Diversification or Desynchronicity: An Organisational Portfolio Perspective to Risk Reduction

Abstract: *Reducing corporate risk has long been a business strategy concern. Many scholars support diversification as a method to achieve risk reduction. Building on organisational portfolio analysis, we develop the concept of 'desynchronicity' as a complement to existing diversification theories about risk reduction. Organisational portfolio analysis views firms as portfolios of business units, suggesting that a low level of correlation between the income streams of business units in the portfolio is the key to effective risk reduction. 'Desynchronicity' is a concept to understand the extent to which the income streams of business units are lowly correlated. Our results show diversification does not necessarily lead to corporate risk reduction. Instead, strategies that strength a firm's 'desynchronicity' are shown to reduce corporate risk.*
Keywords: Diversification, Risk, Desynchronicity, Organisational Portfolio Theory

Reducing corporate risk is one of the main concerns of corporate managers. Corporate risk, which is measured as the fluctuation of corporate income (Gerhart & Trevor, 1996; Miller & Chen, 2003), has a significant impact on the survival and sustainability of firms. Lower risk could increase a firm's credibility and access to financial resources, thereby reducing the cost of capital and chance of bankruptcy (Conrath, 1973; Hurdle, 1974; Matta & McGuire, 2008; Miller & Chen, 2004; Singh & Montgomery, 1987). In the field of strategic management, diversification has long been argued to be an effective strategy for managers to reduce corporate risk (Andersen, Denrell, & Bettis, 2007; Bettis & Mahajan, 1985; Henkel, 2009; Hisey & Caves, 1985; Maurer, 2011). While the effectiveness of diversification on risk reduction is supported by multiple empirical studies (Hoskisson, 1987; Keats & Hitt, 1988; Silhan & Thomas, 1986), division exists over the extent of this effectiveness. Some scholars hold that the relationship between diversification and risk is curvilinear (Lubatkin & Rogers, 1989; Tallman & Li, 1996), and some argue the relationship is neutral (Lubatkin & O'Neill, 1987; McDougall & Round, 1984). Given the inconsistency of these arguments about the relationship between diversification and risk, this study will examine and develop an alternate perspective to understand corporate risk reduction from the lens of Organisational Portfolio Analysis (OPA).

Donaldson, Charlier, and Qiu (2012) investigate the relationship between diversification and risk reduction via the lens of OPA, and state that diversification is not the key factor directly causing risk reduction. OPA views a corporation as a number of individual segments, such as different business units (BUs). If diversification strategies are purely based on the number of BUs and the sales or assets

percentages of BUs to the whole firm, increasing the level of diversification might not secure a reduction of corporate risk because it may not necessarily reduce the correlation between income streams of the BUs (Donaldson et al., 2012). The OPA can explain how this may occur, by the analysis of portfolio effect, which refers to the cumulative effect of a firm's BUs on a firm's level of risk. OPA not only focuses on the level of diversification, but also the income stream movement of an individual BU in relation to that of the corporation. The movement of each BU can be likened to a sinewave: BU income streams can go up and down. If all the income stream movements of BUs are synchronised, this means they move in a similar way and the BUs coefficient correlations with the corporation are 1, thus no risk reduction will occur, no matter how high the level of diversification (i.e., number of different BUs included in the portfolio). While the traditional diversification-risk studies do not technically measure such correlations, OPA has drawn our attention to incorporate correlations between income streams of BUs into our research method on the relationship between diversification and risk, which is the focus of this study.

This study examines two competing hypotheses arising from the traditional diversification literature (Bettis & Mahajan, 1985; Hisey & Caves, 1985; Kim, Hwang, & Burgers, 1993) and the OPA literature (Donaldson, 1998; Donaldson, 2000; Donaldson et al., 2012; Shughart & Donaldson, 2004). It will test how well diversification or a new concept desynchronicity explains variance in corporate risk. This study will rely on Berry-Herfindahl (1971) and Jacquemin-Berry entropy (1979) methods to examine the relationship between diversification and corporate risk. It will also draw on Rumelt's scheme (1974) to define the levels of corporate risk for different diversity groups, and determine whether one type of firm outperforms its peers. Derived from OPA, we introduce the concept of 'desynchronicity', based on the correlation between the income stream of a BU and that of the remaining company (Donaldson, 1998; Donaldson, 2000; Donaldson et al., 2012; Shughart & Donaldson, 2004).

