectionpresents the previous literature of the research. In the third section, thepaper focuses on the model, methodof research, and sources of data. The synthesis and estimationof several models for the growth of firms in Malaysia arethen prepared, and the best one is chosen. Conclusion and discussions are presented in the final section.

2. LITERATURE REVIEW

Information Technology is the study, design, development, implementation, support, or management of computer-based information systems, particularly software applications and computer hardware (ITAA, 2002). In short, Information Technology deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information securely.

Today usage of IT hasa prominent role in the manufacturing industries, and it creates a variety of benefits to businesses and not only affects their current operations but also provides opportunities for new markets, strategies, and relationships (Sambamurthy, 1996).

A study conducted by UNIDO and ECLAC in 2005 on therole of IT in the development of firms found that IT is an effective tool to overcome obstacles for firmsand facilitate international trade. For these purposes,some general and specific usage of IT could be employed by firms. General usage of IT isEmail, E-commerce, Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Customer Relation Management (CRM). The special application of Information Technology in the manufacturing sector is Computer Integrated Manufacturing (CIM), Manufacturing Automation Protocol (MAP), Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP II), Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM) and Flexible Manufacturing.

An important part of literature about the performance of firms has emerged in the last few years, which focuses on the growth and survival of firms after entering the market.

Economists have studied the growth and survival of companies at the industry level and the company level.Two theories, organizational ecology theory and product life cycle, have been proposed at the industry level.

Organizational ecology literature provides a framework for understanding the evolution of companies in terms of legitimacy and competition in their industry (Hannan and Carroll, 1992: Hannan et al., 1998, Jamali et al., 2014). When a firm's cluster is young, it lacks external legitimacy due to the small number of firms. The entry of more firms and an increase in the density of firms in the industry results in a temporarily lower mortality rate and higher growth rate. However, as density increases, the competition intensifies, which leads to a decrease in new entrants and an increase in mortality.

Gort and Klepper (1982) and Klepper (1996) have explored industry evolution and market structure from a "product life cycle" perspective. As technology evolves, many industries exhibit similar patterns. Initially, the number of companies in the industry increased, followed by a sharp decline, and then the number of companies decreased.

Many firms are entering and innovating to provide different versions of the industry's product in the early stages. Even though these firms are usually small, however, due to high prices, the mortality rate is low. With the entry of more firms and increasing industrial output, the price subsequently drops. As the industry grows, the chances of innovation decrease and the dominant product design emerges.Companies compete on the Minimum Efficient Scale (MES), and companies with lower efficiency fail.

The firm-level analysis is primarily concerned with identifying factors that affect the survival and growth of individual firms in similar or different industries. To bridge the differences among the incremental, transformational, and ecological theories of organizational evolution, Tushman and Romanelli (1985) introduced the punctuated equilibrium theory of organizational change. According to them, organizations go through alternate periods of reorientation and convergence. An incremental modification characterizes changes during these periods to existing corporate forms and structures. The organizational change affects the strategies used by the organization and ultimately determines performance and survival, apart from external and internal environmental factors.

Another analysis is based on economic research. Economists analyze the factors of survival and growth in shorter periods and for different industries.The industry in which the company competes,the economic parameters of the company, and its performance can also affect the outcome of growth and survival. One of the first studies on the performance of firms, conducted by Joe Bain (1957), emphasized the role of minimum efficient scale (MES). Mansfield (1962), in his research on dynamic aspects of the industrial organization, also mentioned that long-run capital requirement and minimum efficient size of the firm affects growth and exit of firms.

Jovanovic (1982) provided the model based on a firm's growth, size, and age in which age indicated post-entry learning and showed that firm growth is a function of size and age. A new wave of research has uncovered what Paul Grosky (1991, 1995) has systematically formulated as stylized facts: firm size and age are correlated with the survival and growth of firms. Some researchers such as Wagner (1994), Arrighetti (1993), Baldwin (1995), Mata et al. (1995), and Portugal (1994) in their case studies have also concurred with this relationship.

