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THE RELATIONSHIP BETWEEN ENTERPRISE RISK MANAGEMENT AND COST OF CAPITAL

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ABSTRACT

This paper investigates the effect of enterprise risk management (ERM) implementation on the cost of capital (cost of debt [Cd], cost of equity [Ce], and weighted average cost of capital [WACC]) for the oil and gas industry. The research is conducted using panel data analysis from 2008−2017 for 41 oil and gas companies publicly listed on the Bursa Malaysia. ERM implementation data is collected from company annual reports, while the cost of capital data is obtained from Thomson Reuters DataStream. The results indicate that an increase in the level of ERM implementation reduces the cost of capital, which we argue is one mechanism through which ERM increases firm value. Future research can use our investigation to delve deeper into ERM and value creation topics.

Keywords: enterprise risk management, cost of debt, cost of equity, ERM value creation

INTRODUCTION

Past evidence indicates that organisations need to constantly monitor threats and opportunities to generate profit and compete in the market (Zakaria, 2017; Laisasikorn & Rompho, 2019; Shad et al., 2019; Saeidi et al., 2019). To achieve this, one measure is through the adoption of an enterprise risk management (ERM) integrated framework (Farrell & Gallagher, 2019). Organisations have realised the importance of enterprise risk management (ERM) especially to deal with globalisation, technological advancement, modernisation, and pressure from regulatory bodies. The Committee of Sponsoring Organisations of the Treadway Commission (COSO), an organisation that created one of the most widely used ERM frameworks, warns that businesses must continuously deal with uncertainty, complexity, and volatility by implementing effective ERM (COSO, 2017). The competing ISO 31000 standard has similar warnings (Bharathy & McShane, 2014).

Traditional approaches manage risk in silos, such as individual departments, whereas ERM proposes the holistic management of risks in portfolios to create and protect firm value (Shad et al., 2019). Effective ERM implementation should improve enterprise profitability and the awareness of risks, which is helpful in strategic decision making to increase firm value (Lai et al., 2011). Improved management of operational, financial, and strategic risks should improve strategic decision making to make it more likely that an organisation will achieve higher sales, improve corporate reputation, reinforce corporate governance and internal control, and achieve appropriate regulatory compliance (Baxter et al., 2013; Ching & Colombo, 2014; Bromiley et al., 2015; Shad & Lai, 2015a; Sprčić et al., 2016; Tasmin & Muazu, 2017).

Neo-classical finance theory, such as the capital asset pricing model (CAPM), posits that firm-specific risks should not be managed whereas later finance researchers find that the management of such idiosyncratic risks can increase firm value (McShane, 2018). This concept has been referred to as Value Maximisation Theory of Corporate Risk Management (Lai et al., 2011) and ERM Value Creation (Kraus & Lehner, 2012). Various benefits of ERM that could lead to value creation include optimising the risk/return profile of an enterprise, efficient capital allocation, reducing earnings and stock price volatility, enhancing decision-making capabilities, improving the efficiency of senior management and board oversight of risk, and building investor confidence (Bohnert et al., 2017; Lai & Shad, 2017; McShane, 2018; Farrell & Gallagher, 2019). However, the actual mechanisms by which these benefits lead to value creation are not clear.

Lai and Azizan (2012) perform a literature review and conclude that ERM creates value by managing firm-specific risks, which reduces the risk premium and should reduce the cost of capital. Our manuscript empirically investigates the effect of ERM on the cost of capital as a possible value creation mechanism. We look at the effect of ERM implementation on cost of equity (Ce), cost of debt (Cd), and the weighted average cost of capital (WACC). For example, ERM implementation can reduce the cost of capital by reducing risks and improving the information available about firm risk profile, which can be shared with investors to reduce information asymmetries.

Cost of capital reduction is felt when the organisation issues capital instruments such as stocks and bonds. The risk premium demanded by capital markets for corporate debt, such as a bond, is influenced by rating agencies. Higher ratings indicate greater likelihood that the organisation can repay creditors. ERM practices and reporting can improve firm ratings. For example, Standard & Poor's (S&P), Moody's, and other rating agencies typically assess firm ERM practices as part of the rating process (Weber et al., 2010; Berry-Stölzle & Xu, 2018). The degree of rating agency ERM assessment depends on the industry and is most explicit for financial companies (McShane et al., 2011). The integration of ERM into the rating process improves the risk profile, which can result in lower credit risk in terms of lower interest payments. This ultimately reduces the cost of capital of the organisation, which increases firm value.