This study contributes to the existing literature and managerial practices in three key areas. First, we provide the concept of desynchronicity and examine its impact on corporate risk. The literature on the diversification - risk relationship so far remains scattered and inconclusive. The second contribution of this study is to provide empirical evidence supporting the theoretical validity of the

desynchronicity-risk relationship. Although we recognise that satisfying the criteria for desynchronicity calculation might reduce the sample size, the positive finding in the empirical models of the negative relationship suggests that the desynchronicity measure is a reasonable strategic indicator. In terms of the practical contribution, desynchronicity could assist managers to form strategies that are more effective in risk reduction.

The next section of this study reviews existing literature that examines the diversification-risk relationship and the OPA perspective on corporate risk reduction. The following section includes a description of the data and the method employed, followed by the results. These results are then discussed through the theoretical framework derived from OPA. Finally, we conclude with the implications of the study.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Risk has been identified in a number of different ways (Miller & Reuer, 1996). In the diversification-risk literature, there are two types of measures for defining firm risk: accounting risk, based on the aggregate earning stream, which could be a fluctuation in either profitability or revenue (Ball & Brown, 1969); and market risk, a fluctuation of the stock market price (Blume, 1970). This study focuses on the former as it has more relevance to managerial decision-making (Bettis & Hall, 1982; Marshall, Yawitz, & Greenberg, 1984). The latter not only considers factors that managers can control (e.g., the weight of each BU), but factors beyond managerial control (e.g., estimation of the stock market), which are not the focus of our study (Chang & Thomas, 1989).

Diversification is an established research stream in the field of strategic management (Chatterjee & Wernerfelt, 1991; Chen & Chu, 2012; Miller, 2004; Palich, Cardinal, & Miller, 2000; Park & Jang, 2012). A company with multiple BUs has a certain level of diversification and the more diverse the BUs, the higher the level of diversification. The diversification literature identifies two major approaches to investigate diversification: its degree and type (Datta, Rajagopalan, & Rasheed, 1991). The first approach involves Berry-Herfindahl and Jacquemin-Berry's entropy methods, and the second mostly applies Rumelt's Scheme. This study uses both approaches to investigate diversification and its impact on risk.

Negative Relationship between Diversification and Corporate Risk

The existing literature argues that diversification leads to lower corporate risk, mainly based on three reasons. The first reason is similar to the portfolio logic that managers can apply diversification to obtain a portfolio effect, thereby reducing the overall variance of a firm's income stream (Amit & Livnat, 1988a, 1988b, 1988c, 1989; Chakrabarti, Singh, & Mahmood, 2007). This is because the income streams of a firm's BUs may have different movements across different industries (Amit & Livnat, 1988b). These movements may be leading, lagging, or consistent with the macro business cycle. Firms could have BUs in industries that perform differently from the macro business cycle, thereby reducing the firm's overall volatility in sales and profitability, i.e., lowering corporate risk.

Another factor that may lead to risk reduction through diversification is parenting advantage, involving firms allocating resources internally among BUs (Campbell, Goold, & Alexander, 1995; Goold, Campbell, & Alexander, 1998). This advantage enables firms to overcome a crises, e.g., potential bankruptcy, or to strengthen a particular BU (Datta et al., 1991; Higgins & Schall, 1975; Lewellen, 1971; Lubatkin & Chatterjee, 1994; Mosakowski, 1997). This ability to reallocate financial resources within a firm's portfolio creates a parenting advantage, enhancing the firm's competitiveness and reducing corporate risk (Campbell et al., 1995).

The third reason that a diversified firm could ensure a lower level of corporate risk through diversification is by increasing the size of the firm (Chang & Thomas, 1989; Lubatkin & Chatterjee, 1994; Lubatkin & O'Neill, 1987). Larger-sized firms are likely to have lower corporate risk as they are better able to attract increased debt financing, enjoy the benefits from economies of scale, and are more likely to survive during a crisis (Balakrishnan & Fox, 1993). Based on the above arguments that diversified firms are able to create a portfolio effect, enjoy parenting advantages, and increase their size, we hypothesize that:

Hypothesis 1: *Diversification is negatively associated with corporate risk*

Negative Relationship between Desynchronicity and Corporate Risk

Although substantial research has been done to investigate the diversification-risk relationship, few empirical studies have considered or examined the impact of the correlations between the income streams of BUs. As argued earlier, the diversification of firms into a broader range of businesses may

not ensure risk reduction, if the income stream of these businesses fluctuates in the same direction, leading to a high correlation/synchronisation between income streams in the corporate portfolio. In contrast, firms may generate more risk reduction by diversifying into only one BU that is negatively correlated with the corporate income stream. This is because a downturn in the performance of one BU of a firm could be compensated by an upturn in another BU (Donaldson et al., 2012). Therefore, having BUs with opposite income stream movements is more important to evaluating a firm's level of risk than only considering the level of diversification, which is applied in many previous studies.

