On the Sensitivity of Firm Risk to Executive Compensation (Vega Effect) — the Effect of Life Cycle

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ABSTRACT

The purpose of this study is to examine whether the effect of firm risk on executive compensation (or "vega" effect), will be dependent on the life cycle stage of firms (namely, growth stage, mature stage, and decline stage). This study is based on the financial and executive compensation data of 1,812 listed companies in Taiwan between 2005 and 2007, which are collected from TEJ (Taiwan Economics Journal) database. Our primary empirical results are summarized as follows：

1. Overall speaking, significant positive (negative) vega effects were found on firms in growth (decline) stage; while no significant vega effect was found on firms in mature stage.
2. The significant positive vega effects of growth firms were only found for firms with previous year's firm risk lower than its industry average, but no significant vega effect were found for growth firm with previous year's firm risk higher than its industry average. On the other hand, the significant negative vega effects of decline firms were only found for firms with previous year's firm risk higher than its industry average, but no significant vega effect were found for growth firm with previous year's firm risk lower than its industry average.
3. For firms on mature stage, no significant vega effect were found, regardless of firms' relative risk level of previous year.

The above empirical evidence suggests that firm risk plays an important strategic role on top managers' compensation. When firms were in growth stage with relatively small risk level, compensation scheme will include a positive vega effect to encourage firm managers to take risky projects. On the other hand, when firms were in decline stage with relatively large risk level, compensation scheme will include a negative vega effect to discourage firm managers to take risky projects.

Key words：life cycle, executive compensation, Vega effect

I. INTRODUCTION

Many studies have tried to analyze the role of firm risks played in executive compensation structure. Holmstrom (1979), Holmstrom and Milgrom (1987) and Banker and Datar (1989) suggested that firm risks have a negative impact on firms' pay-performance sensitivity (PPS) based on the following two reasons: (1) firms with larger performance risk will also increases executive compensation risk; therefore firms with larger risk will have lower PPS to reduce executive managers' exposure to risk; (2) it will be more difficult for firms to distinguish good effort from luck for firms with larger risk; therefore firms with larger risk will have lower PPS. However, empirical studies seem to find inconsistent evidence. For example, some studies found that risk have negative impact on PPS (Aggarwal and Samwick (1999) and Kraft and Niederprum (1999)). On the other hand, other studies found that risks have positive (Barber et al., 1996; Prendergast, 2002) or insignificant impact (Yermack, 1995; Bushman et al., 1996; Ittner et al., 1997) on PPS.

These early studies have failed to recognize the possibility of managers' under-investment problem when the executive compensation schemes do not include direct compensation for firm managers who are willing to pursue risky projects with positive NPV. The early agency models only discuss the design of an efficient contract to tailor agents' "effort" to the optimal level. These models ignore the possibility that managers' "investment choice" will also affect firms' future performance. Including risk measure in the compensation structure may be an efficient solution to align managers' risk-taking activities. Several recent empirical studies have found that risks do have an impact on executive compensation. For example, Miller et al.(2002) found that risks have an inverse U-shape effect on executive's compensation. Coles, et al. (2006) found that there are a number of firms exhibiting large "sensitivities of compensation to stock volatility" (the so called "vega effect"). Managers of firms with vega effect on their compensation scheme tend to implement riskier policy choices, including relatively more investment in R&D, more focus (less diversified) and higher leverage. Shareholders of firms requiring intensive innovative investment may include the vega effect in the compensation structure to encourage executive managers to engage in more risk taking. We have also seen many firms issuing stock options at the start-up/growth stage. The issuing of stock options will cause the executive compensation to be directly and positively affected by firm risk.

Following the direction of previous studies about the role played by risk in executive compensation structure, this study intends to analyze whether shareholders will include "vega effects" in executive compensation structure as a strategic tool to align managers' risk-taking activities for firms at different life cycle stages. Since firms in growth stage usually have many risky projects with

positive NPV, shareholders of these firms will tend to include a positive "vega effect" to encourage managers for risk taking. On the other hand, firms in the decline stage will include a negative "vega effect" to discourage managers from "betting it all" by engaging in risky projects with negative NPV. Therefore, this study hypothesizes that firms in the growth stage will include a positive vega effect in the compensation structure, while firms in the decline stage will include a negative vega effect to refrain executive managers from engaging in too much risk-taking. The empirical findings in this study are consistent with this hypothesis.

