Rescission of Executive Stock Options: Theory and Evidence*

Jerry T. Yang [b, †] and Willard T. Carleton [a]

[a] *Department of Finance, University of Arizona, Tucson, AZ 85721-0108, USA*

[b] *Department of Quantitative Finance, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

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Abstract

We examine the ex-ante optimality of rescission of executive stock options while considering the tax effects of new accounting rules associated with this controversial practice. There has been little research conducted on rescission, which was not an issue until 2000 when the stock market plummeted. Rescission may be the least favorable practice from shareholders' ex-post viewpoint. Shareholders, however, will be almost always better off in terms of expected initial payoffs under rescission than under the do-nothing policy if he or she takes the tax benefit and cash flows resulting from the option exercises into account and designs the initial option contract accordingly. The theoretical predictions of our paper shed some light on this contentious practice and empirical evidences verify the rise and fall of rescission.

JEL Classifications: G30; G32; G34; G38; J33; L14

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† Corresponding author: Tel.: 886-3-574-2418; Fax: 886-3-571-5403; jtyang@mx.nthu.edu.tw (J. Yang)

1. Introduction

From an ex-ante contacting viewpoint, we answer the following research questions: (1) To rescind or not to rescind? (2) Can we justify the occurrence of rescission, which was not an issue until 2000 when the stock market plummeted? (3) Do the new accounting (variable) charges that took effect in July 2000 put an end to rescission? and (4) Will the principal (or shareholders) select an initial option-based incentive contract to maximize his/her expected initial payoff in a situation where rescission of the agent's (or the manager's) stock options is possible?

We modify the model of Acharya, John, and Sundaram (2000) (AJS, hereafter) to examine the ex-ante optimality of rescission of executive stock options (ESOs) while considering dilution effects and the tax effects of new accounting rules associated with rescission. This controversial practice allows employees to cancel already-exercised options when share prices fall. Essentially, this practice allows companies to buy back the shares resulting from previous option exercises at original strike prices which are higher than current market values. This tax-motivated strategy is designed to rescue employees who, because of subsequent stock price declines, would not realize sufficient proceeds from selling stock after exercising options to pay the resulting taxes. In rescission, previous option exercises that resulted in purchases of stock whose price has plummeted are canceled and replacement options issued within the same tax year. Loosely speaking, the rescission treats the previous exercise as if it had never occurred for income tax purposes, so as to eliminate employee tax liabilities incurred from unrealized capital gains earlier in the year when stock prices were high.

AJS study the ex-ante optimality of repricing ESOs without considering dilution effects and the tax effects of new accounting rules. We not only incorporate those effects in our two-period model but also analyze their influence on the agent's action in determining the likelihood of firm value in the subsequent period, and on the probability of already-exercised options being rescinded. The new accounting rules associated with rescission took effect in July 2000 and were retroactive to December 15, 1998. As a result, we employ, for both principal and agent, terminal payoff structures different from those in AJS. Finally, the strategy of rescission was not considered in AJS.

In addition to answering the research questions mentioned at the beginning of this section, our paper also provides analytical answers to the following empirical questions: (1) What is the estimated agency cost if the agent is compensated with stock options only and rescission is allowed? (2) Do executive stock options with rescission feature embedded encourage risk-taking actions? (3) Is this a "Heads, I Win; Tails, You Lose" Game? Section 6 elucidates the questions mentioned above and discusses our findings.

Given an exuberant stock market in most of the 1990's, ESOs benefited each party involved. For employees, the goal is to profit from the in-the-money options, which is likely to occur when stock prices are high. For companies, not only do they pay smaller salaries and cash bonuses, but they also get a tax deduction on nonqualified stock options (NQSOs) when employees exercise their options. According to TIAA-CREF, 162 large companies that reported option-related tax deductions in 1999 reported a total of $15.3 billion in option-related tax savings.[1] As a result, however, the inflated earnings resulting from the tax benefits mentioned above should not be expected as the market 'turns south'. As for shareholders, while their earnings per share were diluted, they may have profited from high stock prices because of improved performance by highly motivated employees.

[1] Cited in "Options Overdose", June 4, 2001, Wall Street Journal, page C1.

ESOs, however, are undergoing scrutiny in a period of fallen share prices and the pressure on the market for proven executives. The key task facing corporations is to devise innovative approaches to retaining as well as attracting key talent, in order to achieve the ultimate goal of creating real shareholder value in a fair manner. On one hand, to boost executives' morale, employers try to salvage underwater options while avoiding a variable charge to earnings under the new accounting rules.[2] On the other hand, shareholders have legitimate concerns about potential dilution and question why they even reward executives' poor performance by rescinding already-exercised options and at shareholders' expense. Meanwhile, regulatory agencies such as the Securities and Exchange Commission (SEC) and the Financial Accounting Standards Board (FASB) will continue to be pressed by investor groups to require clearer and more uniform proxy disclosure of equity compensation arrangements. The main focus of this paper is to assess the ex-ante optimality of a rescuing strategy (rescission) in protecting shareholders' interests while facing the challenge of invigorating executive morale deflated as a result of plunging stock prices.

There has been little empirical or analytical research conducted on rescission, which was not an issue until 2000 when the stock market plummeted. Soon after SEC issued the final Staff Announcement No. D-93 in February 2001,[3] rescission almost disappeared in 2001 as quickly as it started in 2000.[4] It is not known just how common the rescission practice was in 2000, but it

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[2] Taking effect in July 2000, the accounting rules imposed by the Financial Accounting Standards Board (FASB) force companies to take a variable charge to earnings for repriced options. This means companies must mark-to-market all repriced options in each quarterly earnings report. See details in Section 2.1.

[3] The SEC Staff Announcement Topic No. D-93, "Accounting for the Rescission of the Exercise of Employee Stock Options" was issued in February 2001. This accounting guidance for rescission specifies the disclosures the SEC staff expects for these transactions and requires that variable accounting be followed for any 2001 rescission.

[4] The Investor Responsibility Research Center (IRRC), a source of independent research on corporate governance, proxy voting and corporate responsibility issues, reports that all option exercise rescissions occurred in 2000. Among the rescissions that took place in 2000, there were only four cases disclosed in the 2001 proxy statements issued by companies in IRRC's research universe of approximately 4,000 companies.

has generated considerable controversy about the use of ESOs. Neither is it clear whether rescission will recur when the next "bubble economy" (like the one at the end of 1990's) happens. The theoretical predictions of our paper shed some light on this controversial practice by showing that given the new accounting rulings, rescission can still be an important and value-enhancing strategy from an ex-ante standpoint.

The rest of this paper is organized as follows. Section 2 describes empirical data and the accounting rules associated with rescission. In Section 3, we introduce the model of AJS. Their benchmark strategy, pre-commitment (or do-nothing in our paper) is discussed in Section 3. In Section 4, the dynamic optimality of rescission is evaluated separately while considering the new accounting rulings and the dilution effect. Section 5 summarizes the results and provides static comparisons given a certain set of state variables. Section 6 discusses estimated agency costs if the agent is compensated only with stock options and answers the questions mentioned in Section 2. Section 7 concludes.

2. Empirical Data and Accounting Rules

2.1 Empirical Data

We conduct a keyword search on Nasdaq-listed companies that reported rescission actions in proxy statements from 2000 to 2002. We first categorize Nasdaq-listed firms into four groups in terms of market capitalization. In each group, we search key words regarding rescission. Panel A shows that there were 24 firms that mentioned rescission in proxy statements in 2000 but the number of firms with rescission messages decreased after 2000. There were 17 firms in 2001 and none in 2002. Totally, our rescission sample consists of 41 Nasdaq-listed firms during 2000 and 2002 although none of them are in the category of over $5 billion, neither in 2002.

Panel A

Year	Market Cap (in millions)				Total
	5 ~ 100	100 ~ 1,000	1,000 ~ 5,000	over 5,000	
2000	14	7	3	0	24
2001	15	2	0	0	17

Panel B (in millions)

Year	# Firms	Mean	Median	S.D.	Maximum
2000	24	481.13	44.00	1,072.29	4,616.30
2001	17	48.42	33.40	56.51	223.40

Panel B shows that the average market capitalization of sample firms in 2000 is $481.13 million, the median is $44.00 million, and the maximum is worth $4,616.30 million. In the sample of Year 2001, the average market cap is $48.42 million, the median is $33.40 million, and the maximum is $223.40 million. The standard deviations of market cap are $1,072.29 million and $56.51 million for Years 2000 and 2001, respectively.

2.2 Accounting Rules

According to the final SEC Staff Announcement No. D-93, if rescission occurs within the same tax year and prior to December 31, 2000, employees, especially top executives, can avoid the tax liability resulting from the exercise of their stock options.[5] Furthermore, in some cases, the loans that companies made to executives so they could buy the stock are also being forgiven. Meanwhile, employers only record an additional compensation expense equal to the tax saving that the companies had foregone in the same year as a result of the rescission. In other words, the compensation cost is recognized only for the forgone tax benefit at the rescission date, but not for future increases in intrinsic value after that date.

In January 2001, the SEC staff provided the following example of a rescission transaction:[6]

> An employee has 1,000 nonqualified vested stock options exercisable at $5 per share. The employee exercises those options when the stock has a quoted market price of $50 per share. The exercise generates a tax liability to the individual of $15,000 and a tax benefit for the company of $15,000,[7] which the company records as a deferred tax asset or a reduction in current taxes payable. The stock issued to the employee is reflected in the financial statements as issued and fully paid-for shares. The employee does not sell the acquired shares.
>
> Later, but within the same tax year, the quoted market price of the underlying stock declines to $8 per share. At that time, the board of directors and the employee agree to "rescind" the exercise of the options. The company then issues 1,000 options with an exercise price of $5 per share and the same terms as the options originally exercised. In addition, the company returns to the employee the $5,000 exercise price previously paid, the employee returns to the company any dividends received during the period the shares were outstanding, and the employee returns to the company the 1,000 shares held since they were issued upon the earlier exercise of the options.

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[5] See footnote # 5.

[6] See the SEC Staff Announcement Topic No. D-93, dated January 17-18, 2001.

For income tax purposes, both the company and the employee assert that the exercise and the subsequent rescission within the same tax year are treated as if neither had occurred. Therefore, the employee no longer owes any tax and the company has no tax benefit.

After January 1, 2001, the reinstated stock options are subject to "variable award" accounting treatment, thus requiring estimated compensation expenses. The rationale is that the rescission, in essence, grants employees a “put” to the company at a stock price that could be at other than “fair value.” Such a repurchase feature results in variable award accounting until the exercise or expiration of the repurchase feature.[8] Put differently, the "marked-to-market" variable accounting means that the company must record an expense each quarter representing the current difference between the option price ($5 in the example mentioned above) and the market price of the shares, which could result in a substantial accounting charge. The process goes on until the options are no longer in effect, either because they have been exercised, have lapsed, or are forfeited.

Finally, the terms of the rescission must be reflected in the earnings-per-share report and included in the statement of changes of stockholder equity.[9] For instance, if a company enters into a rescission transaction similar to the example above, its basic EPS computation should reflect the dilution effect of the option exercise until it is rescinded.

Although the rescission practice has generated considerable controversy about whether it is just another way to eliminate the risk associated with options, it is not clear whether the practice's impact resulting from valuable tax deductions is economically significant. In retrospect,

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[7] SEC assumes that both the employee and the company have 33 percent tax rates.

[8] FASB Interpretation No. 44 dated May 1, 2000 and EITF Issue No. 00-23.

it would be interesting to know if the tax benefit to firms when their employees exercise options in a booming market contributes significantly to inflated earnings. On the other hand, it is not known just how common rescission has become since 1999 but it is predicted that companies may be very reluctant to adopt rescission after January 2001 because of the variable accounting charge. In any case, the SEC's guidance is apparently at odds with FASB staff recommendations, and FASB has not yet issued any guidance of its own on the subject other than to release the SEC guidance.[10]

3. The Model

We construct our model based upon the framework proposed by AJS. We analyze the dynamic optimality of rescuing underwater stock options from the viewpoints of both shareholders (called the "principal", collectively) and managers (called the "agent", collectively). The objective for the principal is to choose an initial option-based incentive contract to maximize his/her expected payoff in a situation where rescission of the agent's stock options is possible.

