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IT Investment and Financial Performance Volatility: The Moderating Role of Industry Environment and IT Strategy Emphasis

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ABSTRACT

Industrial revolution 4.0 makes business competition more challenging and will impact the instability of the company's financial performance. Dynamic environmental conditions make it difficult for companies to make predictions in making decisions. Investing in information technology (IT) is one way for companies to maintain financial stability and competitive advantage in dynamic competition. Resource-Based Theory (RBT) explains that information technology (IT) is a resource that can create a competitive advantage for the company. This study aims to examine the moderating role of dynamic industrial environments and IT strategic emphasis on the relationship between a lag effect of IT investment and firm's financial performance volatility. Using the data of companies listed on the Indonesia Stock Exchange (IDX) for five years starting from 2013–2017, the method used to estimate the research model's parameters is the generalized method of moments (GMM) approach. The results show that the industrial environment and the emphasis on IT strategy have a role in moderating and strengthening the relationship between the time lag in IT investment in reducing the firm's financial performance volatility.

Keywords: IT Investment, Firm's Financial Performance Volatility, Dynamic Industrial Environment, IT Strategic Emphasis, Generalized Method of Moments

Ⅰ. Introduction

Business competition in the era of industrial revolution 4.0 is getting tighter, making company performance fluctuate for no apparent reason. A business that has been around for a long time suddenly decreases performance and even disappears. On the other hand, a new business model quickly gains market share control. Unpredictable business models can become leaders with superior performance. This con-

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dition causes the volatility of the firm's performance to be unstable. The impact of instability makes it difficult for companies to predict and plan for the future, reducing the company's value to investors.

A company's risks, such as high volatility in financial performance and decreased market performance, can be eliminated or minimized by creating competitive strategies. For companies that are value creators, efforts to create strategies based on firm factors are more dominant than based on industry factors (Hawawini et al., 2003). Increasing company capabilities based on resources and competence is always associated with Resource-based Theory (RBT). Barney (1991) explained that competitive advantage could be created when the company's resources have four characteristics: valuable, rational, imperfectly imitable, and non-substitutability (VRIN).

Information technology (IT), as one of the firm's resources, is the primary key for organizations to create a competitive advantage and reduce future performance volatility. IT is considered a key driver of technological innovation and organizational evolution (Liang et al., 2010). Khallaf et al. (2017) state that in a competitive market condition with no barriers to entry, no company will get an abnormal return except for innovating with IT. It shows that the accumulated resources in IT will create a competitive advantage and improve company performance (Chae et al., 2014).

The firm's IT capital expenditures account for around 40% of the total spending each year (Ranganathan and Brown, 2006). Kappelman et al. (2018) stated that the number of companies in the financial, insurance, and banking sectors was the sector that invested the most in IT, namely 15.76% (64 companies) of the 406 companies studied. The phenomenon of IT investment shows that in the digital era, IT has a high value as supporting assets and even the main focus of their business processes. This condition indicates that IT investment will maintain stability and keep the company away from volatility in financial performance due to dynamic business competition.

Economic conditions, rapid technological developments, and disruptions make companies that have long existed and even controlled market share can suddenly experience a decline in performance until bankruptcy. For example, some companies that went bankrupt due to digitalization, such as Nokia, My Space, and Yahoo, were forced to sell to Verizon and Payless. In these conditions, financial performance stability is crucial because it signals to investors who show that the company has quality earnings from its economic performance (Nelson and Skinner, 2013). For management, maintaining the stability of future financial performance is crucial because their performance is measured by the quality of earnings generated by the company of their discretionary activity (Dechow et al., 2010; Nelson and Skinner, 2013). Managers who have high performance will be proven in management's ability to maintain profitability persistence through accounting policies, as well as strategic policies in competitive advantage. In other words, managers will be challenged in terms of the extent to which above-normal gains persist over time (Roberts, 2001). In the context of earnings information quality, the fundamental stability of the company's profit also contributes greatly to the fluctuations in earnings quality.

The era of digitalization has disrupted many established companies, making investors have to be more careful in investing their capital in a company. Companies with high financial performance volatility become threatened in obtaining guaranteed benefits in the long run. Companies that have decreased performance in the era of digitalization due to not doing IT innovations in a sustainable manner. Innovation

using IT will contribute to the company's economic performance, especially when investing in green IT (Khuntia et al., 2018). Companies with a prospector strategy can benefit from exploring current IT or adding new IT investments. While companies that have a defender strategy can exploit existing IT or invest in new IT (Chari et al., 2008; Steelman et al., 2019; Xue et al., 2012).

Companies that invest in IT for business purposes face two choices, whether to exploit their IT by emphasizing increasing efficiency or undertaking IT exploration with an emphasis on innovation that can simultaneously be cost-efficient and increase revenue (Mithas and Rust, 2016; Xue et al., 2012; Yu et al., 2016). Innovations are carried out to create new things that will make the company exist in competition, while efficiency will increase profits, and the residual rights of shareholders can be stable. In this condition, the company can minimize the long-term negative impact on the volatility of financial performance.

The choice of the exploitation and exploration strategy of IT depends on the industry's environmental conditions in which they compete (Winarno and Tjahjadi, 2017; Xue et al., 2012). In addition, the choice of IT investment also depends on the expected benefits the company wants. For example, IT investment is made to support transactional. The expected benefit is cost reduction, while companies that emphasize IT on informational goals, besides reducing costs, also increase profitability (Aral and Weill, 2007). The expected increase in IT investment from year to year is expected to reduce the firm's financial performance volatility caused by aspects that are difficult to explain in competition. Based on these arguments, this study examines the moderating role of the industrial environment, and the IT strategy emphasis on the relationship between IT investment and the financial performance volatility.