The most important rationale that explains this relationship is that most firms enter the market below the minimum efficient scale. Thus, they face a cost disadvantage, making it more difficult for them to survive and grow (Mata et al. 1995). As mentioned by Jovanovich (1982), firms do not know their actual ability at birth. They decide the entry scale based on their beliefs about their ability level, but this level is more often imprecisely estimated.

According to a study by Audretsch et al. (1999), when the minimum efficient scale in an industry is high, the growth rate after the entry of the surviving companies will also be high. However, in such an industry, the exit rate may be high because some new companies and startups may not be able to grow and approach the MES. On the other hand, in industries with low minimum efficient scale, relatively lower growth rates but higher survival rates would be experienced since,in this case, the need for growth and loss of work at sub-optimal scales will not be too serious.

Agarwal and Gort (1996), Agarwal and Audretsch (1999, 2001), Agarwal (1997, 1998),and Jamali et al. (2015) point out that there is a positive relationship between size and the probability of survival and growth, especially in industries that are in the early stages of their life cycle.Duune et al. (1988, 1989) showed that firm survival and growth rates are systematically different in different industries. However, they offer no insight into why there is such diversity in survival.

Audretsch (1995) showed in the industries where innovative activities play an essential role (especially in small companies), newcomers are less likely to survive for a decade than in industries where innovative activities are less important. However, those entrants that can survive exhibit higher growth.

The critical role of market structure has been emphasized by some researchers such as Audretsch (1991), Mata and Portugal (1994), and Audretsch and Mahmood (1994).Their findings showed that structural factors such as the size of companies, the form of average cost, the height of barriers to entry, and the speed of technological progress affect the performance of companies.

In addition, Dome et al. (1995), in their study focused on the role of technology in the growth of manufacturing enterprises and found that increasing capital intensity and the use of advanced manufacturing technologies (AMTs) are positively correlated with the firms' growth and negatively correlated with firm's existence.They also indicated that by increasing technology usage, capital intensity, and productivity, firms' growth generally increases.

Olley and Pakes (1992), Bailey et al. (1992), Liu and Tybout (1993), and Bailey et al. (1994), in their studies, concentrated on the role of productivity. They found that higher productivity is correlated with higher growth rates and lower failure rates for manufacturing facilities. However, there remains considerable variation in plant-level growth and failure that is unexplained by plant-level productivity differences.

Sunk cost is another factor that affects the survival and growth of firms. The sunk cost typically results from investing in durable, immobile, and company-specific assets. The costs of advertising, research and development, and marketing are examples of sunken costs. Dixit (1989) and Hoppenhayn (1992) argued that sunk costs would influence new-firm survival in the industry. Higher suck costs should reduce the likelihood of exit and reduce the observed growth rate for surviving companies. Audretsch (1991 and 1995) provided evidence linking sunk costs to lower probability of exit and lower observed growth rates for surviving companies.

The role of corporate ownership (foreign and domestic or public and private) in the survival and growthof firms has been analyzed by Dunne et al. (1989), Audretsch and Mahmood (1995), and Ozler and Tymaz (2004). They suggested that plant growth and failure patterns are systematically related to the firms' ownership type.

