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Executive Stock Options and Earnings Management: A Theoretical and Empirical Analysis

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We study the effect of the grants of executive stock options (ESOs) and restricted stock on earnings management and insider trading during the vesting years of these grants. In our theoretical model, an informed manager compensated by stock options is mandated to issue an earnings report. Uninformed investors price the stock based on this report. The manager can manipulate the report to affect the stock price, but earnings management is costly to the manager. The optimal report balances the benefits from exercising stock options and the costs of earnings management. Earnings management and insider trading occur at the vesting date only if the options are in the money post manipulation, and are intensified by larger grants. The model identifies three major determinants of the extent of both earnings management and insider trading: The moneyness of the options at the vesting date, the size of the grants, and cumulative stock returns between the grant date and the vesting date. Our empirical results confirm that the moneyness of newly granted stock options and cumulative stock returns are strongly correlated with both earnings management and insider trading in vesting years. In contrast, the size of the grants is only weakly related to earnings management and insider trading in vesting years.

Keywords: Executive stock options; earnings management; insider trading.

1. Introduction

Aimed at aligning the interests of executives and shareholders, stock-based compensation has become the key component of executive compensation over the past two decades. The recent corporate scandals, however, have spurred regulators, investors, and scholars to reexamine the implications of stock-based compensation on shareholders wealth.

Stock-based compensation, on one hand, motivates executives to take real actions to increase firm value.[1] On the other hand, prior research has shown that strong stock-based incentives lead to a higher extent of earnings management, and are further tied to insider trading.[2] Bergstresser and Philippon (2006), Burns and Kedia (2006), and Cheng and Warfield (2005) find a connection between measures of CEO exposure to stock-based compensation and the extent of both earnings management and insider trading.[3]

In this paper we examine this negative side of stock-based compensation (restricted stock and stock options) further. Our goal is to study the triangular relationship among stock-based compensation, earnings management and insider trading by showing how the timing and attributes of option grants affect the timing and magnitude of earnings management and insider trading. More specifically, we will relate the attributes of newly granted options to earnings management and insider trading in the vesting years of these grants.

To guide our thinking, we first propose a simple model of earnings management in the face of executive stock option (ESO) compensation.[4] In our model, a manager compensated by stock options must issue an earnings report. The manager trades off the benefits of inflated stock price with the costs of earnings management. Insider trading in the model comes from exercising

[1] See for instance, Demsetz and Lehn (1985); Himmelberg *et al.* (1999); Core and Guay (1999), Morgan and Poulsen (2001); and Hanlon *et al.* (2003).

[2] The connection between earnings management and earnings-based compensation dates back to Healy's (1985) seminal paper.

[3] The papers differ in the way they measure earnings management. Bergstresser and Philippon (2006) use discretionary accruals and Burns and Kedia (2006) use earnings restatements to measure earnings management, while Cheng and Warfield (2005) capture earnings management by detecting earnings announcements that meet or beat analyst forecasts by only one penny.

[4] Previous models of earnings management in the face of stock-based compensation are Fischer and Verrecchia (2000), Goldman and Slezak (2006), and Guttman *et al.* (2006). These models assume linear compensation schemes and hence do not directly address the effects of stock option attributes (such as the strike price) on earnings management.

stock options and realizing the option value. We distinguish between the grant date and the vesting date of the options.

Our model identifies three key determinants of the extent of earnings management and insider trading at the vesting date of the options. The first is the "moneyness" of the options defined as the stock price divided by the strike price. More deeply in-the-money options induce more earnings management at the vesting date. Intuitively, this result is a consequence of the fact that earnings management is costly. Managers only manipulates earnings if the marginal benefit from manipulation exceeds the marginal cost. Out of the money options (post manipulation) yield no price benefit. Hence, managers manipulate earnings only if the manipulation is expected to push the options into the money.

The moneyness of the options is determined by both the strike price, and the stock price at the vesting date. It is well known that stock options are typically granted at the money. However, prior empirical evidence suggests that firms do (at least implicitly) choose the strike price strategically. Yermack (1997) finds that CEO's receive stock option awards just before good news are released. This effectively lowers the strike price related to the grants. Aboody and Kasznik (2000) find that CEOs manage investors' expectations around award dates by delaying good news and rushing forward bad news, again bettering the conditions of their grants by effectively lowering the strike price. Our model suggests that driving down the strike price in this way during the grant year will eventually result in more extensive earnings management and insider trading during vesting years of the options, since the moneyness of these options becomes larger.

The second determinant of earnings management and insider trading in vesting years is the number of granted options. Everything else being equal, a higher number of granted options increases the marginal benefit of manipulation, inducing more earnings management and insider trading at the vesting date.

The third determinant is the stock price at the vesting date. A higher stock price increases the marginal benefit of manipulation during vesting years, since the options are more likely to be in the money. Thus, higher stock returns between the grant date and the vesting date lead to more earnings management and insider trading during vesting years. Jensen (2005) informally suggests that earnings management will be intensified in periods when stocks are over-priced. He argues that in those periods managers will take actions to support the price. Graham *et al.* (2005) conduct a comprehensive survey over 401 CFOs and show that management's views support stock price motivations for earnings management. We present a formal model suggesting a different intuition. In our model, such a manipulative behavior can occur even in a rational setting, when stocks are correctly priced.

We present two versions of the model. In the first version, investors are rational and are not fooled by the earnings manipulation. The stock price thus reflects true earnings. In the second version, investors are naive and take reported earnings at face value. Regardless of the assumption on the rationality of the investors, our model suggests that earnings management and insider trading resulting from the exercise of stock options will occur only if the stock price is sufficiently high so that stock options become in the money after manipulation. Thus, both versions of the model yield similar empirical predictions.

Our empirical analysis attempts to corroborate these predictions. It is well known that ESOs typically vest during a period of 3–4 years from the grant date. Based on our model, we expect that lower strike prices and larger grants in year $t-\tau$ (for $\tau = 1, 2, 3, 4$) will intensify earnings management and insider trading in year t. Furthermore, the cumulative stock return between the beginning of year $t-\tau$ and the beginning of year t should also be correlated with earnings management and insider trading in year t.

Our main empirical finding is a strong positive correlation between the moneyness of the ESOs granted in years $t-\tau$ (for $\tau = 1, 2, 3, 4$) and the extent of earnings management (measured by discretionary accruals) and insider trading (measured by net insider sales and options exercised) in the vesting year t. For example, for the average firm in the sample, a decrease in the reciprocal of moneyness by one standard deviation in years $t-1$ increases earnings management in year t by 120%; this reduction increases net insider sales by 39.3% and CEO options exercised by 25.5%.[5] Equally strong or stronger results sustain for grants in years with longer lags.

We also find a strong positive correlation between individual stock returns (controlling for market returns) in the period between the grant date and the vesting date, and the amount of both earnings management and insider trading. For example, for the average firm in the sample, an increase of cumulative firm returns by one standard deviation between year $t-3$ and year t increases earnings management in year t by 148%; it increases CEO net

[5] We use the reciprocal of moneyness instead of moneyness in our regressions because the moneyness of stock is infinite.

insider sales by 46.4% and options exercised by 63.1%. Similar results hold for grants in years with other lags.

In contrast, we find a positive but statistically and economically weak correlation between the size of the new grants and the extent of both earnings management and net insider sales at the vesting dates of these grants. We do, however, document an interesting, and economically significant relation between the size of the grants and the timing and magnitude of CEO options exercised: for example, for the average firm in the sample, an increase of the number of granted options by one standard deviation in years $t-2$ increases options exercised in year t by 70.5%.

Moreover, we show that during grant years, earnings management is negatively correlated with the size of the grant. Managers seem to manage earnings downward in years when more options are granted to better the terms of their option grants. This result suggests a "life cycle" of accruals. Managers "save" accruals in grant years by manipulating earnings down. Then they "spend" these accruals in vesting years, when earnings management is positive.

Overall, our results suggest a relation between the attributes of stock option grants and the amount of earnings management and insider trading when the grants vest. The extant literature documents a concurrent correlation between overall managerial incentives and earnings management. Our theoretical model and empirical findings show that moneyness of options and cumulative firm returns are main determinants of both earnings management and insider trading. Furthermore, our timing approach enables us to draw a casual link between incentives and stock returns on one hand, and earnings management and insider trading on the other hand. We also demonstrate the evolvement of earnings management over time from the grant year until the options vest.

We proceed as follows. In Sec. 2, we present a theoretical model. In Sec. 3, we present the empirical results. Section 4 concludes. Proofs for the model are presented in Appendices A and B provides an extension to the model.

2. Model

We present a simple model of earnings management and its relation to executive compensation by options. The spirit of the model is similar to Fischer and Verrecchia (2000), which studies earnings management driven by stock (but not option)-based compensation.

We consider two alternative formulations of this model, one with rational investors and one with naive investors. The empirical evidence on whether investors are actually fooled by earnings management is mixed. Rangan (1998) and Teoh *et al.* (1998a, 1998b) claim that managers succeed in fooling investors by manipulating reports. By contrast, Shivakumar (2000) concludes that investors are not misled and account correctly for the manipulative behavior of managers. We do not wish to take a stand in this debate. We will show that in our context, similar results and same economic intuitions hold in both cases.

Our goal is to generate predictions on the relation between the attributes of granted ESOs, and the resulting earnings management and insider trading when the options vest.

2.1. *Rational investors*

The true earnings of the firm, x, are drawn from a distribution with density f and cumulative F. The support of this distribution is assumed to be $[0, \bar{x}]$, where $\bar{x}$ is possibly ∞. The distribution of earnings is common knowledge.

The manager is compensated by stock options according to a contract (α, K), where $\alpha \in [0, 1]$ is the proportion of the firm equity granted to the manager (also referred to as the number of granted options), and $K \geq 0$ is the strike price. A pure stock compensation corresponds to the case $K = 0$.

The manager (but not the investors) observes the realization of true earnings, x, and is mandated to issue an earnings report, $x^R = \rho(x)$. The investors are assumed to be risk neutral, and they price the stock based on the manager's report and their beliefs about the true earnings. Given the manager's report x^R, we denote the stock price by $\varphi(x^R)$. The value of the option in this case is $\max\{\varphi(x^R) - K, 0\}$.[6]

The time line of the model is as follows (see Fig. 1): at date 0 (the grant date), the manager receives stock options according to the compensation contract. At date 1 (the vesting date) the manager issues an earnings report, the investors set the stock price, and the manager realizes the gains from his holdings by exercising in-the-money options and selling the stock received. At date 2 the true value of the firm is revealed and the manager is penalized for earnings manipulation.

[6] For simplicity we assume a discount rate of 0.