The agent needs to choose an optimal level of effort (or action) to maximize his/her expected terminal payoffs. Anticipating the agent's action, the principal selects an optimal initial option contract (in terms of the number of shares on the underlying stock) to maximize his/her expected initial payoffs given the agent's expected action and payoffs. The probabilistic distribution for the firm value depends on the agent's effort (denoted as a) as well as external factors (denoted as m) of which the agent has no control.

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[9] The disclosure must be in accordance with generally accepted accounting principles, such as FASB Statements 123 (Accounting for Stock-Based Compensation) and FAS 128 (Earnings per Share).

[10] On February 1, 2001, the Financial Accounting Standards Board (FASB) released accounting guidance from the SEC.

We also acknowledge that the only economic impact of new accounting rulings associated with rescission is through the cash flows resulting from taxation. In other words, new accounting charges *per se* have no impact on the firm's terminal value until taxes are imposed as a result of asset liquidation at the terminal date. We assume all payoffs are received at the terminal date t = 2 in our two-period model. The dilution effect of option exercises is also examined. Note that the agent's action can influence the likelihood of firm value being higher in the subsequent period

There is no information asymmetry: the expected terminal payoff structure and all probability distributions are common knowledge. Put differently, we analyze an ex-ante optimal option-based incentive contract offered by the principal and the best response from the agent after the probability of rescission of the agent's options is taken into account.

The probability of underwater options being repriced (denoted as $\pi \in [0,1]$) is assumed to be exogenously determined and both the principal and the agent know this probability distribution.[11] For example, we will discuss in section 6 the ex-ante optimal option-based incentive contract offered by the principal if the probability of repricing is a function of the degree to which existing options are under water. Since Brenner, Sundaram and Yermack (2000) report that repricing is followed by a 40% drop, on average, in the strike price, it is interesting to investigate if there exists, from an ex-ante viewpoint, a threshold level of out-of-the-moneyness that optimally triggers repricings.

We also put emphasis on the influence of the agent's action, or efforts, in determining the likelihood of firm value in the subsequent period. The motivation for this emphasis is that defenders of repricing argue that poor performance prior to repricing is driven by external factors

[11] The probability of underwater options being repriced can be associated with firm characteristics, stock market conditions, and appropriate measures of board independence. An empirical test of repricing determinants would be an interesting exercise but is outside of the scope of this paper.

beyond the agent's control. To justify this argument, we will examine the influence of the agent's action or effort level, along with external factors, on the likelihood of having higher future firm value.

3.1 Two-period Dynamic Model

We extend the model proposed by AJS to incorporate the economic impacts of the new accounting rulings associated with repricing and rescission. AJS find that *some* repricings are almost always optimal for the principal based on higher expected initial payoffs, even from an ex-ante standpoint. That conclusion is made without considering tax implications of new accounting rulings associated with direct repricings, which became effective after December 1998. As a result of these tax impacts and shareholder activism, the traditional repricing in which the exercise price is lowered to then-current market value has been losing its dominance as a solution to rescuing underwater options since 1998.[12] One goal we try to accomplish here is to rationalize the repricing phenomenon and justify the decision-making process of rescission.

It is helpful to refer to Figure 1 while going through our model description below. We assume that both the manager (the "agent") and the owners (the "principal") are risk-neutral. In the two-period model of firm value with dates indexed by t = 0, 1, 2, all payoffs are assumed to be received at the terminal date t = 2.[13] The terminal payoffs for each party at each state of economy are common knowledge. The repricing, if any, will occur at t = 1, and no layoff and bankruptcy will occur throughout these two periods. We further assume that all discount rates

[12] While direct repricing is diminishing as a remedy for underwater options, alternatives to direct repricing have gained in popularity over time. See Yang and Carleton (2002) for detailed analysis.

[13] In an event of rescission, the payoff from exercising in-the-money options can occur at the interim date t = 1 and later on the already-exercised option can be rescinded at t = 2. To simplify the notation, we assume all payoffs are received at the terminal date t = 2.

are zeros to simplify the notation. Our intention is to capture the impacts of the agent's expected actions and the possible repricing in the interim period, including the continuation effect and feedback effect. The (positive) continuation effect results from higher level of effort by the motivated agent in the subsequent period and therefore generates higher terminal payoffs. On the other hand, the (negative) feedback effect is caused by lack of effort from the agent in the initial period because of the anticipation of repricing.

Therefore, our model in essence is a one-period model with an interim period in which possible occurrence of repricing or rescission is anticipated by both parties. In other words, the agent will choose an action (or effort level) in the interim period conditional on whether firm value increases (denoted as H state in Figure 1) or decreases (denoted as L state) from the initial stage to maximize his/her expected terminal payoff. Similarly, the agent selects an initial action at t = 0 to maximize his/her expected payoff in the interim period. Given the expected optimal response from the agent, the principal then chooses to offer, at time 0, $\alpha \in (0, 1]$ options on the firm's terminal value to maximize his/her own expected terminal payoff. Note that if the agent exercises in-the-money options at t = 2, the number of outstanding shares is $(1+ \alpha)$.

Figure 1 illustrates the binomial structure of the model. At the beginning stage I, the principal hires an agent to run the firm whose only share's initial value is normalized to unity. The firm's value at t = 1 can be either H or L with probabilities $P(H) = q\, m + (1\text{-}q)\, a = 1 - P(L)$, where $H = 1 + u$, $L = 1 - u$, and $u \in (0,1)$. The action (or effort level) $a \in [0, 1]$ is taken by the agent at node I. The parameters, m and $q \in [0, 1]$, can be interpreted as the influence of external factors and the extent to which the agent's action may influence the likelihood of firm value in the subsequent period, respectively.

Through the optimization process described above, the expected optimal level of action chosen by the agent (a*) is known to the principal at the initial stage I. To keep our focus on the issues motivating this paper, we assume that m and q are common knowledge between the principal and the agent: they have the same expectation about m and q. In other words, firm value at the end of each period is jointly determined by external factors (m) of which the agent has no control and the agent's action (a) with probabilities of q and (1-q), respectively. Furthermore, if everything else remains constant, the lower the q is, the more control the agent has. Meanwhile, we define p(H) as above to emphasize the fact that the principal and the agent only observe the signals {H or L} without knowing the exact underlying cause. Based on the common expectations about m and q, the principal and the agent make their decisions accordingly. One interesting question we try to answer is how or whether the agent's control (measured by (1-q)) over return distributions influence the decisions of granting initial incentive contract and of resetting the original contract.

Among three possible values at t = 2, HH = H^2, HL = LH, and LL = L^2, the fact that HL<1 by definition also accommodates the analysis when rescission is anticipated. Let $A = \{a_I, a_h, a_l\}$ be the agent's action vector. a_i is the action taken by the agent at node i, where $i \in$ {I, H, L}. Let $W = \{w_{hh}, w_{hl}, w_{lh}, w_{ll}\}$ be the agent's terminal payoffs. If rescission is not considered, W is the compensation profile anticipated by the agent[14] or the intrinsic option value assuming the agent is compensated with stock options only. Note that W is predetermined given the terminal firm value in each of final states. Let $F = \{f_{hh}, f_{hl}, f_{lh}, f_{ll}\}$ be the principal's expected value per share in each of the terminal states. Note that the number of outstanding shares may be

[14] As pointed out by AJS, the anticipated compensation profile at time 2 need not be the same as that offered by the principal at time 0 if a repricing at time 1 is expected by the agent.

greater than one if the agent exercises his/her options. If the firm commits to not repricing or rescinding the options regardless of the firm's terminal value, then

$$f_{hh} = \frac{\mathrm{HH} + \alpha + \pi_c \alpha\,[\mathrm{HH} - 1]}{1 + \alpha}, \text{ where } \pi_c \text{ is the corporate tax rate.} \tag{3.1}$$

$f_{hl} =$ HL

$f_{lh} =$ LH

$f_{ll} =$ LL

Note that the numerator on the right hand of equation (3.1) includes α (the price paid by the agent in exchange for additional α shares) and the tax benefit (= $\pi_c\alpha$ [HH-1]). For simplicity, we assume that only the tax benefit (or liability) resulting from the new accounting rulings has an economic impact on firm value. Personal taxes and other income taxes are ignored. Table 1 lists the principal's share values at the terminal date. Correspondingly, the agent's expected payoffs at the terminal date are

$$w_{hh} = \alpha\,(f_{hh} - 1) \qquad \text{and} \qquad w_{hl} = w_{lh} = w_{ll} = 0$$

since W is simply the intrinsic option value provided the agent is compensated only with stock options.

Table 2 lists the agent's expected terminal payoffs if α call options on firm's terminal value are granted at t = 0. Note that if a repricing at t = 1 is expected, the anticipated improvement of compensation profile may cause a negative feedback effect as far as incentives are concerned.

Not surprisingly, rescission does not change the agent's expected payoff profile at all if the "Do-nothing" column in Table 2 is compared with "Rescission" column or "Repricing" with

"Repricing + Rescission" column.[15] In addition, the reinstated options after rescission are worthless because we assume that all payoffs are received at the terminal date t = 2 and the options are out-the-money (since HL < 1).

3.2 The Agent's Best Response Problem

After the agent takes an action a, a public signal s $\in$ {H, L} is observed. After observing the signal, the agent chooses either a_h or a_l following signal H or L, respectively. Taking the action a in any period also results in a cost or disutility to the agent of $c\,(a) = \frac{1}{2}ka^2$, where k $\in$ (0,1). The assumed quadratic cost function emphasizes increasing marginal costs for the risk-neutral agent.

Given W and $A=\{a\ ,\ a_h\ ,\ a_l\}$, the agent's expected payoff at node H, denoted as U_h, is given by

$$U_h = \mathrm{p(H)}w_{hh} + \mathrm{p(L)}w_{hl} - c(a_h). \tag{3.2}$$

where p(H) = $qm + (1 - q)a_h$ = 1 - p(L) and H > 1 > L.

Similarly, the expected payoff at node L is denoted as

$$U_l = \mathrm{p(H)}w_{lh} + \mathrm{p(L)}w_{ll} - c(a_l). \tag{3.3}$$

Thus, the agent's expected initial payoff given W and A is

$$U(a, U_h, U_l) = \mathrm{p(H)}\,U_h + \mathrm{p(L)}\,U_l - c(a). \tag{3.4}$$

The agent's objective is to choose an optimal action set $A^* = \{a^*, a_h^*, a_l^*\}$ to respond to the anticipated offer W, which must satisfy:

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[15] The reason is that rescission, a tax-motivated strategy, is originally designed to rescue employees who would not have sufficient proceeds from selling the stock to pay the tax occurring after option exercise, because of subsequent stock price declines. In section 4.2, we will take into account the agent's personal taxes while analyzing the optimality of rescission.

$$a_h^* = arg \max_{a_h} U_h(a_h, w_{hh}, w_{hl}), \qquad a_l^* = arg \max_{a_l} U_l(a_l, w_{lh}, w_{ll})$$

If we let $U_h^* = U_h\ (a_h^*, w_{hh}, w_{hl})$ and $U_l^* = U_l\ (a_l^*, w_{lh}, w_{ll})$, the optimal initial action a^* is

$$a^* = \arg\max_a U(a, U_h^*, U_l^*)$$

3.3 The Principal's Choice of Incentive Contract

The main task for the principal is to choose a grant of α call options on the firm's terminal value at t = 0 to maximize his/her own initial expected payoff. Recall that we assume that the principal is risk-neutral and the principal-agent relationship will last the full two periods. If the principal grants the agent an initial compensation offer and commits to not altering the contract throughout the periods regardless of market conditions, the principal's expected payoff at node H, denoted as V_h, is given by

$$V_h = p(H)\, f_{hh} + p(L)\, f_{hl} \tag{3.5}$$

where $F = \{f_{hh}, f_{hl}, f_{lh}, f_{ll}\}$ is the principal's expected value per share in each of terminal states. Similarly, expected payoff at node L is denoted as V_l,

$$V_l = p(H)\, f_{lh} + p(L)\, f_{ll} \tag{3.6}$$

Thus, the principal's expected payoff at t = 0 is

$$V(\alpha, V_h, V_l) = p(H)\, V_h + p(L)\, V_l. \tag{3.7}$$

The principal's objective is to choose an initial grant, α^*, to maximize his/her expected payoff at t = 0, knowing the agent's compensation profile W and expected actions $A^* = \{a^*, a_h^*, a_l^*\}$.