Donaldson et al. (2012) apply an OPA perspective to incorporate the correlation between income streams in a corporate portfolio into the analysis of corporate risk. They introduce a new concept: synchronization compensation, the risk offset by the different income fluctuations of BUs. If a corporation has only two business units with equal income streams and one is countercyclical to the other, then the corporate risk will be completely offset. Donaldson et al. (2012) argue that synchronisation compensation is more effective in risk reduction than having BUs with low risk. However, they did not create a method to measure the level of synchronisation of a corporate portfolio in order to examine how much synchronisation compensation a firm may have. Built on Donaldson et al. (2012), we apply desynchronicity to measure the extent to which a firm's corporate portfolio enjoys a high level of synchronisation compensation by having BUs with lowly correlated income streams.

[Insert Figure 1 about here]

Desynchronicity refers to the combined effects of BUs' weight of income streams and the extent to which these income streams are lowly correlated (Shughart & Donaldson, 2004). The measure of desynchronicity is different from the traditional measure of diversification by Berry-Herfindahl (1971), Jacquemin-Berry entropy (1979) and Rumelt's scheme (1974), which neglect a BU's income stream in correlation with the remaining corporate portfolio. To further explain the concept of desynchronicity, we provide four graphs to describe different circumstances. If all the BUs of a diversified firm, including the newly acquired BU, have income streams moving in the same direction (Graph 1), they are highly correlated and thereby no reduction of risk is generated. If a firm acquires a high risk BU, i.e., high fluctuation in its income stream, with an income stream that

fluctuates in the same direction with the existing BUs (Graph 2), the new BU will significantly increase corporate risk. On the other hand, if the new BU's income stream is moving in the opposite direction to the existing BUs (Graph 3), this BU will increase the desynchronicity (the extent to which the BUs are generating lowly correlated income streams) and thereby reducing corporate risk. Actions that enhance a firm's desynhronicity decrease the level of corporate risk. Therefore, an efficient diversification strategy for risk reduction is diversified to BUs that increase instead of decrease the desynchronicity of corporate portfolio. Our study argues that even moderate desynchronicity (Graph 4) could lead to a significant reduction in corporate risk. Unlike Donaldson et al. (2012) who categorise the BUs having a negative correlation with the corporation as countercyclical, we present a desynchronicity index that counts all reduction of risk as long as a BU is not cyclical with others. Based on the portfolio effect of OPA, we predict that desynchronicity will be negatively associated with a firm's corporate risk.

Hypothesis 2: *Desynchronicity is negatively associated with corporate risk*

DATA AND METHODS

The dataset targets the entire set of firms in the COMPUSTAT segment database for the years 2002-11. We assess BU financial data of sample firms over a ten-year period in order to adequately perform desynchronicity. This method is constrained by the limited availability of public data as well as inconsistencies with regard to this data linked to BU name changes across the time periods. In this database, we include firms with at least two available BUs' sales for the entire period, and exclude firms missing certain data across the period, leaving a final sample of 737 diversified firms.

Dependent Variables

Accounting risk is measured in two ways: coefficient of variation (CV) of sales; and the standard deviation of return on assets (SD of ROA) (Ferri & Jones, 1979; Miller & Chen, 2003). In this study, we follow the income stream tradition and focus on risk based on fluctuation in sales and profitability: two complementary measures. Corporate risk is measured by accounting rather than market risk, as it is more relevant to managerial decisions and stakeholder benefits. Corporate risk can be represented by the historical volatility of a firm's sales, as sales constitute the basis and source of the bulk of a firm's income (Robins, 1993; Wagner, Hoisl, & Thoma, 2013). The volatile nature of

profitability is also widely used to define the level of risk and the SD of ROA is the standard ex post measures of risk (Andersen et al., 2007; Bettis, 1982; Cootner & Holland, 1970; Libby & Fishburn, 1977).

