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The asymmetric relation between earnings management behaviors: evidence from executive compensation incentives

Pei-I Chou[1] · **Chia-Hao Lee**[2]

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Abstract The purpose of this paper is to examine whether executive stock-based compensation incentives induce the relation between accrual-based earnings management (AEM) and real earnings management (REM) to become asymmetric. The empirical results show that there is the substitute relation between AEM and REM when CEOs have the lowest degree of stock-based compensation incentives. However, there is the complementary relation between AEM and REM when CEOs have the median degree of stock-based compensation incentives. Moreover, the results also present a trade-off relation exists in the highest degree financial incentives during the post-SOX period, but this relation does not exist in the same regime during the pre-SOX period. These findings provide new insight into executive compensation mechanism for shareholders, investors, and regulators, resulting in the efficiency to prevent managers from obtaining private gains at shareholders' expense.

Keywords Earnings management · Executive stock-based compensation incentives · Panel threshold model

JEL Classification G14 · G34 · C23 · C24

✉ Chia-Hao Lee
Chlee@nutc.edu.tw

Pei-I Chou
autumn227@gmail.com

[1] Department of Business, National Open University, New Taipei, Taiwan

[2] Department of Finance, National Taichung University of Science and Technology, Taichung, Taiwan

1 Introduction

A series of accounting scandals, such as Enron, Worldcom, American insurance group, Monsanto, Autonomy Corporation, Satyam Computer Services and Toshiba etc., show that managers manipulate the firm performance by earnings management behaviors for obtaining some private gain at shareholders' expense (Rangan 1998; Teoh et al. 1998; Shivakumar 2000; DuCharme et al. 2004; Lovata et al. 2016, and Michelson et al. 2000), and then have shaken the foundations of investor confidence in the ethics of financial systems. Therefore, the relation between executive benefit and their earnings management behavior becomes an important issue for modern corporate governance. Collins and Hribar (2000), Cheng and Warfield (2005) and Bergstresser and Philippon (2006) find that stock-based compensation incentives bring compensation risk to managers due to uncertainty of future wealth, and then induce managers to exercise their accounting discretion for maximizing their compensation, even if using the stock-based compensation incentives to link executive personal wealth with firm performance can mitigate agency problems and creating firm value (Guay 1999; Hanlon et al. 2003; Ittner et al. 2003; Jensen and Meckling 1976; Mehran 1995; Nagar et al. 2003).

As documented in the literature, earnings management behaviors involve accruals-based earnings management (AEM) and real earnings management (REM) (Schipper 1989). In fact, AEM employs within GAAP accounting choices to obscure a firm's true performance (Dechow and Skinner 2000), while REM is utilized by changing the timing or structure of an operation, investment, and/or financing transaction to fabricate the reported earnings (Graham et al. 2005). The distinct underlying processes in these two types of earnings management behaviors induce the different economic consequences. Thus managers should use an appropriated earnings management to manipulate their earnings levels. For example, Graham et al. (2005) provide the evidence suggesting that managers prefer REM compared to AEM because REM can be indistinguishable from optimal business decisions. Furthermore, Cohen et al. (2008) and Cohen and Zarowin (2010) document that the level of AEM declines, while the level of REM increases after the passage of SOX. Ewert and Wagenhofer (2005) and Zang (2012) reveal that managers use AEM and REM as the substitute.

In theory, REM activities would influence both firm's accruals and operating cash flows, and then investors are unable to evaluate firms' earnings quality by separating REM into the "good" for necessary business operation and the "bad" for earnings manipulation (Chen et al. 2015), although costs involved in such activities can be economically significant to the firm value. As a result, investors have different evaluations on the value of firm which managers engage in different earnings management methods (Chen et al. 2015). The magnitudes of stock-based compensation incentives lead managers to bear different degrees of risk due to the direct linkage of executive personal wealth to firm value and instigate managers to change their earnings management strategies. However, the impact of executive stock-based compensation incentives on the relation between AEM and REM do not be considered in these studies given that earnings management decisions indeed crucially depend on the management compensation incentives (Fabrizi and Parbonetti 2016). Given that the inherent risks of stock-based compensation incentives and the different operating process of AEM and REM, we expect that the manager with more stock-based compensation incentives would face higher uncertainty of private wealth, and they take advantage of AEM and REM.