Previous studies and empirical tests on IT investment with firm performance showed inconclusive results and caused financial performance to experience volatility for no apparent reason (Winarno and Tjahjadi, 2017). Contingency factors can potentially explain inconsistencies or weak relationships between variables following the context, often called moderating variables (Baron and Kenny, 1986). Contextual variables in IT investment can be variables that arise from outside the company or within the company. Companies will not perform better even if they make IT investments without considering the industry environment and the firm's long-term strategic emphasis. For example, the industrial environment (Sabherwal et al., 2019; Winarno and Tjahjadi, 2017; Xue et al., 2012) is a contextual variable that emerges from outside the company, and the choice of strategy the company uses is a contextual variable from within the company (Chari et al., 2008; Mithas and Rust, 2016).

Our research differs from previous studies; Firstly, we use the concept of time lag to re-examine the relationship between IT investment and financial performance volatility by setting companies in Indonesia. Secondly, as a developing country, Indonesia has different industrial characteristics from developed countries that have been carried out in previous studies (Chen et al., 2017; Havakhor et al., 2019; Kim et al., 2017; Thakurta and Guha Deb, 2018). Finally, we use the GMM approach in estimating the statistical model to overcome the weaknesses of the dynamic model estimated by OLS in previous studies, which gave inefficient and inconsistent estimation results. The structure of the article can be organized as follows. Section 2 represents previously relevant IT investment and financial performance volatility literature. Meanwhile, Section 3 describes the research method used. Furthermore, Section 4 reports our main empirical results. The last section, Section 5, describes the conclusions and limitations of the study.

Ⅱ. Literature Review

2.1. Resource-Based Theory, IT Investment, and Productivity Paradox

Resource-based theory (RBT) is a concept that can be used to analyze the position of company assets or resources, both tangible and intangible, to determine strategies for creating competitive advantage. Barney (1991) explains that assets that have VRIN characteristics or characteristics (Value, Rareness, Imperfectly imitable, and Non-substitutability) can provide a sustainable competitive advantage (Liang et al., 2010). The RBT view considers IT a resource that can create a competitive advantage for a company (Bharadwaj, 2000; Liang et al., 2010; Wade and Hulland, 2004;). IT investment is capital expenditure to acquire IT assets (Steelman et al., 2019) in hardware, software, data storage media, and networks. The expected benefits of IT investment depend on the strategic objectives and the category of IT assets the company uses, whether for efficiency or innovation (Aral and Weill, 2007). The IT investment productivity paradox arises because there is no positive relationship between IT spending and productivity or profitability. Brynjolfsson (1993) makes four categories that can explain the productivity paradox, namely: (1) the Miss-measurement of outputs and inputs; (2) the learning process and adjustment; (3) Redistribution and dissipation of profits; (4) Mismanagement over IT. The exciting thing about the appearance of time lag is the learning effects, structural effects, and complementary effects (Shaft et al., 2007).

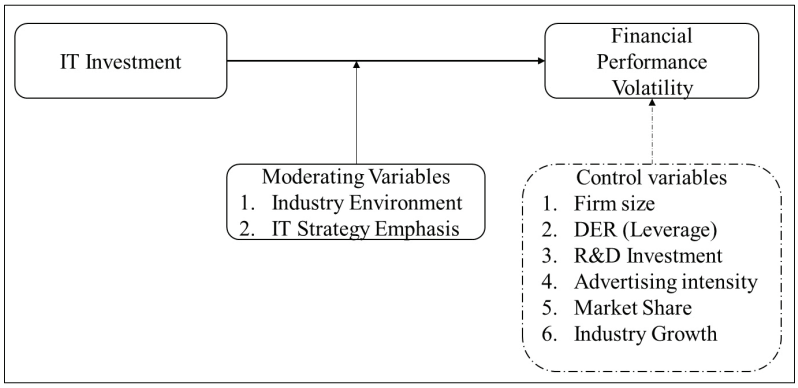
2.2. Firm Financial Performance and Volatility

The firm's financial performance is organizational effectiveness related to financial and operational performance (Liang et al., 2010), often called accounting-based performance. Accounting-based performance measures will reflect past performance, such as the perceived performance on IT investment in the previous period (Lim et al., 2011). This measure can be Return on Assets (ROA), Return on Equity (ROE), and Return on Sales (ROS). Operational efficiency indicators for the choice of companies to exploit IT are measured by cost reduction, namely a measure of the decrease in the cost of goods sold (COG/S) and a decrease in operating and sales costs (Bharadwaj, 2000; Wang et al., 2008; Zhu and Huang, 2012).

Early-stage IT investment may reduce relatively significant performance or have a high capital expenditure burden, so the company has not felt the expected benefits. There may be changes in the next period, but not yet significant, and in a certain period, the optimal benefits will only be achieved (Winarno, 2019). This condition shows that the firm's financial performance is volatile. Several things can be explained; IT investment is a capital expenditure such as R&D, which has a probability of success or failure. It has great potential to increase income volatility (Kobelsky et al., 2008b). Conversely, according to the concept of information processing view, IT acts as a mechanism for processing data into information that provides speed in making decisions on unexpected challenges and threats arising from the business and competitive environment (Kobelsky et al., 2008b), lowering the volatility of income than what it should be.

2.3. Contingency-based Research

According to contingency theory, the continuity of a relationship depends on the context (Chenhall, 2007). The relationship between IT investment and firm performance volatility also shows inconsistency,



<Figure 1> Research Model

which means contingent factors influence the relationship (Hitt and Brynjolfsson, 1996). This study suspects that the relationship between IT investment and the firm's financial performance volatility depends on several contextual variables. <Figure 1> illustrates two main factors that significantly influence this relationship. Firstly, the external environment, which in this study is defined as the industrial environment (Xue et al., 2012). Secondly, its strategic emphasis on IT investment has been made (Mithas and Rust, 2016).