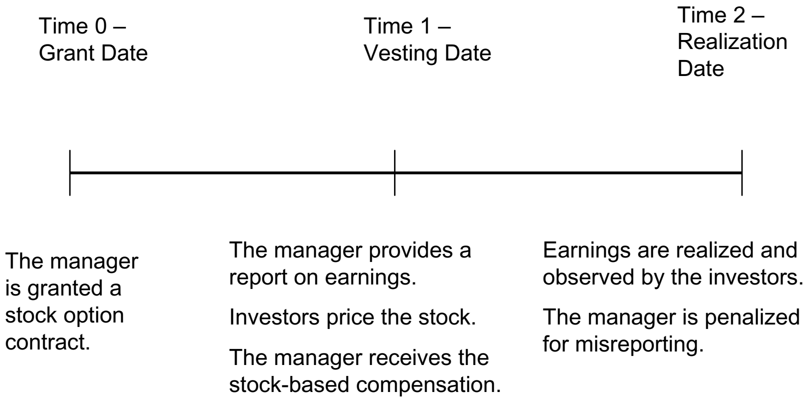

Fig. 1. Time line.

The payoff to a manager who observes x and reports x^R is given by[7]

$$u^M(x, x^R) = \alpha \max\{\varphi(x^R) - K, 0\} - \beta(x^R - x)^2. \tag{1}$$

The first term is the total value of the stock options. It is the number of granted options multiplied by the value of a stock option if exercised. The second term is the cost of earnings management; it is convex in the amount of misreporting.[8] We specifically assume that earnings management is costly to the manager. This can be due to psychic, legal or reputational costs. For instance, the manager can face a reputation loss if he has to restate earnings in the future. Earnings management can also be costly due to the loss of flexibility, because the manager has used up much of the available accruals. Parameter $\beta > 0$ represents the unit penalty for misreporting. It is related to the stringency of accounting standards as well to the efficiency of the enforcement of accounting rules. Under this formulation, only the manager bears the cost of earnings management. A case in which earnings management damages firm value directly is discussed in Appendix B. The results are similar.

[7] This objective function is a variant of the one originally used by Fischer and Verrecchia (2000) and Guttman *et al.* (2006). They, however, restrict attention to stocks only and so do not consider the implications of stock option compensation. Furthermore, those papers assume a normal distribution of earnings while our approach applies to any continuous distribution, with either bounded or unbounded support.

[8] The choice of a quadratic cost function is for mathematical tractability. It is a convenient way to capture the tension between the benefits and the costs of earnings manipulation.

A perfect Bayesian equilibrium is composed of a reporting function for the manager $\rho(\cdot)$ and a pricing function for investors $\varphi(\cdot)$ such that:

(1) Reporting $\rho(x)$ is optimal for the manager given the pricing function of investors. Namely, $\rho(x) = \arg\max_{x^R} u^M(x, x^R)$.
(2) Investors' pricing function $\varphi(\cdot)$ is consistent with $\rho(\cdot)$ using Bayes rule whenever possible, namely $\varphi(x^R) = E(x \mid x^R)$.

This reporting game may have multiple equilibria. While all other equilibria involve some extent of pooling and require additional distributional conditions as well as restrictive assumptions on out-of-equilibrium beliefs, there exists a unique separating equilibrium.[9] We focus on this separating equilibrium in our model.

Formally, an equilibrium is separating if the reporting function of the manager completely reveals his private information to the investors. Namely, $\rho(\cdot)$ is invertible and $\varphi = \rho^{-1}$. In a separating equilibrium, rational investors are not fooled by the manager's report; they can precisely infer the manager's type (true earnings) based on the earnings report. The manager, however, may still find it optimal to misreport, trading off the benefit of the increased option value and the cost of earnings management. The following proposition characterizes the unique separating equilibrium.

Proposition 1. *There exists a unique separating equilibrium given implicitly by*

$$\varphi(x^R) = \rho^{-1}(x^R) = \begin{cases} x^R & \text{if } x^R \le K \\ x^R - \dfrac{\alpha}{2\beta} + \dfrac{\alpha}{2\beta} e^{\frac{2\beta(K - x^R)}{\alpha}} & \text{if } x^R > K \end{cases}. \tag{2}$$

The equilibrium reporting function $\rho(x)$ strictly increases in x for all $x \ge 0$.

Proof. See Appendix A.

Deriving the reporting function $\rho(\cdot)$ directly is not possible. Equation (2) gives the inverse of the equilibrium reporting function. This implicit formulation allows us to study all the properties of this equilibrium.

Observe first that a manager with earnings below or at K reports truthfully. In contrast, a manager with earnings above K manipulates reported

[9] We have analyzed but do not report a group of partially pooling equilibria similar to those analyzed in Guttman *et al.* (2006), but with option instead of pure stock compensation. The empirical predictions are qualitatively similar to the ones derived from the more accessible separating equilibrium on which we focus.

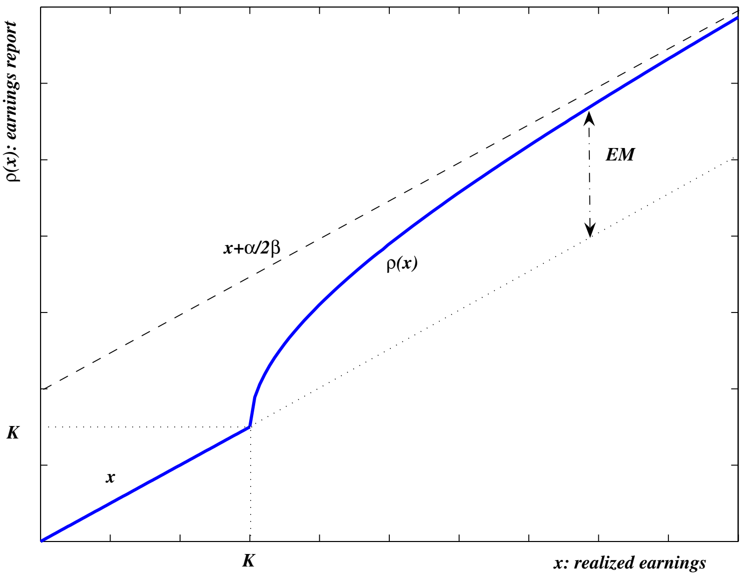

Fig. 2. Separating equilibrium-rational investors.

Note: The figure depicts reported earnings $\rho(x)$ (on the vertical axis) against realized earnings x (on the horizontal axis). The manager reports truthfully ($\rho(x) = x$) when realized earnings are below the strike price (if $x \leq K$) while manipulating earnings upward when realized earnings is greater than the strike price (when options are in the money). Earnings management ($\text{EM} = \rho(x) - x$) is bounded from above by $\frac{\alpha}{2\beta}$, where α is the number of granted options and β is the unit penalty for misreporting.

earnings upwards. The extent of earnings manipulation is $\rho(x) - x = \frac{\alpha}{2\beta} \times (1 - e^{\frac{2\beta(K-\rho(x))}{\alpha}})$ when $x > K$. Since the expression in parentheses is positive and smaller than 1, earnings management is positive and bounded from above by $\frac{\alpha}{2\beta}$. Figure 2 depicts the reporting strategy using $\alpha = 0.4$, $\beta = 0.5$, and $K = 0.3$.

The intuition for this implicit reporting function is as follows. The manager, regardless of the true earnings, never manipulates earnings downwards; such a manipulation not only reduces the stock price, and hence the option value, but also incurs a cost of earnings management. It is useful to consider the threshold manager with true earnings $x = K$ (also referred to as a type K manager). Such a manager strictly prefers to report truthfully. This assures him a zero profit: the options have zero value and there is no manipulation cost. Had this manager manipulated earnings upwards, he would have to manipulate significantly due to the steep curve at K (see Fig. 2; the slope of the reporting function at K is infinite). The cost of earnings management then dominates the value of the options.

Any manager with true earnings less than K also reports truthfully. The payoff for the truthful reporting is zero. If he manipulates earnings upwards and reports a value below K, the payoff is negative: the options remain underwater and he incurs the cost of earnings management. On the other hand, if this manager reports above K, he obtains the same option value as a type K manager for the same report, while he has to manipulate earnings by a larger amount. Since a type K manager is better off telling the truth, the manager whose true earnings are below K reports truthfully as well.

Finally, any manager with earnings greater than K manipulates earnings upwards. The extent of manipulation is determined by the first order condition of the maximization problem. In equilibrium, when earnings are sufficiently high, it is incentive compatible for the manager to inflate earnings. The investors set beliefs accordingly and take this inflation into account when pricing the stock. Had the manager reported truthfully in these states he would have been penalized since investors rationally expect the manipulation.

2.1.1. *Properties of the equilibrium*

Lowering the strike price (a lower K) increases the marginal benefit of manipulation. When the strike price is low, the manager tends to manipulate earnings more since he benefits more from a higher stock price. Graphically, a lower strike price has two effects: first, it enlarges the range in which earnings are inflated; second, it increases the extent of misreporting for each realization of earnings above K; see Fig. 3. Both effects work in the direction of intensifying the extent of earnings management.

Increasing the number of granted options (a higher α) also increases the marginal benefit of manipulation. Thus, a higher α induces the manager to engage in more earnings management. In contrast, increasing the penalty for misreporting (a higher β) mitigates earnings management. Figure 4 demonstrates these two effects. The magnitude of earnings management is bounded from above by $\frac{\alpha}{2\beta}$. As α increases or β decreases, this bound shifts upwards, and the magnitude of earnings management increases everywhere above K.

Finally, for any given α and K, a higher realization of true earnings (a higher x) increases the marginal benefit of manipulation. Furthermore, the marginal benefit of manipulation is 0 if the stock price (post manipulation) falls below the strike price. Since in a separating equilibrium the stock price is equal to x, we obtain that higher stock prices at the vesting date will induce more earnings management. This can be seen in both Figs. 3 and 4, where higher values of x induce more earnings management.

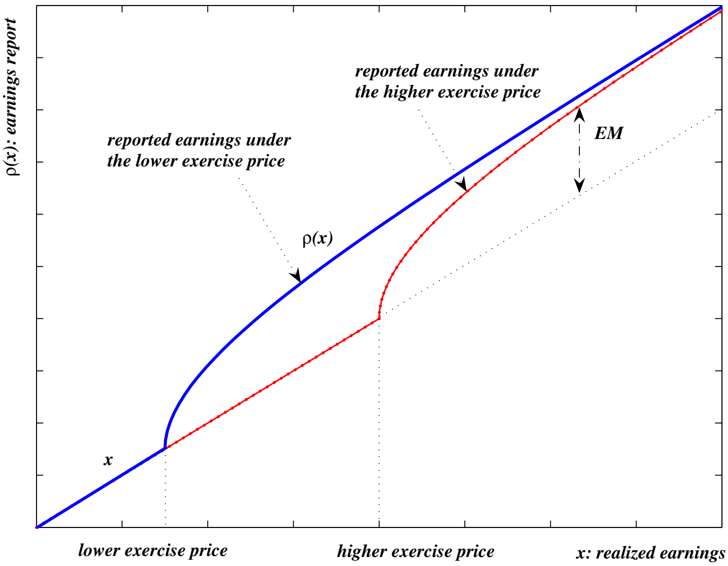

Fig. 3. The effect of changing K on the reporting strategy.

Note: The figure depicts reported earnings $\rho(x)$ (on the vertical axis) against realized earnings x (on the horizontal axis). Increasing the strike price of stock options mitigates earnings management ($\mathrm{EM} = \rho(x) - x$). First, earnings management occurs in a smaller interval. Second, the magnitude of earnings management is smaller point-wise when it does occur.