Therefore, when CEO's potential total compensation is more closely tied to the value of stock and option holdings, and then the manager has possibility to engage in these two earnings management methods simultaneously to increase or maintain the firm value. On the contrary, if the CEO's potential total compensation is less closely tied to the value of stock and option holdings, and then managers would engage in one of these earnings management methods. For demonstrating the relation between different magnitudes of stock-based compensation incentives and the relations between AEM and REM, we modify the compensation incentives measure of Bergstresser and Philippon (2006) to capture the effect of executive financial incentives, and for avoiding that dividing the sample into few groups by specific values which are artificially determined not only leaves out important information but also results in the sample selection problem, we apply panel threshold regression model developed by Hansen (1999) to explore whether the relation between AEM and REM becomes asymmetric due to the different magnitudes of executive stock-based compensation incentives.

For improving the reliability of financial reporting and showing the financial reality of firms' business operations in response to numerous corporate and accounting scandals, the mandates of SOX require CEOs and CFOs be responsible for guaranteeing the veracity of their financial statements and force them to reimburse compensations and profits from stock sales for penalizing their unethical behavior (Cohen et al. 2009). It implies that the passage of SOX places considerable additional compensation risk on CEOs, and hence encourages executives to change their earnings management methods (Cohen et al. 2008; Cohen and Zarowin 2010). However, critical voices claim that more stringent monitoring leads to inefficiencies in corporate governance. Consequently, the second objective of this study is to investigate whether the stock-based compensation cause an asymmetric relation exists between AEM and REM during the pre- and post-SOX periods.

Our findings make several contributions to the related literature. First, although prior studies have addressed the issue of executive switching earnings management behaviors, these studies do not consider that different magnitudes of stock-based compensation incentive have different impacts on the earnings management strategies. Therefore, given the inherent risks of stock-based compensation incentives and the different operating process of AEM and REM, ours is the first paper to use the panel threshold regression model to capture the threshold effects of the magnitudes of stock-based compensation incentives. The empirical results show that there are two threshold effects of stock-based compensation incentives on the relation between AEM and REM. Second, consider the threshold effects of executive stock-based compensation incentives on the relation between different earnings management strategies, we find that there is the substitute relation between AEM and REM when CEO CEOs have the lowest degree of stock-based compensation incentives. However, there is the complementary relation between AEM and REM when CEOs have the median degree of stock-based compensation incentives. The evidence implies that an asymmetric relation exists between AEM and REM over the period from 1997 to 2007. Finally, we find that a trade-off relation exists in the highest degree financial incentives during the post-SOX period, and implying the passage of SOX affects manager's earnings management strategies. These findings provide new insight into executive compensation mechanism for shareholders, investors, and regulators, resulting in the efficiency to prevent managers from obtaining private gains at shareholders' expense.

The remainder of this paper is organized as follows. Section 2 outlines research designs and describes sample data. Section 3 presents and discusses empirical findings, and final section makes conclusions.

2 Research design

2.1 Data

Our sample includes U.S. firms listed in Compustat and ExecuComp database. We restrict our sample to all nonfinancial and non-regulated firms with available data and at least eight observations in each four-digit SIC group per year. Furthermore, we require that each firm-year observation has the necessary data to calculate the AEM and REM proxies and CEO stock-based compensation incentive measure employed in our analysis. We delete the observations of two earnings management proxies that were larger than three standard deviations of the entire sample distribution to avoid the effects of outliers. Our sample period starts from 1997 to 2007 even though the ExecuComp data can be obtained from 1992 due to the availability of consistent disclosure of option portfolios beginning that year. All information on managerial compensation is collected from the ExecuComp, and accounting data are from the Compustat database.