Oil and gas is a volatile industry dealing with a heavy regulatory burden and facing a variety of risks including workers' health and safety, operational, economic, social, and environmental concerns. This industry is one of the most important in the current era and also one of the riskiest due to being capital and labour intensive, high risk, and high reward (Shad et al., 2020) with the potential of both high profitability and enormous fines. Hence, the value of ERM is becoming much more important in the oil and gas industry and can play a significant role in identifying potential issues and taking precautionary measures (Karami et al., 2020; Shad & Lai, 2019). Furthermore, oil and gas operations can have negative impacts on the economy, environment, and society causing stakeholders to incur high risk. Therefore, this industry needs to implement an integrated risk management system, which is critical to deal with business uncertainty, mitigate hazards, overcome current and future challenges, and comply with regulations (Meidell & Kaarbøe, 2017). The focus of this investigation is Malaysian oil and gas companies, which were responsible for 27% of Malaysian federal tax collection between 2008 and 2018. This level of risk justifies the oil and gas industry as a suitable target for enterprise risk management research.

ERM has been the focus of studies for various types of companies but not for the oil and gas industry (Pranesh et al., 2017). Several studies examine the significance of corporate risk management on financial performance in developed and emerging economies beyond the context of the financial industry (Sax & Andersen, 2019). Florio and Leoni (2017) examine the association between level of ERM implementation and performance among Italian listed companies. Their results reveal that companies with higher level ERM attain higher financial and market performance. Iswajuni et al. (2018) indicate a positive impact of ERM implementation on firm value among Indonesian manufacturing companies. Abdullah et al. (2018) examine the relationship between ERM implementation and financial performance using a sample of 435 Malaysian publicly listed companies from 2001 to 2013. They find that firms with ERM implemented are much more likely to have higher performance relative to firms without ERM. Research by Saeidi et al. (2019; 2020) show that ERM implementation has a significantly positive relationship with the performance of Iranian financial institutions. In contrast, González et al. (2020) find no evidence of improvement in the level of financial stability for Spanish listed companies after ERM adoption. ERM can be industry/firm specific and another contribution of this paper is to investigate another industry.

Our paper aims to shed more light on the relation between the level of ERM implementation and the cost of capital and extends the scant work on this topic by not just looking at Ce, but also Cd and WACC. Our sample consists of 41 oil and gas companies listed on Bursa Malaysia with data collected from 2008 to 2017. Applying Generalised Least Squares (GLS) random effects regression with various control variables, this research provides evidence that firms with a higher level of ERM implementation have lower Cd, Ce, and WACC. This work contributes to the existing body of knowledge regarding ERM implementation and value creation and provides a basis for deeper investigation of the topic.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Prior studies indicate that ERM is a basic concern for academia and industry (Meidell & Kaarbøe, 2017; McShane, 2018; Silva et al., 2019). Many organisations, especially larger ones, have attempted to implement ERM with the objective to improve performance. Numerous studies investigate the relationship between ERM and firm performance such as McShane et al. (2011), Waweru and Kisaka (2013), Shad and Lai (2015b), and Zou et al. (2017). Particularly, McShane et al. (2011) find that firm performance is positively impacted by

ERM adoption among US insurance companies, especially in the earlier stages of implementation. Waweru and Kisaka (2013) find a significant positive relationship between ERM and firm performance among companies listed in the Nairobi Stock Exchange (NSE). Similarly, Shad and Lai (2015b) investigate ERM adoption among publicly listed Malaysian companies and find that ERM implementation adds economic value through increased net operating profit after tax and return on invested capital. Nair et al. (2014) find evidence that ERM is a dynamic capability, which allows firms with superior ERM implementation to lose less value during a market crisis and recover more quickly.

The benefits of ERM implementation mentioned in the Introduction affect the firm capital structure, which means the way the firm finances investments by equity and/or debt to achieve objectives. Raising debt and equity capital incurs costs such as interest payments and other financial obligations. Based on COSO (2004), ERM helps to reduce firm total risk by reducing earnings volatility, which improves the effectiveness capital usage (McShane, 2018). A well-implemented ERM program reduces risk and motivates the debt markets to provide lower cost financing (Berry-Stölzle & Xu, 2018).

