Journal of Economics and Management, 2019, Vol. 15, No.1, 93-115

Impact of Diversified Mergers and Acquisitions on Corporate Risk

Chu-Hua Wu*

College of Management, Yuan Ze University, Taiwan

Hao-En Chiang

College of Management, Yuan Ze University, Taiwan

This study uses two indices, namely the entropy index and Herfindahl–Hirschman index (HHI), to measure whether the degree of diversification of an organization significantly changes the total and systematic risk after mergers and acquisitions (M&A). The standard deviation of return on assets (ROA) is used to measure the total corporate risk, and the beta coefficient is used to evaluate the systematic risk. The results indicate that an increasing degree of diversification after M&A can effectively reduce ROA volatility; more specifically, related M&A reduce ROA volatility, whereas unrelated M&A reduced beta. When a sample is divided into two groups based on corporate characteristics, organizations with a larger size, higher research and development intensity, superior financial slack, superior performance, and lower leverage ratio reduce more volatility than those in the other group.

Keywords: diversification, mergers, acquisitions, corporate risk

JEL classification: M14, G32, G34

* Correspondence to: No. 135, Yuan-Dong Rd, Chung-Li Dist., Taoyuan. Tel: 886-3-4638800*3663, Fax: 886-3-4633824, email: chwu@saturn.yzu.edu.tw, We acknowledge two anonymous referees and the editor for their valuable comments and insightful suggestions. We also thank the financial support from Ministry of Science and Technology (MOST: 106-2632-H-155-001). All remaining errors and omissions are our own.

1 Introduction

Mergers and acquisitions (M&A) are commonly used for companies to expand their business. Studies on M&A have generally focused on corporate market performance and have rarely discussed risk change after M&A. Diversification through reductions in portfolio risk has often been mentioned in previous studies. This study examines whether diversification reducing portfolio risk is still valid for diversification of organizations in terms of business. Therefore, this study analyzes whether organizations can reduce risk by adopting a diversified M&A strategy.

Organizations can create synergy through related or unrelated diversification and thus gain competitive advantages. Diversification can be divided in several types, such as geographical, international, vertical, and horizontal diversification (Hitt *et al.*, 1997). All of these types are crucial for the strategic behavior of organizations. According to corporate characteristics and financial status, managers may have different strategies. With the progress in science and technology, international diversification is another method for large organizations to conduct flexible operations. After the firm benefits from diversification, the cost of capital or labor can decline, and the probability of investment may increase. Moreover, diversification has several limitations, the increasing level of diversification initially improves the performance of organizations; however, performance may decline because of monitoring and coordination costs. In addition, because of the differences in the culture or systems of each company, conflicts of interest may occur during the negotiation or communication process. To evaluate the level of diversification, we use the entropy index, which was first proposed by Jacquemin and Berry (1979). Researchers have developed this index to provide an objective measure of strategic differences and the level of diversification.

Risk is a crucial indicator for organizations and can be divided into various types, such as market risk, liquidity risk, default risk, and exchange risk. All of these factors affect the willingness of investors to invest in companies. Although a high-level of risk may provide high returns, most investors are rational and averse risks. They prefer targets with a stable return or low volatility of return (low risk). However, less information is available on the relationship of corporate uncertainty

and corporate strategies with risk after M&A. Financial researchers have observed that the systematic risks of M&A may vary among M&A-related events (Jensen and Ruback, 1983). Investors can reduce their unsystematic risk through a diversified portfolio, thus instructing corporate managers to avoid spending excessive resources on reducing firm specific risk. By contrast, strategic management researchers indicate that the size and direction of transfers depends on the extent of M&A. The actions of managers can change the potential risk of a merger when the organization diversifies. The degree of systematic risk reduction varies with the relevance of the business diversification. Therefore, organizations can attract investors if they can identify associated diversifications that effectively reduce the systematic risk.

On the basis of the relevant literature, further tests are performed, and the results indicate a negative correlation between the corporate diversification level and corporate risk. Corporate managers can reduce the operating risk of their organization through diversified M&A. This finding is consistent with portfolio theory in finance. Second, when selecting target acquisition companies, the correlation between the businesses of the acquiring and targeted companies affects their decisions. Benefits and risks are present for both related diversifications to reduce competitors and unrelated diversifications to start a new business. Related and unrelated diversifications can reduce the volatility of ROA and the systematic risk, respectively.

This study emphasizes the risk changes after M&A rather than market performance and investigates the effect of different diversifications. The remainder of this paper is organized as follows: Section 2 reviews the relevant literatures and presents the hypotheses. Section 3 presents the data and methodology on measuring the level of diversification and corporate risk. Section 4 provides the empirical results. Conclusions are provided in Section 5.

2 Literature Review and Hypotheses

2.1 Diversification and Mergers and Acquisitions

Goudie and Meeks (1982) report that diversification and entry into a merger can be motivated by three factors, namely profitability, growth, and increasing profit

stability. Merger strategies may differ according to the characteristics of individual industries, and the result may not be the same. For example, the series of industries, paper, printing, and publishing, yields the lowest gross profit from a diversified merger. Diversification can be divided into two parts, namely related and unrelated diversifications, and firms select different strategies when entering into a new market. Montgomery and Wernerfelt (1974) state that the business of organizations starts with the most related industries, subsequently expands through less related industries, and stops when potential synergy reduces to zero. When the corporate business line has higher complexity, diversifying the new business is more difficult. According to Zhou (2011), the increasing corporate capital and research and development (R&D) intensity reduces the likelihood of diversification. R&D and capital-intensive organizations are more likely to expand than to diversify within the available sectors. The increasing leverage increases the level of oversight and control of lenders, thus reducing the diversification (particularly irrelevant diversification). A high similarity between the businesses of the acquiring and target firms (source of cooperation) increases the probability of business entry. When the existing business is more complex (cost of the coordination source), a business is less likely to be dispersed to any new business because an input potential amplifies the negative impact of complexity on entry.