Note that the probability (π) of underwater options being repriced at node L is assumed to be exogenously determined with both the principal and the agent having the same expectation about π. We will discuss in Section 6 the ex-ante optimal option-based incentive contract offered by the principal if π is a function of degree to which existing options are under water (measured by u). We let π be a function of the agent's action and examine an argument claimed by shareholder activists: repricing may not be a value-maximizing but a self-serving strategy by an executive-friendly board.

3.4 The Terminal Payoff Structure

Table 2 lists the agent's terminal payoffs $W = \{ w_{hh} , w_{hl} , w_{lh} , w_{ll} \}$ if initial α call options on firm's terminal value are granted. Note that HL = LH <1. This simplification enables us to focus on the discussion of rescission without qualitatively changing our results. We also assume that the options are granted at-the-money (hence the exercise price is unity) as the majority of firms have done in practice.[16] Except in rescission, W is simply the intrinsic option value provided the agent is compensated only with stock options. For instance, the agent expects $w_{lh} = \alpha (f_{lh}$ -L) if repricing occurs at node L. f_{hh} is the diluted share value and L is the share price paid by the agent. In rescission, however, W represents the agent's terminal payoffs from the acquired shares at node H or the unexercised options. For example, the agent expects $w_{hh} = \alpha (f_{hh} - 1)$ if the agent exercises the options at node H at a price of unity and at the end (t = 2) the acquired shares are worth f_{hh} each. On the other hand, if the principal rescinds the already-exercised options (or equivalently buys back the shares at a price of unity) at node HL, the agent expects $w_{hl} = 0$ because the rescission treats the previous exercise as if it had never occurred. Since HL<1, $w_{hl} = 0$ and f_{hl} = HL.

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[16] See Brenner, Sundaram, and Yermack (2000) for example.

Table 1

The principal's expected share values at the terminal date.

Scenarios	Do Nothing[1]	Repricing[2]	Rescission[3]	Repricing + Rescission
f_{hh}	$\frac{HH+\alpha+\pi_c\alpha[HH-1]}{1+\alpha}$	$\frac{HH+\alpha+\pi_c\alpha[HH-1]}{1+\alpha}$	$\frac{HH+\alpha+\pi_c\alpha[HH-1]}{1+\alpha}$	$\frac{HH+\alpha+\pi_c\alpha[HH-1]}{1+\alpha}$
f_{hl}	HL	HL	HL + $\pi_c\ \alpha$ (1- HL) [4]	HL + $\pi_c\ \alpha$ (1- HL)
f_{lh}	LH	$\frac{LH+\alpha\ L+B_R}{1+\alpha}$ *	LH	$\frac{LH+\alpha\ L+B_R}{1+\alpha}$
f_{ll}	LL	LL + $\pi_c\alpha$ [(1-L) + (LL-L)]	LL	LL + $\pi_c\alpha$ [(1-L) + (LL-L)]

* B_R (= $\pi_c\alpha$ [(1-L) + (LH-L)]) is the tax benefit resulting from the accounting charges associated with repricing, where π_c is the corporate tax rate.

1. Do-nothing occurs when the firm commits to not repricing or rescinding the options regardless of the firm's terminal value. Note that in this case the options are in-the-money only at node HH.

2. Repricing occurs at node L; reset the exercise price to L for all α options.

3. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume all payoffs are received at the terminal date t = 2.

4. Since the reinstated options after rescission are subject to variable accounting charges, the principal receives a tax benefit, $\pi_c\ \alpha$ (1- HL), at node HL.

Table 2

The agent's terminal payoffs if initial α call options on firm's terminal value are granted.

Scenarios	Do Nothing[1]	Repricing[2]	Rescission[3]	Repricing + Rescission
w_{hh}	$\alpha\,(f_{hh} - 1)$*	$\alpha\,(f_{hh} - 1)$	$\alpha\,(f_{hh} - 1)$	$\alpha\,(f_{hh} - 1)$
w_{hl}	0	0	0	0
w_{lh}	0	$\alpha\,(f_{lh} - \mathrm{L})$	0	$\alpha\,(f_{lh} - \mathrm{L})$
w_{ll}	0	0	0	0

* Note that personal taxes are ignored and that the options are granted at-the-money (hence the exercise price is unity).

1. Do-nothing occurs when the firm commits to not repricing or rescinding the options regardless of the firm's terminal value. Note that in this case the options are in-the-money only at node HH.

2. Repricing occurs at node L; reset the exercise price to L for all α options.

3. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume all payoffs are received at the terminal date t = 2 and personal taxes are ignored.

Table 1 lists the principal's expected share value at t = 2. In the case of repricing, for example, the principal's expected payoff (or share value) at node LH is

$$f_{lh} = \frac{HH+\alpha L+B_R}{1+\alpha}$$

Note that $B_R = \pi_c \alpha$ [(1-L) + (LH-L)]. α (1 - L) is the "fixed effect", deducted at node L since the firm will have to deduct the difference in value between the original stock options and the repriced options from its earnings when the repricing occurs. The "variable effect" (or "marking-to-market effect"), α (LH-L), is posted on the repriced options at node LH. Note that the corresponding variable charge at node LL, α (LL - L), is negative, reflecting the feature of marking-to-market.

In the case of rescission, since the reinstated options after rescission are subject to variable accounting charges, the principal receives a tax benefit, $\pi_c\ \alpha$ (1- HL), at node HL without improving the agent's expected terminal payoffs. However, we need to point out that our two-period model neither captures the continuation effect of rescission, if any, beyond the terminal date (t = 2) nor considers the costs of replacing the agent. We will discuss this consideration in Section 6.

3.5 Equilibrium under Do-nothing

First, we derive an equilibrium for our benchmark strategy, do-nothing, in which repricing and rescission of the initial award are ruled out. The principal grants the agent an initial compensation offer and commits to not altering the contract later regardless of market conditions. Since the majority of executive stock options are issued at-the-money (see Brenner, Sundaram, and Yermack (2000)), we will assume that any initial options awarded by the principal carry an exercise price of unity.

Under the do-nothing strategy, the agent's best responses $A(\alpha) = \{a, a_h, a_l\}$ are

$$\begin{cases} a_l = 0, \\ a_h(\alpha) = \min\{1, \alpha(1-q)(f_{hh} - 1)/k\}, \\ a(\alpha) = \min\{1, (1-q)\, U_h(\alpha) / k\} \end{cases} \tag{3.8}$$

where $$f_{hh} = \frac{\mathrm{HH} + \alpha + \pi_c \alpha [\mathrm{HH} - 1]}{1 + \alpha} \qquad (\pi_c\text{: corporate tax rate})$$

$$U_h(\alpha) = [\, p(a_h(\alpha))\,][\, \alpha (f_{hh} - 1)\,] - \frac{1}{2} k\, [a_h(\alpha)]^2$$

Proofs of the results are provided in the Appendix A.1.

The principal's expected payoffs at nodes H and L, are given by equations (3.5) and (3.6), respectively. Then the principal's expected initial payoff given W and $A(\alpha)$ is

$$V(\alpha, V_h, V_l) = p(a)\, V_h + [1 - p(a)]\, V_l \tag{3.9}$$

The principal's objective is to choose an initial grant, α^*, to maximize his/her initial expected payoff, given the agent's compensation profile W and expected actions $A(\alpha) = \{a, a_h, a_l\}$.

4. Equilibrium under Rescission

To keep our focus on underwater options, we assume that repricing only occurs when the options are out-of-the-money (e.g., at node L) with a probability of π. When repricing takes place, all existing options (α) are reset at a new exercise price of L, meaning the renewed options are issued at-the-money. In practice, repricing almost always occurs when options are under water; resetting the contracts when options are in the money is virtually non-existent. In the case of rescission, we assume the agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL with a probability of u. Recall that u indicates how deeply the options are under water at the end of Period 1 (for example, L = 1 - u and u $\in$ (0,1)). For simplicity, we assume all payoffs are received at the terminal date t = 2.

As a tax-motivated strategy, rescission is designed to rescue employees who would not have sufficient proceeds from selling the stock to pay the tax occurring after option exercise, because of subsequent stock price declines. Hence, we take personal tax into account while analyzing the optimality of rescission. For simplicity, we assume that the agent's personal tax rate is the same as the corporate tax rate (π_c).

The exercise at node H generates a tax liability to the agent of T = $\pi_c\alpha$ (H-1) and a tax benefit for the principal of same amount, which the company records as a deferred tax asset or a reduction in current taxes payable. The payoffs under rescission for the principal and the agent are listed in Tables 3 and 4, respectively. The dynamic optimization procedure for solving the principal's ex-ante contracting problem is analogous to the one under repricing. First, we use superscripts N and R to denote no-rescission and rescission, respectively. For instance, at node H, the agent needs to choose a_h to solve

$$\max_{a_h \in [0,1]} \{\pi U_h^R + (1-\pi) U_h^N\}$$

where
$$U_h^R = p(a_h)[\alpha f_{hh} - \alpha - \mathrm{T}] + (1-p(a_h))[\,0\,] - \frac{1}{2} k a_h^2 ,$$

$$U_h^N = p(a_h)[\alpha f_{hh} - \alpha - \mathrm{T}] + (1-p(a_h))[\,\alpha f_{hl} - \alpha - \mathrm{T}\,] - \frac{1}{2} k a_h^2 ,$$

$$p(a_h) = qm + (1-q)a_h , \qquad \mathrm{T} = \pi_c\alpha\,(\mathrm{H}-1) ,$$

$$f_{hh} = \frac{\mathrm{HH} + \alpha + \mathrm{T}}{1+\alpha}, \qquad \text{and} \qquad f_{hl} = \frac{\mathrm{HL} + \alpha + \mathrm{T}}{1+\alpha}. \tag{4.1}$$

This leads to the following solution

$$a_h(\alpha) = \begin{cases} min\{1, \frac{1-q}{k}[\alpha(f_{hh} - f_{hl}) + \pi(\alpha f_{hl} - \alpha - \mathrm{T})]\} & \text{if } \alpha > \pi(\alpha + \mathrm{T})/[f_{hh} - (1-\pi) f_{hl}] \\ 0 & \text{otherwise} \end{cases} \tag{4.2}$$

Thus, the agent's continuation payoff $U_h(\alpha)$ at node H is given by

$$U_h(\alpha) = [p(a_h(\alpha))][\alpha f_{hh} - \alpha - \mathrm{T}] + (1-\pi)[1- p(a_h(\alpha))][\alpha f_{hl} - \alpha - \mathrm{T}] - \frac{1}{2}k[a_h(\alpha)]^2 \tag{4.3}$$

Proofs of the results under rescission are provided in the Appendix A.2

.

Table 3

The agent's terminal payoffs if initial α call options are exercised at node H.

Scenarios	Do Nothing [1]	Rescission [2]
w_{hh}	$\alpha(f_{hh} - 1) - T$ [3]	$\alpha(f_{hh} - 1) - T$
w_{hl}	$\alpha(f_{hl} - 1) - T$	0
w_{lh}	0	0
w_{ll}	0	0

1. Do-nothing occurs when the firm commits to not rescinding the options regardless of the firm's terminal value. Note that in this case the options are in-the-money only at node HH.

2. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume all payoffs are received at the terminal date t = 2 and personal tax rate is the same as corporate tax rate.

3. Note that personal taxes are considered and the options are granted at-the-money (hence the exercise price is unity). $T = \pi_c \alpha (H-1)$ is the tax liability as a result of exercising options at node H. Note that T is also the tax benefit for the principal, which the company records as a deferred tax asset or a reduction in current taxes payable. f_{hh} is the expected share value at node HH, which is equal to $\frac{HH + \alpha + T}{1+\alpha}$. Similarly, $f_{hl} = \frac{HL + \alpha + T}{1+\alpha}$.