As summarised in McShane (2018), the argument here is contrary to the notion of neo-classical financial theory. The capital structure work of Modigliani and Miller (1958) implies that risk management is irrelevant. The CAPM of Sharpe (1964) and Lintner (1965) postulates that firm-specific risk can be diversified away by well diversified investors and thus should not be managed.

ERM advances beyond the traditional silo-based risk management approach by considering risks in portfolios and analysing correlations among risks (Luppino et al., 2014; Bromiley et al., 2015) and should include all risks including dynamic emerging risks (Shetty et al., 2018; Marotta & McShane, 2018; Poyraz et al., 2020). This holistic understanding of interactions among risks should reduce the cost of capital (Berry-Stölzle & Xu, 2018). Hann et al. (2013) state that diversified firms have a lower cost of capital. ERM adoption should strengthen the financial capabilities and creditworthiness of a company and reduce the risk for credit providers (Brealey et al., 2012) resulting in a lower Cd for the borrowing organisation (Farrell & Gallagher, 2019). Moreover, an effective ERM program can reduce earnings volatility, which can reduce taxes, asymmetric information costs, underinvestment costs, payments to non-diversifiable shareholders and agency costs (McShane, 2018). Underinvestment costs means that high earnings volatility can result in a firm not having enough cash on hand to take advantage of all positive net present value (NPV) projects (Mayers & Smith, 1987).

Credit rating agencies now include the effectiveness of a firm's risk management system in determining credit ratings, which should result in a lower cost of capital. For example, S&P scrutinises whether a company has a systematic, consistent, strategic, and sophisticated risk management program that efficiently reduces losses through the optimisation of the risk-return trade-off (Bohnert et al., 2019). Firms with more advanced ERM should get a higher credit rating, resulting in lower borrowing costs and higher firm value (McShane et al., 2011; Berry-Stölzle & Xu, 2018). The Malaysian Rating Corporation Berhad (MARC), developed by Bank Negara Malaysia in 1996, has become the premier credit rating agency in the country. The MARC rating is based on the assessment of five major factors within the company, which include investment manager reputation in the industry, the depth of investment proficiency, the strength of its portfolio and risk management program, track record, and corporate governance infrastructure. Also, ERM adoption should reduce earnings and return volatility, which is desired by equity holders, resulting in greater investment in that firm (Farrell & Gallagher, 2019).

This article intends to extend prior empirical research by Lai and Samad (2011) and Berry-Stölzle and Xu (2018). Lai and Samad (2011) survey executives of companies traded on the Malaysian stock exchange. The survey includes questions about the ERM implementation intensity and the cost of external financing. In analysis of survey results, they find a relation between ERM implementation and lower cost of external financing. Berry-Stölzle and Xu (2018), find a statistically significant association between ERM implementation and reduction in the Ce capital for large insurance companies. We perform random effects GLS regression including firm-specific control variables to investigate the relation of ERM implementation level on Ce, Cd and the WACC.

Based on these arguments, a well-functioning ERM program brings various advantages to the firm that creates a channel through which the reduction in the cost of capital can take place. Therefore, summarising the arguments above, we make the following testable hypotheses.

H1: Greater ERM implementation level has a negative relation with firm Cd.

H2: Greater ERM implementation level has a negative relation with firm Ce.

H3: Greater ERM implementation level has a negative relation with firm WACC.

DATA AND METHODOLOGY

Sample Selection and Data Analysis

The study is based on a sample of 41 oil and gas companies listed on Bursa Malaysia over the period from 2008 to 2017. The main source of ERM implementation data is from the annual reports, which are sourced through Bursa Malaysia's website as well as the websites of each respective company. The Cd and Ce data is obtained from Thomson Reuters DataStream. The data were analysed using STATA 14.0. This empirical work has been done through panel data analysis. Table 1 is a summary of this information.

Table 1
Sample selection summary

Target population	41 Oil and Gas PLCs on the Malaysian Stock Exchange (Bursa Malaysia)
Data source and time frame	ERM implementation data: Annual reports from Bursa Malaysia's website and company websites Cd, Ce and WACC data: Thomson Reuters DataStream Time frame: 2008 to 2017

The first step in using panel data is to check the stationarity of data for which a panel unit root test is applied. Barreira and Rodrigues (2005) postulate that the existence of unit root, random walk, or non-stationarity in the panel data may cause a misinterpretation of estimated results that may lead to spurious regression coefficients. We apply a Levin, Lin and Chu test that is applicable when the number time periods is small (10 years) relative to the number of individuals (41 companies) in the sample (Hall & Mairesse, 2002). Next the data are diagnosed by various tests for outlier identification and removal, normality, multicollinearity, and serial correlation. Table 2 summarises the results for the diagnostic tests.