Independent Variables

The level of diversification. This study applies the three most widely applied methods to assess the levels of diversification. First, the Berry-Herfindahl method is a traditional measure of diversification, which is dependent on Standard Industrial Classification (SIC) for examining the extent to which the firm operates in different industries (Berry, 1974; Montgomery, 1982; Pitts & Hopkins, 1982). Second, the Jacquemin-Berry entropy method is based on the Berry-Herfindahl method and is widely applied by numerous scholars (Amit & Livnat, 1988b; Kochhar & Hitt, 1998; Lee & Lieberman, 2010; Markides & Williamson, 1996; Nayyar, 1992; Su, 2010). Third, Rumelt's scheme is utilised to separate firms into four general groups and to examine whether they have statistical differences (Bettis, 1981; Bettis & Hall, 1982; Bettis & Mahajan, 1985; Christensen & Montgomery, 1981; Rugman, 1976).

The level of desynchronicity. Desynchronicity is proposed as a competing method of diversification to examine the effect it has on risk. Donaldson et al. (2012) treat firms as a combination of BUs. They introduce synchronisation which considers the alignment of each BU's profit cycle. The BU weight is calculated by the profit. However, in some circumstances, this profit could be negative, and thus makes the calculation unrealistic. The method employed to apply this concept is to compare one BU's correlation against the combined BUs of the firm. Donaldson et al. (2012) argue that negative correlation will lead to a reduction in corporate risk. Building on a synchronisation view of firms as BUs, this study considers the alignment of each BU's cycle, in this case, sales or profitability cycles. In this study, desycnhronicity index calculates the correlation between the sales of each division and of the remaining firm, and then, multiplies the weight of the BU to obtain the weighted correlation. Finally, the weighted correlation results are added together and the result is the firm's level of corporate synchronisation. Similar to the entropy method, we take a nature log on corporate synchronisation. This is because logging could result in the residuals being normally distributed. This in turn decreases the impact of the tail effect. As the corporate

synchronisation is among the range -1 to 1, this study uses 1 to subtract the above result, in order to convert the residual to a normal distribution. From this method, we generate a desynchronization index, which provides a method of calculating a firm's level of BU desynchronicity.

Controls. We include the following eight variables as controls: (1) firm size (the natural logarithm of a firm's assets); (2) firm age (the natural logarithm of the firm's years in COMPUSTAT); (3) industry dummy; (4) a variable to capture firm participation in international markets; (5) a dummy variable to define whether a firm's headquarters is in the US; and (6) firm performance (referred as ROA).

Analyses

Our hypotheses were tested using regression and ANOVA. For Jacquemin-Berry entropy, Berry-Herfindahl and desynchronicity methods, we ran four models to display the regression results between these methods and corporate risk. A first-stage regression used variables identified in the scholarly literature that affect risk. The first model applies CV of sales in ten years (2002-11) as the benchmark to calculate the level of corporate risk. The second model applies SD of ROA in ten years as the benchmark to calculate the level of corporate risk. Given that risk is influenced by other fixed effects such as board independence (Hamilton & Nickerson, 2003), we addressed the issue of missing variables by using time-series, two different periods (five years each). The third model applies CV of sales and calculates each variable as the variation between the two periods (2002-06 vs. 2007-11). The fourth model applies SD of ROA and calculates each variable as the variation between the two periods. Since a few outliers might introduce a substantial bias in the estimation, the analysis eliminates the outlier effect by winsorisating the continuous variables at the 99th and 1st percentiles of their respective distribution (David, O'Brien, Yoshikawa, & Delios, 2010; Patel & Cooper, 2013). Based on Rumelt's scheme, we categorise our sample firms into four groups: single, dominant, related and unrelated businesses. Then we summarize results of an ANOVA of the four diversification groups for corporate risk defined as CV of sales (Group A) and SD of ROA (Group B). Among Group A, which is formed by the sample of 737 COMPUSTAT firms, 48 are single business firms, 292 are dominant firms, 262 are related diversified firms and 135 are unrelated diversified firms. Out of the

sample of 332 firms in Group B, 22 are single business firms, 124 are dominant firms, 107 are related diversified firms and 79 are unrelated diversified firms.

RESULTS

This study shows the descriptive statistics, specifically the means, standard deviation, and correlations for both Group A in Table 1 and Group B in Table 2. As shown in Table 1, both Jacquemin-Berry entropy (Entropy diversification) and Berry-Herfindahl (B-H diversification) methods are negatively correlated with corporate risk, defined as the CV of sales, yet neither of them has a statistical significance, indicating the level of diversification is not a strong indicator of corporate risk. This assumption is confirmed in Table 2 as neither diversification method having a negative statistically significant relationship with corporate risk, defined as the SD of ROA. On the other hand, the correlation between corporate risk and desynchronicity is significantly negative in Table 1, and the similar result is shown in Table 2. For the calculation of the change in sales/ROA, the descriptive statistics are not presented, as time-series methods eliminate the fixed-effects and only size and ROA are left.

