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MANAGERIAL OVERCONFIDENCE, COMPENSATION INDUCED RISK TAKING, AND EARNINGS MANAGEMENT

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ABSTRACT

This study examined Taiwanese listed company and OTC (Over-the-Counter) firms to explore empirically managerial overconfidence and compensation incentives induced risk-taking, and the impact on accrual-based earnings management (AEM) and real earnings management (REM). The study results show that overconfident managers are more likely to adopt REM than AEM. Compensation induced Delta risk-taking is irrelevant to AEM but could lower the propensity for REM, and compensation induced Vega risk-taking could increase the magnitude of AEM but lower the magnitude of REM. These results remain robust after including interaction dummy between overconfidence and Delta risk-taking, and interaction dummy between overconfidence and Vega risk-taking for further analysis and Logistic Regression. In addition, this study also finds that overconfidence could mitigate the positive relationship between Vega risk-taking and AEM.

JEL: G34, G41

KEYWORDS: Risk-Taking, Earnings Management, Overconfidence, Compensation Incentive

INTRODUCTION

Since the twenty-first century, the world has witnessed a series of major accounting fraud scandals, making earnings management a hot issue in the accounting and finance. Schipper (1989) argued earnings management as the purposeful intervention of a firm's management in the financial reporting process to capture private gain, and divided earnings management into two types: accrual-based earnings management (AEM) and real earnings management (REM). Graham et al. (2005), Ewert and Wagenhofer (2005), and Wang and D'Souza (2006) argued that managers adopt REM only on a limited accrual basis, and that REM and AEM have a complementary relationship. Roychowdhury (2006), Burnett et al. (2012) and Chi et al. (2011) argued that a firm's management prefers to use real activities to realize earnings management. A recent study by Chan et al. (2015) found, American listed firms saw a significant decrease in AEM but a significant increase in REM, it means that substitution between REM and AEM after voluntary adoption of compensation Clawback Provisions that the board of directors authorize to recoup compensation paid to executives based on misstated financial reports.

In terms of accounting principles, accruals are usually characterized by reversal. Although AEM distorts statement information, the effect is short term. REM exerts a long-term effect on firms, negatively affecting future cash flows and impairing long-term firm value (Roychowdhury, 2006; Cohen et al., 2008; Ewert and Wagenhofer, 2005). This study focuses on the impact of the personality trait of overconfidence in managers and managerial compensation induced risk-taking on AEM and REM. In terms of managerial overconfidence, most of the prior literature focused on how managerial overconfidence correlated to corporate investment and financing policies, corporate mergers and acquisitions, or earnings management. Few studies considered both managerial overconfidence and compensation incentives. Hsieh, Bedard, and Johnstone (2014) investigated the case in which overconfident CEOs used AEM and REM to meet or beat analysts' predictions. Schrand and Zechman (2012) found that overconfident managers are more likely to manage earnings or engage in excessive risk, and believe it is sufficient to cover the reversal. Li and Hung (2013) investigated Taiwanese listed firms to find that family control could alleviate the positive relationship between managerial overconfidence and AEM. The purpose of compensation incentives is to resolve the agency problem. However, when linked to performance and stock prices, compensation incentives may also drive managers to sacrifice shareholders' profits and attain private gains (Schipper, 1989). Managerial compensation includes cash, stock and stock options; cash includes compensation and cash bonuses. Compensation is associated with performance and promotions, whereas cash bonuses, stock and stock options depend on performance. When performance is linked to stock prices, managerial risk-taking behaviors will be affected. Although most of the prior literature studied compensation and earnings management, few extensively explored the impact of compensation incentives induced risk-taking on earnings management. The design of managerial compensation aims at linking compensation with stock prices to urge managers to take actions that maximize shareholder wealth and create firm value (Guay, 1999; Hanlon et al., 2003; Ittner et al., 2003; Jensen and Meckling, 1976; Mehran, 1995; Nagar et al., 2003). With compensation linked to stock prices, the change and volatility of stock prices have different effects on managerial wealth. The sensitivity of shareholder wealth to stock prices is called *Delta*, while the sensitivity of shareholder wealth to stock volatility is called *Vega*. Lambert et al. (1991), Carpenter (2000), Knopf et al. (2002), and Ross (2004) argued that *Delta* makes managers with a high degree of risk aversion less willing to take risks, whereas *Vega* makes such managers willing to take higher risks; risk-taking behavior affects managers' earnings management behavior.

Because of the nature of accounting information, AEM causes short-term damage to firm value, and some of AEM behaviors may be illegal and may be uncovered in the future. REM causes long-term damage to firm value, with behaviors that are legitimate but unethical, and it is not prone to attracting the attention of accountants or supervisory authorities. Therefore, it is necessary to explore further the impact of overconfidence and compensation incentives induced risk-taking behaviors on earnings management behaviors. The results of the preliminary analysis show that managerial overconfidence is significantly positive in explaining REM but significantly negative in explaining AEM. This result is validated in the logistic regression analysis for robustness, indicating that overconfident managers are more likely to adopt REM than AEM. Considering compensation incentives induced risk-taking, the results of this study show that *Delta* risk-taking had no explanatory power for AEM and REM, whereas *Vega* risk-taking has a negative effect on REM and a positive effect on AEM. This indicates that if compensation incentives induced *Vega* risk-taking is higher, manager is more likely to adopt AEM than REM. Compensation induced *Delta* risk-taking is irrelevant to AEM, but can lower the magnitude of AEM. In addition, this study also further finds that overconfidence could mitigate the positive relationship between *Vega* risk-taking and AEM. This study has three contributions. First, Yu (2014) used an agent model to explain why boards of directors employ overconfident CEOs, and design compensation contract schemes that allow earnings manipulation; however, the study did not provide empirical validation or discuss earnings management resulting from AEM and REM. Our study proposes providing empirical evidence of the impact of managerial overconfidence on earnings management. Second, our study follows recent prior literature associated with earnings management to validate both AEM and REM, and finds that managerial overconfidence is positively associated with REM, but negatively associated with AEM. Third, prior literature associated with earnings management did not explore both the positive and negative impacts of compensation incentives induced risk-taking. Our study analyzes risk-taking from both positive and negative perspectives, filling this gap in the literature.

This paper is organized as follows. Introduction section describes research motivation and objectives. Next section reviews related literature, integrating the prior literature associated with earnings management, and then the relationships between managerial overconfidence and risk-taking and earnings management are explored. Data and methodology section develops the empirical design, identifies the data sources and defines the analytical method and study variables. Empirical analysis results and discussion section describes data characteristics and empirical regression analysis results. Conclusion section gives a comprehensive summary of the empirical analysis, providing conclusions, significance and addresses this paper’s limitations and suggestions for future research.

LITERATURE REVIEW

Managers may have different motivations for adopting earnings management, but their objectives all include misleading affiliated parties or external users about the corporate financial status by manipulating, judging or altering financial statements (Healy and Wahlen, 1999). Schipper (1989) divides earnings management into two types: accrual-based earnings management (AEM) and real earnings management (REM). AEM does not involve real, economic activities, but involves actions that take advantage of the flexibility provided by accrual basis accounting, and consequently affect the earnings reported in financial statements. REM involves actions taken by a firm's management to affect its financial statements by manipulating the points or amount of firms' real, operating activities, or making decisions about abnormal operating activities to accomplish earnings management.

Roychowdhury (2006) divided the common methods of REM measure into three individual metrics: abnormal cash flows from operation activities, production costs and discretionary expenses. Common methods of REM include sales manipulation through price discounts, reduction of discretionary expenses (management and sales, advertising, or research and development (R&D) expenses), and inventory adjustments to lower fixed costs per unit and increase gross margin. Roychowdhury (2006) and Cohen et al. (2008) found that in the long term, REM exerts a negative impact on the cash flows of future operations. Graham et al. (2005) stated that 80% of chief financial officers (CFOs) achieve the desired earnings target by reducing discretionary expenses, such as advertising and R&D expenses. Roychowdhury (2006) further stated that managers are very willing to undertake costly REM because REM is less prone to attracting the attention of auditors and supervisory authorities than AEM. Cohen et al. (2008) stated that the occurrence of many accounting frauds urged supervisory authorities to create laws for firm regulation. For example, after the USA passed the Sarbanes Oxley Act (SOX) in 2002, that the number of firms adopting AEM declined significantly, while the number of firms adopting REM increased significantly.