Table 2
Diagnostics test results

Test	Check	Threshold	Remarks
Levin Lin Chu	Data stationarity	p-value < 0.05	Data has stationarity
Cook's distance	Outliers	± 3 times the mean	No outliers exist
Skewness & Kurtosis	Normality	± 1.96 at α of 0.5	Normally distributed
Variance Inflation Factor (VIF)	Multicollinearity	VIF < 10	None
Wooldridge	Serial correlation	p-value > 0.05	None
Breusch-Pagan/LM	Heteroscedasticity	p-value < 0.05	Use GLS
Hausman	Endogeneity	p-value > 0.05	Use random effects

The Breusch-Pagan/LM test is employed to determine whether to use ordinary least squares (OLS) or GLS as the appropriate regression model for hypothesis testing. Finally, the Hausman specification test is employed to determine whether the fixed effects (FE) or the random effects (RE) model is suitable for the analysis. Table 3 provides additional information for Breusch-Pagan/LM and Hausman test results for each of the three models (Cd, Ce, and WACC). The Levin, Lin, and Chu test (p-value < 0.05) indicates the data has stationarity (no unit root). Outliers, non-normality multicollinearity, and serial correlation do not appear to be a problem. The Breusch-Pagan/LM test (p-value < 0.05) indicates that the GLS model is appropriate. The Hausman test (p-value > 0.05) rejects the null hypothesis that the fixed effects GLS model is appropriate and accepts the alternative hypothesis that the random effects GLS model is appropriate.

Table 3
Breusch-Pagan/LM and Hausman test results

Particulars	OLS vs GLS		Random vs. Fixed Effect (GLS)	
Tests	Breusch-Pagan/LM		Hausman	
	Particulars	Constant Variance	Particulars	Constant Variance
Model 1 (Cd)	Chi-square	594.05	Chi-square	7.78
	p-value	**0.001**	p-value	**0.100**
Model 2 (Ce)	Chi-square	679.45	Chi-square	12.13
	p-value	**0.001**	p-value	**0.164**
Model 3 (WACC)	Chi-square	1405.8	Chi-square	18.92
	p-value	**0.001**	p-value	**0.211**

Measuring ERM Implementation Level

A key challenge encountered by empirical studies regarding ERM is to find a suitable and meaningful instrument for determining ERM adoption, especially the measurement of ERM implementation level (Gatzert & Martin, 2015). Previous work applies various methods to measure corporate ERM activities that Sprčić et al. (2017) divide into five categories: Chief Risk Officer (CRO) hiring announcements; keyword searches for terms, such as "risk committee;" surveys; ERM index development; and S&P's rating criteria. Numerous studies, such as Hoyt and Liebenberg (2011) and Pagach and Warr (2010), obtain information regarding ERM implementation by searching reports for keywords that indicate ERM implementation, such of CRO hiring announcements. Other work searches the internet for direct statements that companies have implemented ERM and assign 1 if a statement is found for a company and 0 otherwise. Both of these methods are limited by the difficulty of determining level of ERM implementation. Kaplan and Mikes (2014) state that ERM is a complex system within the organisation and measuring ERM activity through binary values does not provide information on differences in the level of ERM implementation.

Data to evaluate ERM implementation level can also be collected by using survey instruments or by reviewing corporate published reports (Waweru & Kisaka, 2013). Survey-based methods are sometimes employed by researchers to examine the penetration level or stage of ERM implementation. For instance, Beasley et al. (2005) use a survey instrument for finding the level of ERM implementation. A Likert scale is used with value ranging from 1 to 5, where 1 = No plans to implement ERM program, 2 = Exploring ERM but no decision being made, 3 = Planning to implement ERM program, 4 = Partial ERM program in place, and 5 = Complete ERM program in place. However, allowing companies to self-evaluate can potentially lead to biased results. Monda and Giorgino (2013) and Gordon et al. (2009) measure the ERM implementation level in an organisation by creating an ERM index.

We determine ERM implementation level (1 to 5) based on S&P criteria by performing content analysis of annual reports for the firms in our data set. S&P evaluates and scores the risk management culture, risk controls, emerging risk management, risk models, and strategic risk management then aggregates these scores into an overall ERM implementation level for the organisation as shown in Table 4. However, S&P performs this explicit ERM rating only for financial institutions, such as insurance companies and banks (McShane et al., 2011) and not for other industries, such as oil and gas.