Ⅲ. Hypothesis Development

3.1. IT Investment and Financial Performance Volatility

In general, IT investment implementation requires time, and benefits cannot be obtained directly during the year of the investment period (Campbell, 2012; Lee and Kim, 2006). Karanja and Bhatt (2014) explain that in calculating the benefits obtained from IT investment, usually there are measurement problems because of the benefits arising from the introduction, or transformation of, existing IT infrastructure. The lag benefit from IT investment assets' utilization is due to the learning process and adaptation to new IT (Shaft et al., 2007). Several studies have found evidence that in approximately 3 to 4 years, companies will get the greatest return on IT investment in previous years (Campbell, 2012; Zhu and Huang, 2012). The company experienced relatively high volatility in its financial performance throughout the year before a stable benefit period was obtained.

IT investment, if associated with a function of time, at the initial stage, will show relatively slow performance due to the learning process from both the individual aspect and the organization as a whole (Shaft et al., 2007). High financial performance volatility will appear when the company is in the initial investment period until the first benefit is obtained (Winarno et al., 2021). In this condition, changes in volatility will be stable over a certain period, IT investment will be stable in providing benefits and tends to be persistent. Financial performance will provide good and quality information, if the income is more persistent (Dechow et al., 2010; Nelson and Skinner, 2013). IT investment enables companies to reduce the risk of changing technology-based environments, thereby reducing revenue volatility. Based on this argument, it can be hypothesized as follows.

H1: There is a relationship between the time lag of IT investment and the firm's financial performance volatility.

3.2. Moderating Role of Industry Environment and IT Strategy Emphasis on the Influence of IT Investment and Financial Performance Volatility

A dynamic and competitive business environment will spur increased market exposure and potential revenue (Steelman et al., 2019; Xue et al., 2012). IT investment for companies to improve firm performance will be determined by external factors such as competition and the industrial business environment (Xue et al., 2012). Digital business strategy arises from the interaction between current business strategies and variations in the industrial environment (Sabherwal et al., 2019; Winarno and Tjahjadi, 2017). In a dynamic and complex industrial environment, companies tend to have high sales volatility and heterogeneity of environmental elements (Xue et al., 2012); when companies invest in IT, they will be used to encourage the creation of new products/services so that they can increase revenue.

Sabherwal et al. (2019) stated that IT investment would show a stronger positive relationship to its financial performance when there are more significant environmental changes. The global business, which causes an increasingly dynamic and complex industrial environment characterized by volatile and unpredictable changes (Winarno and Tjahjadi, 2017; Xue et al., 2012), makes the firm's performance fluctuate with high deviations and high levels of competition and will be risky for the future. IT investment can be a solution in stabilizing firm performance in a dynamic environment because IT can maintain the firm's competitive advantage. Therefore, IT investment will be able to reduce the volatility of the firm's financial performance in a dynamic and complex industrial environment. That is, the significant change referred to in this research is that IT investment will have a more significant and more prominent effect on performance, which shows low volatility when the company is in a dynamic, turbulent environment, which tends to be an unpredictable change in the industry (Kobelsky et al., 2008a; Stoel and Muhanna, 2009). Based on this explanation, the following hypothesis can be formulated.

H2a: Time lag effect of IT investment will have a stronger impact on the firm's financial performance volatility in dynamic environmental conditions.

IT expenditure is carried out by companies when associated with a strategic emphasis on IT investment (IT strategic emphasis). The choice of strategy is an expression of the dominant strategic goals of each company (Mithas and Rust, 2016). The strategy for IT for the company will impact the choice when determining the type of technology and application that will be used to achieve good IT governance for the company (Mithas and Rust, 2016).

IT investment-oriented companies for infrastructure, transaction, informational and strategic purposes will provide different benefits (Aral and Weill, 2007). Emphasizing the cost reduction strategy, it will be more appropriate for companies to invest in IT with transactional and informational types. Mithas and Rust (2016) state that companies with the main emphasis on IT investment on revenue or cost (revenue or cost emphasis) have lower benefits than companies with dual emphasis orientation. Companies that carry out IT exploration with an emphasis on dual strategies will benefit from lowering

costs and increasing revenues. Under these conditions, companies that invest in IT will maintain the volatility of future financial performance by emphasizing this strategy. Based on this explanation, the following hypothesis can be formulated.

H2b: Time lag effect of IT investment has a stronger impact on the firm's financial performance volatility when setting a dual strategic emphasis strategy than a single strategic emphasis.

Ⅳ. Research Methodology

4.1. Data and Samples

Our sample comprises 603 firm-year observations from the company's listed on the Indonesia Stock Exchange (IDX) covering 2013 – 2017. We collected data from the annual report and Indonesian Capital Market Directory (ICMD). We eliminate firm-year observations due to missing observations or variables. The five years is expected to provide an overview of the time lag problem in several previous studies. The second reason, several studies have different results regarding the impact of the lag time in IT investment ranging from one to four years (Brynjolfsson, 1993; Campbell, 2012; Cline and Guynes, 2001; Lee and Kim, 2006), so that the period in this study is expected to provide consistent results.

4.2. Variables and Measurement

4.2.1. Dependent Variable

Firm financial performance is measured accounting basis. Performance proxies related to accounting in this study use several proxies that have been used in previous research (Aral and Weill, 2007; Hitt and Brynjolfsson, 1996; Mithas and Rust, 2016; Thakurta and Guha Deb, 2018; Winarno, 2019), namely Return on Assets (ROA), and Return on Sales (ROS). The firm's financial performance's volatility is the standard deviation of changes in financial performance obtained from either the ROA or ROS ratios within a particular year. This study uses two years, namely, financial performance (t + 1 and t + 2), which is calculated from the time after IT investment.