To further examine the strategic role of vega effect, this study also examine whether the vega effect at different life cycle stage will also be dependent on a firm's relative risk level to its industry's. After all, the shareholders of a growth firm will encourage managers' risk taking only when ithe firm's risk level is relatively smaller than its industry average risk level. On the other hand, a firm in decline stage will discourage risk taking only when its risk level is relatively larger than its industry average risk level. The empirical findings in this study are also consistent with this congesture.

This empirical findings in this study suggest that the vega effect is included in executive compensation structure as a strategic tool to align managers' risk-taking activities for firms at different life cycle stages.

II. METHODOLOGY

Sample and Procedure

The financial and executive compensation data of listed firms in Taiwan from year 2005 to 2007 were used in this empirical analysis. We exclude financial firms and government-owned enterprises, firms with missing compensation or financial data; and firms with extreme value observations. There are 1,812 sample firms left for this studies.

Life Cycle

We divide collected samples into three life cycle stages based on methods developed by Anthony and Ramesh (1992) and revised by Chiou and Hung (2008), Lin et. Al., (2008)[1], with four specific-firm factors, which are sales growth ratio (SG), capital expenditure ratio (CE), R&D ratio (RD), and firm ages (AGE). The sample characteristics are shown as Table 1, that firms on growth stage with higher sales growth, capital expenditure, and proceed more R&D activities, while firms on decline stage with opposed conditions.

Table 1 The Mean Financial Figures of Firms at Different Life Cycle Stages

Life cycle stage	SG	CE	RD	Age
Growth (G)	28.85%	7.75%	5.35%	15.35

[1] Chiou and Hung (2008), Lin et al., (2008) proposed that e firms are not common to pay dividends in practical, so that the dividend payout ratio is not an proper index for divide life cycle in Taiwan.

Mature (M)	13.94%	3.52%	2.63%	25.59
Decline (D)	-4.20%	-3.25%	0.55%	33.28

Key Measures

Dependent Variable (Executive Compensation, COMP)

Hambrick et al.(1992) include the compensation of the top five best-paid managers as the executive compensation. However, TEJ data does not provide detailed compensation figures of each top executive managers. It only provides the total compensation and the number of employees of the top several brackets. Thus we use the following procedures to measure the executive compensation of each firm. Firsr, we accumulate the total compensations from the top brackets until the number of total employees just going over 5 persons, and then divide the total compensations by the number of employees in these brackets accumulated.

Independent Variables

1. **Return:** Lambert and Larcker (1987) and Warner et al. (1998) proposed that stock returns can truly reflect firm's value and operating performance, therefore, we use the dividends-adjusted annual stock returns as our performance measurement.
2. **Risk:** Following Coles et al. (2006), we use the standard deviation of daily stock returns in each year to proxy for firm risk.
3. **Life Cycle:** We separated sample firms into three life cycle stages followed the methods developed by Anthony and Ramesh (1992) and revised by Chiou and Hung (2008), Lin et. Al., (2008). Three dummy variables (LC^G, LC^M and LC^D) are used to define the three different life cycle stages (Growth, Mature, and Decline).
4. **Relative Risk of Previous Year:** We set up two relative risk dummy variables (D1 and D2) to identify firms with different relative risk level to their industry's. D1 equals 1 when the firm's risk of previous year is below its industry's risk level, while D2 equals 1 when the firm's risk of previous year is above its industry's risk level.

Control Variables

1. **Year:** We set the year dummy variable to control for the specific-year factor.
2. **Industry:** Kwon and Yin (2003) suggested that the structure of executives' compensation in high-tech firms are dissimilar with other industry, so that we set an high-tech industry dummy variable to control the factor.
3. **Firm Size:** Larger firms have more complex strategic decision and rely more heavily on executive's professional knowledge, therefore, larger firms will provide executives higher compensation. We use the natural logarithm of total assets as the proxy for firm size (Finkelstein and Hambrick, 1989; Smith and Watts, 1992; Ryan and Wiggins, 2002).

Empirical Models

We use the following three models to recognize the role of risk on executive's compensation. At first, we take model 1 as the benchmark model to examine the risk direct impact on executive's compensation without considering life cycle stage. Second, we use model 2 to indentify whether the effect of firm risk on executive compensation, will be dependent on the life cycle stage of firms. In the end, we use model 3 to further examine how stockholders' will use compensation to impact executives' attitudes toward to risk, considering the firm's relative risk to its industry's average risk level.