Table 4
S&P rating for ERM implementation level

Level	Definition
Excellent 5	The organisation has an excellent ability to identify, measure, and manage risk within company determined acceptance levels.
Strong 4	The organisation has developed acceptable criteria for risk control and a process for determining risk limits from overall risk tolerance that is tied to risk-adjusted returns.
Adequate 3	The organisation has an entirely functioning risk control system in place for all key risks. The adopted risk management process is concrete and well established.
Weak 2	The organisation sometimes deliberates risk management for corporate decision making. Management has yet to adopt a proper risk management framework, often does not apply risk management to business decisions, or has very recently adopted risk management that has not yet been tested.
No ERM 1	The organisation has no ERM framework in place and no plan to implement one.

Sources: Standard & Poor Ratings (2005) and McShane et al. (2011)

Measuring Cost of Capital

The cost of capital is a widely used term in financial management and investment decisions (Bhatnagar et al., 2015). Cost of capital encompasses two components: cost of debt (*Cd*) and cost of equity (*Ce*). *Cd* is the average rate of interest the firm pays for its debt. *Ce* is the valuation of the rate of the return expected by shareholders (including dividends) for taking the risk of investing in that firm. To compute *Cd*, the following equation is used:

$$Cd = \text{Total interest expenses} \times (1 - \text{Tax rate})$$

Where,
Total interest expense is the cost incurred by the organisation for their borrowing. Tax rate is the average tax rate at which the organisation is taxed on earned income.

The CAPM is used to calculate *Ce*:

$$Ce = Rf + \beta\,(\mathrm{Rm} - Rf)$$

Where,
Ce = Cost of equity
Rf = Risk-free interest rate
β = Beta coefficient (measure of systematic risk)
Rm = Market returns on portfolio
(Rm − *Rf*) = Market risk premium

Cd and *Ce* are used to calculate the *WACC*:

Where,
Ce = Cost of equity
Cd = Cost of debt
D = Market value of firm debt
E = Market value of firm equity
V = Total value of firm debt + equity

The data to calculate *Cd*, *Ce* and *WACC* are obtained from Thomson Reuter's DataStream. To ensure that our results are rigorous to method choice, averages are computed for each firm-year observation. This average value of *Cd*, *Ce*, and *WACC* are used as the dependent variables in our analysis.

Measuring Control Variables

Firm-specific characteristics such as firm reputation, size, and profitability are included as control variables. The use of control variables is very important in any study since these variables may affect the cost of capital and omitting such variables can bias results in the relationship between ERM implementation and firm performance (Sithipolvanichgul, 2016).

Firm reputation

Corporate reputation can influence the cost of capital, for example, by lowering borrowing costs (Pittman & Fortin, 2004). Firm reputation is proxied by calculating the age of the company, which is the number of years since firm incorporation (Pittman & Fortin, 2004; Sithipolvanichgul, 2016). Specifically, we determine company age by the commencement date of company operations or registration date on Bursa Malaysia.

Firm size

Prior studies have shown that firm size is significantly associated with ERM implementation and firm performance (Lechner & Gatzert, 2017). As the size of the firm increases, an organisation may face more risks and have more resources, making larger firms more likely to implement an ERM program. The empirical study by Beasley et al. (2005) provides evidence that the firm size and ERM adoption has a significant positive relationship. An investigation by Hou et al. (2012) indicates that firm size is negatively related to cost of capital. Agustini (2016) postulates that larger firms have less risk than smaller firms implying that smaller firms will have higher *Ce* because investors will demand higher expected returns. To measure the firm size, the natural log of the firm total assets is used as follows:

Firm Size = *Ln* (total assets)

Firm profitability

Successful and profitable corporations are more likely to create value, attract investors, and trade at a premium according to Waweru and Kisaka (2013) who find evidence of a relationship between ERM implementation and profitability. Mohamad and Saad (2012) postulate a positive relationship between profitability and cost of capital whereas Manurung (2014) and Yapa (2015) find a negative relationship. Return on Assets (ROA) is used as the proxy for profitability as follows:

ROA = Net Income / Total Assets

STATISTICAL MODEL SPECIFICATION

To observe the impact of ERM implementation level on the cost of capital, we develop three regression models. The specification of this model is in line with our theoretical justification and hypotheses formulation.

