Research Article

Effect of Firm Characteristics and Enterprise Risk Management on Firm Performance: Empirical Study of Listed Companies in SET100 Index

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ABSTRACT

This study aims to explore the influence of enterprise risk management (ERM) adoption on the firm performance by exploring the influence of 2017 COSO ERM adoption on the firm performance of listed firms in SET100 from 2015 to 2017. The study observes 298 firm-years by using multiple regression analysis. Results show that ERM adoption negatively affects firm value. ERM is possibly used as a risk management technique by firms with high risk exposure due to high operating leverage. This suggests that ERM may be a tool for risk management, but it does not indicate that the firm is performing well.

Keywords: COSO, Enterprise Risk Management, Firm Value

บทความวิจัย

ผลกระทบของลักษณะของบริษัทและการบริหารความเสี่ยงทั่วทั้งองค์กรต่อผลการดำเนินงานของกิจการ : กรณีบริษัทจดทะเบียนในตลาดหลักทรัพย์ในกลุ่ม SET100 INDEX

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บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาผลกระทบของการนำการบริหารความเสี่ยงทั่วทั้งองค์กร (Enterprise Risk Management: ERM) มาใช้ต่อผลการดำเนินงานของกิจการ โดยแสดงถึงผลกระทบของการนำ 2017 COSO ERM มาใช้ต่อผลการดำเนินงานของบริษัทใน SET100 ตั้งแต่ปี พ.ศ. 2558 ถึง 2560 การศึกษานี้วิเคราะห์ข้อมูล 298 ตัวอย่าง โดยใช้การวิเคราะห์ถดถอยพหุคูณ ผลการศึกษาพบว่า การนำ ERM มาใช้มีผลกระทบทางลบต่อมูลค่าของกิจการ ซึ่งมีความเป็นได้ว่าการใช้ ERM ในประเทศไทยนั้น ถูกนำมาใช้ในกิจการที่มีความเสี่ยงสูงซึ่งสังเกตได้จากการมี operating Leverage สูง ดังนั้น การศึกษานี้จึงชี้ให้เห็นว่า ERM อาจเป็นเครื่องมือสำหรับการช่วยจัดการความเสี่ยง แต่ไม่ได้บ่งบอกว่ากิจการต้องมีผลการดำเนินงานที่ดี

คำสำคัญ: โคโซ่ การบริหารความเสี่ยงทั่วทั้งองค์กร มูลค่ากิจการ

1. Background of the Study

The proposed study examines the influence of enterprise risk management (ERM) on the financial performance of Thai firms. ERM is described as a systematic practice of risk management in the organization which treats risk as a concern for the entire organization (Nocco & Stultz, 2006). ERM is a relatively new organizational management practice which draws on a body of theoretical and empirical organizational research and practice in 1940s and 1950s (Dickinson, 2001). The main impetus for adoption of ERM is the emerging focus on shareholder value during the 1990s which leads to the increasing demand for risk management (Dickinson, 2001; Nocco & Stultz, 2006). According to contingency theories of ERM, the structure and practice of ERM depend on the conditions that the firm operates within its organization (Mikes & Kaplan, 2015). There are five conditions to affect how to implement ERM within the firm (Gordon, Loeb, & Tseng, 2009) which include industrial competition, environmental uncertainties, firm size, firm complexity, and monitoring by the board of directors (Gordon, et al., 2009). These conditions are unique for each firm and create differences in the appropriate implementation of ERM. Although ERM is routinely recommended or even required by regulatory authorities as an operating condition for firms, there has been relatively little research into the practice from the management perspective (Bromiley et al., 2015). This research, therefore, aims to explore the influence of enterprise risk management (ERM) adoption on the financial performance of Thai publicly listed firms. This study provides academic and practical contributions to the literature on ERM adoption for firms that are establishing an ERM adoption program or those that want to improve the effect of their existing ERM program.

2. Literature Review and Hypotheses Development

ERM emerges as an organizational practice during the mid-1990s, responding to the increased pressure for shareholder value in strategic planning and a growing awareness of the cost of risk to the organization (Dickinson, 2001). There have been multiple definitions of ERM demonstrated in the literature review which mostly focus on organization-wide management of risk (Bromiley et al., 2015).

In 2017, Committee of Sponsoring Organizations (COSO) have launch the new framework of enterprise risk management (COSO-ERM) as COSO-ERM 2017 superseding COSO-ERM 2004 (COSO, 2017). The newest framework integrates risk management into strategy and performance (Enterprise Risk Management—Integrating with Strategy and Performance). It demonstrates a set of 20 principles organized into five interrelated components: governance and culture; strategy and objective-setting; performance; review and revision; and information, communication, and reporting (COSO, 2019). The framework work is developed from the currently dynamic business and economy condition which

require high relevance between risk management and business strategy and performance so that an organization can efficiently pursue it goal.