2.2 Empirical model and methodology

Prior studies suggest that there is a relation between AEM and REM. However, the inherent risk of stock-based compensation incentives could bring different impacts on executive wealth and then influence executives how to switch the different earnings management behaviors. Consequently, we infer that the impacts of executive stock-based compensation incentives induce the asymmetric relation between AEM and REM due to the different costs of these two earnings management and inherent risk of stock-based compensation incentives. To examine the asymmetric relation between AEM and REM, we construct the empirical model as follow.

$$AEM_{i,t}^{L} = \alpha_0 + \alpha_1^{L} REM_{i,t}^{L} + \sum_{n} \alpha_n Controls_{i,t-1} + \varepsilon, if\ IR_{i,t-1} \leq \gamma \tag{1}$$

$$AEM_{i,t}^{H} = \alpha_0 + \alpha_1^{H} REM_{i,t}^{H} + \sum_{n} \alpha_n Controls_{i,t-1} + \varepsilon, if\ IR_{i,t-1} > \gamma \tag{2}$$

where α_{1L} and α_{1H} represent the relations between AEM and REM. *IR* represents the executive stock-based compensation incentives, and γ is a specific value to distinguish high and low degrees of executive stock-based compensation incentives. The main purpose of Eq. (1) is to measure the relation between AEM and REM while *IR* is less than or equal to specific value. Similarly, Eq. (2) is used to measure the relation between AEM and REM in which *IR* is more than a specific value. However, dividing the sample into few groups by specific values which are artificially determined not only leaves out important information but also results in the sample selection problem. As a

result, we rearrange Eqs. (1) and (2) as Eq. (3) and further use the panel threshold regression model developed by Hansen (1999) to examine our hypothesis.

$$AEM_{i,t} = \alpha_0 + \alpha_1^L REM_{i,t} \times I\left(IR_{i,t-1} \leq \gamma\right) + \alpha_1^H REM_{i,t} \times I\left(IR_{i,t-1} > \gamma\right) + \sum_n \alpha_n Controls_{i,t-1} + \varepsilon \quad (3)$$

where I (*IR*) represents the indicator function; *IR* represents the threshold variable; γ represents the specific estimated threshold value, and $Control_{i,t-1}$ represents control variables of firm i in year t-1. Regarding the estimation procedures of γ, we firstly eliminate the individual effect by using the "within transformation" estimation techniques in the traditional fixed effect model of panel data. Then, using the ordinary least squares and minimizing the concentrated sum of squares of errors,$S_1(\hat{\gamma})$, to receive the estimators of our threshold value and the residual variance, $\hat{\gamma}$ and $\hat{\sigma}^2$, respectively. If the *IR* is larger than γ, the indicator is equal to 1; otherwise it is zero. It is worthy to note that as far as we know, the causality relationship between AEM and REM is indistinct, and therefore we also rearrange Eq. (3) as the following equation to robust our hypothesis.

$$REM_{i,t} = \alpha_0 + \alpha_1^L AEM_{i,t} \times I\left(IR_{i,t-1} \leq \gamma\right) + \alpha_1^H AEM_{i,t} \times I\left(IR_{i,t-1} > \gamma\right) + \sum_n \alpha_n Controls_{i,t-1} + \varepsilon \quad (4)$$

In Eqs. (3) and (4), we consider size (*SIZE*), turn (*TURN*), return on asset (*ROA*), leverage (*LEVER*) and lag earnings management methods as control variables to avoid our results being driven by the more volatile operating environments of firms. We also include book-to-market ratio (*BM*) to reflect that firm's growth affects investors' response to earnings performance. In addition, *SIZE* and *BM* are used to control the influences of firms' life-cycle and external fund requirements. In fact, the levels of earnings management in the prior period have possibility to influence executive earnings management behaviors in next period, and then we consider the REM or AEM in the prior period into our empirical models. Furthermore, for investigating whether the threshold effect of executive incentive on the relation between different earnings management behaviors is similar during the pre-SOX (1997–2001) and post-SOX (2003–2007) periods, we separately explore Eqs. (3) and (4) during the pre- and post-SOX periods.

In order to examine whether the degrees of *IR* result in the existence of an asymmetric relation between AEM and REM, we test whether the effects of different *IR* regimes in Eq. (3) or in Eq. (4) are equal, and hence constructing the following hypothesis.

$$H_0 : \alpha_1^L = \alpha_1^H$$
$$H_1 : \alpha_1^L \neq \alpha_1^H$$

If α_{1L} is significantly different from α_{1H}, the asymmetric relation exists. That is to say, *IR*, which indicates the degrees of executive stock-based compensation incentives, brings different degrees of incentive effect on the relation between AEM and REM. To examine the threshold effect of compensation incentives on the two kinds of earnings

management behaviors, we employ the likelihood ratio test[1] to investigate the null hypothesis with no threshold effect ($H_0 : \alpha_{1L} = \alpha_{1H}$). Given the existence of threshold effect, we use Eq. (5) to test the asymptotic distribution of the specific estimated threshold value, $H_0 : \gamma = \gamma_0$.

$$LR(\gamma) = \frac{S_1(\gamma) - S(\gamma)}{\hat{\sigma}^2} \tag{5}$$

If LR statistic is significant, the null hypothesis is rejected and implies that estimated threshold value (γ) is not equal to the actual threshold value (γ_0).