A firms degree of diversification varies with its corporate structure. Berry-Stölzle *et al.* (2012) indicate that in insurance industries, more volatile businesses exhibit higher levels of diversification. Organizations diversify in the related product markets. When they encounter growth constraints, they may consider extending into unrelated markets. Organizations encountering growth barriers exhibit a higher level of total diversification than their counterparts. Similar situations are observed in older and younger firms. Opaque insurance corporations have considerably higher levels of unrelated diversification than do transparent corporations.

The distance between subordinate companies affects the inclination of corporations during decision-making processes. Deng and Elyasian (2008) state that geographic diversification can reduce the risk; however, when the distance between a bank holding company (BHC) and its branches increases, the firm's value is reduced and the risk increases. Diversification and risk reduction are negatively

associated, and the association disappears when BHCs diversify in remote areas. This result indicates that BHCs must consider the effect of distance on the risk and firm value for optimal decisions. When considering synergistic and coordination costs for policy design, the level of diversification is crucial. Hoskisson *et al.*, (1991) propose that diversification ensures profitability at an initial stage; however, with increasing diversification, profitability may decline. These results can probably be attributed to the following reasons: First, when the organization expands its business, the information overload and asymmetries of information may be severe in widely diversified organizations. Second, managers at low levels create suitable conditions for opportunistic behavior in case of information overload at the top managerial level, resulting in high monitoring costs at the bottom. Third, corporate culture may reduce executive information processing, and extensive diversification may result in a loss of cultural coupling because of a multicultural system, which is not effective for control. Finally, when investors are aware of unsatisfactory financial performance because of extensively diversified firms, they may withdraw. Thus, the company may undergo malicious acquisitions.

Related and unrelated diversification can reduce the systematic risk. Chatterjee and Lubatkin (1990) indicate that although unrelated mergers reduce systematic risk, the reduction is less effective than that of related mergers. However, when the systematic risk of the target organization is controlled for the construction in different sources, unrelated mergers are effective at reducing the stockholder risk.

On the basis of the aforementioned literature, the following hypotheses are proposed:

H1: Diversified M&A can effectively reduce corporate ROA volatility (risk).

H2: Diversified M&A can reduce organizations' systematic risk (beta).

H3: Related diversification results in lower ROA volatility than does unrelated diversification.

2.2 Corporate Risk and Mergers and Acquisitions

Systematic and unsystematic risks of organizations are crucial to corporate managers, who are always asked to maintain these risks and prevent increment. Therefore, M&A may be one of the motivations of risk reduction. Previously, strategic

management and modern financial theory are generally used for comparison when discussing mergers and economic performance. According to Lubatkin and O'Neill (1987), the degree of related mergers does not reduce the unsystematic risk of organizations. According to their results, the highest reduction in the unsystematic risk is observed at the first diversification. Only related mergers can reduce the systematic risk and total risk. Vertical and single-business mergers reduce the systematic risk of an acquiring firm. A decrease in systematic risk reduces the cost of capital. When the opportunity of investment increases organizations may intensify their positions in the current business or expand to other domains. Moreover, Lubatkin and O'Neill suggest that when organizations aim to reduce their exposure to environmental uncertainty, organizations must propose vertical and single diversification. They must be attentive toward competitive advantages in their corresponding markets.

Obi and Emenogu (2003) observe the improved performance and reduction of the total risk for conglomerate M&A. Strategic coordination with different industries is a platform for effectively reducing macroeconomic risks. An enterprise group enhances the capability of resource redeployment by employing diversity in different industries, which reduces the systematic risk. The increasing level of concentration may reduce synergy. Dzhagityan (2012) indicates a positive relation between the scope and growing capabilities of post-M&A economies during economic instability. In contrast to other types of traditional credit institutions, financial holding companies exhibit appropriate stock market performance because of cross-industry diversification, risk diversification, and steady income sources. The potential for coping with systemic risks is high, thus increasing the market value. Several factors indicate that only in the frame of horizontal M&A, the systematic risk is sustained by a combination of factors. Companies are easily affected by systematic risk, which places substantial risk on post-M&A value creation. However, post-M&A strategies are weakened by the negligence or misconception of evident and implicit risk factors at a macro level, which indicates an absence of M&A activity management. To ensure cross-elasticity between these risk areas, a paradigm shift in M&A focus is required in which risk management is synchronized with regulation.

Relevant studies indicate that several factors have different impacts on the risk

after M&A. Several factors are related to the corporate structure or characteristics, such as the firm size, financial slack, leverage ratio, and R&D intensiveness. To compare the aforementioned effects on diversification, the sample is further divided into two groups by using a median of six control variables.

H4a: Large corporations with more diversified M&A exhibit lower ROA volatility than do small corporations.

H4b: Corporations with higher growth rate and more diversified M&A exhibit lower ROA volatility than do those with the lower growth rate.