Managerial Overconfidence and Earnings Management

Overconfidence is the tendency for people to overestimate their knowledge and abilities, and the precision of their information, usually making their judgment of the probability of the occurrence of an event much higher than the actual likelihood of the occurrence (Bhandari and Deaves, 2006). March and Shapira (1987), and Goel and Thakor (2008) found that senior managers are more likely to show overconfidence than other managers are. According to prior literature, overconfident managers of a firm have unrealistically high expectations for the firm's future performance (Wong, 2008), and believe that they can make the expectations come true (Malmendier and Tate, 2005a). Yu (2014) explains why boards of directors employ overconfident CEOs and design compensation contract schemes that allow earnings manipulation. Hribar and Yang (2016) empirically stated that overconfident managers are optimistic about earnings predictions, and may conduct earnings management to attain the earnings goal they set. Schrand and Zechman (2012) found that firms with overconfident CEOs are more likely to have misreported financial statements, which are subsequently the subject of enforcement by the Securities and Exchange Commission. Hsieh, Bedard, and Johnstone (2014) found that, after the passage of SOX in 2002, overconfident CEOs were more likely to have discretionary accruals. They remained more likely to engage in real activities management through abnormally high cash flows and have abnormally low discretionary expenses. Managerial overconfidence may cause managers to manipulate earnings, and consequently lead to firms' financial failures.

Compensation Incentives Induced Risk Taking and Earnings Management

From the agency perspective, the design of the compensation mechanism aims at linking managerial wealth with shareholder wealth to urge managers to take actions that maximize shareholder wealth and create firm value (Guay, 1999; Hanlon et al., 2003; Ittner et al., 2003; Jensen and Meckling, 1976; Mehran, 1995; Nagar et al., 2003). However, when compensation is linked to stock prices, stock price will affect managers' future wealth (Nagata and Hachiya, 2007), and may drive managers to sacrifice shareholders' benefits and adopt earnings management to attain private gains (Schipper, 1989). Healy (1985) proposed the bonus plan hypothesis, and argued that bonuses are positively associated with firms' earnings, so managers may increase discretionary accruals to obtain more current or future bonuses. Bergstresser and Philippon (2006) and Meek, Rao, and Skousen (2007) found that managerial compensation is the result of AEM, including earnings inflated by earnings management and stock prices. Kedia and Philippon (2009) argued that the CEO compensation is an incentive for managers to manipulate earnings.

From the agency perspective, the purpose of equity-based compensation design is to encourage risk-averse and non-diversified managers to invest in risk-enhancing positive net present value (NPV) projects, which align with shareholders' benefits (Jensen and Meckling, 1976; Smith and Stulz, 1985). Managerial compensation may contain stock bonuses and stock options, and consequently equity-based compensation may lead to excessive risk-taking by managers (Carpenter, 2000; Ross, 2004; Hanlon et al., 2004). Much theoretical literature stated that the equity-based managerial compensation mechanism can lead to a greater propensity to manipulate financial statements (Goldman and Slezak, 2006; Crocker and Slemrod, 2007; Benmelech et al., 2010). Empirical research also shows that equity-based managerial compensation is positively associated with the magnitude of earnings manipulation (Cheng and Warfield, 2005; Bergstresser and Philippon, 2006; Trompeter et al., 2013). Chen, Lee, and Chou (2015) empirically found that equity-based compensation has a positive effect on AEM and a negative effect on REM. When equity-based compensation is linked to stock prices, the change and volatility of stock prices have different effects on managerial wealth. The sensitivity of shareholder wealth to stock prices is called *Delta*, while the sensitivity of shareholder wealth to the volatility of stock returns is called *Vega*.

Lambert et al. (1991), Carpenter (2000), Knopf et al. (2002), and Ross (2004) argued that the stock option portfolio has two opposite effects on managerial risk-taking incentives: *Delta* makes managers less willing to take risks, while *Vega* makes managers more willing to take risks. Bergstresser and Philippon (2006) and Cornett, Marcus, and Tehranian (2008) found that CEO *Delta* is positively associated with AEM. However, Jiang, Petroni, and Wang (2010) found no correlation between CEO *Delta* and AEM, but do find a positive relationship between CFO *Delta* and AEM. Chava and Purnanandam (2010) assumed that AEM increases stock prices and reduces stock returns, and found that *Delta* is positively associated with AEM, while *Vega* is negatively associated with AEM. In contrast, Armstrong et al. (2013) argued that AEM increases stock prices and stock returns volatility, and empirically found that *Delta* and *Vega* are both positively associated with AEM. Related literature has not explored the impact of compensation induced *Delta* and *Vega* risk-taking on REM. Although AEM has been considered in the literature, the findings are inconsistent. In addition, managerial overconfidence may also encourage risk-taking. Therefore, it is necessary to explore extensively the relationship between overconfidence, compensation induced *Delta*, *Vega* risk-taking, and AEM/REM.

DATA AND METHODOLOGY

Data Source and Sample Descriptions

This study used Taiwanese listed and OTC (Over-the-Counter) firms as the research object, and collected data from the database of the Taiwan Economic Journal (TEJ). There are 729 firms to be studied. We collect information in the form of quarterly data from 2006 to 2015, spanning 10 years and involving 40 quarters in total. The sample is selected according to the following rules: (1) firms demoted as full-cash delivery stocks are excluded; (2) financial and securities companies are excluded because the finance and securities industries are special and subject to special laws and regulations; (3) according to Roychowdhury (2006) and Zang (2012), industries with less than 15 sample firms are excluded, such as the cement, glass ceramics, paper, rubber, and automotive, and oil and electricity industries, to measure the magnitude of earnings management; (4) firms with financial data missing and extreme values are excluded. The industry distribution of the final sample is presented in Table 1. According to Table 1, the industry represented by the largest number of firms is the electronics industry. Therefore, in the regression analysis model, a dummy control variable is added, indicating whether a firm belongs to the electronics industry.

Ordinary Least Squares (OLS) Regression

The preliminary regression analysis is carried out using the ordinary least squares (OLS) method, using accrual-based earnings management (AEM) and real earnings management (REM) as the dependent variables, with managerial overconfidence, and compensation incentives induced *Delta* and *Vega* risk-taking as the explanatory variables, with credit rating, corporate governance, and corporate characteristics as control variables. The regression model is as follows (for the definition of variables, refer to next section):

$$\begin{aligned}|Y_{i,t}| = \beta_0 + OverC_{i,t} + \beta_2\, Delta_{i,t} + \beta_3 Vega_{i,t} + \beta_4 OverC_{i,t} * Delta_{i,t} \\ + \beta_5 OverC_{i,t} * Vega_{i,t} + \beta_6 TCRI_{\ i,t} + \beta_7 BoardS_{i,t} + \beta_8 DirEX_{i,t} \\ + \beta_9 HoldM_{i,t} + \beta_{10} ChairM_{i,t} + \beta_{11} InstF_{\,i,t} + \beta_{12} InstD_{\,i,t} + \beta_{13} CompS_{\ i,t} \\ + \beta_{14} DebtR_{i,t} + \beta_{15} ROA_{\ i,t} + \beta_{16} EstD_{i,t} + \beta_{17} Electronic_{i,t} + \varepsilon_{i,t} \qquad (1)\end{aligned}$$

In Eq. (1), the dependent variable (Y_i) is a dummy variable, which is substituted into Eq. (1) with *REM*

Table 1: Distribution of Industries and Manufacturers Included in the Samples

Industry Name	Manufacturer Quantity	Sample Quantity	Percentage
M1200 Food	18	720	2.47%
M1300 Plastics	21	840	2.88%
M1400 Textile Fiber	43	1,720	5.90%
M1500 Electric Machinery	46	1,840	6.31%
M1700 Chemistry, Biology, and Medicine	54	2,160	7.41%
M2000 Steel	27	1,080	3.70%
M2300 Electronics	468	18,720	64.18%
M2500 Building Material Construction	52	2,080	7.13%
Total	729	29,160	100.00%

representing REM magnitude or *AEM* representing AEM magnitude. This study intended to explore the magnitude, but not the direction, of earnings management. Hence, absolute values of these two dependent variables are obtained for the analysis. *OverC* is a dummy variable for managerial overconfidence. *Delta* is the sensitivity of a manager's total compensation to stock price changes. *Vega* is the sensitivity of total compensation to stock returns volatility, $TCRI_{t-1}$ is the credit rating. *BoardS* is the size of the board of directors, *DirEX* is the proportion of independent directors in the board of directors. *HoldM* is the proportion of the shares held by the vice general manager and senior managers. *ChairM* indicates whether the chairman of the board serves as the general manager. *InstF* and *InstD* are the proportions of the shares held by foreign and domestic institutional investors, respectively. *CompS* is the size of the firm. *DebtR* is the debt ratio. *ROA* is return on assets. *EstD* is the number of years that a firm has been established, and *Electronic* is a dummy variable indicating whether a firm belongs to the electronics industry.