Many studies have identified antecedents of firm adoption. The most commonly identified positive factors have included firm size and institutional ownership (Gatzert & Martin, 2015; Hoyt & Liebenberg, 2011; Senol & Karaka, 2017). Negative factors have included leverage, asset opacity, and reinsurance use (Hoyt & Liebenberg, 2011) as well as industry competition, firm size, and monitoring by board of directors (Gordon, Loeb, & Tseng, 2009). Firm size, institutional ownership and leverage are three factors identified most frequently.

Gordon, et al. (2009) argued that ERM adoption and performance were dependent on firm size. This relationship has been upheld in empirical tests. According to the literature review of Gatzert, et al. (2015), many previous studies indicated that firm size positively affected ERM adoption. Hoyt & Liebenberg (2011) and Senol & Karaca (2017) also discovered a positive influence of firm size on ERM adoption. Another study in SMEs and large firms supported the positive interaction of firm size and degree of ERM adoption (Paape & Speklé, 2012). Other authors also described that firm size crucially and positively influenced ERM adoption (Desender, 2011; Pagach & Warr, 2007). Overall, the evidence on firm size and ERM adoption strongly supports a positive effect. Hypothesis 1 is stated as follows.

H1: Firm size positively affects ERM adoption.

Institutional ownership is also widely discovered to have a critical influence on ERM adoption, although there are some mixed findings (Mikes & Kaplan, 2013). Gatzert, et al. (2015) found that almost every study they reviewed showed a significant, positive influence of institutional ownership on firm adoption of ERM. Such impact was also found by Hoyt and Liebenberg (2011). The ownership structure of firms, including institutional ownership, is also found to be a factor in both ERM adoption and ERM design choices (Paape & Speklé, 2012). However, there is some conflicting evidence. For example, another adoption study finds that institutional ownership is not a significant factor (Pagach & Warr, 2007). In summary, most evidence on institutional ownership suggests a positive effect. Based on these findings, Hypothesis 2 can be stated as follows.

H2: Institutional ownership positively affects ERM adoption.

Leverage is generally supposed that firms with high leverage (indicating high risk or potential financial distress) would be more likely to adopt ERM (Mikes & Kaplan, 2013). However, the correctness of this supposition is unclear. There were mixed findings in Gatzert, et al.'s (2015) literature review on leverage and ERM adoption because both positive effect and negative effect were equally likely found in many studies while some studies indicated no significant effect. Pagach and Warr (2007) showed a positive influence on ERM adoption. Hoyt & Liebenberg (2011) and Lechner & Gatzert (2018) discovered

a negative impact while Desender (2011) finding did not demonstrate a crucial influence. Therefore, the role of leverage is unclear. Given the slightly more predominant finding in the previous studies, this research supposes a negative effect. Therefore, hypothesis 3 is stated as follows.

H3: Leverage negatively affects ERM adoption.

Following the identification of common factors in ERM adoption, the same three factors are considered for their effects on firm value. The size of the firm has commonly been employed as a control variable in studies of ERM and value of the firm. For example, Gordon et al. (2009) discovered that firm size had a positive and critical influence on firm performance. Another finding demonstrates that firm size slightly and positively impacts firm value (Grace et al., 2015). Several researches which explore the influence of ERM on firm value have also identified firm size as a control variable and most of them find the significant and positive effect (Andersen, 2008; Florio & Leoni, 2017; Lechner & Gatzert, 2018; Lin, et al., 2012; Mackay & Moeller, 2007; Pagach & Warr, 2010; Wu, Marshall, Chipulu, Li & Ojiako, 2014). Only two studies demonstrate that firm size negatively influences firm value (Baxter et al., 2013; McShane, et al., 2011). The general interaction of firm size and firm value is a positive impact. Therefore, Hypothesis 4 states as follows.

H4: Firm size positively affects firm value.

Institutional ownership is believed to affect both ERM adoption and firm value due to the fact that institutional investors are more participated in the firm's management and they demand better risk oversight and risk management compared to other classes of investors (Krause & Tse, 2016). This factor has been tested less than other control variables such as firm size and leverage. There is mixed evidence on the interaction of institutional ownership and firm value. Hoyt & Liebenberg (2011) discovered a positive influence of institutional ownership on firm value under some conditions of ERM implementation. However, other studies have not demonstrated the crucial interaction of institutional ownership and firm value (Baxter, et al., 2013; Wu, et al., 2014). Therefore, the contribution of institutional ownership to firm value is unclear. The general trend of previous findings is a positive effect. Hypothesis 5 is as follows.

H5: Institutional ownership positively affects firm value.

Firm leverage positively affects firm value but this contribution becomes contradictory when the risk adjusted measures of firm value are used (Cheng & Tzeng, 2011; Fang et al., 2009). Firms with low leverage retain a high degree of investment flexibility so they can vastly increase their investments when such investments are required (Marchica & Mura, 2010). Therefore, the negative impact that leverage contributes to firm value is demonstrated in almost all ERM researches (Andersen, 2008; Baxter, et al.