4.2.2. Independent Variable

The independent variable in this study is IT investment. IT investment is defined as capital expenditure related to IT investment (IT Spending), either capitalized or directly financed in the current period. IT investment consists of tangible assets (such as hardware, data storage, and networking) and intangible assets (Aral and Weill, 2007; Chari et al., 2008; Mithas and Rust, 2016; Ravichandran et al., 2009). We operationalize IT investment by proxying the firm's IT expenditure change divided by its total assets (Xue et al., 2012). Using this proxy shows the ratio of the increase in IT investment compared to the company's total assets. Based on this measure, the impact of increasing IT investment in the previous period will be visible, and the performance achieved will be clearly measurable. The following is a formula for measuring IT expenditure.

$$ITEXPA_{it} = \frac{Total\ IT\ investment_{\ it} - Total\ IT\ investment_{it-1}}{Total\ Aset_{it}}$$

4.2.3. Moderating Variables

This study has two moderating variables: the dynamic industrial environment and IT strategy

emphasis. The industrial environment of the company i in period t (IE_{ijt}) is operationalized as a standard deviation in the level of industrial sales over several periods by regressing industry net sales (*INS*) as the dependent variable and period as the independent variable (Sabherwal et al., 2019), the standard error value of the independent variable is sales volatility (Ensley et al., 2006; Sabherwal et al., 2019; Xue et al., 2012).

$$INS_{jt} = \beta_0 + \beta_1 t + e_{jt}$$

The total value of industry net sales is calculated using the formula $INS_{jt} = \sum_{i=1}^{n_j} NS_{ijt}$. NS_{ijt} is the *Net Sales* firm i in industry j in year t.

The second moderating variable is the strategic emphasis on IT investment (strategic emphasis). Mithas and Rust (2016) state that there are three choices made in strategic decisions to invest in IT, namely cost reduction (cost reduction emphasis), revenue expansion (revenue expansion emphasis), and emphasis on both (dual emphasis). IT Strategic emphasis is measured using dummy variables, namely 1 for dual emphasis and 0 for single emphasis.

4.2.4. Control Variables

The control variables in this study are divided into company level (firm-level) and industry level (industry-level). The company-level control variables used are (1) *firm size* Company size is included as a control variable because the size of the company impacts economies of scale and has an impact on firm performance. Company size in this study is proxied by total assets (Bharadwaj et al., 1999; Chari et al., 2008; Mithas and Rust, 2016); (2) *Leverage-*LEV_{it}: Leverage measures the book value of liabilities against the book value of equity which shows that when it is higher, it will reduce the firm's performance (Winarno et al., 2021); (3) *R&D Investment-*$RDEXP_{it}$: the R&D carried out is an indication that the company has a goal to improve performance by conducting research and innovation whose impact will improve the firm's financial performance (Bharadwaj et al., 1999; Chari et al., 2008; Mithas and Rust, 2016); (4) *Advertising intensity-* $ADVEXP_{it}$: advertising spending is part of a strategy to increase market share, the impact of which is to increase firm performance (Chari et al., 2008; Mithas and Rust, 2016); and (5) *Market Share-*MS_{it} (Bharadwaj et al., 1999; Chari et al., 2008).

The industrial level control variable used is an *Industry Sales Growth-*ISG_{it}. ISG is an increase in the firm's sales growth ratio compared to the same group industry. An increase in ISG will impact the firm's financial performance (Chari et al., 2008). Industry sales growth has a score of "1" if the company has a growth ratio from the previous period. On the contrary, a score of "0" if the company does not grow, and even there is a decrease in sales compared to the average industry sales.

4.3. Model Specification

Models in equations 1, 2, and 3 are autoregressive models used to test this study's hypothesis.

$$VFP_{it} = \alpha + \beta_1 FPV_{it-1} + \beta_2 ITEXPA_{it-1} + \beta_3 ITEXPA_{it-2} + \beta_4 MS_{it} + \beta_5 TA_{it} + \beta_6 ISG_{it} + \beta_7 ADVEXP_{it} + \beta_8 RDEXP_{it} + \beta_9 LEV_{it} + \varepsilon_{it} \quad (1)$$

$$VFP_{it} = \alpha + \beta_1 FPV_{it-1} + \beta_2 ITEXPA_{it-1} + \beta_3 IE_{it-1} + \beta_4 ITEXPA_{it-1} IE_{it-1} + \beta_5 MS_{it} + \beta_6 TA_{it} + \beta_7 ISG_{it} + \beta_8 ADVEXP_{it} + \beta_9 RDEXP_{it} + \beta_{10} LEV + \varepsilon_{it} \quad (2)$$

$$VFP_{it} = \alpha + \beta_1 FPV_{it-1} + \beta_2 ITEXPA_{it-1} + \beta_3 ITSE_{it-1} + \beta_4 ITEXPA_{it-1} ITSE_{it-1} + \beta_5 MS_{it} + \beta_6 TA_{it} + \beta_7 ISG_{it} + \beta_8 ADVEXP_{it} + \beta_9 RDEXP_{it} + \beta_{10} LEV + \varepsilon_{it} \quad (3)$$

The best estimation results will be obtained assuming that the regressor variables are strictly exogenous and can control unobservable effects. A dependent lag in this research model, which is strictly not exogenous, is one of the causes and makes the model a dynamic endogeneity problem (Bond, 2002; Ullah et al., 2018). The parameter estimation method of the dynamic panel data model will be more appropriate for GMM because this approach considers the correlation between the dependent variable lag and the residue.