2.3 Earnings management and compensation incentives variables

2.3.1 Earnings management metrics

In this study, we use absolute discretionary accruals, abnormal cash flow from operations, abnormal discretionary expense and abnormal production costs as the proxies of earnings management for exploring whether the different degrees of executive financial incentives has impacts on the relation between of AEM and REM. With respect to AEM, we measure the absolute discretionary accruals by using the modified cross-section Jones model (Jones 1991), consistent with the methods of Cohen et al. (2008). With respect to REM, we use the model of Dechow et al. (1995) as implemented in Roychowdhury (2006) to estimate abnormal cash flow from operations (*R_CFO*), abnormal discretionary expense (*R_DISCEXP*) and abnormal production costs (*R_PROD*).[2] Given the level of sales, the firm in which manager attempts to manipulate earnings upward for matching the target earnings experiences one to three phenomena at the same time: unusually low cash flows from operations, unusually low discretionary expenses, and unusually high production costs in the income statement, we based on the suggestions of Roychowdhury (2006) and Cohen et al. (2008) and the approach of Cohen et al. (2008) to standardize *R_CFO*, *R_PROD* and *R_DISCEXP*, and then sum up these three variables to construct the real activities earnings management measure, REM, for capturing the effects of REM through all of these three variables.

2.3.2 Executive stock-based compensation incentives

For investigating the effect of executive financial incentives on the relation between different earnings management behaviors, we use the stock-based compensation as the executive financial incentives. In general, stock-based compensation package includes stock ownership, stock options, and restricted stock. In practice, firms use stock option and stock ownership rather than restricted stock as CEO compensation. However, Carter et al. (2007) document that firms more concerned about earnings shifts CEOs'

[1] The F statistic can be expressed as follows: $F = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2}$, where S_0 and $S_1(\hat{\gamma})$ are sums of squared errors under null and alternative hypotheses, respectively. However, the asymptotic distribution of F is non-standard, and hence following the bootstrap method proposed by Hansen (1999), we obtain the approximations of the F statistics and then calculate the *p*-values by repeating 1000 times bootstrap procedure. If the p-value is less than significance levels, the null hypothesis is rejected and implying there is a threshold effect in the regression.

[2] The detailed calculations, please see the approaches of Roychowdhury (2006) and Cohen et al. (2008).

equity compensation components from options into restricted stock after the start of expense options. Therefore, we add the value of restricted stock held by executives to modify the stock-based compensation incentives measure of Bergstresser and Philippon (2006) to construct Eq. (6) for capturing the incremental effect of restricted stock on executive financial incentives given that restricted stock can be considered a special case of stock options when the exercise price is zero (Kadan and Yang 2016).

$$PCTSC_{i,t} = 0.01 \times PRICE_{i,t} \times \left(Shares_{i,t} + Options_{i,t} + RS_{i,t}\right) \tag{6}$$

where $PCTSC_{i,\,t}$ is defined as the dollar change in the value of a CEO's stock-based compensation holdings that would come from a one percentage point increase in the company stock price for firm i in year t; $PRICE_{i,\,t}$ represents the stock price for firm i in year t; $Shares_{i,\,t}$ represents the total number of shares held by CEO for firm i in year t; $Options_{i,\,t}$ represents the total number of options held by CEO for firm i in year t, and $RS_{i,\,t}$ represents the total number of restricted stocks held by CEO for firm i in year t. Then, we use the $PCTSC_{i,\,t}$ to calculate the incentive, $IR_{i,\,t}$, by Eq. (7).[3]

$$IR_{i,t} = PCTSC_{i,t} / \left(PCTSC_{i,t} + Salary_{i,t} + Bonus_{i,t}\right) \tag{7}$$

where $Salary_{i,\,t}$ and $Bonus_{i,\,t}$ represent the salary and bonus earned by CEO for firm i in year t, respectively. In line with the definition of Bergstresser and Philippon (2006), when the proportion of stock-based compensation value to total compensation is higher, the wealth of managers attributes greater importance to stock-based compensation. In this study, we identify *IR* as the threshold effect on the relation between AEM and REM.