$$Cd_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t} \quad \text{(i)}$$

$$Ce_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t} \quad \text{(ii)}$$

$$WACC_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t} \quad \text{(iii)}$$

Where; $Cd_{i,t}$ represents firm i's Cd, $Ce_{i,t}$ represents firm i's Ce, and $WACC_{i,t}$ represents firm i's $WACC$ in year t; $ERMI_{i,t}$ is ERM implementation level in firm i in year t; $FRep_{i,t}$ is reputation of firm i in year t; $FSize_{i,t}$ is size of firm i in year t; $PR_{i,t}$ is profitability of firm i in year t; $\mu_{i,t}$ is the error term in the measurement of the variables.

EMPIRICAL RESULTS

Descriptive Statistics

Descriptive analysis of the variables described previously is depicted in Table 5. The results indicate ERM implementation level (*ERMI*) of sample firms ranges from 0.94 to 4.22 with a mean of 3.20. The *ERMI* among our sample of Malaysian companies is consistent with other countries with evidence showing that a most firms have adopted ERM as a strategic management tool, but there is significant variation in level among firms (Berry-Stölzle & Xu, 2018; McShane, 2018)

The *Cd*, *Ce*, and *WACC* have average values of 7.19%, 10.77%, and 8.98%, respectively over the sample period. Oil and gas companies in Malaysia are capital intensive in nature and generally rely heavily on equity financing (Foo et al., 2015). As expected, the rate of return that shareholders require for their investment is higher than the average rate of interest the companies pay for debt financing. Malaysia has a well-developed debt market that allows not only direct borrowing from financial institutions but also the issuance corporate bonds (Foo et al., 2015). The *WACC* represents the hurdle rate that companies must achieve to create value with investments.

Descriptive analysis of the control variables indicates that firm age (proxy for reputation) ranges between 4 and 57 years and averages 20.25 years. The mean firm size (natural log of total assets) is 12.21 and ranges from 0.21 to 16.45. Average profitability (ROA) is 2.98% with a relatively wide range from −7.0% to 7.91%.

Since the cost of capital is the required return for shareholders, they expect higher returns for firms perceived to be riskier, meaning that the *Ce* for a riskier firm should be higher. The oil and gas industry is considered as one of the riskiest (capital intensive, high risk, high reward) in the world economy (Foo et al., 2015), meaning that shareholders should expect higher return. As shown in Table 5,

the *Ce* in our sample (10.77%) is higher than the average *Cd*, which is 7.19%. This difference is expected because shareholders take on more risk by being subordinate to debt holders in being repaid their capital.

Table 5
Descriptive statistics results

Variables	N	Minimum	Maximum	Mean
ERMI	410	0.94	4.22	3.20
Cd	410	1.52	12.59	7.19
Ce	410	4.00	20.50	10.77
WACC	410	5.54	22.04	8.98
Firm reputation	410	4.00	57.00	20.25
Firm size	410	0.21	16.45	12.21
Firm profitability	410	−7.00	7.91	2.98

Correlation Analysis

Table 6 provides results for the Pearson correlation analysis, which is employed to determine the direction of the relationship between the variables and to look for multicollinearity issues among the variables. The level of *ERMI* has a negative relationship with the *Cd*, *Ce*, and *WACC*. Firm reputation has a negative correlation with all three cost of capital variables, profitability is negatively correlated with the *Cd* and equity, and firm size has a negative correlation only with the *Cd*. The correlation between *ERMI* and *Cd* is the highest at −0.502 among all variables, followed by the *Ce* −0.367. Tabachnick and Fidell (2007) suggest that a multicollinearity can be an issue if the Pearson correlation coefficient is greater than 0.90 between variables, which is not evident in this analysis. VIF analysis shown in Table 2 also indicates that multicollinearity is not likely an issue.

Table 6
Pearson correlation analysis

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)
ERMI	(1)	1						
Cd	(2)	−0.502	1					
Ce	(3)	−0.367	−0.091	1				
WACC	(4)	−0.215	0.286	0.666	1			
Firm reputation	(5)	0.269	−0.103	−0.124	−0.048	1		
Firm size	(6)	0.233	−0.081	0.133	0.195	0.199	1	
Profitability	(7)	0.018	−0.029	−0.056	0.192	0.275	0.331	1

Note: ERMI = Level of Enterprise Risk Management Implementation.