[Insert Table 1 & 2 about here]

Table 3 shows the results based on Jacquemin-Berry entropy method to predict corporate risk. As shown in all modes, a negative diversification-risk is not supported. Model 1 shows that entropy diversification has a negative yet not significant effect on corporate risk defined as a CV of sales ($b = -0.05$, $p >. 05$). The effect persists when corporate risk is defined as SD of ROA in Model 2 ($b = -0.05$, $p >. 05$). The neutral relationship still holds in first difference methods. Specifically, entropy method does not have a statistical significance in relation to corporate risk defined as Δ CV of Sales ($b = -0.18$, $p >.05$) and Δ SD of ROA ($b = -0.16$, $p >.05$) in Model 3 and 4, respectively. This evidence suggests that based on the entropy diversification method, the level of diversification is not related to the level of corporate risk, which does not support Hypothesis 1.

[Insert Table 3 about here]

Table 4 presents the diversification-risk relationship, by using Berry-Herfindahl method. Compared to the entropy method, the Berry-Herfindahl method has a similar p-value and R-square. Even if the relationships between diversification and risk are all negative, only Model 3 has a

marginal statistical significance, indicating the empirical evidence for diversification-risk hypothesis is very limited. Model 1 indicates that Berry-Herfindahl diversification has a negative yet not significant effect on corporate risk defined as a CV of sales (b = -0.12, p >. 05). The effect is consistent when the corporate risk is defined as SD of ROA in Model 2 (b = -0.08, p >. 05). For first difference data, Berry-Herfindahl diversification only has a marginal statistical significance associated with Δ CV of Sales (b = -0.39, p <. 10) and no association with Δ SD of ROA (b = -0.46, p >. 05) in Model 3 and 4, respectively. Therefore, none of the models have statistical significance (<. 05) between diversification and corporate risk, and Hypothesis 1 is not proved in this study.

[Insert Table 4 about here]

In Rumelt's scheme, the significance level of this method is higher than 0.05 and shows no significant main effect for diversification groups on corporate risk. As shown in Table 5, there was a marginal significant main effect for diversification groups on corporate risk defined as CV of sales. To examine whether one of the groups is superior to others in terms of corporate risk, this study compares the risk mean of each group. The significance level of the ANOVA test for ROA method is higher than 0.10, which means the diversification groups have the similar corporate risk. Therefore, this study only presents a post-hoc analysis for corporate risk defined as CV of sales. As depicted in Table 6, the results show that firms with related diversification have marginally significant lower risk than firms as single businesses. Overall, there is no statistically significant difference (<. 05) between Rumelt's four groups in terms of corporate risk.

[Insert Table 5 & 6 about here]

In sum, the evidence for Hypothesis 1 is not sufficient. Among the three measures of diversification, very limited evidence supports the hypothesis that diversification is negatively associated with risk. Therefore, diversification might not be the key factor for risk reduction and a new indicator is needed.

Table 7 presents the effects of desynchronicity on corporate risk. Model 1 applies CV of sales to define corporate risk and supports the argument that a higher level of desynchronicity reduce corporate risk (b = -0.18, p <.001). For the risk defined by the SD of ROA, the result still shows a significant negative relationship between corporate risk and desynchronicity in Model 2 (b = -0.36, p

<. 001). In conjunction with the findings from the first difference regressions in Model 3 (b = -0.19, p <.001) and 4 (b = -0.32, p <.001), this study supports Hypothesis 2, which concludes that corporate risk decreases when desynchronicity is increased. This is consistent with the argument that desynchronicity, instead of diversification, is the key to reducing the level of corporate risk.

[Insert Table 7 about here]

DISCUSSION

With the above empirical tests, our results suggest that diversification may not be the key cause of risk reduction. We conclude that three commonly used diversification measures do not capture the underlying portfolio logic behind risk reduction. Our results, from 737 firms show that the level of diversification defined under the Berry-Herfindahl, the entropy method and Rumelt's method does not necessarily relate to a low level of corporate risk. The evidence for a negative relationship between diversification and risk is very limited and weak. This study challenges conventional diversification theory that firms reduce the level of corporate risk through a high level of diversification. The largely unexpected results, in particular the neutral relationship between measures of diversification and corporate risk, merit specific attention for future research.