3 Empirical results

3.1 Descriptive statistics

Table 1 shows the descriptive statistics of the main variables of interest and Table 2 reports the correlation matrix over the period from 1997 to 2007. The results of Table 1 document that the means of absolute discretionary accruals (*ABS_DA*) are 0.105 and 0.161 during the pre- and post-SOX periods, and the standard deviations are 0.147 and 0.335, respectively. These findings show that a larger magnitude of AEM takes place during the post-SOX period, but a large dispersion of AEM exists in these firms. With respect to the REM, we find that the means are −0.013 and −0.044 during the pre- and post-SOX periods, and implying that managers use more REM after the passage of SOX. However, the magnitude of using REM is more dispersion during the pre-SOX period than the magnitude during the post-SOX period. On the average, we find that the degrees of the CEO's potential total compensation tied to the value of stock and option holdings are 0.176 and 0.187 during the pre- and post-SOX periods, respectively. The evidence shows that the CEO's potential total compensation is more closely tied to the

[3] Following the assumption of Bergstresser and Philippon (2006), the "delta" of the options in the CEO's portfolio is one. That is to say, a dollar increase in the price of a firm's share translates one-for-one to the value of an option.

Table 1 Descriptive Statistics

Variables	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
	Whole period (1997–2007)			Pre-SOX period (1997–2001)			Post-SOX period (2003–2007)		
DA	0.028	0.004	0.287	0.002	0.001	0.181	0.057	0.005	0.368
ABS_DA	0.132	0.057	0.256	0.105	0.055	0.147	0.161	0.062	0.335
R_CFO	−0.084	−0.108	0.581	−0.046	−0.011	0.556	−0.129	−0.178	0.578
R_PROD	−0.033	0.012	0.628	−0.033	0.046	0.674	−0.019	−0.004	0.577
R_DISCEXP	−0.081	−0.105	0.460	−0.065	−0.047	0.485	−0.104	−0.109	0.435
REM	−0.036	0.011	1.131	−0.013	0.120	1.254	−0.044	−0.038	0.956
IR	0.180	0.092	0.215	0.176	0.086	0.215	0.187	0.100	0.213
BM	0.411	0.342	0.348	0.399	0.334	0.325	0.421	0.351	0.362
LEVER	0.165	0.149	0.155	0.172	0.150	0.163	0.155	0.142	0.142
ROA	5.305	6.616	10.940	6.618	6.968	10.214	4.824	6.459	10.625
SIZE	3.148	3.150	0.568	3.028	3.045	0.556	3.263	3.258	0.560
TURN	0.992	0.870	0.606	1.058	0.966	0.575	0.930	0.771	0.620

value of stock and option holdings during the post-SOX period. The result in Table 2 shows that there is a negative relation between *ABS_DA* and *REM*, and consistent with the findings of Cohen et al. (2008), Cohen and Zarowin (2010) and Zang (2012). In particular, we find that there is a positive relation between *ABS_DA* and *IR*. However, a negative relation exists between *REM* and *IR*. These results imply that the stock-based compensations give managers more incentives to use *AEM* rather than *REM* over the period from 1997 to 2007.

3.2 The asymmetric relation between AEM and REM

The main objective of this paper is to investigate whether the impact of executive stock-based compensation incentive induces the relationship between AEM and REM to become an asymmetric due to the uncertainty of executive's future wealth. Therefore, according to the suggestion of Hansen (1999), we firstly examine whether a threshold effect exists. Table 3 reports the results for threshold effect and the bootstrapped critical values. In panel A, we find the statistic of one threshold is 13.503 and significant with a bootstrap *p*-value of 0.022, and the statistic of two thresholds is 9.659 and significant with a bootstrap p-value of 0.052 in the whole period. The evidence shows that the degree of executive stock-based compensation incentives has two threshold effects on the relation between AEM and REM. With respect to the pre- and post-SOX periods, we also find that the statistics of two thresholds are 8.391 and 26.664 and significant with bootstrap *p*-values of 0.078 and 0.060, respectively. Meanwhile, we find that there are the similar results in panel B of Table 3, and implies that there are indeed two thresholds effects on the relation between AEM and REM in the whole period or during pre- and post-SOX periods while we employ the Eq. (4) to investigate whether the impact of executive stock-based compensation incentive bring about the asymmetric relation between AEM and REM. Consequently, we conclude that the degrees of