Ⅴ. Empirical Results and Discussion

5.1. Sample Characteristics

<Table 1> shows that in the service sector (ISS - 6, 7, 8, 9), as many as 494 (82%) observations, and in the manufacturing or processing sector (ISS - 3, 4, 5), as many as 104 (17%) observations, and the remaining 5 (1%) observations are industrial sectors producing raw materials. Based on the sample pattern in this study, it can be concluded that the category of companies in the service sector is more numerous, dominates the sample, and shows that service compa-

<Table 1> Sample Distribution

Panel A: Sample Selection	
	Sample size
1. Firm-year observations of companies listed on IDX between 2013 - 2017	2,480
2. Missing observations to calculate IT Investment	(1,670)
3. Missing observations in obtaining other explanatory variables in IDX	(100)
4. Missing observations in obtaining other control variables	(107)
Firm-year observation for data analysis	603

Panel B: Sample Distribution by Year		
Year	Firm-year Observations	Percent (%)
2013	113	18.74
2014	124	20.56
2015	127	21.06
2016	122	20.23
2017	117	19.40
Total	603	100.00

<Table 1> Sample Distribution (Cont.)

Panel C: Sample Distribution by Industry Sub-sector (ISS) Classification						
ISS-1	ISS-2	Industrial Classification	All			
			ISS-2		ISS-1	
			n	%	n	%
Mining	2.2	Oli and Gas	5	1	5	1
Basic and Chemical Industry	3.1	Cement	12	2	38	6
	3.2	Ceramics, Porcelain, and Glass	8	1		
	3.3	Metal and allied product	5	1		
	3.5	Plastics and packaging	3	0		
	3.6	Animal feed	5	1		
	3.8	Pulp and paper	5	1		
Others Industry	4.2	Automotive and Components	5	1	15	2
	4.3	Textiles and Garments	5	1		
	4.5	Cable	5	1		
Consumer Goods Industry	5.1	Food and Drink	16	3	51	8
	5.2	Cigarette	4	1		
	5.3	Pharmaceuticals	11	2		
	5.4	Cosmetics & Household Goods	18	3		
	5.5	Houseware	2	0		
Property and Real Estate	6.1	Property and Real Estate	21	3	38	6
	6.2	Building construction	17	3		
Utility Infrastructure and Transportation	7.1	Energy	9	1	73	12
	7.2	Toll Roads, Seaports, Airports & others	5	1		
	7.3	Telecommunication	23	4		
	7.4	Transportation	23	4		
	7.5	Non-Building Construction	13	2		
Finance	8.1	Bank	132	22	209	35
	8.2	Financial institutions	19	3		
	8.3	Securities Company	19	3		
	8.4	Insurance	26	4		
	8.5	Other Sectors	13	2		
Trade-in Services and Investment	9.1	Wolesale	24	4	74	29
	9.2	Retail	34	6		
	9.3	Restaurants, Hotels, and Tourism	28	5		
	9.4	Advertising, Printing, and Media	26	4		
	9.5	Healthcare	11	2		
	9.6	Computer and Services	30	5		
	9.7	Investment company	14	2		
	9.8	Others	7	1		
Observation (n - %)			603	100	603	100

nies need IT investment more than other sectors.

Analysis of the level 2 industrial sub-sector (ISS-2), the results of <Table 1> (Panel C) show that of the largest sector, namely the service sector, the financial industry sub-sector (8.1; 8.2; 8.3; 8.4; and 8.1) dominates with 209 (35%) observations IT-invested financial companies. The financial industry sub-sector that invests the most in IT is the banking industry sub-sector with 132 (22%) observations, while the remaining 13% is the insurance sub-sector (4%); financing institutions sub-sector (3%); securities company sub-sector (3%); and other sectors 2%. The research sample shows that banking companies dominate IT investment in the financial industry. It provides evidence that the banking industry is an industry group whose main activity rests on IT investment used and is heavily influenced by IT developments.

<Table 2> is a descriptive statistical value that is an initial description of the research variables used to test the model. Descriptive statistics can provide an initial report of the data patterns of each variable. The average IT investment in the research sample companies was IDR 310,453 million per year. The average has also increased for the last three years, namely in 2015, 241,182 million. In 2016, the average was 277,940 million; in 2017, the average was 322,118 million. The upward trend over the three years showed that the average year-to-year increase in IT investment was approximately 15% from the previous year. These results indicate that companies in Indonesia make additional IT investments every year. The average IT investment/expenditure on sales each year is 3.5%.

5.2. Discussion

<Table 3> shows a correlation between IT investment (ITEXPA - as measured by the total logarithm of IT investment/ total assets) and three accounting-based financial performance measures (ROA and ROS). IT investment has a negative correlation with ROA and ROS. <Table 4> and <Table 5> provide the results of the primary analysis.

5.2.1. IT Investment and Financial Performance Volatility

Hypothesis 1 in this study states a relationship between a lag effect of IT investment and the firm's financial performance volatility. The results according to <Table 3> show that IT investment in the lag of one year shows a statistically significant and negative impact (-2.272, and significant at the 1% level)

<Table 2> Descriptive Statistics

	VROA	VROS	ITEXPA	MS	TA	ISG	ADVEXP	RDEXP	LEV
Mean	0.037391	0.630986	0.006134	0.142057	0.503753	0.514096	131066.7	30452.84	2.435755
Median	0.012446	0.030143	0.000669	0.044327	0.067328	1	7601	0	1.306795
Maximum	2.264775	134.3478	0.194152	1	203.678	1	5268000	3092853	18.20747
Minimum	0	0	5.97E-07	9.53E-05	-13.54069	0	0	0	-10.06
Std. Dev.	0.123463	7.271414	0.023083	0.221326	8.578909	0.500216	451936.9	266209.4	2.970134
Skewness	12.8321	16.58676	5.956717	2.21642	22.3382	-0.05641	7.105197	10.32334	1.269064
Kurtosis	206.7388	286.0201	41.56426	7.40662	524.7373	1.003182	63.41214	110.7894	6.306593
Sum	22.5469	380.4846	3.698557	85.66022	303.7628	310	79033250	18363061	1468.76
Sum Sq. Dev.	9.176325	31829.82	0.320747	29.48917	44305.8	150.6302	1.23E+14	4.27E+13	5310.66
Observations	603	603	603	603	603	603	603	603	603