To explain the neutral diversification-risk relationship, we offer two reasons. First, managers who support portfolio theory may be overly confident about the measures of diversification, which are mainly based on the sales or assets weight of each BU relative to the whole firm. We posit that firms will not enjoy a reduction in risk if they fail to consider correlations among BUs. Second, diversification may not have much effect on risk reduction if a new BU has higher risk and is highly correlated with other BUs, which would negate the portfolio effect. In this case, having more BUs might even increase risk, as results show that firms might have higher corporate risk after adding a new BU.

The study raises three insights for managers promoting a diversification strategy. First, they should have more realistic expectations of the relationship between diversification and risk. Since a diversification strategy is not closely associated with lowering corporate risk, it may not be an appropriate strategy to increase the level of diversification for the purpose of risk reduction. Second, diversified firms with higher levels of desynchronicity could enjoy lower levels of corporate risk. This

requires a certain period of time, e.g., up to 10 years, to detect the cycles of each BU. Lastly, managers can use desynchronicity as an indicator to gauge the level of risk in a portfolio. This allows for a more precise understanding of the impact of a new or existing BU on the level of risk across the portfolio.

This study has a number of limitations that may offer opportunities for further research. First, the vast majority of firms in the data set do not have comprehensive BU data over a ten-year period (2002-11). Furthermore, the models applied in this study, regardless of cross-section or panel data, are based on historical data. The question of whether the desynchronicity will remain similar in the next period could also be a new avenue for research. In addition, this study mainly focuses on corporate risk and it has the potential to examine the impact of desynchronicity on return. Finally, one side issue that is argued in this study was endogeneity, an area of great interest to management scholars (Hamilton & Nickerson, 2003). This study used a lag (of two periods) method to overcome fix-effects. For random-effects, unless finding instrument variables, the problem will be difficult to solve. Nevertheless, endogeneity is not a fatal issue in this study, yet it is worth exploring at a later stage.

CONCLUSION

This study indicates that diversification may not be the key to reduce the level of corporate risk, lending considerable support to the validity of desynchronicity as a useful concept to explain the relationship between diversification and risk reduction. By examining the relationship between a firm's level of desynchronicity and corporate risk, this study presents the first large-scale analysis and contrasts two hypotheses derived from diversification theory and the OPA perspective. The concept of desynchronicity and its measure developed in this study provide a new avenue for researchers to investigate the relationship between diversification and risk reduction. This study also provides managers a new tool to investigate their corporate portfolio and its risk performance. As implementing diversification strategies are resource intensive and costly, understanding the actual determinants of corporate risk reduction helps managers to make more informed decisions regarding the composition of the corporate portfolio and the risk implications of acquiring or divesting a BU.