The moneyness of the options is defined as the stock price divided by the strike price: x/K. Since earnings management is decreasing in K and increasing in x we obtain that earnings management is increasing in the moneyness. This measure is more convenient than just the strike price as it is normalized and so enables an empirical researcher to compare across firms.

In sum, our model suggests that a lower strike price, a higher stock price at the vesting date (hence higher moneyness), and a larger number of granted options will all be correlated with more extensive earnings management. The next corollary formalizes these observations.

Corollary 1. *Earnings management is positive only if the stock price at the vesting date exceeds the strike price. In this case, earnings management is decreasing in the strike price, increasing in the stock price (hence increasing in moneyness), and increasing in the number of granted options.*

Proof. See Appendix A.

2.1.2. *Insider trading*

The manager realizes his gains by exercising stock options at the vesting date. This will result in managerial insider trading in the amount of

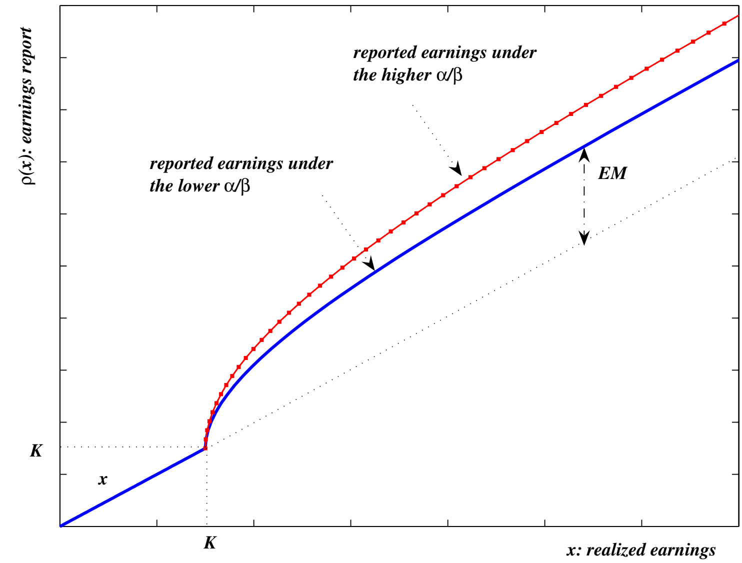

Fig. 4. The effect of changing $\frac{\alpha}{\beta}$ on the reporting strategy.

Note: The figure depicts reported earnings $\rho(x)$ (on the vertical axis) against realized earnings x (on the horizontal axis). Increasing the number of granted options α or reducing the unit penalty of earnings management β intensify earnings management ($\text{EM} = \rho(x) - x$) for each realization of earnings above the strike price (if $x > K$).

$\alpha(\varphi(x^R) - K) = \alpha(x - K)$ when the options are in the money; and 0 when the options are out of the money. Hence, insider trading is higher when the strike price is low relative to the stock price (the moneyness is high) and when α is large. Formally, we have

Corollary 2. *The amount of insider trading is decreasing in the strike price, increasing in the stock price at the vesting date* (*hence increasing in moneyness*), *and increasing in the number of granted options.*

We conclude that in-the-money options induce a large amount of earnings management followed by increased insider trading. These two go hand in hand and are intensified by large grants at relatively low strike prices.

2.2. *Naive investors*

In the previous section we assumed that investors are rational, and they price the stock using Bayes rule. In particular, in a separating equilibrium they "see through" the manager's manipulation and can back out the true earnings. In this section we use an alternative approach assuming that investors are fooled by the manager, taking his report at face value to price the stock. Our goal here is to show that similar comparative statics and empirical implications sustain.

If investors are naive then they believe the manager completely and set the stock price equal to the reported earnings: $\varphi(x^R) = x^R$.[10] The objective function of the manager is therefore,

$$u^M(x, x^R) = \alpha \max\{x^R - K, 0\} - \beta(x^R - x)^2.$$

The first term is the total value of the options. The second term is the penalty for earnings management.

For $x^R > K$, the first order condition of $u^M(x, x^R)$ with respect to x^R yields

$$\alpha - 2\beta(x^R - x) = 0. \tag{3}$$

Thus, we obtain $x^R = x + \frac{\alpha}{2\beta}$. A manager with type $x \leq K$ can avoid manipulation and then assure himself a payoff of 0. This implies that managers will manipulate only if $x > K - \frac{\alpha}{4\beta}$. To see this, note that by manipulating, a manager assures himself a payoff of

$$\alpha\left(x + \frac{\alpha}{2\beta} - K\right) - \beta\left(\frac{\alpha}{2\beta}\right)^2.$$

Since the manager can always guarantee a payoff of 0 (by avoiding manipulation), this expression must be greater than 0. This yields $x > K - \frac{\alpha}{4\beta}$.

On the other hand, $x^R = x$ if $x \leq K - \frac{\alpha}{4\beta}$ since when the earnings are sufficiently low, the penalty for misreporting dominates the benefit of the increased option value due to the boosted stock price. The manager then reports truthfully. We obtain

Proposition 2. *When investors are naive, the optimal reporting function for the manager is*

$$\rho(x) = \begin{cases} x & \text{if } x \leq K - \dfrac{\alpha}{4\beta}; \\ x + \dfrac{\alpha}{2\beta} & \text{if } x > K - \dfrac{\alpha}{4\beta}. \end{cases}$$

The manager manipulates earnings upwards by a constant of $\frac{\alpha}{2\beta}$ when the realized earnings are above the threshold of $K - \frac{\alpha}{4\beta}$; see Fig. 5. Compared with the case of rational investors, the manager manipulates earnings more often and by a larger amount. In both cases, however, the manipulation occurs only if the stock options are in the money post manipulation.

Note that the comparative statics are similar to those obtained in the case of rational investors. In both cases lowering the strike price of the options

[10] Recall that the discount rate is assumed to be 0.

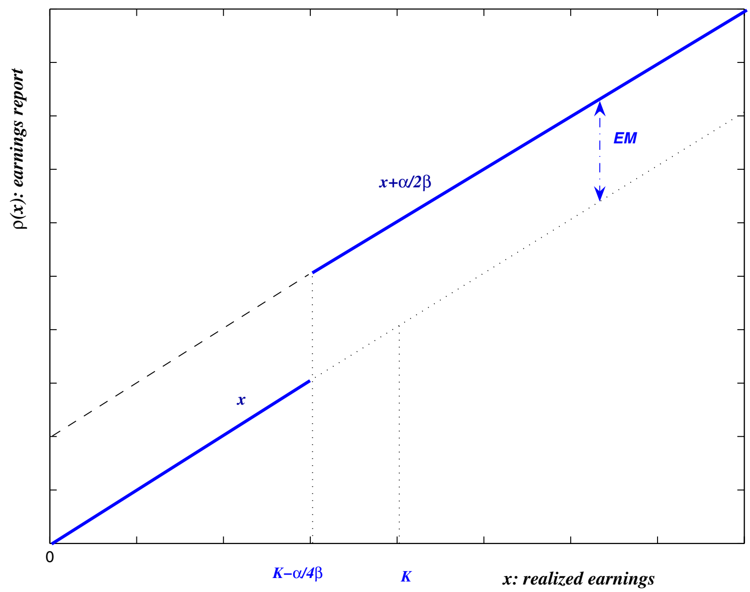

Fig. 5. Naive investors.

Note: The figure depicts reported earnings $\rho(x)$ (on the vertical axis) against realized earnings x (on the horizontal axis). The investors take the managerial reported earnings at face value when they are naive. Therefore, more earnings management occurs than in the case when investors are rational. Specifically, when the options are near or in the money ($x > K - \frac{\alpha}{4\beta}$), the manager manipulates earnings upward by $\mathrm{EM} = \frac{\alpha}{2\beta}$, where α in the number of granted options, β is the unit penalty for earnings management, and K is the strike price.

increases the probability of earnings management. Therefore, lowering the strike price and increasing the number of granted options will be associated with more earnings management. Similarly, higher stock prices at the vesting date will be associated with more earnings management. In particular, higher moneyness leads to more earnings management.

As for insider trading, the options will be in the money only if $x > K - \frac{\alpha}{4\beta}$. In this case, the manager exercises options and receives $\alpha(x + \frac{\alpha}{2\beta} - K)$. This value increases in x, decreases in K and hence increases in the moneyness of the options. Insider trading also increases in the number of granted options α. Thus, as in the case of rational investors, insider trading goes hand in hand with earnings management. More in-the-money options lead to a higher extent of earnings management, which in turn leads to more insider trading.

2.3. *Empirical hypotheses*

Both rational and naive cases in our model lead to the same economic intuitions. Managers manipulate earnings at vesting years when options are either in the money or slightly out of the money. Higher moneyness, larger grants, and higher prices at the vesting date all lead to more earnings management and insider trading.

Based on these results we suggest the following three empirical hypotheses:

H1. Everything else being equal, earnings management and insider trading in vesting years will be more positive for managers compensated with options that are more deeply in the money (higher moneyness).

H2. Everything else being equal, earnings management and insider trading in vesting years will be more positive for managers receiving a higher number of option grants.

H3. Everything else being equal, earnings management and insider trading in vesting years will be positively correlated with the cumulative stock returns in the period between the grant year and the vesting year.

Note that our model's predictions focus on earnings management and insider trading in the vesting year (Date 1 in the model). Our model is mute regarding earnings management and insider trading in the grant year. It is likely that during the grant years, managers will be inclined to manipulate earnings downward to better the conditions of the grants. While this is outside the scope of our theoretical model it is quite intuitive, and so we make the following hypothesis:

H4. Everything else being equal, earnings management in the grant year will be negatively correlated with the number of granted options.

Finally, earnings management and insider trading go hand in hand in our model. They both exist only in cases of relatively high stock prices and more in-the-money options. For this reason we also obtain the following prediction regarding the concurrent occurrence of the two.

H5. Everything else being equal, there is a positive correlation between the amount of insider trading and the amount of earnings management. This relationship will be intensified following periods of high stock returns.

3. Empirical Tests

In this section, we empirically test Hypotheses 1 to 5. We explain the econometric approach, describe the data, and present the empirical results.

3.1. *Measuring earnings management*

We measure earnings management using discretionary accruals. We use a cross-sectional version of the modified Jones (1991) model introduced by Dechow *et al.* (1995). It is similar to the cross-sectional Jones model used in Teoh *et al.* (1998a, 1998b).