2013; Bertinetti et al., 2013; Florio & Leoni, 2017; Hoyt & Liebenberg, 2011; Lechner & Gatzert, 2018; Lin et al., 2012; Mackay & Moeller, 2007; McShane et al., 2011). Only one study finds a contradictory positive effect (Wu, et al., 2014). Therefore, this study expects the negative effect indicated by these previous studies, as expressed in Hypothesis 6.

H6: Leverage negatively affects firm value.

The final relationship studied is the contribution of ERM adoption to firm value. According to many studies, ERM adoption positively impacts firm value (Gates et al., 2012; Nocco & Stolz, 2006) and the correctness of such effect becomes the main question of this research. Most studies reviewed for this research support the positive influence of ERM on firm value. Andersen (2008) demonstrated the positive contribution of ERM to firm performance, especially in knowledge-intensive industries with high innovation expenditures. Baxter et al. (2013) pointed out a critical and positive impact of ERM implementation on performance in both ROA (operational performance) and Tobin's q (market performance). Bertinetti et al. (2013) identified a critical and positive contribution of ERM to firm performance in European stock market. Florio and Leoni (2017) discovered the impact that the degree of ERM implementation contributes to both market performance and financial performance of Italian firms. Gordon et al. (2009) supported this positive relationship between ERM and firm value in their study of American insurance firms. Grace, et al. (2015) also identified a positive interaction of ERM implementation and market value which was higher in firms with more extensive ERM implementations. Hoyt and Liebenberg (2011) estimated an ERM premium of 16.5% on firm value derived from Tobin's q but Mackay and Moeller (2007) estimated an ERM premium of only 2% to 3% in the oil industry. Similarly, positive findings were found by a study in European markets (Lechner & Gatzert, 2018). For all researches reviewed, it could be highlighted that the impact of ERM implementation was not the strongest (nor the weakest) factor in the model which included several additional firm performance factors as control variables. The coefficients typically ranged between .100 and .200 indicating the small effect of ERM. However, there were a few exceptions because the effect of ERM implementation was stronger (Lechner & Gatzert, 2018). Lin, et al. (2011) identified the contradictory finding on ERM discount of 11.5% in Tobin's q. McShane, et al. (2011) supported traditional risk management (TRM) rather than ERM because of TRM's association with the risk management premium while Wu et al. (2014) found an insignificant contribution of ERM to firm value. The general trend demonstrated in the literature supports a positive influence of ERM implementation on firm value, the seventh and final hypothesis is proposed as follows.

H7: ERM adoption positively affects firm value.

The studies above allow for the formulation of a conceptual framework which covered all seven hypotheses expressed as figure 1.

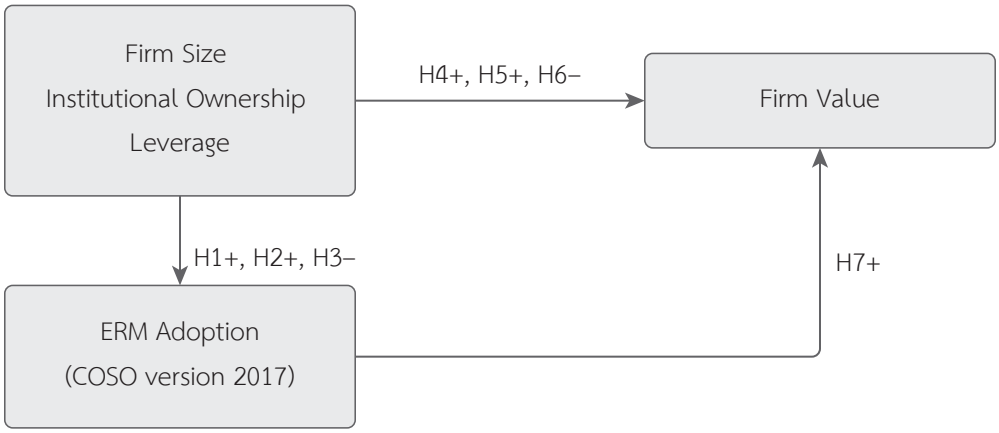

Figure 1: Conceptual framework of the paper

3. Research Methodology

This study observes information from population of listed companies in Thailand. While there is some precedent for investigation of ERM adoption of companies in the literature (Krause & Tse, 2016), this is ruled out for the current study because of the lack of publicly available financial information and potentially incommensurate reporting regimes. In 2018, there were 772 firms listed on the Stock Exchange of Thailand (SET, 2018). This research draws its sample from the SET100, which represents the 100 largest firms listed on the SET by market value (SET, 2019). All firms included in the SET100 index in the years 2015–2017 are included in the dataset which leads to a total sample size of n = 300 firm-years. This study uses a cross-sectional rather than time series approach and data is collected from annual statements (Form 56-1), which are required to be made publicly available under the terms of SET listing.