Table 2 Pearson Correlation - Earnings Management Behaviors, CEO Incentive and Firm Characteristics

Variables	*ABS_DA*	*R_CFO*	*R_DISCEXP*	*R_PROD*	*REM*	*IR*	*BM*	*LEVER*	*ROA*	*SIZE*	*TURN*
ABS_DA	1.000										
R_CFO	0.178***	1.000									
R_DISCEXP	−0.088***	−0.157***	1.000								
R_PROD	−0.018	−0.333***	−0.304***	1.000							
REM	−0.066**	−0.635***	−0.495***	0.850***	1.000						
IR	0.080***	0.137***	0.024	−0.101***	−0.136***	1.000					
BM	−0.039	−0.159***	−0.041	0.117***	0.163***	−0.190***	1.000				
LEVER	−0.061**	−0.214***	−0.050*	0.127***	0.201***	−0.223***	0.085***	1.000			
ROA	0.036	0.203***	0.001	−0.178***	−0.204***	0.144***	−0.321***	−0.264***	1.000		
SIZE	0.034	0.014	−0.016	0.001	0.001	0.088***	−0.161***	0.149***	0.081***	1.000	
TURN	−0.026	−0.052	0.004	0.101***	0.081***	−0.054*	−0.040	−0.147***	0.141***	−0.116***	1.000

*, **, and *** represents 10%, 5%, and 1% significance levels, respectively

Table 3 Tests for threshold effects (Threshold variable: IR)

Period	Threshold	Panel A $AEM_{i,t} = \alpha_0 + \alpha_1^L REM_{i,t} \times I(IR_{i,t-1} \le \gamma) + \alpha_1^H REM_{i,t} \times I(IR_{i,t-1} > \gamma) + \sum \alpha_n Controls_{i,t-1} + \varepsilon$				Panel B $REM_{i,t} = \alpha_0 + \alpha_1^L AEM_{i,t} \times I(IR_{i,t-1} \le \gamma) + \alpha_1^H AEM_{i,t} \times I(IR_{i,t-1} > \gamma) + \sum \alpha_n Controls_{i,t-1} + \varepsilon$			
		LR statistic	Critical values			*LR* statistic	Critical values		
			10%	5%	1%		10%	5%	1%
Whole	One	13.503**	8.999	11.267	16.149	16.366***	7.087	8.559	12.662
	Two	9.659*	7.797	9.743	14.452	10.673**	6.745	9.365	15.129
	Three	3.338	8.897	11.189	14.507	2.494	6.462	7.939	11.865
Pre-SOX	One	2.148	8.986	11.097	16.824	2.095	9.341	11.651	16.692
	Two	8.391*	7.911	9.164	11.644	8.958*	8.635	10.063	13.002
	Three	4.882	9.927	12.791	16.512	4.958	9.220	10.884	14.817
Post-SOX	One	4.169	12.499	19.165	32.532	5.471	8.128	10.779	15.345
	Two	26.664*	19.015	29.067	65.044	7.174*	7.046	9.211	14.449
	Three	1.629	29.219	33.556	60.038	5.808	8.111	10.926	14.265

*, **, and *** represents 10%, 5%, and 1% significance levels, respectively

executive stock-based compensation incentives have two threshold effects on the relation between AEM and REM over the period from 1997 to 2007.