Logistic Regression

This study used Logistic Regression to analyze the robustness of the results, and divided the sample into high and low groups of REM and AEM magnitudes, using the medians of REM and AEM to separate the firms. The dependent variable (Y_i) is a dummy variable, which sets firms with high REM and low AEM to 1, and firms with low REM and high AEM to 0. The explanatory variables are the same as in the OLS regression analysis. The analytical model is as follows:

$$P_i = E(Y_i) = \mathrm{F}(\beta' X_i) = \frac{1}{(1 + e^{-\beta' X_i})} = \frac{e^{\beta' X_i}}{(1 + e^{-\beta' X_i})} \tag{2}$$

In Eq. (2), P_i is the probability of occurrence, Y_i is the dependent variable of the regression equation, β' is the transposed vector of the regression coefficient and X_i is the vector of explanatory variables, which are the same as in Eq. (1). The probability of occurrence, *P*, is a value between 0 and 1. If *P* is closer to 1, there is a higher probability of occurrence of the dependent variable (*Y*). If *P* is closer to 0, there is a lower probability of occurrence of the dependent variable (*Y*).

Variable Definition

Real Earnings Management (REM)

Roychowdhury (2006) divided REM into cash flows from abnormal operation activities, abnormal production costs and abnormal discretionary expenses. Their estimators are as follows. For cash flow from abnormal operation activities,

$$\frac{\mathrm{OCF_{i,t}}}{\mathrm{A_{i,t-1}}} = \alpha_0 + \alpha_1\left(\frac{1}{\mathrm{A_{i,t-1}}}\right) + \alpha_2\left(\frac{\mathrm{S_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \alpha_3\left(\frac{\Delta\mathrm{S_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \varepsilon_{\mathrm{i,t}} \tag{3}$$

$$\frac{\widehat{OCF_{i,t}}}{\mathrm{A_{i,t-1}}} = \hat{\alpha}_0 + \hat{\alpha}_1\left(\frac{1}{\mathrm{A_{i,t-1}}}\right) + \hat{\alpha}_2\left(\frac{\mathrm{S_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \hat{\alpha}_3\left(\frac{\Delta\mathrm{S_{i,t}}}{\mathrm{A_{i,t-1}}}\right) \tag{4}$$

$$Abn\_OCF_{i,t} = \frac{OCF_{i,t}}{A_{i,t-1}} - \frac{\widehat{OCF_{i,t}}}{A_{i,t-1}} \tag{5}$$

Where $OCF_{i,t}$ is cash flows from operation activities, $A_{i,t-1}$ is total assets in the previous period, $S_{i,t}$ is net operation revenue in the current period, $\Delta S_{i,t}$ is the difference between net operation revenue in the current period and that in the previous period, and $\varepsilon_{\mathrm{i,t}}$ is the residual. $Abn\_OCF_{i,t}$ represents cash flows from abnormal operation activities, which is the difference between the actual and estimated values of $OCF_{i,t}$. For abnormal production costs, cost of sales,

$$\frac{\mathrm{COGS_{i,t}}}{\mathrm{A_{i,t-1}}} = \beta_0 + \beta_1\left(\frac{1}{\mathrm{A_{i,t-1}}}\right) + \beta_2\left(\frac{\mathrm{S_{i,t}}}{\mathrm{A_{i,t-1}}}\right) + \varepsilon_{\mathrm{i,t}} \tag{6}$$

Where $COGS_{i,t}$ is the cost of sales in the current period, $A_{i,t-1}$ is total assets in the previous period, $S_{i,t}$ is the net operation revenue in the current period and $\varepsilon_{\mathrm{i,t}}$ is the residual. Inventory variation variable,

$$\frac{\Delta INV_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (7)$$

Where $\Delta INV_{i,t}$ is the variation between inventory in the current period and that in the previous period, $A_{i,t-1}$ is total assets in the previous period, $\Delta S_{i,t}$ is the variation between net operation revenue in the current period and that in the previous period, $\Delta S_{i,t-1}$ is the variation between net operation revenue in the previous period and that two periods prior, and $\varepsilon_{i,t}$ is the residual.

Production Costs = Cost of Sales + Inventory Variation Variable,

$$\frac{PROD_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \beta_3\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \beta_4\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (8)$$

$$\frac{\widehat{PROD}_{\iota,t}}{A_{i,t-1}} = \hat{\beta}_0 + \hat{\beta}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\beta}_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_3\left(\frac{\Delta S_{i,t}}{A_{i,t-1}}\right) + \hat{\beta}_4\left(\frac{\Delta S_{i,t-1}}{A_{i,t-1}}\right) \quad (9)$$

$$Abn\_PROD_{i,t} = \frac{PROD_{i,t}}{A_{i,t-1}} - \frac{\widehat{PROD}_{\iota,t}}{A_{i,t-1}} \quad (10)$$

Where $PROD_{i,t}$ is the sum of the cost of sales and inventory variation variables. $A_{i,t-1}$ is total asset in the previous period. $S_{i,t}$ is net operation revenue in the current period. $\Delta S_{i,t}$ is the variation between net operation revenue in the current period and that in the previous period. $\Delta S_{i,t-1}$ is the variation between net operation revenue in the previous period and those two periods prior, and $\varepsilon_{i,t}$ is the residual. $Abn\_PROD_{i,t}$ is abnormal production cost, which is the variation between the actual and estimated values of $PROD_{i,t}$. For abnormal discretionary expenses,

$$\frac{DIS.EXP_{i,t}}{A_{i,t-1}} = \gamma_0 + \gamma_1\left(\frac{1}{A_{i,t-1}}\right) + \gamma_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) + \varepsilon_{i,t} \quad (11)$$

$$\frac{\widehat{DIS.EXP}_{\iota,t}}{A_{i,t-1}} = \hat{\gamma}_0 + \hat{\gamma}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\gamma}_2\left(\frac{S_{i,t}}{A_{i,t-1}}\right) \quad (12)$$

$$Abn\_DIS.EXP_{i,t} = \frac{DIS.EXP_{i,t}}{A_{i,t-1}} - \frac{\widehat{DIS.EXP}_{\iota,t}}{A_{i,t-1}} \quad (13)$$

Where $DIS.EXP_{i,t}$ is discretionary expenses (such as R&D, advertising, management and sales expenses), $A_{i,t-1}$ is total assets in the previous period, $S_{i,t}$ is net operation revenue in the current period, and $\varepsilon_{i,t}$ is the residual. $Abn\_DIS.EXP_{i,t}$ is abnormal discretionary expenses, which is the difference between the actual and estimated values of $DIS.EXP_{i,t}$. Following Roychowdhury (2006) and Cohen et al. (2008), the regression coefficients are calculated to obtain the corresponding abnormal standard values. As cash flows from abnormal operation activities and abnormal discretionary expenses increased, earnings management relatively decreased. Earnings management increased as abnormal production costs increased. REM magnitude can be given by:

$$\left|REM_{i,t}\right| = \left|(-1)Abn\_OCF_{i,t} + Abn\_PROD_{i,t} + (-1)Abn\_DIS.EXP_{i,t}\right| \tag{14}$$

Accrual-Based Earnings Management (AEM)

Common models for measuring AEM include the Healy Model (1985), the DeAngelo Model (1986), the Jones Model (1991), the Industry Model (Dechow and Sloan, 1991), and the Modified Jones Model (Dechow et al., 1995). Kothari, Leone, and Wasley (2005) argued that the previous discretionary accruals (DA) estimation models might produce estimate biases, and then propose returns of asset (ROA) included in the Modified Jones Model to adjust performance. This proposed addition not only can control biases caused by abnormal operation performance, but also can examine the extent to which management implements discretionary accruals. Hence, this study used the model proposed by Kothari et al. (2005) to calculate the magnitude of AEM. The calculation is as follows:

$$\frac{TA_{i,t}}{A_{i,t-1}} = \delta_0 + \delta_1\left(\frac{1}{A_{i,t-1}}\right) + \delta_2\left(\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}}\right) + \delta_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \delta_4 ROA_{i,t-1} + \varepsilon_{i,t} \tag{15}$$