All the data used in calculating discretionary accruals are from the *Compustat* database. All the empirical results remain qualitatively the same when discretionary accruals are calculated using the current accruals based approach proposed by Teoh *et al.* (1998a, 1998b) or cash flow based approach proposed by Hribar and Collins (2002).[11]

The first step is to calculate total accruals which are basically the difference between net income before extra items and operating cash flows. Formally, we follow Dechow *et al.* (1995) and calculate total accruals for firm i in year t, $TA_{i,t}$, as:

$$TA_{i,t} = (\Delta CA_{i,t} - \Delta Cash_{i,t}) - (\Delta CL_{i,t} - \Delta STD_{i,t}) - Dep_{i,t}, \qquad (4)$$

where all terms in (4) are scaled by firm assets at the beginning of the year $A_{i,t-1}$ (*Compustat* item 6 in year $t-1$) and

$$\begin{aligned} \Delta CA_{i,t} &= \text{change in current assets (item 4)},\\ \Delta Cash_{i,t} &= \text{change in cash and cash equivalent (item 1)},\\ \Delta CL_{i,t} &= \text{change in current liabilities (item 5)},\\ \Delta STD_{i,t} &= \text{change in debt included in current liabilities (item 34)},\\ Dep_{i,t} &= \text{depreciation and amortization (item 14)}. \end{aligned}$$

Total accruals are decomposed into two components: non-discretionary accruals and discretionary accruals. Non-discretionary accruals are the accruals induced by normal business activities, such as increased sales and fixed assets. Discretionary accruals are not a direct consequence of normal business activities and are subject to managerial judgement.

To separate discretionary accruals from non-discretionary accruals, we follow DeFond and Subramanyam (1998) and run the following cross-sectional regression using all firms with the same two-digit SIC code for each year:

$$TA_{i,t} = \delta + \eta_1(\Delta Sales_{i,t} - \Delta REC_{i,t}) + \eta_2 PPE_{i,t} + v_{i,t}, \qquad (5)$$

[11] In some contexts of studies, the differences between discretionary accruals of the firms of interest and those of control firms are examined, see Kothari *et al.* (2005). In our case, there does not exist a natural choice of the control group, precluding this type of analysis.

where all terms in (5) are scaled by firm assets at the beginning of the year $A_{i,t-1}$ (item 6 in year $t-1$) and

$$\begin{aligned} TA_{i,t} &= \text{total accruals calculated in Eq. (4)}, \\ \Delta Sales_{i,t} &= \text{change in revenues (item 12)}, \\ \Delta REC_{i,t} &= \text{change in accounts receivable (item 2)}, \\ PPE_{i,t} &= \text{level of gross property, plant and equipment (item 7)}. \end{aligned}$$

The residuals of the regressions $v_{i,t}$ reflect discretionary accruals. By running industry-year regressions, we control for the influence of changing industry-wide economic conditions on earnings management.

3.2. *Measuring insider trading*

We measure insider trading in two ways. The first is the dollar value of options exercised (*SOPTEXERC* in the *ExecuComp* database) scaled by firm equity. This measure is incomplete because it does not include insider trading stemming from the sales of restricted stock. To address this we also measure insider trading as net insider sales scaled by firm equity, calculated using data in the *Thomson Financial* database.[12] We consider a transaction in this database as insider trading if it satisfies all of the following criteria:

(1) The transaction is a purchase or a sale of stock (open market or private), or an exercise of stock options.[13]
(2) The transaction has at least 100 shares.[14]
(3) The transaction price (except the strike price of options) does not deviate from the closing price of the trading day by more than 20%.
(4) The transaction does not exceed more than 10% of firm equity.

These criteria have been used in the insider trading literature, see for example, Beneish (1999) and Lakonishok and Lee (2001). Net insider sales are calculated as the difference between insider sales and insider buys. Option exercises are treated as purchasing stocks at the strike prices, and selling at the recorded transaction prices if stocks from options exercised are sold subsequently.

[12] All results are robust if we use total compensation including option exercised ($TDC2$ in the *ExecuComp* database) to replace firm equity as the sealer.
[13] The *TRANCODE* field is in {P,S,M,X,J,F}.
[14] Many smaller transactions are automatic, for example, reinvestment of dividends.

3.3. *Data*

We use the *Compustat Industrial Annual* database for the financial statement data, the *Standard & Poor's ExecuComp* database for the compensation data, and *Thomson Financial* for the insider trading data. The period under consideration is 1993–2004.[15]

We restrict attention to CEOs of firms that are in the *ExecuComp* database and have the *Compustat* data to calculate discretionary accruals (PPE levels, change in sales, and change in accounts receivable). We omit financial institutions (SIC codes between 6000 and 6999) and regulated utilities (SIC codes between 4900 and 4999) because they are subject to unique disclosure requirements. We then group the observations into industries by the first two-digit SIC code in each year. Model (5) is then estimated individually for each two-digit SIC-year with at least 10 observations, similar to Teoh *et al.* (1998a, 1998b) and Kothari *et al.* (2005). This leaves us with 12,049 firm-year observations in 352 industry-year groups (covering 1788 firms in 34 industries) for running regressions specified in (5).

When we include in our model controls for a series of CEO characteristics (such as ownership, bonus and salary payments, CEO tenure) and firm characteristics (such as size, book-to-market, operating and stock performance, volatility of returns, debt ratio) the sample size is reduced to 10,296 firm-year observations.

We present summary statistics of CEO characteristics, firm characteristics and insider trading in Table 1.

Panel A reports statistics of CEO compensation. The mean of the total compensation is about \$4 million, of which the majority is awarded in stock options. On average, the value of stock option grants is roughly 7.5 times the value of restricted stock grants. Moreover, restricted stock is present in 20.4% of firm-years, stock options are present in 74.8% of firm-years, and bonuses are present in 78.7% of firm-years.

Panel B of Table 1 reports firm characteristics. Observe that firms in the sample are large, consistent with previous empirical examinations that use the *ExecuComp* data. The mean market capitalization and book assets are about \$6.5 billion and \$4 billion, respectively.

Panel C of Table 1 reports statistics on insider trading. CEOs on average pocket about \$1.4 million via exercising stock options. They trade 9.7 times each year of which 6.9 times are sales. The value of net CEO sales is about \$6.5 million.

[15] The *ExecuComp* database starts at 1992, however the data for that year is only partial.

Table 1. Descriptive statistics.

	N	Mean	Median	Std. Dev.
Panel A: Descriptive statistics on CEO compensation				
Stock options (B-S value) ($ thousand)	10,247	2,027.4	633.1	3,856
Restricted stock ($ thousand)	10,296	272.3	0	991.0
Bonus ($ thousand)	10,296	576.0	325.0	810.8
Salary ($ thousand)	10,296	604.0	550.0	301.6
Total compensation ($ thousand)	10,247	3,932	2,062	5,385
Ownership	10,143	2.754%	0.349%	0.061
Rec_Mon	8,065	0.8614	0.9079	0.3571
Grnt	10,296	0.30%	0.13%	0.0066
Options_Grnt	10,296	0.28%	0.12%	0.0063
Panel B: Descriptive statistics on firm characteristics				
Market capitalization ($ Million)	10,296	6,480	1,144	21,733
Book value of assets ($ Million)	10,296	4,183	1,023	10,947
Book-to-market assets	10,296	0.6161	0.6022	0.2771
CFO/lagged assets	10,296	0.1118	0.1122	0.1106
Return	10,235	0.1617	0.0915	0.5530
Market_return	10,296	0.1254	0.2116	0.1967
Volatility	10,293	0.4754	0.4133	0.2599
Debt_ratio	10,265	0.1501	0.1186	0.1419
Panel C: Descriptive statistics on insider trading				
Total number of tradings	4,670	9.690	4	18.43
Total number of sales	4,670	6.862	2	16.76
Net dollar value sales (sales-buys) ($ thousand)	4,670	6,530	722.1	18,823
Net sales scaled by firm value	4,670	0.1379%	0.0141%	0.0050
Dollar value of option exercised ($ thousand)	10,296	1,413	0	4,369
Option exercised scaled by firm value	10,296	0.0555%	0	0.0016

Note: The descriptive statistics in panels A and B are based on 10,296 firm-years (1993–2004) used in the regressions of earnings management on moneyness and grants of stock and stock options. Panel C reports the insider trading data used in the regressions of insider trading on moneyness and grants of stock and stock options. Compensation data are from *Standard & Poor's ExecuComp*. Stock options is the aggregate Black–Scholes value of stock options granted during the year (*BLK_VALU*). Restricted Stock is the value of restricted stock granted during the year (*RSTKGRNT*). Ownership is the percentage of the company's shares owned by the CEO. Total compensation ($TDC1$) includes salary, bonus, other annual compensation, restricted stock, stock options granted, long-term incentive plan (LTIP), and all other compensation. *Rec_Mon* is the reciprocal of moneyness of stock options, defined in (7). *Grnt* and *Options_Grnt* are the total number of granted stock and stock options, and the number of granted options only, both scaled by outstanding shares. Firm characteristics are taken from the *Compustat Industrial Annual*: Market capitalization equals the closing price of firm stock times the number of outstanding shares at the end of the fiscal year (*Compustat* item 25 * item 199); Book value of assets is total assets (item 6); Book-to-market assets is book value of assets (item 6) divided by market value of assets (book value of debt (item 6-item 60) plus market capitalization); CFO/lagged assets is cash flows from operations (item 308) scaled by lagged assets (item 6), return is the annual return ($TRS1YR/100$); Volatility is calculated using daily stock returns (*RET* in *CRSP*); and *debt_ratio* is debt (item 9 + item 34) divided by total market value of assets. In panel C, net dollar value sales is the dollar value of CEO sales (including options exercised) less CEO buys from *Thomson Financial* database. Dollar value of options exercised is the *SOPTEXER* variable from the *ExecuComp* database.

Table 2 summarizes regression fit statistics and distributional properties of discretionary accruals (using model (5)). We find a positive coefficient on ($\Delta Sales - \Delta REC$) and a negative coefficient on PPE. This is consistent with prior research on discretionary accruals; see, for instance, Larcker and Richardson (2004). The mean adjusted R^2 is 21.2%. On average, discretionary accruals account for 0.19% of the beginning-year total assets. In dollar terms, there is \$7.9 million of discretionary accruals for the average firm in the sample. It accounts for about 4.5% of earnings as measured by income before extra items (item 123 in *Compustat*).

3.4. *Main explanatory variables*

Recall that H1, H2 and H3 suggest that earnings management in vesting years will be impacted by the moneyness of the options, the number of granted options, and the rate of returns in the period between the grant year and the vesting year. Stock options and restricted stock typically vest over 3–4 years.[16] Thus, we expect that:

(1) Earnings management and insider trading in year t will be positively correlated with the *moneyness* of the options granted in year $t - \tau$ for $r = 1, \ldots, 4$.
(2) Earnings management and insider trading in year t will be positively correlated with the *number of options granted* in year $t - \tau$ for $\tau = 1, \ldots, 4$.
(3) Earnings management and insider trading in year t will be positively correlated with the *cumulative returns* between the beginning of year $t - \tau$ and the beginning of year t for $\tau = 1, \ldots, 4$.

To test these predictions we use proxies for the moneyness of the options, the number of granted options and the cumulative historic returns as follows.

3.4.1. *Moneyness of options*

Recall that moneyness is defined as the ratio of the stock price to the strike price of the options. Since the moneyness of restricted stock is infinite we use the reciprocal of moneyness in our empirical analysis.

[16] This fact is well-known for options but less so for restricted stock. To make sure, we checked the proxy statements of 50 randomly-selected firms (in various industries) that granted restricted stock during 2003. While showing various vesting patterns, the majority of the restricted stock vests in three to four years, similar to stock options.