Table1. *The summary of literature review*

Research	***Findings***
Mansfild (1962)	Minimum efficient size of the firm affectsthe growth and exit of firms
Jovanovic (1982), Geroski (1991, 1995), Mata et al (1995)	Growth is a function of size and age
Audretsch et al. (1999)	In industries where the minimum efficient scale is low, the growth rates are relatively lower
Agarwal and Audretsch (1999, 2001) Agarwal (1997, 1998)	A positive relationship between size and the likelihood of survival and growth holds in particular in industries that are in earlier stages of their life cycles
Audretsch(1991), Audretsch&Mahmood (1994) and Mata & Portugal (1994)	Technological progress relative to the performance of firms
Dome et al. (1995)	The growth of firms generally increases with technology usage, capital intensity(K/L), and productivity
Olley and Pakes (1992), Bailey et al. (1992), Liu and Tybout (1993), and Bailey et al. (1994)	Higher measured productivity is correlated with higher growth rates
Dixit (1989) and Hoppenhayn (1992)	A greater degree of sunk costs should reduce the likelihood of exit and lead to lower observed growth rates for surviving firms
Dunne et al (1989), Audretsch and Mahmood, (1995), and Ozler and Tymaz (2004)	Growth and failure of firms systematically dependon the firms' ownership type

3. METHODOLOGY

The model used to test the hypotheses in this paper was proposed by Ijiri and Simon(1977) and developed by Del Monte and Papagni(2003).This model is shown in Equation 1.

$$g_{it} = \alpha_i \, (X)^d_{i,t} \, S^{B-1}_{i,t-1} \, e^{Vi,t} \qquad (1)$$

$$\frac{S_{i,t}}{S_{i,t-1}} = \alpha_i \, (X)^d_{i,t} \, S^{B-1}_{i,t-1} \, e^{Vi,t} \qquad (2)$$

Equation 1 consists of the following parameters.

i) Intercept, a growth factor that affects equally all firms in the industry

ii) X matrix; the individual growth ratio of a firm that depends on the firm's characteristics

iii) Equation 2, growth rate in one period dependson the firm size (S) on the previous period; and

iv) eVit, a causal factor of multiplicative type

After taking the logarithm from Equation 2, we have

$$\log S_{i,t} - \log S_{i,t-1} = log\alpha_i + d \; logX_{i,t} + (B-1)logS_{i,t-1} + V_{i,t} \qquad (3)$$

And

$$\log S_{i,t} = log\alpha_i + d\ logX_{i,t} + BlogS_{i,t-1} + V_{i,t} \tag{4}$$

Equation 4 is used to assess the hypothesis. In this equation, S(i,t) is the average size of firms, X(i,t) is the matrix of variables that affect the firm performance, and V(i,t)is a random factor or an error term.Due to the importance of time-series variation in the growth of firms and all its determinants, the panel data method has been considered to control for group-specific effects during the times and accounts for the potential endogeneity of the explanatory variables as well. As shown in equation 4, there are lag variables in the model to allow the size of firms to adjust to their previous time effects. Therefore, dynamic panel data is used to analyze the role of information technology expenditure on the growth of firms in the Malaysian manufacturing sector. This method controls for group-specific effects during the times and accounts for the potential endogeneity of the explanatory variables. The estimation method for testing the model is the GMM estimator proposed by Arellano and Bond (1991). As implied, the GMM estimator by taking the first difference from the model, wipes out the time-invariant or country-specific effects from the model. At the same time, it gets rid of any endogeneity that may be due to the correlation of these group-specific effects and the regresses on the right-hand side. To obtain consistent estimates of the parameters, they assumed that the error term is serially uncorrelated. This implies that there is a no-order serial correlation. The consistency of the GMM estimator depends on the validity of the instruments and the assumption that the differenced error terms do not exhibit second-order serial correlation. For testing the consistency of the GMM estimators, two tests proposed by Arellano and Bond (1991) will be used. The Sargan test for over-identifying restrictions is the first test. This test examines the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation procedure. The Arellano -Bond test examines the assumption of no second-order serial correlation. Failure to reject the null hypothesis of both tests gives support to our estimation procedure.

While some researchers such as Jovanovich (1982), Baldwin and Rafiquzzaman (1995), and Piergiovani et al. (2002) used changes in value-added, production, or sale as a proxy for growth, other researchers like Dunne et al. (1987), Audretsch (1995), Boeri and Bellman (1995), and Doms et al. (1995) used changes in the number of employees as a proxy for the growth of firms. Following the second group, his paper has employed total employment as the size of firms.