MULTIVARIATE ANALYSIS

As described in the sample selection and data analysis section, Breusch-Pagan/LM and Hausman tests indicate that the random effects GLS model is appropriate for the multivariate analysis.

Regression Results and Discussion

Table 7 provides results for the three GLS random effects regressions (i, ii, iii) presented in section statistical model specification, for testing the three hypotheses (1, 2, 3) developed in literature review and hypotheses development section. Overall, the results reveal that the cost of capital is reduced as the *ERMI* increases, which is a possible mechanism through which ERM creates firm value. Regression *i* results indicate that *ERMI* has a significantly negative relationship with firm *Cd*, which supports Hypothesis 1. Significantly negative results are also found for regressions ii and iii, providing evidence in favour of hypotheses 2 and 3, respectively, that increasing *ERMI* reduces the *Ce* and *WACC*, respectively. The coefficients on *ERMI* in the three models indicate that firms with a one level higher *ERMI* have a 7.4%, 11.7%, and 6.7% lower *Cd*, *Ce*, and *WACC*, respectively.

The R^2 for the *Cd*, *Ce*, and *WACC* regressions are 0.251, 0.227, and 0.138, respectively. These results are in line with the study most like ours (Berry-Stölzle & Xu, 2018) who found that firms that have implemented ERM have a 5.95% lower *Ce* compared firms without an ERM program. The R^2 for their *Ce* regression with nine independent variables is 0.663 versus 0.227 for our *Ce* regression with four independent variables.

Table 7
Random-effects GLS regression estimation for Cd, equity, and WACC

Model (i): $Cd_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t}$

Model (ii): $Ce_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t}$

Model (iii): $WACC_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t}$

	Cd - Model (i)	*Ce* - Model (ii)	*WACC* - Model (iii)
ERMI	−0.074***	−0.117***	−0.067***
	(0.006)	(0.010)	(0.016)
Firm Reputation	−0.030**	−0.051***	−0.329***
	(0.043)	(0.028)	(0.056)
Firm Size	−0.079*	−0.017**	−0.023*
	(0.120)	(0.007)	(0.133)
Profitability	0.021	0.013**	0.126**
	(0.023)	(0.028)	(0.062)
_cons	1.153***	1.653***	5.060***
	(0.000)	(0.113)	(0.230)
R^2	0.251	0.227	0.138
GLS	RE	RE	RE
Obs. (41*10)	410	410	410

Note: ERMI = Enterprise Risk Management Implementation Level; *Cd* = Cost of Debt; *Ce* = Cost of Equity; *WACC* = Weighted Average Cost of Capital; Significance levels are $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Consistent with previous work described in measuring control variable section, two of our control variables (firm reputation and firm size) have a significantly negative relationship with cost of capital, which in this study, means the *Cd*, *Ce*, and *WACC*. More concretely, highly reputable and large firms are considered to be less risky by investors and creditors and thus should have lower costs of capital. Such firms face a lower probability of bankruptcy, and therefore, required return by investors should be lower (Cao et al., 2015; Sharfman & Fernando, 2008). The firm profitability control variable is not significantly related to the *Cd*. However, profitability has a positive and significant relationship with the *Ce* and *WACC*. These results reflect the mixed findings of previous work. A possible explanation is that a firm can be more profitable on average even if earnings are volatile, which makes the firm appear to be riskier.

Robustness Test

A key question arises about the robustness of empirical results. We checked robustness of the empirical results by two methods. This study uses control variables in the main models for investigating the relationship between ERM implementation level and the cost of capital (*Cd*, *Ce*, and *WACC*). For one method, this study carried out a sensitivity analysis without control variables for the three models. The results of the robustness analysis excluding control variables show a similar significant impact of ERM implementation level on the cost of capital. In other words, the results of the study are not sensitive to including the firm-specific characteristics (firm reputation, firm size, and profitability) as control variables.