Where TA_t is total accruals, $A_{i,t-1}$ is total assets in the previous period, $\Delta REV_{i,t}$ is the variation in operation revenue, $\Delta REC_{i,t}$ is the variation in receivables, $PPE_{i,t}$ is total depreciable fixed assets, and $ROA_{i,t-1}$ is the ROA in the previous period. The estimated parameters $\hat{\delta}_0, \hat{\delta}_1, \hat{\delta}_2, \hat{\delta}_3,$ and $\hat{\delta}_4$ in Eq. (15) are obtained using OLS estimation, and then are substituted into Eq. (16) to obtain nondiscretionary accruals (*NonDA*), which finally are subtracted from total accruals to obtain *DA*.

$$\frac{NonDA_{i,t}}{A_{i,t-1}} = \hat{\delta}_0 + \hat{\delta}_1\left(\frac{1}{A_{i,t-1}}\right) + \hat{\delta}_2\left(\frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}}\right) + \hat{\delta}_3\left(\frac{PPE_{i,t}}{A_{i,t-1}}\right) + \hat{\delta}_4 ROA_{i,t-1} \tag{16}$$

In Eq. (16), $NonDA_{i,t}$ is nondiscretionary accrual. Discretionary accrual $DA_{i,t}$, namely AEM, is the difference between total actual accruals and nondiscretionary accruals obtained using Eq. (16). This study used the absolute value of AEM as the dependent variable of the regression equation.

Managerial Overconfidence (*OVERC*)

According to the overconfidence measurement concept proposed by Malmendier and Tate (2005b), this study used the agency variable indicating whether there is a continuous increase in the proportions of shares held by the vice general manager and senior managers to measure overconfidence. If the total share ratio increases continuously in the last four quarters, managers in the firm have the tendency to be overconfident, and *OverC* is set to 1; otherwise *OverC* is set to 0.

Delta and *Vega* Risk-Taking

Delta measures the sensitivity of total compensation (including compensation, bonuses, special fees, cash, stock bonuses, dismissal pay, and stock options) of the vice general manager and senior managers to stock prices change. *Vega* measures the sensitivity of total compensation of the vice general manager and senior managers to stock return volatility.

Credit Rating (*TCRI*)

Credit ratings are used to assess a firm's solvency. The lowering of a credit rating has a negative impact on firms; for example, firm value decreases and the firm's stock price declines (Griffin and Sanvicente, 1982; Kliger and Sarig, 2000). Firms with a poor credit rating will be motivated for earnings management (Datta and Dhillon, 1993; Grant, Grant, and Ortega, 2007). The Taiwan Corporate Credit Risks Index (TCRI), originated by the TEJ, considers a firm's operation status, short-term solvency, investment efficiency and asset management. TCRIs are divided into nine degrees from 1 to 9. Degree 1 indicates almost no credit risk, while Degree 9 indicates the highest credit risk. As the credit rating of the current quarter cannot indicate whether a manager has adopted earnings management for that quarter, this study used the credit rating of the next quarter to control for the impact of credit ratings on earnings management.

Control Variables Related to Corporate Governance

The board of directors plays an important role in corporate governance, and a sound board of directors is an important mechanism that prevents managers from gaining private benefits. John and Senbet (1998) stated that the independence of the board of directors is a factor that influences the efficiency of the board. Prencipe et al. (2011) and Kang and Kim (2012) stated that an independent board of directors can effectively monitor managers' manipulation of earnings. Peasnell et al. (2005) has proposed evidence for the negative relationship between the number of outside directors and the magnitude of earnings management, and found that a higher proportion of outside directors indicates lower discretionary accruals, and consequently improves the quality of financial statements. Ahmed and Duellman (2007) have proposed evidence for the positive relationship between the independence of the board of directors and earnings management. The previous literature all supports the active monitoring hypothesis, and states that institutional investors make long-term investments. Shleifer and Vishny (1986) argued that institutional investors holding a certain proportion of shares enable monitoring of corporate operations and protection of their investment profits.

Fama and Jensen (1983) stated that outside directors have a high incentive for monitoring, and a firm where the chairman of the board serves as the general manager will see board function seriously affected. Beasley et al. (2000) stated that the number of directors differs significantly between firms with financial misreporting and other firms in the same industry. Dechow et al. (1996) proved that a larger board size has a higher correlation with earnings management. Eisenberg et al. (1998) stated that the size of the board of directors is negatively associated with earnings management and a smaller board of directors supervises and operates more efficiently. Yermack (1996) argued that a smaller board increases firm value, whereas a larger board endangers firm value and lowers operational efficiency. According to related literature, we define the control variables in this study related to corporate governance, as follows:

Size of the board of directors (*BoardS*): measures the number of members in the board of directors. This is a dummy variable, which is set to 1 if the board size is greater than the median of the sample; otherwise, it is set to 0.

Proportion of independent directors (*DirEX*): the proportion of independent directors in the board of directors.

Proportion of shares held by managers (*HoldM*): indicates whether the vice general manager and senior managers increase their shares consecutively in four quarters during the study period.

Chairman of the board serves as the general manager (*ChairM*): This is a dummy variable set to 1 if the chairman serves as the general manager; otherwise, it is set to 0.

Proportion of shares held by institutional investors (*InstF* and *InstD*): These variables represent the total proportions of shares held by foreign investors (*InstF*) and domestic investors (*InstD*).

Control Variables Related to Corporate Characteristics

Control variables related to corporate characteristics include the debt ratio, firm size, establishment years, and the firm belongs to the electronics industry, which are defined respectively as follows:

Debt ratio (*DebtR*): total assets divide total debts.
Company size (*CompS*): the natural logarithm of the firm's assets.
Establishment years (*EstD*): the number of years from the establishment of the firm to the time of the study.
Electronics industry or not (*Electronic*): a dummy variable that is set to 1 if the firm belongs to the electronics industry; otherwise, it is set to 0.

EMPIRICAL ANALYSIS RESULTS AND DISCUSSION

Data Characteristics

Tables 2 and 3 provide descriptive statistics and correlation analysis data of the sample respectively. Table 2 shows that most variables tend to skew right. Table 3 shows that the correlation coefficients between variables are low and there may be no serious collinearity issue. Table 3 also shows that real earnings management (REM) is significantly negatively correlated with accrual-based earnings management (AEM), indicating that these two earnings management methods can be alternatives of each other. REM is significantly positively associated with managerial overconfidence, whereas AEM is significantly negatively associated with managerial overconfidence, indicating that overconfident managers prefer REM to AEM. REM is significantly negatively correlated with *Delta* and *Vega* risk-taking, whereas AEM is significantly positively correlated with them, indicating that managers with higher *Delta* and *Vega* risk-taking prefer AEM to REM. However, these are preliminary results, and need to be verified in the subsequent regression analysis.

Ordinary Least Squares (OLS) Regression Analysis

Tables 4 and 5 provide the OLS regression analysis results, with AEM and REM as the dependent variables. Table 4 shows that the coefficient of OverC is significantly negative for AEM, whereas Table 5 shows that the coefficient of OverC is significantly positive for REM. It means overconfident managers prefer REM, and will not utilize accrual items for earnings management. Graham et al. (2005), Ewert and Wagenhofer (2005), and Wang and D’Souza (2006) found that REM has a complementary relationship with AEM.