Figure 1: the BUs' movements and Desynchronicity

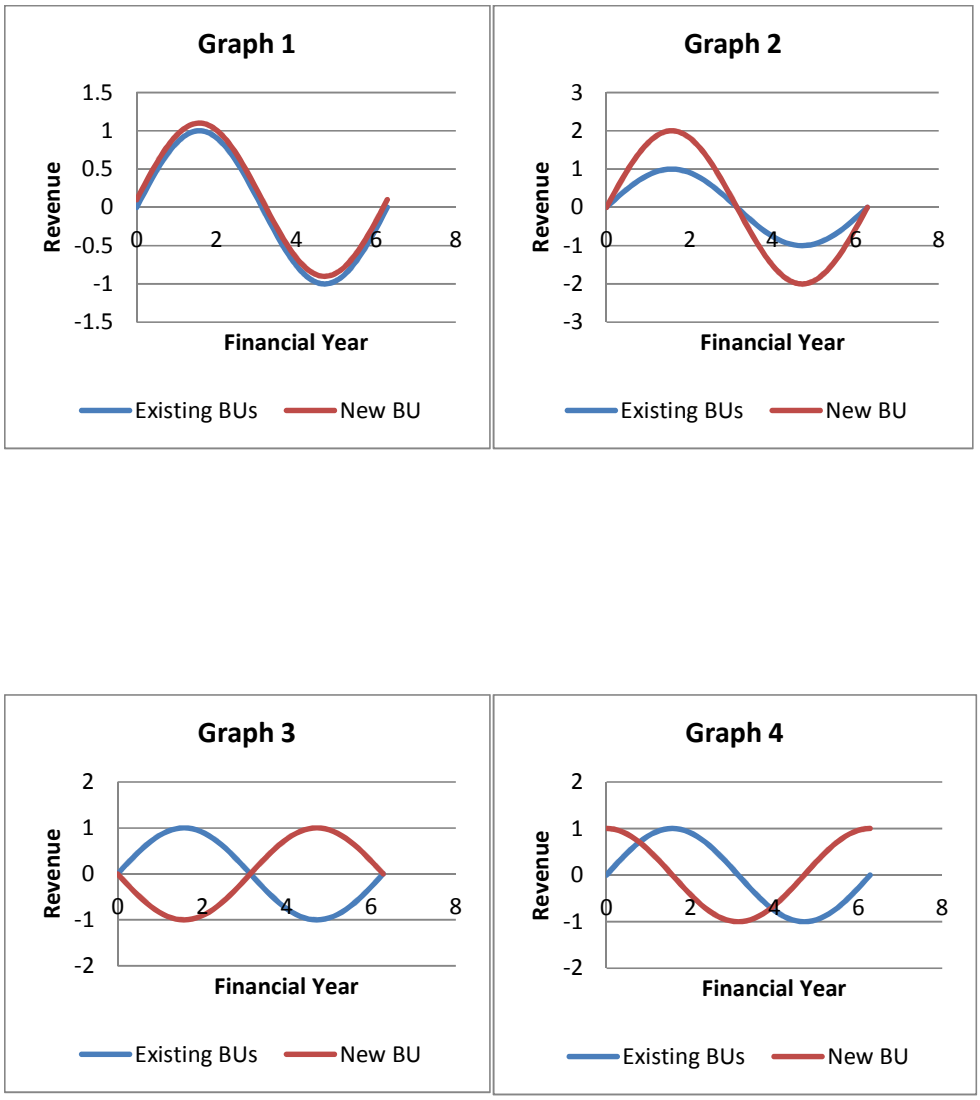

Table 1: Descriptive Statistics and Correlations of Variables (CV of sales for risk)

	Variable	Mean	SD	Max	Min	1	2	3	4	5	6	7	8
1	Corporate risk	-1.42	0.56	-0.06	-3.04								
2	Entropy diversification	0.68	0.32	1.92	0.02	-0.02							
3	B-H diversification	0.42	0.18	0.84	0.00	-0.03	0.96**						
4	Desynchronicity	-1.14	1.19	0.66	-4.99	-0.38**	-0.10**	-0.10**					
5	MNC	0.14	0.35	1.00	0.00	0.01	-0.07	-0.06	0.05				
6	Location	0.17	0.37	1.00	0.00	0.14**	0.12**	0.08*	-0.10**	0.00			
7	Size (LN)	7.31	2.20	13.94	1.56	-0.06	0.19**	0.11**	-0.15**	-0.07*	0.35**		
8	ROA	0.04	0.07	0.33	-0.66	0.04	0.05	0.00	-0.27*	-0.05	0.07	0.25**	
9	Age (LN)	3.40	0.50	4.16	2.49	-0.23**	0.11**	0.09*	0.01	-0.08*	-0.28*	0.10*	0.07*

n=737, * p<. 05, ** p<. 01.

Table 2: Descriptive Statistics and Correlations of Variables (SD of ROA for risk)

	Variable	Mean	SD	Max	Min	1	2	3	4	5	6	7	8
1	Corporate risk	-3.00	0.94	-0.45	-5.59								
2	Entropy diversification	0.68	0.33	1.54	0.00	-0.02							
3	B-H diversification	0.41	0.19	0.76	0.00	0.03	0.97**						
4	Desynchronicity	-0.38	0.71	0.65	-3.72	-0.26**	-0.03	-0.04					
5	MNC	0.12	0.33	1.00	0.00	0.01	-0.13*	-0.14*	-0.07				
6	Location	0.11	0.32	1.00	0.00	0.00	0.03	0.01	-0.04	0.05			
7	Size (LN)	7.17	2.01	12.11	2.20	-0.42**	0.17**	0.09	-0.06	-0.06	0.31*		
8	ROA	0.04	0.07	0.33	-0.66	-0.20**	0.02	-0.03	0.12*	-0.05	0.03	0.21**	
9	Age (LN)	3.47	0.49	4.16	2.49	-0.11*	0.14*	0.10	-0.03	-0.13*	-0.23**	0.13*	0.08

n=332, * p<. 05, ** p<. 01.