Table 4

The principal's net terminal payoffs if initial α call options are exercised at node H.

Nodes	Do Nothing	Rescission [1]
HH	f_{hh} [2]	f_{hh}
HL	f_{hl}	HL + π_c α (1- HL) [3]
LH	LH	LH
LL	LL	LL

1. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume all payoffs are received at the terminal date t = 2 and personal tax rate is the same as corporate tax rate.

2. Note that personal taxes are considered and the options are granted at-the-money (hence the exercise price is unity). $T = \pi_c\alpha$ (H-1) is the tax liability as a result of exercising options at node H. Note that T is also the tax benefit for the principal, which the company records as a deferred tax asset or a reduction in current taxes payable. f_{hh} is the expected share value at node HH, which is equal to $\frac{\mathrm{HH}+\alpha+\mathrm{T}}{1+\alpha}$. Similarly, $f_{hl} = \frac{\mathrm{HL}+\alpha+\mathrm{T}}{1+\alpha}$.

3. Since the reinstated options after rescission are subject to variable accounting charges, the principal receives a tax benefit, π_c α (1- HL), at node HL. Note that f_{hl} is greater than HL + π_c α (1- HL).

5. Results

In this section, we summarize the influence of the parameters of interest on the principal's expected initial payoff (V) in equilibrium and on the optimal initial option grant (α) under three strategies: do-nothing and rescission in subsections 5.1 and 5.2, respectively.

5.1 Do-nothing

Figures 2 and 3 summarize the influence, under the do-nothing strategy, of the parameters of interest on the principal's expected initial payoff (V) in equilibrium and on the optimal initial option grant (α). Recall that k is the cost parameter for the agent's cost function ($= \frac{1}{2} ka^2$) and the likelihood of higher firm value in next period is p(H) = $q\ m$ + (1-q) a. The parameter m represents the influence of external factors on p(H). The influence of the agent's action or effort level (a) on the likelihood of having higher future firm value is measured by (1 - q): *ceteris paribus*, the lower the q is, the more control the agent has.

5.1.1 The Cost Parameter for the Agent's Cost Function (*k*): Higher *k*, Lower *V*

Panels (A) and (B) in Figure 2 show the effect of the cost parameter for the agent's cost function on the principal's expected payoff (V) and on the optimal initial option grant (α). When k is low (for example, $k < 0.2$ in Panel (B)), V decreases and α increases as k increases. When $k > 0.2$, the principal is worse off in terms of expected initial payoffs as k increases while offering maximal amount of options ($\alpha = 1$). The reason is that high-cost agents give less effort at the initial stage and the high-value stage (H). Note that, at the low-value stage (L), no agents have any incentive to give any effort because their options are worthless anyway.

5.1.2 The Influence of External Factors (m): Higher m, Higher V

Panels (C) and (D) in Figure 2 show that given k, the principal will have a higher expected initial payoff for providing smaller amount of options if the agent's action has a larger impact (indicated by a smaller q) on the likelihood of being in the high-value state (H). In other words, the options are worth more to the agent if the probability of being in the high-value state is more likely influenced by the agent's action than by some external factors (measured by m). As for the influence of external factors, as indicated in Panel (C), V increases and α remains nearly constant ($\alpha \approx 1$) before decreasing as m increases. This means that if the firm's value is more likely to increase because of some external factors, the principal's expected payoff will increase without granting more options to induce the agent's effort.

5.1.3 The Influence of the Agent's Actions (q): Lower q, Higher V

Panel (E) in Figure 2 shows that the principal's expected payoff (V) decreases and the option grant (α) increases as q increases until a local minimum (or maximum) is reached for V (or α), respectively. The intuition is that if the agent expects that his/her effort is not as important as external factors (indicated by a higher q) in determining the likelihood of reaching a high-value state, p(H), more options are needed to provide the agent with incentives. Hence, the principal's expected payoff decreases as a result of dilution. This pattern will continue until q reaches the point where the benefit from the agent's efforts is less than the cost of inducing those efforts. Meanwhile, as q increases, the increasing contribution from external factors on p(H) improves the principal's welfare regardless of the agent's efforts. That is why there is a U-shaped pattern for the principal's expected payoff in Panels (E) and (G). However, if no external factors influence p(H), or p(H) is a function of the agent's effort only, one can see in Panel (F) that V monotonically decreases and α increases monotonically as q increases.

5.1.4 The Variability of Possible Outcomes (*u*): Higher *u*, Higher *V*

Figure 3 shows the relationship between the principal's optimal decision (α) and the variability of possible outcomes (u). Intuitively, Panels (A) and (B) illustrate that the principal will offer fewer (options) while expecting more initial payoff in a volatile environment in which options are more valuable or the potential upside reward provides enough incentives for the agent. Not surprisingly, if the cost (or disutility) of the agent's efforts is higher, the principal will offer more (options) while expecting less initial payoff, as we compare Panel (C) to (A) or Panel (D) to (B).

The spread between two possible outcomes (H or L) at the end of period 1 is $2u$ by assumption. *Ceteris paribus*, a higher u leads to a higher volatility of the firm's market value. Let σ^2 be the variance of the firm's market value at t = 1. A simple calculation shows that $\sigma^2 = 4u^2p(1-p)$, where $p = q\ m + (1-q)\ a$, is the probability of being a high-value state at t = 1. The maximal σ^2 is reached at $a = 0.5$ if m = 0.5 and $q = 0$ or $q = 0.5$.

In Panels (E) through (H), we see that the agent's optimal initial action (or effort level), a^* is an increasing function of u as we expect. Recall that a^* is chosen to maximize the agent's expected initial payoff. It turns out that under some conditions, a^* maximizes not only the agent's expected initial payoff but also the variance of the firm's market value at t = 1. For example, Panel (H) shows that the high-cost ($k = 0.3$) and influential ($q = 0$) agent will choose $a^* = 0.5$ when $u = 0.2$ to maximize his/her expected initial payoff while achieving maximal volatility of the firm's market value at t = 1. For a less influential agent (i.e., $q = 0.5$ as indicated in Panel (G)), it takes a wider spread between two possible outcomes to induce an a* which can maximize both the expected initial payoff and the volatility of firm value at t = 1 (e.g., $u \approx 0.4$ when $q = 0.5$ and $k = 0.3$ as in Panel (G)). More interestingly, if we combine Panels (B) and (F), we see that the principal's expected initial payoff increases as u increases with fewer options being offered and the agent's optimal initial effort remaining maximal ($a^* = 1$).

5.2 Rescission

Recall that as a tax-motivated strategy, rescission is not designed to provide or align incentives. Hence, rescission is not expected to influence the decision of granting an initial incentive contract. We use superscripts N and R to denote do-nothing and rescission, respectively. Figure 4 shows the influence of the parameters of interest on the difference of the principal's expected payoff (denoted as $V^{R\text{-}N}$) in equilibrium and on the difference of optimal initial option grant (denoted as $\alpha^{R\text{-}N}$) when rescission occurs at node HL with a probability equal to one. Again, from an ex ante standpoint, a positive (or negative) $V^{R\text{-}N}$ indicates that the principal will be better (or worse) off under the rescission strategy than under the do-nothing strategy.

Interestingly, both the principal and the agent in many cases are better off in terms of expected initial payoffs under rescission than under do-nothing regardless of the cost parameter (k), the influence of external factors (m), and the influence of the agent's actions (q). One explanation, based on Figure 4, is that the principal anticipates the tax benefits and positive cash flows resulting from option exercises at node H if no rescission occurs at node HL. Therefore, the principal will grant as many options as he or she can offer at the initial stage ($\alpha^{N} \approx 1$). As a result, we see little effect on the principal's initial incentive contract decision ($\alpha^{R\text{-}N} \approx 0$), a higher level of effort from the agent at the initial stage (higher a^*), and the negative feedback effect at stage H (lower a^*_h). On average, the agent will almost always be better off under a sure rescission policy in terms of expected initial payoffs than under do-nothing while the principal is indifferent.

5.2.1 The Cost Parameter for the Agent's Cost Function (k): Higher k, Higher V if q = 0

If rescission is considered a sure thing, Panels (A) and (B) in Figure 4 show the effect of the cost parameter for the agent's cost function on the principal's expected payoff and on the optimal initial option grant. As mentioned above, the optimal initial option grant does not change much because of rescission. The impact of the agent's cost parameter on the principal expected initial payoff depends on the agent's influence on the likelihood of being in the high-value state (measured by q). When $q = 0.5$ as in Figure 4: Panel (A), the principal is worse off under rescission than under do-nothing if $k \geq 0.25$. When the agent's action is the sole factor in determining the likelihood of being in the high-value state ($q = 0$ as in Panel (B)), the principal is better off under rescission than under do-nothing if $k \geq 0.25$. The question here is whether the effect of increased initial incentive outweighs the effect of the decreased incentive at stage H. If yes (no), the principal is better (worse) off. Then, the next question is how the parameters of interest, such as k and q, change the balance between these two effects. For instance, the principal will be better off under rescission if he or she hires a high-cost agent whose action is the sole factor in determining the likelihood of being in the high-value state.

5.2.2 The Influence of External Factors (*m*): Constant on α but Negative on *V*

Panel (C) in Figure 4 shows that given k = 0.1 and q = 0.5, the principal will offer the same amount of options and have higher expected initial payoffs under a sure rescission policy if m < 0.7. However, the difference in the principal's expected initial payoffs decreases as the influence of external factors (measured by m) increases. It is trivial that if the agent's action is the sole factor in determining the likelihood of being in the high-value state (H), for example q = 0 in Panel (D), the external factors make no difference between rescission and no-rescission.

5.2.3 The Influence of the Agent's Actions (*q*)

Recall that the lower the q is, the more control the agent has on the likelihood of reaching the high-value (H) state. The result based on Figure 4 is threefold. First, the agent's control (measured by q) over return distributions does not change the decision to grant the initial incentive contract except when q is too low (q = 0.1) or too high (q = 0.8) as indicated in Panel (E). Second, if $q \approx 0.8$ and rescission will occur at node HL for sure, the principal will offer fewer options initially while expecting same initial payoff. Third, if the agent exercises options at node H and rescission occurs at node HL, the principal will probably only hire an agent whose action has greater influence ($q \leq 0.7$) on the probability of reaching the high-value state (H) than do external factors (measured by m).

Panels (E) through (H) in Figure 4 show non-negative $V^{R\text{-}N}$'s, indicating that the principal is better off in terms of expected initial payoffs under rescission. If the principal hires a low-cost agent (i.e., k = 0.1 as indicated in Panels (E) and (F)), fewer options will be granted initially under rescission when q < 0.2. If a high-cost agent (i.e., k = 0.3 as indicated in Panels (G) and

(H)) is hired, the principal will offer the same amount of options as that under do-nothing. On average, the principal will be better off hiring a low-cost agent.

On the other hand, Panels (E) and (G) show that the difference of optimal initial option grant, $\alpha^{\text{R-N}}$, decreases first and then increases as q increases. If the agent's effort is not as important as external factors (i.e., $q > 0.7$) on determining the likelihood of being a high-value state, p(H), fewer options will be granted initially if rescission will occur at node HL for sure than if external factors are more important than the agent's effort.

The intuition is that the principal will offer more options to realize the tax benefits and positive cash flows resulting from option exercises at node H as assumed, before considering rescission. Our results show that the negative feedback effect caused by rescission is offset by the increased initial incentive only for the high-cost agent (high k) whose influence is relatively high ($q \leq 0.5$). In other words, the principal expects to induce a higher level of initial effort from the agent to offset the negative impact caused by rescission, a tax-motivated strategy, at stage H only if doing so is relatively cheap and worthwhile. Otherwise, the principal's expected payoff under rescission decreases as a result of increased incentive and lost tax benefit. This pattern will continue until q reaches the point where the agent's effort in determining the probability of reaching the high-value state (H) is as important as external factors (i.e., $q \leq 0.5$).