Table 2. Regression fit statistics of discretionary accruals.

	Independent Variables	
	$\Delta Sales - \Delta REC$	PPE
Panel A: Mean coefficient estimates for accrual models from 352 two-digit SIC-year regressions		
Coefficient	0.044	−0.039
Z_statistics	17.82	−18.63
% Positive	69.03	26.99

Distributional Statistics				
Mean	Std. Dev.	$Q1$	Median	$Q3$
Panel B: Adjusted R^2 across 352 industry-year regressions				
0.212	0.239	0.042	0.178	0.366

Distributional Statistics							
Mean	Std. Dev.	1%	$Q1$	Median	$Q3$	99%	% Positive
Panel C: Discretionary accruals scaled by lagged assets for 12,049 firm-year observations							
0.0019	0.0669	−0.2130	−0.0307	0.0013	0.0333	0.2306	51.10

Note: The statistics are based on 12,049 firm-year observations (1993–2004). Parameter estimates are averages from the 352 two-digit SIC-year regressions. Z_statistic is $Z = \frac{1}{\sqrt{N}} \sum_{j=1}^{N} \frac{t_j}{\sqrt{k_j/k_j - 2}}$, where N is the number of SIC-year groups, t_j is the t_statistic for SIC-year j, and k_j is the degrees of freedom for the corresponding t-statistic. Discretionary accruals are the residuals estimated using the modified Jones model across 352 two-digit SIC-year groups. All data are from *Compustat Industrial Annual*, and are scaled by beginning-year total assets (*Compustat* item 6). Formally, we use

$$TA_{i,t} = \delta + \eta_1(\Delta Sales_{i,t} - \Delta REC_{i,t}) + \eta_2 PPE_{i,t} + \varepsilon_{i,t},$$

where $\Delta Sales_{i,t}$ is the change in sales (*Compustat* item 12) of firm i in year t, $\Delta REC_{i,t}$ is the change in accounts receivable (item 2), $PPE_{i,t}$ is the level of gross property, plant and equipment (item 7), and total accruals are calculated by

$$\begin{aligned} TA_{i,t} = {} & \Delta[\text{current assets } (4) - \text{cash } (1)] - \Delta[\text{current liabilities } (5) \\ & - \text{debt included in current liabilities } (34)] \\ & - \text{depreciation and amortization } (14). \end{aligned}$$

To estimate the strike price of the options granted to the manager in year $t - \tau$ we must take into account the fact that the manager may receive several grants during each year. To incorporate this, we first calculate the weighted average strike price using the Black–Scholes value of each grant as weights.[17] Restricted stock is treated as options with a zero strike price.

[17] We also conducted (but do not report) tests using a number-weighted average strike price and obtained qualitatively the same results.

Formally, the weighted average strike price of ESOs (*WAK*) for firm i in year $t-\tau$ is defined as:

$$WAK_{i,t-\tau} = \sum_{j=1}^{m_{i,t-\tau}} EXPRIC_{i,t-\tau,j} \frac{BLKSHVAL_{i,t-\tau,j}}{RSTKGRNT_{i,t-\tau} + BLK\_VALU_{i,t-\tau}}, \quad (6)$$

where all terms in (6) are from the *ExecuComp* database and

$$\begin{aligned} m_{i,t-\tau} &= \text{number of occasions when options are granted} \\ &\quad\ \text{during the year,} \\ EXPRIC_{i,t-\tau,j} &= \text{strike price of the options in the } j\text{th grant,} \\ BLKSHVAL_{i,t-\tau,j} &= \text{Black–Scholes value of the options in the } j\text{th grant,} \\ RSTKGRNT_{i,t-\tau} &= \text{total value of restricted stock grants,} \\ BLK\_VALU_{i,t-\tau} &= \text{aggregate Black–Scholes value of options granted} \\ &\quad\ \text{during the year.} \end{aligned}$$

The reciprocal of moneyness (denoted by *REC_MON*) is then calculated by dividing *WAK* by the average stock price at the beginning and the end of year t:

$$REC\_MON_{i,t-\tau} = \frac{WAK_{i,t-\tau}}{(PRCCF_{i,t} + PRCCF_{i,t-1})/2}, \quad (7)$$

where $PRCCF_{i,t}$ is the close price of firm i's stock at the end of fiscal year t.

3.4.2. *Number of granted options*

We measure this variable as the total number of stock options granted during the year, scaled by outstanding shares. Formally, the number of granted stock options for firm i in year $t-\tau$ is

$$OPTIONS\_GRNT_{i,t-\tau} = \frac{SOPTGRNT_{i,t-\tau}}{1000 * SHRSOUT_{i,t-\tau}}.$$

3.4.3. *Number of granted stock and stock options*

We measure this variable as the total number of restricted stock and stock options granted during the year, scaled by outstanding shares. Formally, the number of granted stocks and options for firm i in year $t-\tau$ is

$$GRNT_{i,t-\tau} = \frac{RSTGRNT/PRCCF_{i,t-\tau} + SOPTGRNT_{i,t-\tau}}{1000 * SHRSOUT_{i,t-\tau}}.$$

3.4.4. *Cumulative returns*

Our model suggests that higher stock price during vesting years will be positively correlated with both earnings management and insider trading. The model does not specify the source of the high stock price — is it due to outstanding performance of the firm's share or due to overall market conditions. Thus, empirically we will use two measures of cumulative returns. The first is $RET_{i,t-\tau}$ which measures the cumulative returns of firm i from the beginning of year $t-\tau$ to the beginning of year t (using $TRS1YR$). The second is the cumulative market return from the beginning of year $t-\tau$ until the beginning of year t (using $VWRETD$ from the $CRSP$ database).[18]

Panel A of Table 3 describes the mean, median, and standard deviation of REC_MON, $GRNT$, RET, and M_RET for different lags: $\tau = 0, \ldots, 4$. Panel B presents the correlations between the four main explanatory variables. Observe that the correlations are generally quite small.

3.5. *Empirical results*

3.5.1. *Earnings management and stock-based compensation*

To gauge the effect of the three main explanatory variables on earnings management we run five separate regressions $(\tau = 0, \ldots, 4)$ of earnings management on the main explanatory variables and controls as follows:

$$\begin{aligned} DA_{i,t} = {} & \delta + \eta_{1,t-\tau} REC\_MON_{i,t-\tau} + \eta_{2,t-\tau} GRNT_{i,t-\tau} + \eta_{3,t-\tau} RET_{i,t-\tau} \\ & + \eta_{4,t-\tau} M\_RET_{t-\tau} + \theta_1 OWNERSHIP_{i,t} + \theta_2 BONUS_{i,t} \\ & + \theta_3 SALARY_{i,t} + \theta_4 TENURE_{i,t} + \theta_5 SIZE_{i,t} + \theta_6 BM_{i,t} + \theta_7 CFO_{i,t} \\ & + \theta_8 VOLATILITY_{i,t} + \theta_9 DEBT\_RATIO_{i,t} + \theta_{10} GIM\_dummies \\ & + \theta_{11} Year\_dummies + \theta_{12} Industry\_dummies + \varepsilon_{i,t}, \end{aligned} \tag{8}$$

$DA_{i,t}$ is earnings management of firm i in year t as measured by *Discretionary Accruals* (the residuals from model (5)). The four main explanatory variables are the moneyness of the options, the number of granted options, and the two types of returns. We control for both CEO and firm characteristics that have been identified in prior research as affecting earnings management. Specifically:

$OWNERSHIP_{i,t}$ is the percentage of CEO ownership ($SHROWN/(1000 * SHRSOUT)$) at the beginning of the year.

[18] We also used (but do not report) a combined measure of abnormal returns in which we subtracted the market returns from firm returns. The results are similar.

Table 3. Statistics of *REC_MON*, *GRNT*, *RET*, *M_RET* and the lagged variables.

	$\tau = 0$			$\tau = 1$			$\tau = 2$			$\tau = 3$			$\tau = 4$		
	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ
Panel A: Mean, median, standard deviation															
REC_MON	0.8614	0.9078	0.3571	0.8982	0.8451	0.5344	1.0046	0.8001	0.9275	1.079	0.7441	1.2834	1.1205	0.6974	1.6114
GRNT	0.30%	0.13%	0.0065	0.30%	0.13%	0.0067	0.29%	0.12%	0.0064	0.28%	0.11%	0.0064	0.27%	0.10%	0.0064
RET	0.1616	0.0915	0.5530	0.1618	0.0810	0.5642	0.3253	0.1566	0.9553	0.5091	0.2385	1.4792	0.7031	0.3388	1.7744
M_RET	0.1254	0.2116	0.1967	0.1121	0.2116	0.1913	0.2615	0.3464	0.3192	0.4777	0.5024	0.4574	0.7309	0.7581	0.5435

	$\tau = 0$			$\tau = 1$			$\tau = 2$			$\tau = 3$			$\tau = 4$		
	GRNT	*RET*	*M_RET*	*GRNT*	*RET*	*M_RET*	*GRNT*	*RET*	*M_RET*	*GRNT*	*RET*	*M_RET*	*GRNT*	*RET*	*M_RET*
Panel B: Correlation matrix															
REC_MON	0.0379	−0.126	−0.035	0.0756	−0.406	−0.111	0.0821	−0.420	−0.109	0.0633	−0.327	−0.118	0.0614	−0.299	−0.083
GRNT		−0.008	−0.029		−0.010	−0.030		0.0089	−0.032		0.0168	−0.047		0.0021	−0.068
RET			0.2189			0.1940			0.1401			0.1534			0.1584

Note: The statistics are based on 12,049 firm-year observations (1993–2004). *REC_MON* is the reciprocal of moneyness of stock options, *GRNT* is the grant of stock options as percentage of shares outstanding, *RET* is the firm return, and *M_RET* is the value-weighted market return. Notice that $RET_{t-\tau}$ and $M\_RET_{t-\tau}$, $\tau = 1, \ldots, 4$, are the cumulative firm returns from the beginning of year $t - \tau$ to the beginning of year t.

$BONUS_{i,t}$ is the bonus payments scaled by total compensation ($BONUS/TDC1$).
$SALARY_{i,t}$ is salary payment scaled by total compensation ($SALARY/TDC1$).
$TENURE_{i,t}$ is log of number of years from becoming *CEO* (*BECCAMECE*) to the end of 2005.
$SIZE_{i,t}$ is log of market value of assets (*Compustat* item 6 − item 60 + item 25 ∗ item 199).
$BM_{i,t}$ is book value of assets (item 6) divided by market value of assets.
$CFO_{i,t}$ is operating cash flows scaled by lagged assets (item 308/item 6).
$VOLATILITY_{i,t}$ is the annual volatility calculated using daily stock returns during year t from *CRSP*.
$DEBT\_RATIO_{i,t}$ is the ratio of total debt (item 9 + item 34) to the market value of the assets.

Following Bergstresser and Philippon (2006) we created four dummies for the GIM governance index[19]: $G \leq 6$, $7 \leq G \leq 9$, $10 \leq G \leq 12$, and $G \geq 13$. We also control for year dummies and Fama–French 48-industry dummies.