H4c: Corporations with higher R&D expenditure have more diversified M&A exhibit lower ROA volatility than do those with lower R&D expenditure.

H4d: Corporations with higher financial slack and more diversified M&A exhibit lower ROA volatility than do those with lower financial slack.

H4e: Corporations with superior previous performance and more diversified M&A exhibit lower ROA volatility than do those with worse previous performance.

H4f: Corporations with lower leverage ratio and more diversified M&A exhibit lower ROA volatility than do those with higher leverage ratio.

3 Data and Methodology

Data of public traded firms in the United States are obtained from the following three primary sources: All financial information variables, such as business segments, segment sales, total assets, cash, and ROA, are extracted from Compustat. Merger samples are obtained from Security Data Corporation M&A Database (SDC). Both stock return and market return data are collected from Center for Research in Securities Prices (CRSP). The sample excludes financial industry groups with 2-digit standard industrial classification (SIC) codes of 60-69, firm value of less than 1 million, incomplete M&A deal status, and missing data. Samples are 5% winsorized. Because both items of the segment net sales and business segment availability code before 2010 could not be collected, the sample period is 2011–2016. The final sample comprises 836 M&As. If an organization has more than one M&A in a year, only first M&A is considered.

3.1 Dependent Variables

According to Frankel and Litov (2009), to measure the change in the corporate risk, the variance of ROA is used for evaluating the earnings persistence and stability of profitability. The variance of ROA is calculated using the quarterly data for 2 years after M&A. M&A in 2016 are calculated using four quarters in 2017. Covariance (r_i,r_m) and variance (r_m) are calculated using monthly data for 2 years after M&A. Only M&A in 2016 are calculated using the 12 months in 2017. Therefore, to measure the total risk of the company, the square root of the variance of ROA (i.e., the ROA standard deviation (SDROA)) is used to evaluate ROA volatility. Beta is used to evaluate the systemic risk and is calculated as follows:

$$Beta = correlation(r_i, r_m) \times \frac{\sigma_i}{\sigma_m} \ or \ Beta = \frac{Covariance(r_i, r_m)}{Variance(r_m)} \quad (1)$$

3.2 Independent Variables

Palepu (1985) and Hoskisson *et al.* (1993) use the entropy index to assess the level of diversification. It is a continuous measure and is calculated as follows:

$$DT = \sum_{j=1}^{n} P_j * ln(1/P_j) \quad (2)$$

where P_j and ln(1/P_j) are defined as the share of sales in segment j and the weight for each segment j (the logarithm of the inverse of its sales), respectively. Therefore, the entropy measure considers the number of segments in which the firm operates. To measure the changes before and after the mergers, $\Delta DT_{i,j} = DT_{i,t+j} - DT_{i,t}, j = 1,2$ is used to estimate the change after M&A. A higher entropy index is associated with higher diversification. Related diversification is defined as diversification resulting from business in four-digit segments within two-digit industry groups based on an SIC code. Unrelated diversification is defined as diversification from the business in different two-digit industry groups.

The Herfindahl–Hirschman index (HHI) is used to measure the degree of diversification, which is originally an indicator of industrial concentration. However, an extended definition of the HHI (Jacquemin and Berry, 1979) has been used in

studies on diversification in various fields . The formula is as follows:

$$H = 1 - \sum_{j=1}^{n} P_j^2 \tag{3}$$

where P_j^2 is defined as the square of share sales in segment j. Similar to an entropy index, $\Delta HHI_{i,j,} = HHI_{i,t+j} - HHI_{i,t} \quad for \ j = 1,2$ is used for measurements. The closeness of the index to 1 is positively associated with the degree of diversification.

According to several financial studies (Hitt *et al.*, 1997; Zhou, 2011), other control variables include the firm size (log of total assets), growth rate (net sales in year *t* minus net sales in year *t−1*divided net sales in year *t−1*), R&D intensity (ratio of R&D expenditure to total assets), financial slack (ratio of cash to total assets), previous performance (ratio of EBIT to total assets), leverage (ratio of debt to total assets), firm scope (number of segments with four-digit SIC), and countries (number of countries).

Table 1. Sample Descriptive Statistics (N = 836)

SDROA is calculated using the standard deviation of ROA in eight quarters from *t + 1* (*Q1*) to *t + 2* (*Q4)*. M&A samples from 2016 are calculated using four quarters from *t + 1* (*Q1*) to *t + 1* (*Q4*); the same method is used to calculate the covariance of stock and market returns and the variance of market returns. The beta coefficient for the sample is 835, and the DT_{t+2} and HHI_{t+2} of the samples are 726.

Table 1 presents sample descriptive statistics. For total assets, the sample mean (median) value is \$15,667.28 (\$3,128.850) million. The mean (median) of both DT and HHI are higher, indicating that after M&A, the level of diversification increases.

For countries, thy dummy variable equals to one if M&A belongs to domestic. This study includes 575 domestic M&A and 261 foreign M&A.