Table 2: Descriptive Statistics of the Sample

Category	Variables	Average	Median	STD Error	Minimum	Maximum
Dependent Variable	|REM|	0.1269	0.0557	0.2193	0.0000	3.6340
	|AEM|	0.1647	0.0442	0.9185	0.0000	62.168
Independent Variable	*OverC*	0.1104	0.0000	0.3134	0.0000	1.0000
	Delta	1.1682	1.0734	0.6964	0.0370	7.0639
	Vega	30.017	25.870	11.853	12.348	170.30
	TCRI	2.1110	2.0000	0.7450	1.0000	4.0000
Corporate Governance	*BoardS*	0.4344	0.0000	0.4957	0.0000	1.0000
	DirEX	0.2139	0.1838	0.1262	0.0000	0.8767
	HoldM	0.0105	0.0033	0.0212	0.0000	0.2594
	ChairM	0.3412	0.0000	0.4741	0.0000	1.0000
	InstF	0.0797	0.0258	0.1290	0.0000	0.7985
	InstD	0.0228	0.0004	0.0496	0.0000	0.7239
Control Variable	*CompS*	21.262	21.142	1.0855	18.722	25.878
	DebtR	0.3815	0.3724	0.1732	0.0101	0.9982
	ROA	0.0490	0.0391	0.0712	-0.8851	0.8053
	EstD	0.9317	1.0000	0.2523	0.0000	1.0000

|REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t. OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. This table provides descriptive statistics and correlation analysis data of the sample respectively, and shows that most variables tend to skew right.

Table 3: Analysis of Correlation Coefficients

Variable	|REM|	|AEM|	OverC	Delta	Vega	TCRI	BoardS	DirEX
|REM|	1							
|AEM|	-0.0247 ***	1						
OverC	0.0168 **	-0.0126 *	1					
Delta	-0.0404 ***	0.0136 *	0.0135 *	1				
Vega	-0.115 ***	0.0770 ***	-0.0234 ***	-0.0485 ***	1			
$TCRI_{t-1}$	-0.0395 ***	-0.0336 ***	-0.0317 ***	0.0766 ***	-0.171 ***	1		
BoardS	0.0061	0.0002	0.0125 *	-0.0401 ***	0.0125 *	-0.133 ***	1	
DirEX	-0.0103	-0.0313 ***	-0.0217 ***	-0.0573 ***	0.0858 ***	0.0444 ***	0.0132 *	1
HoldM	0.0546 ***	-0.0247 ***	-0.0159 **	-0.0216 ***	-0.0007	0.0525 ***	-0.0637 ***	-0.0124 *
ChairM	-0.0010	-0.0030	-0.0098	0.0201 ***	-0.0713 ***	0.0835 ***	-0.0985 ***	-0.0756 ***
InstF	0.0632 ***	0.104 ***	-0.0005	-0.0208 ***	0.0383 ***	-0.416 ***	0.0622 ***	-0.0625 ***
InstD	0.0236 ***	0.0826 ***	0.0018	-0.0575 ***	0.0526 ***	-0.311 ***	0.0908 ***	-0.0031
CompS	0.0264 ***	0.138 ***	0.0061	0.128 ***	0.158 ***	-0.409 ***	0.108 ***	-0.220 ***
DebtR	0.0753 ***	0.0796 ***	0.0046	0.0215 ***	0.0099	0.284 ***	-0.0275 ***	-0.0141 *
ROA	0.0015	-0.0160 **	0.0216 ***	-0.0745 ***	0.0992 ***	-0.442 ***	0.0497 ***	0.0244 ***
EstD	-0.142 ***	0.0203 ***	-0.0227 ***	0.0774 ***	0.104 ***	0.0248 ***	-0.0660 ***	0.153

*This table provides descriptive statistics and correlation analysis data of the sample respectively, and shows that the correlation coefficients between variables are low and there may be no serious collinearity issue. It also shows that REM is significantly negatively correlated with AEM, indicating that these two earnings management methods can be alternatives of each other. |REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t. OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. * Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level.*** Indicates statistical significance at the 1% level.*

Roychowdhury (2006), Burnett et al. (2012) and Chi et al. (2011) argued that, compared to using accrual items to implement earnings management, managers prefer manipulating actual earnings to realize earnings management. Chan et al. (2015) found that, after adopting a Clawback Provision, US listed firms saw a significant decrease in AEM but a significant increase in REM, suggesting that REM tends to replace AEM. Compared with the previous literature, this study finds that overconfident managers preferred REM to AEM.

Table 3: Analysis of Correlation Coefficients (Continued)

Variable	HoldM	ChairM	InstF	InstD	CompS	DebtR	ROA	EstD
|REM|								
|AEM|								
OverC								
Delta								
Vega								
$TCRI_{t-1}$								
BoardS								
DirEX								
HoldM	1							
ChairM	0.0462 ***	1						
InstF	-0.102 ***	-0.0857 ***	1					
InstD	-0.0579 ***	-0.0636 ***	0.255 ***	1				
CompS	-0.147 ***	-0.138 ***	0.458 ***	0.290 ***	1			
DebtR	0.0255 ***	-0.0237 ***	0.0059	-0.0494 ***	0.0934 ***	1		
ROA	0.0211 ***	-0.0422 ***	0.177 ***	0.150 ***	0.145 ***	-0.148 ***	1	
EstD	-0.0245 ***	0.0215 ***	-0.0298 ***	-0.0479 ***	0.0035	0.0421 ***	-0.0555 ***	1

*This table provides descriptive statistics and correlation analysis data of the sample respectively, and shows that the correlation coefficients between variables are low and there may be no serious collinearity issue. It also shows that REM is significantly negatively correlated with AEM, indicating that these two earnings management methods can be alternatives of each other. |REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t. OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. * Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

In the past, researchers have rarely studied the correlation between managerial compensation induced risk-taking incentives and earnings management. The analysis results in Tables 4 and 5 show that *Delta* risk-taking is irrelevant to AEM, and is negatively correlated with REM; that is, *Delta* risk-taking can lower the magnitude of REM. The design of compensation incentive mechanisms aims at solving the agency problem. Agency theory holds that the appropriate compensation incentive based on equities can make managers' interests consistent with those of shareholders (Jensen and Meckling, 1976). The principal-agent model of Holmstrom (1979) and Shavell (1979) explained why shareholders must link managerial compensation to performance to provide managers with incentives to increase firm value. The empirical results of Jensen and Murphy (1990) suggested that the pay-performance sensitivity of managerial compensation contracts is too low to provide a significant incentive for managers to act in the interests of shareholders. Hall and Liebman (1998) showed that, since the 1990s, the pay-performance sensitivity of managerial compensation contracts has seen a significant increase due to the increased frequency of the use of stock options. This study further verified that compensation incentives induced risk-taking is independent of AEM, but helps lower the magnitude of REM. The analysis results in Tables 4 and 5 show that *Vega* risk-taking significantly increases the magnitude of AEM, but significantly reduces the magnitude of REM. The design of the *Vega* risk-taking incentive mechanism aims at linking stock returns volatility to managerial wealth. A higher *Vega* risk-taking incentive indicates that the volatility of stock returns volatility can bring managers more wealth, encourage managers to take risks, and make stock prices more volatile. Both Guay (1999) and Angie (2009) argued that *Vega* risk-taking incentives can encourage managers to take risks, align managers' interests with shareholders, and overcome managers' risk averse attitudes.

Prior literature presents different opinions on the relationship between *Delta* risk-taking and AEM. Some studies support a positive relationship (Bergstresser and Philippon, 2006; Cornett, Marcus and Tehranian, 2008; Chava and Purnanandam, 2010; Armstrong et al., 2013). Some research supports no relationship (Jiang, Petroni, and Wang, 2010). Regarding the relationship between *Vega* risk-taking and AEM, some literature also supports a positive relationship (Armstrong et al., 2013) while other literature supports a negative relationship (Chava and Purnanandam, 2010). This study not only clarifies the relationship between *Delta* risk-taking and AEM, it also finds that *Vega* risk-taking, just like *Delta* risk-taking, could reduce the magnitude of REM and could increase the magnitude of AEM. AEM is different from REM. Graham et al. (2005), Ewert and Wagenhofer (2005), and Wang and D' Souza (2006) argued that the means of manipulation used for REM affect the normal operations of a firm, and even reduce the firm's long-term value (Graham et al., 2005); consequently risk-taking managers tend to use AEM rather than REM. These arguments are in line with the finding of this study.