Out of the five regressions, four are lagged ($\tau = 1, \ldots, 4$) and allow us to test the predictions of the model. The case $\tau = 0$ considers the concurrent relation between earnings management and ESO grants. This regression allows us to test H4 (which is not a result of our model).

Note that our theory makes a link between previous equity grants and current earnings management. Our theoretical argument is no longer valid if there is a change in CEO between years $t - \tau$ and t since the options granted to the CEO in year $t - \tau$ are not relevant to the reigning CEO in year t. Thus, in all our regressions we drop the observations if the CEO has changed between the grant year and the vesting year.[20] Note also that we use the signed value (not the absolute value) of discretionary accruals. This is again suggested by our theory.

Hypotheses H1, H2, and H3 suggest that the coefficient of *REC_MON* should be negative, the coefficient of *GRNT* should be positive, and the coefficient of *RET* and (perhaps) *M_RET* should be positive.

The results are presented in Table 4. The table shows that earnings management in year t increases in the moneyness of the ESOs granted in years $t - 1$ to $t - 4$ (consistent with *H*1): the coefficient of *REC_MON* is negative

[19] For detailed descriptions on the GIM index, see Gompers *et al.* (2003).
[20] We also repeated (but do not report) the analysis without dropping these observations. The results are similar, but the economic significance is somewhat reduced.

and strongly significant for $\tau = 1, \ldots, 4$. The economic significance of the results is also considerable. For the average firm in the sample, a decrease of one standard deviation in *REC_MON* in years $t-1$ to $t-4$ increases earnings management in year t by \$9,612, \$13.97, \$27.92, and \$29.66 million, accounting for 120.9%, 175.7%, 351.3%, and 373.2% of discretionary accruals. If, perhaps more realistically, *REC_MON* decreases by 10% in years $t-1$ to $t-4$, then discretionary accruals in year t increase by 19–27.4%.

Recall that H2 suggests that the number of granted options will increase earnings management in vesting years. Contrary to the strong results regarding moneyness, the results on the number of granted options are (perhaps surprisingly) weak. The coefficients of *GRNT* in Table 4 for the cases $\tau = 1, \ldots, 4$ are positive as expected, but are only significant for the case $\tau = 3$. This suggests that a larger number of granted options in year $t-3$ induces more earnings management in year t. The economic significance of the case $\tau = 3$ is considerable. For the average firm in the sample, an increase of the number of granted options by one standard deviation in year $t-3$ leads to positive discretionary accruals of \$7,932 million in year t, which equals to 99.81% of average discretionary accruals in our sample.

Recall that H4 suggests a negative relation between the number of granted options and concurrent earnings management. The case $\tau = 0$ enables us to test this hypothesis. The coefficient of *GRNT* for $\tau = 0$ is significantly negative and economically large. For the average firm in the sample, a decrease in the number of granted options by one standard deviation induces an upward

Table 4. Earnings management and compensation.

	$\tau = 0$	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
Intercept	0.0713	0.0733	0.0662	0.0552	0.1001
	(0.000)	(0.000)	(0.009)	(0.117)	(0.033)
CEO characteristics					
$REC\_MON_{t-\tau}$	0.0046	−0.0043	−0.0036	−0.0052	−0.0044
	(0.024)	(0.014)	(0.008)	(0.000)	(0.000)
$GRNT_{t-\tau}$	−0.5090	0.0746	0.0541	0.2963	0.0338
	(0.000)	(0.494)	(0.671)	(0.040)	(0.850)
OWNERSHIP	0.0013	−0.0119	−0.0091	−0.0087	−0.0135
	(0.942)	(0.515)	(0.661)	(0.717)	(0.616)
BONUS	0.0129	0.0114	0.0079	0.0164	0.0218
	(0.030)	(0.028)	(0.166)	(0.015)	(0.005)
SALARY	−0.0202	−0.0150	−0.0112	−0.0064	−0.0024
	(0.000)	(0.000)	(0.017)	(0.244)	(0.710)
TENURE	0.0026	0.0000	0.0000	0.0009	−0.0009
	(0.037)	(0.972)	(0.984)	(0.629)	(0.671)

Table 4. (*Continued*)

	$\tau = 0$	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
Firm characteristics					
$RET_{t-\tau}$	−0.0028	0.0058	0.0056	0.0019	0.0006
	(0.060)	(0.000)	(0.000)	(0.011)	(0.346)
$M\_RET_{t-\tau}$	0.0000	−0.0030	0.0055	−0.0021	0.0267
	(0.998)	(0.699)	(0.649)	(0.886)	(0.794)
SIZE	−0.0032	−0.0019	−0.0014	0.0000	−0.0007
	(0.000)	(0.004)	(0.068)	(0.979)	(0.508)
BM	−0.0430	−0.0320	−0.0326	−0.0284	−0.0343
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CFO	−0.1763	−0.1741	−0.1802	−0.1781	−0.1959
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
VOLATILITY	−0.0552	−0.0448	−0.0362	−0.0240	−0.0294
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DEBT-RATIO	0.0310	0.0274	0.0331	0.0267	0.0257
	(0.000)	(0.000)	(0.000)	(0.008)	(0.029)
No. of Obs.	7,572	6,552	4,917	3,553	2,498
Adjusted R^2	0.090	0.090	0.095	0.087	0.107

Note: The table presents the results of cross-sectional regressions of discretionary accruals on the reciprocal of money-ness (*REC_MON*) over 10,296 firm-years (1993–2004). Formally, we run five separate regressions ($\tau = 0, \ldots, 4$) using

$$\begin{aligned} DA_{i,t} = {} & \delta + \eta_1 REC\_MON_{i,t-\tau} + \eta_2 GRNT_{i,t-\tau} + \eta_3 RET_{i,t-\tau} + \eta_4 M\_RET_{t-\tau} \\ & + \theta_1 OWNERSHIP_{i,t} + \theta_2 BONUS_{i,t} + \theta_3 SALARY_{i,t} + \theta_4 TENURE_{i,t} \\ & + \theta_5 SIZE_{i,t} + \theta_6 BM_{i,t} + \theta_7 CFO_{i,t} + \theta_8 VOLATILITY_{i,t} + \theta_9 DEBT\_RATIO_{i,t} \\ & + \theta_{10} GIM\_dummies + \theta_{11} Year\_dummies + \theta_{12} Industry\_dummies + \varepsilon_{i,t}, \end{aligned}$$

where $DA_{i,t}$ is the discretionary accruals scaled by lagged assets. $REC\_MON_{i,t-\tau}$ is the reciprocal of moneyness of stock and options granted in year $t-\tau$, as defined in (7). $GRNT_{i,t-\tau}$ is the total number of restricted stock and stock options granted during the year as a percentage of the total number of outstanding shares; $OWNERSHIP_{i,t}$ is the ownership as a fraction of the total shares outstanding; $BONUS_{i,t}$ and $SALARY_{i,t}$ are bonus and salary payments scaled by total compensation ($TDC1$), respectively, and $TENURE_{i,t}$ is the log of the number of years from becoming CEO to 31 December 2005. $RET_{i,t-\tau}$ and $M\_RET_{t-\tau}$ are the cumulative returns from the beginning of year $t-\tau$ to the beginning of year t for firm i and market respectively (using $TRS1YR$ and $VWRETD$); $SIZE_{i,t}$ is the log of market value of assets; $BM_{i,t}$ is book value of assets divided by market value of assets; $CFO_{i,t}$ is cash flows from operations scaled by lagged assets; $VOLATILITY_{i,t}$ is calculated using daily returns; and $DEBT\_RATIO_{i,t}$ is the ratio of total debt to market value of assets. GIM governance index is sorted into four groups: $G \leq 6$, $7 \leq G \leq 9$, $10 \leq G \leq 12$, $G \geq 13$. P-values appear in parentheses below coefficient estimates.

manipulation of earnings by \$13.84 million in the grant year, which equals 174.1% of the average discretionary accruals. As expected, during the grant years, managers manipulate earnings downwards. This leads to better conditions of their grants and enables them to save accruals for future vesting years.

Thus, our results suggest a life-cycle of accruals. Managers save accruals during years of significant option grants by managing earnings down. Then, they use the saved accruals in vesting years to manage earnings up. By doing so, managers both improve the terms of their grants up front, and increase the value of their options ex-post when they vest. Some more insight into this life-cycle argument can be obtained by considering the magnitude of the coefficient of the *GRNT* variable in years t to $t-4$. The size of the coefficient for year t is negative and roughly equal to the sum of the coefficients in years $t-1$ to $t-4$. This suggests that the accruals "saved" in grant years are indeed utilized in vesting years to manage earnings upwards.

Recall now that H3 suggests a positive correlation between cumulative stock returns and the extent of earnings management in vesting years. Table 4 shows that historic firm returns are indeed critical. The coefficient of $RET_{i,t-\tau}$ is positive for $\tau = 1, \ldots, 4$ and statistically significant for $\tau = 1, \ldots, 3$. By contrast, market returns turn out to be irrelevant: The coefficients of $M\_RET_{t-\tau}$ are all insignificant. Thus, it appears that the historical stock performance of individual firms, but not market performance, affects earnings management.

The economic magnitude of the effect of cumulative firm returns on earnings management is also considerable. For the average firm in the sample, if the cumulative firm returns from the beginning of years $t-1, \ldots, t-4$ to the beginning of year t increase by one standard deviation, then discretionary accruals in year t increase by \$13.68, \$22.37, \$11.75, and \$4,452 million, accounting for 172.2%, 281.5%, 147.9% and 56% of discretionary accruals. If, perhaps more realistically, cumulative firm returns increase by 30%, then discretionary accruals increase by 9.5–91.6%.

Finally, it is interesting to consider the control variables in our model. Observe that higher bonus payments induce more earnings management, which is consistent with prior research; see, for instance, Healy (1985). In contrast, salary payments appear to mitigate earnings management, perhaps, due to the wealth effect. CEO tenure and stock ownership are not statistically significant.[21]

As for firm characteristics: large firms tend to have less discretionary accruals per unit of assets.[22] Firms with more growth opportunities and lower current operating performance are engaged in more earnings management, in

[21] Replacing CEO tenure by CEO age does not change the result qualitatively.

[22] We also used (but do not report) the log of market capitalization as *SIZE* and book-to-market equity as *BM* and obtain qualitatively the same results.

line with Larcker and Richardson (2004). Firms with high volatility of returns tend to have lower discretionary accruals. Moreover, firms with more debt tend to engage in more earnings management, in line with DeFond and Jiambalvo (1994).

3.5.2. *Insider trading and stock-based compensation*

Recall that H1, H2, and H3 suggest a positive correlation between insider trading in vesting years and the moneyness of the options, the number of granted options and cumulative stock returns. To test these we use a model identical to (8) with the only difference that the dependent variable is insider trading.

Table 5 reports the result when insider trading is measured by net insider sales scaled by firm equity. Table 6 reports results when insider trading is measured by the dollar value of options exercised scaled by firm equity. In each table, we report the results of four regressions corresponding to $\tau = 1, \ldots, 4$.