Table 2 Empirical Models

Model 1: $\ln(\text{Comp.})_{i,t} = \beta_0 + \beta_1 * \text{Return}_{i,t} + \beta_2 * \Delta\text{Risk}_{i,t} + \beta_3 * \text{Year}_{i,t} + \beta_4 * \text{industry}_i + \beta_5 * \text{Size}_{i,t} + \varepsilon_{i,t}$
Model 2: $\ln(\text{Comp.})_{i,t} = \beta_0 + \beta_1 * \text{Return}_{i,t} + \beta_2 * LC_{i,t}^{T} * \Delta\text{Risk}_{i,t} + \beta_3 * LC_{i,t}^{M} * \Delta\text{Risk}_{i,t} + \beta_4 * LC_{i,t}^{D} * \Delta\text{Risk}_{i,t} + \beta_5 * \text{Year}_{i,t} + \beta_6 * \text{industry}_i + \beta_7 * \text{Size}_{i,t} + \varepsilon_{i,t}$
Model 3: $\ln(\text{Comp.})_{i,t} = \beta_0 + \beta_1 * \text{Return}_{i,t} + \beta_2 * D1 * \Delta\text{Risk}_{i,t} + \beta_3 * D2 * \Delta\text{Risk}_{i,t} + \beta_4 * \text{Year}_{i,t} + \beta_5 * \text{industry}_i + \beta_6 * \text{Size}_{i,t} + \varepsilon_{i,t}$

Results

Descriptive Statistics

Table 2 shows that the ranges of executive's compensation (from 4 to 11,751 thousands) and the changing of firm risk (from -92% to 1,130% thousands) are widely, indicating our sample firms risk and compensation levels are quite different.

Table 3 Descriptive statistics

Variables	Mean	S.D.	Max	Medium	Minimum
Ccmp (thousands)	1,156.99	1,360.082	11,751.000	713.570	4.000
Return (%)	29.003	68.113	1,025.322	14.787	-74.962
ΔRisk (%)	0.212	0.777	11.296	0.073	-0.920
Ln (Firm Size)	15.282	1.296	20.247	15.114	11.986

Regression Results

Table 4 reports the regression results for model 1 and 2. As indicated in the results for model 1, when life cycle is not considered in the model, the risk may seem to have no effect on executive's incentive compensation. However, when life cycles are included in the analysis, we found that risk impacts compensation differently at different life cycles. When the firm is in growth (decline) stage, the risk has a significant positive (negative) impact on executive compensation. However, when the firm is in mature stage, risk does not play any role in executive compensation. This finding is consistent with our conjectures that shareholders use vega effect strategically in executive compensation structure to align managers' risk-taking activities for firms at different life cycle stages.

Table 4 Regression Results－Model 1 and Model 2

Variable/Model	Model 1	Model 2
Return	0.089***	0.089***
$\Delta Risk$	0.027	
$LC^G * \Delta Risk$		0.062***
$LC^M * \Delta Risk$		0.003
$LC^D * \Delta Risk$		-0.050**
Year	-0.034	-0.031
Industry	0.257***	0.249***
Firms Size	0.370***	0.372***
Adj. R^2	0.179	0.184
F	80.118***	59.368***

Notes: ***,**, and * indicate significance at the 10, 5 and 1percent levels respectively.

Table 5 shows further insight about the vega effect. Firms on growth (decline) stage will only include positive (negative) vega effect when firms' risk of last year are smaller (greater) than the industry's average risk. On the other hand, when firms on mature stage, the risk of this year will not affect the executive compensation, regardless these firms' relative risk of last year.

Table 5 Regression Results－Model 3

Variable/Life cycle	Growth Stage	Mature Stage	Decline Stage
Return	0.105***	0.091***	0.006
$D1 * \Delta Risk$	0.081*	-0.030	0.047
$D2 * \Delta Risk$	0.057	-0.001	-0.089*
Year	-0.124**	-0.007	0.024
Industry	0.173**	0.166***	0.305***
Firms Size	0.416***	0.377***	0.323***
Sample Size	360	1,076	376
Adj. R^2	0.197	0.150	0.150

F	15.827***	32.772***	12.047***

Notes: ***,**, and * indicate significance at the 10, 5 and 1percent levels respectively.

CONCLUSION

Our study contributes to this literature by documenting different vega effects for firms on different life cycle stage. Risk are included in the executive compensation scheme as a strategic tools to align executive manager's risk taking activity with the best interest of shareholders at different life cycle stages.

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