Variables	Description	Mean	Median	Std. dev.	Min	Max
SDROA	Standard deviation of ROA	0.013	0.007	0.015	0.002	0.059
Beta	Covariance(r_i,r_m)/Variance(r_m)	1.172	1.144	0.653	-0.002	2.506
DT_t	Entropy index of year *t*	0.881	0.886	0.422	0.074	1.590
DT_{t+1}	Entropy index of one year after M&A	0.908	0.912	0.393	0.175	1.590
DT_{t+2}	Entropy index of two years after M&A	0.902	0.911	0.392	0.156	1.591
HHI_t	Herfindahl-Hirschman index of year *t*	0.495	0.527	0.215	0.017	0.780
HHI_{t+1}	Herfindahl-Hirschman index of one year after M&A	0.513	0.537	0.197	0.072	0.780
HHI_{t+2}	Herfindahl-Hirschman index of two years after M&A	0.512	0.535	0.196	0.065	0.779
Total Assets	Total assets(M)	15,667	3,128.	54,407	16.340	717,242
Firm Size	Log(total assets)	3.500	3.495	0.691	2.241	4.874
Growth Rate (%)	(net sales in year t - net sales in t-1)/net sales in t-1	8.601	6.474	13.940	-14.779	42.204
R&D	R&D expenditure/total assets	1.670	0.215	2.532	0.000	8.589
Financial Slack (%)	Cash/total assets	8.681	6.431	7.494	0.341	26.214
Past Performance (%)	EBIT/total assets	9.531	9.202	5.343	- 0.340	20.667
Leverage (%)	Total debt/total assets	56.511	57.049	18.390	22.696	92.152
Firm Scope	Number of segments	3.647	3.000	1.713	1.000	14.000
Countries	Number of countries	1.341	1.000	0.534	1.000	4.000

3.4 Methods

To estimate the impact of diversified M&A, the following equations are used for evaluating the hypothesis. $\Delta D_{i,t+j}$ denotes the two variables $\Delta DT_{i,t+j}$ and $\Delta HHI_{i,t+j}$.

H1:

$$SDROA_{i,t} = \alpha + \beta_1 \Delta D_{i,t+j} + \beta_2 firm\ \ size_{i,t} + \beta_3 growth\ \ rate_{i,t} + \beta_4 R\&D_{i,t} + \beta_5 finanical\ \ slack_{i,t} + \beta_6 past\ \ performance_{i,t} + \beta_7 leverage_{i,t} + \beta_8 firm\ \ scope_{i,t} + \beta_9 countries_{i,t} + \varepsilon_{i,t}, j=1, 2 \quad (4)$$

H2:

$$Beta_{i,t} = \alpha + \beta_1 \Delta D_{i,t+j} + \beta_2 firm\ \ size_{i,t} + \beta_3 growth\ \ rate_{i,t} + \beta_4 R\&D_{i,t} + \beta_5 finanical\ \ slack_{i,t} + \beta_6 past\ \ performance_{i,t} + \beta_7 leverage_{i,t} + \beta_8 firm\ \ scope_{i,t} + \beta_9 countries_{i,t} + \varepsilon_{i,t}, j=1, 2 \quad (5)$$

Equations (4) and (5) include the full sample for evaluating H1 and H2. Related M&A and unrelated M&A subsamples are used to evaluate H3. For H4, the financial variable is used to divide the sample into two based on the following factors: higher and lower than the median. The variable used to divide the sample is not included in the regression equation.

Table 2. Correlation Matrix

This table shows the correlation coefficients between the key variables. DT is significantly negatively related to both SDROA and beta. DT and HHI are strong positively and significantly related. $\Delta DT_1 = DT_{t+1} - DT_t$ and $\Delta DT_2 = DT_{t+2} - DT_t$; $\Delta HHI_1 = HHI_{t+1} - DT_t$ and $\Delta HHI_2 = HHI_{t+2} - HHI_t$. Control variables such as firm size, R&D intensity, and past performance are negatively and significantly related to SDROA. As in previous studies, R&D is negatively and significantly related to ΔDT and growth rate.

	SDROA	Beta	ΔDT_1	ΔDT_2	ΔHHI_1	ΔHHI_2	Firm Size	Growth Rate	R&D	Financial Slack	Past Performance	Leverage	Firm Scope	Countries
SDROA	1													
Beta	0.065**	1												
ΔDT_1	-0.021	-0.049	1											
ΔDT_2	-0.006	-0.034	0.460***	1										
ΔHHI_1	0.008	-0.033	0.934***	0.454***	1									
ΔHHI_2	0.004	-0.028	0.402***	0.944***	0.420***	1								
Firm Size	-0.166***	-0.018	-0.095***	-0.137***	-0.101***	-0.108***	1							
Growth Rate	-0.059*	0.041	-0.006	0.102***	0.008	0.118***	-0.124***	1						
R&D	0.089**	-0.006	-0.061*	-0.062*	-0.049	-0.057	0.014	-0.147***	1					
Financial Slack	0.103***	0.028	0.018	0.024	0.015	0.012	-0.220***	-0.057	0.319***	1				
Past Performance	-0.167***	-0.060*	-0.009	-0.038	-0.025	-0.033	0.124***	0.017	0.092***	0.071**	1			
Leverage	-0.042	0.043	-0.007	-0.039	-0.024	-0.035	0.323***	0.002	-0.304***	-0.391***	-0.067*	1		
Firm Scope	0.036	-0.010	-0.165***	-0.183***	-0.174***	-0.083**	0.385***	-0.001	-0.001	-0.044	0.009	0.056	1	
Countries	-0.029	-0.015	-0.017	-0.015	0.001	-0.025	0.156***	-0.049	0.120***	0.082**	0.082*	-0.051	0.083**	1

Note: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively

Table 2 shows the correlation coefficients between the primary variables. DT exhibits negative relations with both SDROA and beta; however, it is not significant. DT and HHI have a highly positive and significant relation (the correlation coefficients are 0.934 and 0.944). Therefore, to prevent the collinearity problem, only one diversification variable is used in each regression equation. Control variables include the firm size, R&D, previous performance with negative and significant relation with SDROA. For control variables, the firm size has negative and significant relations with the growth rate and financial slack and positive and significant relations with previous performance, leverage, firm scope, and countries. Although no significant relations are observed between diversification indices and dependent variables, after controlling for year and industry fixed effects, DT and HHI are negatively and significantly related to SDROA.