The first analysis looks at all insider trading including options exercised, stock purchases and sales, etc. Results are reported in Table 5. More deeply in-the-money options are associated with more insider trading (negative coefficients of the *REC_MON*, the reciprocal of the moneyness) in vesting years. The result is statistically significant except in the case of $\tau = 3$. For the average firm in the sample, a decrease in *REC_MON* by one standard deviation in years $t - 1$ to $t - 4$ increases net CEO sales in year t by 39.3%, 65.3%, 11.3%, and 62.7%.

Surprisingly, the link between net CEO sales in vesting years and the number of grants of stock and options is weak and it is statistically significant only for $\tau = 2$. For an average firm in the sample, an increase of grants of stock and options in year $t - 2$ by one standard deviation induces net CEO sales by \$1,225 million in year t, which accounts for 18.8% net CEO sales.

The effect of cumulative firm returns on insider trading is again positive and statistically significant across the board. For the average firm in the sample, increasing the cumulative firm returns from the beginning of years $t - 1, \ldots, t - 4$ to the beginning of year t by one standard deviation increases net CEO sales by 35.7%, 19.8%, 46.4%, and 35.7%. A more realistic 30% increase in cumulative firm returns increases net insider sales in year t by 6–19%. On the other hand, cumulative market returns turn out to be irrelevant: all coefficients of $M\_RET_{t-\tau}$ are insignificant.

Our next analysis focuses on a sub-sample of insider trading, which is directly related to the exercise of stock options. Thus, we ignore purchases of

Table 5. Net insider sales and compensation.

	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
Intercept	0.2616	0.1640	0.1771	0.2071
	(0.196)	(0.433)	(0.693)	(0.661)
CEO characteristics				
$REC\_MON_{t-\tau}$	−0.0741	−0.0675	−0.0089	−0.0392
	(0.000)	(0.000)	(0.501)	(0.004)
$GRNT_{t-\tau}$	1.5990	2.9531	−0.3961	1.5059
	(0.270)	(0.077)	(0.819)	(0.373)
OWNERSHIP	1.8521	1.8217	1.6992	1.9899
	(0.000)	(0.000)	(0.000)	(0.000)
BONUS	0.0853	0.1040	0.1482	0.3190
	(0.111)	(0.075)	(0.032)	(0.000)
SALARY	−0.1506	−0.1518	−0.1221	−0.1361
	(0.001)	(0.002)	(0.034)	(0.044)
TENURE	0.0688	0.0601	0.0655	0.0577
	(0.000)	(0.000)	(0.000)	(0.003)
Firm characteristics				
$RET_{t-\tau}$	0.0637	0.0209	0.0316	0.0203
	(0.000)	(0.029)	(0.000)	(0.000)
$M\_RET_{t-\tau}$	−0.0170	0.0494	0.0685	0.5479
	(0.798)	(0.642)	(0.609)	(0.549)
SIZE	−0.0256	−0.0242	−0.0354	−0.0237
	(0.000)	(0.001)	(0.000)	(0.021)
BM	−0.1364	−0.1305	−0.1100	−0.1172
	(0.002)	(0.011)	(0.064)	(0.097)
CFO	0.3765	0.2736	0.4607	0.3471
	(0.000)	(0.004)	(0.000)	(0.013)
VOLATILITY	0.2272	0.2575	0.1751	0.3861
	(0.000)	(0.000)	(0.004)	(0.000)
DEBT_RATIO	−0.1451	−0.0466	−0.1690	−0.1817
	(0.077)	(0.615)	(0.111)	(0.150)
No. of Obs.	3,216	2,619	2,051	1,479
Adjusted R^2	0.158	0.134	0.137	0.185

Note: The table presents the results of cross-sectional regressions of net CEO sales (scaled by market capitalization) on *REC_MON*, the reciprocal of moneyness, during 1993–2004. Formally, we run five separate regressions ($\tau = 1, \ldots, 4$) using

$$\begin{aligned} &NET\_SALES_{i,t} \\ &\quad = \delta + \eta_1 REC\_MON_{i,t-\tau} + \eta_2 GRNT_{i,t-\tau} + \eta_3 RET_{i,t-\tau} + \eta_4 M\_RET_{t-\tau} \\ &\qquad + \theta_1 OWNERSHIP_{i,t} + \theta_2 BONUS_{i,t} + \theta_3 SALARY_{i,t} + \theta_4 TENURE_{i,t} \\ &\qquad + \theta_5 SIZE_{i,t} + \theta_6 BM_{i,t} + \theta_7 CFO_{i,t} + \theta_8 VOLATILITY_{i,t} + \theta_9 DEBT\_RATIO_{i,t} \\ &\qquad + \theta_{10} GIM\_dummies + \theta_{11} Year\_dummies + \theta_{12} Industry\_dummies + \varepsilon_{i,t}, \end{aligned}$$

where $NET\_SALES_{i,t}$ is the dollar value of CEO net sales during the fiscal year as percentage of firm's market capitalization; $REC\_MON_{i,t-\tau}$ is the value-weighted average strike price for the options granted in year $t - \tau$ scaled by the average of the stock prices in year t, as defined in (7). Other variables are the same as in Table 4. P-values appear in parentheses below coefficient estimates.

Table 6. Options exercised and compensation.

	$\tau = 1$	$\tau = 2$	$\tau = 3$	$\tau = 4$
Intercept	0.2310	0.1679	0.1997	0.2477
	(0.000)	(0.010)	(0.029)	(0.053)
CEO characteristics				
$REC\_MON_{t-\tau}$	−0.0104	−0.0118	−0.0061	−0.0070
	(0.021)	(0.001)	(0.044)	(0.032)
$OPTIONS\_GRNT_{t-\tau}$	1.3066	2.4500	1.3497	2.9675
	(0.000)	(0.000)	(0.000)	(0.000)
OWNERSHIP	−0.1095	−0.0277	−0.0513	−0.0153
	(0.020)	(0.603)	(0.409)	(0.835)
BONUS	0.0155	0.0157	0.0011	0.0071
	(0.242)	(0.284)	(0.949)	(0.740)
SALARY	−0.0846	−0.0852	−0.1088	−0.0846
	(0.000)	(0.000)	(0.000)	(0.000)
TENURE	0.0340	0.0296	0.0245	0.0212
	(0.000)	(0.000)	(0.000)	(0.000)
Firm characteristics				
$RET_{t-\tau}$	0.0356	0.0193	0.0093	0.0107
	(0.000)	(0.000)	(0.000)	(0.000)
$M\_RET_{t-\tau}$	0.0429	0.0823	0.0833	0.6951
	(0.029)	(0.008)	(0.031)	(0.012)
SIZE	−0.0170	−0.0155	−0.0227	−0.0168
	(0.000)	(0.000)	(0.000)	(0.000)
BM	−0.0617	−0.0542	−0.0668	−0.0414
	(0.000)	(0.000)	(0.000)	(0.023)
CFO	0.1347	0.0993	0.1764	0.1458
	(0.000)	(0.000)	(0.000)	(0.000)
VOLATILITY	0.0374	0.0367	0.0028	0.0267
	(0.001)	(0.003)	(0.842)	(0.160)
DEBT_RATIO	0.0008	0.0166	0.0444	0.0108
	(0.969)	(0.448)	(0.091)	(0.735)
No. of Obs.	6,551	4,916	3,552	2,497
Adjusted R^2	0.123	0.116	0.109	0.111

Note: The table presents the results of cross-sectional regressions of the CEO option exercises on *REC_MON*, the reciprocal of moneyness, during 1993–2004. Formally, we run five separate regressions ($\tau = 1, \ldots, 4$) using

$$
\begin{aligned}
&OPTIONS\_EXERCISED_{i,t} \\
&\quad = \delta + \eta_1 REC\_MON_{i,t-\tau} + \eta_2 OPTIONS\_GRNT_{i,t-\tau} + \eta_3 RET_{i,t-\tau} + \eta_4 M\_RET_{t-\tau} \\
&\qquad + \theta_1 OWNERSHIP_{i,t} + \theta_2 BONUS_{i,t} + \theta_3 SALARY_{i,t} + \theta_4 TENURE_{i,t} \\
&\qquad + \theta_5 SIZE_{i,t} + \theta_6 BM_{i,t} + \theta_7 CFO_{i,t} + \theta_8 VOLATILITY_{i,t} + \theta_9 DEBT\_RATIO_{i,t} \\
&\qquad + \theta_{10} GIM\_dummies + \theta_{11} Year\_dummies + \theta_{12} Industry\_dummies + \varepsilon_{i,t},
\end{aligned}
$$

where $OPTIONS\_EXERCISED_{i,t}$ is the dollar value of CEO options exercised during the fiscal year as percentage of firm's market capitalization; $REC\_MON_{i,t-\tau}$ is the value-weighted average strike price for the options granted in year $t - \tau$ scaled by the average of the stock prices in year t, as defined in (7); $OPTIONS\_GRNT_{i,t-\tau}$ is the number of granted options scaled by the number of shares outstanding in year $t - \tau$. Other variables are the same as in Table 4. P-values appear in parentheses below coefficient estimates.

stock and sales of stock that are not related to option exercise. In particular, we do not take into account the sale of vested restricted stock.

The results (presented in Table 6) are stronger than the results related to the complete insider trading data. In particular, moneyness is significant for all lags, and both the number of granted options and cumulative firm returns are highly significant, both statistically and economically. For the average firm in the sample, a decrease in *REC_MON* by one standard deviation in years $t-1$ to $t-4$ increases CEO options exercised in year t by 25.5%, 52.6%, 35.9%, and 51.7%. An increase of *OPTIONS_GRNT* by one standard deviation in years $t-1$ to $t-4$ increases options exercised in year t by 39.3%, 70.5%, 39.1%, and 85.7%. Moreover, an increase of cumulative firm returns from the beginning of years $t-1, \ldots, t-4$ to the beginning of year t by one standard deviation increases CEO options exercised in year t by 92.1%, 84.6%, 63.1%, and 87.1%. A more realistic increase of 30% in cumulative firm returns increases CEO options exercised in year t by 12.8–49%.

Note also that contrary to previous results, Table 6 shows that insider trading related directly to stock options is also affected by historic market returns: the coefficient of *M_RET* is significant for all lags and its magnitude dramatically exceeds the magnitude of *RET*, the individual firm cumulative returns.

As for the control variables (see Tables 5 and 6): higher ownership, greater bonuses, longer tenure, better operating performance, better growth options, and higher volatility tend to increase net insider sales; while higher salary, larger firms, and higher debt ratio tend to reduce net insider sales. On the other hand, higher ownership at the beginning of vesting year tends to mitigate CEO option exercise perhaps due to potential stock sales.

3.5.3. *Insider trading and earnings management*

In our model, insider trading and earnings management go hand in hand and both exist when stock prices are relatively high and options are more in the money. We demonstrate the existence of a direct link between insider trading and earnings management. The results add to prior findings of Bergstresser and Philippon (2006), Burns and Kedia (2006), Cheng and Warfield (2005), and Beneish (1999). Those papers document such a concurrent correlation but do not focus on the relation to prior returns. Our model, and the following empirical results identify prior returns as an important determinant of the link between earnings management and insider trading: both occur after ramp-ups in prices.