Table 8
Robustness check results

Model (i): $Cd_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \mu_{i,t}$
Model (ii): $Ce_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \mu_{i,t}$
Model (iii): $WACC_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \mu_{i,t}$
Model (iv): $Beta_{i,t} = \alpha_1 + \beta_1 ERMI_{i,t} + \beta_2 FRep_{it} + \beta_3 FSize_{it} + \beta_3 PR_{it} + \mu_{i,t}$

Variables	*Cd* Model (i)	*Ce* Model (ii)	*WACC* Model (iii)	Beta Model (iv)
ERMI	−0.053*** (0.014)	−0.026*** (0.005)	−0.0142** (0.007)	−0.0421** (0.018)
Firm reputation				0.229** (0.001)
Firm size				0.0418** (0.006)
Profitability				0.013** (0.042)
_cons	8.571 (0.024)	0.0098 (0.134)	0.001 (0.114)	0.831 (0.001)
R^2	0.073	0.062	0.019	0.251
GLS	RE	RE	RE	RE
Obs. (41*10)	410	410	410	410

Note: ERMI = Enterprise Risk Management Implementation Level; *Cd* = Cost of Debt; *Ce* = Cost of Equity; *WACC* = Weighted Average Cost of Capital; Significance levels are $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

In addition, we ran the regression using beta as an alternative measure for dependent variable, which a proxy for systematic risk that indicates the volatility of the stock price against the volatility of the overall stock market index and is considered a good risk-taking estimator (Florio & Leoni, 2017). Table 8 presents the results which are similar to the full model with some differences in coefficient magnitude and significance levels.

CONCLUSION, IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS

Prior studies have found evidence for a positive relation between ERM and firm performance and value. However, the mechanisms for the value creation is unclear. This manuscript argues that one mechanism through which ERM creates value is by decreasing firm cost of capital. Building of the scant work related to cost of capital, we conclude that firms with more advanced ERM have lower Cd, Ce, and WACC. In this way, our paper makes significant contributions to the existing body of knowledge regarding ERM implementation and value creation. Control variables in our models indicate that firm reputation and size are significant and fundamental factors influencing the adoption of ERM and reduction in the cost of capital whereas the findings for firm profitability are mixed. Our sample consists of 41 oil and gas companies listed on Bursa Malaysia. We employ a weighted average content analysis method based on S&P ERM rating criteria over a 10-year period to determine an ERM implementation level for the firms in the sample. The Cd and Ce information is sourced through Thomson Reuters DataStream. Empirical analysis is performed through panel data analysis using GLS random effects regression estimation to determine the relation between ERM implementation level and our cost of capital measures.

Possible explanations for the relation between ERM implementation and lower cost of capital is that ERM reduces risks and improves information available about firm risk profile, which managers can share with investors and creditors to reduce information asymmetries. Firms with risky profiles in the eyes of investors will incur higher costs when raising capital. This comes in the form of either decreased demand for equity or issuing debt with higher interest rates. Moreover, the findings of this study should provide managers confidence that ERM implementation can have positive financial results, which we argue results by reducing the cost of capital. Credit rating agencies should consider the

potential of ERM implementation to lower firm risk. Malaysia has a considerably developed debt market, which includes not only direct borrowing from financial institutions but also corporate bond issuance (Foo et al. 2015). We argue that debt financing is crucial for emerging markets such as Malaysia because debt financing is a cheaper source of financing compared to equity financing. This paper indicates that Malaysian oil and gas companies can reduce debt financing costs by implementing ERM. Regulators and legislators should become aware of these findings and consider legislation that promotes ERM adoption not only for oil and gas companies but also for other companies in emerging and developed economies.

This research contributes to the understanding of the relation between ERM and value creation but is not without limitations. One limitation was the lack of access to a data source from which data could be pulled to create control variables to further distinguish between the effects of ERM on the Cd and Ce. Future research could expand beyond our work to include such control variables. The object of our investigation are oil and gas companies, which are capital intensive, risky, and an essential component of the worldwide economy. Specifically, this manuscript targets publicly traded oil and gas companies in Malaysia. The results from this paper cannot be extrapolated to include other industries and even the oil and gas industry outside Malaysia.

Our study provides theoretical direction for other researchers to further examine the relation between ERM and firm value creation. Future research can use this work as a basis for investigating ERM and value creation for other industries and other countries. For example, a comparative analysis can be performed between developed and developing economies on the efficacy of ERM implementation. Potential work can also examine other financial indicators, such as net operating profit after tax, economic value-added, and return on invested capital and non-financial indicators, such as reputation, human resources, marketing, and management performance instead of the cost of capital. The scope of this study is limited to 41 companies and data collected for ten years period, constructing a panel of 410 firm-year observations. Research with a larger sample size could increase the statistical power of the analysis, reduce the probability of error, and identify new aspects of ERM practices and cost of capital reduction. Lastly, future studies are also recommended to test this model for the effect of other moderators, such as sustainability reporting, corporate governance mechanisms, and innovation.

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