5.2.4 The Variability of Possible Outcomes (*u*)

Figure 5 shows the impact of the variability of possible outcomes (u) on the principal's optimal compensation decision (α) and on the principal's expected initial payoff (V) under rescission with a probability of unity. Panels (A) through (D) in Figure 5 are analogous to the corresponding panels in Figure 3. There is little difference between rescission and do-nothing in terms of the impact of the variability of possible outcomes, measured by u.

Panels (E) through (H) in Figure 5 show that the agent's optimal initial action (or effort level) under rescission, a^*, is less than or equal to that under do-nothing. Note that we take personal taxes into account and assume options will be exercised once stage H is reached while analyzing the case of rescission. Hence, it is not surprising to see that the agent will not give the highest level of optimal initial effort until the spread (u) between two possible outcomes is wider than under do-nothing.

6. Discussion

In this Section, we discuss the estimated agency costs if the agent is compensated only with stock options and we answer the questions raised in Section 2.

6.1 Agency Costs

We estimate the agency costs if the agent is compensated with stock options only. The agency cost is defined as the difference in expected initial payoffs between each principal-agent case with different strategy and the base case of sole-proprietorship.

Table 5 shows that the estimated agency cost is 3.16% in our one-principal-one-agent framework if the firm adopts do-nothing strategy with a probability of 0.2.[17] Table 5 also shows that the principal's expected initial payoff under rescission is 6.34% lower than that in the base case of sole-proprietorship. Note that, however, we assume in case of rescission that the agent

[17] In this particular case, we set u = 0.2, the corporate tax rate, $\pi_c = 0.34$, and the probability of repricing (or rescission) is set to be equal to u. Note that the likelihood of higher firm value in next period, $p(H) = q\,m + (1- q)\,a$.

exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. The decrease in the principal's expected initial payoff under rescission is mainly due to the decreased incentive at period 1 and the lost tax benefit. If both repricing and rescission are considered possible, the estimated agency cost is 6.13%.

One of our contributions in this paper is that our simple model can generate a range of estimated agency costs, depending on the influence of external factors (measured by m) and the influence of the agent's action (measured by q) on the probability of reaching high-value state (H). In addition, the estimated agency costs also depend on the cost parameter for the agent's cost function, the volatility of future firm value, and the likelihood of event occurrence (rescission). An empirical test or justification for agency cost estimates in cases of rescinding executive stock options would be an interesting exercise.

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m represents the influence of external factors on p(H). The influence of the agent's action (a) is measured by q. The cost parameter for the agent's cost function, k, is set to be 0.05.

Table 5

This table shows the estimated agency costs if the agent is compensated with stock options only. We set u = 0.2, the corporate tax rate, π_c = 0.34, and the probability of repricing (or rescission) is set to be equal to u. Note that the likelihood of higher firm value in next period, p(H) = q m + (1- q) a. m represents the influence of external factors on p(H). The influence of the agent's action (a) is measured by q. The cost parameter for the agent's cost function, k, is set to be 0.05.

Organization / Strategy	Mean Expected Payoff [5]	Estimated Agency Costs [6]	
Sole-proprietorship [1]	1.1789	0	+0.00%
Principal-Agent / Do-nothing [2]	1.1416	-0.0373	-3.16%
Principal-Agent / Repricing [3]	1.1443	-0.0346	-2.94%
Principal-Agent / Rescission [4]	1.1041*	-0.0747	-6.34%
Principal-Agent / Repricing+Rescission [5]	1.1066	-0.0723	-6.13%

1. We assume that the sole owner-manager has the same cost function (and cost parameter) as the agent in the principal-agent framework.
2. Do-nothing occurs when the firm commits to not rescinding the options regardless of the firm's terminal value. Note that in this case the options are in-the-money only at node HH.
3. Repricing occurs at node L; reset the exercise price to L for all α options.
4 The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume all payoffs are received at the terminal date t = 2 and the personal tax rate is the same as corporate tax rate.
5. The mean expected payoff is the principal's average expected initial payoff while integrating over the parameter space of {m, q}.
6. The agency cost is defined as the difference in expected initial payoffs between each principal-agent case with different strategy and the base case of sole-proprietorship.

* Note that personal taxes are considered under rescission and the options are granted at-the-money (hence the exercise price is unity). We assume that the agent's personal tax rate is the same as the corporate tax rate (π_c). Hence, $\pi_c\alpha$ (H-1) is the agent's tax liability as a result of exercising options at node H.

6.2 Do Executive Stock Options Encourage Risk-taking Actions?

Conventional wisdom suggests that executive stock options provide agents with incentives to take actions that increase firm risk since options increase in value with the volatility of the underlying stock. In section 5.1.4, we see that the agent's optimal initial action (or effort level), a^*, is an increasing function of the variability of possible outcomes (u) as we expect. Recall that a^* is chosen to maximize the agent's expected initial payoff. It turns out that under some conditions, a^* maximizes not only the agent's expected initial payoff but also the variance of the firm's market value at t = 1. For a less influential agent (higher q), it takes a wider spread between two possible outcomes to induce an a^* which can maximize both the expected initial payoff and the volatility of firm value at t = 1. More interestingly, our results show that the principal's expected initial payoff increases as u increases with fewer options being offered and the agent's optimal initial effort remaining constant.

Since the agent in our model is compensated solely with stock options, the above-mentioned finding suggests that under some conditions executive stock options do indeed encourage agent's risk-taking actions, even from an ex-ante viewpoint. Among others, Orphanides (1996) and Rajgopal and Shevlin (2002) provide empirical evidence on the relationship between stock option compensation and risk taking behavior. Our paper constructs an analytical framework and shows that given an option incentive contract, the agent will expect to take actions which maximize not only the agent's expected initial payoff but also the variance of the firm's market value in the next period as long as enough up-side reward is provided.

6.3 Do Accounting Charges Matter?

Yes. We compute average equilibrium payoffs under both do-nothing and repricing strategies but without incorporating the dilution effect and the tax effect associated with the new accounting rules. We use superscripts A and NA to denote accounting and no-accounting respectively. The following table shows that the principal's expected initial payoff under do-nothing (repricing) is overestimated by 24.27% (22.58%) if the dilution effect and the tax effect are not included in payoff structure. On the other hand, the initial option grant under do-nothing (repricing) is underestimated by 3.75% (11.70%). According to these results, we claim that the combined impact of the dilution effect and the tax effect on the principal's expected initial payoff and on the decision of initial option contract is economically significant.

Variables	**Do-nothing**	**Repricing**
	($\pi = 0$)	($\pi = 1$)
V^{A}	1.4258	1.4426
α^{A}	0.5995	0.6583
V^{NA}	1.7718	1.7683
α^{NA}	0.5770	0.5812

6.4 Can We Justify the Occurrence of Rescission?

Yes. The principal anticipates the tax benefits and positive cash flows resulting from option exercises at node H if no rescission occurs at node HL. Therefore, the principal will grant as many options as he or she can offer at the initial stage ($\alpha^{N} \approx 1$). As a result, we see little change on the principal's initial incentive contract decision ($\alpha^{R\text{-}N} \approx 0$), a higher level of effort from the agent at the initial stage (higher a^*), and the negative feedback effect at stage H (slightly lower a^*_h). Overall, Table 6 shows that both the principal and the agent will be better off under a sure rescission policy in terms of expected initial payoffs than under do-nothing, although the principal is statistically indifferent.

The above-mentioned results are intuitively consistent. First, rescission should have no influence on the decision to grant an initial incentive contract since rescission, a tax-motivated strategy, is not designed to provide or align incentives. Second, once the agent exercises options at node H, there is no incentive-alignment issue between the principal and the agent. As long as rescission is not guaranteed at the initial stage, the agent has sufficient incentives to avoid reaching stage HL because of the tax liability resulting from exercising options at node H. This means that the negative feedback effect can be mitigated by the uncertainty of rescission.

Table 6 describes average equilibrium payoffs under both do-nothing and rescission strategies. The averages are taken by integrating variables of interest over the parameter space, ($\{k, u, m, q\}$). We show that in Table 6 the agent under a sure rescission policy ($\pi = 1$) will offer a higher level of effort (a^*_0 increases from 0.3664 to 0.4065) at the initial stage. Once stage H is reached, the agent will give less effort (a^*_h decreases from 0.5887 to 0.5400) to reflect the negative feedback effect resulting from the anticipation of rescission at node HL. As expected, the agent is better off under a sure rescission policy in terms of expected initial payoffs (U increases by 14%, from 0.0712 under do-nothing to 0.0812 under a sure rescission policy).

Interestingly, the principal is also better off in terms of expected initial payoffs under rescission than under do-nothing (V increases by 4%, from 1.2918 under do-nothing to 1.3033 under a sure rescission policy). Section 5.3 also mentions another interesting policy implication: If there is a sure rescission policy in place, the principal will be better off under rescission if he or she hires a high-cost agent whose action is the sole factor in determining the likelihood of being in the high-value state.

6.5 Is this a "Heads, I Win; Tails, You Lose" Game?

The question here is if executives anticipate that both rescission and repricing may take place in the future, whether and how the firm and executives respond from an ex-ante viewpoint. More precisely, we examine if the agent will be better off under the combined strategy than under the rescission strategy alone ("Heads, I Win") and if the principal will be worse off under the combined strategy than under the repricing strategy alone ("Tails, You Lose").

Our results show in Table 7 that in order to enhance a positive continuation effect once node L is reached the principal will offer more options at the initial stage than he/she will if only rescission is considered possible. However, the agent will choose a lower level of initial effort than he/she will in case of rescission or repricing to reflect the negative feedback effects from both ends. The weighted average optimal level of effort at period 1 (a^*_1) under the combined strategy is in-between the ones under repricing and rescission alone. Consequently, from an ex-ante viewpoint, the agent will have a higher expected initial payoff (0.1036) than under rescission (0.0812). The 27.57% increase in the agent's expected initial payoff mainly results from accepting more initial options. On the other hand, the principal will have a lower expected initial payoff (1.3158) than under repricing (1.4426) because of the negative feedback effects from both ends. According to these results, we will argue that it is a "High (H), the agent wins; Low (L), the principal loses" game.

<u>Table 6</u>: Do-nothing vs. Rescission

This table describes average equilibrium payoffs under both do-nothing and rescission strategies. The averages are taken by integrating variables of interest over the parameter space, ({k, u, m, q}). π is the probability of rescission at node HL. a^*_0 is the agent's optimal initial action, on average, and a^*_1 is the weighted average optimal action at period 1. Standard errors are in the parentheses. Note that rescission is analyzed while considering the agent's personal taxes.

Variables	Do-nothing[1]	Rescission[2]			
	($\pi = 0$)	$\pi = 1$	$\pi = 0.5$	$\pi = 0.2$	$\pi = u$
V	**1.2918**	**1.3033**	1.2952	1.2925	1.2989
	(0.7957)	(0.7880)	(0.7932)	(0.7951)	(0.7912)
U	0.0712	**0.0812**	0.0749	0.0724	0.0779
	(0.1064)	(0.1135)	(0.1087)	(0.1071)	(0.1124)
α	0.6722	0.6313	0.6532	0.6643	0.6554
	(0.4022)	(0.4221)	(0.4126)	(0.4068)	(0.4119)
a^*_0	**0.3664**	**0.4065**	0.3797	0.3703	0.3881
	(0.4241)	(0.4255)	(0.4253)	(0.4245)	(0.4285)
a^*_1	0.3644	0.3637	0.3629	0.3634	0.3651
	(0.3919)	(0.3948)	(0.3937)	(0.3927)	(0.3940)
a^*_h	**0.5887**	**0.5400**	0.5668	0.5803	0.5679
	(0.4461)	(0.4426)	(0.4458)	(0.4460)	(0.4445)
a^*_l	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

1. Do-nothing occurs when the firm commits to not rescinding the options regardless of the firm's terminal value. Note that in this case the agent takes personal taxes into account and the options are in-the-money only at node HH.

2. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume that all payoffs are received at the terminal date t = 2 and the personal tax rate is the same as corporate tax rate.