As mentioned earlier, we try to analyze the relationship between information technology expenditure and the growth of firms. Therefore, information technology expenditure is the main independent variable in the model. This variable is measured by the total information technology expenditure and denoted as IT in the model.

In addition, the minimum efficient scale (MES) is one of the variables which affects the firm's growth. MSE is measured by the average production per firm for firms in the midpoint class size (defined by product shipments) as a percentage of shipment values in each year (Clark and Stanley, 1999). It is expected that the firm's growth and MES are positively correlated. As the MES increases, a firm of any given size must grow to realize maximum efficiency or attain a size similar to those in the industry accounting for most of the shipments. Thus, as Autretsch (1995) implies positive relationship is expected to emerge between the MES of output and the post-entry growth rate.

The other variable is productivity (PRO) which is measured by the total output divided by the total input of each firm. In the model, PRO shows productivity, and it is expected that PRO should have a positive correlation with the growth of firms. That total output is the next variable that is measured by the total value of production. The total input is calculated by the summation of total costs of containers consumed and packing materials, the value of lubricant, gas, and fuel consumed, water and electricity purchased, cost of repairing and maintenance of assets, payment for non–industrial services, R&D expenditure, and other input costs.

According to Voghouei et al. (2021), increases in capital formation are positively correlated with a firm's growth. They viewed capital intensity as a proxy for technology usage. In the model, the capital-labor ratio is another variable for technology usage, and it is measured by the total amount of capital divided by the total number of employees in the firm each year. Capital refers to the total value of purchases and construction of fixed assets (including alteration,, major addition, and improvement to existing assets that extend their normal economic life or raise productivity) plus the total value of a producer's acquisition, minus certain additions to the value of non-produced assets and disposal of fixed assets. In the model, KL denotes this variable, and it is envisaged that KL should have a positive correlation with the growth of firms.

The significance of some costs such as R&D, marketing and advertisement, and learning in firms' growth has led to the creation of a variable known as a sunk cost. The sunk cost is measured by the total amount of nonproductive cost in each firm. Nonproductive costs include research and development, learning, advertisement, journals and books, and communication costs. This variable is denoted as SUNK in the model (based on DOS definition).

The variable TEC captures the role of technology, a dummy variable that takes one for firms in high technology sectors and zeroes for others. Porter (2001) and OECD (2004) define the high-tech sectors asOffice & computing equipment, Aircraft (aerospace), Drugs and medicines, Communications equipment, Electrical machinery, and Scientific instruments. TEC and the growth of firms are envisaged to have a positive correlation with each other.

An interaction variable between productivity and information technology is employed to capture the effect of productivity on the growth of firms that emanated from information technology, and it is denoted by IT*PRO. Besides, year dummies are included in the model to evaluate the impact of the aggregate effects of unobserved factors in a particular year on the performance of all the groups equally.

4. DATA ANALYSIS

There are two main data resources for the Malaysian manufacturing sector which are used in this study. One is the census of the manufacturing sector for 2010 and 2015, and the other is the survey of the manufacturing sector for 2011, 2012, 2013, 2014, and 2016. The key indicators for 153 firms were offered by the Department of Statistics (DOS), based on the related questionnaires.

Table 2 presents the results of the estimation, and each column of the table corresponds to a different model. The first model does not include any interaction and lag variables. The second model is similar to the first one but without year dummy variables for 2013 and 2016, while the third model contains all the variables except year dummy variables for 2013 and 2016. The last model includes all the variables except lag variables and year dummy variables for 2013 and 2016.

The impact of information technology expenditure on a firm's performance with a time lag has been emphasized by some researchers such as Weil and Olson (1988), Banker et al. (2001), and Shaft et al. (2007). Therefore IT and its interaction with productivity are taken into account in the model with a time lag.