Table 4 demonstrates the empirical results of threshold estimation in the whole period, pre- and post-SOX periods. In the column (1). we find that the point estimates of two thresholds are 12.9% and 20.2%, and hence separate all of the observations into three regimes: $IR_{i,\ t-1} \le 0.129$, $0.129 < IR_{i,\ t-1} \le 0.202$ and $IR_{i,\ t-1} > 0.202$, indicating that the firms have low, median and high degrees of executive stock-based compensation incentives. The coefficients of three regimes, α_1^L, α_1^M and α_1^H, are −0.350, 0.087 and 0.002, respectively, and α_1^L as well as α_1^M both are significant at the 1% level under the consideration of homogenous standard errors. The coefficients of three regimes imply that the executive earnings management behaviors to respond to swings in the degrees of their stock-based compensation incentives, α_1^L, α_1^M and α_1^H, are different in these three regimes. In the first regime ($IR_{i,\ t-1} \le 0.129$), the estimate of coefficient shows that the REM increases by 0.350 unit with one unit decrease in the AEM, implying that the two manipulation strategies substitute each other. On the other hand, there is the complementary relation between REM and AEM in the other regimes ($0.129 < IR_{i,\ t-1} \le 0.202$ and $IR_{i,\ t-1} > 0.202$). We further use the AEM as the independent variable and REM as the dependent variable and find that all of the observations into three regimes are separated by the point estimates of two thresholds (12.0% and 19.0%). The empirical results in the column (4) also support that the executive earnings management behaviors also respond to the degrees of their stock-based compensation incentives. These results imply that the different degrees of executive stock-based compensation incentives have different impacts on the relation between AEM and REM, and then bring about the asymmetric relationship between AEM and REM.

Considering that the additional compensation risk from the passage of SOX has the possibility to encourage executives changing their earnings management methods, we use Eqs. (3) and (4) to investigate the effects of executive stock-based compensation incentives on the relation between two earnings management methods during the pre- and post-SOX periods. In the column (2), we find that the point estimates of two thresholds are 10.7% and 20.3%, and separate all of the observations into three regimes ($IR_{i,\ t-1} \le 0.107$, $0.107 < IR_{i,\ t-1} \le 0.203$ and $IR_{i,\ t-1} > 0.203$) during the pre-SOX period. The coefficients of three regimes, α_1^L, α_1^M and α_1^H, are −0.014, 0.049 and −0.014, respectively. The coefficient of α_1^M is only significant at the 5% level under the consideration of homogenous standard errors, and indicating that the there is a distinct complementary relation between AEM and REM when the importance degree of the wealth of managers attributes to stock-based compensation ranges from 10.7% to 20.3%. This evidence shows that managers with the medium degree of executive stock-based compensation incentives simultaneously use AEM and REM to manipulate the reported earnings. In the first and last regimes, there are the unobvious trade-off relation between AEM and REM. Similarly, we find that there is a complementary relation between AEM and REM in the second regime while there are no apparent substitute relations between two earnings management behaviors in the other regimes.

In the column (3), we find that the point estimates of two thresholds are 1.30% and 1.7%, and separate all of the observations into three regimes ($IR_{i,\ t-1} \le 0.013$, $0.013 < IR_{i,\ t-1} \le 0.017$ and $IR_{i,\ t-1} > 0.017$) during the post-SOX period. The coefficients of three regimes, α_1^L, α_1^M and α_1^H, are −0.018, 0.935 and −0.012, respectively. The

Table 4 Tests for threshold estimation: Whole period, Pre-SOX and Post-SOX periods