The analysis results in Tables 4 and 5 show that the credit rating (TCRI) in the previous period has a significantly positive relationship with AEM and REM. According to the variable design of this study, a higher credit rating indicates poor credit. Hence, the analysis results in Tables 4 and 5 indicate that a firm with poor credit tends to use AEM and REM. A firm with poor credit has higher capital cost (Diamond, 1989; Kisgen and Strahan, 2010), and consequently tends to have the incentive to manipulate earnings. Demirtas and Cornaggia (2013) and Jung, Soderstrom, and Yang (2013) found that managers will use earnings management to obtain better credit ratings. Our study further detects that credit ratings are related to the two types of earnings management. For the control variables, Tables 4 and 5 show that return on assets (ROA) is negatively correlated with AEM and REM, whereas the debt ratio (DebtR), firm size (CompS), and whether a firm belongs to the electronics industry (Electronic) are positively correlated with AEM and REM. That is, a firm with higher profitability is less likely to adopt AEM and REM; an electronics firm with larger size and higher debt ratio is more likely to adopt AEM and REM. No consistent results have been achieved on the explanatory direction and significance of other control variables in terms of AEM and REM. Since the control variables are not the focus of this study, the difference between AEM and REM will not be discussed further. Tables 6 and 7 present the results of the analysis in which the interaction dummy of overconfidence and Delta risk-taking, and the interaction dummy of overconfidence and Vega risk-taking are added, respectively. Tables 6 and 7 show that, after the interaction dummy is added. Overconfidence still has a significantly negative relationship with AEM, and has a significantly positive relationship with REM. Delta risk-taking has no explanatory power for AEM, but still has a negative relationship with REM.

Table 4: OLS Analysis Result for AEM

Variables	**M1**	**M2**	**M3**	**M4**	**M5**
Constant	-2.226***	-2.230***	-2.239***	-2.155***	-2.385***
	(0.130)	(0.131)	(0.130)	(0.135)	(0.141)
OverC	-0.0435**				-0.0396**
	(0.0169)				(0.0168)
Delta		0.0005			0.0100
		(0.0078)			(0.0078)
Vega			0.0078***		0.0081***
			(0.0005)		(0.0005)
$TCRI_{t-1}$				0.0165**	0.0292***
				(0.0083)	(0.0096)
BoardS	-0.0206*	-0.0208*	-0.0186*	-0.0196*	-0.0151
	(0.0108)	(0.0108)	(0.0108)	(0.0109)	(0.0108)
DirEX	0.0306	0.0328	-0.0283	0.0335	-0.0293
	(0.0437)	(0.0437)	(0.0436)	(0.0437)	(0.0436)
HoldM	-0.158	-0.147	-0.256	-0.138	-0.249
	(0.253)	(0.253)	(0.252)	(0.253)	(0.252)
ChairM	0.0243**	0.0246**	0.0282**	0.0244**	0.0271**
	(0.0114)	(0.0114)	(0.0113)	(0.0114)	(0.0113)
InstF	0.324***	0.326***	0.340***	0.343***	0.380***
	(0.0471)	(0.0472)	(0.0469)	(0.0486)	(0.0485)
InstD	0.940***	0.941***	0.929***	0.965***	0.991***
	(0.114)	(0.114)	(0.113)	(0.115)	(0.115)
CompS	0.0898***	0.0898***	0.0755***	0.0922***	0.0788***
	(0.0059)	(0.0060)	(0.0060)	(0.0061)	(0.0063)
DebtR	0.337***	0.336***	0.328***	0.321***	0.296***
	(0.0312)	(0.0313)	(0.0311)	(0.0330)	(0.0329)
ROA	-0.426***	-0.430***	-0.523***	-0.387***	-0.420***
	(0.0773)	(0.0775)	(0.0772)	(0.0832)	(0.0829)
EstD	0.0943***	0.0951***	0.0713***	0.0958***	0.0695***
	(0.0212)	(0.0213)	(0.0212)	(0.0212)	(0.0212)
Electronic	0.0387***	0.0384***	0.0578***	0.0382***	0.0585***
	(0.0032)	(0.0032)	(0.0034)	(0.0032)	(0.0034)
Adj-R^2	0.035	0.035	0.043	0.035	0.043

This table provides the OLS regression analysis results, with AEM and REM as the dependent variables, and shows that the coefficient of OverC is significantly negative for AEM, The analysis results in table show that Vega risk-taking significantly increases the magnitude of AEM, but significantly reduces the magnitude of REM. The design of the Vega risk-taking incentive mechanism aims at linking stock returns volatility to managerial wealth. A higher Vega risk-taking incentive indicates that the rate of stock returns volatility can bring managers more wealth, encourage managers to take risks, and make stock prices more volatile. |REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t. OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study.
** Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

Table 5: OLS Analysis Result for REM

Variables	**M1**	**M2**	**M3**	**M4**	**M5**
Constant	-0.114***	-0.124***	-0.112***	-0.128***	-0.133***
	(0.0342)	(0.0344)	(0.0342)	(0.0356)	(0.0357)
OverC	0.0091**				0.0092**
	(0.0045)				(0.0044)
Delta		-0.0074***			-0.0089***
		(0.0018)			(0.0021)
Vega			-0.0011***		-0.0011***
			(0.0001)		(0.0001)
$TCRI_{t-1}$				0.0219***	0.0232***
				(0.0022)	(0.0023)
BoardS	0.0007	0.0004	0.0005	0.0010	-0.0020
	(0.0029)	(0.0025)	(0.0029)	(0.0029)	(0.0025)
DirEX	0.0391***	0.0297***	0.0469***	0.0383***	0.0364***
	(0.0115)	(0.0102)	(0.0115)	(0.0115)	(0.0103)
HoldM	0.644***	0.581***	0.656***	0.645***	0.581***
	(0.0666)	(0.0593)	(0.0665)	(0.0666)	(0.0592)
ChairM	-0.0040	-0.0023	-0.0045	-0.0042	-0.0024
	(0.0030)	(0.0027)	(0.0030)	(0.0030)	(0.0027)
InstF	0.0547***	0.0737***	0.0525***	0.0575***	0.0428***
	(0.0124)	(0.0111)	(0.0124)	(0.0126)	(0.0114)
InstD	-0.0157	0.0283	-0.0142	-0.0107	-0.0116
	(0.0299)	(0.0268)	(0.0299)	(0.0301)	(0.0270)
CompS	0.0059***	0.0034**	0.0078***	0.0064***	0.0012
	(0.0016)	(0.0014)	(0.0016)	(0.0016)	(0.0015)
DebtR	0.134***	0.0888***	0.135***	0.132***	0.115***
	(0.0082)	(0.0073)	(0.0082)	(0.0083)	(0.0077)
ROA	-0.0924***	-0.0128	-0.0790***	-0.0826***	-0.0758***
	(0.0203)	(0.0182)	(0.0204)	(0.0212)	(0.0195)
EstD	-0.119***	-0.103***	-0.116***	-0.119***	-0.101***
	(0.0056)	(0.0050)	(0.0056)	(0.0056)	(0.0050)
Electronic	0.0307***	0.0250***	0.0281***	0.0303***	0.0227***
	(0.0008)	(0.0008)	(0.0009)	(0.0009)	(0.0008)
Adj-R^2	0.069	0.069	0.071	0.072	0.075

This table shows that the coefficient of OverC is significantly positive for REM. It means overconfident managers prefer REM, and will not utilize accrual items for earnings management. The analysis results in table show that Vega risk-taking significantly increases the magnitude of AEM, but significantly reduces the magnitude of REM. The design of the Vega risk-taking incentive mechanism aims at linking stock returns volatility to managerial wealth. A higher Vega risk-taking incentive indicates that the rate of stock returns volatility can bring managers more wealth, encourage managers to take risks, and make stock prices more volatile. |REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t. OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study.
** Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

Vega risk-taking still has a significantly positive relationship with AEM and has a significantly negative relationship with REM. That is, the explanatory directions of managerial overconfidence, *Delta* risk-taking and *Vega* risk-taking to AEM and REM are similar to Tables 4 and 5, respectively. As shown in Tables 6 and 7, the interaction dummy of overconfidence and *Delta* risk-taking has no significant explanatory power for AEM and REM. This means that, whether REM is adopted or not, the impact of overconfidence on

Table 6: OLS Analysis Result of AEM with the Interaction Dummies of OverC and *Delta/Vega*