The variable measurement approach is adapted from previous studies that have investigated the same relationships examined in this study. These variables have standard measures that can be calculated from information in financial statements or extracted directly from these financial statements. The biggest measurement variance is that some studies use a stepped measure or an aggregate index for degree of ERM adoption, rather than a binary variable (Andersen, 2008; McShane et al., 2011; Florio & Leoni, 2017; Gordon et al., 2009). This research uses the similar aggregate index. The ERM adoption measure is based on the 2017 COSO Framework for ERM (COSO, 2017). The COSO framework includes 20 distinct components across five areas of the firm's governance and culture,

strategy and objective-setting, performance, review and revision, and information, communication, and reporting. Each of these items is measured using a binary variable (0 = does not meet condition, 1 = meets condition) with scores aggregated. A score of 20 would indicate 100% ERM adoption while a score of 0 indicates no attempt at ERM adoption. However, for the first principle about exercising board risk oversight, the board meeting practice is rarely appeared even in Thailand so that this study adopts the board meeting practice from IOD New Zealand (2014).

Table 1 summarizes the operationalization and measurement of variables used in the research, including the sources from which the measurements are adapted.

Table 1 Summary of operational variable definitions

Variable	Definition	Sources
Firm Size (SIZE)	Ln (Total Assets)	Andersen (2008) Baxter et al. (2013) Bertinetti, et al. (2013) Florio & Leoni (2017) Gordon et al. (2009) Hoyt & Liebenberg (2011) Lechner & Gatzert (2018) McShane et al. (2011) Senol & Karaka (2017)
Institutional Ownership (INST)	% institutional ownership (interest of the first top 10 shareholders)	Baxter et al. (2013) Bertinetti et al. (2013) Hoyt & Liebenberg (2011)
Leverage (LEV)	Total debt/Total equity	Andersen (2008) Baxter et al. (2013) Bertinetti et al. (2013) Florio & Leoni (2017) Hoyt & Liebenberg (2011) Lechner & Gatzert (2018) Senol & Karaka (2017)
ERM Adoption (ERM)	2017 COSO principle (20 items)	COSO (2017) IOD New Zealand (2014)

Table 1 Summary of operational variable definitions (Cont.)

Variable	Definition	Sources
Firm Value (VALUE)	Tobin's q: (Market Value + Short Term Liabilities + Long Term Liabilities)/Total Assets	Baxter et al. (2013) Bertinetti et al. (2013) Florio & Leoni (2017) Hoyt & Liebenberg (2011) Lechner & Gatzert (2018) Mackay & Moeller (2007) McShane et al. (2011) Senol & Karaka (2017)

This study uses multiple regression analysis. Preliminary analysis includes descriptive statistics for all variables (mean, median, and normality testing). The descriptive statistics are used to investigate the characteristics of individual variable and to examine the extent to which the variables are normally distributed (Denis, 2019). The model used in this study is shown below:

$$ERM_{ij} = f(SIZE_{ij}, INST_{ij}, LEV_{ij}) \quad (1)$$

$$VALUE_{ij} = f(SIZE_{ij}, INST_{ij}, LEV_{ij}, ERM_{ij}) \quad (2)$$

Where i and j are firm and year of samples.

4. Results and Discussion

Data is drawn from the firms included on the SET100 index from 2015 to 2017 which represent a potential 300 firm-years. However, a total of 298 firm-years is included in the data while two firm-years are excluded because of the incomplete data availability.

Table 2 summarizes the descriptive statistics for the variables. Skewness and kurtosis values indicate that the VALUE variable is not normally distributed (with both values > 3). A visual inspection of the distribution of VALUE confirms that it is not normally distributed (see Figure 2). In fact, as this figure shows, all variables display non-normal distributions. However, these variables do not have significant outliers in general, but they were typically either leptokurtic or platykurtic and left-skewed (except for ERM which is left-skewed). Following recommendations about dealing with non-normal distribution of data (Wooldridge, 2013), log transforms are calculated to determine its appropriateness with the result of no concern. The analysis is continued with the non-normal distribution of the data with the acknowledgement that this could make the estimates generated by the OLS process too high (Wooldridge, 2013).

Table 2 Pearson's correlation matrix and descriptive data

	SIZE	INST	ERM	LEV	VALUE
SIZE	1				
INST	0.537**	1			
ERM	0.505**	0.242**	1		
LEV	0.596**	0.227**	0.322**	1	
VALUE	–0.445**	–0.075	–0.232**	–0.222**	1
Mean	11.0	0.435	0.570	2.01	2.20
Median	10.9	0.420	0.600	1.14	1.39
SD	1.61	0.265	0.171	2.25	2.44
Min	7.31	0.00	0.120	0.0854	0.638
Max	14.9	0.925	0.900	10.2	27.0
Skewness	0.449	0.0426	–0.509	1.96	5.79
Std. errors skewness	0.141	0.141	0.141	0.141	0.141
Kurtosis	0.053	–1.38	-0.408	2.98	47.0
Std. error kurtosis	0.281	0.281	0.281	0.281	0.281
Shapiro-Wilk p	< .001	< .001	< .001	< .001	< .001