Table 7: Do-nothing vs. Repricing and Rescission Combined

This table describes average equilibrium payoffs under both do-nothing and combined (repricing and rescission) strategies. The averages are taken by integrating variables of interest over the parameter space, ({k, u, m, q}). π is the probability of rescission at node HL. a^*_0 is the agent's optimal initial action, on average, and a^*_1 is the weighted average optimal action at period 1. Standard errors are in the parentheses. Unlike repricing, Rescission is analyzed while considering the agent's personal taxes.

Variables	Do-nothing[1]	Repricing + Rescission[2]			
	(π = 0)	π = 1	π = 0.5	π = 0.2	π = u
V	1.2918	**1.3158**	1.3070	1.2986	1.3138
	(0.7957)	(0.7568)	(0.7750)	(0.7873)	(0.7681)
U	0.0712	**0.1036**	0.0831	0.0751	0.0883
	(0.1064)	(0.1202)	(0.1103)	(0.1075)	(0.1178)
α	0.6722	**0.6831**	0.6793	0.6781	0.6799
	(0.4022)	(0.4076)	(0.4071)	(0.4046)	(0.4061)
a^*_0	0.3664	**0.3535**	0.3611	0.3647	0.3717
	(0.4241)	(0.4109)	(0.4198)	(0.4227)	(0.4214)
a^*_1	0.3644	**0.4446**	0.4044	0.3807	0.4002
	(0.3919)	(0.3924)	(0.3862)	(0.3885)	(0.3931)
a^*_h	0.5887	0.5421	0.5684	0.5811	0.5695
	(0.4461)	(0.4400)	(0.4445)	(0.4455)	(0.4431)
a^*_l	0.0000	0.2332	0.1159	0.0461	0.1147
	(0.0000)	(0.2479)	(0.1224)	(0.0480)	(0.1192)

1. Do-nothing occurs when the firm commits to not repricing and rescinding the options regardless of the firm's terminal value. Note that in the case of rescission the agent takes personal taxes into account and the options are in-the-money only at node HH.

2. Repricing will occur, if any, at node L; reset the exercise price to L for all α options. The agent exercises the options at node H and the principal rescinds the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL. To simplify the notation, we assume that all payoffs are received at the terminal date t = 2 and the personal tax rate is the same as corporate tax rate.

7. Conclusion

We examine the ex-ante optimality of rescission of executive stock options (ESOs) while considering dilution effects and the tax effects of new accounting rules associated with rescission. We find that under some conditions, ESOs with rescission feature embedded do indeed encourage the agent's risk-taking actions, even from an ex-ante viewpoint. Although an increasing body of literature empirically tests this hypothesis, our paper sheds some light on this issue from an analytical ex-ante contracting viewpoint. We show that given an option incentive contract, the agent, under some conditions, will expect to take actions which maximize not only the agent's expected initial payoff but also the variance of the firm's market value in the subsequent period. This result is consistent with the intuitive understanding of the convex payoff structure of executive stock options.

Rescission may be the least favorable practice from the principal's ex-post viewpoint. The principal, however, will be almost always better off in terms of expected initial payoffs under rescission than under the do-nothing policy if he or she takes the tax benefit and cash flows resulting from the option exercises into account and designs the initial option contract accordingly. Put differently, the presumed negative effect on the agent's incentive at period 1 may be outweighed by the deliberate initial contract and the potential cash inflow and tax benefit resulting from the agent's exercise of existing options at node H. Hence, rescission may be, from an ex-post viewpoint, a business practice in which firms bail out the executives at shareholders' expense. Rescission can still be an important and value-enhancing strategy from an ex-ante standpoint.

Appendix A

Equilibrium under the Strategies Indicated

We follow the proofs in the Appendix A of Acharya, John, and Sundaram (2000) (hereafter AJS). One key difference is that we assume $p(\mathrm{H}) = p(a) = q\, m + (1- q\,)a$ instead of $p(\mathrm{H}) = p(a) = a$, where m, a, and $q \in [0,1]$. Another difference is in the terminal payoff structures for both principal and agent because of the dilution effect and the tax effect of new accounting rules associated with repricing. Those rules took effect in June 2000 and retroactive to December 15, 1998. The strategy of rescission is not considered by AJS. The payoff structures for each strategy under consideration are listed in Table 1 through Table 4.

A.1. Equilibrium under Do-nothing

Let α be the number of call options (each with a strike of unity) awarded to the agent at time 0. The terminal payoff structures for both principal and agent are listed in Table 1 and Table 2, respectively. Contingent upon reaching the node H, the agent solves

$$\max_{a_h \in [0,1]} \{ p(H)(\alpha(f_{hh} - 1)) + p(L)0 - \frac{1}{2} k a_h^2 \}$$

where $p(\mathrm{H}) = p(a_h) = qm + (1- q\,)\, a_h = 1- p(\mathrm{L})$, and

$$f_{hh} = \frac{\mathrm{HH} + \alpha + \pi_c \alpha [\mathrm{HH} - 1]}{1+\alpha} \qquad (\pi_c\text{: corporate tax rate})$$

This has the solution

$$a_h(\alpha) = \begin{cases} \alpha(1\text{-}q)(f_{hh}\text{-}1)/k & \text{if } \alpha < k/[(1\text{-}q)(f_{hh}\text{-}1)] \\ 1 & \text{otherwise} \end{cases} \tag{A1}$$

Thus, the agent's and principal's continuation payoffs $U_{\text{h}}(\alpha)$ and $V_{\text{h}}(\alpha)$ from the node H are given by

$$U_h(\alpha) = [p(a_h(\alpha))][\alpha(f_{hh} - 1)] - \frac{1}{2}k[a_h(\alpha)]^2 \tag{A2}$$

and
$$V_h(\alpha) = [p(a_h(\alpha))]\, f_{hh} + [1 - p(a_h(\alpha))]\, f_{hl}. \tag{A3}$$

At node L, the options are guaranteed to finish out of the money, so we have $a_l = U_l = 0$ and

$$V_l = (qm)\, f_{lh} + (1 - qm)\, f_{ll}.$$

At the initial node, now, the agent solves

$$\max_{a \in [0,1]} \{ p(a) U_h(\alpha) - \frac{1}{2} k a^2 \}$$

where $p(a) = qm + (1 - q)\, a = 1 - p(\text{L})$.

Hence, the optimal initial action for the agent is

$$a(\alpha) = \begin{cases} (1-q)\, U_h(\alpha) / k & \text{if } U_h(\alpha) < k/(1-q) \\ 1 & \text{otherwise} \end{cases} \tag{A4}$$

Given the agent's optimal response ((A1), (A2), (A3) and (A4)) to an initial offer of α, the principal now chooses α to maximize his/her initial expected payoff (V):

$$\max_{\alpha \in [0,1]} \{[p(a(\alpha))] V_h(\alpha) + [1 - p(a(\alpha))] V_l\} \tag{A5}$$

Our goal is to solve (A5). To simplify the notation, we will suppress the dependence on α in the following discussion. There are four possibilities that could be induced by α in equilibrium: (1) $a_h < 1$, $a < 1$, (2) $a_h < 1$, $a = 1$, (3) $a_h = 1$, $a < 1$, and (4) $a_h = a = 1$. For instance, in case (1), those inequalities can hold only if $a_h = \alpha(1-q)(f_{hh} - 1)/k$ and $a = (1 - q)\, U_h(\alpha)/k$. Equivalently, for these to hold, α must satisfy

$$\alpha < k/[(1\text{-}q)(f_{hh}\text{-}1)] \qquad \text{and} \qquad U_h(\alpha) < k/(1\text{-}q). \tag{A6}$$

Should α not satisfy both conditions, equilibria of this form evidently do not exist. Otherwise, solving $\partial V/\partial\alpha = 0$ generates a candidate equilibrium solution as long as α satisfies the two inequalities in (A6). We will check these conditions for given specific values of the parameters while simulating the results.

To establish the optimal value of α under the do-nothing strategy, we need to first identify the potential solutions for α's in all cases above. Then we compare the values of the objective function (V) at these solutions (as well as the value when $\alpha = 0$) given any set of values for the parameters u, q, m, π_c and k. Finally, the optimal value of α is the one that maximizes the principal's expected initial payoff (V) as required. Q.E.D.

A.2. Equilibrium under Rescission

In this section, we will establish equilibria when rescission is possible. In case of rescission, we assume, without loss of generality, the agent exercises the options at node H and the principal will rescind the already-exercised options (or equivalently buys back α shares at a price of unity) at node HL with a probability of $\pi \in [0,1]$. Later, we assume $\pi = u$. Recall that u indicates how deeply the options are under water at the end of Period 1 (for example, L = 1 - u and $u \in (0,1)$). For simplicity, we assume all payoffs are received at the terminal date t = 2.

As a tax-motivated strategy, rescission is designed to rescue employees who would not have sufficient proceeds from selling the stock to pay the tax occurring after option exercise, because of subsequent stock price declines. Hence, we take personal tax into account while analyzing the optimality of rescission. For simplicity, we assume that the agent's personal tax rate is the same as the corporate tax rate (π_c).

The exercise at node H generates a tax liability to the agent of T = $\pi_c \alpha$ (H-1) and a tax benefit for the principal of same amount, which the company records as a deferred tax asset or a reduction in current taxes payable. The payoffs under rescission for the principal and the agent are listed in Tables 3 and 4, respectively.

The proof, procedure-wise, is analogous to the one under repricing. First, we use superscripts N and R to denote no-rescission and rescission, respectively. For instance, at node H, the agent needs to choose a_h to solve

$$\max_{a_h \in [0,1]} \{\pi U_h^R + (1-\pi) U_h^N\}$$

where $$U_h^R = p(a_h)[\alpha f_{hh} - \alpha - \mathrm{T}] + (1-p(a_h))[0] - \frac{1}{2} k a_h^2 ,$$

$$U_h^N = p(a_h)[\alpha f_{hh} - \alpha - \mathrm{T}] + (1-p(a_h))[\alpha f_{hl} - \alpha - \mathrm{T}] - \frac{1}{2} k a_h^2 ,$$

$$p(a_h) = qm + (1-q)a_h ,$$

$$f_{hh} = \frac{\mathrm{HH} + \alpha + \mathrm{T}}{1+\alpha} \quad \text{and} \quad f_{hl} = \frac{\mathrm{HL} + \alpha + \mathrm{T}}{1+\alpha} .$$

Note that T = $\pi_c \alpha$ (H-1) is the tax liability to the agent as a result of exercising options at node H. T is also the tax benefit to the principal, which the company records as a deferred tax asset or a reduction in current taxes payable.

This leads to the following solution

$$a_h(\alpha) = \begin{cases} min\{1, \frac{1-q}{k}[\alpha(f_{hh} - f_{hl}) + \pi(\alpha f_{hl} - \alpha - \mathrm{T})]\} & \text{if } \alpha > \pi(\alpha + \mathrm{T})/[f_{hh} - (1-\pi) f_{hl}] \\ 0 & \text{otherwise} \end{cases} \quad \text{(A7)}$$

Thus, the agent's continuation payoff $U_h(\alpha)$ at node H is given by

$$U_h(\alpha) = [p(a_h(\alpha))][\alpha f_{hh} - \alpha - \mathrm{T}] + (1\text{-}\pi)[1\text{-}\ p(a_h(\alpha))][\alpha f_{hl} - \alpha - \mathrm{T}] - \frac{1}{2}k[a_h(\alpha)]^2 \qquad \text{(A8)}$$

At node L, the options are guaranteed to finish out of the money, so we have

$$a_l = U_l = 0 \qquad \text{and} \qquad V_l = (qm)\ \mathrm{LH} + (1\text{-}qm)\ \mathrm{LL}. \qquad \text{(A9)}$$

As for the principal, his/her continuation payoffs $V_h(\alpha)$ and $V_l(\alpha)$ are given by

$$V_h(\alpha) = p(a_h(\alpha))f_{hh} + [1\text{-}\ p(a_h(\alpha))]\ [\pi(\mathrm{HL} + \pi_c\alpha(1\text{-HL})) + (1\text{-}\pi)\ f_{hl}] \qquad \text{(A10)}$$

and $$V_l(\alpha) = p(a_l(\alpha))(\mathrm{LH}) + [1\text{-}\ p(a_l(\alpha))]\ (\mathrm{LL}) \qquad \text{(A11)}$$

Hence, the optimal initial action for the agent is

$$a(\alpha) = arg \max_{a\in[0,1]} \{ p(a)U_h(\alpha) - \frac{1}{2}ka^2 \}$$

where $\quad p(a) = qm + (1\text{-}\ q)\ a$

Hence, the optimal initial action for the agent is

$$a(\alpha) = \begin{cases} \min\{1,\ (1\text{-}\ q)\ U_h(\alpha)\ /\ k\} & \text{if } U_h(\alpha) > 0 \\ 0 & \text{otherwise} \end{cases} \qquad \text{(A12)}$$

Given the agent's optimal response ((A15), (A17) and (A20)) to an initial offer of α, the principal now chooses α to maximize his/her initial expected payoff:

$$\max_{\alpha\in[0,1]} \{[\ p(a(\alpha))]V_h(\alpha) + [1 - p(a(\alpha))]V_l\} \qquad \text{(A13)}$$

The procedure for solving (A13) is exactly the same as that for solving (A5). As in the Appendix A.1, we first identify the potential solutions for α's in all possible cases. Then we compare the values of the objective function (V) at these solutions (as well as the value when α = 0) given any set of values for the parameters u, q, m, k, π_c and π. Finally, the optimal value of α is the one that maximizes the principal's expected initial payoff (V) as required.