Variables	M6	M7	M8	M9
Constant	-2.226***	-2.240***	-2.223***	-2.393***
	(0.131)	(0.130)	(0.130)	(0.141)
OverC	-0.0348**	-0.0442**	-0.0520**	-0.0487**
	(0.0139)	(0.0182)	(0.0231)	(0.0203)
Delta	0.0016		0.0135	0.0113
	(0.0082)		(0.0082)	(0.0082)
Vega		0.0081***	0.0081***	0.0083***
		(0.0005)	(0.0005)	(0.0005)
$TCRI_{t-1}$				0.0293***
				(0.0096)
OverC*Delta	-0.0075		-0.0124	-0.0114
	(0.0247)		(0.0246)	(0.0246)
OverC*Vega		-0.0028*	-0.0029*	-0.0029*
		(0.0016)	(0.0016)	(0.0016)
BoardS	-0.0205*	-0.0184*	-0.0177	-0.0151
	(0.0108)	(0.0108)	(0.0108)	(0.0108)
DirEX	0.0305	-0.0308	-0.0304	-0.0300
	(0.0437)	(0.0436)	(0.0437)	(0.0436)
HoldM	-0.157	-0.262	-0.260	-0.243
	(0.253)	(0.252)	(0.252)	(0.252)
ChairM	0.0243**	0.0280**	0.0276**	0.0273**
	(0.0114)	(0.0113)	(0.0114)	(0.0113)
InstF	0.325***	0.339***	0.344***	0.381***
	(0.0472)	(0.0469)	(0.0470)	(0.0485)
InstD	0.941***	0.926***	0.940***	0.990***
	(0.114)	(0.113)	(0.114)	(0.115)
CompS	0.0897***	0.0754***	0.0737***	0.0787***
	(0.0060)	(0.0060)	(0.0061)	(0.0063)
DebtR	0.337***	0.329***	0.330***	0.297***
	(0.0313)	(0.0311)	(0.0311)	(0.0329)
ROA	-0.425***	-0.519***	-0.511***	-0.420***
	(0.0775)	(0.0772)	(0.0774)	(0.0829)
EstD	0.0942***	0.0706***	0.0686***	0.0698***
	(0.0213)	(0.0212)	(0.0212)	(0.0212)
Electric	0.0387***	0.0580***	0.0583***	0.0583***
	(0.0032)	(0.0034)	(0.0034)	(0.0034)
Adj-R^2	0.035	0.043	0.044	0.044

*This table presents the results of the analysis in which the interaction dummy of overconfidence, Delta risk-taking, the interaction dummy of overconfidence and Vega risk-taking are added, respectively. It also shows that, after the interaction dummy is added. Overconfidence still has a significantly negative relationship with AEM, and has a significantly positive relationship with REM. Delta risk-taking has no explanatory power for AEM, but still has a negative relationship with REM. Vega risk-taking still has a significantly positive relationship with AEM and has a significantly negative relationship with REM. |REM| is the absolute value of REM of firm i in quarter t; OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1). BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. * Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

Delta risk-taking does not change significantly. In terms of *Vega* risk-taking, the interaction dummy of overconfidence and *Vega* risk-taking is significantly negatively related with AEM, but its relationship with REM is not significant. It seems overconfidence mitigates the positive relationship between *Vega* risk-taking and AEM, but does not significantly affect the relationship between *Vega* risk-taking and REM.

<u>Robust Test - Logistic Regression Analysis</u>

The result of the OLS regression analysis shows that overconfident managers prefer REM to AEM, to implement earnings management, and this result will not change due to the addition of overconfidence, *Delta* risk-taking, *Vega* risk-taking and interaction dummies between overconfidence and risk-taking. To verify the robustness of this result, AEM and REM variables are divided into high and low groups using the median. A dummy variable is used to set firms with high REM and low AEM to 1, and firms with low REM and high AEM to 0. Logistic Regression Analysis is conducted, with the analysis results presented in Table 8. Table 8 shows that overconfident managers are more likely to adopt high REM and low AEM. That verified some of the results in Tables 4 and 5, indicating that the OLS regression analysis results in this study are robust. In terms of *Delta* risk-taking and *Vega* risk-taking, Table 8 shows that the Logistic Regression Analysis Model (M8) of all variables is significantly negative. *Delta* risk-taking is irrelevant to the probability of a firm adopting high REM and low AEM, but *Vega* risk-taking is significantly negatively. That is, the higher *Vega* risk-taking is, the less likely the firm is to adopt high REM and low AEM. In terms of the variables related to credit ratings, some results in Tables 4 and 5 show that firms with poor credit ratings in the previous period are more likely to adopt AEM and REM. Table 8 further shows that firms with poor credit ratings are more likely to adopt high REM and low AEM.

Table 8 shows that, after the interaction dummies between overconfidence and *Delta* risk-taking and between overconfidence and *Vega* risk-taking are added (M6 to M8), the explanatory powers of overconfidence, *Delta* risk-taking, and *Vega* risk-taking do not change much, and their significant explanatory directions remain unchanged. The interaction dummy between overconfidence and *Delta* risk-taking is irrelevant to the probability of high REM and low AEM, but the interaction dummy between overconfidence and *Vega* risk-taking has a significantly negative effect on the probability. That is, if the *Vega* risk-taking of overconfident managers is increased, the probability of high REM and low AEM will be lowered. In terms of control variables, Table 8 shows that ROA, debt ratio (DebtR), firm size (CompS) and years of establishment (EstD) are negatively correlated with the probability of high REM and low AEM. That is, a firm with higher profit, a higher debt ratio, larger size, and a longer life is less likely to adopt high REM and low AEM. Table 8 also shows that a firm in which the board of directors (BoardS) is large and the proportion of shares held by managers (HoldM) is high is more likely to adopt high REM and low AEM. In addition, Table 8 shows that high REM and low AEM are more likely to be adopted in the electronics industry (Electronic).

Table 7: OLS Analysis Result of REM with the Interaction Dummies of OverC and *Delta/Vega*

Variables	M6	M7	M8	M9
Constant	-0.125***	-0.113***	-0.126***	0.0867***
	(0.0344)	(0.0342)	(0.0343)	(0.0332)
OverC	0.0098**	0.0132**	0.0016**	0.0018**
	(0.0049)	(0.0055)	(0.0066)	(0.0075)
Delta	-0.0073***		-0.0088***	-0.0072***
	(0.0022)		(0.0019)	(0.0019)
Vega		-0.0010***	-0.0009***	-0.0010***
		(0.0001)	(0.0001)	(0.0001)
$TCRI_{t-1}$				-0.0232***
				(0.0023)
OverC*Delta	-0.0004		0.0008	-0.0006
	(0.0065)		(0.0058)	(0.0058)
OverC*Vega		-0.0003	0.0001	0.0002
		(0.0004)	(0.0004)	(0.0004)
BoardS	0.0003	0.0004	-0.0001	-0.0020
	(0.0029)	(0.0029)	(0.0029)	(0.0025)
DirEX	0.0384***	0.0473***	0.0468***	0.0365***
	(0.0115)	(0.0115)	(0.0115)	(0.0103)
HoldM	0.643***	0.658***	0.658***	0.581***
	(0.0666)	(0.0666)	(0.0665)	(0.0592)
ChairM	-0.0037	-0.0045	-0.00410	-0.0024
	(0.0030)	(0.0030)	(0.0030)	(0.0027)
InstF	0.0519***	0.0528***	0.0493***	0.0427***
	(0.0124)	(0.0124)	(0.0124)	(0.0114)
InstD	-0.0237	-0.0142	-0.0238	-0.0115
	(0.0300)	(0.0299)	(0.0300)	(0.0270)
CompS	0.0068***	0.0078***	0.0091***	0.0012
	(0.0016)	(0.0016)	(0.0016)	(0.0015)
DebtR	0.133***	0.135***	0.134***	0.115***
	(0.0082)	(0.0082)	(0.0082)	(0.0077)
ROA	-0.0978***	-0.0800***	-0.0860***	-0.0758***
	(0.0204)	(0.0204)	(0.0204)	(0.0195)
EstD	-0.118***	-0.116***	-0.114***	-0.101***
	(0.0056)	(0.0056)	(0.0056)	(0.0050)
Electronic	0.0306***	0.0281***	0.0278***	0.0227***
	(0.0008)	(0.0009)	(0.0009)	(0.0008)
Adj-R^2	0.070	0.071	0.071	0.075

*|REM| is the absolute value of REM of firm i in quarter t; OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1). BoardS is the size of the board of firm i in quarter t. DirEX is the proportion of independent directors in the board of directors of firm i in quarter t. HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t. ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t. InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively. CompS is the size of firm i in quarter t. DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. * Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