Note * $p < .05$, ** $p < .01$

The correlation matrix in Table 2 indicates that there are significant and negative correlations between VALUE and SIZE, ERM and LEV but the critical correlation between VALUE and INST is not discovered. The crucial correlations between the internal variables tested in the model are demonstrated but most of these correlations are relatively weak. Only correlations between SIZE and the rest of the variables could be described as moderate ($r > .400$). In addition, given the fact that they are related (for example, larger firms can be expected to have higher institutional ownership), their correlations are not unexpected.

The Shapiro-Wilk test is used to evaluate the normality of errors for all four variables. This test confirms that all variables involved in the model do not display normality of error (which would be indicated by $p > .05$, as normal distribution of error is the null hypothesis of the Shapiro-Wilk test (Wooldridge, 2013).

Hypotheses are tested in two groups of ERM adoption factors (Hypotheses 1 through 3) and firm value factors (Hypotheses 4 through 7). The outcomes of the assumption tests are summarized in the followings. Hypotheses 1 through 3 are tested together. These hypotheses state that SIZE and INST positively affects ERM while LEV has a negative effect. Given the fact that the variables do not have a normal distribution as shown in the descriptive statistics, the robust test of standard errors named Breusch-Pagan test is used to determine the potential problem. The outcome of this Breusch-Pagan test (conducted with the Koenker variant because of the non-normal distribution) is significant ($X^2(3) = 14.580$, $p = .002$) which indicates the rejection of the null hypothesis of homoscedasticity. SIZE is the only variable that displays a critical contribution to the variance. Omitting the SIZE variable leads to a non-significant test ($X^2(2) = .233$, $p = .890$). It can be stated that SIZE has a significantly different distribution of the variance from the other two variables of INST and LEV. All significant effects are due to SIZE. Given the occurrence of heteroscedasticity, SIZE is eliminated from the analysis and the test for ERM adoption is continued with only INST and LEV. Figure 2 shows the actual versus predicted values which indicates that there is not a clear linear distribution between actual ERM and predicted ERM. Finally, the outcome of VIF (Table 3) indicates that there is no evidence of collinearity within the model (VIF < 10).

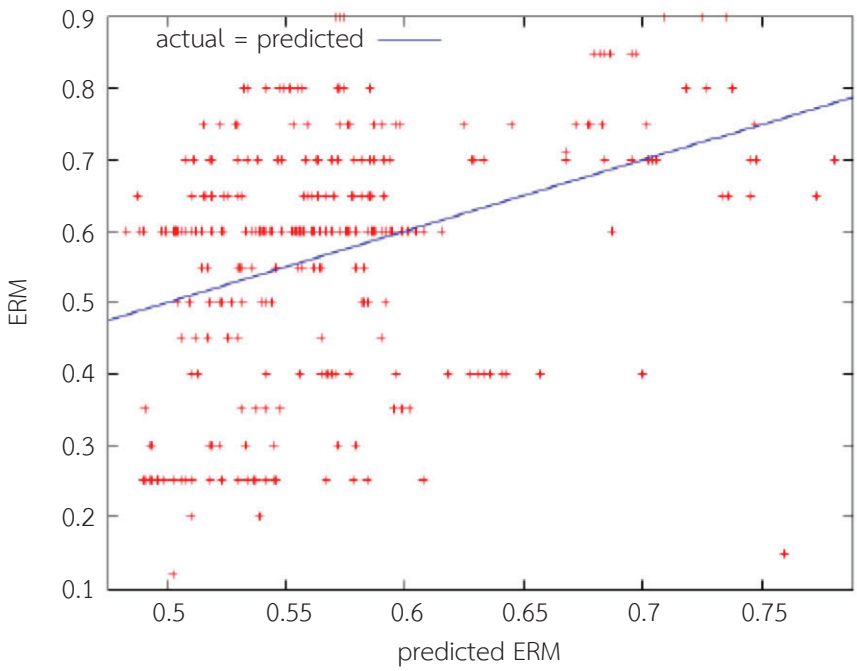

Figure 2 Actual versus fitted observations for ERM (Hypotheses 1 through 3)

Table 3 Variance inflation factor (VIF) (multicollinearity) for Hypotheses 1 through 3

Variables	VIF
INST	1.056
LEV	1.054

In sum, the assumption of homoscedasticity could be met by removing the SIZE variable. The assumptions of normal distribution and linear parameters are not fully met. These assumptions are flexible and indicate the possibility of optimistic estimation of squared errors rather than the inaccurate modelling (Wooldridge, 2013).