<Table 3> Correlations Matrix Among Variables

	1	2	3	4	5	6	7	8	9	10
VROA	1									
VROS	.411**	1								
ITEXP	0.041	-0.006	1							
ITEXPA	-0.032	-0.007	.649**	1						
MS	0.008	-0.029	.188**	0.043	1					
TA	-0.064	0.038	-0.006	-0.017	-0.031	1				
ISG	-0.061	-0.004	0.045	-0.01	0.056	-0.025	1			
ADVEXP	-0.01	-0.022	.675**	.342**	.325**	-0.013	0.041	1		
RDEXP	.082*	-0.006	-0.014	-0.02	.316**	-0.004	0.017	.281**	1	
LEV	-.179**	-0.042	-0.039	-.096*	-.175**	-0.035	0	-0.006	-0.008	1

Notes: ***, **, and * denote, respectively, significance at the 1, 5, and 10 percent levels, based on two-tailed tests.

on the firm's financial performance volatility. Furthermore, lag year 2 shows a statistically significant and positive result (3.0337, and significant at the 1% level). This condition illustrates that changes in volatility will be stable in a certain period and after the investment is stable in providing benefits. IT investment enables companies to reduce the risk of changing technology-based environments, thereby reducing revenue volatility. However, the time lag effect of IT investment on the volatility of optimal financial performance will differ in each industry depending on the learning process and the dynamics of the industry environment (Winarno et al., 2021).

5.2.2. Moderating Role of Industry Environment and IT Strategy Emphasis on the relationship between IT Investment on Financial Performance Volatility

<Table 4> shows that IT investment will effectively reduce the firm's financial performance volatility at a one-year lag. Therefore, in this section, to test the consistency of these results by adding moderating variables, namely the industrial environment and IT strategy emphasis, testing is only carried out with a lag of 1 year. The parametric estimation of the model in this section uses the GMM approach. The estimation results in <Table 5> indicate that the model being tested shows that the instrument variables used

<Table 4> IT Investment and Financial Performance Volatility – Fixed Effect

Variables	VROA (Model 1)	VROS (Model 2)
C	0,0628	0.3030
ITEXPA(-1)	-2.2720***	-13.635***
ITEXPA(-2)	3.0337***	19.328***
MS	-0.0435	-0.5493*
TA	-0.0116***	0.4136***
ISG	-0.0076	0.064099
RDEXP	-3.16E-08	-2.28E-07
AVEXP	2.35E-08	1.78E-07
LEV	-0.0065***	-0.0454*
Industry Dummies	Included	Included
Year Dummies	Included	Included
Observation	603	603
Adj R^2	0.237469	0.4604
F Statistic	13.495***	35.246***

Notes: This table contains testing the relationship between IT Investment and Financial Performance Volatility (VROA and VROS) with fixed effect.
***, **, and * denote, respectively, significance at the 1, 5, and 10 percent levels

<Table 5> Industry Environment, IT Strategy Emphasis, IT Investment, and Financial Performance Volatility – System GMM Two-step Estimators with Robust Standard Error

Variables	DV= VROA (Model 1)	DV= VROS (Model 2)
VROA(-1)	0.4657***	
VROS(-1)		0.4925***
ITEXPA(-1)	0.1449*	0.1777***
IE(-1)	0.8893***	0.8746***
ITSE(-1)	0.6286***	0.5421***
ITEXPA(-1)* IE(-1)	0.3313***	0.3107***
ITEXPA(-1)*ITSE(-1)	0.2058***	0.1848***
MS	0.1946	0.2729
TA	-0.0576	-0.0538
ISG	0.2809	0.2564
RDEXP	-0.3787***	-0.4276***
ADVEXP	0.8050	0.2308
LEV	-0.4213	0.3817
Observation	603	603
AR(1)	0.0325**	0.0238**
AR(2)	0.5668	0.8723
Hansen J test	4.2998	3.2619
Prob(J-statistic)	0.5071	0.6596

Notes: This table contains the results of testing the moderating role of Industry Environment and IT Strategy Emphasis on the impact of IT Investment and Financial Performance Volatility (VROA and VROS) with the System-GMM estimation technique two-step estimators with robust standard errors.
***, **, and * denote, respectively, significance at the 1, 5, and 10 percent levels
DV = Dependent Variable

in the model are valid so that the resulting model estimates can be consistent and efficient. Furthermore, the first-order serial correlation (AR 1) for the four research models has a serial correlation in the first order. In contrast, the second-order serial correlation (AR 2) has no serial correlation in the second order, so the assumptions for the two models are fulfilled. The results of hypothesis testing can be presented briefly as follows.

Hypothesis 2a in this study examines the moderating role of the industrial environment in the relationship between a lag effect of IT investment and financial performance volatility. This study looks at the impact of the company's industrial environmental factors, namely the dynamic environment, measured by the volatility in industrial sales. The results in <Table 5> provide evidence that the industrial environment has a role in moderating or strengthening the positive relationship between the time lag (1 year) of IT investment and the volatility of the firm's financial performance as measured by VROA, and VROS. It can be seen from the large value of the interaction coefficient of IT investment with the industrial environment on firm financial performance, which shows a positive and significant coefficient with VROA performance (coefficient 0.3313, and significant at 1% level), and VROS performance (coefficient 0.3107, and significant at the 1% level).