4 Empirical Results

4.1 Results of Diversification on Firm Risk

Table 3 presents the results of OLS regression analyses for evaluating the hypotheses on the impact of diversification on ROA volatility. Columns (1)–(4) start with the OLS model and only two measure indices indicating the difference after M&A. When the year and industry fixed effects are controlled, coefficients of ΔDT_1 and ΔDT_2 for the difference of DT after 1 and 2 years, respectively, are significantly negative at a 5% level. ΔHHI_2 is significantly negative at 5% level, whereas ΔHHI_1 is negative but nonsignificant. Columns (5)–(8) present the result of regressions (6) and (7) with the control variables. When controlling other variables, the coefficients of ΔDT_1 and ΔDT_2 are −0.009 and −0.004 and are significant at a 5% level. Moreover ΔHHI_1 and ΔHHI_2 are significantly negative at a 10% level. Among control variables, firm size, financial slack, and previous performance are negatively and significantly associated with SDROA, whereas the leverage ratio is positively associated with SDROA. This indicates that firms with a larger size, superior financial slack, and higher performance have reduced ROA volatility after M&A. Firms with a higher leverage ratio may have increased corporate risk. However, because the beta results are negatively correlated but nonsignificant, the results are

not presented in the table. Therefore, H1 is supported but not H2. The nonsignificance of beta may be attributed stock market return measurements, which include noise from future expectations of investors. More information disturbance may be present in the stock market. No evidence is available on the reduction of the systematic risk.

Table 3. ROA Volatility

Ordinary least squares regressions of two measure indexes and control variables when controlling the year and industry effects. The numbers of samples 1 and 2 years year after merging are 836 and 726, respectively. The ΔDT results after 1 and 2 years are significantly negative at a 5% level, whereas the difference of HHI after 1 and 2 years are significantly negative at a 10% level after adding control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	0.006 (-1.06)	0.007 (-1.19)	0.006 (-0.95)	0.007 (-1.15)	0.012 (-1.53)	0.001 (-1.33)	0.012 (-1.44)	0.011 (-1.27)
ΔDT_1	-0.009** (-2.39)				-0.009** (-2.44)			
ΔDT_2		-0.004** (-2.00)				-0.004** (-2.00)		
ΔHHI_1			-0.012 (-1.64)				-0.013* (-1.75)	
ΔHHI_2				-0.009* (-1.96)				-0.008* (-1.64)
Firm Size					-0.003* (-2.75)	-0.003** (-2.00)	-0.003** (-2.37)	-0.003** (-2.07)
Growth Rate					-0.003 (-0.74)	-0.005 (-1.17)	-0.003 (-0.69)	-0.005 (-1.11)
R&D					-0.009 (-0.24)	-0.047 (-1.12)	-0.009 (-0.23)	-0.042 (-1.01)
Financial Slack					0.016* (-1.81)	0.015 (-1.45)	0.016* (-1.73)	0.014 (-1.43)
Past Performance					-0.030** (-2.50)	-0.028** (-2.09)	-0.032*** (-2.60)	-0.029** (-2.13)
Leverage					0.007* (-1.74)	0.008* (-1.94)	0.007* (-1.69)	0.008* (-1.92)
Firm Scope					0.000 (-0.41)	0.000 (-0.48)	0.000 (-0.54)	0.000 (-0.75)
Countries					0.001 (-0.54)	0.000 (-0.20)	0.001 (-0.60)	0.000 (-0.17)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	836	726	836	726	836	726	836	726
Adj. R^2	0.001	0.005	-0.001	0.005	0.072	0.073	0.071	0.073

Notes: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively.

4.2 Results of Diversification on Related and Unrelated Merger and Acquisitions

To examine whether the correlation between firms in the M&A impact on the corporate risk, the sample is divided into two groups based on the two-digit SIC code. If the firm has both related and unrelated M&A in the same year, then it belongs to related M&A groups. The sample includes 520 related M&A events and 316 unrelated M&A events.

Table 4. Related and Unrelated M&A

The sample is divided into two groups based pm two-digit SIC code. Related and unrelated M&A included 520 and 316 cases, respectively. From the results, we find that firms can reduce their ROA volatility through related M&A. On the other hand, firms can reduce their beta through unrelated M&A.