Threshold variable	Whole (1)		Pre-SOX (2)		Post-SOX (3)		Threshold variable	Whole (4)		Pre-SOX (5)		Post-SOX (6)	
	Estimator of Regime 1	Estimator of Regime 2	Estimator of Regime 1	Estimator of Regime 2	Estimator of Regime 1	Estimator of Regime 2		Estimator of Regime 1	Estimator of Regime 2	Estimator of Regime 1	Estimator of Regime 2	Estimator of Regime 1	Estimator of Regime 2
IR_{t-1}	0.129	0.202	0.107	0.203	0.013	0.017	IR_{t-1}	0.120	0.190	0.176	0.203	0.099	0.480
REM	Estimator	t_{OLS}	Estimator	t_{OLS}	Estimator	t_{OLS}	*AEM*	Estimator	t_{OLS}	Estimator	t_{OLS}	Estimator	t_{OLS}
α_1^L	−0.035	−2.467***	−0.014	−1.393	−0.018	−0.179	α_1^L	−0.036	−2.076**	−0.629	−0.724	−0.106	−0.465
α_1^M	0.087	3.443***	0.049	2.085**	0.935	4.395***	α_1^M	0.090	2.412***	2.949	2.380**	0.773	2.155**
α_1^H	0.002	0.130	−0.014	−0.984	−0.012	−0.485	α_1^H	0.006	0.352	−0.612	−0.726	−0.727	−1.683*
Variables	Estimator	t_{OLS}	Estimator	t_{OLS}	Estimator	t_{OLS}	Variables	Estimator	t_{OLS}	Estimator	t_{OLS}	Estimator	t_{OLS}
$LEVER_{t-1}$	−0.015	−0.139	−0.126	−1.823*	−0.004	−0.026	$LEVER_{t-1}$	0.018	0.197	0.337	0.592	1.523	3.561***
$SIZE_{t-1}$	−0.004	−0.059	0.009	0.501	0.037	0.917	$SIZE_{t-1}$	0.049	0.942	0.442	3.016***	−0.015	−0.129
$TURN_{t-1}$	0.127	2.215**	0.003	0.200	0.016	0.479	$TURN_{t-1}$	0.085	1.782*	0.240	1.884*	0.360	4.007***
ROA_{t-1}	0.001	0.606	−0.093	−0.964	0.001	−0.070	ROA_{t-1}	0.002	1.754*	−1.696	−2.135**	−0.018	−2.563***
BM_{t-1}	−0.004	−0.125	−0.038	−1.240	−0.030	−0.505	BM_{t-1}	−0.004	−0.133	0.355	1.427	0.148	0.882
AEM_{t-1}	0.076	1.938*	−0.279	−4.704***	−0.242	−3.919***	REM_{t-1}	0.113	3.112***	−0.201	−3.348***	−0.115	−1.687*
IR_{t-1}	−0.083	−1.067	0.133	2.887***	−0.072	−0.667	IR_{t-1}	−0.085	−1.223	−0.200	−0.400	−0.562	−1.882*

*, **, and *** represents 10%, 5%, and 1% significance levels, respectively

coefficient of α_1^M is only significant at the 1% level under the consideration of homogenous standard errors, and indicating that when the importance degree of the wealth of managers attributes to stock-based compensation ranges from 1.3% to 1.7%, managers simultaneously use AEM and REM. On the contrary, we do not find that there are positive relations between AEM and REM in the first and last regimes. Furthermore, we use the AEM as the independent variable and REM as the dependent variable, and also find that the point estimates of two thresholds are 9.9% and 48%, and separate all of the observations into three regimes ($IR_{i,\ t-1} \leq 0.099$, $0.099 < IR_{i,\ t-1} \leq 0.480$ and $IR_{i,\ t-1} > 0.480$) in the column (6). With respect to the effect of executive stock-based compensation incentives on the relation between AEM and REM, the empirical results show that there are a significantly positive relation in the median regime and a significantly negative relation in the highest regime. These evidence document that the passage of SOX induce managers with the highest degree of compensation incentives to change their earnings management methods for avoiding that their immoral management behaviors suffer the punitive sanctions, however, managers with moderate compensation incentives use AEM and REM simultaneously.

4 Conclusion

According to the agency theory, using stock-based compensation incentives to link executive personal wealth to firm performance can push managers to take consistent actions with the interests of shareholders. However, the inherent risk of stock-based compensation and the underlying process of AEM and REM would induce managers to change their earnings management behaviors. Therefore, we examine the impacts of the different magnitude of stock-based compensation on the relation between AEM and REM. The empirical results show that there are indeed two thresholds effects on the relation between AEM and REM in the whole period or during pre- and post-SOX periods while we employ the threshold model to investigate the impact of executive stock-based compensation incentive on the relation between AEM and REM. Furthermore, the findings show that there is the substitute relation between AEM and REM when CEOs have the lowest degree of stock-based compensation incentives. Conversely, there is the complementary relation between AEM and REM when CEOs have median and the highest degrees of stock-based compensation incentives. Considering that the additional compensation risk from the passage of SOX has possibility to encourage executives changing their earnings management methods, we furthermore find that managers with medium degree of executive stock-based compensation incentives simultaneously use AEM and REM to manipulate the reported earnings while there are no obvious trade-off relations between AEM and REM in the lowest and the highest degrees of stock-based compensation incentives during the pre- and post-SOX periods. We also find that a significantly negative relation exists in the highest degree of stock-based compensation incentives during the post-SOX period. These evidence document that the passage of SOX induce managers with the highest degree of compensation incentives to change their earnings management strategies for avoiding that their immoral management behaviors suffer the punitive sanctions, however, managers with moderate compensation incentives use AEM and REM simultaneously.

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