STATA is used for estimation the generalized method of moment (GMM) estimator (Arelano and Bond, 1991), which is employed in this paper. This approach allows the past value of the dependent variable (Lempt-1) to affect its current value (Lemp). The consistency of the GMM estimator is checked with two diagnostic tests. The Sargan test and their p-value use for checking the validity of instruments. The second test examines the assumption of no second-order serial correlation. Failure to reject the null hypothesis of both tests gives support to our estimation procedure.

By comparing the four models in Table 2, it was found that model 1 and model 2 could not be selected. The reason would be due to the insignificant effect of technology on the growth of firms in these two models.

Model 3, which incorporates the time lag effect of information technology, cannot be considered the best model. As shown in Table 2, information technology, the interaction between information technology and productivity, and sunk cost in model 3 do not significantly affect the firm's growth. Model 4 is considered the best model. Since it has the interaction variable between information technology and productivity, and all the variables compatible with the theories, show a significant impact on the firm's growth.

The p-value of Arellano and Bond (1) for model 1 is lower than 10% (1.7 %), while the p-value of Arellano and Bond (2) is more than 10% (75.1%). Therefore, this model has no autocorrelation. The Sargan test is 10.34 (P = 0.3233), which indicates that the null hypothesis will not be rejected as the calculated chi2 in the model is smaller than chi2 in the table with a 5% confidence interval. It should be mentioned that the Sargan test is used to verify independence between the instruments and the error term. The null hypothesis, in this case, is that the instruments and the error term are independent. Thus, a failure to reject the null for the Sargan test would be evidence supporting the fact that the instruments are indeed valid (Arelano and Bond, 1991). In other words, this regression is not over-identified. Furthermore, the coefficients of the first model are more significant than the other models. Hence the first model is the best among the other estimated models.

Table2. *Estimation results*

Numbers in parentheses are SE, Numbers in brackets are probabilities

Variables	Model 1	Model 2	Model 2	Model 4
Lemp (t-1)	0.33547* (0.062393)	0.5626727* (0.0638963)	0.433981* (0.056813)	0.6938911* (0.053927)
Lvad	0.0709973 (0.061536)	0.171633** (0.079425)	0.28746* (0.065402)	0.2420604* (0.062087)
Lit	-0.017641*** (0.010634)	0.0159385 (0.0140784)	-0.05138 (0.04281)	-0.1193836** (0.055257)
Lmes	-0.0021428 (0.053739)	-0.209263* (0.0597463)	-0.14001* (0.045033)	-0.1667801* (0.048499)
Lsunk	0.3943322* (0.047558)	0.3272694* (0.0507198)	0.310052* (0.043004)	0.2327173* (0.039073)
Lkl	-0.1549328* (0.038414)	-0.2136404* (0.0601906)	-0.19486* (0.057617)	-0.2404732* (0.056130)
Lpro	0.5520471** (0.223002)	0.8147414* (0.305696)	0.775483* (0.245034)	0.704187** (0.31071)
Lit*Lpro			0.070071 (0.05962)	0.092018* (0.037203)
Tec	-0.0227742 (0.164455)	0.339104** (0.1607366)	-0.14177 (0.095219)	0.089115** (0.043975)
LLit			0.095453 (0.067396)	
LLit*LLpro			-0.09418 (0.06564)	
D2013	-0.0589904* (0.015709)			
D2014	-0.0774705* (0.016640)	0.047203* (0.0147073)	-0.01175 (0.015246)	0.0451049* (0.014812)
D2015	-0.1907968* (0.021513)	-0.0184855 (0.019039)	0.004457 (0.016206)	-0.0419181* (0.01787)
D2016	-0.2832181* (0.025776)			
Constant	1.168842* (0.273350)	0.2855878 (0.320624)	0.8635799* (0.324748)	-0.4427763*** (0.272741)
Sargan test	[0.6311]	[0.0032]	[0.0037]	[0.0036]
Ar.Bond 1	[0.0073]	[0.00010]	[0.0016]	[0.0003]
Ar.Bond 2	[0.6469]	[0.0615]	[0.0506]	[0.3934]