	Related		Unrelated	
	SDROA	Beta	SDROA	Beta
Intercept	0.026* (-1.82)	0.856 (-1.28)	0.015 (-1.22)	2.880*** (-4.60)
ΔDT_1	-0.009* (-1.76)	0.027 (-0.11)	-0.007 (-1.19)	-0.639** (-2.01)
Firm Size	-0.005*** (-3.21)	-0.020 (-0.26)	-0.005** (-2.14)	-0.215* (-1.87)
Growth Rate	-0.003 (-0.55)	0.319 (-1.22)	0.007 (-0.96)	0.017 (-0.05)
R&D	-0.066 (-1.27)	-0.583 (-0.24)	0.070 (-1.02)	-2.002 (-0.58)
Financial Slack	-0.003 (-0.25)	-0.014 (-0.02)	0.041*** (-2.69)	-0.795 (-1.05)
Past performance	-0.043*** (-2.72)	-0.652 (-0.85)	-0.040 (-1.62)	0.900 (-0.73)
Leverage	0.002 (-0.39)	0.324 (-1.24)	0.011 (-1.45)	0.149 (-0.39)
Firm Scope	0.000 (-0.54)	0.014 (-0.56)	0.001 (-0.02)	-0.022 (-0.62)
Countries	0.000 (-0.12)	-0.011 (-0.17)	0.001 (-0.02)	-0.020 (-0.21)
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Observations	520	519	316	316
Adj. R^2	0.067	0.002	0.084	-0.003

Notes: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively

Columns (1) and (2) in Table 4 present the result of related M&A groups. Columns (3) and (4) present the result of unrelated M&A groups. In the related M&A group, diversification significantly reduces the ROA volatility, for which the coefficient is −0.009 at a 10% level. In the unrelated M&A group, beta reduction is significantly at 5% level, the coefficient is −0.639. The firm can reduce the corporate systematic risk through unrelated diversification. This result is different from those of previous studies. Chatterjee and Lubatkin (1990) indicated that the effect of related M&A exhibits higher beta reduction than that of unrelated M&A. However, according to the theory of investment, a company can reduce the systematic risk through diversification. Therefore, if the firm aims to reduce the systematic risk, it should have more unrelated M&A than related M&A. For control variables, the firm size is significantly negative in two groups, whereas the leverage ratio is significantly positive, which indicates that firms with a larger size and lower leverage ratio can reduce the corporate risk. These results support H3 and partially support H2 in unrelated M&A.

These results from the market may be obtained because enterprises engaging in related M&A are already familiar with the industries they are operating in. Therefore, they do not require excessive resources for integrating new businesses. Hence, the volatility did not considerably change after mergers. Because beta is measured from the stock market, and stock price includes the investor expectation of the future performance of the firm. If companies merge with unrelated industrial firms in an unstable market, the unrelated M&A can prevent centralization in the same industry, thereby reducing losses from the stock market.

4.3 Results of Diversification on Subsample of Corporate Features

To evaluate whether corporate characteristics affect their performance of diversification, the sample is divided into two groups based on the median of the control variables.

Table 5. SDROA Subsample

Two groups are separated based on the median of six control variables. Panel A displays the above-median group, and panel B shows the below-median group. Firms with larger size, higher R&D intensity, better financial slack, stronger past performance, and lower leverage ratio can reduce their ROA volatility relatively more effectively. The coefficients of ΔDT_1 and ΔDT_2 for firm size and past performance are negative and significant at a 1% level.

Panel A	Firm Size		Growth Rate		R&D		Financial Slack		Past Performance		Leverage	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	0.026***	0.026***	0.012	0.011	0.010	0.018	0.017	0.016	0.013	0.013	0.047***	0.045***
ΔDT_1	-0.018***		-0.007		-0.011*		-0.011*		-0.014***		-0.002	
ΔDT_2		-0.012***		-0.001		-0.005*		-0.005*		-0.011***		0.001
Firm Size			-0.001	-0.001	-0.001	-0.001	-0.004**	-0.004**	-0.001	0.000	-0.007***	-0.006**
Growth Rate	-0.001	-0.003			-0.013*	-0.020**	-0.010*	-0.013**	-0.003	-0.003	0.003	0.003
R&D	0.062	0.015	0.141**	0.122*			-0.054	-0.081	0.103**	0.111*	-0.100	-0.201**
Financial Slack	0.010	-0.003	0.005	5.3E-05	0.019	0.005			-0.007	-0.012	-0.006	-0.001
Past erformance	-0.040*	-0.039	-0.022	-0.014	-0.035*	-0.041**	-0.034*	-0.039**			-0.036	-0.022
Leverage	-0.012**	-0.008	0.009	0.011*	0.002	0.002	0.007	0.009	-0.012**	-0.019***		
Firm Scope	-0.000	-0.000	0.000	0.000	-9E-05	-0.000	0.001	0.001	4.2E-05	8.8E-05	-0.000	-0.000
Countries	-0.002*	-0.003**	5.9E-05	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.000	-0.001
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	418	358	418	384	418	354	418	362	418	350	418	363
Adj. R^2	0.013	0.013	0.048	0.045	0.061	0.071	0.112	0.127	0.011	0.015	0.050	0.049

Notes: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively.

Panel B	Firm Size		Growth Rate		R&D		Financial Slack		Past Performance		Leverage	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	0.009	0.011	0.027**	0.026**	0.010	-0.002	0.019	0.011	0.008	0.014	0.010	0.011
ΔDT_1	-0.001		-0.007		-0.004		-4E-05		-0.006		-0.020**	
ΔDT_2		-0.002		-0.003		-0.001		0.001		-0.001		-0.011***
Firm Size			-0.004**	-0.004**	-0.001	-0.001	-0.004*	-0.002	-0.005***	-0.006***	-0.001	-0.001
Growth Rate	0.001	-0.003			0.008	0.008	0.004	-0.000	-0.006	-0.008	-0.006	-0.013**
R&D	-0.069	-0.143**	-0.055	-0.087			0.112	-0.015	-0.241***	-0.265***	0.013	-0.005
Financial Slack	0.020	0.021*	-0.001	-0.002	0.022*	0.028*			0.048***	0.043**	0.035***	0.030**
Past Performance	-0.044**	-0.052***	-0.025	-0.025	-0.049***	-0.044**	-0.036*	-0.023			-0.039**	-0.028
Leverage	0.009	0.013**	0.010*	0.012*	0.010*	0.015***	0.0157**	0.019**	0.012	0.016**		
Firm Scope	-0.000	-0.000	-0.001	-0.001	0.001	0.001	-0.000	0.000	0.001	0.001	0.001	0.000
Countries	0.002	0.003*	-0.000	-0.000	0.001	0.001	0.000	-0.001	0.001	0.001	-0.000	1.4E-05
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	418	368	418	342	418	372	418	364	418	376	418	363
Adj. R^2	0.149	0.122	0.087	0.094	0.065	0.068	0.021	0.028	0.085	0.102	0.088	0.100