Q.E.D.

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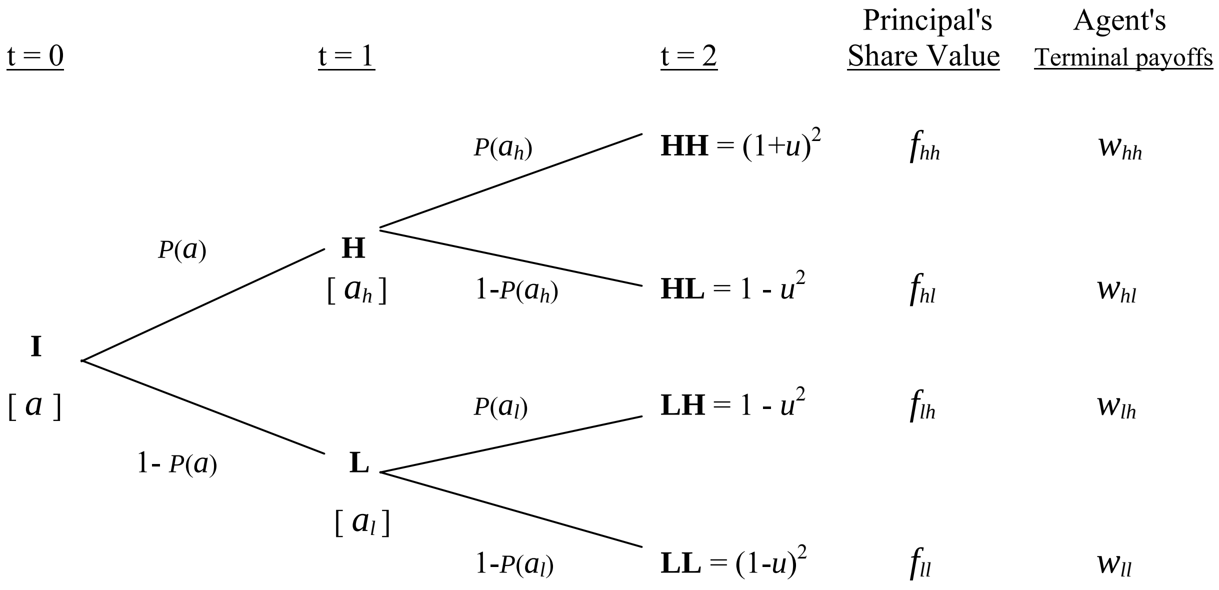
Figure 1



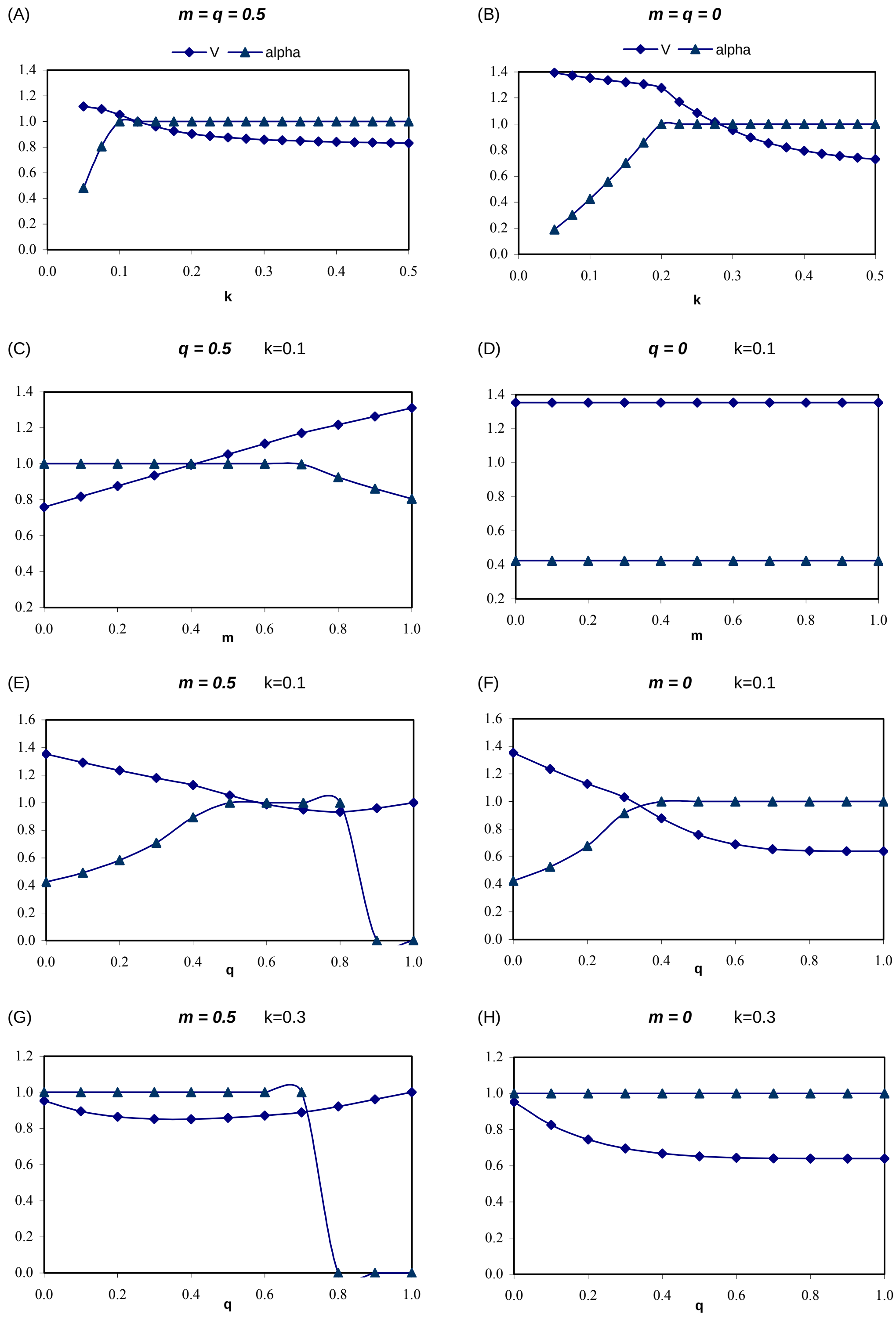
where $P(a) = q\, m + (1\text{-}q)\, a$

Parameters/Variables	Range	Descriptions
α	(0, 1]	The option contact offered by the principal at node I
a	[0,1]	The action (or effort level) taken by the agent at node I
a_h	[0,1]	The action (or effort level) taken by the agent at node H
a_l	[0,1]	The action (or effort level) taken by the agent at node L
$P(a)$	[0.1]	The probability of reaching node H
q	[0,1]	The extent to which the agent's action may influence $P(a)$
m	[0,1]	The influence of external factors on $P(a)$.
u	(0,1)	The variability of firm value at t = 1 (H = 1 + u, L = 1 - u)
π	[0,1]	The probability of underwater options being repriced at node L

Figure 1. A two-period binomial model and distribution of terminal cash flows.

<u>Figure 2:</u> Do-nothing
Sensitivity of Cost (k), Market (m), and Control (q) Variables

Under the do-nothing strategy, this figure shows the influence of the parameters of interest on the principal's expected payoff (V) in equilibrium and on the optimal initial option grant (alpha). The base parameters are fixed at u = 0.2, and the corporate tax rate, π_c = 0.34. Note that the likelihood of higher firm value in next period, p(H) = *q m* + (1-*q*) *a*. *m* represents the influence of external factors on p(H). The influence of the agent's action (*a*) is measured by *q*. *k* is the cost parameter for the agent's cost function.



<u>Figure 3</u>: Do-nothing
Sensitivity of the Variability of Possible Outcomes (u)

Under the do-nothing strategy, this figure shows the influence of return volatility (u) on the principal's expected initial payoff (V) in equilibrium and on the optimal option grant (alpha). Note that H = 1+ u, and L = 1 - u and we set the corporate tax rate, $\pi_c = 0.34$. The likelihood of higher firm value in next period, p(H) = *q m* + (1-*q*) *a*. *m* represents the influence of external factors on p(H). The influence of the agent's action (*a*) is measured by *q*. *k* is the cost parameter for the agent's cost function. We set *m* = 0.5, unless indicated otherwise. *a** is the optimal initial action (or effort level) chosen by the agent.

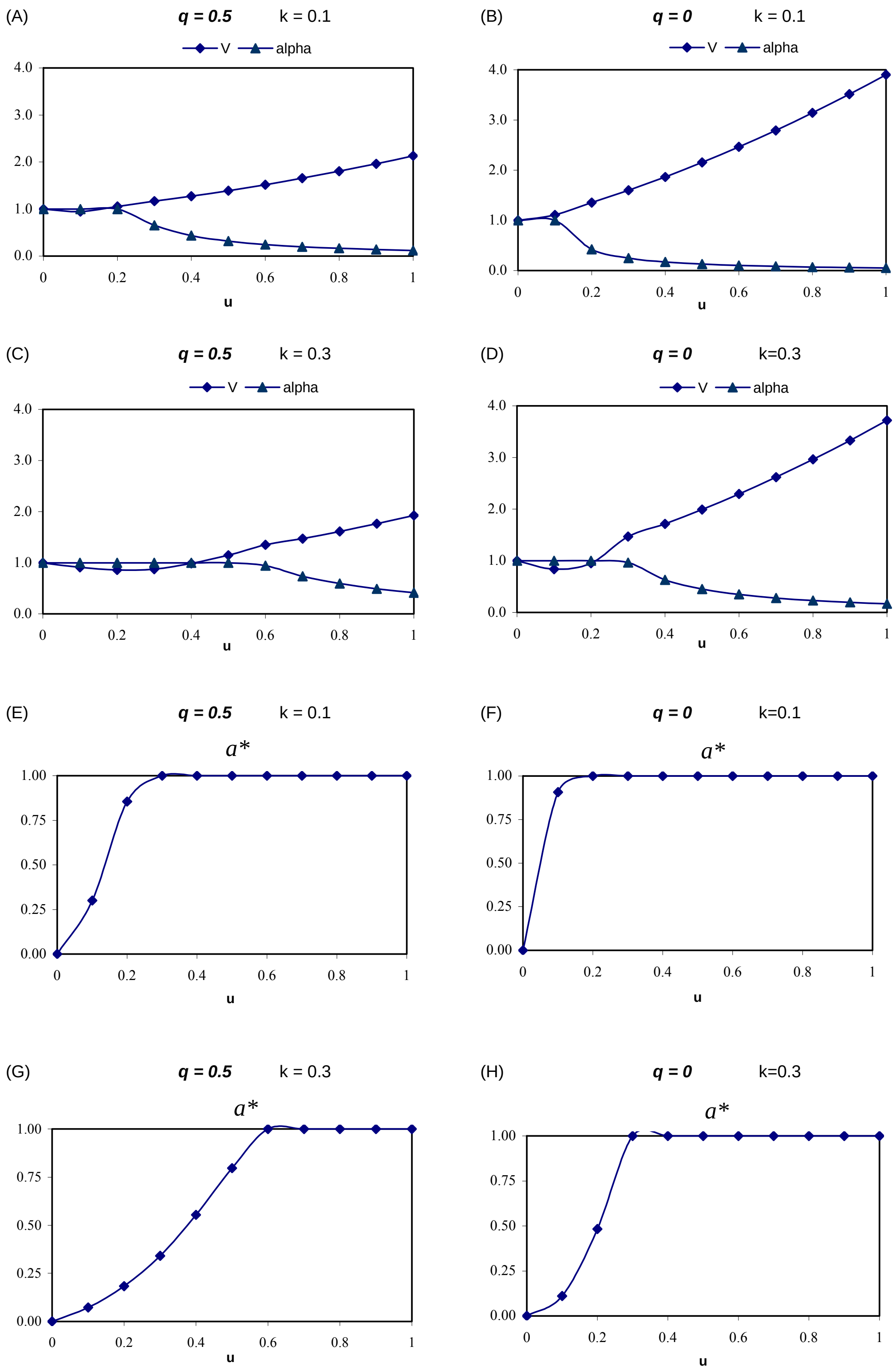


Figure 4: Rescission with a Probability of Unity
Sensitivity of Cost (k), Market (m), and Control (q) Variables