****) Significant at 10%,**) Significant at 5%*) Significant at 1%*

As shown in Table 2, the year dummies are significantfor 2014 and 2015. It means that there are year effects in the models for these years. Based on the estimation results in this table, the best-estimated model is as below:

$Lemp_{it=}$ -0.4427763+0.6938911$Lemp_{it\text{-}1+}$0.2420604$Lvad_{it}$-0.1193836Lit_{it}-0.1667801$Lmes_{it}$

(0.272741)(0.053927)(0.062087)(0.055257)(0.048499)+0.2327173$Lsunk_{it+}$0.2404732Lkl_{it}+0.7041873$Lpro_{it}$ +0.092018Lit_{it}*$Lpro_{it+}$0.089115 $Ltec_{it}$

(0.039073) (0.056130)(0.31071)(0.037203)(0.043975)+0.045105D2014-0.0419181*D2015*

(0.014812)*)(*0.01787*)* (5)

The results show that the size of firms in the previous period (Lempit-1) has a positive effect on the growth of firms. It means that firms of bigger size in the previous year experienced a higher growth rate in the current year. This result negates Gibrat's Law (1931), which states that a firm's size and growth rate are independent.

Value added is another factor, which is taken into account in the model. The findings show that value-added has a positive impact on the growth of firms. Similarly, productivity has a positive impact on the growth of firms. These results confirm the results of previous studies such as Olley and Pakes (1992), Liu and Tybout (1993), and Bailey et al. (1994), which indicate that productivity has a positive effect on the growth of firms.

The minimum efficiency of scale (MES) in the model has a negative effect on the growth of firms. It means that in each sub-sector, when MES is high, the growth of firms is low and vice versa. The findings for the growth of firms in the Malaysian manufacturing sector do not support the findings of Audretch et al. (1999) about the positive impact of MES on the growth of firms.

Besides, the model results point out that sunk cost has a positive effect on the growth of firms. It means that some costs such as R&D cost, marketing cost, and other nonproductive costs are significant for the growth of firms in the Malaysian manufacturing sector. This result is contrary to the findings of Dixit (1989) and Hoppenhayn (1992).

The results of the selected model show that firms that operate in technology-based sectors have a higher growth rate than normal firms. This is similar to the finding of Dome et al. (1995) about the positive impact of technology on the growth of firms.

The role of the capital-labor ratio (KL) on the growth of firms is significantly negative. This result does not corroborate with the findings of Doms et al. (1995), who mentioned that the growth of firms is correlated with capital intensity.

The coefficient of interaction between productivity and information technology has a significant and positive effect on growth, which means that the productivity that emanated from information technology positively and significantly affects the growth of firms.

Since information technology in the equation appears as a part of the interaction term, the marginal effect should be computed to show its impact on the firm's growth. Furthermore, to estimate the relative importance of productivity for the growth of firms, the marginal effect of productivity should be calculated. Based on equation 5, the marginal effect of information technology and productivity are:

$$\frac{\partial g}{\partial Lit} = -0.1193836 + 0.092018 * Lpro_{it} \tag{6}$$

$$\frac{\partial g}{\partial Lpro} = 0.7041873 + 0.092018 * Lit_{it} \tag{7}$$

where g is the growth of firms.

The results of the marginal effects based on mean, maximum, and minimum of observations are shown in Table 3.