Notes: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively.

Panel A in Table 5 shows the result of groups higher than median. Excluding the growth rate and leverage ratio, the other coefficients of ΔDT of four groups are significant and negative. These results indicate that companies can reduce ROA volatility through increasing financial structure, firm size, R&D intensity, financial slack, and previous performance. The coefficients of change 1 year after M&A in the firm size and previous performance groups are −0.018 and −0.014 at a 1% level of significance, respectively. By contrast, panel B displays the results of a group lower than median, in which only the coefficients of ΔDT_1 and ΔDT_2 in the lower leverage ratio group are negative and significant at a 5% (1%) level. These results show that companies with an improved corporate status, such as larger firm size, higher R&D intensity, higher financial slack, superior previous performance, and lower leverage ratio, can efficiently reduce their ROA volatility when conducting diversified M&A. Moreover, the coefficients of geographic dispersion are significant and negative regardless of firm size. These results support hypotheses H4a, H4c, H4d, H4e, and H4f but do not support H4b.

Table 6. Beta Subsample

The unrelated M&A subsample is used to test whether companies with better financial structure can reduce beta after M&A. Except for leverage, other control variables in the subsample are higher than the median. The results show that firms with larger size, higher growth rate, and more financial slack can reduce beta through diversification.

	Firm Size		Growth Rate		R&D		Financial Slack		Past Performance		Leverage	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	3.480***	4.352***	0.578	0.561	3.047***	2.978***	3.517***	3.734***	1.130	1.391**	1.176	1.191
ΔDT_1	-1.145**		-1.436**		-0.626		-0.634		-0.192		-0.713	
ΔDT_2		-0.240		-0.277		-0.385		-0.668*		0.078		0.103
Firm Size			-0.031	-0.005	-0.183**	-0.168	-0.133	-0.225	-0.346**	-0.327*	-0.236	-0.111
Growth Rate	-0.439	-0.589			-0.010	-0.048	1.506**	1.771***	0.906	0.917	-0.246	-0.312
R&D	-16.078*	-16.102**	-5.141	-7.660			-3.633	-1.831	-3.197	-2.891	-6.519	-10.563*
Financial Slack	-3.167	-3.737*	-0.319	-0.181	-1.532	-1.320			0.110	-0.595	-2.069*	-2.103*
Past Performance	-0.203**	-2.907	0.710	1.179	-0.044	-0.407	4.410**	4.830*			2.958	2.028
Leverage	-0.689	-2.088***	0.110	0.047	0.305	-0.148	0.077	0.082	0.395	-0.136		
Firm Scope	-0.058	-0.063	-0.017	-0.008	-0.046	-0.036	-0.107	-0131*	-0.020	-0.028	-0.069	-0.083
Countries	-0.112	-0.149	-0.165	-0.062	-0.006	-0.071	-0.122	-0.030	-0.089	-0.049	-0.119	-0.180
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	158	128	158	145	158	129	158	131	158	125	417	362
Adj. R^2	0.017	0.001	0.008	-0.015	0.023	-0.022	0.009	-0.036	-0.007	0.005	-0.009	-0.014

Notes: *, **, and *** represent statistical significance at 10%, 5%, and 1%, respectively.

Because beta is only significant and negative with ΔDT_1 in the unrelated group presented Table 4, the groups are divided from the unrelated M&A sample, and the effect of corporate characteristics on beta is observed. Compared with the full sample, the firms with a larger size, higher growth rate, and superior financial slack can reduce their beta for unrelated M&A. The coefficients are negative and significant at a 5% level.

5 Conclusions

This study provides some essential findings. A sample of 836 M&A cases during 2011–2016, two indices, entropy index, and HHI is used to measure the level of diversification in the firms. To evaluate the corporate risk, two variables, namely SDROA and the beta coefficient, are used. SDROA measures corporate volatility in profitability, whereas beta measures the corporate systematic risk. The results provide some insights. First, diversification can reduce ROA volatility; however, it cannot reduce the corporate systematic risk. Second, related and unrelated M&A can help firms reduce corporate risk. Related M&A reduce ROA volatility, whereas unrelated M&A reduce systematic risk. Third, the subsample results indicate that companies with a larger firm size, higher R&D intensity, superior financial slack, stronger past performance, and lower leverage ratio can efficiently reduce their corporate volatility for M&A.

This study provides strategic implications for investors. If a firm with a superior financial status opts for diversified M&A, corporate volatility is reduced. The result shows investing this firm may help investors diversify their portfolio risk. For firm managers, the results illustrate the effect of diversification on corporate risk. To improve stability of profitability, managers must opt for the related diversified M&A strategy. To reduce the systematic risk, the manager must search for unrelated diversification targets.