This result means that the higher and more dynamic the industrial environment is, the stronger the relationship between a lagged IT investment and the firm's financial performance volatility will be. These results show that companies that invest in IT and are in a dynamic environment will have a high level of future economic performance volatility. IT investment will have a stronger positive relationship with firm financial performance volatility in the form of profitability (ROA and ROS) when the company is in a dynamic environment indicated by high sales volatility. Conversely, IT investment will have a negative or weaker relationship with its firm financial performance volatility in a simple and static environment, namely in an industrial environment with medium or low sales volatility (Li and Ye, 1999; Xue et al., 2012).

Companies in a dynamic industrial environment will find it challenging to maintain their competitive advantage and affect company productivity (Mithas et al., 2013; Revilla et al., 2013). Dynamic environ-

ments have unpredictable trends and developments, but the other side of the environment also provides opportunities that come and go very quickly (Li and Ye, 1999). One of the company's efforts to respond to this environment is that it invests in IT, the primary business resource and the key to long-term competitive advantage. In the early stages/of a year, IT investment's value will increase the firm's financial performance volatility, especially in companies with dynamic industrial environments. These results may not provide good information about the consistency with the hypotheses and theories on the relationship between IT investment and its financial performance volatility under dynamic environmental conditions. However, different IT investments can depend on the size of the company and the type of IT investment implemented. This condition will interfere with the sensitivity of the test results of the research model. To test the sensitivity of the results in <Table 5>, we tested the magnitude of IT investments in each

<Table 6> Sub-sample test: Industry Environment, IT Strategy Emphasis, IT Investment and Financial Performance Volatility – System GMM two-step estimators with robust standard error

Variables	DV: VROA				DV: VROS			
	Model 1 IV: ITEXPA(-1) MV: IE		Model 2 IV: ITEXP(-1) (MV: ITSE)		Model 3 IV: ITEXPA(-1) MV: IE		Model 4 IV: ITEXP(-1) (MV: ITSE)	
	Low	High	Low	High	Low	High	Low	High
VROA(-1)	0.3529***	0.6928***	0.8802**	0.0088**				
VROS(-1)					0.0875***	0.1848**	0.4114**	0.14688**
ITEXPA(-1)	9.3616	2.7232**	6.5022	1.9501***	628.151	6.6488***	5.381*	1.5962**
IE(-1)	-1.13E-05	-1.33E-05*			2.74E-05	2.35E-06		
ITSE(-1)			6.39E-06	2.92E-06			1.92E-05	9.83E-05**
ITEXPA(-1)* IE(-1)	-0.0014	-0.0007**			-0.0124**	-0.0016***		
ITEXPA(-1)*ITSE(-1)			-0.0047**	-0.0004***			-0.0055**	-0.0004**
MS	0.0084	0.0244*	-0.0029	-0.0066	0.0028	0.0007	-0.0119	-0.0019
ISG	0.0004	0.0038	-0.0002	0.0031***	0.1142***	0.0044***	0.111***	0.0054***
RDEXP	8.98E-08	5.68E-09	-1.74E-09	5.54E-08**	-4.05E-09	1.40E-07***	-7.09E-07	-6.90E-09
ADVEXP	7.28E-10	8.97E-11	-2.71E-11	-8.47E-10**	-1.67E-10	-2.23E-09**	-2.47E-09	2.17E-11
LEV	-0.0078	-0.0035	-0.0001	0.0047**	-0.0109	0.0028	-0.0198	-0.0026
Observation	339	264	339	264	339	264	339	264
AR(1)	0.0556*	0.0138**	0.0522*	0.0100**	0.0549*	0.0431**	0.0019***	0.0177**
AR(2)	0.4626	0.4667	0.2029	0.1632	0.2735	0.5081	0.1177	0.4110
Hansen J test	3.9118	4.8486	5.3234	6.0212	2.8169	3.6759	5.6975	3.4951
Prob(J-statistic)	0.5621	0.5346	0.3777	0.3042	0.7282	0.5969	0.3368	0.6241

Notes: This table contains the results of testing the moderating role of Industry Environment and IT Strategy Emphasis on the impact of IT Investment and Financial Performance Volatility (VROA, and VROS) with the System-GMM estimation technique two-step estimators with robust standard errors.

***, **, and * denote, respectively, significance at the 1, 5, and 10 percent levels

company category presented in <Table 6>.

Hypothesis 2b in this study examines the moderating role of IT Strategy Emphasis on the relationship between the lag time in IT investment and its financial performance volatility. The selection of types and the number of IT expenditures invested in the company to improve its performance are contingent on the specified strategic emphasis. Four categories of IT assets are invested in a company: IT infrastructure, transactional IT, informational IT, and strategic IT (Aral and Weill, 2007). The four categories each have their expected performance benefits. <Table 5> shows that the IT strategic emphasis statistically affects the relationship between IT investment (a lagged year) and the firm's financial performance volatility as measured by VROA and VROS. It can be seen from the large value of IT investment (t-1) interaction coefficient with IT strategic emphasis (t-1) on the firm's financial performance volatility. Its value is positive and significant with the financial performance volatility-VROA (coefficient 0.2058, and significant at level 1%) and financial performance volatility-VROS (coefficient 0.1848, and significant at 1% level). The three elasticity coefficients of the ITEXPA variable (-1) have increased after the variable has interacted with the ITSE variable (-1), which means that the ITSE (-1) variable has a moderating role in strengthening the relationship between a lag effect IT investment and the volatility of the firm's financial performance. This result means that IT investment will have a stronger positive relationship to the firm's financial performance volatility in profitability (ROA and ROS) when the company emphasizes the choice of IT strategy dual emphasis.

5.2.3. Sensitivity test analysis for the subsample of firm size and IT Investment

<Table 5> shows that the period after IT investment in high environmental uncertainty (dynamic) conditions will result in higher volatility in the firm's financial performance. This result contradicts the evidence in hypothesis 1, which states that IT investments can reduce the volatility of firm performance in later periods.