As before, we measure insider trading using both net insider sales and options exercised scaled by firm equity. The results are presented in Table 7.

Table 7. Insider trading and earnings management.

	Net Sales Scaled by Firm Equity		Options Exercised	
	Coefficient	P-value	Coefficient	P-value
Intercept	0.2612	(0.002)	0.2201	(0.000)
DA	0.4850	(0.000)	0.1093	(0.000)
CEO characteristics				
OWNERSHIP	1.7616	(0.000)	−0.1771	(0.000)
BONUS	0.0706	(0.138)	0.0116	(0.254)
SALARY	−0.0708	(0.054)	−0.0728	(0.000)
TENURE	0.0778	(0.000)	0.0022	(0.000)
Firm characteristics				
$RETURN_{t-1}$	0.0916	(0.000)	0.0396	(0.000)
$RETURN^{M}_{t-1}$	−0.0274	(0.675)	0.0362	(0.033)
SIZE	−0.0187	(0.002)	−0.0153	(0.000)
BM	−0.1513	(0.000)	−0.0423	(0.000)
CFO	0.3504	(0.000)	0.1337	(0.000)
VOLATILITY	0.2210	(0.000)	0.0413	(0.000)
DEBT_RATIO	−0.2547	(0.001)	−0.0067	(0.660)
Number of Observations	4,357		9,409	
Adjusted R^2	0.152		0.103	

Note: The table presents the results of cross-sectional regressions of dollar value CEO net sales and options exercised on discretionary accruals (DA) during 1993–2004. Formally, we use

$$\begin{aligned} &INSIDER\_TRADING_{i,t} \\ &\quad = \delta + \eta_1 DA_{i,t} + \eta_2 RET_{i,t-\tau} + \eta_3 M\_RET_{t-\tau} + \theta_1 OWNERSHIP_{i,t} \\ &\qquad + \theta_2 BONUS_{i,t} + \theta_3 SALARY_{i,t} + \theta_4 TENURE_{i,t} + \theta_5 SIZE_{i,t} + \theta_6 BM_{i,t} \\ &\qquad + \theta_7 CFO_{i,t} + \theta_8 VOLATILITY_{i,t} + \theta_9 DEBT\_RATIO_{i,t} + \theta_{10} GIM\_dummies \\ &\qquad + \theta_{11} Year\_dummies + \theta_{12} Industry\_dummies + \varepsilon_{i,t}, \end{aligned}$$

where *Insider_trading* is equal to $NET\_SALES_{i,t}$: the dollar value of CEO net sales as percentage of market capitalization (using the *Thomson Financial* database) in the first column, while *Insider_trading* is equal to the dollar value of options exercised (using the *ExecuComp* database) as percentage of the market value of the firm in the second column. $DA_{i,t}$ is discretionary accruals scaled by lagged assets. Control variables are the same as in Table 4. P-values are presented in parentheses.

For the average firm in the sample, an increase of discretionary accruals by one standard deviation is associated with an increase of net CEO sales of \$2,103 million, accounting for 32.2% of net insider sales in the same year; it increases options exercised by \$473.8 thousand, accounting for 33.5% of options exercised.

Increasing firm returns in the previous year by one standard deviation increases net insider sales by \$3.35 million, accounting for 51.3% of average net insider sales; it increases options exercised by about \$1.45 million, accounting for 102.5% of average options exercised. Observe that the lagged market returns do not affect net CEO sales but it does affect CEO option exercise.

4. Conclusion

Stock-based compensation is designed to align the interests of executives with those of shareholders. A large body of evidence suggests that stock-based compensation indeed enhances firm value. However, mechanisms that ensure incentive provisions inevitably induce executives to engage in earnings management.

Given that earnings management carries with it some costs to the manager, our model suggests that it will be carried out only when the options granted to the manager are either in the money or close to the money. This suggests a relation between the moneyness of stock option grants and the extent of both earnings management and insider trading during vesting years. Moreover, this suggests a positive correlation between insider trading and earnings management in the vesting years of the options. In general, earnings management and insider trading will be more pronounced during periods of high stock prices and following periods of relatively high stock returns. Our theoretical model also suggests a positive correlation between the number of granted options and the extent of earnings management and insider trading in vesting years.

Our empirical results support the predictions regarding the effects of the moneyness of the options and the effect of high stock prices on both earnings management and insider trading during vesting years. Moreover, we find a positive but weaker relation between the number of granted options and measures of both earnings management and insider trading during vesting years.

Overall, our timing approach enables us to suggest a causality between the attributes of option grants and the extent of earnings management and insider trading during the vesting years of these grants. Larger option grants with lower strike prices will be followed by high levels of earnings management and insider trading during vesting years, especially after periods of high stock returns.

Our results suggest a life cycle of earnings management: Managers lower earnings and better the grant conditions during the years when more ESOs are granted. In vesting years, they manage earnings upward to boost the stock price and to pocket more profits through insider trading.

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Appendix A. Proofs

Proof of Proposition 1. For $x \leq K$ we have $\rho(x) = x$ and

$$u^M(x, x) = 0. \tag{A.1}$$

For $x > K$ we have

$$u^M(x, x^R) = \alpha(\varphi(x^R) - K) - \beta(x^R - x)^2. \tag{A.2}$$

The first-order condition with respect to x^R renders

$$\frac{d}{dx^R}\varphi(x^R) - \frac{2\beta}{\alpha}x^R + \frac{2\beta}{\alpha}x = 0. \tag{A.3}$$

Since in equilibrium $x = \varphi(x^R)$, we obtain the following linear, first-order differential equation for an equilibrium

$$\frac{d}{dx^R}\varphi(x^R) = -\frac{2\beta}{\alpha}\varphi(x^R) + \frac{2\beta}{\alpha}x^R. \tag{A.4}$$

All potential solutions of this equation are given by

$$\varphi(x^R) = x^R - \frac{\alpha}{2\beta} + Me^{-\frac{2x^R\beta}{\alpha}}, \tag{A.5}$$

where M is a constant.

The constant M is given by the boundary condition $\varphi(K) = K$. We then have

$$M = \frac{\alpha}{2\beta} e^{\frac{2K\beta}{\alpha}}, \tag{A.6}$$

and the separating equilibrium is given by

$$\varphi(x^R) = x^R - \frac{\alpha}{2\beta} + \frac{\alpha}{2\beta} e^{\frac{2\beta(K - x^R)}{\alpha}}, \tag{A.7}$$

as required.

Plugging (A.7) into (A.2), it is straightforward to verify that the utility of the manager is concave in x^R; i.e.,

$$\frac{d^2}{dx^{R2}} u^M(x, x^R) = 2\beta(e^{\frac{2\beta(K - x^R)}{\alpha}} - 1) < 0, \tag{A.8}$$

for any $x^R > K$. Therefore, the first-order condition is sufficient for a global maximum.

For $x \leq K$, $\rho(x) = x$. Thus, the reporting strategy $\rho(x)$ strictly increases in x. For $x > K$, denote $y = y(x) \equiv \frac{2\beta(K-\rho(x))}{\alpha}$ for notational convenience. Since $-\infty < K - \rho(x) < 0$, we have $0 < e^y < 1$. Implicit differentiation then yields

$$\frac{\partial \rho(x)}{\partial x} = \frac{1}{1 - e^y} > 0. \tag{A.9}$$

Q.E.D.

Proof of Corollary 1. Recall that the reporting strategy $\rho(x)$ satisfies the implicit function (2). As in the proof of Proposition 1, we denote $y = y(x) \equiv \frac{2\beta(K-\rho(x))}{\alpha}$ for $x > K$. We have $-\infty < y < 0$ and thus $0 < e^y < 1$. Additionally, because $\rho(x)$ increases in x by (A.9), y decreases in x. Implicit differentiation yields:

$$\begin{aligned} \frac{\partial \rho(x)}{\partial K} &= -\frac{e^y}{1 - e^y} \\ \frac{\partial(\rho(x) - x)}{\partial x} &= \frac{e^y}{1 - e^y} \\ \frac{\partial \rho(x)}{\partial \alpha} &= \frac{1}{2\beta} \frac{1 - e^y + ye^y}{1 - e^y}. \end{aligned} \tag{A.10}$$

Because $0 < e^y < 1$, we have $\frac{\partial \rho(x)}{\partial K} < 0$ and $\frac{\partial(\rho(x)-x)}{\partial x} > 0$. Notice that $\frac{1-e^y+ye^y}{1-e^y}$ decreases in y, and hence increases in x for $x > K$. Moreover, as $y \to 0$ ($x \to K$), the limit of this expression is 0 (using L'Hospital's Rule). Thus, for any $y < 0$, we have $\frac{1-e^y+ye^y}{1-e^y} > 0$. Therefore, we have $\frac{\partial \rho(x)}{\partial \alpha} > 0$. Q.E.D.

Appendix B. Extensions — Earnings Management Damages Firm Value Directly

In reality, earnings management is costly to the firm as well as to the manager. For instance, to boost sales at the end of a quarter, the manager may reduce prices to an extent that damages firm value in the long run. Incorporating the damage of earnings management to firm value, investors maximize the intrinsic value of the firm when designing the ESO contract.

To incorporate the direct damage to the firm, we write the third stage payoff for the manager who observes x and reports x^R as

$$u^M(x, x^R) = \alpha \max\{\varphi(x^R) - \gamma(x^R - x)^2 - K, 0\} - \beta(x^R - x)^2, \qquad \text{(B.1)}$$

where $\gamma \geq 0$ measures the severity of the damage of earnings management to firm value. The stock price is then given by $\varphi(x^R) - \gamma(x^R - x)^2$. In (B.1), the first term is the total value of the stock options, while the second term is the direct cost of earnings management to the manager.

All the results in the second and third stages sustain with this new formulation replacing β with $\alpha\gamma + \beta$. Intuitively, the unit cost of earnings management to the manager is the sum of the direct cost to the manager β and the reduction in the manager's option value due to the damage to firm value $\alpha\gamma$.

Proposition 3. *There is a unique separating equilibrium in the reporting stage given by*

$$\begin{aligned}\varphi(x^R) &= \rho^{-1}(x^R) \\ &= \begin{cases} x^R & \text{if } x^R \leq K; \\ x^R - \dfrac{\alpha}{2(\alpha\gamma + \beta)} + \dfrac{\alpha}{2(\alpha\gamma + \beta)} e^{\frac{2(\alpha\gamma+\beta)(K - x^R)}{\alpha}} & \text{if } x^R > K. \end{cases}\end{aligned} \qquad \text{(B.2)}$$

The equilibrium reporting function $\rho(x)$ strictly increases in x for all $x \geq 0$.

Proposition 1 is a special case of Proposition 3 when $\gamma = 0$. We have the following comparative statics.

Corollary 3. *Earnings management is positive only if the stock price at the vesting date exceeds the strike price. In this case, earnings management is decreasing in the strike price, increasing in the stock price (hence increasing in moneyness), increasing in the number of granted options, decreasing in the stringency of the accounting standards, and decreasing in the severity of the direct damage to the firm.*

Proof. The proof is similar to the proof of Corollary 1, we omit it.

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