In summary, the study provides evidence that diversification M&A can reduce the corporate risk. However, because the countries variable is nonsignificant, evaluating whether cross-border M&A can reduce the corporate risk is still an unsolved problem. Therefore, further research must be conducted to measure the cross-border risk when considering other national factors, such as culture, language,

law system, and religion, for mergers.

When measuring the level of diversification, researchers can use different methods, such as the diversification of product using Hoberg–Phillips databases. In addition, because SDROA is measured to evaluate the long-term profitability risk, the results of the test may not immediately reflect the market risk during M&A. Researchers may try other indices to measure the change of risk, such as short-term credit default swap during M&A.

References

Ahern, K. R., Daminelli, D. and C. Fracassi, (2012), "Lost in Translation? The Effect of Cultural Values on Mergers around the World," *Journal of Financial Economics*, 117, 165-189.

Berry-Stölzle, T. R., Liebenberg, A. P., Ruhland, J. S. and D. W. Sommer, (2012), "Determinants of Corporate Diversification: Evidence From the Property-Liability Insurance Industry," *The Journal of Risk and Insurance*, 79, 381-413.

Chatterjee, S. and M. Lubatkin, (1990), "Corporate Mergers, Stockholder Diversification, and Changes in Systematic Risk," *Strategic Management Journal*, 11, 4, 255-268.

Deng, S. and E. Elyasiani, (2008), "Geographic Diversification, Bank Holding Company Value, and Risk," *Journal of Money, Credit and Banking*, 40, 6, 1217-1238.

Dyl, E. A., (1988), "Corporate Control and Management Compensation - Evidence on the Agency Problem," *Managerial and Decision Economics*, 9, 21-25.

Dzhagityan, E., (2012), "The Effect of Ex Post Risks on Post-M&A Performance Efficiency," University of Liverpool Management School, Financial University under the Government of Russian Federation, MPRA, Apr. 2012.

Erel, I., Liao, R. C. and M. S. Weisbaach, (2012), "Determinants of Cross-Border Mergers and Acquisitions," *The Journal of Finance*, 67, 1045-1082.

Frankel, R. and L. Litov (2009), "Earnings persistence," *Journal of Accounting and Economics*, 47, 182-190.

Green, M. B. and R. G. Cromley, (1982), "The Horizontal Merger: Its Motives and Spatial Employment Impacts," *Economic Geography*, 58, 358-370.

Goudie A. W. and G. Meeks, (1982), "Diversification by Merger," *Economica*, New Series, 49, 447-459.

Hankins, K. W., (2011), "How Do Financial Firms Manage Risk? Unraveling the Interaction of Financial and Operational Hedging," *Management Science*, 57, 2197-2122.

Hitt, M. A., Hoskisson, R. E. and H. Kim, (1997), "International Diversification: Effects on Innovation and Firm Performance in Product-Diversified Firms," *The Academy of Management Journal*, 40, 767-798.

Hoskisson, R. E., Hitt, M. A. and C. W. L. Hill, (1991), "Managerial Risk Taking in Diversified Firms: An Evolutionary Perspective," *Organization Science*, 2, 3, 296-314.

Hoskisson, R. E., Hitt, M. A., Johnson, R. A. and D. D. Moesel, (1993), "Construct Validity of an Objective (Entropy) Categorical Measure of Diversification," *Strategic Management Journa*l, 14, 3, 215-235.

Jacquemin, A. P. and C. H. Berry, (1979), "Entropy Measure of Diversification and Corporate Growth," *The Journal of Industrial Economics*, 27, 4, 359-369.

Jensen, M. C. and R. S. Ruback, (1983), "The Market for Corporate control: The Scientific Evidence," *Journal of Financial Economics*, 11, 5-50,.

Kochhar, R. and M. A. Hitt, (1998), "Linking Corporate Strategy to Capital Structure: Diversification Strategy, Type and Source of Financing," *Strategic Management Journal*, 19, 6, 601-610.

Lubatkin, M. and H. M. O'Neill, (1987), "Merger Strategies and Capital Market Risk," *The Academy of Management Journal*, 30, 665-684.

Montgomery, C.A. and B. Wernerfelt, (1988), "Diversification, Ricardian Rents, and Tobin's q.," *Journal of Economics*, 19, 623-632.

Obi, C.P. and A. Emenogu, (2003), "Bank Holding Company Expansion into Nonbank Functions: Is the Rise in Systematic Risk Rewarded?" *Managerial Finance*, 29, 9-22.

Ouimet, P. P., (2013), "What Motivates Minority Acquisitions? The Trade-Offs between a Partial Equity Stake and Complete Integration," *The Review of Financial Studies*, 26, 1021-1047.

Palepu, K., (1985), "Diversification Strategy, Profit Performance and the Entropy Measure," *Strategic Management Journal*, 6, 239-255.

Swaminathan, V., Murshed, F. and J. Hulland, (2008), "Value Creation Following Merger and Acquisition Announcements: The Role of Strategic Emphasis Alignment," *Journal of Marketing Research*, 45, 38-47.

Thompson, R. S., (1984), "Managerial and Decision Economics," *Managerial and Decision Economics*, 5, 98-103.

Zhou, Y. M., (2011), "Synergy, Coordination Costs, and Diversification Choices," *Strategic Management Journal*, 32, 624-639.