Regression outcomes. Table 4 summarizes the regression outcomes generated for this regression test. The outcomes show that both INST and LEV have significant and positive effects on ERM adoption, but INST has a stronger effect than LEV. Even though the test result is significant ($p(F) < .001$), this model is relatively poorly fitted (Adjusted R-square = .128) because it explains only 12.8% of the variance in ERM. This is also reflected in the graph in Figure 2. As a result of this outcome, Hypothesis 1 is not supported because SIZE must be removed from the model due to heteroscedasticity. Hypothesis 2 is supported but hypothesis 3 is not supported. LEV has a weak but significant and positive effect on ERM adoption.

Table 4 Hypotheses 1 through 3 regression outcomes

	Coefficient	t
Const	0.477**	24.80
INST	0.115**	3.173
LEV	0.021**	4.588
Sum squared residuals	7.502	
F	19.283**	
S.E.	0.159	
Adjusted R^2	0.128	

Note regress ERM as dependent variable and * $p < .05$, ** $p < .01$

Hypotheses 4 through 7 state that SIZE, INST, and ERM positively affect VALUE while LEV negatively affects firm value. The assumption testing outcomes, regression results and hypotheses testing summary are explained. The first assumption of OLS is linearity of the model in parameters which is tested by using a graph of the observed versus predicted values (Figure 3). This shows that the bulk of the observed values follow the expected line of the prediction, although there are some outlying values. However, these outliers are not in a position that affects the slope of the prediction line and the investigation of individual points indicates that they appear to be legitimate (although extreme) values. As a result, the analysis is continued with all points in place.

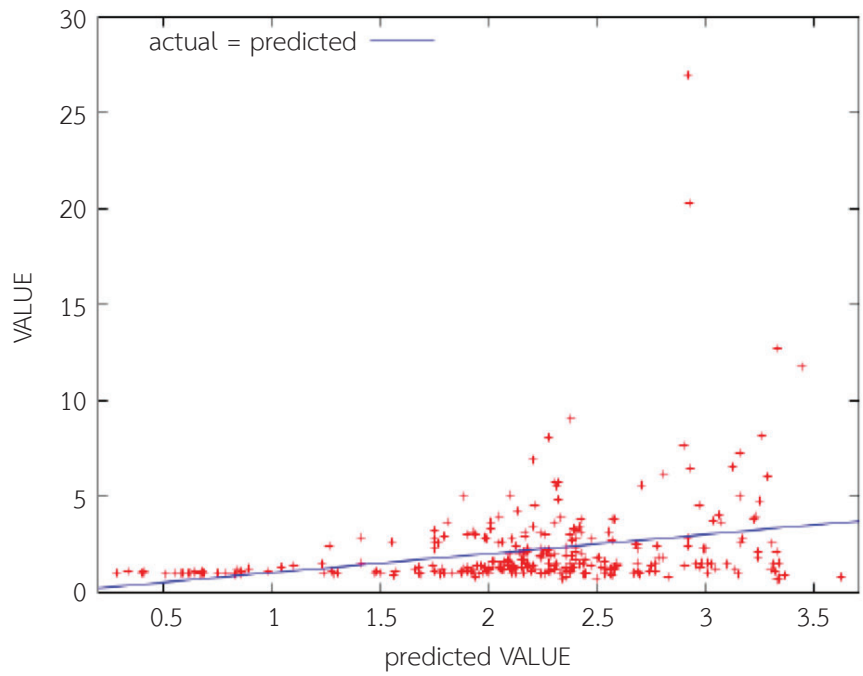

Figure 3 Observed versus predicted values (test of linear parameters) for Hypotheses 4 through 7

The Breusch-Pagan test is used to evaluate homoscedasticity (or homogeneity of variance). Because the data is not normally distributed, the Koenker variant test is used. The outcome ($X^2(4) = 13.269$, $p = .008$) demonstrated the rejection of the null hypothesis of homoscedasticity. SIZE is the only variable that has a significant effect. Upon the removal of SIZE variable from the model, the Breusch-Pagan test indicates the acceptance of the null hypothesis of homoscedasticity ($X^2(4) = 5.828$, $p = .120$). As a result, this variable is removed from the model.

The variance inflation factor (VIF) is utilized to estimate the collinearity of all independent variables in the model (Table 5). These statistics display adequate independence (VIF < 10) therefore the model is acceptable.

Table 5 Variance inflation factor (VIF) (multicollinearity) for Hypotheses 4 through 7

Variables	VIF
INST	.1091
LEV	1.146
ERM	1.155

In sum, the testing of the hypotheses indicates some problems in meeting the assumptions of OLS and some adaptations could be made to account for these problems. The data shows an approximate linear distribution of the parameters, although there are some outliers. There are some problems with the normal distribution of the variables, which could not be corrected through the log transform or other mechanisms such as removal of outliers (mainly because these outliers are legitimate). However, the problem of heteroscedasticity could be solved by eliminating the SIZE variable from the regression equation. Although the assumptions of normal distribution are not met, the linear distribution of the parameters and homoscedasticity are met. The regression technique can be used with non-normally distributed data. It must be noted that this may skew the standard error of the estimate, therefore it may not provide the fully unbiased model (Wooldridge, 2013). Even though there is some concern on non-normality, the analysis is continued because the technique can still be used.