Table 3
Effect of Entropy Diversification on Corporate Risk

Variables	Model1 CV of Sales Risk		Model2 SD of Profit Risk		Model3 Δ CV of Sales Risk		Model4 Δ SD of Profit Risk	
Entropy diversification	-0.05	(0.06)	-0.05	(0.15)	-0.18	(0.12)	-0.16	(0.21)
Controls								
MNC	0.05	(0.06)	0.01	(0.14)				
Location	0.147*	(0.06)	0.35*	(0.16)				
Size (LN)	-0.01	(0.01)	-0.18***	(0.03)	-0.38***	(0.07)	-0.27*	(0.11)
ROA	0.45	(0.29)	-1.72**	(0.64)	-0.42	(0.41)	-5.04***	(0.72)
Age (LN)	-0.23***	(0.04)	-0.07	(0.10)				
Industry dummies	Yes		Yes		No		No	
Intercept	0.05	(0.56)	-0.63	(0.90)	-0.21***	(0.04)	0.27***	(0.06)
N	737		332		765		369	
F	7.03		9.69		12.95		21.49	
R-squared	0.13		0.32		0.05		0.15	
Adj. R-squared	0.11		0.28		0.05		0.14	

Standard errors are in parentheses
*** p<. 001, ** p<. 01, * p<. 05, † p<. 10

Table 4
Effect of Berry-Herfindahl Diversification on Corporate Risk

Variables	Model1		Model2		Model3		Model4	
	CV of Sales Risk		SD of Profit Risk		Δ CV of Sales Risk		Δ SD of Profit Risk	
B-H diversification	-0.12	(0.11)	-0.08	(0.25)	-0.39 †	(0.22)	-0.46	(0.40)
Controls								
MNC	0.05	(0.06)	0.01	(0.14)				
Location	0.15*	(0.06)	0.35*	(0.16)				
Size (LN)	-0.01	(0.01)	-0.18***	(0.03)	-0.38***	(0.07)	-0.27*	(0.11)
ROA	0.44	(0.29)	-1.72**	(0.64)	-0.45	(0.41)	-5.11***	(0.72)
Age (LN)	-0.23***	(0.04)	-0.07	(0.10)				
Industry dummies	Yes		Yes		No		No	
Intercept	0.07	(0.56)	-0.63	(0.90)	-0.21***	(0.04)	0.27***	(0.06)
N	737		332		765		369	
F	7.08		9.68		13.14		21.77	
R-squared	0.13		0.32		0.05		0.15	
Adj. R-squared	0.11		0.28		0.05		0.15	

Standard errors are in parentheses
*** p<. 001, ** p<. 01, * p<. 05, † p<. 10

Table 5
Analyses of Variance of Diversification Groups on Corporate Risk

Sales method	df	MS	F	Sig.
Diversification groups	3	0.77	2.46	0.06
Error	733	0.31		
Corrected total	736			
ROA method	df	MS	F	Sig.
Diversification groups	3	0.003	0.37	0.77
Error	328	0.009		
Corrected total	331			

Table 6
Diversification Groups in relation to Risk Mean Test

	Difference between means	Simultaneous 95% confidence limits		Comparisons significant at the 0.10 level are indicated by †
UD – RD	0.09	-0.07	0.24	
UD – Dominate	0.08	-0.07	0.23	
UD – Single	-0.12	-0.36	0.125	
RD – Dominate	-0.004	-0.13	0.12	
RD – Single	-0.20	-0.43	0.02	†
Dominate – Single	-0.20	-0.42	0.02	

Table 7
Effect of Synchronicity on Corporate Risk

Variables	Model1 CV of Sales Risk		Model2 SD of Profit Risk		Model3 CV of Sales Risk		Model4 SD of Profit Risk	
Desynchronicity	-0.18***	(0.02)	-0.36***	(0.06)	-0.19***	(0.01)	-0.32***	(0.04)
Controls								
MNC	0.05	(0.05)	-0.07	(0.13)				
Location	0.11 †	(0.06)	0.34*	(0.15)				
Size (LN)	-0.03**	(0.01)	-0.19***	(0.02)	-0.24***	(0.06)	-0.26*	(0.10)
ROA	-0.24	(0.28)	-1.21*	(0.61)	-0.41	(0.37)	-4.35***	(0.66)
Age (LN)	-0.23***	(0.04)	-0.10	(0.09)				
Industry dummies	Yes		Yes		No		No	
Intercept	-0.27	(0.51)	-0.57	(0.85)	-0.12***	(0.03)	0.26***	(0.06)
N	737		332		765		369	
F	16.83		13.06		78.45		47.93	
R-squared	0.26		0.38		0.24		0.28	
Adj. R-squared	0.24		0.35		0.23		0.28	

Standard errors are in parentheses
*** p<. 001, ** p<. 01, * p<. 05, † p<. 10

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