To assess the relationship between information technology and productivity, which are used as part of the interaction term, has significant effects on a firm's growth, it is necessary to compute the standard error of marginal impact. According to Barmbor et al. (2005), the standard error of interest for information technology is:

$$\sigma_{\frac{\partial g}{\partial \mathrm{Lit}}} = \sqrt{\mathrm{Var}(\widehat{\beta_{\mathrm{lit}}}) + \mathrm{Lpro}^2\mathrm{Var}(\widehat{\beta_{\mathrm{lpro}}}) + 2\mathrm{Lpro}\ \mathrm{cov}(\widehat{\beta_{\mathrm{lit}}}, \widehat{\beta_{\mathrm{lpro}}})} \tag{8}$$

and for productivity is:

$$\sigma_{\frac{\partial g}{\partial Lpro}} = \sqrt{Var(\widehat{\beta_{lpro}}) + Lit^2 Var(\widehat{\beta_{lit}}) + 2Lit\ cov(\widehat{\beta_{lit}}, \widehat{\beta_{lpro}})} \tag{9}$$

The results are shown in Table 3.

Table3.*The marginal effects of IT and productivity*

	Information technology (L*it*)			Productivity (Lpro)		
	Coefficient	Std error	T	Coefficient	Std error	t
Mean	-0.582684	0.110414	-5.2773*	0.7470438	0.349117	2.1398*
Minimum	-0.068946	0.565493	-0.1219	0.8833731	0.289081	3.055797*
Maximum	-1.401660	0.608604	-2.3031*	0.5363630	1.021046	0.52530

From the above, it is noted that the effect of information technology on the growth of firms is negative for those firms whose productivity is around the maximum or mean of observations. However, for firms whose productivity is around the minimum of the observations, the impact of information technology is insignificant. It means that there is no significant effect of information technology for firms with the lowest level of productivity. One reason for this could be due to the substation of information technology expenditure with the labor force in the manufacturing sector, and it causes a decrease in the growth of firms. Another reason could be due to the fact that information technology could be effective for performance when the firms have obtained a certain threshold of productivity.

Moreover, the effect of productivity on the growth of firms is positive and significant for firms where information technology is at the mean or minimum level. For those firms where information technology is around the maximum of observations, the effect is positive but insignificant. The findings for productivity for mean and minimum observations confirm the results of previous studies such as Olley and Pakes (1992), Liu and Tybout (1993), and Bailey et al. (1994), which showed that productivity has a positive effect on the growth of firms.

5. Discussion and Recommendation

This study focuses on the growth of firms in the Malaysian manufacturing sector. It analyzes the effects of information technology on the growth of 153 firms during the period 2010 and 2016 by using dynamic panel data generalized method of moment(GMM) estimator. Results showed that information technology has a negative impact on the growth of firms, which is measured by the number of employments. The main reason for this could be due to the substitution of the labor force with information technology expenditure. Moreover, the results showed that lagged information technology expenditure does not affect the growth of firms in the Malaysian manufacturing sector. In fact, investing in information technology impacts the growth of firms during the same period, which denotes that information technology expenditure is a fast return investment. Furthermore, the results also showed that information technology does not affect the growth of firms that are under a certain level of productivity.

The other findings are similar to some of the previous studies done in other countries. The results confirmed that information technology expenditure, capital-labor ratio, and minimum efficiency scale have a negative effect on the growth of firms. In contrast, the size of firms in the previous year, sunk costs, value-added, technology, and productivity positively affect the growth of firms in the Malaysian manufacturing sector.

One of the most critical challenges for governments, especially in developing countries, is creating more jobs. On the one side, Governments, by investing in the manufacturing sector, try to create jobs. On the other side,profits and opportunities from information technology in the manufacturing sector, tempts policymakers to invest in information technology.Resultsof the study in the Malaysian manufacturing sector show that information technology expenditure has a negative impact on the growth of firms. In other words, investing in information technology does not create more jobs. The reason should be due to the substitution of the labor force with information technology.Therefore, policies that concentrate on information technology cannot be useful for jobcreation.

Moreover, policymakers should keep in mind that promoting information technology does not impact the performance of firms under a certain level of productivity.Promotional policies on Information Technology have a positive effect just when the firms have passed a certain level of productivity.

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