Table 8: Logistic Regression Analysis Results

H_REM、L_AEM (High Real Earnings Management and Low Accrual-Based Earnings Management)								
Variables	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**
Individual Independent Variable						**Interaction Dummy Added**		
Constant	1.252***	1.325***	1.122***	0.274	3.435***	2.855***	2.787***	3.441***
	(0.433)	(0.434)	(0.435)	(0.456)	(0.480)	(0.437)	(0.437)	(0.480)
OverC	0.108*				0.0535*	0.0611*	0.1090*	0.0425*
	(0.0570)				(0.0282)	(0.325)	(0.0559)	(0.0221)
Delta		0.0428			-0.0378	-0.0316		-0.0499*
		(0.0262)			(0.0267)	(0.0278)		(0.0281)
Vega			-0.0337***		-0.0263***		-0.0252***	-0.0262***
			(0.0022)		(0.0020)		(0.0021)	(0.0021)
$TCRI_{t-1}$				0.0760**	0.120***			0.119***
				(0.0322)	(0.0328)			(0.0328)
OverC*Delta						0.121		0.119
						(0.0864)		(0.0866)
OverC*Vega							-0.0018**	-0.0017**
							(0.0077)	(0.0007)
BoardS	0.129***	0.133***	0.122***	0.0986***	0.130***	0.103***	0.0988***	0.0879**
	(0.0368)	(0.0368)	(0.0372)	(0.0369)	(0.0373)	(0.0369)	(0.0371)	(0.0372)
DirEX	-0.0348	-0.0401	0.160	0.0303	0.143	0.0357	0.203	0.213
	(0.152)	(0.152)	(0.154)	(0.151)	(0.154)	(0.151)	(0.153)	(0.153)
HoldM	3.168***	3.180***	3.742***	4.257***	3.964***	4.355***	4.767***	4.606***
	(0.972)	(0.973)	(0.987)	(0.960)	(0.990)	(0.959)	(0.965)	(0.966)
ChairM	0.0070	0.0047	-0.0058	0.0793**	-0.0085	0.0782**	0.0687*	0.0718*
	(0.0385)	(0.0385)	(0.0388)	(0.0386)	(0.0389)	(0.0386)	(0.0388)	(0.0388)
InstF	0.127	0.145	0.0469	0.370**	0.197	0.454***	0.402**	0.246
	(0.156)	(0.157)	(0.158)	(0.161)	(0.161)	(0.157)	(0.157)	(0.162)
InstD	-0.579	-0.550	-0.642*	-0.0087	-0.391	0.119	0.151	-0.120
	(0.361)	(0.361)	(0.370)	(0.377)	(0.373)	(0.372)	(0.380)	(0.385)
CompS	-0.0806***	-0.0863***	-0.0175	-0.162***	0.0049	-0.146***	-0.101***	-0.116***
	(0.0197)	(0.0199)	(0.0201)	(0.0206)	(0.0210)	(0.0201)	(0.0202)	(0.0213)
DebtR	-2.106***	-2.101***	-2.011***	-2.584***	-2.122***	-2.666***	-2.589***	-2.460***
	(0.110)	(0.110)	(0.111)	(0.116)	(0.113)	(0.111)	(0.112)	(0.117)
ROA	-1.783***	-1.748***	-1.398***	-0.478	-1.026***	-0.246	0.0862	-0.338
	(0.279)	(0.279)	(0.280)	(0.302)	(0.290)	(0.282)	(0.283)	(0.303)
EstD	-0.926***	-0.935***	-0.835***	-0.822***	-0.830***	-0.813***	-0.745***	-0.744***
	(0.0771)	(0.0772)	(0.0773)	(0.0761)	(0.0775)	(0.0762)	(0.0762)	(0.0764)
Electronic	0.330***	0.332***	0.268***	0.300***	0.252***	0.298***	0.246***	0.245***
	(0.0135)	(0.0135)	(0.0141)	(0.0131)	(0.0144)	(0.0131)	(0.0137)	(0.0137)
Adj-R^2	0.0755	0.0755	0.0904	0.0780	0.0920	0.0784	0.0921	0.0921

*|REM| is the absolute value of REM of firm i in quarter t; |AEM| is the absolute value of AEM of firm i in Quarter t; OverC is the dummy variable for managerial overconfidence of firm i in quarter t; if the proportion of shares held increase consecutively in four quarters, this variable is set to 1; otherwise, this variable is set to 0. Delta is the sensitivity of total compensation of the vice general manager and senior managers to the stock price change of firm i in quarter t; Vega is the sensitivity of total compensation of the vice general manager and senior managers to stock returns volatility of firm i in quarter t; TCRI(t-1) is the credit rating level of firm i in quarter (t-1); BoardS is the size of the board of firm i in quarter t; DirEX is the proportion of independent directors in the board of directors of firm i in quarter t; HoldM is the proportion of the shares held by the vice general manager and senior managers of firm i in quarter t; ChairM indicates whether the board chairman serves as the general manager in firm i in quarter t; InstF and InstD are the proportions of shares held by foreign investors and domestic investors of firm i in quarter t, respectively; CompS is the size of firm i in quarter t; DebtR is the debt ratio of firm i in quarter t; ROA is the return on assets of firm i in quarter t; EstD is the number of years from the establishment of firm i to the time of the study. * Indicates statistical significance at the 10% level. ** Indicates statistical significance at the 5% level. *** Indicates statistical significance at the 1% level.*

CONCLUSIONS

In this study, data from Taiwanese listed and OTC (Over-the-Counter) companies from 2006 to 2015 are investigated to explore empirically managerial overconfidence, compensation induced risk-taking, and the impacts on accrual-based earnings management (AEM) and real earnings management (REM). Although previous literature investigated the relationship between managerial overconfidence with AEM and REM, as well as the relationship between compensation with AEM and REM, few studies completely investigated managerial overconfidence and compensation incentives induced risk-taking, and the impact on AEM and REM.

The results of both the preliminary analysis and robustness analysis show that overconfident managers prefer REM to AEM. Compensation induced *Delta* risk-taking is irrelevant to AEM, and is negatively associated with REM, indicating that *Delta* risk-taking can lower the magnitude of REM. Compensation induced *Vega* risk-taking can increase the magnitude of AEM and reduce the magnitude of REM. The analysis including the interaction dummies between overconfidence and *Delta* risk-taking and between overconfidence and *Vega* risk-taking shows that the same direction of the relationships of overconfidence, *Delta* risk-taking, and *Vega* risk-taking to AEM and REM remain unchanged, indicating that the results of this study are robust. In addition, the study further finds that the interaction dummy between overconfidence and *Delta* risk-taking has no explanatory power for AEM and REM, but the interaction dummy between overconfidence and *Vega* risk-taking has a negative effect on AEM and REM. That is, overconfidence will mitigate the positive relationship between *Vega* risk-taking and AEM, but has no impact on the negative relationship between *Vega* risk-taking and REM.

The economic costs incurred by AEM are short-term and easily subsequently recognized, whereas the impact of REM is long-term and harder to detect, which is more of an ethical issue. Prior literature found that, in recent years, saw a significant decrease in AEM but a significant increase in REM, it means that substitution between REM and AEM after voluntary adoption of compensation Clawback Provisions that the board of directors authorize to recoup compensation paid to executives based on misstated financial reports.

The results of this study show that overconfident managers tend to use REM rather than AEM. This means that overconfident managers, despite overestimating their information and knowledge and underestimating risks, are less likely to take the risk of being detected but instead adopt an earnings management pattern that may cause long-term loss to their firms. Securities regulatory authorities should pay more attention to this problem. In addition, the design of compensation incentives mainly aims at linking managerial compensation and stock price changes or volatility to make managers' interests consistent with those of shareholders. According to the results of the analysis in this study, stock price changes and volatility will reduce the probability of REM, but stock price changes will increase the probability of earnings management. This result shows that the existing design of compensation incentives cannot eliminate the phenomenon of earnings management. Therefore, boards of directors should call for additional research to propose a more effective monitoring mechanism and design of managerial compensation. The paper is limited in the selection of Taiwanese listed and OTC firms as the research object, and collected data from the database of the Taiwan Economic Journal (TEJ). Some are not included in the sample. Firms demoted as full-cash delivery stocks, financial and securities companies, and industries with less than 15 sample firms are notably absent from the sample. In a future study, another interesting extension of this paper would be a more detailed examination of correlation between risk-taking induced managerial overconfidence and earnings management induced risk-taking. In a further study, we could put managerial experience and working years into the model to examine how earning management induced managerial overconfidence affects stock price volatility.

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