The outcomes in Table 6 indicates that the model is significant (p(F) < .001), although the regression model is weak with only 6.8% of VALUE predicted by the variables. The results show that INST is nonsignificant for VALUE but both LEV and ERM significantly and negatively influence VALUE. The contribution of ERM is stronger than that of LEV.

Given these results, Hypothesis 4 is not supported because SIZE variable is removed from the model due to heteroscedasticity. Hypothesis 5 is not supported because INST is not significant for firm value. Hypothesis 6 is supported because LEV critically and negatively influence firm value. However, Hypothesis 7 is not supported because ERM has a crucial and negative contribution to VALUE rather than a positive impact.

Table 6 Hypotheses 4 through 7 regression outcomes

	Coefficient	t
Const	4.003**	8.131
INST	0.057	0.106
LEV	–0.179**	–2.758
ERM	–2.577**	–2.999
Sum squared residuals	1629.40	
F	8.309**	
S.E.	2.353	
Adjusted R^2	0.068	

Note regress VALUE as dependent variable and * $p < .05$, ** $p < .01$

Table 7 summarizes the hypothesis outcomes. Hypotheses 1 and 4 are not supported because SIZE variable is eliminated from the model due to heteroscedasticity during the assumption check. Most of the remaining hypotheses are not supported due to directionality rather than non-significance. These results are detailed in the next section.

Table 7 Summary of hypothesis test outcomes

Hypothesis	Independent	Dependent	Outcome	Supported?
1	SIZE	ERM	Eliminated	No
2	INST	ERM	B = .115	Yes
3	LEV	ERM	B = .021	No
4	SIZE	VALUE	Eliminated	No
5	INST	VALUE	Non-Significant	No
6	LEV	VALUE	B = –.179	Yes
7	ERM	VALUE	B = –2.577	No

The hypothesis testing indicates that institutional ownership and leverage significantly and positively influence ERM adoption while leverage and ERM adoption crucially and negatively affect firm value. Institutional ownership is not significant for f value of the firm but it was significant for ERM adoption. Firm size must be eliminated due to heteroscedasticity. Some of these findings are different from

what are expected in the literature review, therefore some discussion to explain these findings should be made.

Firm size is eliminated from the main models because of heteroscedasticity but it is tested separately as an individual factor. The correlation tests indicate a significant and moderate correlation of SIZE with both ERM (positive) and VALUE (negative) as shown in Table 2. This correlation suggests that the findings of previous researches identifying SIZE as a critical factor in ERM adoption could also be possible for the SET100 data if the dataset are large enough to approach a normal distribution for size (Gordon et al., 2009; Desender, 2011; Gatzert et al., 2015; Hoyt & Liebenberg, 2011; Paape & Speklé, 2012; Pagach & Warr, 2007; Senol & Karaca, 2017). The finding on the SIZE-VALUE relationship is consistent with only two researches in the literature review (McShane et al., 2011; Baxter et al., 2013). It is possible that the SIZE-VALUE relationship of SET100 data in this study may be different from other markets.

Institutional ownership significantly and positively affects ERM adoption, but it does not influence firm value. The findings of several previous studies have confirmed that institutional ownership influences ERM adoption (Paape & Speklé, 2012; Gatzert et al., 2015; Mikes & Kaplan, 2015) and only one study has the opposite finding (Pagach & Warr, 2007). The rationale for this effect is clear because institutional owners can advocate or force the organization to adopt ERM either through informal pressure or through presence on the board (Gatzert et al., 2015). Thus, this finding is consistent with what is expected. The research does not support the INST-VALUE effect. However, this effect is much less certain than others because some studies reject it (Wu, et al., 2014; Baxter, et al., 2013) while others support it (Hoyt & Liebenberg, 2011). The contribution of institutional ownership to firm value is studied less than others (Krause & Tse, 2016) so the findings could be inconsistent. This research has contributed to the literature by investigating this relationship, even though there is a negative finding, it should not be considered as non-productive.