We try to examine the impact of environmental uncertainty on the ability of IT investment to reduce the volatility of the firm's financial performance by dividing the sample into companies with above-average IT investment values (high category) by comparing companies that invest in IT below average (low category). This treatment is based on the argument that large companies with high IT investments have the potential to attract investors, seen from the certainty of providing stable profits in the future by investing in IT.

Future certainty by investing in IT can be a company to win the competition, increasing performance certainty and lowering financial performance volatility. <Table 6> shows empirical evidence on all models and confirms with theory, both under conditions of high environmental uncertainty (H2a supported) and the emphasis of IT strategy on the dual emphasis (H2b supported). IT investments will decrease a firm's financial performance volatility with ROA volatility proxies and ROS volatility. Therefore, IT investment in a dynamic environment and applying dual emphasis will provide benefits to stabilize the volatility of future financial performance. Only one result in model 1 shows that IT investment cannot reduce the volatility of financial performance in conditions of high environmental uncertainty, namely in conditions of small companies and below-average IT investments. The condition of companies in this category shows that small companies that force themselves to continue investing in IT in conditions of high environmental uncertainty still provide high financial performance volatility. Companies that do not have a strong asset structure in the face of uncertainty will be at risk

of investing in IT. In other words, IT investment is risky for small companies, especially with high environmental uncertainty, especially IT investments emphasizing efficiency and innovation.

Aral and Weill (2007) stated that when a company invests in IT included in the infrastructure and informational category, it is strategically oriented to obtain lower costs. In the long run, it aims to get higher profitability. A company invests in IT only as a transactional IT asset investment with a strategic objective to automate the process. The expected benefit the company will get is only a lower cost (cost reduction). Emphasis on IT investment strategy with a dual strategy orientation will be more difficult to replicate than an investment that is only oriented to a single strategy. A dual strategy-oriented form of IT investment is one way for companies to make these assets imperfectly imitable for other companies because it will be more difficult to imitate these investments (Mithas and Rust, 2016).

This research contributes to theory development, especially to the literature related to RBT theory. The second theoretical contribution is that while some studies still find the IT productivity paradox, this study proves that productivity is obtained when the time lag for IT investment can reduce future firm financial performance volatility.

Ⅵ. Conclusions, Limitations, and Suggestions

6.1. Conclusions

IT investment is a form of capital expenditure to acquire assets for transactional, tactical, or strategic purposes (Cline and Guynes, 2001). The expected performance achieved by the company may be obtained at the time of investment (immediate). It may also require time (lag) so that the IT investment can provide optimal benefits for the firm (Campbell, 2012; Devaraj and Kohli, 2003; Khallaf et al., 2017), which will lead to volatility in the firm's financial performance.

This study provides evidence that a one-year time lag on IT investment has a negative impact on the firm's financial performance volatility. The company will obtain the relationship between financial performance volatility and profitability after one year of IT investment (t + 1). Furthermore, at a time lag of 2 years after IT investment, there is a positive impact on the firm's financial performance volatility. An organizational learning process, structural effects, and complementary effects need to be understood. Thus, there will be a time lag for IT implementation so that benefits are obtained by the firm (Shaft et al., 2007). The different impact of the one and 2-year time lag shows that the benefits of IT investment in reducing risk in the form of financial performance volatility are in year 1.

In contrast, in year two, it will add positive volatility to the firm's financial performance in the form of ROA and ROS volatility. This study also shows that the relationship between IT and the firm's financial performance volatility will be stronger in a dynamic, unpredictable, and rapidly changing environment. In a dynamic environment, IT owned by the company will explore to create innovations, while in a static condition, IT will tend to be used to increase efficiency (Xue et al., 2012).

The strategic emphasis on IT investment spending is also a contextual variable that affects the relationship between IT investment and company performance. Our research proves that IT investment will significantly decrease the firm's financial performance volatility for companies investing in dual emphasis orientation than when the company only emphasizes

one of reducing costs or increasing revenue. Companies will benefit from their IT performance when they can intelligently manage and organize their IT capabilities to realize the increased dual strategy emphasis (Aral and Weill, 2007).

This research contributes to theory development, especially to the literature related to RBT theory. The second theoretical contribution is that while some studies still find the IT productivity paradox, this study proves that productivity is obtained when the time lag for IT investment can reduce future firm's financial performance volatility. Our study helps understand that IT investment will significantly reduce the firm's financial performance volatility depending on contextual aspects such as the industry environment and strategic factors.

6.2. Limitations

Several limitations can be identified in this study. First, the limitations of the search model for disclosure of IT investment in financial statements occur when it is likely that the company that has IT investment does not specifically segregate into certain account classifications/fixed asset classifications, then that company will not be included in the research sample. Second, this study has a short observation period of 5 years, so it cannot test the impact of time lag on long-term effects. Third, the IT investment is measured by the total change in the firm's IT investment. It is also unable to control the impact of continuous IT implementation or new during the observation period, as well as controlling investment in the form of program packages or developing and customizing itself.

6.3. Suggestions

Based on some of the research limitations in the previous section, several suggestions can be used for further research, namely: First, researchers need to classify companies that are high technology and low technology first. Companies that fall into the high technology category tend to disclose IT investments explicitly. Second, future research can extend the research period but must also have balanced panel data to test long-term impacts. Third, following the limitations of the IT investment categorization, further research can justify/or create sample groups according to the type of classification on investment, namely types of strategic IT investments, tactical IT investments, threshold IT investments, and tractional IT investments. Future researchers can also use other techniques to get pieces of IT investment in the company so that the impact of new IT investment can be seen with the effects of sustainable IT investment.

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