We use the letters N and R to denote do-nothing and rescission, respectively. When rescission occurs at node HL with a probability equal to one, this figure shows the influence of the parameters of interest on the difference of the principal's expected payoff [V(R-N)] in equilibrium and on the difference of optimal initial option grant [alpha(R-N)]. We set u = 0.2 and the corporate tax rate, $\pi_c = 0.34$. Note that the likelihood of higher firm value in next period, $p(H) = q\, m + (1-q)\, a$. m represents the influence of external factors on p(H). The influence of the agent's action (a) is measured by q. k is the cost parameter for the agent's cost function.

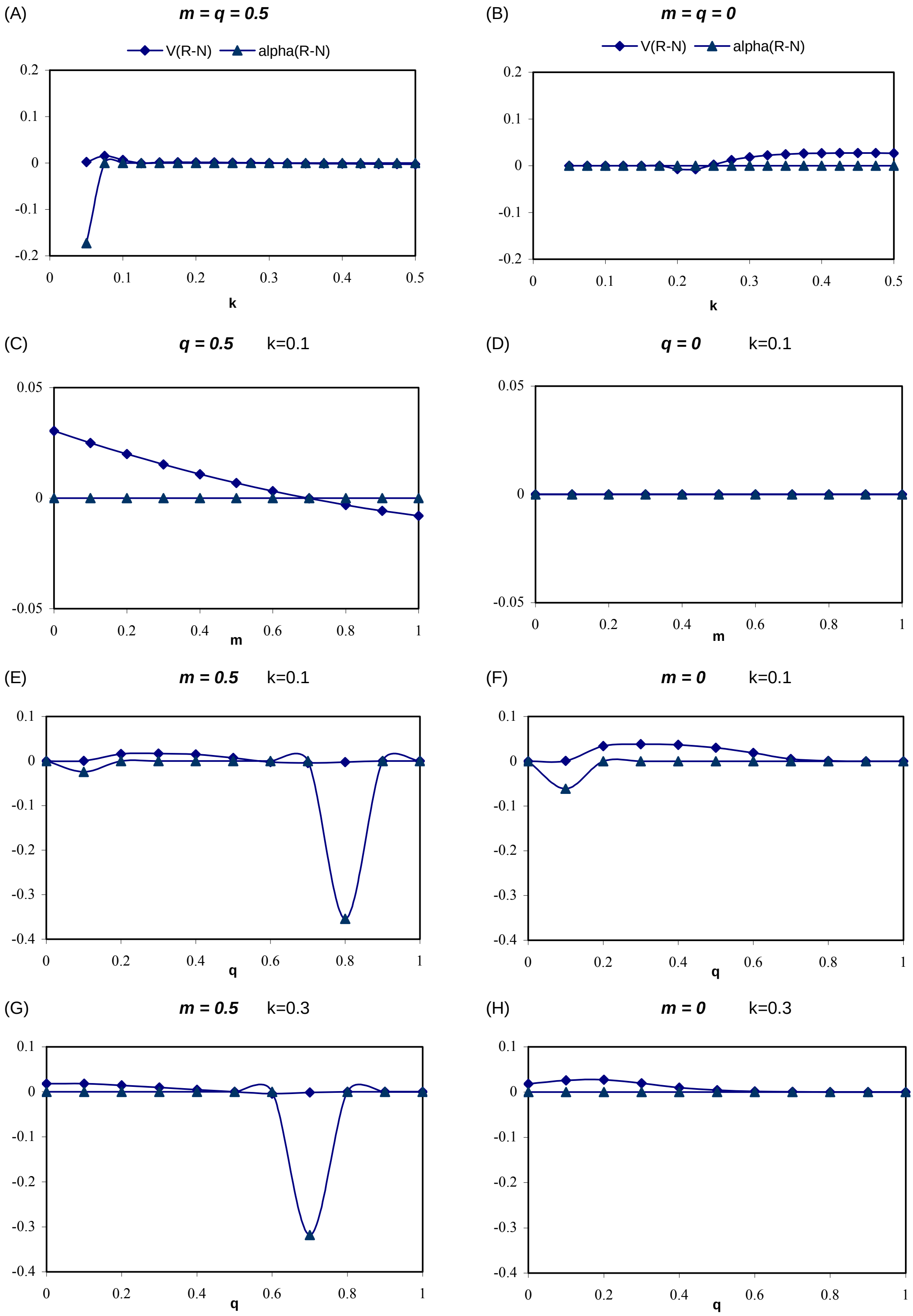
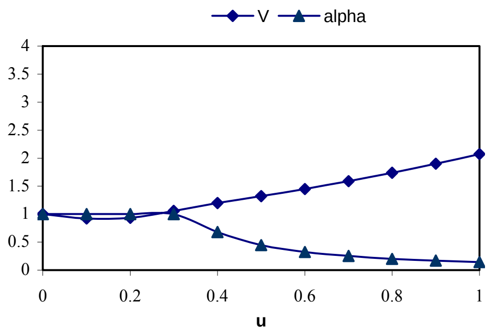


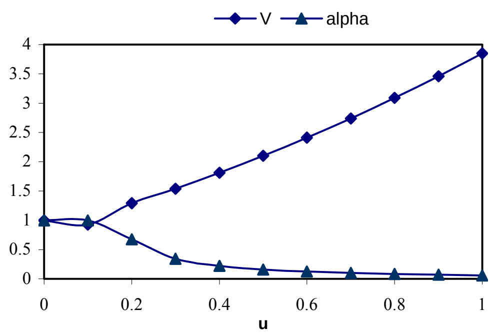
Figure 5: Rescission with a Probability of Unity
Sensitivity of the Variability of Possible Outcomes (u)

Under rescission with a probability of unity, this figure shows the influence of return volatility (u) on the principal's expected initial payoff (V) in equilibrium and on the optimal option grant (alpha). Note that H=1+ u, and L=1 - u and we set the corporate tax rate, π_c = 0.34. The likelihood of higher firm value in next period, p(H) = $q\ m + (1\text{-}q)\ a$. m represents the influence of external factors on p(H). The influence of the agent's action (a) is measured by q. k is the cost parameter for the agent's cost function. We set $\boldsymbol{m}$ **= 0.5**, unless indicated otherwise. a* is the optimal initial action (or effort level) chosen by the agent.

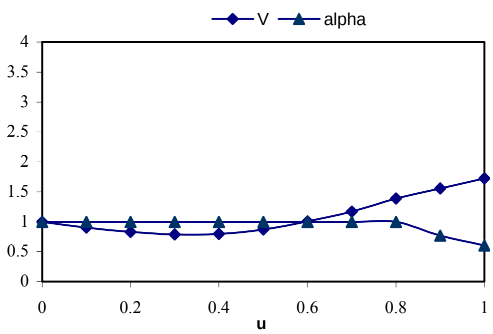
(A) ***q = 0.5*** k = 0.1



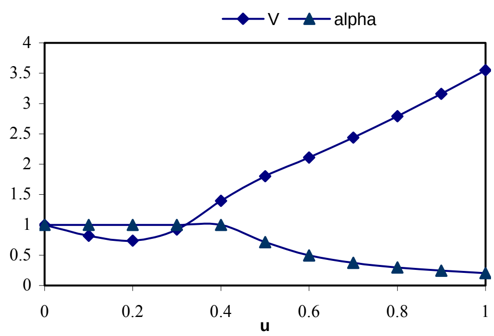
(B) ***q = 0*** k = 0.1



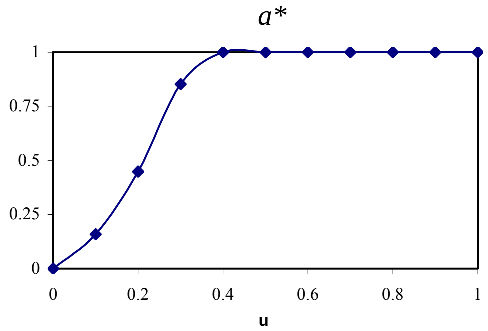
(C) ***q = 0.5*** k = 0.3



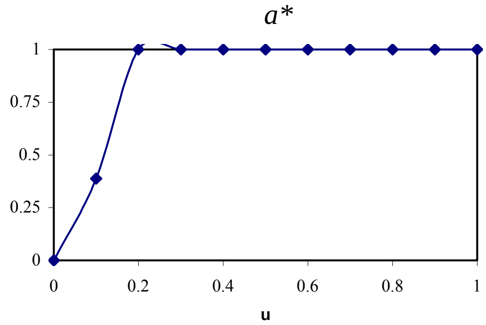
(D) ***q = 0*** k=0.3



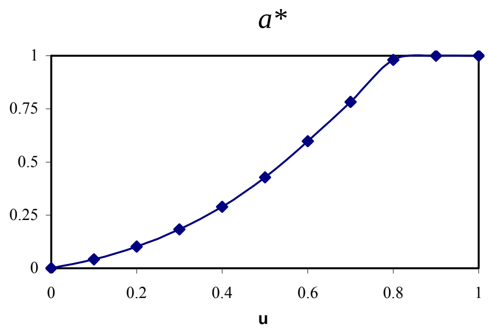
(E) ***q = 0.5*** k = 0.1



(F) ***q = 0*** k=0.1



(G) ***q = 0.5*** k = 0.3



(H) ***q = 0*** k=0.3

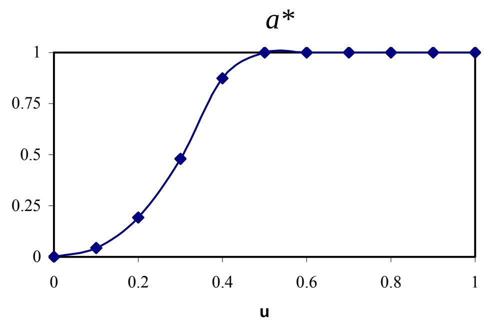


Figure 6: Rescission with a Probability of u (=0.2)
Sensitivity of Cost (k), Market (m), and Control (q) Variables

We use the letters N and R to denote do-nothing and rescission, respectively. When rescission occurs at node HL with a probability equal to u, this figure shows the influence of the parameters of interest on the difference of the principal's expected payoff [V(R-N)] in equilibrium and on the difference of optimal initial option grant [alpha(R-N)]. We set u = 0.2 and the corporate tax rate, $\pi_c = 0.34$. Note that the likelihood of higher firm value in next period, $p(H) = q\, m + (1\text{-}q)\, a$. *m* represents the influence of external factors on p(H). The influence of the agent's action (*a*) is measured by *q*. *k* is the cost parameter for the agent's cost function.