The effect of leverage is consistent with what is expected for the firm value (large and negative) but it is different from what is expected for ERM adoption (small but positive). This is one of the most interesting findings due to such inconsistent evidence on the LEV-ERM adoption relationship. In theory, the highly leveraged firms would be expected to be more likely to adopt ERM because they require protection against a higher level of risk exposure than firms that are less highly leveraged (Mikes & Kaplan, 2013). In this study, leverage slightly but critically and positively influence ERM adoption. The evidence on this relationship is very mixed because the findings of some studies have positive effects (Pagach & Warr, 2007), other findings have negative effects (Hoyt & Liebenberg, 2011; Lechner & Gatzert, 2018) and others have no significant effect (Desender, 2011). This research is beneficial to the literature in terms of demonstrating the significant effect of leverage on ERM adoption based

on the SET100 data. The confirmation of Mikes and Kaplan (2013) that highly leveraged companies are more likely to utilize ERM as a risk mitigation measure appears to hold here. Several researches firmly support the negative contribution of leverage to firm value (utilizing a risk-adjusted measure such as Tobin's q) (Andersen, 2008; Baxter et al. 2013; Bertinetti et al. 2013; Cheng & Tzeng, 2011; Fang et al., 2009; Florio & Leoni, 2017; Hoyt & Liebenberg, 2011; Lechner & Gatzert, 2018; Lin et al., 2012; Mackay & Moeller, 2007; McShane et al., 2011). Therefore, this finding is consistent with the expectation indicated in the literature.

ERM adoption has a negative influence on firm value rather than the positive impact which is surprising because in theory, ERM adoption should increase firm value (Gates et al., 2012; Nocco & Stolz, 2006) and such effects are demonstrated in many previous researches (Anderson, 2008; Baxter et al., 2013; Bertinetti et al., 2013; Florio & Leoni, 2017; Gordon et al., 2009; Grace et al., 2015; Hoyt & Liebenberg, 2011; Lechner & Gatzert, 2018). Only a few studies have contradicted this finding (Lin, et al., 2011; McShane, et al., 2011; Wu, et al., 2014). Thus, the finding in this study contradicts most of the body of literature which gives the reason for the observation of this finding. Given the positive relationship of leverage and ERM implementation, along with the negative relationship of leverage and firm value, one probable reason is that firms with greater risk exposure because of their high leverage may be more potential to utilize ERM measures either as a serious effort to control their risk exposure or as a signal to investors on their awareness of their increased risk and their effort to mitigate it (or both). This could indicate that highly leveraged companies may be more potential to utilize ERM which leads to a negative effect to value.

5. Conclusions

The analysis indicates that firm size positively affects ERM adoption but negatively firm value and this could not be tested directly because of high homogeneity of variance. In the first regression test, both institutional ownership and leverage positively affect ERM adoption. In the second regression test, firm leverage and ERM adoption negatively affect firm value. These findings may result from the positive relationship of leverage and ERM adoption which suggests that firms with high risk exposure (as indicated by high leverage) may use ERM adoption either as a market signal or as a mechanism to reduce risk exposure. However, this may not be effective, so it results in lower market value.

In conclusion, this study supports a relationship between 2017 COSO ERM adoption and firm performance, although this relationship may be more complicated in Thai firms than others. ERM is possibly used as a risk management technique by firms with high risk exposure due to high operating leverage. This suggests that ERM may be a tool for risk reduction, but it does not indicate that the firm is performing well. The implication of these findings is discussed below.

This study demonstrates academic and practical implications. The main academic implication is that researchers need to reconsider the theoretical basis of ERM and how it is used within firm. This research suggests that ERM and high leverage may co-occur, implying that ERM is used when the firm has already been under stress rather than as a preventative measure. This possibility has been brought up by other researchers and it is worth considering as a possible factor in the use of ERM.

There are also implications for shareholders and managers in these findings. One of these implications is that neither shareholders nor managers should view ERM adoption as a panacea for risk management. The findings show that firms deploying ERM strategies may still be under some significant risk because of their high leverage which affects the firm's market value. This means that ERM cannot be considered as a substitute for useful risk management and it cannot influence the firm performance as strongly as it is expected given the positive theory of ERM as a risk reduction method. This should be kept in mind by the investors when they assess the investment risks.

There are several limitations to this research. One of these limitations is the ERM adoption index which is actually not adoption but this study tries to derive its index relating to COSO ERM 2017. The ERM adoption index is calculated by the researcher based on the COSO model of ERM 2017. This ERM adoption index is used because there is no standard or consensus measure of ERM adoption and because many of the indicators of ERM are not visible in public information. Therefore, this measure is a proxy measure for ERM adoption rather than a conclusive measure so that the results may be bias. However, there is no other measure that can be more effective, so it is difficult to eliminate this limitation to the study at the present time. Another limitation is that the research only includes a limited time period (2015 to 2017) which makes the exogenous changes such as effects of institutional change not reflected in the study and there is a limited sample size.

There are some recommendations for future research that can be identified from this study. One of these recommendations is to use a broader view of ERM to understand variances in adoption and effects between different markets. Because this study and most previous studies have only included firms in one market, it is possible that other factors such as regulatory oversight or investor protections could impact the interaction of ERM adoption and firm performance. Therefore, comparing firms in different markets in terms of ERM adoption and firm value, and including measures of institutional strength and other market factors that could influence the relationship, could help identify the influence of these factors. Another opportunity for additional research is the investigation of ERM adoption on future performance of the firm using a time series approach. This type of research could help determine whether ERM adoption contributes to firm performance in future periods.

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